EUROSIM 2007

Proceedings of the 6th EUROSIM Congress on Modelling and Simulation

Edited by
Borut Zupančič
Rihard Karba
Sašo Blažič

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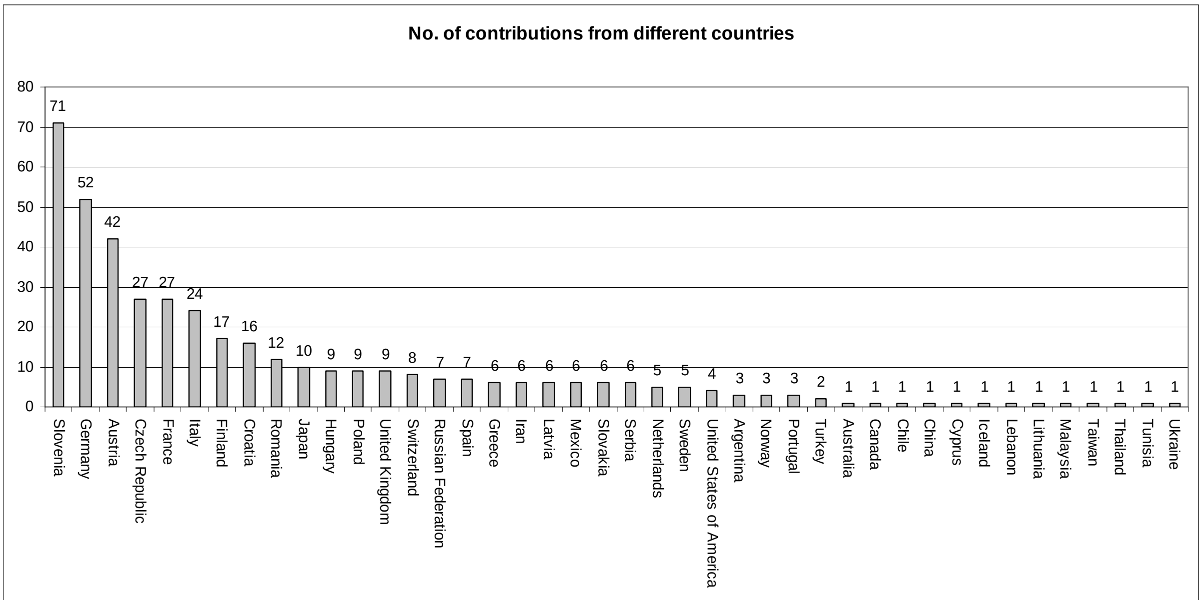
PREFACE

EUROSIM is the Federation of European simulation societies, and was set up in 1989. Its purpose is to promote, especially through its member societies, the idea of modelling and simulation in different fields, in industry, research and development. EUROSIM has two publications focussing on modelling and simulation: the scientific journal *Simulation Modelling Practice and Theory* (SIMPRA) published by Elsevier, with scientific contributions; and the newsletter/journal *Simulation News Europe* (SNE), published by ARGESIM, with technical notes, application contributions and news from the societies. At present EUROSIM has eleven full members and three observer members. So it covers almost the whole European region.

The EUROSIM Congress is organised every three years by a member society of EUROSIM. After Capri, Vienna, Helsinki, Delft and Paris the 6th EUROSIM Congress is being organised by the Slovenian Society for Simulation and Modelling, SLOSIM, and takes place in Ljubljana, the capital of Slovenia.

The efforts of the organisers have resulted in an unexpectedly large interest in the event, as much more than five hundred papers from almost 50 countries were submitted. Altogether 420 contributions from 42 countries were included in the final programme – see graph below.



This proves that modelling and simulation is, in spite of being a very traditional discipline, still attractive, modern, and with a wide range of applications and research possibilities, and is closely connected with many of the most sophisticated and modern disciplines.

The scope of the congress includes all aspects of continuous, discrete (event) and hybrid modelling, simulation, identification and optimisation approaches. The programme scheme consists of tutorials, plenary lectures, regular sessions, special sessions, poster sessions and a student competition.

Tutorials cover the more general areas of broader interest. Below you can find the titles and the authors of the tutorials. Each tutorial lasts 3 hours. The first and second tutorials are organised with hands-on working in the computer room.

The Titles of the Tutorials	Presenters
Introduction to Object-Oriented Modeling and Simulation with Modelica Using the OpenModelica Environment	Fritzson P., Lundvall H., Brugård J.
Super-Object-Oriented Programming and Model Nesting	Kindler E.
Inverse Simulation Methods and Applications	Murray-Smith D.

The plenary lectures will be presented by five outstanding speakers, all of them well known in the field of modelling and simulation. The lectures will cover a wide range of modelling and simulation topics.

The Titles of the Plenary Papers	Presenters
Electronic Circuit Modeling and Simulation in Modelica	Cellier F.
Integrated Multiscale Simulation of Continuous Casting of Steel	Šarler B.
Experiences and Trends in Modelling and Simulation of Integrated Industrial Processes	Juslin K.
An Ode for the Renaissance	Breitenecker F.
The Challenge of Modeling High Speed Flows	Longo J.M.A.

The regular programme consists of regular papers and posters. The only distinction is in the form of presentation: oral or poster. There are 34 regular sessions with oral presentation with 203 contributions and 1 poster session with 30 contributions, altogether 233 papers, which cover the congress' scope and topics. All the papers were revised by at least three members from the International Programme Committee. The figure below shows the number of congress topics declared by authors for theirs contributions with regard to methods and application areas. Only more frequently chosen topics are shown.

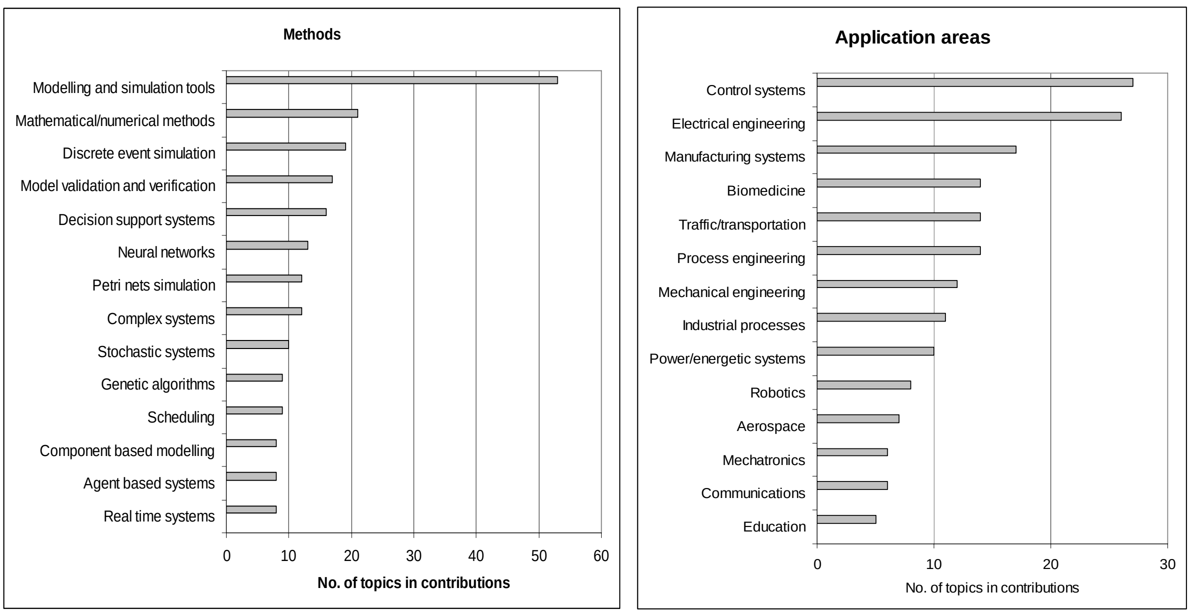


Figure: Number of contributions describing different methodologies and application areas.

Twenty-three **special sessions** (some are organised as tracks) with 168 papers are organised by experts from the area of modelling and simulation and cover rather specific areas relating to modelling and simulation. Partly these are invited papers, and partly they were submitted after the session organisers' call. The review procedure was organised by the session organisers. You can see the names of the sessions and the organisers in the table below. At this point we would like to express our gratitude to the session organisers.

The Titles of Special Sessions	**Organisers**
Education in Simulation / Simulation in Education	Wiechert W.
Simulation in Economics and Business	Štemberger M., Orsoni A.
Modelling of Cryogenic Systems and their Applications	Rachid A., Chadli M., Coppier H.
Modelling and Simulation in Mechatronics	Schmucker U.
Computational Intelligence and Discrete Simulation	Huyet A.L, Pierreval H.
Increased Predictability of Crash Models	Eichberger A.
Digital Factory/Simulation and Optimization of Industrial Processes	Jósvai J., März L.
Successful Application of Simulation in Industry	Juslin K.
Fuzzy Systems	Škrjanc I.
Simulations, Modelling and Optimization of VLSI Circuits	Strle D.
Multidisciplinary Design Optimization	Dellino G., Lino P., Meloni C., Rizzo A.
Algebraic Methods and Algorithms in Modelling Discrete Dynamical Systems	Li A.
Simulation in Electric Power Systems	Mihalič R.
Modelling and Simulation in Medicine and Pharmacy	Drinovec J., Mrhar A., Atanasijević-Kunc M.
Modelling and Simulation in Structural Mechanics	Lebon F., Maceri F.
Models Networks for Process Systems Simulation	Savković - Stevanović J.B.
Control and Decision for Complex Systems	Popescu D., Tanguy G.D.
Simulation of Multifield and Multiscale Problems in Structural and Material Engineering	Callari C., Maceri F.
Agent-Based and Dynamic Approaches to Modelling in Economics	Wöckl J., Almeder C.
Domain Modelling through Autonomous Discovery	Bratko I.
Alternative Modelling and Comparisons and Benchmarking in Modelling and Simulation	Breitenecker F., Wiechert W.
Modelling and Simulation in the Vehicle Thermal Management System	Puntigam W.
Modelling of Structural Dynamic Systems – Model Reduction Methods	Schwarz P., Breitenecker F.

The student competition contains papers describing the work of undergraduate or bachelor/master students. This means that it is not intended for PhD students unless they are presenting their earlier work. Ten students will compete in this session.

The papers in these proceedings follow the same order as in the programme. We hope that both publications – the Programme and the Proceedings – will help the attendees and session chairs during the sessions.

Finally we would like to express our gratitude to our financial sponsors and exhibitors: Slovenian Research Agency, Elektro Slovenia - our golden sponsor, Incontrol Enterprise Dynamics, Mobitel, Fotona, MAK Technologies, GEN-I, Elsevier, Bausch-Gall,

Instrumentation Technologies, INEA, MathCore, Esteco, Technix, HSE, IEEE Slovenia Section, Krka, Marand, Trimo, RACI, LIV, Termo, XJ Technologies, Cinkarna and Ventil.

We hope that your participation at the 6th EUROSIM Congress will be pleasant and productive, scientifically and socially. We would also like to take this opportunity to encourage you and your colleagues to attend the next 7th EUROSIM Congress, which will take place in September 2010 in Prague.

Ljubljana, September 2007

Borut Zupančič
Chair of the Congress, President of EUROSIM

Rihard Karba
Chair of the IPC, President of SLOSIM

Sašo Blažič

ORGANISATION

The main congress organisers:

University of Ljubljana, Faculty of Electrical Engineering
SLOSIM – Slovene Society for Simulation and Modelling
Technical support: Congress agency Cankarjev dom

The congress is co-organised by other EUROSIM member and observer societies:

ASIM................Arbeitsgemeinschaft Simulation (Austria, Germany, Switzerland)
CROSSIM ....Croatian Society for Simulation Modelling
CSSS.................Czech and Slovak Simulation Society
DBSS................Dutch Benelux Simulation Society (Belgium, The Netherlands)
FRANCOSIM ..Société Francophone de Simulation (Belgium, France)
HSS...................Hungarian Simulation Society
ISCS ....Italian Society for Computer Simulation
PSCS.................Polish Society for Computer Simulation
SIMS.................Simulation Society of Scandinavia (Denmark, Finland, Norway, Sweden)
UKSIM ....United Kingdom Simulation Society (UK, Ireland)
CEA SMSG ......Spanish Modelling and Simulation Group
LSS...................Latvian Simulation Society
ROMSIM..........Romanian Society for Modelling and Simulation

The congress is co-sponsored by:

ARRS ....Slovenian Research Agency
IEEE ....IEEE - Slovenia Section
ACSS................Automatic Control Society of Slovenia
ECMS...............European Council for Modelling and Simulation
SCS...................The Society for Modeling and Simulation International
CASS................Chinese Association for System Simulation
JSST ....Japan Society for Simulation Technology
KSS...................Korea Society for Simulation
IASTED...........International Association of Science and Technology for Development

COMMITTEES

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MO-2-P2: STUDENT COMPETITION I

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TH-1-P9: SIMULATION ENVIRONMENTS

PLENARY PAPERS

ELECTRONIC CIRCUIT MODELING AND SIMULATION IN MODELICA

François E. Cellier[1], Christoph Clauß[2], Alfonso Urquía[3]

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Abstract

In recent years, three separate efforts took place at three different institutions to provide an electronic circuit modeling and simulation capability within the framework of Modelica, an object-oriented general-purpose environment for the modeling of physical systems. In order to be generally usable, no domain-specific knowledge is hard-coded into the Modelica software. Modelica only understands mathematics, not physics. Consequently, all domain-specific knowledge must be formulated as part of the model. Recent advances in symbolic algorithms and software technology have made it feasible to implement a full-fledged electronic circuit simulator in Modelica without making unacceptable sacrifices on the run-time efficiency of the resulting simulation code. What is being gained in the process is an improved transparency of the models that are being implemented, a significantly improved ease of maintainability and extensibility of the code, and a dramatically improved flexibility in combining electronic models with mechanical and thermal models. These are demands that industry now makes on a circuit simulator, demands that cannot easily be met using the traditional approach to electronic circuit simulation.

Keywords: Electronic circuit simulation, Object-oriented modeling, Modelica, Multi-energy modeling, Bond graph.

Presenting Author's biography

François E. Cellier received his BS degree in electrical engineering in 1972, his MS degree in automatic control in 1973, and his PhD degree in technical sciences in 1979, all from the Swiss Federal Institute of Technology (ETH) Zurich. Dr. Cellier worked at the University of Arizona as professor of Electrical and Computer Engineering from 1984 until 2005. He recently returned to his home country of Switzerland. Dr. Cellier's main scientific interests concern modeling and simulation methodologies, and the design of advanced software systems for simulation, computer aided modeling, and computer-aided design. Dr. Cellier has authored or co-authored more than 200 technical publications, and he has edited several books. He published a textbook on Continuous System Modeling in 1991 and a second textbook on Continuous System Simulation in 2006, both with Springer-Verlag, New York.

INTEGRATED MULTISCALE SIMULATION OF CONTINUOUS CASTING OF STEEL

Božidar Šarler[1], Robert Vertnik[1], Henrik Gjerkes[1], Agnieszka Lorbiecka[1], Bojan Senčič[2], Gojko Manojlović[2], Janko Cesar[2]

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Abstract

This work copes with a simulation system for modeling of steady-state and transient temperature, velocity, and concentration fields on micro and macro level in continuously cast steel strand (billet, slab, bloom) as a function of the process parameters. The numerical solution of coupled partial differential equations is based on recently developed meshless technology, involving collocation with radial basis functions. The system is designed for estimation of influence of process parameters on strand conditions and development of casting of new materials. The options of simulation system, which enable the technologist automatic setup of process parameters, are described. The regulation coefficients of the casting machine control system can be calculated based on this system. Regulation coefficients are used for compensation of the changes of process parameters that are difficult to control (casting temperature, temperature of cooling water, heat transfer in the mold) with the easily controlled parameters (coolant water flow, casting speed) in such way that the surface temperature and liquid pool depth remain invariant. The on-line and off-line sub-modules of the system are elaborated. The on-line module helps the technologist in monitoring of the status of the main process parameters and safety related issues. The off-line post-processing module is based on the simulation system and real process parameters data base, and helps the technologists in estimation of the reasons for possible casting defects and suppression of them. The implementation of the simulation system in billet caster of Steelworks Štore-Steel, Štore, Slovenia – one of the major European producers of spring steels, is elaborated.

Keywords*:* Continuous casting of steel, simulation system, temperature, velocity, concentration, microstructure, properties, regulation.

Božidar Šarler. Professor of Materials Science and Engineering and Head of Laboratory for Multiphase Processes at the University of Nova Gorica, Slovenia. His research interest is focused on development of mesh reduction numerical techniques for solid and fluid mechanics problems, solid-liquid phase change, and development of industrial simulation systems for continuous casting of steel and aluminium alloys. He led several major modernisations in Slovenian aluminium and steel industry connected with information of the production and intruduction of simulation tools for process yield, safety, and quality optimisation.

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EXPERIENCES AND TRENDS IN MODELLING AND SIMULATION OF INTEGRATED INDUSTRIAL PROCESSES

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Abstract

Modelling and simulation should efficiently support all engineering and operational processes during the complete life-cycle of an industrial plant. However, modelling of an integrated industrial plant has been and is still a very challenging endeavour because of the huge number of details that needs to be considered. The manual extraction of required model specification data from various sources has still required availability of dedicated mathematical modelling experts and the working procedures have been very time consuming, expensive and error prone. The resulting large set of heterogeneous equations has required both efficient and reliable solution methods and much computing power. Now there are efficient dedicated simulation tools available in the market and as well as sufficient computation power. The experienced slow take-up of modelling and simulation has been explained with that simulation has been separated from other engineering disciplines. Support for easy access to required modelling data is expected from the evolving semantic specifications of both separate components and integrated plants in accordance with ISO interoperability standards. Further, the OPC de-facto standard adopted by most DCS vendors makes it nowadays easy to connect a digital control system to a computerised process model. Testing of real control system configurations can be made in advance with models instead of real plants. Application projects in co-operation with global industrial players in the fields of power plants, pulp and paper processes, and control systems engineering are referred to. The Apros software taken into use has an own specification script that supports interfacing to other formal data repositories. The contents of useful repositories should also include such data that is needed for dynamic model specifications.

Keywords: Integrated plant models, Successful use cases, Interoperability standards

Presenting Author's biography

Chief Research Scientist Dr. Kaj Juslin acts presently as Customer Manager of Business Solutions at VTT Technical Research Centre of Finland. In addition, he teaches postgraduate courses in simulation at Helsinki University of Technology. He is a member of the Technical Committee on Mathematical Modelling of IMACS. He is also member of the editorial boards of several commercial journals in the field of simulation. He is former president of both EUROSIM (1996 - 1998) and SIMS (1985 - 1988). He has chaired several simulation congresses.

AN ODE FOR THE RENAISSANCE

Felix Breitenecker, Katharina Breitenecker, Florian Judex,
Nikolas Popper, Siegfried Wassertheurer

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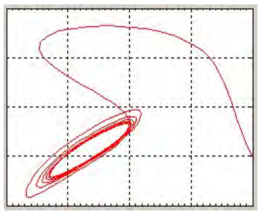
Abstract

- Is it possible to model in some detail the love dynamics between two person by ODEs ?
- Is it possible to describe a famous historic love story between two persons by ODEs ?
- Suppose, one person expresses its love by odes, is it possible to express it also by ODEs ?
- Is it possible to describe the poet's inspiration for writing odes by ODEs ?

All these questions can be answered positively, making use of three coupled nonlinear differential equations. Two states mimic the love for each other, coupled like a predator-prey model; a third state evaluates the poetic inspiration, following the poet's love emotions. Based on works by S. H. Strogatz, S. Rinaldi, and F. J. Jones (mathematics, literary science), one concludes:


$$\frac{dL}{dt} = -\alpha_1 L + R_L P + \beta_1 A_P$$
$$\frac{dP}{dt} = -\alpha_2 P + R_P L + \beta_2 A_L$$



- Laura, a beautiful, but married lady, inspired Petrarch for poems, which express ecstatic love as well as deep despair. Petrarch's grade of emotion in love for Laura can be established by evaluation of poems written between 1328 and 1350, showing Petrarch's emotional 'oscillating' behaviour between ecstatic love and deep despair.
- A nonlinear coupled ODE model can simulate love dynamics of two persons, taking into account mutual attraction, rejection, and neglect. Poetic inspiration can be modelled as function of love emotion.
- This model can be identified for Petrarch and Laura, getting an love dynamics for Petrarch, which coincides with Petrarch's emotional cycle derived from 'graded' poems.
- Analysis of the model shows a broad variety of phenomena: limit cycles, stable steady states, bifurcations, ….
- Experiments with this model and with an extended model for modern times, supported by a GUI, provide interesting case studies for different kind of love dynamics - attraction, rejection and neglect. Stable equilibria or limit cycles – which mimicry better real life love dynamics ?

Keywords: Love Dynamics, Limit Cycles, Dynamical Systems

Presenting Author's biography

Felix Breitenecker studied 'Applied Mathematics' and acts as professor for Mathematical Modelling and Simulation at Vienna University of Technology He covers a broad research area, from mathematical modelling to simulator development, from DES via numerical mathematics to symbolic computation, from biomedical and mechanical simulation to process simulation. He is active in various simulation societies: president and past president of EUROSIM since 1992, board member and president of the German Simulation Society ASIM, member of INFORMS, SCS, etc.He has published about 250 scientific publications, and he is author of two 3 books and editor of 22 books. Since 1995 he is Editor in Chief of the journal editing the journal Simulation News Europe.

THE CHALLENGE OF MODELING HIGH SPEED FLOWS

J.M.A. Longo[1], K. Hannemann[2], V. Hannemann[2]

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Abstract

Current and expected developments in space transportation have led to growing interest in new space vehicles. These new vehicles require essential improvements over current vehicles in order to ensure economic viability and to fulfill mission and safety constraints. The size and complexity of this problem has led to growing importance of numerical methods for design and optimization involving all disciplines as well as the optimal use of all technical potentialities is necessary. The material presented here reviews the growth and advances achieved at DLR in the last years. The status of the physical modeling, code development issues such as algorithms, grid generation and validation strategy is provided. Viscous, high speed unsteady flows are still restricted to simple problems due to a strong demand in computer resources. The short coming to obtain adequate data for code validation in high speed flow problems is discussed. It turns out that little progress has been realized in numerical modeling since past major difficulties to obtain reliable experimental data in the high enthalpy flow environments still remain. On the other side, CFD based multidisciplinary analysis is emerging as a key discipline in aerospace design. Supported by a continuous, almost linear, grows in computer capacity and performance, this new procedure to conduct configuration analysis is paying off its way. A number of selected applications of multidisciplinary problems with complex physics are presented.

Keywords: Hypersonics, Multidisciplinary Analysis, Chemical Models, Compressible Flows, Turbulence Models.

Presenting Author's biography

José M.A. Longo received his degree in aeronautical engineering from the Catholic University Córdoba of Argentina and his Doctor degree from the Technical University Braunschweig of Germany. Dr. Longo's main scientific interest concern modeling, simulation and design in aerodynamics, gas dynamics and aerothermodynamics. He became head of the Spacecraft Branch of the Institute of Aerodynamics and Flow Technology of DLR at Braunschweig in the year 2000. He has managed several space programs at national level as well as for the European Space Agency; serving also on several scientific advisory boards.

TUTORIALS

INTRODUCTION TO OBJECT-ORIENTED MODELING AND SIMULATION WITH MODELICA USING THE OPENMODELICA ENVIRONMENT

Peter Fritzson[1], Adrian Pop[1], Peter Aronsson[2], Håkan Lundvall[1], David Broman[1], Daniel Hedberg[2], Jan Brugård[2]

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Abstract

Modelica is a modern, strongly typed, declarative, equation-based, and object-oriented language for modeling and simulation of complex systems. Major features are: ease of use, visual design of models with combination of lego-like predefined model building blocks, ability to define model libraries with reusable components, support for modeling and simulation of complex applications involving parts from several application domains, and many more useful facilities. This paper gives an overview of some aspects of the Modelica language and the OpenModelica environment – an open-source environment for modeling, simulation, and development of Modelica applications.

Keywords: Modelica, OpenModelica, Modeling, Equation-Based, Open Source

Main Author's biography:

Peter Fritzson is a Professor and Director of the Programming Environment Laboratory (PELAB), at the Department of Computer and Information Science, Linköping University, Sweden. Peter Fritzson is chairman of the Scandinavian Simulation Society, secretary of the European simulation organization, EuroSim; and vice chairman of the Modelica Association. His main area of interest is software engineering, esp. design, programming languages and environments, including modeling and simulation.

Presenting Authors' biographies:

Håkan Lundvall, MSc, is a PhD student at PELAB, Linköping University, Sweden. He is involved in the OpenModelica efforts since several years, and has among other things designed and implemented the hybrid and discrete event support. His main area of interest is generation of parallel code from Modelica, targeting clusters and multi-core architectures.

Jan Brugård, MSc, is the CEO of MathCore Engineering AB, Linköping, Sweden. He is an experienced modeler with several years of experience of modeling complex engineering applications, primarily mechanical and electrical applications, and is a driving force behind the development of the MathModelica System Designer product.

SUPER-OBJECT-ORIENTED PROGRAMMING AND MODEL NESTING

Eugene Kindler

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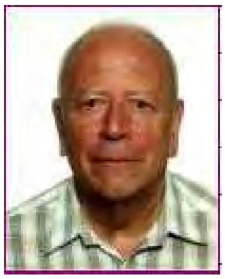
Abstract

While the term object-oriented programming (OOP) settled down the paradigm of classes as encapsulations of data and methods (procedures), specialization of classes (subclasses) and virtuality of the methods (late bindings), there are further offers related to OOP but enhancing it in essential way; they are sometimes called super-object-oriented programming (SOOP). Curiously, SOOP arose with OOP and rooted more tightly in simulation than OOP itself. Nowadays, after 40 years of existence of both paradigms, one can observe essential contributions of SOOP, among which there is simulation of intelligent systems having elements (computers, persons) that create and use their "private" (simulation) models for decision support; that allows deciding with respect to possible future consequences. The properties that enrich SOOP above OOP will be in detail explained (namely: life rules, block structure, classes local in other classes and in blocks, and quasi-parallel control), their relation to general aspects of computer simulation (namely to the process paradigm) will be exposed and existing applications will be presented. The participants will get a free and efficient PC implementation of SIMULA programming language, in which particular examples will be formulated.

Keywords: Object-oriented programming, Super-object-oriented programming, Simula, Intelligent systems simulation.

Presenting Author's biography



Eugene Kindler studied mathematics at Charles University in Prague, concluding with grades of Doctor of philosophy (in logic), Doctor of sciences (in theory of programming) and (from Czechoslovak academy of sciences) Candidate of sciences in physics/ mathematics. At Prague Research Institute of Mathematical Machines (1958-1966), he participated at the design of the first Czechoslovak electronic computers and designed and implemented the first Czechoslovak ALGOL compiler for it. At Biophysical Institute at the Faculty of General Medicine of Charles University (1967-1973), he designed and implemented the first Czechoslovak simulation language and then introduced the object-oriented programming into Czechoslovakia. Nowadays, as professor emeritus of applied mathematics, he teams up with Ostrava University. As visiting or invited professor, he worked at the University in Italian Pisa, at West Virginia University in Morgantown, at the University of South Brittany in French Lorient and at University of Blaise Pascal in French Clermont-Ferrand. His main interest is simulation of systems containing elements that use simulation models.

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INVERSE SIMULATION METHODS AND APPLICATIONS

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Abstract

This paper provides background information for a tutorial which introduces the concepts of inverse simulation. Conventional simulation methods involve finding the response of a system to a particular form of input or disturbance for a given set of initial conditions. Inverse simulation methods reverse this process and attempt to find the control inputs required to achieve a particular response. This inverse approach has been applied with success in a number of fields but it is in aeronautical applications that it has found most favour so far, particularly in the context of helicopter flight mechanics. The piloting strategy required for an aircraft to perform a defined manoeuvre is predicted and can be used to analyse handling qualities, pilot workload, agility and control system performance. Recently the methods have also been applied to problems of ship manoeuvring and navigation and to underwater vehicles. The methods are particularly well suited to investigation of actuator performance and the effects of actuator limiting in control system design. The paper outlines the algorithms most widely used for inverse simulation and introduces some relatively novel approaches which are believed to have some advantages for applications involving control system performance investigations. The paper includes discussion of possible numerical problems encountered when using these algorithms and more fundamental issues associated with the dynamic properties of inverse models. The impact of inverse simulation in providing enhanced understanding about the dynamic properties of the system under investigation is emphasized. Although aeronautical applications are dominant in published work in this field the approach is of general applicability and any dynamic system may be treated in the same way.

Keywords: Inverse, Simulation, Model, Manoeuvre, Helicopter, Ship.

Presenting Author's biography

David Murray-Smith is an Emeritus Professor of the University of Glasgow. Until October 2005 he was Professor of Engineering Systems and Control in the Department of Electronics and Electrical Engineering, where he is still actively involved in research. His current research interests are in system modelling and control techniques applied to a range of engineering and biomedical systems. With Linghai Lu (Research Student and co-author of this paper) he is engaged on research on the further development and application of inverse simulation methods and their application in feed-forward control system design.

HISTORY OF EUROSIM

A BRIEF HISTORY OF EUROSIM

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Abstract

It seems from distant memories, that the first stirrings of interest in promoting collaboration between European Simulation Societies probably occurred at the Summer Computer Simulation Conference, SCSC 1986 in Reno, Nevada, where I met some other European simulationists and I became more aware of Continental European simulation activities. The author was one of a small group of simulationists who was keen to promote collaboration between the simulation societies of Europe. I subsequently took part in the ESM 88 European Simulation Environments Conf., Nice, France, in May,1988, where I met many European simulationists. Of course, in 1988, this meant Western Europe. This lead to a number of meetings of interested representatives from the then major players in Europe. In turn, this gave rise to the fledgling EUROSIM Board, subsequently formalised in terms of an agreed set of Byelaws and a set of working rules. This was formalised at the EUROSIM Board meeting and formally announced at the SCS 3rd European Simulation Congress, held at Edinburgh University in September 1989. Subsequently, this gave rise to the 1st EUROSIM Congress, held in Capri, Italy, in September, 1992 under the auspices of the Italian Society, ISCS chaired by Prof. Franco Maceri. The rest, as they say, is history.

Keywords: Eurosim, History, European Societies, Board, Congresses.

Presenting Author's biography

Richard Zobel graduated in Electrical Engineering from London University in 1963. His first experience of simulation was obtained during 1962-66 at Sperry Gyroscope whilst working on naval surface to air missiles, using mainly valve analog computers. His Ph.D., obtained in 1970 at Manchester University, concerned hybrid analog-digital computing. As Lecturer and Senior Lecturer he became involved in digital signal processing, instrumentation and design environments with special emphasis on the simulation aspects of real-time embedded systems. He is a Committee Member and former Chair of UKSim, former Secretary of EUROSIM, and was a European Director of SCSI.. He is now an independent consultant, and still very active. He is currently working with the Computer Engineering Department as a visiting academic at the Prince of Songkla University, Phuket and Hat Yai Campuses in South Thailand.

CONGRESS PAPERS

List of special sessions

MO-1-P6	ALGEBRAIC METHODS AND ALGORITHMS IN MODELLING DISCRETE DYNAMICAL SYSTEMS (S12)
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MO-1-P8	MODELLING AND SIMULATION IN STRUCTURAL MECHANICS (S15)
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MO-2-P4	EDUCATION IN SIMULATION / SIMULATION IN EDUCATION I (S01-I)
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WE-1-P8	COMPUTATIONAL INTELLIGENCE AND DISCRETE SIMULATION (S05)
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TH-2-P7	COMMUNICATIONS

GREY-BOX MODELING OF AN OCEAN VESSEL FOR OPERATIONAL OPTIMIZATION

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Abstract

Operational optimization of ocean vessels, both off-line and in real-time, is becoming increasingly important due to rising fuel cost and added environmental constraints. Accurate and efficient simulation models are needed to achieve maximum energy efficiency. In this paper a grey-box modeling approach for the simulation of ocean vessels is presented. The modeling approach combines conventional analysis models based on physical principles (a white-box model) with a feed forward neural-network (a black-box model). Two different ways of combining these models are presented, in series and in parallel. The results of simulating several trips of a medium sized container vessel show that the grey-box modeling approach, both serial and parallel approaches, can improve the prediction of the vessel fuel consumption significantly compared to a white-box model. However, a prediction of the vessel speed is only improved slightly. Furthermore, the results give an indication of the potential advantages of grey-box models, which is extrapolation beyond a given training data set and the incorporation of physical phenomena which is not modeled in the white-box models. Finally, included is a discussion on how to enhance the predictability of the grey-box models as well as updating the neural-network in real-time.

Keywords: ocean vessel, **operational optimization**, **grey-box modeling**, **serial approach**, **parallel approach**.

Presenting Author's Biography

Dr. Leifur Þ. Leifsson is a faculty member at Reykjavik University, Reykjavik, Iceland. He graduated with a Ph.D. in Aerospace Engineering from Virginia Tech, Blacksburg, USA in the year 2006. His speciality is in the field of aerodynamics and multidisciplinary design optimization. In the year 1999 he graduated with a C.Sc. in Mechanical and Industrial Engineering from the University of Iceland, Reykjavik, Iceland and a M.Sc. in Mechanical Engineering in the year 2000. Leifur has worked on several projects in the industry, which include design and development of autonomous underwater vehicles, aircraft design and operational optimization of marine vessels.

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SIMULATION OF THE COALESCENCE OF DROPLETS EMPLOYING LATTICE BOLTZMANN AND LEVEL SET METHODS

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Abstract

A hybrid lattice Boltzmann and level set method (LBLSM) for two-phase immiscible fluids with large density differences is proposed, where the two fluids are assumed incompressible. The common Navier-Stokes incompressible equations are replaced by lattice Boltzmann method for calculating the velocities of the domain. The interface of the two fluids is captured by the level set function that is a robust technique for capturing sophisticated changes in geometry and topology. The surface tension force is replaced by an equivalent force field which is proportional to the curvature of the interface and the experimental coefficient of surface tension. The method can be applied to simulate two-phase fluid flows with density ratio up to 1000 and viscosity ratio up to 100. In case of zero or known pressure gradient the method is completely explicit. Assuming zero pressure gradient, the coalescence of two droplets is simulated. Besides, the entrapment of a small bubble between the interfaces of the two droplets was also captured in the simulation. The results are in agreement with experimental results, so the new method (LBLSM) is valid for simulation of droplet phenomena. Afterwards the coalescence of three droplets is simulated and the evolution of the droplets in a proposed time scale is investigated.

Keywords: Lattice Boltzmann method; Level set method; droplet coalescence.

Presenting Author's Biography

Siamak Kazemzadeh Hannani is currently associate professor of Mechanical Engineering at Sharif University of Technology. He is Director of Thermo-Fluid Division and Center of Excellence for Energy Conversion. He obtained his doctorate from University of Lille1, France, in 1996. His research interests include CFD, Turbulence Modeling and Heat Transfer.

MODELING AND SIMULATION OF HYDRAULIC SYSTEM FOR TRANSLATIONAL AND ROTATIONAL MOTION

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Abstract

The main focus in this paper is on modeling and computer simulations of hydraulic systems for achieving a linear or rotary actuator motion, which are mostly used for high-power industrial applications. The hydraulic servo systems are very important systems for control applications because they take the advantages of both the large output power of traditional hydraulic systems and a high servo control response of electric systems. A nonlinear dynamic model for both translational and rotational motion of hydraulic actuator has been derived, which can be used in simulation studies of dynamic behavior of system and for advanced controller design. The hydraulic control system model has been derived as coupled sets of nonlinear algebraic and differential equations, which includes the main phenomena of physical system. This form of modeling equations has been resulted in a block-oriented system model. The simulation model includes the flow and force equations necessary to describe dynamic behavior of the control system and allows the prediction of performance of hydraulic system through computer simulation. A simulation model depicting the two control systems has been built, which may be used for an easy comparison of dynamical behavior of common hydraulic systems in industry. The model also contains several important dynamic characteristics those substantially influence the performance of the system within the operation range. Model development and preliminary experimental testing on laboratory setup are in progress.

Keywords: Hydraulic system, Mathematical model, System simulation

Presenting Author's biography

Željko Šitum. Received the BS degree in 1993, the MS degree in 1997, and the Ph.D. degree in 2001 in mechanical engineering from the University of Zagreb, Croatia. He is an Assistant Professor at the Department of Control Engineering at the Faculty of Mechanical Engineering and Naval Architecture on the University of Zagreb. His research interests include control of dynamic systems, fluid power systems control, mechatronics and computer simulations.

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DYNAMICAL CHARACTERIZATION OF A VIBRATING MEMBER GYROSCOPE USING FINITE ELEMENT METHOD

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Abstract

The subject of this paper is to show how a dynamic analysis of a micro machined vibrating-member gyroscope based on the finite element method (FEM) can be performed. Furthermore it is shown how to use results of the FEM analysis as input for a system simulation.
To get an overview of the dynamical behavior of the micro electro-mechanical system a modal analysis must be performed. To understand the dynamics of the structure under driving conditions the results of the harmonic response of the structure must be analyzed. In this paper we perform all these analysis steps with the help of FEM. We use ANSYS for preprocessing and solution procedures. A given device is simulated and the results are compared to measurements. In addition we mention good practice in performing different simulations and we report conditions where simplifications in our modeling and simulation procedure are allowed. We also want to stress the importance of using appropriate material models and meshing procedures.
Finally we propose a model of the gyro-structure which can be used for a system simulation. In this lumped parameter model approach we are able to simulate zero rate offset of the device and also effects due to different DC bias voltages.

Keywords: Gyroscope, FEM, ANSYS, System model.

Presenting Author's Biography

Armin Satz. Graduated in 'Technical Physics' at the Vienna University of Technology. He finished his master thesis 'Lifetime Effects in Electron energy Loss Spectrometry' in April 2006. Since then he has been working towards his PhD at KAI Kompetenzzentrum Automobil und Industrie-Elektronik in Villach, Austria.

MODELING OF NON-CONTACT HANDLING DEVICE BY USING AIR SWIRLING FLOW

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Abstract

Previously semiconductor work pieces like wafers were picked up and carried by contacting methods. Such contacting methods, which often involve a manipulator having a direct surface contact with the work piece, are accompanied with problems of surface scratching and generation of static electricity. In order to avoid contact between a handling device and work pieces while picking and moving them, many non-contact handling approaches were proposed and proved to be effective. Among them, pneumatic non-handling approaches are widely used by using air flow to apply a force to the work piece. Because air flow is magnetic free and generates little heat, pneumatic devices can deal with any material, insulator or conductor, magnetic or non-magnetic. As is known, air swirling flow is applied in many applications, for example, separation of particles and improvement of combustion. It is found that negative pressure can be made by centrifugal force. Consequently, we had proposed a new pneumatic levitation approach named Vortex method by utilizing air swirling flow to achieve non-contact handling. In the approach, compressed air is blown tangentially through a nozzle into a small circular cylinder, and then spins along the cylindrical wall. The air swirling generator is called vortex cup. As a result, negative pressure is made by centrifugal force so that a work piece, placed under the vortex cup, can be picked up. However, the work piece will levitate at intervals of several hundred micrometers away from the vortex cup as air is discharged to atmosphere though the gap. Consequently, the work piece doesn't have any contact with the vortex cup. Furthermore, it is found that there is a stable levitation region where the levitation of the work piece can be kept stable. In our present work, we made an investigation on its basic characteristic by experiments and proposed a simple model for calculations.

Keywords: Swirling Flow, Non-contact handling, Vortex method, Attractive force

Introduction of Author

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PhD student of Mechano-Micro Engineering Department of Tokyo Institute of Technology Japan. Researching on pneumatic non-contact handling device.

MATHEMATIC MODEL AND CONTROL METHOD BASED ON HYBRID INTELLIGENCE

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Abstract

A mathematic model based on RBF(Radial Basic Function) neural network and genetic algorithm for multivariable optimal control with the lowest operational cost by limiting total substrate discharge in activated sludge process were discussed. It shows that the RBF neural network has preferable convergence for modeling the process. On the whole, mapping is nonlinear from inputs to output of RBF network; and output of network is linear to adjustable parameter. The RBF neural network was trained and simulated by a lot of observed data, and the result showed that the RBF neural network may be used to model the process and predict the water quality of outlet of SBR(Sequential Batch Reactive Mud Method) system. Genetic algorithm is an effective searching method to resolve the optimal problem in this case. Based on satisfying the requirements of precision, binary coding is used to express units, and 20 bits of binary digits express DO(Deliquescent Oxygen), Q_w separately. According to the adaptive degree of units, which can be operated genetically through genetic operator, superior units can be saved, inferior ones are eliminated, and a group of new units can be obtained. This algorithm avoids the difficulty of guessing iteration initial value and increases calculation efficiency, The optimization strategy made up of RBF neural network and genetic algorithms is adopted. After achieving the discharge standard of biochemical oxygen demand, the control rule for variables to make operation cost be least is found by simulation.

Keywords: Mathematic model, RBF neural network, Genetic algorithm, Sewage disposal process, Simulation.

Presenting Author's biography

Zaiwen Liu. male, was born in Beijing, China. Now he is a professor in the School of Information Engineering, Beijing Technology and Business University. His research mainly includes system modeling and simulation, intelligence control, computer control system and measurement control network.

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RBF NEURAL NETWORK WITH LINEARLY APPROXIMATED FUNCTIONS ON FPGA

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Abstract

This article focuses on implementation of the Radial Basis Function (RBF) neural network by using linearly approximated functions. The presented approach is suitable for hardware implementations on FPGA that may accelerate the simulation of neural networks of this type. The approach of linearly approximated functions goes beyond the complexity of multipliers and large look-up tables for implementing activation functions and replaces them with simpler logic circuits based on adders and shifters. We show that some combination of building blocks consisting of many multiplexers (if implemented separately) can be replaced by a small set of invertors (if combined). This considerably reduces the amount of hardware necessary to implement the RBF neurons. Further, we present the results of our pilot implementation of the RBF neural network on FPGA consisting of arithmetic blocks for neural calculations, memory blocks for prototype storage, and controllers. Bus interconnections among neurons and command based control of neurons provide very good scalability of the proposed architecture. It allows increasing the number of RBF neurons as well as increasing the dimension of the input vector. The pipelining technique used for RBF neurons allows full utilization of the hardware. All functional blocks of the RBF neural network are implemented in synthesizable VHDL, simulated by the ModelSim 6.2d VHDL simulator and synthesized for the Xilinx Virtex-4 device by the Xilinx ISE 8.2i. As a result of synthesis, we provide a number of parameters such as the maximum clock frequency and the number of function blocks that characterize the resulting synthesized FPGA design.

Keywords: neural network, Radial Basis Function (RBF), linear approximation, neural hardware, FPGA.

Presenting Author's biography

Rudolf Marek is a postgraduate student and researcher at the Department of Computer Science and Engineering. He received his Master's degree in Electronics and Computer Science & Engineering from the Faculty of Electrical Engineering, Czech Technical University in Prague in 2006. His research is focused on hardware acceleration of computational intelligence algorithms.

USE OF RADIAL BASIS FUNCTIONS AND LEVEL SET METHOD FOR SOLVING ONE-DIMENSIONAL PHASE CHANGE PROBLEMS

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Abstract

Mathematically, the interface motion is expressed implicitly in an equation for the conservation of thermal energy at the interface (Stefan's conditions). This introduces a non-linear character to the system which treats each problem somehow uniquely. Due to their wide range of applications the phase change problems have drawn considerable attention of mathematicians, engineers and scientists. These problems are often called Stefan's or moving boundary value problems. One common feature of phase change problems is that the location of the solid-solid interface is not known a priori and must be determined during the course of analysis. The solution is obtained either by analytical solution or numerical methods. Recently, the numerical methods have focused on the idea of using a mesh-free methodology for the numerical solution of partial differential equations based on radial basis functions. Level set methods have become an attractive design tool for tracking, modelling and simulating the motion of free boundaries in fluid mechanics, combustion, computer animation and image processing. The surface itself is zero level set of an implicit function in a higher dimension. In our case we will study solid-solid transformation. The numerical solutions will be compared with analytical solutions. In our work we will present radial basis functions and level set methods for solving one-dimensional Stefan's problems.

Keywords: Radial Basis Functions, Level set Method, Dynamic interfaces.

Presenting Author's Biography

Leopold Vrankar was born in Trbovlje, Slovenia. He received his PhD in Geotechnology at University of Ljubljana, Faculty of Natural Sciences and Engineering in 2004, with dissertation modeling of radionuclide migration through porous material with meshless method. At the moment he is working at the Slovenian Nuclear Safety Administration.

MISSING DATA IMPUTATION AND THE INDUCTIVE MODELING

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Abstract

Missing data is a big problem in simulation for data mining and data analysis. Real world applications often contains missing data. Many data-mining methods is unable to create models from data which contains missing values. Traditional approach is to delete vectors with missing data. Unfortunately, this approach may lead to decreased accuracy of the models and in the worst case all data in dataset may be deleted. For this reason many different imputation techniques were developed and some are widely used. In this paper, we present a comparison of several well-known techniques for missing data imputation. Presented techniques includes imputation of mean value, zero, value from nearest input vector and few others. In this paper we show which techniques are the best in estimation of missing values. To test imputation methods we used several different datasets. We compare the imputation methods in two ways. The first is to compare imputed data with original data. The measure of similarity is RMS. The second test was to compare the accuracy of inductive models generated from datasets with missing values replaced by different imputation techniques. Results shows that no method can be chosen as the best becouse the performance of each method depends on characteristics of the data.

Keywords: Missing data, Missing data imputation, GAME Neural network, Inductive modeling method

Presenting Author's Biography

Miroslav Čepek is a PhD student at the Department of Computer Science and Engineering of the Czech Technical University in Prague. He graduated in 2006. He is interested in biological signal processing and data mining.

DATA MODELS IN VIEW OF COOPERATIVE DIALOGUE SYSTEMS

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Abstract

Databases and information systems that are based on the widespread relational data model are often hard to use because they do not explicitly attempt to cooperate with the user. In dialogue systems or natural-language interfaces, for instance, the most vital cooperative-answering technique is *query relaxation*, which expands the scope of a query by relaxing the constraints implicit in the query in order to capture neighbouring or possibly relevant information. Thus, dialogue systems, particularly information-providing dialogue systems, require a cooperative data model. Since none of the most common data models, e.g., relational data models, deductive data models, and object-oriented data models, enable query relaxation, we refer to a very promising data model, which results from a natural generalization of the relational data model from set-theoretic algebra of relations to a category-theoretic setting. This data model includes the fundamental relational data model, and it is able to represent all the basic relational operations in many richer-structured environments. Apart from the standard domain orderings such as numerical and alphabetical orderings, it comprises heterogeneous semantic orderings, and thereby supports query relaxation.

Keywords: Data models, Dialogue systems, Cooperative behaviour, Query relaxation, Relational databases.

Presenting Author's Biography

Melita Hajdinjak is a Fellow Researcher and Teaching Assistant at Faculty of Electrical Engineering, University of Ljubljana, Slovenia. She has a B.Sc. in Mathematics from Faculty of Mathematics and Physics, an M.Sc. and Ph.D. in Electrical Engineering from Faculty of Electrical Engineering, and is currently working toward her Ph.D. in Mathematics. Her area of interest includes knowledge representation, natural-language dialogue systems, human-machine communication, and theoretical computer science. For the bachelor work she has attained the Franc Močnik Award, and for the doctoral disseratation she has attained the Pomurje Research Award 2006. She is fluent in German and English and has elementary knowledge of French.

COMPUTING DEDEKIND SUMS USING THE EUCLIDEAN ALGORITHM

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Abstract

This paper presents an algorithm for computing Dedekind sums $\sigma_i\big(\frac{1}{r}(a_1,\dots,a_n)\big)$ by using the Euclidean algorithm and algebraic properties of σ_i. In Theorem 2.2 an explicit relation between a polynomial α with rational coefficients, which is obtained by the Euclidean algorithm, and $\sigma_0,\ \sigma_1,\dots,\sigma_{r-1}$ will be determined. The main advantage of the algorithm is that by knowing α all σ_i can be calculated simultaneously. When $a_1,\dots,a_n$ are relatively prime to r, the algorithm can be put in a particularly simple and compact form. Several examples are explicitly computed by using `Mathematica.`

Definition 0.1 Fix positive integers r and $a_1,\dots,a_n$. The sums σ_i are defined by

$$\sigma_i = \frac{1}{r}\sum_{\substack{\varepsilon\in\mu_r\\ \varepsilon^{a_i}\neq 1\,\forall i=1,\dots,n}} \frac{\varepsilon^i}{(1-\varepsilon^{a_1})\cdots(1-\varepsilon^{a_n})}, \tag{1}$$

where ε runs over rth roots of unity. It is obvious that $\sigma_i = \sigma_{r+i}$. Therefore we only need to consider σ_i for $i = 0,1,\dots,r-1$ and call it the ith *Dedekind sum.* If we want to stress that not all $a_1,\dots,a_n$ are relatively prime to r, then σ_i is called the ith *generalised Dedekind sum.* When $a_1,\dots,a_n$ are relatively prime to r the above sum is taken over all rth roots of unity. Let

$$A = \prod_{i=1}^{n}(1-t^{a_i}) \qquad \text{and} \qquad B = \frac{1-t^r}{1-t}. \tag{2}$$

Then by the Euclidean algorithm there exist polynomials $\alpha,\beta\in\mathbb{Q}(t)$ such that

$$1 = \alpha A + \beta\frac{B}{\mathrm{hcf}\,(A,B)}. \tag{3}$$

This way obtained α is called *the Inverse of* $\prod_{i=1}^{n}(1-t^{a_i})$ *modulo* $\frac{1-t^r}{1-t} = 1+t+\cdots+t^{r-1}$.

Keywords: Dedekind sums, Euclidean algorithm, computing.

Presenting Author's Biography

Anita Buckley. Her main research area is algebraic geometry. Currently a teaching assistant for mathematics at the University of Ljubljana. Completed PhD in Mathematics at the University of Warwick, England in 2003. Graduated in theoretical mathematics at the University of Ljubljana, Slovenia in 1998.

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CONSTRUCTION OF SELF-ADJOINT DETERMINANTAL REPRESENTATIONS OF SMOOTH CUBIC SURFACES

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Abstract

We consider a smooth cubic surface S and its determinantal representations. The equivalence classes of determinantal representations correspond to sixes of skew lines on S. There are 72 such sixes of lines on S and thus there are 72 nonequivalent determinantal representations of S. The aim of our paper is to provide two procedures for computation of determinantal representations of cubic surfaces. For smooth real cubic surface we also construct self-adjoint and definite determinantal representations when they exist. For the first procedure we assume that S is given as a blow-up of six points in a projective plane and for the second that we are given equations of a line on S or an equation a tritangent plane of S. The key step in the constructions is computation of explicit equations of all the 27 lines on S. Exact computations are possible if S is given as a blow-up of six points or if we are given an equation of a tritangent plane. It is known that if we are given a defining polynomial for S then, in general, computation of a line or a tritangent plane requires transcendental methods since the Galois group of the corresponding equation is not solvable. One can then use transcendental methods introduced by Klein and Coble or use numerical methods and approximate computations instead of exact ones.
Both authors were supported in part by the Research Agency of the Republic of Slovenia.
Math. Subj. Class. (2000): Primary. 13P99, 14J26, 14Q10. Secondary. 15A15, 68W30.

Keywords: Cubic surfaces. Blow-up. Determinantal representations. Self-adjoint and definite determinantal representations.

Presenting Author's Biography

Tomaž Košir is a professor of mathematics at the Faculty of Mathematics and Physics, University of Ljubljana. He did his Ph.D. in 1993 at the University of Calgary in Canada. After that he spent two years at Dalhousie University, Halifax, Canada as a postdoctoral fellow. Later, he was a visiting professor at the University of Southern California in Los Angeles and at Dalhousie University. His main research interest are in algebra, geometry, and their applications in partial differential equations.

ALGEBRAIC METHODS IN MULTIVARIATE POLYNOMIAL INTERPOLATION

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Abstract

In this paper we apply the Gröbner Bases Techniques to solve one type of multivariate polynomial interpolating problem which has applications in modeling finite discrete time series. Consider a set of *n*-dimensional points $T = \{P_1, P_2, \cdots, P_m, P_{m+1}\}$ over the field $\mathbb{R}$ of real numbers**.** The multivariate polynomial interpolation problem with respect to the set $T' = \{P_1, P_2, \cdots, P_m\}$ is stated as: given $\mathbf{b}$ = $(b_1, b_2, \cdots, b_m) \in \mathbb{R}^m$**,** find a polynomial f (in n variables) such that $f(P_i) = b_i$ for all $i = 1, 2, \cdots, m$. We call such an f an interpolator on or on T' targeting at **b**. Further, we view the set *T* as a discrete time series. A polynomial model of *T* is a function $\mathbf{f} = \{f_1, f_2, \cdots, f_n\}$ such that $f(P_i) = P_{i+1}$ for all $i = 1, 2, \cdots, m$**.** Each f_i is an *n*-variable polynomial interpolator on T'. We demonstrate methods using different monomial orders (or term orders) to construct polynomial interpolators of different types. A *Maple* code is developed based on the *Buchberger-Möller Algorithm* to construct separators which play a key role in the interpolation. We show that the set of separators constructed by the algorithm under a fixed order is unique. The behavior of two term orders, the *lex* order and the *graded reverse order,* in the construction of the interpolators are investigated. A relationship between the number of variables appearing in the constructed interpolator and its total degree is given. A method to construct single variable interpolators is discussed. Examples are provided to illustrate the process.

Keywords: Gröbner Bases, separator, polynomial interpolation.

Presenting Author's biography

Aihua Li**.** Dr. Aihua Li is an associate professor at Montclair State University located in New Jersey, USA. She received her Ph. D. from the University of Nebraska-Lincoln in the area of commutative algebra with concentration on structures of commutative Noetherian rings and prime ideals. Her current research interests include solving polynomial and matrix equations, difference equations, ring theory, number theory, algebraic applications in modeling discrete time series and the effective computational methods. Dr. Li's research programs have been funded by various state and national agencies. Currently she has several active research projects with undergraduate students, funded by an NSF Center for Undergraduate Research in Mathematics program. She is an active referee for six journals and a reviewer for the Mathematics Reviews.

DISTANCE BASED METHODS IN PHYLOGENTIC TREE CONSTRUCTION

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Abstract

One of the most fundamental aspects of bioinformatics in understanding sequence evolution and relationships is molecular phylogenetics, in which the evolutionary histories of living organisms are represented by finite directed (weighted) graphs, in particular, directed (weighted) trees. There are basically two types of phylogenetic methods, distance based methods and character based methods. Distance based methods include two clutering based algorithms, UPGMA, NJ, and two optimality based algorithms, Fitch-Margoliash and minimum evolution [1]. This paper focuses on distance based methods. The paper starts with some preliminary knowledge and definitions in the area, including finite directed graphs, directed trees and matrices. It discusses the verification of the metric property of distance matrices, including detections of errors if a distance matrix fails to satisfy the metric property, and then provides an algorithm in modifying the distance matrix to satisfy the metric property. The second part of the paper is a brief survey based on the excerpts from the references, on various frequently used distance based phylogenetic tree construction methods, both cluster-based and optimality base methods, including UPGMA, Neighbor Joining, Fitch-Margoliash, and Minimum Evolution methods. Also, it discusses the assessment of the phylogenetic trees and some analysis of the algorithms.

Keywords: molecular phylogenetics, distance based, clutering based, optimality based.

Presenting Author's Biography

Chuang Peng. The author received his B.S in 1982 and M.S in 1985 from Beijing Normal University. He then taught at the same school for four years as an assistant professor and lecturer. He enrolled in the docorate program in University of Georgia, Athens, Georgia in 1989, and completed the program in 1995. Right after his graduation from University of Georiga, he joined faculty members at Morehouse College in Atlanta, Georgia. He is currently a full professor in the Department of Mathematics, and a member in the Bioinformatics group at the college.

WAVELET COMPRESSION OF SEMI-REGULAR TETRAHEDRAL VOLUME MESHES

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Abstract

In this article we introduce a new compression scheme that can be effectively used to compress volume data sets by exploiting a multiresolution model based on a semi-regular tetrahedral mesh, that is a mesh that is regular except on the coarsest level. In order to generate the multiresolution representation, we use a wavelet based approach that allows compression and progressive transmission. Starting with an initial semi-regular tetrahedral mesh Γ_∞ and successively applying the wavelet transform, we construct coarser representation levels of the given mesh. At the end, a coarse base mesh Γ_0 together with a sequence of detail coefficients are obtained from the decomposition of the mesh at these different levels of detail. In order to do that, we use a Haar-like wavelet basis defined over a tetrahedron as the first step for defining this kind of bases over an object represented by tetrahedra. The considered base mesh is represented at the lowest resolution and it does not have the connectivity subdivision property. The obtained result is a hierarchical data description suited for compression. In addition, we can obtain higher levels of compression using the lossy and lossless compression algorithms proposed in this paper. In the case of transmission, we have analyzed a protocol that allows progressive transmission of the mesh.

Keywords: 3D Compression, Wavelets, Semi-Regular Meshes.

Presenting Author's biography

Liliana Castro received a bachelor and a Master in Mathematics in 1979 an 1982, respectively and the Doctorate in Control Systems in 2001 at the Universidad Nacional del Sur (UNS), Bahía Blanca, Argentina. Since 1999 she is Associate Professor at the Departamento de Matemática, UNS and she is also with the Instituto de Investigaciones en Ingeniería Eléctrica *Alfredo Desages*. Since 2000 she is head of the Modeling Group at the Laboratorio de Investigación y Desarrollo en Visualización y Computación Gráfica, Departamento de Ciencias e Ingeniería de la Computación, UNS. She teaches undergraduate introductory courses on multivariate analysis, a graduate course on wavelet analysis and a graduate course on functional analysis. Her research interests include nonlinear system modeling, identification, piecewise linear approximation of nonlinear systems and geometric modeling using wavelets.

SOME CONSIDERATIONS ON GLOBAL AND LOCAL THERMAL COMFORT BASED ON FIALA‘S THERMAL MANIKIN IN THESEUS-FE

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Abstract

Thermal management topics like air conditioning and thermal comfort become more and more important during vehicle development. As a consequence the need for suitable tools and methods to predict the human comfort behaviour in cabins increases rapidly. THESEUS-FE is a finite element based software tool with a fully coupled implementation of Fiala's thermal sensation manikin presented in [1]. This paper will demonstrate the finite element based implementation of the new manikin FIALA-FE in an existing solver environment, various thermal comfort topics will be discussed in a second step. Additionally this paper explains the application of the finite element theory on the complete framework of formulas that represents the thermoregulatory human system. Because the major challenge was not the numerical solution of the bio heat equation based on the finite difference method, as shown in [1], but on a method that allows to create a special finite element type, representing a single human material layer. Finally this paper will discuss different aspects of global and local thermal comfort prediction, based on mathematical models from literature. The usage of certain human state variables (like the mean skin temperature) will be discussed in terms of comfort prediction. At the end the idea of the 'equivalent temperature' by using simulated skin and cloth temperatures leads to a quite simple-to-use method of assessing local thermal comfort at given boundary conditions, typical for a vehicle simulation. Considering not only surface-to-surface radiation and convection but also sun radiation, seat contact and evaporation the equivalent temperature can then be derived at each body part of a thermal manikin.

Keywords: Thermal Manikin, Thermal Comfort Prediction, Finite Element Method.

Presenting Author's biography

Stefan Paulke. Fished his civil engineering studies at the Technical University of Munich in 1997. From 1997 until 2001 he worked as a scientific assistant at the chair of Technical Mechanics, University of the Armed Forces in Munich, and completed his PhD thesis on thermo-mechanical coupling effects in 2001. Afterwards he started working at P+Z Engineering as a CAE Engineer. One year later he joined the THESEUS-FE project and is today the responsible technical manager of this commercial software tool. In 2006 and 2007 he implemented the new thermal manikin FIALA-FE.

MODELING AND SIMULATION OF COMPRESSORS IN MOBILE AIR-CONDITIONING SYSTEMS

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Abstract

This paper presents a detailed mechanical and thermodynamic Modelica model for a CO_2 compressor used in prototype air-conditioning cycles for buses. The mechanical parts are modeled with Modelica's Multibody Library. The thermal part is modeled with basic thermodynamic conservation laws and uses the interface library TILFluids for refrigerant property data. The compressor is simulated as a component in a complete air-conditioning cycle. The Modelica library TIL is used for all remaining components in the complete air-conditioning cycle. Due to the very short timescale of the compressor physics in combination with the high effort for calculating fluid property data of the complete cycle, the total integration time is very high. Therefore, a simple multi-rate integration method was implemented by using co-simulation. The middleware TISC was used to couple the compressor model with the remaining air-conditioning cycle. Suction pressure, suction enthalpy and discharge pressure are the input variables for the compressor; suction mass flow rate, discharge mass flow rate and discharge enthalpy are the output variables. With this technique, the simulation speed of the complete air-conditioning cycle including the detailed compressor model could be increased by a factor of 40.

Keywords: Modelica, multi-rate integration, air-conditioning and refrigeration, thermal system, compressor, co-simulation

Wilhelm Tegethoff is engaged in modeling and simulation of thermal systems such as air-conditioning, refrigeration and heat pump systems for more than ten years. In 1995 he started working at Konvekta AG in R&D dealing with absorption systems and CO_2 as refrigerant. In 1999 he received his PhD from the TU Braunschweig. Afterwards he worked for one year as visiting lecturer in Brazil. Since seven years he is employed at the Institut für Thermodynamik at TU Braunschweig where he is responsible for the thermal science simulation group. He teaches Modelica and C++ for application in thermal science. In 2003 he founded the spin-off TLK-Thermo GmbH together with Nicholas Lemke and Jürgen Köhler. TLK offers engineering services and custom-made software for thermal systems.

INTELLIGENT COMBINATION OF SIMULATION TOOLS AND EXPERIMENTAL INVESTIGATIONS BY MEANS OF THE V APPROACH

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Abstract

With the V-approach full vehicle prototype testing can be reduced by increasing numerical simulation and components tests. Full vehicle prototype testing is necessary to prove different functionalities of the vehicle and to prove the interaction of the different sub-systems under real vehicle conditions. To reduce full vehicle prototype testing the methodology behind the simulation must be able to simulate interdependencies within the entire vehicle simulation model. This paper presents a methodology for intelligent combination of simulation tools and experimental investigations by means of the so called V-approach. Within this approach the entire system is divided into several sub-systems which are stripped to component level and verified by means of experimental investigations. Afterwards the models are re- assemble to a comprehensive simulation model of the entire vehicle. For this purpose a platform for coupling of several simulation tools and co-simulation is required, which is presented in this paper. The Coupling process is done with an independent Co-Simulation environment (ICOS). With this tool it is possible to build up a validated entire vehicle simulation model which is based on the coupling of validated simulation sub-models. Furthermore in the presented paper comparisons between the entire vehicle simulations and measurements of an entire vehicle are shown. With this approach it is possible to prove different functionalities of the vehicle and to understand the interactions of the different sub-systems with an entire vehicle simulation model by coupled simulation.

Keywords: Combination simulation and tests, Coupled Simulation, Co-Simulation, V-approach, full vehicle simulation,

Presenting Author's biography

Wolfgang Puntigam received his master degree from the university of applied science in Graz, department automotive engineering in 2001. He finished his PhD at the technical university in Graz, department mechanical engineering in 2007. Since 2003 he is employed at the Virtual Vehicle Research Center GmbH (vif). Since 2005 he is divisional director of the department Thermo- and Fluid Dynamics at the vif. His interests are comprehensive vehicle simulation, coupled simulation and co-simulation, as well as the thermal management, hybrid systems, alternative modelling techniques and robust optimization.

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THERMAL MANAGEMENT SIMULATION APPROACH FOR PARALLEL HYBRID VEHICLES

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Abstract

The most challenging goals facing the automotive industry are reducing emissions and increasing fuel economy. These requirements are not only imposed by the society, but also by different cooperative agreements and legislative efforts such as the PNGV Program (USA), the ACEA (Europe) commitment to reduction of CO_2 emissions to 120 grams and the California Low Emission Vehicle Legislation.
The hybrid electric vehicles are seen as a solution for reducing of the pollution emissions and for improving of the fuel economy. Beside the conventional cooling system for the engine, the hybrid vehicle needs cooling systems for the electrical drive and the energy storage system as well. The thermal integration of the additional components leads to complex and coupled cooling systems. Therefore, a novel simulation model of the entire thermal management of the hybrid vehicle is required. This paper introduces an approach for the simulation of the vehicle thermal management system in a parallel hybrid vehicle within a comprehensive simulation environment. The hybrid drive train is developed by using a combination of the vehicle dynamics simulation program veDYNA and Matlab/Simulink. The simulation of the cooling system is performed by the 1D simulation program KULI. In order to carry out a comprehensive thermal calculation, a coupled simulation using the independent co-simulation environment tool ICOS is performed.

Keywords: Modeling and Simulation, Thermal Management, Cooling System, Hybrid Vehicle, Co-Simulation

Presenting Author's biography

Filip Kitanoski received the master degree from the Vienna University of Technology, Austria in 2005. Since 2005 he is a junior researcher at The Virtual Vehicle Competence Center GmbH (vif) and his research interests are in the area of the vehicle thermal management systems, as well as modeling, simulation and optimization of the vehicle as an entire system. He also works and has special interests in future ground vehicle propulsion systems.

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SIMULATING THERMAL MANAGEMENT OF BATTERY MODULES FOR THE PROPULSION OF HYBRID VEHICLES

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Abstract

The coupling of 1D and 3D Tools is gaining constantly more applications in automotive development processes. This paper demonstrates the possibility to couple the 3D Computational Fluid Dynamics (CFD) tool FLUENT with the 1D Software KULI to simulate the thermal management of battery modules for the propulsion of hybrid vehicles. One of the most important aspects of hybrid vehicles is to ensure the cooling of the propulsive components (electric motor and converter) and the battery module. The durability of each cell of the battery module strongly depends on the temperature rise during the charging- and discharging process. Hence the behavior of the entire battery module was simulated and optimized prior the availability of hardware components using both 3D and 1D tools. The optimization process aimed at restricting the temperature range of each cell to a reasonable level.The Heat Transfer Coefficient (HTC) of the cells was calculated with FLUENT and used to simulate the transient behavior of the module with KULI. A transient charging and discharging cycle was used to simulate real driving conditions. The focus was laid on comparing different cooling strategies (air and water cooling) with respect to efficiency and feasibility. Moreover the heat-up of the cell itself was simulated and the results were compared with measurements, showing good agreement.

Keywords: CFD simulation, Hybrid vehicle, Battery cooling, Coupled simulation

Presenting Author's biography

Christian Kussmann received his master degree from the university of applied science in Graz, department automotive engineering in 2002. Directly after his study he entered Magna Steyr, where he was working in the field of CFD and 1D simulations. In 2006 he became the groupleader of the department "Thermal Simulations and Aerodynamics". His interests are complete vehicle simulation, coupled simulation techniques, the thermal management, hybrid systems and aerodynamics.

RESOLUTION METHODS DEDICATED TO STRESS FORMULATED CONTACT PROBLEMS

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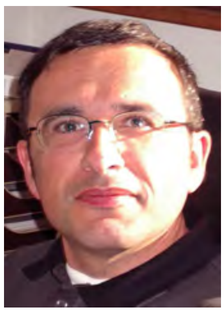
Abstract

This paper deals with numerical methods for unilateral contact problems with dry friction (Signorini-Coulomb problems) written in terms of stresses (dual formulation). The formulation of the problem is first presented, we use the equilibrium finite element method to discretize it. With this method, the stress field is obtained by derivation of an Airy stress function which nodal values are taken to be the degrees of freedom. Therefore, forces can not be prescribed directly as displacements are prescribed in the classical finite element method (primal formulation). Forces are thus introduced in the system using Lagrange multipliers. For this reason, the matrix system is not positive definite and dedicated solvers have to be used. Four solvers are thus proposed, three of them are based on the condensation of the problem on the contact zone, using various partitions of the global matrix system and various linear solvers to perform condensation. The obtained condensed system is then solved and contact and friction conditions are applied using a classical Gauss Seidel relaxation algorithm. One solver is based on the use of the augmented Lagrangian version of the problem and is solved using the Uzawa algorithm. Two solvers are shown to be very efficient and allow the problem to be solved quickly.

Keywords: Contact, friction, equilibrium finite elements, augmented Lagrangian, condensation.

Presenting Author's Biography



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WIRES AND CABLES IN SOME DISCRETE STRUCTURES OF CIVIL ENGINEERING

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Abstract

Wires and cables are valuable components for the design of mechanical structures, due to their high strength-to-lightness ratio. Their efficiency is only guaranteed when they are subjected to tensile stress: indeed, they exhibit a unilateral behaviour with a lack of stiffness in compression. The tensile state depends on the distribution of stress through the whole structure. The computation of this stress state requires to deal with nonsmooth relations arising from the modelling of the unilateral behaviours, leading to specific numerical strategies. Two examples of such structures are investigated. Tensegrity structures are light reticulated systems composed of bars in compression and a large number of tensioned cables. As poetically defined by Fuller [1], they are viewed as “islands of compression in an ocean of tension.” TexSol™ is a reinforced geomaterial made of sand and wires. This type of material is adapted for the embankments requiring a strong slope or works which may be subjected to a dilatation strain. In this case, the nonsmoothness is not reduced to the wire behaviour but concerns as well the frictional contact between grains and between grains and wires.

Keywords: Nonsmooth dynamics, unilateral behaviour, tensegrity, granular matter.

Presenting Author’s Biography

David Dureisseix. He entered the *Ecole Normale Supérieure de Cachan* (ENS Cachan, France) in 1988, and received the *Agrégation* in Mechanics in 1991. Its research activities began in the Mechanics and Technology Laboratory. He defended his Ph.D. thesis in 1997, and became Assistant Professor at the ENS Cachan. He is now Professor at the University Montpellier 2 in the Mechanics and Civil Engineering Laboratory. Head of the MultiContact System research team, its research activities concern domain decomposition, simulation of multiscale and multiphysics problems, and nonsmooth mechanics. Web page: http://www.lmgc.univ-montp2.fr/ dureisse

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SIMULATION OF DECOHESION AND FRACTURE ALONG AN INTERFACE VIA GEOMETRICALLY NONLINEAR COHESIVE ELEMENTS. APPLICATION TO ADHESIVE JOINTS

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Abstract

This paper describes a geometrically nonlinear formulation for an interface and its application to the analysis of adhesive joints configurations failing in the fully nonlinear regime. The core of the adopted approach is that of using a cohesive-zone model to mimic the behaviour of the adhesive layer within a corotational-like element formulation, i.e. large displacements and rotations with small strains. In particular, the adherends are allowed to experience large elastoplastic deformations while the progressive interface decohesion is modelled via the damage mechanics approach developed by the authors, that is here suitably extended to include geometric effects. This gives rise to two main differences with respect to the underlying linear formulation, namely, the need for the continuous tracking of the discontinuity surface due to the explicit dependence of the cohesive tractions on the orientation of the surface itself and the presence of geometric terms in the tangent stiffness. Numerical examples and comparisons with experimental results are provided that show the ability to capture the highly nonlinear response for a single-lap joint and an asymmetric T-peel test, where fracture of the adhesive layer is accompanied by large rotations and extensive plastic deformation of the joint arms.

Keywords: Adhesive joints, Decohesion, Damage, Nonlinear kinematics, Finite elements

Presenting Author's Biography

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NUMERICAL SIMULATION OF DELAMINATION PHENOMENA IN FIBER REINFORCED COMPOSITE LAMINATES

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Abstract

Delamination mechanisms strongly affect the material integrity of composite structures, especially when the crack growth is generated by impact or dynamic loading conditions. In this framework, experimental observations have been shown that high speeds crack propagation characterizes the composite structures leading to catastrophic failure mechanisms. In this paper, the dynamic behavior of composite structures in the framework of steady-state crack growth is investigated. The proposed methodology considers the laminated structures as composed by first-order shear deformable plate elements interconnected by interface elements, whose constitutive relationships are based on fracture and contact mechanics. Analytical solutions of the relevant governing equations are proposed and closed form expressions for energy release rates (ERRs) are provided, emphasizing the influence of the beam formulation and the kinematic modeling on the crack tip solution. In particular, analytical expressions for total energy release rate and its mode components at the delamination front are provided in terms of the interface variables or the beam stress resultant discontinuities, emphasizing the influence of the inertial contributions on the ERRs. By means of these expressions the influence of transverse shear on interface fracture analysis is discussed and comparisons with other beam-based delamination models adopted in the literature are established. A parametric study, developed for mixed mode loading condition, is proposed to evaluate the effects produced on the ERRs by the inertial description of the structures and the speed of the crack tip front.

Keywords: delamination, dynamic energy release rate, mode partition, steady crack growth.

Presenting Author's biography

Paolo Lonetti. Born in Cosenza (Italy) 14th of January 1974. Position: from January 2005 Researcher at the Department of Structural Engineering, University of Calabria, Italy. Teaching Activities: Theory of Structures, Strength of materials. Current research activities: Composite materials, Damage, Fracture, Homogenization, Long span bridges.

NUMERICAL SIMULATION OF THE MINTING PROCESS FOR INNOVATIVE COINS

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Abstract

The aim of this work is to give consistent design criteria in innovative coinage processes. The use of finite element computer simulation in the design path leading to manufacture is a deep seated practice in many scientific and technological domains. The minting process has always required considerable efforts in prototype modelling of dies and blanks, leading to a longer time needed from design to market. However, discretised solid mechanics, allowing for elasto-plasticity non linear algorithms, has involved, at most, the investigation of the response of blanks. As a matter of fact the development of innovative bi- and trimetallic coins was definitely supported by the employment of FEM simulations. In principle, only by resorting to refined frictional contact algorithms can the aesthetical and quantitative parameters of the output coin be looked into. The prediction capabilities of numerical simulations have been explored in the present work in order to optimise the design of an innovative trimetallic coin.

Keywords: Numerical simulation, Contact mechanics, Coinage

Presenting Author's Biography

Federico Alberto Tocchetti. Born in Naples 1975 and educated in his birthtown, graduated in civil engineering at the University of Naples in 1999. In 2003 he attained the PhD degree in structural engineering at "Tor Vergata" University in Rome with a thesis on stress based algorithms for unilateral frictional contact problems between elastically deformable bodies. Presently a contract professor at "Tor Vergata" University, he has a research assignment at ITC-CNR Institute for Technology in Construction. Research topics: contact mechanics, computational mechanics, numerical simulation.

BUSINESS PROCESS MANAGEMENT AND DISCRETE EVENT SIMULATION: A TOOL SURVEY

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Abstract

Business process management is one of the most cost-effective and rewarding ideas to come along in years. Many different techniques can be used for modelling and managing business processes in order to give an understanding of possible scenarios for improvement. In order to realize the expected impacts of business process change, most of companies use simple accounting techniques (Activity Based Costing Analysis or Return on Investment) or static process modelling techniques, which have not the advantage of capturing the dynamic characteristic of business processes. Discrete event simulation modelling of business processes creates added value in understanding, analyzing and designing processes by introducing dynamic aspects.

The survey of the literature in this domain provides a list of reasons for the introduction of simulation modelling into process management. This paper focuses on a process of simulation features of Business Process Management (BPM) tools evaluation. The paper presents discrete event simulation (DES) in the context of BPM projects. An approach that could help managers in the selection of business process simulation tools is proposed. Two simulation tools (ARIS Simulation and IBM WebSphere Modeler) that are relevant for BPM field are evaluated. The results of the comparison and evaluation are discussed and the recommendations for further research are formulated.

Keywords: Business process management, Discrete-event simulation, ARIS, IBM WebSphere

Presenting Author's biography

Vesna Bosilj Vuksic received a Dipl.Econ., M.Sc and Ph.D. in Information Systems from the University of Zagreb. She is a professor of Business Process Management, Simulation Modelling and Business Computing at the Faculty of Economics and Business, University of Zagreb, at the Department of Business Computing. Her current research interests are in graphical methods in simulation modelling, business process management and information systems development. She participates actively in research within the framework of the Ministry of Science and Technology's scientific projects, and is a member of international scientific research projects. She is the author of a number of research papers and books.

REFORMS OF THE SLOVENIAN PERSONAL INCOME TAX SYSTEM

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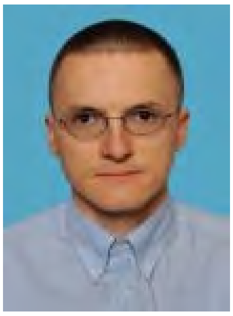
Abstract

In the last few years Slovenia has introduced changes into its personal income tax (hereinafter: PIT) system which has reduced the tax burden for the majority of taxpayers. It includes higher allowances for children, a broader tax base, and it is based on the worldwide income concept. In addition, the 20% scheduler taxation of capital income equalises Slovenia with several other EU countries which apply relatively modest taxation of capital to keep it within the national tax jurisdiction. Also in line with the EU practice is the abolition of the 50% marginal tax rate and its replacement with a 41% rate. From the individual taxpayer's point of view, on average, all taxpayers are better off due to the reforms. Their after-tax income is now higher than under the system before the PIT reforms. However, the results suggest that the changes clearly increased the after-tax income of taxpayers with a high income while they had only modest consequences for taxpayers with a lower income. The real costs of the PIT reforms are the switch in the government budget which can expect a drop of revenue not only regarding PIT. With the reduction of PIT and the abolition of payroll tax, the effective taxation of labour has fallen and their budget consequences are so far being covered by other taxes.

Keywords: redistributive effect, income inequality

Presenting Author's biography

Mitja Čok is an assistant professor at the University of Ljubljana, Faculty of Economics. He is working mostly in the area of taxation and income inequality.



AN EXTENDED PRICING AND INVENTORY CONTROL MODEL WITH REFERENCE EFFECTS

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Abstract

This paper addresses the simultaneous determination of pricing and inventory replenishment in the face of demand uncertainty with the objective of maximizing total expected discounted profits. We give a short review on recent work in literature: the operations-oriented stream of literature which uses rich cost models but rather neglect demand side dynamics and the marketing orientated stream which accounts for intertemporal demand correlations . In this paper we aim at a joint optimization of production and pricing decisions in inventory management, where demand is sensitive to the firm's pricing history and consumers do not only react to the current price. This socalled reference price - known from marketing literature - is formed on the basis of past purchases, where consumers e.g. buy products just because they are on sale and are less likely to buy a product after prices have gone up. Thus prices are perceived as discounts or surcharges relative to the reference price.

The investigated model is a combined stochastic dynamic pricing and inventory control model for a single item of a monopolistic firm based on periodic review. We study the optimal policies of pricing and ordering decisions and try to get some insight into the optimal solution's properties. We further investigate the impact of the newly introduced reference price on the optimal solution compared to optimal policies, using the commonly used but less realistic demand model of operations research. Since there are yet no analytical results available for this extended model the only means of providing a decision-support system for dynamic retail pricing and promotion planning is by numeric optimization via dynamic programming.

Keywords: Pricing, Inventory Control, Dynamic Programming

Presenting Author's Biography

Lisa Gimpl-Heersink. Master of Science in Technical Mathematics (OR, Statistics, Management Science) at Graz University of Technology. Working experience in life insurance mathematics and logistic software algorithm design. Currently PhD position as a research associate at the Vienna University of Economics and Business Administration, Institute for Production Management. Research interests: integrated demand and supply chain management, pricing and inventory control models (numerical and analytical optimization), dynamic programming.

SIMULATION SYSTEM FOR CRISIS MANAGEMENT

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Abstract

Natural or man-induced hazards may have severe consequences. The response to such disasters may require massive resources from large number of responding entities, therefore a holistic approach and efficient crisis management is needed. Recent crises have shown that systems for crisis management are in need of significant improvements. It is critical to provide new tools for improving training and decision making capability to a large number of responding entities. Since it is difficult to recreate exact situation of the catastrophic disaster in real environment, training based on field experience is usually not possible. Correct procedure training and the preparedness of the crisis responders, is possible through virtual simulation where incident scenarios can be created and actors' roles can be trained in a synthetic environment where disaster events can be adequately presented. The realistic qualities of computer games today make them a perfect tool for training in virtual environments and they appear to be ideal solution for merging traditional Modeling & Simulation environments with crisis management training needs. All above mentioned guidelines were regarded in our research projects where operational prototype training tool for crisis management named CROM was constructed which is a cost-effective simulation system for planning, training, interactive education, testing and validating for all decision levels, from government to single company level. The purpose of this paper is to present new ideas for simulation modeling in crisis management based on military concepts and serious games initiative for interactive training in virtual environments. This paper seeks to explore answers to the following questions:

- Is there a future for virtual reality based simulation systems for crisis management?
- How can we implement military concepts with the help of games solutions into crisis management simulation systems for civilian purposes?
- Can computer assisted exercises improve crisis preparedness and coordination for different response entities?

Keywords: crisis management, incident, simulation modeling, virtual reality, training.

Author's biography

Boris Glogovac holds a bachelor degree in mechanical engineering. He has over 15 years of experience in visual simulation area. In the year of 2001 he started visual software solutions firm named Logon where he is working on various management positions. He supervised the production of several visual simulation projects for Nuclear Power Plant Krsko, Slovenian Electricity Holding, Ministry of the Economy, Ministry of Defense, etc. Currently he is involved in two research projects in the area of military simulations. He is finishing postgraduate Master of Science program at a Faculty of economics, University of Ljubljana.

SIMULATION MODELLING OF SUPPLY CHAIN PROCESSES – A CASE STUDY FROM WHOLESALE

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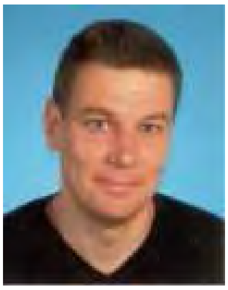
Abstract

In today's global market the main focus of competition is not only between different companies but also between supply chains. The paper shows that technological changes are important for effective supply chain management, however, the main cause of supply chain improvements are organizational changes and an integration of business processes that lead to more mature processes in all involved companies and at the supply chain level. It can be realized by using effective business process management methods that include estimation of process maturity, modelling, process analysis and performance measurement, continuous improvement etc. The concepts are illustrated with a case study of Merkur supply chain in which already introduced changes are evaluated with simulation modelling and process maturity measurement methods. Three different versions of the process were modelled: the process before IS implementation (AS-WAS); the current process (AS-IS), where several activities were automated; and the proposed redesigned process (TO-BE), where more radical changes are planned that require several organisational changes. The case shows that business process management on the supply chain level brings benefits to all companies involved. The decrease in work costs and reduction in process and lead times begins with IT implementation and the increase in maturity. However, in order to further improve the process, more considerable organisational changes are needed. It can be seen from the case study that business process modeling and discrete-event simulation are valuable mechanisms for realizing the actual business value of business-to-business e-commerce.

Keywords: Supply chain management, Business process management, Business process orientation, Process maturity, Business process simulation modelling.

Presenting Author's biography



Jurij Jaklic received his Master Degree in Computer Science in 1992 from the University of Houston and his PhD in 1997 from the University of Ljubljana, Slovenia. Currently he is an associate professor at the Faculty of Economics, University of Ljubljana. His main research interests are business process renovation, e-business, decision support systems, and data and business process modelling.

STRUCTURAL PROPERTIES OF SWITCHING BOND GRAPH

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Abstract

Switching systems are very common in various engineering fields (e.g. hydraulic systems with valves,.., electric systems with diodes, relays,…, mechanical systems with clutches...). Such systems are a particular case of hybrid systems. These systems are characterized by a Finite State Automaton (FSA) and a set of dynamic systems, each one corresponding to a state of the FSA. The change of states can be either controlled or autonomous. The aim of this work is to investigate the structural controllability for controlled switching linear systems modelled by bond graph.

Several concepts appeared in the last decade addressing the controllability problem of these systems: controllable sublanguage concept [9], hybrid controllability concept [10], between-block controllability concept [11]. Controlled switching linear systems (CSLS) on which we focus in this work belong to the hybrid controllability concept as they address a reachability problem of hybrid states.

In the other hand, the bond graph concept is an alternate representation of physical systems. Some recent works permit to highlight structural properties**.** In [7]**,** the structural controllability property is studied using simple causal manipulations on the bond graph model. The objective of this work is to extend these properties to CSLS systems. The bond graph structure junction contains informations on the type of the elements constituting the system, and how they are interconnected, whatever the numerical values of parameters.

The structural controllability of CSLS is studied using simple causal manipulations on the bond graph model. For that, formal representation of structural controllability subspace, is given for bond graph model. It is calculated using causal manipulations. The base of this subspace is used to propose a graphical procedure to study the structural controllability.

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Keywords: Hybrid systems, Switching systems, Bond graph, Structural controllability.

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Received the bachelor degree in Electrical Engineering from University of Artois (France) in 2001, the Master degree in Electronics, Electrical and Control Engineering from University of Sciences and Technologies of Lille (France) in 2002, and the Master degree in Control Engineering from Ecole Centrale Lille (France) in 2003. Currently, he is an PhD student in LAGIS (Laboratoire d'Automatique, de Génie Informatique et Signal), France.
His research interests include: analysis of switched and hybrid systems, bond graphs.

IMAGE PROCESSING FOR BIOLOGIC MODELS USING FRACTAL TECHNIQUES

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Abstract

The article discusses problems of classification based on the fractal theory with applications in biology. Here are introduced the necessary notions for defining and quantitative evaluation of fractals and an algorithm for fractal dimension computation based on biofractal contours processing is also presented. The actual application is dedicated to the analyse the particularities of some species from Gentianaceae family, with the purpose of establishing their affiliation to the Gentina genus, knowing the fact that, up to the present, there had been used only evaluations based on the distinctive morphological characteristics. Concretely, there were extracted window-images from the rind and the central cylinder of the root and stem and also from the mesophyll and leaf nervure/rib. The contours of the window-images were processed with the "box-counting" algorithm in order to establish the fractal dimensions for the analysed sections. The algorithm based on the „box-counting" method offers two major advantages: it is easy to implement in case of using a computer and can be applied for images no matter how complex. We consider that, by acquiring samples from more sections of a species (the studied one) for the statistical processing of the data, will lead to very precise characterizations of that species, for the first time in botanic. The results are encouraging for the development of fractal techniques not only in botanic, but in other biology domains.

Keywords: fractals, fractal dimension, biologic models.

Presenting Author's biography

Andreea Udrea is a teaching assistant at the Automatics and Computer Science Faculty, University "Politehnica" of Bucharest. Her teaching areas include Object Oriented Programming and Control Systems for Continuous Processes. She also carries out research activities and handles research projects within the ACPC Research Centre. She graduated the same Faculty in September 2006. She completed her diploma project – "Control of an autonomous electric vehicle" – at Ecole Polytech Lille, France. Now she is attending the master courses in Advanced Automatics.

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ADAPTIVE FUZZY CONTROL OF DC MOTORS USING STATE AND OUTPUT FEEDBACK

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Abstract

Conventional PID of state feedback controllers for DC motors have poor performance when changes of the motor or load dynamics take place. Moreover, neglecting the impact of external disturbances and of nonlinearities may risk the stability of the closed-loop system. To handle these shortcomings adaptive fuzzy control of DC motors is proposed. This paper proposes a method for the control of DC motors, which can be applied to linear or nonlinear models, and which is also robust to uncertainties or external disturbances. Neuro-fuzzy networks are used to approximate the unknown motor dynamics. The information needed to generate the control signal comes from feedback of the full state vector or from feedback of only the system's output. In the latter case a state observer is used to estimate the parameters of the state vector. The stability of the closed-loop system is proved with the use of Lyapunov analysis. The performance of the proposed control approach is evaluated through simulation tests. Comparing to model-based approaches, the advantages of the proposed adaptive fuzzy control are summarized in the following: (i) there is no dependence upon identification of the mathematical model (linear or nonlinear) expressing the dynamics of the DC motor, (ii) since training of the neuro-fuzzy approximators is repeatedly undertaken in every control cycle, any changes to the motor dynamics can be identified online, and hence the control approach is useful for time-varying models, (iii) regarding operation under external disturbances and measurement noise the proposed adaptive fuzzy controller offers improved robustness. Finally, in case that the control is based only on output feedback there is no need to use specific sensors (for instance accelerometers) to measure all elements of the motor's state vector.

Keywords: DC motors, adaptive fuzzy control, state feedback, output feedback, H_∞ tracking, neuro-fuzzy approximators, state observer.

Presenting Author's Biography

Gerasimos Rigatos. The author received a diploma in Electrical and Computer Engineering (1995) and Ph.D. (2000), both from the National Technical University of Athens (NTUA), Greece. In 2001 he was a post-doctoral researcher at the Institut de Recherche en Informatique et Systèmes Aléatoires, in Rennes, France, while in 2007 he was an invited researcher at Université Paris XI Orsay, Insitut d' Electronique Fondamentale. Since 2002 he holds a researcher position at the Industrial Systems Institute, in Patras, Greece. His research interests include robotics and control, fault diagnosis, computational intelligence and adaptive systems. He is a member of IEEE and of the Technical Chamber of Greece.

MULTI-MODEL ADAPTIVE CONTROL

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Abstract

A multiple models adaptive control system will be presented. The advantages of this control with respect to the classical control will be illustrated on a level control system with nonlinear model plant. A recent recursive method in open and closed-loop identification and an R-S-T controller design has been proposed to guarantee the performances in the adaptive control scheme. The real time control system implementation confirms the opportunity of using the multi-models adaptive control architecture in the case when the nonlinear plant model introduces a typical large parameter variation. The article presents a method to choose the algorithms, in order to meet the adaptive regulation performance requirements. The obtained results show that the control strategy based on a single model and on a single controller generates a time response that is more affected by noise than the response given by an adaptive strategy. The multiple models adaptive control procedure proposed has the following advantages: a more precise model is chosen for the closed loop operating system, the R-S-T adaptive control ensures very good real time results for closed loop nonlinear system. It can be appreciate that the multiple models adaptive control can be recommended to improve the performances of the nonlinear control systems.

Keywords: multi-models, closed-loop identification, R-S-T control, adaptive control, real time application.

Presenting Author's biography

Cristian Flutur is a teaching assistant at the Automatic Control and Computer Science Faculty. His teaching areas regard Signals and Systems, Feedback Systems Theory and Optimization Techniques. He also carries out research activities and handles research projects within the ACPC research center. He graduated the same Faculty in September 2006. He completed his diploma project – "Nonlinear Models' Sensitivity in the Context of Parametric Incertitude" – at Ecole Centrale de Lille, in France.

IDENTIFICATION, CONTROL AND DECISIONS FOR HEATING PROCESSES

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Abstract

The paper presents some results of the research performed by the authors on control systems and optimization for the operating process of the heating installations from the blast furnace at a steel plant. This system was developed on two relevant levels: modeling and control level and optimization level, interconnected in a hierarchical control structure. The acquisition and control level was implemented using specialized microcontrollers. For this level, several systems have been analyzed, which can be grouped in two main categories: combustion control and heating control. The first category comprises fuel flow and combustion air flow, while the other category includes cold air flow and temperature. Since the fuel flow is obtained as a mixture of two out of three components: furnace gas, methane gas and coke gas, for each of them a flow control system is calculated. The supervisory level, concerning the optimization of the combustion process, was implemented on an operator console. Some constraints that determine the well-functioning of the system at desired parameters, such as cowper cupola temperature, residual gases temperature and CO concentration, are taken into account. The solution of the optimization problem represents the optimal decision, translated in real-time procedure as references for the acquisition and control level.

Keywords: heat flows, identification algorithms, control system design, real-time systems, optimization problems.

Presenting Author's biography

Dumitru Popescu is a professor at the Automatic Control and Computer Science Faculty. He obtained the diploma of engineer in Electronics and Telecommunications at the University Politehnica of Bucharest (UPB) in 1966. He also obtained a diploma in Mathematics from the University of Bucharest in 1975. In 1978, he obtained his Ph. D. title in Automated Systems, at UPB. Since 1991, he is professor at the Automatic Control and Computer Science Faculty from UPB and director of the Research Centre in Automatics, Process Control and Computers (APCC). His teaching areas comprise Process Control and Advanced Automatics. Dumitru Popescu is also an associated teacher at universities from France and Italy and member of the IFAC Technical Committee for Bio-engineering and Chemical Processes.

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HIGH ACCURACY SIMULATION OF ORBIT DYNAMICS: AN OBJECT-ORIENTED APPROACH

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Abstract

The development process for spacecraft control systems relies heavily on modelling and simulation tools for spacecraft dynamics. For this reason, there is an increasing need for adequate design tools in order to cope efficiently with tightening requirements for simulation accuracy and efficiency. In the last few years a Modelica library for spacecraft modelling and simulation has been developed, on the basis of the Modelica Multibody Library; the aim of this paper is to demonstrate improvements in terms of simulation accuracy and efficiency which can be obtained by using Keplerian parameters instead of Cartesian coordinates as state variables in the spacecraft model. Thanks to the features of the Modelica modelling language, and of the tools supporting it, it is straightforward to extend the rigid body model of the standard MultiBody library, by adding the equations defining a transformation of the body center-of-mass coodinates from Keplerian parameters to Cartesian coordinates, and by setting the former as preferred states, instead of the latter; the tool then handles the state transformation automatically. The remaining parts of the model, including the model of the gravitational field, are left untouched, thus ensuring maximum re-usability of third-party code. The results shown in the paper demonstrate the superior accuracy and speed of computation in the reference case of a point-mass gravity field.

Keywords: Spacecraft dynamics, Object-oriented modelling, Modelica, Numerical integration.

Presenting Author's Biography

Francesco Casella. Francesco Casella got his Electronics Engineering degree in 1994 and a PhD in Computer and Control Science in 1999 from Politecnico di Milano, where he is Assistant Professor since 2001. His current research interests include modelling and control of energy conversion systems, and object-oriented modelling for control applications in general. He's an active member of the Modelica Association. He has published over 40 papers in referenced journals and international conference proceedings.

FLYING THROUGH DESIGN SPACES: EFFICIENT EVOLUTIONARY OPTIMISATION OF AIRCRAFT WINGS

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Abstract

Today's high-tech products, such as civil aircraft wings, are designed by multidisciplinary teams of experts. Dedicated modeling and simulation tools are used to assess the behavior of the design for each relevant discipline. The required consistency among the different single discipline models is achieved by using an integrated design model, which includes a (large) set of design parameters on which each of the discipline models is based. In order to find the best design, the application of optimization algorithms in combination with the modeling and simulation tools is common practice nowadays. However, for products that require complex models and extensive simulations to assess their behavior, like aircraft wings, such design optimizations may become infeasible due to complicated computational sequences or excessive computational cost. To alleviate such complications, the products' behavior should be assessed more efficiently. This paper presents a meta-modeling approach, applied to aircraft wing design where aircraft range and fuel consumption are optimized. This approach allows to quickly and conveniently evaluate the wing behavior, and to virtually fly through the considered wing design space. Extensive optimizations, exploiting thousands of meta-model evaluations, are performed using multi-objective genetic algorithms, yielding sets of Pareto optimal wing design points. These points represent those wing designs that have the best feasible fuel consumption for each value of range, and hence directly provide the designer with the most relevant design information.

Keywords: multidisciplinary analysis, integrated design model, meta-modeling, Pareto front, multi-objective optimization.

Presenting Author's biography

E. Kesseler received his Drs degree in physics in 1980 from the University of Amsterdam. He has worked at NLR Amsterdam, the Netherlands for over 20 years on a variety of IT and aerospace topics.

DECISION ARCHITECTURES FOR UNINHABITED AUTONOMOUS AIR SYSTEMS

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Abstract

Technology for the operation of Uninhabited Air Vehicles is undergoing a major change. Hitherto, the emphasis has been on managing the change from remote or tele-operation of the vehicle's flight controls to more automatic modes of control. Such automatic modes have limits in their appropriateness and can become quite complex and unwieldy. Progression of technology to achieve appropriate responses in a wide variety of perhaps, unforeseen, circumstances, such as emergencies and failures, **and** without instant reversion to human control, is required. Development of autonomous systems – those which are capable of independent decision and action – offer a potential route towards this.

This paper describes work to understand the nature and characteristics of autonomous systems suitable for the safe and independent operation of air vehicles. In particular, it explores the nature of appropriate decision architectures and system requirements, particularly with respect to safety and robustness. It is noted that the the domain of UAV operations is characterized by supervisory control, reduced situational awareness as the pilot and the craft are not co-located, and spatio-temporal reasoning. Finally it proposes autonomous avionic system reference architecture and outlines the testing and experimental programme envisaged for the operation of a design based on that architecture in a Modelling & Simulation (M&S) Synthetic Environment (SE).

Keywords: Autonomous, Systems, Uninhabited, Decision, Avionics.

Presenting Author's biography

Charles Patchett is a former RAF fast jet Navigator and now an avionic systems engineer leading the Autonomous Systems Research Group at BAE Systems, Warton, UK. His group is currently undertaking technical R&D under the UK ASTRAEA programme in the areas of Decision Modelling, Sense & Avoid technology and Adaptive Routing. Together with inputs from Systems Health and Prognostics researchers at BAE Systems, the group has demonstrated key aspects of these technologies by developing and integrating the required sub-systems into a virtual Uninhabited Autonomous Air System (UAAS) and flying this in challenging scenarios in an M&S SE.

MATLAB-SIMULINK NONLINEAR MODELING AND SIMULATION OF AIRCRAFT LONGITUDINAL DYNAMICS

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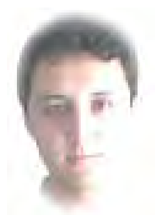
Abstract

A safe and cost-effective way to establish an extended flying qualities database is to conduct exploratory investigations using piloted simulations. In this technical report, a nonlinear mathematical model is obtained and some simulations techniques are investigated with Matlab-Simulink. The aircraft aerodynamics in sense of aerodynamic lift, drag and pitch moment coefficients, simple thrust of a engine and rigid body dynamics for longitudinal motion of a four turbofan engine large passenger commercial aircraft Airbus A340-300 are presented. The modeling steps are explained clearly for all sub block-sets of the model and all required equations for the mathematical model are given in the report except the function specified in the text with quotation marks. Three different flying maneuvers are performed to illustrate modeled aircraft motion for an assumed flying altitude and condition. For such case a standard atmospheric mathematical model is used. The time responses of three different simulations which examine longitudinal aircraft dynamics are added at the end of the report and results are discussed in sense of the stability of aircraft motion. The presented nonlinear aircraft model in this study is flexible for any type of fixed wing aircrafts and can be adapted by changing aerodynamic coefficients and thrust value of engines.

Keywords: Nonlinear modeling, longitudinal dynamics, aircraft, Simulink.

Presenting Author's biography

Erkan Abdulhamitbilal received a Bachelor of Science degree in 2002 and Master of Science in 2005 on Astronautics Engineering from Istanbul Technical University. The areas of interest and working are system dynamics, modeling, simulation, stability analysis and automatic control techniques of aerospace vehicles.



MODELLING OF LEADER-FOLLOWER SPACECRAFT FORMATIONS IN 6DOF

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Abstract

This paper concerns modelling of relative translation and rotation of formation flying spacecraft in Earth orbits. A nonlinear 6 degree-of-freedom (DOF) mathematical model of relative translation and rotation in a leader-follower formation consisting of two spacecraft is derived, with a formulation similar to general Euler-Lagrange system. The model of relative translation is based on the laws of Newton, specifically Newton's law of gravitational attraction from which the two-body problem can be derived. The relative rotation is based on Euler's momentum equations and the attitude is represented by Euler parameters, or unit quaternions. Based on the models of relative translation and rotation, the total 6DOF model is derived. The model is referenced both in a leader orbit coordinate system and in an Earth-fixed inertial coordinate system. The leader orbit coordinate system is located in the centre of mass of the leader spacecraft, whereas the Earth-fixed inertial coordinate system is located in the centre of the Earth. The rotation matrices between the different coordinate systems are presented. The Earth-fixed model is based on work in the field of marine control systems. The system properties for both the models are presented, where properties like symmetry, skew-symmetry and positive definiteness of matrices can be incorporated into the stability analysis when designing control systems. These system properties represent physical properties of the system. Furthermore, simulations of the model referred to leader orbit coordinate system are presented where the impact of perturbing forces and torques are illustrated. The perturbing forces and torques considered in the simulation are due to atmospheric drag and the oblateness of the Earth.

Keywords: Leader-follower spacecraft formation, mathematical modelling, relative translation and rotation, Earth orbit, 6 degree-of-freedom

Presenting Author's Biography

Lisa Maria Svendsen is from Norway. She has a bachelor degree in Electrical Engineering with a specialization in telecommunication at Sør-Trøndelag University College in Trondheim, Norway. Furthermore, she has a master degree in Space Technology at Narvik University College in Narvik, Norway. After graduating she started working at Triad AS, Norway. Triad AS works with scientific research in various fields of physical science where the main field is the characterization of general targets and geophysical phenomena by electromagnetic and acoustic waves.

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ACCELERATING SOLAR WIND CALCULATIONS

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Abstract

A hybrid simulation model (PIC code) for the solar wind interaction with the ionosphere of stellar objects is optimized sequentially and its runtime almost halved. Parallelization with decomposition of the computational grid in static subdomains supported by a single ghost cell performs well because particles are almost uniformly distributed and thus cause no load balancing problems. We observe that we can spawn two independent threads on a dual-core Xeon processor without any performance loss due to the effective Hyper-Threading. We have compared partitionings in two different directions namely x and y. A partitioning in x direction shows a performance degradation due to increased L2 cache traffic and more communication traffic than a partitioning in the direction of y. If we combine both partitionings the application will show an increasing speedup with up to 32 processors. For production runs the performance is reasonable with an effecitvity of 78% with up to 16 processors. This effectivity could be improved on a cluster with faster network interfaces or a more effective open source MPI implementation. Currently we reach on a Gb Ethernet network for a unidirectional send only a bandwidth of 25 MB/s compared to 128 MB/s hardware bandwidth. In total, sequential optimization and parallelization both have reduced the waiting time for a simulation by a factor of 23 on 16 processors.

Keywords: Solar Wind, PIC, MPI, Performance Optimization, Profiling

Presenting Author's Biography

J. Schüle, born 1960, studied Chemistry at universities in Tübingen and Münster (Germany). After his PhD he worked three years as Post-Doc in Stockholm (Sweden) and Berlin. Since 1990 he has been employed at the computing centre at the Technical University Braunschweig. In his spare time he got a diploma degree in Mathematics. Since 1993 he has given lectures in various topics of Parallel and High Performance Computing.

WORKFLOW INTEGRATION OF COMPUTER AIDED ENGINEERING: AN EDUCATIONAL APPROACH

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Abstract

The increasing importance and frequent use of computer aided engineering (CAE) methods motivate universities for educational activities in the interdisciplinary field of Computational Engineering (CE). Current approaches in the education of CE focus mainly on the specific topics, which are driven from a domain-centric perspective. Didactic concepts focusing on the stand-alone application fields hinder a holistic understanding of CE. Industrial applications of CE are applied indeed in the product creation process, for which data and processes are to be defined and managed regarding the product lifecycle aspects.
The department of Computer Integrated Design (DiK) of the Faculty of Mechanical and Process Engineering has been involved in the study program "Computational Engineering" from the very beginning. Within this frame a new course "Introduction to CAE-D" has been established in the fall semester 2006 with a scope on the interdisciplinary feature of CE. Understanding of CAE as a process within the product lifecycle plays a crucial role in the syllabus. This contribution presents key points of a new approach towards an educational concept for CE considering the lifecycle aspects. The course aims at describing CAE as a dominating link between the engineering design and analysis, which enables efficient and reliable product verification. Students from different departments are made familiar with the notion of data integrity of CAE within a process chain.

Keywords: Computer Aided Engineering, Computational Engineering, Education, Process/Data Integration, Lifecycle

Presenting Author's biography

Orkun Yaman. Graduated from the Middle East Technical University (METU) in Ankara with a degree of "Bachelor of Science in Mechanical Engineering", Orkun Yaman obtained his Masters Degree in Mechanical and Process Engineering from the Technische Universität Darmstadt in the field of Numerical Methods in Mechanical Engineering. He has been working since 2004 at the Department of Computer Integrated Design as a research assistant and doctoral student. He is responsible for the CAD/CAE education. His research activities involve data and process integration of computational methods and tools into the product creation process.

AN INTERACTIVE GRAPHICAL TRACE-DRIVEN SIMULATOR FOR TEACHING BRANCH PREDICTION IN COMPUTER ARCHITECTURE

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Abstract

In modern superscalar microarchitectures that speculatively execute a great quantity of code, without performing branch prediction, it won't be possible to aggressively exploit instruction level parallelism from programs. Both the architectural and technological complexity of current processors emphasizes the negative impact on performance due to every branch misprediction. Due to this importance, branch prediction becomes a core topic in Computer Architecture curricula. The fast development of computer science and information technology domains, and of computer architecture especially, have determined that many software tools used not long ago in research, to be enhanced with an interactive graphical interface and to be taught in Introductory Computer Organization respectively Computer Architecture courses. The lack of simulators dedicated to branch prediction used for didactical purposes despite of plenty used in research goals, represents the starting point of this paper. The main aim of this work consists in identifying the difficult-to-predict branches, to quantify them at benchmarks level and to find the relevant information in order to reduce their numbers. Finally, we evaluate the impact of these branches on three commonly used prediction contexts (local, global and path) and their corresponding predictors, ranging from classical two-level predictors to present-day predictors (neural – *Simple Perceptron* and *Fast Path-based Perceptron*). The developed ABPS simulator provides a wide variety of configuration options. Beside statistics related to the number of difficult-to-predict branches, the simulator generates graphical results illustrating the influence of different simulation parameters (number of entries in prediction table, history length, etc.) on prediction accuracy, resource usage, etc., for every implemented predictor.

Keywords: Simulation, Advanced Microarchitectures, Branch Predictors, Benchmarks.

Presenting Author's biography

ADRIAN FLOREA obtained his MSE (1998) and his PhD in Computer Science from the 'Politehnica' University of Bucharest, Romania (2005). He is a lecturer of Computer Science and Engineering at the 'Lucian Blaga' University of Sibiu, Romania. Adrian is an active researcher in the fields of High Performance Processor Design and Dynamic Branch Prediction. He published over 19 scientifically papers about Computer Architecture in some prestigious journals (ISI-INSPEC) and international conferences. He got "*Tudor Tanasescu*" Romanian Academy Award 2005, for the book entitled "Microarchitectures simulation and optimization" (in Romanian). His Web-page can be found at http://webspace.ulbsibiu.ro/adrian.florea/html/ .

ROLE-BASED VIEW CONTROL IN WEB-BASED SIMULATION ENVIRONMENTS

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Abstract

In the last years simulation tools have been developed for all disciplines of nuclear engineering. Many of these were only designed for the needs of an expert, familiar with the physical models and the implementation details of the simulation tool. Therefore most of the simulation tools have an optimized physical model but their user interface is neglected, so often results are presented in cryptic output files.

This paper shows how the role-based view control (RBVC) in combination with web-based simulation environments enables the re-use of existing simulation tools for training and education. The RBVC model is introduced and the resulting architecture for web-based simulation-environments, that offers a plug-in interface for proprietary simulation tools, is presented.

A web-based simulation environment extended by techniques and methods for computer supported cooperative work (CSCW) and computer supported collaborative learning (CSCL), is described. The benefit of the extended simulation environment for common face-to-face teaching as well as expert support in a world wide cooperation and collaboration via internet is presented. The paper shows the integration of remote participants and lecturers in face-to-face courses and the possibility of repetition with expert supported course content via the internet afterwards.

Keywords: Simulation Environment, Education, RBVC, RBAC, CSCW, CSCL.

Presenting Author's biography

Andreas Piater. The author was born in 1973. In the end of 2002 he finished his studies in mechanical engineering at the University of Stuttgart where he continued working as a scientific assistant in the field applied informatics for nuclear engineering. Since 2003 he has been working on his doctoral thesis in the field role-based access and view control for nuclear engineering. There he works on role models and implements these in an architecture for web-based simulation environments in the field nuclear sciences. He has been working with Apache Web Server, Apache Cocoon, Java/J2EE, MySQL, Db4O, SOAP, and the newer AJAX technologies like Google Web Toolkit for many years. Today the resulting software architecture is used in different German and European scientific projects.

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TEACHING FINITE ELEMENTS: AN ALTERNATIVE APPROACH USING MODELICA

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Abstract

The Finite Element Method (FEM) is one of the most important simulation methods in engineering and natural sciences. However, it rather seldom is an integral part of a simulation lecture. Likewise, books on the FEM typically avoid the term "simulation". This strange distinction between "general" simulation methods, on the one hand, and Finite Elements (FEs), on the other hand, has historical, cultural, didactical and methodological roots.
Interestingly, modular or object oriented approaches to complex system simulation have many ideas in common with the classical FEM. This gives rise to an alternative teaching approach which seamlessly integrates the basics of FEs into an advanced simulation lecture on continuous time simulation. The advantage of this concept is the exploitation of commonalities between FEs and modular modeling to speed up the learning process.
The modular approach aims at a quick but completely transparent implementation of first FE simulations by using Modelica. Having understood the basic computational machinery the students will then be highly motivated to learn about the theoretical foundations of the FEM. The concept was tested with encouraging results in the Siegen simulation courses.
Since Modelica, as a general purpose system, is not really a good FE tool, the classical trisection into preprocessor, numerical solver and postprocessor has been implemented by combining Modelica with Matlab. The preprocessor allows drawing simple 2D meshes from which a Modelica file is automatically generated. The postprocessor takes up the Modelica output file and visualizes the simulation results on a 2D mesh. All intermediate steps are completely transparent to the students. Making the experience that all steps of a basic FE simulation can be practically managed on an elementary level frees the method from several theoretical and formal burdens.

Keywords: Finite Elements, Modelica, modular modeling, simulation education

Presenting Author's biography

WOLFGANG WIECHERT studied mathematics and computer science at the University of Bonn and obtained his PhD in 1991. From 1991 to 1996, he worked at the Jülich Research Center. 1996, he became a professor for simulation at the Institute of Systems Engineering at the University of Siegen. His major research fields are the development of new methods and tools for modeling and simulation in materials sciences, production processes, micro fluidic devices, systems biology, and multi sensorics.

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MODELING AND SIMULATION EDUCATION CONCEPTS IN SYSTEM DYNAMICS OF MANAGEMENT STUDIES

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Abstract

This article describes experiences in the teaching of a modeling and simulation course for students of a school for organizational sciences. Our course consists of time continuous simulation based on System Dynamics (SD) and discrete event simulation (DES). The course is in the 3rd year and students have by then already taken courses of mathematics, statistics, theory of systems, as well as organizational and economic courses. The final grade of the course is derived from the student's project and written exam. In this paper, we will discus methods of teaching SD. Of course, by definition simulation represents experimentation on a computer model. Therefore, we have also developed the simulation model in order to explicate the usefulness of the simulation in solving management problems. Students took part in an experiment where they had to solve a managerial decision problem supported by a simulation model. They were assigned to work under different experimental conditions. Experimental results were then analyzed and discussed in the students' projects. Students' contribution was rewarded as a part of their final grade. Also, students were kept motivated throughout the course, by special rewards for their in-class participation. After the experiment, students had to complete a questionnaire on their opinion of the course. The results show that management students, taking the course of Modeling and Simulation, thought that application of the simulation model do contributes to a greater understanding of the problem, faster finding of solutions and greater confidence in participants. All participants agree that clear presentation of the problem motivates participants to find the solution.

Keywords: group decision, learning model, system dynamics, experiment design.

Presenting Author's biography

Miroljub Kljajić graduated from the Faculty of Electronics, University of Ljubljana in 1970. He received his MS in 1972 and his PhD in 1974 at the same university. In 1970 he was employed at the Institute Jozef Stefan, Department for Biocybernetics and Robotics. Since 1976 he works at the Faculty of Organizational Sciences, University of Maribor as Professor of System Theory, Cybernetics, and Modeling and Simulation. He has been principal investigator of many national and international projects from modeling and simulation. As author and co-author he has published over two hundred scientific articles.

THE GPSS++ MODELLING LANGUAGE: OBJECT-ORIENTED VERSION OF GPSS

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Abstract

This paper describes the modelling language GPSS++. One of the main purposes of the language is its use in education. It extends the well-known discrete-event modelling language GPSS in several aspects, among which an object-oriented modelling is one of the most important. Other extensions of GPSS++ are: support for modular and hierarchical modelling, support for hybrid modelling (discrete and continuous), and significantly enhanced features for description of model behaviour (by using features of a general purpose programming languages). Syntax of the language is also modernized. In the same time, GPSS++ tries to retain the basic GPSS concept of modelling that uses transactions and blocks. The paper describes the main features of the GPSS++ mentioned above. Results of comparison of models written in GPSS and GPSS++ are given. The main advantages of GPSS++ over old versions of the language are better organization of the model and improved readability and writeability. Also, the language is better adapted to the programmers with the background in modern and widely used object-oriented languages. In addition, GPSS++ is better suited for larger models due to its modular and hierarchical organization. GPSS++ is currently under development and here we describe its first version and we also give directions for future improvements and research.

Keywords: Modelling languages, GPSS, Object-oriented languages.

Presenting Author's biography

Danko Basch received B.Sc. in electrical engineering (1991), M.Sc. in computer science (1994), and Ph.D. also in computer science (2000) from the Faculty of Electrical Engineering and Computing (FER), University of Zagreb, Croatia. In 1992 he joined the FER (Department of Control and Computer Engineering) as a researcher. At present, he works at the same Department as an associate professor. His research interests include programming language design and implementation, and also modelling and simulation languages.

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COMPUTATION OF POSITIVE REALIZATIONS OF MIMO HYBRID LINEAR SYSTEMS WITH DELAYS USING THE STATE VARIABLE DIAGRAM METHOD

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Abstract

In this paper the realization problem for 2D positive multi-input and multi-output (MIMO) linear hybrid systems with delays in state vector and input is addressed. A method based on the state variable diagram for finding positive realizations of a given proper transfer matrix is proposed. The essence of proposed method for solving of the realization problem for positive 2D hybrid systems with delays in state vector and input will be presented on single-input single-output (SISO) system. The solution for MIMO systems will be obtained by generalization of method proposed for SISO systems. Sufficient conditions for the existence of a positive realization of a given proper transfer matrix are established. This conditions gives only the answer is there exists positive realization for given proper transfer matrix, they do not consider the stability of obtained realization. A procedure for computation of a positive realization is proposed for SISO systems and generalized for MIMO systems. The considerations are illustrated by two numerical examples. First example illustrate solving procedure for SISO system with one delay and the second example illustrate solving procedure for system with two inputs, two outputs and one delay.

Keywords: hybrid 2D system, multi-input multi-output, delay, positive realization, computation.

Presenting Author's biography

Łukasz Sajewski. Born 08.12.1981 in Poland. Completed his studies in Bialystok Technical University in faculty of Electrical Engineering in the field of Control Engineering and Microprocessor Techniques. In July 05 2006 was awarded the professional title of MSc with the grade Very Good. Same year he started PhD studies in Bialystok Technical University in faculty of Electrical Engineering in the field of Positive Systems.
His research interests cover the automatic control systems theory, specially positive 1D and 2D systems.

CO-SIMULATION OF CHI AND SIMULINK MODELS

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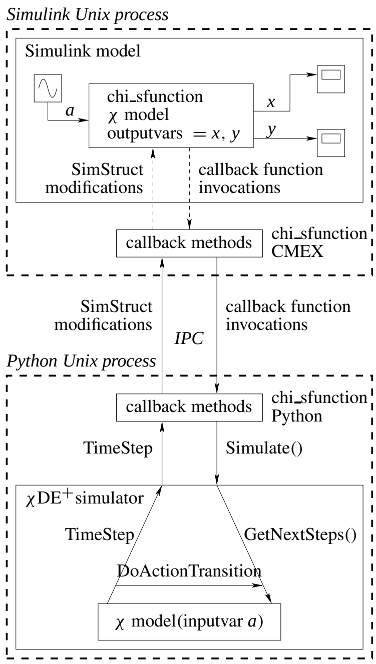
Abstract

Using the model-based engineering paradigm for the design of a system, the system is decomposed into several components and models are developed for these components. The models are preferably specified using domain-specific modelling formalisms. By means of co-simulation, the component models can be combined to obtain the overall system behavior. Furthermore, co-simulation enables the reuse and combination of already existing and validated subsystem models without re-entering model data. In this paper, we present a co-simulation framework (see figure at the right) that is based on the S-function interface as present in Matlab Simulink, to simulate models that consist of subsystems modelled using Matlab Simulink and subsystems modelled in the hybrid process algebra Chi (χ). The principles of the implementation of the framework are described and the framework is illustrated by means of a bottle filling system example.



Keywords: hybrid systems, model-based engineering, modelling, co-simulation, Chi formalism, Simulink

Presenting Author's Biography

Ramon Schiffelers received his Ph.D degree from the Eindhoven University of Technology in February 2006. His thesis was called 'Modelling, Simulation and Verification of Hybrid Systems'. Currently, he is participating in the Darwin project that aims to provide generic methods that will lead to the design of high evolvable systems. He is a member of the (Dutch) Institute for Programming research and Algorithmics (IPA).

CONSTRUCTION OF A HYBRID TRAFFIC MODEL BASED ON JUTS CELLULAR MODEL

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Abstract

This paper deals with a description of an extension of the JUTS traffic simulation system. The model is run on the basis of cellular automata model and is microscopic in its nature. However, there is a need for implementing some parts of the simulation map at a lower level of detail and perform the simulation over them together with the remaining microscopic parts. Moreover, there is a demand for a possible automatic set up of the simulation map macroscopic segments according to a previously validated microscopic model and also, as a future improvement, for switching different segments of the simulation map into a low detail macroscopic level during the simulation run. All these demands represent a hard task, but the main question is the connection between the microscopic cellular automata model of the JUTS system and the new macroscopic model designed for it. There are other models connecting macroscopic models and the microscopic ones. But these combinations involve macroscopic models and microscopic car-following model or models combining mesocopic queuing network models with the macroscopic ones or mesoscopic kinematic wave theories with macroscopic models. On the other side the hybrid model used in JUTS have to be very similar to JUTS structure to allow a possible automatic settings of model parameters or possibly switching the details level. The paper describes the construction of such a model and its incorporation into the JUTS system.

Keywords: simulation, traffic, traffic simulation, model, hybrid model, macroscopic models, microscopic models, JUTS, object oriented, Java

Presenting Author's Biography

David Hartman was born in Karlovy Vary, Czech Republic, and went to the University of West Bohemia, where he studied software engineering and obtained his degree in 2003. Then he entered PhD. studies at the Department of Computer Science at this university and has worked on traffic and general simulation problems, data acquisition problems and algorithm analysis. He is a member of DSS research group (Distributed Systems, Software engineering and Simulations) and creator and one of the leading members of the JUTS traffic simulation project.

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PATTERN ORIENTED AGENT-BASED MULTI-MODELING OF EXPLOITED ECOSYSTEMS

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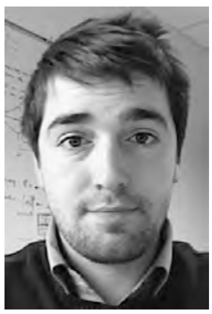
Abstract

Modeling and simulating exploited ecosystems is a complex process that most often requires to manipulate a complex model. Indeed, experts have to use heterogeneous models and assemble them to build the global model, possibly in an incremental manner. We argue that a multi-model methodology and simulation tool enabling to partly automate the modeling and simulation processes and help grasp the complexity of the real systems are needed. Based on the pattern oriented modeling and the multi-agent approach, our proposition is data-oriented. We use a society of models based on agents that interact through the environment and enable coupling of models through environment mediated influences. We specify three roles for modeling agents: (1) the *model-agent* handles an expert's model; (2) the *controler-agent* watches upon the environment; (3) the *observer-agent* builds observable objects. Goals of *model-agents* are structured by the inputs and outputs of the agents that have a specific semantic and shape. The environment is organized by the data (*artefacts*) in which *patterns*, produced by *model-agents*, are outlined. In this paper, we exhibit the framework and methodology of our proposition. We also try to show that our *model-agent*-based approach can help experts build their models in collaboration with agents and we exhibit the local processes that enable us to envision automation of the modeling process. At last, we use a didactic simulation scenario of a theoretical exploited fish population to exhibit our methodology and simulation tool.

Keywords: Modeling methodology, pattern oriented modeling, multi-agent simulation

Presenting Author's Biography



Stephane Bonneaud is doing its PhD in the Computer Science Laboratory for Complex Systems at the European Center for Virtual Reality, where he works on the modeling and simulation processes of exploited ecosystems. Stephane has a master degree (research) in cognitive sciences (Paris 11), where he had to deal with automatic extraction of semantic patterns in discussions. He also has a master degree (research) in Artificial Intelligence (Paris 6) where he worked on modeling and simulating emergency evacuation scenarios using agent-based techniques and working with the Ω language.

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FRAMEWORK FOR MODEL-BASED DESIGN OF MULTI-AGENT SYSTEMS

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Abstract

Artificial agents and multi-agent systems are attractive area which touches many other areas of interest including non-informatics ones like sociology or economy as well as many topics relating to computers, for example artificial intelligence or system design. When we have to develop a multi-agent system we need, among others, to build agent architectures together with some decision algorithms and communication protocols. Before such systems are realized in a real world we should sufficiently test and verify them. Presented text describes a new approach to building artificial agents and multi-agent systems using methodology of model-based design. In this methodology some models are used during the design process. The models are used for testing of particular elements behavior as well as for testing of behavior of the system as whole – in both cases by their simulation. Environment surrounding the elements is also simulated in the model and particular systems are tested whether they fulfills given objectives in proper way. When all the system elements work well in the model then they could be realized in some real environment. Our effort is to develop a tool that would allow model-based design of systems with artificial agents. For this reason we have been building application called T-Mass (Tool for Multi-agent System Development) which is aimed right on the model-based development of such systems and provides some important facilities for building rational agents. As a part of the tool we developed language called t-Sapi by which agents' behavior is controlled. Also we made two-phase synchronous algorithms for control of the model run. This paper shows how some popular agent architectures could be built with the t-Sapi language and how then they are used in the multi-agent simulation model. We also present some remarks about usage of the modeled agents and their consequent realization in real multi-agent applications.

Keywords: Simulation models, Agent control language, Reactive and BDI agents, Model-based design.

Presenting Author's biography

František Zbořil jr. is assistant professor at Faculty of Information technology, Brno University of Technology. His major interests comprise several area related to artificial intelligence and modeling, mainly artificial agent architectures, multi-agent systems modeling as well as computer vision and robotics. His actual research is aimed onto realization of intelligent agent-based systems for runtime risk analysis and management.

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Extending the OPNET Simulation Environment for Mobile Agents in Network Congestion Control

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Abstract

Despite the continuous developments concerning the performance of the global Internet, and hence networking in general, congestion management remains to be a significant challenge. This is due to the heterogeneity of (1) the infrastructure (wired and wireless), (2) network flows (responsive and unresponsive to congestion), and the enormous growth of users and the variety of services. There are number of solutions proposed to tackle congestion, especially concerning the co-existence of responsive and unresponsive transport protocols. One of those, termed as Combined Model for Congestion Control (CM4CC), in addition to the set of classical congestion control mechanisms employed by TCP, introduced mobile agents to manage the unresponsive flows, such as UDP.

The paper goes beyond the theoretical foundations of CM4CC, established in a few early articles, by using the simulation paradigm to validate the model. In order to do so, various scenarios are implemented in the simulation environment provided by the Optimized Network Engineering Tool (OPNET). The results of the simulation study clearly prove that CM4CC, which is a collaborative effort by TCP feedback mechanisms and mobile agents monitoring and control of the network and in particular the behaviour of UDP sources, is more than a promising venue towards a comprehensive congestion management. Inter alia, the focus is on the extensions made to the OPNET to accommodate mobile agents beyond the multi-tier system, and thus extending the original simulation capacity to the areas such as congestion management, network performance enhancement and stability.

Keywords: Responsive and unresponsive flows, Congestion control, Mobile agent packet, Simulation.

Presenting author's biography

Nguyen Hong Van. Ms. Van is a Ph.D. student at the Department of Computer and Systems Sciences, Stockholm University and Royal Institute of Technology. She works for the Ministry of Science and Technology of Vietnam, and her academic stay in Sweden is made possible through a scholarship from the Swedish government, which is administered by SIDA.

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NEUROGENESIS: FROM EXPERIMENTAL DATA TO SYSTEM DYNAMICS MODEL

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Abstract

Formation of the cerebral cortex is one of the most complex processes of the mammal development. It has been postulated that time of origin of particular cortical neurons along with their position within proliferative population determine majority of their properties within mature brain. Also, during early postnatal life, substantial reduction of neuron number occurs as the consequence of programmed cell death that further modifies structure and function of maturing brain. In this paper we present the first attempt, at least according to the thorough search through available literature, to integrate available experimental data on dynamics of cerebral cortex neuron production, cortical stratification, and postnatal programmed cell death within cerebral cortex into single system dynamics simulation model. Stella Research modeling software was employed to build up a model and perform simulation experiments. Results of the simulation experiments confirmed that parameters of cell cycle kinetics of the pseudostratified ventricular epithelia (PVE), particulary ‘q factor’ (proportion of asymmetric mitoses within proliferative population during neurogenetic interval that give birth to young postmitotic neurons) fundamentally influence final amount of cerebral cortex neurons. Model enables effortless expansion by incorporation of other proliferative populations that colonize cerebral cortex or rise from PVE. Hypothesis testing in the course of experiments on animal models is additional possible use of this model.

Keywords: System dynamics, modeling, computer simulation, neurogenesis, cerebral cortex development.

Presenting Author’s biography

Jadranka Božikov graduated in Mathematics and earned MSc and PhD degree in field of Biomedicine and Health Sciences at Zagreb University. Since 1978 she works in Department for Medical Statistics, Epidemiology and Medical Informatics at Andrija Štampar School of Public Health, Medical School, University of Zagreb, currently as associated professor. She introduced simulation modeling methods and applications as teaching subject for medical students and graduates and supervised several MSc theses obtained by young researchers who employed system dynamics approach and continuous simulation techniques in their investigation of the phenomena in medicine and public health. URL: www.snz.hr/~jbozikov.

NUMERICAL MODELS OF SKIN ELECTROPERMEABILIZATION

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Abstract

The application of electric pulses to biological cells causes the electroporation of cell membrane, increasing its permeability thus enabling the uptake of larger molecules that otherwise can not cross the membrane, such as drug molecules or DNA, into the cell. Electroporation can also be used to enhance transdermal drug delivery or DNA transfection in skin. The electropermeabilization process in skin was described theoretically, by means of numerical modeling, leaning on data derived from the in vivo experiments published previously. The numerical models took into account the layered structure of skin, macroscopical changes of its bulk electric properties during electroporation, as well as the creation of localized sites of increased molecular transport termed local transport regions (LTRs). The output of the models was compared with the current and the voltage measured during *in vivo* experiments and a good agreement was obtained. Also, comparing the voltages needed for a successful electropermeabilization of the skin fold as suggested by the model, with voltages achieving good *in vivo* gene transfection, good agreement can be observed. Finally, a comparison of our results with already published findings on skin electropermeabilization showed that the voltage amplitudes suggested by the model are also well in the range of the voltage amplitudes reported by other authors to cause skin permeabilization. With the models presented we used the available data to explain the mechanism of the tissue electropermeabilization propagation beyond the initial conditions dictated by the tissue initial specific conductivities.

Keywords: electroporation, finite element method, plate electrodes, local transport regions.

Presenting Author's biography

Nataša Pavšelj. Her main research interests lie in the field of electroporation, including finite element numerical modeling of electric field distribution in different biological tissue setups (subcutaneous tumors, skin fold) and cell systems (multicellular spheroids) and comparison of the theoretical results with the experimental work. In the last couple of years, her research work is specifically oriented on understanding and describing the process of skin electropermeabilization, mostly involving numerical modeling as well as in vivo experimenting.

LOCALIZATION OF ELECTRICAL ACTIVITY SOURCES IN HUMAN BRAIN DURING EPILEPTIC SEIZURES WITH EEG ANALYSIS

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Abstract

The human brain consists of about 100 billions of neurons, which are highly interconnected. One of the most important characteristic of neural cells is that they can produce electrical signals, therefore, measurements of electrical activity of brain represents a possibility for brain exploration. Measuring scalp potentials is one of the most often used and one of the oldest non-invasive methods for studying brain activity. The method is known as Electroencephalography (EEG). Potentials on scalp carry the information on certain brain activity and by analyzing the time-series data the information can be extracted from the recorded potentials. This information can be used for monitoring and diagnosing certain clinical situations, such as epilepsy. Data from three persons during epileptic seizure was used in the study and Brainstorm software was used to localize dipole sources in the brain. In spite of the fact, that concentric-spheres model was used and that only 32 electrodes were used for EEG measurements and that general electrode positions were used, the system provided very realistic results. Nevertheless, it can occur that real source location is not the most probable-one suggested by the program, therefore, only the specialist can decide at the end what is most probable location of the source. Brainstorm provides a relatively fast tool for identification of sources under Matlab environment.

Keywords: electroencephalography, modelling, simulation, source localization, epilepsy

Presenting Author's Biography

Ilka Peyrer-Heimstätt was born on the 06.12.1982 in Vienna, Austria. After she finished school in 2001, she stared studying technical mathematic of natural science on the University of Vienna. She stayed half a year in Ljubljana, Slovenia to write her diploma thesis at the University of Ljubljana, Faculty of Electrical Engineering. She graduated in june 2007. Beside the study of technical mathematic she is an ambitious amateur photographer. Her first exhibition was shown in 2005 in Vienna.

DISEASES AND FACTORS OF RISK MODELLING REGARDING THE DEVELOPMENT OF STROKE

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Abstract

In the paper simulation results of developed dynamical mathematical model are presented enabling the observation of different diseases and risk factors which are strongly correlated with a potential development of serious disease complications. Proposed model structure enables sequential model construction, relative observation of risk factors and diseases development (independent of the number of people in the concrete country) but can also be applied to specific data (population) taking into account age-distribution at the observed area. The first modelling phase includes the development of five different groups of patients with diabetes type 2, obesity, smoking, hypercholesterolemia and hypertension where also all possible combinations were taken into account. In the second design phase serious complications are observed between which stroke is presented in the paper while the influence to coronary heart disease, peripheral arterial-vascular disease, end-stage renal disease and congestive heart failure are still under investigation. Modelling results of the first and second phase were transferred to the third design phase where they were used for quantitative evaluation of circumstances in Slovenia and developed regions. In this stage we have added also the information of treatment prices regarding each observed disease to enable the observation of healing effect to overall treatment outgoings. From presented results it can be concluded that efficient treatment of the first phase diseases can prevent a great number of serious complications which in addition means also lower overall treatment price.

Keywords: Diabetes type 2, Hypercholesterolemia, Hypertension, Risk factors, Stroke.

Presenting Author's biography

Maja Atanasijević-Kunc. She received B.Sc., M. Sc. and Ph. D. degrees from the Faculty of Electrical Engineering, University of Ljubljana, Slovenia where she is currently assistant professor. Her research interests include modelling and simulation of dynamical systems and control systems analysis and design, specially of MIMO-systems.

ATLAS OF PHYSIOLOGY AND PATHOPHYSIOLOGY – INTERNET SIMULATION PLAYGROUND

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Abstract

The Atlas of physiology and pathophysiology (http://www.physiome.cz) is an interactive multimedia web-based educational application that facilitates the process of physiological system functions interpretation. It helps to comprehend the principles of system malfunctioning and to identify its reasons. The connection of a multimedia environment and a simulation models enables to experience the problem in a virtual reality. The educational simulator provides a way for trying out the behaviour of a simulated object without any risk. The atlas development workflow demands the cooperation between many professionals. The model designed by a mathematician is made to fit a scenario prepared by a physiologist. Then the model is implemented connecting the model with graphical components designed by a graphic designer. To suit various needs during the Atlas preparation, we have used various technologies and approaches, namely the .NET framework, the Control Web framework, Matlab/Simulink and Adobe Flash with ActionScript v2.0. The Atlas is available for medical students (in Czech language version) from March 2007 and the official evaluation of Atlas educational contribution begins from the autumn 2007. The Atlas of physiology and pathophysiology is a free acessible application. All educational text, interactive animation and simulation models including the source code are for free to all who are interested. Any form of cooperation with other European teams resulting e.g. in translation of our Atlas is welcome.

Keywords: E-learning, Modeling in physiology, Interactive on-line simulation

Presenting Author's biography

Ondřej Vacek. Postgradute student of Jiří Kofránek at The Laboratory of Biocybernetics and Computer Aided Teaching which is part of the Institute of Pathophysiology of the 1st Faculty of Medicine, Charles University in Prague. Graduated as MSc. in biomedical engineering at Czech Technical University in Prague (graduated in 2007). Within the scope of his studies is: regulation in physiology, its modeling and utilization in education and the designing of extensive scalable models.

TIME BEHAVIOUR OF PROSTATA TUMOR MARKERS: FROM MODELLING TO A WEB TOOL FOR PHYSICIANS

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Abstract

This paper deals with mathematical optimization and modelling in the area of medical examination for prostate cancer and how to develop a web application to help physicians in case of diagnosis and for definition the next appointment for an appraisal.
The PSA marker can be measured via a simple blood test and is considered to have exponential behaviour from the fitting function point of view. But this behaviour is assumed to be exponential, when a person has prostate cancer or in the case that after a prostate ablation a part of the tumor is left in the body of the patient. The doubling time of this marker should be calculated out of free starting values and their x – axis value in months. For the whole system a PHP – framework is provided and a connection from this so defined graphical input/output – interface to a MATLAB Webserver is done. The first task is a nonlinear fit problem. We have to find parameters *a, b* and *c* as real numbers, so that the function

$$f(time) = a + b * exp(c * time)$$

has a good least square error fitting to the measurements. Our solution is the approximation for the doubling time of the value in the last measurement point. This can be done easily by a numerical fixed point iteration or for the redefined model as a zero crossing detection. As an extension the effects of measurements errors are shown by calculating the Gaussian – Variance – Analysis. In the summary other possibilities for using the implemented interface to support physicians with web tools for simulation are presented.

Keywords: PSA, web application, nonlin. fit, PHP/MATLAB interface, prostate cancer

Presenting Author's biography

Nikolas Popper. He has earned a degree in technical mathematics at the Vienna Univerity of Technology. He has experience in industry projects as well as research and development knowledge. Currently he is working in the area of visualization in computer graphics and modeling and simulation of epidemics. He is co-proprietor of the company 'die Drahtwarenhandlung' and offers as well technical solutions (defect detection on pictures, simulations, …) as animations and films. Furthermore he is doing a PhD thesis in the area of alternative and coupled models.

A COMPONENT ORIENTED APPROACH TO MULTIDISCIPLINARY SIMULATION OF MECHATRONIC SYSTEMS

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Abstract

Due to the multidisciplinary and complex structure of mechatronic products, their complete modeling and simulation is a hard challenge. On the other hand complete models are a key element of the development process of mechatronic systems. Starting from proofed modeling methods for mechanical, electrical and software systems, an integrated component oriented method for the modeling and simulation of multidisciplinary mechatronic systems will be presented in this paper. The basic concept uses components that represent shape/geometry and functions of real world components. Well defined external interfaces allow combining several components to build up more complex ones leading to complete systems in a straightforward bottom up process. The automated generation of multidisciplinary simulation models in semi-symbolic form from extended 3D-CAD models is a key element of the method that guarantees the consistency of generated models avoids errors of manual modeling and reduces modeling effort significantly. Applying the generation process on single components, result in very compact and efficient simulation code. The models are used on a mixed continuous / discrete simulation platform that preserves the component structure of the models during simulation, which allows the simulation of large systems on the basis of verified precompiled sub-components. The support of modules, usually restricted to the specification of mechatronic systems, in our approach is continued to the simulation model which results in encapsulated robust simulation models.

Keywords: Multidisciplinary modeling, component orientation, mechatronic system modeling.

Presenting Author's biography

Roland Kasper got a Diploma of Mechanical Engineering from the Technical University of Karlsruhe in 1978. Subsequent to a Dr.-Ing. Degree from the University of Paderborn in 1986 he was working with Robert Bosch Company as a researcher and senior researcher for eight years. Since 1994 he is a full professor of Mechatronics at the University of Magdeburg, Faculty of Mechanical Engineering. Further he is a member of the Saxonian Academy of Science at Leipzig, a member of the grant committee for collaborative research centres of the DFG (German Research Foundation) and a member of the acatec.

Acknowledgement: This project is funded by the DFG (German Research Foundation).

CONTACT PROCESSING IN THE SIMULATION OF THE MULTI-BODY SYSTEMS

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Abstract

Contact processing, including collision detection and contact response, is one of the most difficult, but most important areas in the simulation of the multi-body systems. However, the most widespread multi-body simulators, like Matlab/SimMechanics, don't support the contact processing. Other multi-body simulators, like Vortex or ODE, support the contact processing, but are more limited in the rest of the functionality. This paper presents the overview of the most popular techniques in the contact processing by simulation of the multi-body systems and shows the implementation of the chosen contact processing technique into Matlab/Simulink. The collision detection has been implemented using existing software tool Solid. The contact response for both contact phenomena - collision forces and friction forces – has been developed for the force-based approach. The functionality of the developed contact processing has been performed by the contact tasks of an anthropomorphic manipulator and a six-legged robot. Both kinds of robots represent the structures with serial and parallel kinematics respectively. They are typical multi-body systems for investigation of the single and multiple contacts as well as the stiff connected with environment and the free moved in environment respectively. The functionality of the developed contact processing has been compared with identical contact tasks in Vortex.

Keywords: contact processing, collision detection, contact response, contact forces and torques.

Presenting Author's biography

Vadym Rusin received the Dipl.-Ing. and the M.Sc. degrees from Technical State University of Donetsk (Ukraine) in 1998 and 1999, respectively, all in electrical drive and automation. Since 2000 PhD student at the University in Magdeburg (Germany) and research engineer at the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg (Germany). Working fields: industrial automation, mobile and service robots, intelligent drives control, simulation of the mechatronical systems. About 20 publications.

SIMULATING THE DYNAMICS OF NANOPOSITIONING AND NANOMEASURING MACHINES USING METHODS OF MULTI-BODY SYSTEM DYNAMICS

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Abstract

In connection with the Sonderforschungsbereich 622 at TU Ilmenau, the scientific and technical bases to design and construct nano-positioning and nano-measuring (NPM) machines are elaborated. The measuring related characteristics of NPM machines are considerably influenced by the system's behaviour. For simulation, multi-body system (MBS) models were developed in order to determine these influences.
This research is focused on the development of a positioning and measuring machine with a moving range of 200 x 200 x 25 mm³. Therefore a high precision vertical axis has to be designed. High precision guides and drives are needed to satisfy requirements like high resolution, high stiffness and low friction. One main focus is the simulation of vertical drive units (vertical axis) which enable the compensation of the guidance error emerging from movement in three-dimensional space. For this purpose the simulation programs alaska 5 and MATLAB/Simulink were combined. The mechanical subsystem is simulated using alaska 5 and MATLAB/Simulink deals with the drive and control subsystems.
The simulation of a high precision vertical axis as multi-body system (MBS) will be presented in this paper. The results will be used to develop a model based control of the vertical axis. The objective is the optimisation of the complete system in terms of dynamical behaviour and stability. The numerical results of the simulation are evaluated and the models are adjusted by experimental assessments.

Keywords: multi-body system, dynamics, simulation, high precision axis.

Presenting Author's biography

Erik Gerlach was born 1969. He received the degree in electrical engineering in 1996 and the Ph.D. (Dr.-Ing.) in 2003 from the Technische Universität (TU) Ilmenau, Germany. His dissertation was on the optimization of robot trajectory. He was an assistant at the department of quality management, TU Ilmenau, from 1996 to 1997. Since 1997 he is scientific assistant at the department of technical mechanics, TU Ilmenau. His main research field is the simulation of multi-body systems. Since 2003, he has been working with the Sonderforschungsbereich 622 "Nanopositionier- und Nanomess-maschinen" at TU Ilmenau.

BEYOND THE LIMITS OF KINEMATICS IN PLANNING KEYFRAMED BIPED LOCOMOTION

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Abstract

The methods of locomotion planning for biped robots have been studied for many years. Presently, several companies have announced the commercial availability of various humanoid robot prototypes with diverse controllability.
However a family of existing humanoids is being controlled using so called "keyframes". The keyframe technique lets us specify the target angular position of the joints only in discrete time-steps, whereby the length of the individual intervals is also defined. These platforms have built-in path planning algorithms and have their own control electronics: i.e. no external feedback is given about actual joint torques. The widely spread locomotion planning methods cannot be applied directly to this kind of robots, thus they need a different approach.
In this paper, we present an iterative technique of keyframed humanoid motion planning based on numerical optimization methods for the application of stable biped stair climbing.
Using inverse kinematics and the existing techniques for creating keyframed character animation, one can relatively easily generate a reference movement, which can be executed real-time using a fast kinematics model of the given robot. In this case we get the reference time curves of the robot segments' poses. It is a fact, that due to gravitational-, inertial- and frictional effects, the motion won't exactly be the same in the real world. Assuming we have built a detailed, sophisticated dynamics model (running offline) we can formulate a norm that describes the distance between these outputs. In this article we present our idea, how the motion could be automatically tailored by lowering this norm using numerical methods in a way, that the output of the dynamic model better approximates the reference motion.
Finally, we show our experimental results obtained by implementations running within a modern simulation environment as well as on our test humanoid platform.
This paper is an extended and revised version of [1].

Keywords: Humanoid, Keyframe, Motion planning, Dynamics, Stair climbing

Presenting Author's biography

Tamás Juhász is an early stage researcher at the Virtual Engineering Expert Group of Fraunhofer Institute in Magdeburg, Germany. Since 2003 – being a PhD student of informatics at BUTE, Hungary – he has published many lectured articles in the field of mobile robot simulation and advanced 3D visualization techniques.

USE OF SEMI-EMPIRICAL PRESSURE RELIEF VALVE MODEL IN FREQUENCY DOMAIN ANALYSIS OF FLUID POWER CIRCUITS

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Abstract

The semi-empirical method for modeling various fluid power components has appeared to be very effective and thus it is used in many time-domain simulation programs. In studies carried out early 90's effective non-linear time-domain semi-empirical models for pressure relief valves were proposed. In this method an analytical model is brought into a form in which its parameters can be identified by using measured characteristic curves. This paper shows that this model can also be used in frequency-domain analysis of fluid power circuits including short or long pipelines. This model provides similar advantages to as it provides in time-domain analysis, i.e. it is not required to dismantle the valve to identify the parameters. The model is also in a compact form in which the number of parameters that can be identified from measured characteristic curves is the lowest possible. The applicability of the linearized semi-empirical model is demonstrated in analyzing dynamics of fluid power circuits with short and long pipelines. The frequency domain analysis of the fluid power circuits are mainly needed in stability analysis on closed loop systems and in pressure transient analysis of long pipelines. The advantage of the presented model is clearly its usability over the entire operating range of the system. It is because its parameters are firstly identified in non-linear time-domain and then the model is linearized in the vicinity of the selected operating point.

Keywords: pressure relief valve, modeling, semi-empirical, frequency domain

Presenting Author's biography

Heikki Handroos has been Prof. of Machine Automation and Head of Institute of Mechatronics and Virtual Engineering in Lappeenranta University of Technology since 1993. He earned his M.Sc and D.Sc degrees in Tampere University of Technology, 1985 and 1991. His research interests range from modeling, simulation and control of servodrives to serial and parallel robotics. He has published about 150 scientific journal and conference papers.

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COMPUTATIONALLY EFFICIENT TWO-REGIME FLOW ORIFICE MODEL FOR REAL-TIME SIMULATION

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Abstract

Mainly in fluid power system simulation the orifice flow is clearly in turbulent area. Only when a valve is closed or an actuator driven against end stopper the flow becomes laminar as pressure drop over an orifice is approaching zero. So, in terms of accuracy, the description of laminar flow is hardly necessary. Unfortunately, when purely turbulent description of the orifice is used, numerical problems occur when pressure drop becomes close to zero. They do because the first derivative of flow with respect of pressure drop approaches infinity when pressure drop approaches zero. Also the second derivative is discontinuous. This causes numerical noise and also infinite small integration step when variable step integrator is used. In this study a numerically efficient model for the orifice flow is proposed by using a cubic spline function for describing the flow in the laminar and transition areas. Parameters for the cubic spline are selected such that its first derivative is equal to first derivative of pure turbulent orifice flow model in the boundary condition. The superiority of this model comes from the fact that no geometrical data is needed in calculation of flow from the pressure drop. In real-time simulation of fluid power circuits there exists a trade-off between accuracy and calculation speed. This investigation is made for the two-regime flow orifice model. The effect of selection of transition pressure drop and integration time step on the accuracy and speed of solution is investigated.

Keywords: Real-time, simulation, two-regime, orifice model.

Presenting Author's biography

Rafael Åman. M.Sc student in Lappeenranta University of Technology. Research assistant in Institute of Mechatronics and Virtual Engineering since 2006. Simulation of mechatronics and motion base control as research interests.

MODELING AND SIMULATION OF MOS TRANSISTOR MISMATCH

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Abstract

The paper is an overview of MOS transistor mismatch modeling and simulation over the existent literature. The fluctuations of physical parameters and line width are the main causes of mismatch. There are two types of mismatch. Systematic mismatch can be reduced to great extent with proper layout. Different patterns are available, that are able to reduce from linear to n-th order polynomial systematic mismatch. Stochastic mismatch can only be reduced with better process control and larger transistor areas. There are different approaches for calculating the standard deviation representing stochastic mismatch. Simple formulas (e.g. square root of area rule) are most commonly used. With the reducing of the transistor area some new effects should be considerate and more complex formulas are needed. On the other hand correlation functions and frequency domain analysis with spatial spectra give more accurate results. These two approaches are more general but they do not give physical insight and the final layout should be known. Mismatch can be simulated in several ways. Brute force simulation based on Monte-Carlo analysis is appropriate for any kind of distribution but it is the most time expensive. Simulations based on small signal analysis are faster because less circuit simulations are needed to calculate the sensitivity. Two different approaches to calculate the sensitivity are presented in this paper.

Keywords: MOS transistor mismatch, simulation, modeling

Presenting Author's Biography

Gregor Cijan. Received the uni. dip. ing. degree in electrical engineering from the University of Ljubljana in 2006. Since 2006 he has been a junior researcher with the Regional Development Agency of Northern Primorska. Currently he is a Ph.D. student at the Faculty of Electrical engineering, University of Ljubljana. His research interests include circuit simulation, circuit optimization, and modeling and simulation of device mismatch.

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SIMULATED ANNEALING FOR SIZING OF INTEGRATED CIRCUITS IN SPICE

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Abstract

This paper presents a new optimization algorithm for automatic sizing of integrated circuits (IC) in SPICE. We refer to the new method as DESA. It is a hybrid between two very popular oprimization methods. The first one is differential evolution (DE) which is a robust population based optimization method and has received a lot of attention in the recent years. It was also sucessfully applied to many practical applications. The second method is the simulated annealing algorithm (SA) which is a fairly simple but very powerfull stochastic global optimization method. Combination of DE and SA (DESA) is expected to exploit good global search capabilities of SA and efficient search mechanism and fast convergence of DE. DESA is fairly simple to implement and has only a few parameters. In order to verify its performance in IC design it was implemented in SPICE OPUS simulation and optimization tool. It was compared with the multistart version of the constrained simplex method (multistart COMPLEX), which was already part of SPICE OPUS and produced good results in IC optimization. The performance of DESA and the multistart COMPLEX method was verified on seven real-world cases of IC design. The comparison in terms of the final solution quality and the number of required cost function evaluations showed that DESA outperformed the multistart COMPLEX method on all considered test cases.

Keywords: global optimization, simulated annealing, differential evolution, IC design

Presenting Author's Biography

Árpád Bűrmen was born in Murska Sobota, Slovenia in 1976. He received his Uni.Dipl.-Ing. degree and his Ph.D. degree from the Faculty of Electrical Engineering, University of Ljubljana, Slovenia in 1999 and 2003, respectively. Since 2002 he has been a teaching assistant at the Faculty of Electrical Engineering. His research interests include continuous and event driven simulation of circuits and systems, optimization methods, their convergence theory and applications, and algorithms for parallel and distributed computation.

MODELING FRAMEWORK FOR HIGH-LEVEL EVALUATION OF EMBEDDED SYSTEMS

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Abstract

As technology advances, options for realization of heterogeneous systems increase. Traditional approach to embedded systems design does not offer satisfactory support for building efficient contemporary designs. Nowadays designers use a variety of hardware (HW) and software (SW) co-design methodologies in order to meet application constraints as fast as possible. The paper presents a graphical modeling framework used for high-level modeling, evaluation and design-space exploration of heterogeneous systems. The framework provides designer graphical elements for using modeling concepts from system modeling libraries. Graphical modeling relieves the designer of the manual-typing source code and thus hides many details of system-level design languages that normally need to be taken care of. The graphical framework also provides different constraint checks during modeling and automatically generates an executable model for evaluation of a heterogeneous system.
The applicability of the modeling framework is illustrated within a case study where a system-level modeling of a simplified digital camera is presented. Case study exemplifies the use of the framework and shows what information is obtained from an executable model built on a high-level of abstraction. Evaluation of results serves as a basis for further design decisions. Graphical modeling enables rapid changes in the model and thus speeds-up design-space exploration.

Keywords: Embedded systems, High-level design, Graphical modeling, System-level simulation, Design-space exploration.

Presenting Author's biography

Klemen Perko received his B.Sc. degree in electrical engineering from the Faculty of Electrical Engineering, University of Ljubljana, in 2004. Since then, he has been working as HW and System Design Engineer. In October 2004, he started working towards the Ph.D. degree at the Faculty of Electrical Engineering, supported by Ministry of Higher Education, Science and Technology. His current research interests include HW/SW codesign, high-level modeling and design of embedded systems and systems on a single chip.

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SENSITIVITY ANALYSIS IN MOSFET ANALOG INTEGRATED CIRCUITS

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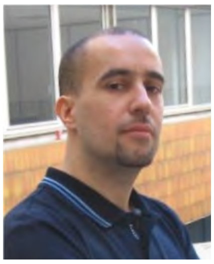
Abstract

Generally in the optimization phase of analog integrated circuits, sensitivity analysis is performed in order to reduce the high number of iterations needed to reach the best solution and equally to ensure that possible fluctuations of the parameters of the circuit won't affect the good behavior of the performance. A major design goal is to establish the degree of influence of each parameter on the target performance and to detect sensitive parameters, i.e. those whom fluctuations around their nominal value will modify in an unacceptable way the performance. The computational effort has to be focused only on this reduced set of parameters in order to optimize the solution. Traditionally, sensitivity analysis has been performed with respect to electrical parameters (resistance, inductance, capacitance etc.). In the context of MOSFET integrated circuits, these parameters belong either to the equivalent circuit of transistors or to interconnection paths and consequently the designer has no direct access to them. For this reason, sensitivity analysis with respect to technological or geometrical parameters of the components is certainly more useful. In this paper a method to compute performance sensitivities with respect to the dimensions and the technological parameters of various MOSFETs is presented. Some results are shown and we discuss how this approach can be extended to tolerance analysis, in order to estimate the maximum fluctuations of the target performance, when the tolerances on each parameter are imposed. This is expected to improve fabrication yield efficiency.

Keywords: Analog integrated circuits, MOSFET, Modeling, Sensitivity, Tolerance

Presenting Author's biography

Farouk Vallette obtained his PHD in applied physic in 1993. He's working on applications of sensitivities to tolerance analysis and circuit design in the SYEL (Systèmes Electroniques) team in University Pierre & Marie Curie, Paris 6, since 1996.



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SIMULATION SYSTEM FOR RUN-TIME RECONFIGURABLE NETWORKS-ON-CHIP

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Abstract

Complexity of System-on-Chip design has grown step by step in the last decade. Beside tremendous capacities of transistors developers have to deal with new features such as run-time reconfiguration. Run-time Reconfiguration, in particular, rapidly emerged and is currently provided by several FPGA series. Those features demand new methodologies for modelling and simulation, verification, and evaluation. Furthermore, the focus moves towards the interconnect structure that has to be scalable and adaptable to multiple requirements. To cope with the challenges of interconnect and system-on-chip design, hardware designers divide their systems into smaller sub-systems. A general approach for dividing up complete systems is tile-based modelling where tiles contain similar-sized groups of elements. This model is introduced for static as well as for dynamically reconfigurable systems. The one-to-one relation of the simulation model of a single tile and real tile on an FPGA is sketched and re-used for a tile-based model of run-time reconfigurable networks-on-chip. Additionally, its application to an existing adaptive network-on-chip, CoNoChi, supporting irregular topologies and changes of topology at run-time is shown. A complete simulation suite based on SystemC is introduced with the goal to establish a base for other application-specific derivatives.

Keywords: Tile-based Modelling, Network-on-Chip, Run-Time Reconfiguration, SystemC.

Presenting Author's Biography

Carsten Albrecht received his Diploma degree in Computer Science from the University of Lübeck in 2002. During his studies, he gained research experience at the University Claude Bernard of Lyon, France, in 1999 and work experience at Alstom Power Switzerland in 2000. Both placements set the focus to parallel processing applications. In 2002, he joined the Institute of Computer Engineering, University of Lübeck. First, he studied multi-threaded processor design and application-specific processors in the field of network computing. His current research topic is modelling, simulation and application-specific management of dynamically reconfigurable systems.

SPEEDING UP VERILOG GATE-LEVEL SIMULATION WITH BI-PARTITIONING

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Abstract

Iterative design methodologies based on a simulation-debugging-update cycle form the basis of Verilog design development. An automated flow to speed up iterative design cycles is presented here. Compilation speedup is obtained by partitioning the circuit in order to exploit the locality of code updates during a typical iteration, in order to recompile only the modified parts of the design. Simulation speedup is obtained by interfacing multiple instances of the same simulator together through a cosimulation interface, either on single-core or dual-core computers. Particular care is taken in the design of the cosimulation interface to ensure the same accuracy as during a single-kernel simulation.
A smartcard circuit embedding an asynchronous ARM processor is used as a demonstrator. The speedup is analysed on both single and dual core machines with gate-level simulation. An unexpected result is that even on a single-core computer, in some circumstances, partitioning a simulation and simulating both parts simultaneously leads to some speedup in spite of the losses due to the cosimulation interface. During the iterative design cycle experiments, the main result is a 30% speedup achieved with all the simulators on a single core and 50% speedup on dual-cores.

Keywords: Verilog, Cosimulation, Speedup.

Presenting author's biography

Lilian Janin is a Research Associate in the School of Computer Science at the University of Manchester, where he received his Ph.D. degree in 2004. His research interests are in simulation and visualisation of large asynchronous systems. He has been working since 2000 ond the Balsa asynchronous simulator and visualisation system. His work is now mainly focused on a co-simulation debugging environment for heterogeneous synchronous-asynchronous circuits.

AN APPROACH TO PREDICT DESIGN CHOICES IMPACT ON RAILWAY SERVICE DEPENDABILITY

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Abstract

Service Dependability has been recognized in the transportation literature as an effective measure of transit systems service quality. Being a stochastic measure of the delay collected by a train in a generic travel, it may be profitably utilised as an indicator to choose, among different options, the design solution able to increase the level of satisfaction of the final user as well. In this paper the authors present a procedure for estimating the impact of design choices, dealing with subsystems architecture, basic components reliability performances or maintenance policies, on the service quality provided by a railway or metro system. The procedure is based on the use of an innovative modular simulator, developed by the authors. Through a Monte Carlo approach and a suitable post-processing of the results of the simulated samples, the tool provides the user with a set of indicators for estimating the service quality and the effectiveness of different traffic and fleet management policies, as well as maintenance strategies, in both rated and degraded operating conditions. The simulation results for a case study dealing with a railway High Speed application are presented and discussed. Such study aims at estimating the impact of loco and feeding system failures, as well as of the adopted maintenance strategies, on the quality of the service provided by the transportation system. At last, the authors propose an analytical expression to estimate Service Dependability for the analysed case study, fully customisable by the simulation outcomes.

Keywords: Reliability, Maintenance, Railway, Train delay, Monte Carlo.

Presenting Author's biography

Stefano Savio received the Ph.D. degree in Electrical Engineering from the University of Genova, Italy, in 1989. Associate Professor at the Electrical Engineering Department of Genova, he is author of more than 100 papers, most of them dealing with the Product Assurance assessment for industrial and transportation systems, as far as modelling and simulation oriented to RAMS prediction are concerned. As far as applied research is concerned, he was Evaluation Manager of the EU projects MARCO and COMBINE, Project Coordinator of the EU projects COMBINE 2 and F-MAN, and is currently Leader of the Work Package *Reliability and Economics* within the EU project UNIFLEX-PM.

DISCRETE SIMULATION OF TRAFFIC FLOWS IN HIGHWAY TUNNELS

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Abstract

Tunnels are an element of roadway network characterized by their specific principles of operation. They must therefore be analyzed separately from the rest of the traffic system, especially when traffic safety is considered, which is influenced by numerous factors (technical, technological, organizational, psychological, sociological, etc.). These factors are not considered, or are considered to a lesser extent, in traffic safety studies of the road network.

In this paper, we have analyzed traffic flows in the wide area of the Slovene highway network A1 by using simulations. In this area there are four successive tunnels and the Jasovnik tunnel (left tube) was chosen to be studied according to different scenarios leading to congestion. In the analysis, the parameters (such as the number of vehicles, velocity, vehicle structure, system response time) varied and the response to these parameters was measured. Measures were suggested to reduce the consequences of congestion considering the results of micro-simulations of traffic flows, and suggestions were given for a possible enhancement of the traffic safety in the tunnels. The computer programme Vissim 4.10 was used for micro-simulations of traffic flows, using the car-following model. This paper is aimed at presenting the application of simulations when decisions have to be taken about improving the measures and when the tunnel is in the planning phase.

Keywords: car-following model, traffic flow simulations, highway tunnels, traffic safety.

Presenting Author's Biography

Matjaž Šraml is an assistant professor, holding a Ph.D degree of Mechanical Engineering, employed at the Faculty of Civil Engineering, University of Maribor. His specialization refers to the pedagogical topics of "Devices, systems and constructions for transport" and "Traffic technique". So far he has been included in several applicable and fundamental projects. He is a principal researcher of international bi-lateral projects and participates in other international projects as well. He is also a member of several professional associations and an author and a co-author of original scientific, scientific and technical articles in the field of his specialization, which refers to the simulation of material flow, logistics and transport analysis and the analysis of technical systems.

THE ANALYSIS OF PEDESTRIANS STREAM ON THE ROUNDABOUT CAPACITY USING MICRO-SIMULATION MODEL

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Abstract

The use of modern roundabouts as a viable traffic control measure instead of traffic light or priority intersections is increasing over the past decades. Their strength lies in their ability to reduce the number of vehicular conflicts at intersections and thereby enhance the intersection capacity and safety. In the past, many authors have used different ways of determining the capacity of roundabouts and different approaches of determining the influence of the stream of non-motorised traffic flow on the capacity of a roundabout. The main purpose of this paper is to analyse the influence of the strong pedestrian stream and circulated stream of motorised vehicles on the capacity of the one-lane roundabout. The observed area of traffic flow is a representative part of roundabouts where the strongest traffic flows occur. An approach is suggested for dimensioning roundabouts with modelling traffic flows, using the discreet simulation method and considering the statistically evaluated entry data for motorised vehicle and pedestrian stream. The presented model derives from the expected time void in the vehicular traffic flow, used by the pedestrians, presuming their priority when joining the traffic. The simulation analysis has been performed on a roundabout in Maribor, where measurements of motorized vehicle traffic flow and pedestrian traffic flow had taken place.

Keywords: Roundabouts, Traffic analysis, Micro-simulation modelling, Performance analysis.

Presenting Author's biography

Matjaž Šraml is a docent, holding Ph.D degree of mechanical engineering (2001), working on the Faculty of Civil Eng. and Faculty of Mechanical Eng., University of Maribor. His habilitation refers to pedagogical topic of "Traffic technique" and "Devices, systems and constructions for transport". He has been included in applicable and fundamental projects. He is a principal researcher of international bi-lateral projects and also participates in some other international projects. He is also a member of several professional associations and he is author and co-author of original scientific, scientific and technical articles in the field of his habilitation, refers to simulation of material flow, logistics and transport analysis, analysis of technical systems.

CUSTOMISING VEHICLE ATTRIBUTES FOR ROAD TRAFFIC MICROSIMULATION MODELLING

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Abstract

Vehicle classification including their proportions, physical and kinematics attributes is a necessary step when building a microsimulation model of any road network. Microscopic simulators are based on modelling individual vehicle/driver units and their interaction which points to the importance of having a proper vehicle attributes specified in order to achieve the modeling results that match real-life conditions. The substitution of default vehicle attributes that are usually built into microsimulation software by a locally customised vehicle fleet will allow for more accurate estimation of traffic performance indicators, such as speeds, travel times, capacity, fuel consumption etc. In particular, the accurate classification of vehicles is essential for reliable vehicle emissions predictions, since the type and fuel used by vehicles has a significant effect on their emissions level. Vehicle data that is being collected around the world may vary in its form and detail but single databases very rarely will contain all the information needed for microsimulation tasks. Therefore, main sources of vehicle registration data will need to be supplemented by other sources. This paper describes the development of vehicle fleet profiles and their attributes suitable for modelling Australian road networks. It describes the development of the customised vehicle fleet to be used in Paramics microsimulation modelling package by Quadstone in the United Kingdom (UK) but it can easily be extended to any other traffic microsimulation software.

Keywords: Microsimulation, Vehicles, Roads, Kinematics.

Presenting Author's biography

Branko Stazic is a Regular Member of Eastern Asia Society for Transportation Studies (EASTS) with ten years of experience as a Transportation Engineer working for both, the University of South Australia (UniSA) and the State Government Transport Agency. For last seven years he has been working as a Research Associate at the UniSA and is involved in research, teaching and supervision of postgraduate students working on Transport Modelling projects. He holds a Master's Degree in Transport Systems Engineering from University of South Australia and he is currently undertaking a PhD research degree course at the same University. His involvement in research projects has resulted in the publication of a number of recent conference papers in the area of Transport Microsimulation modelling.

THE SCALE EFFICIENCY MODEL OF AIRSPACE SECTOR CAPACITY

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Abstract

This study develops a measuring scale efficiency model of an air traffic controller to analyze the actual utility of airspace capacity and to realize the efficiency of airspace sector management. This study is basically on the key factors of air sector characteristic, air traffic composition, flight mix, and the procedure of air traffic control to analyze these factors and how they influence and relate to each other. Meanwhile, this research measures the relation between air traffic and airspace sector and with mathematical programming of data envelopment analysis to measure the efficiency of air sectors. The input variables are the number of hourly entry flight for each airspace sector, the number of hourly exit flight for each airspace sector, and the number of hourly flight entry/exit neighboring airspace sector for each airspace sector. The output variable is the number of hourly flight (hourly workload) for each airspace sector. The outcome shows that the hourly scale efficiency of the east airspace capacity in the Taipei terminal is better than the north and west sector. The after recombination outcome of improving hourly efficiency for airspace capacity is better than before recombination. Therefore, this model can be employed to study airspace sector planning strategies, and also can be used as a reference and tool to compare scale efficiency of sector capacity and differences between air routes and terminals.

Keywords: Scale efficiency, Airspace sector capacity, Data envelopment analysis.

Presenting Author's biography

Sui-Ling, Li is an associate professor of Department of Shipping and Transportation Management, National Penghu University and teaches Air Transportation, Transportation Economics, Transportation Planning, Airline Marketing, Logistics Management and Operation Research. She completed his Ph.D. degree at Institute of Traffic and Transportation College of Management, National Chiao Tung University. Her research areas include air transportation, airport planning, air traffic management and transportation planning. Her research papers have been published at Transportation Planning and Technology, Journal of Eastern Asia Society for Transportation Studies, Transportation Planning Journal, Journal of the Chinese Institute of Transportation, Proceedings of International Conference for Applications of Advanced Technology in Transportation, Transportation Research Boarding Annual Meeting, Annual Air Transport Research Society World Conference, IEEE Intelligent Transportation Conference System, International Symposium on Logistics, and Great China Logistics Forum.

AN INTEGRATED APPROACH TO LOCAL PUBLIC TRANSPORT SERVICES AND EFFICENCY IN COMPANY MANAGEMENT. A MODEL APPLICATION

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Abstract

The design of public transport systems is a complex activity which develops on different levels. The process is made of different components, as the design of service levels and definition of service parameters, as planning bus routes, planning bus stops, setting frequency and time-tables. The process is based largely on customer satisfaction; therefore the design of the service will be demand-oriented. The service design has an effect on the cost of the service and therefore it is a constraint.

Experience shows that it is not conceivable to design a system which is budget – restrictions free, therefore it is not possible to fulfil passenger requirements without keeping in account the limits set by service production costs, that is offering a service which is conceived independently from company efficiency, or effectiveness.

In standard approaches, all the service data (i.e. timetable) is a given invariable data for the problem solving. The proposed approach intends to solve the problem of vehicle scheduling by considering the service data, defined in the first step, as a variable of the system; therefore, during the process of optimization of the vehicle scheduling, it is possible to modify the time table given as input, in function of the optimization of the company's business efficiency.

The approach presented in this paper is based on the consideration that the constraints set in the service planning phases, if considered rigid, are a strong limitation to the achievement of efficiency in the company business process.

Therefore in the phase of vehicle and crew scheduling, the constraints on the service data are relaxed, allowing small modifications to the time table.

Keywords: bus service design, Time table, vehicle scheduling, crew scheduling.

Presenting Author's biography

Giovanni Leonardi. Degree in Civil Engineering, and PhD in Transports Engineering, is Associated Professor with The Department of Transport of the Faculty of Engineering of the University of Reggio Calabria. He is author and co-author of many scientific papers relative to road, railway and airport engineer, transport and environmental issues.

A TRUST-BASED MODEL FOR MULTI-AGENT SYSTEMS

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Abstract

Trust is very important aspect in our everyday interaction with people, groups and institutions in our society. We have trust in our environment, people and institutions as well. We are often rated and judged on the basis of our trustworthiness and this defines a different manner of the interactions in our social life. We behave more openly towards subjects on account of the strong confidence and this subjects can access different types of information which can be confidential. In the case of abuse of the information, the trust of the subject rapidly decrease and it is very hard to restore it. Some research in this area are aimed to use these trust principles from real-word and shift it into digital environment nowadays. In autonomous multi-agent systems, where agents are operated in a networked environment, it is particular possible to use these principles of trust to establish protocols for agents interaction. If we try to shift this real-word trust principles to multi-agent systems, we meet with some essential problems. This paper try to show a possible approaches to the basic problems with multi-agent systems based on trust. It presents the way to simulate the trust or the reputation from a viewpoint of application and safety in multi-agent systems.

Keywords: Trust, Reputation, Multi-agent system

Presenting Author's Biography

Jan Samek was born in 1982 in Opocno, Czech Republic. He attended on secondary secondary Technical School of Electrical Engineering, He graduated from Brno University of Technology, Czech Republic with MSc. degree in 2006 in Electrical Engineering and Computer Science. He is a student of PhD study Computer Science in Brno University of Technology since 2006. His MSc. theses was *Security of Information Systems* - this theses was about an analysis of information systems from the security point of view, especially analysis of risks and threats of current information systems approaches. He is also member of Brno University Security Laboratory (BUSLab). His research interests: IT security, information systems, intelligent systems – especially multi-agent systems and their security.

Acknowledgment: The research has been supported by the project MSM0021630528 (Ministry of Education, Youth and Sports, Czech Republic) "Security-Oriented Research in Information Technology".

MULTI-AGENT SIMULATION OF THE INDUSTRIAL REFRIGERATOR MATERIAL FLOWS

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Abstract

This paper is devoted to the development of a system multi-agent imitating model uniting set of technological processes, material flows and transport operations, allowing to reproduce and predict an industrial - marketing refrigerator condition in concrete situations of raw material and storekeeping receipt, production plans and realization depending on dynamics of external deliveries and trading organizations orders. When administrating the complex production and technical processes of the agroindustrial refrigerator in the condition of the uncertainty and risk the optimal decision-making depends on the simulation of the production moments, mean analytical description and consequent interaction of many engineering processes, financing and transport dealership. Authors of the given article have developed and have written the imitating model and the program, using the universal language Simplex 3. This simulation model allows to reproduce and forecast the production process's state and sale operations in concrete situations of the raw material delivery and the inventory management, as well as the production plan of working and sales of products against the fluctuation of the external delivery and the trading organizations' orders. At the same time it may be examined and optimized the finances by the simulation's methods within the main production and production cold store. It involves the multiform production and the queues for servicing, as well as the approval of decision-makings to minimize the costs, resources, etc. That is why the contribution of authors to the given work is great.

Keywords: Simulation, Material flows, Agroindustrial refrigerator, Optimization methods, Imitating modeling.

Presenting Author's biography

Liubov A. Sheshenina is the postgraduate student of the chair "Computer Technologies and Systems" of the Moscow State University of Applied Biotechnology; 1983 of birth. She has graduated from school and has entered the Moscow State University of Applied Biotechnology in 2000. Scientific interests: the system analysis and systems of imitating modeling. In 2005 she has graduated from the university and has entered the postgraduate courses.

INTEGRATION OF SIMULATION, ANALYSIS OF VARIANCE AND GOAL PROGRAMMING FOR MINIMIZATION OF MAKESPAN AND TARDINESS

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Abstract

This paper presents an integrated computer simulation, goal programming and analysis of variance algorithm to solve the job shop scheduling problem with multiple objectives. The proposed algorithm is applied to an actual textile dyeing, printing and finishing workshop for minimization of tardiness and makespan in which we first, simulate the workshop operation using Awesim (SLAM II) language. The proposed simulation model itself enables managers to find schedule of jobs on machines given a defined combination of decision parameters which provide the smallest completion time of jobs. We then, utilize design of experiment (DOE) for determining the decision parameters in order to estimate the effect of both qualitative and qualitative factors through metamodeling. A goal programming model is used to find the optimum values of decision variables subject to a set of technical and managerial constraints. Additionally, we conduct a sensitivity analysis since the managers are tending to know the impact of RHS (right hand side values). The significance and advantage of the proposed algorithm is its concentration on two main managerial objectives simultaneously whereas previous studies were able to consider a single criterion. Although we illustrate the performance of the proposed algorithm by its application in a small case, this general procedure has this advantage to be applicable in large scale problems.

Keywords: Goal programming, Minimization, Analysis of Variance, Makespan, Tardiness, Multi-criteria decision making.

Presenting Author's biography

Azadeh Dabbaghi received her B.Sc. in 2005 from the industrial management department and is currently pursuing her master's degree in industrial (system) engineering at the University of Tehran. She is a PhD candidate and her research directions are: Multi Criteria Decision Making (MCDM), Multi Attribute Utility Theory (MAUT), Scheduling and Simulation optimization. She is now a senior expert in the administration directorate at NIOC (National Iranian Oil Company)

APPLICATION OF GENETIC ALGORITHM TO A BICRITERIA SINGLE MACHINE SCHEDULING PROBLEM OF MINIMIZING MAXIMUM EARLINESS AND NUMBER OF TARDY JOBS

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Abstract

Today's importance of on time deliveries according to JIT concept makes managers to consider a desired set of extra "due date related " criteria in the workshop scheduling. These criteria can be stated as tardiness, number of tardy jobs, and earliness. In bicriteria scheduling problems one criterion can stands for the manufacturer concerns and the other can represent customer concerns. In this paper we focus on the bicriteria scheduling problem of minimizing the number of tardy jobs and maximum earliness for single machine, in which the idle time is not allowed. The problem is known to be NP-hard. This problem has not been solved by any meta heuristic. Thus, we developed a genetic algorithm (GA) by exploiting its general structure that further improves the initial population, utilizing a heuristic algorithm on the initial population. We present a computational experiment, considering the real conditions of industrial systems based on generating stochastic processing times and due dates in different intervals to test the algorithm for both high and low processing time that shows the out performance of the improved GA by comparing the results with a pair wise interchange method, applied on the two famous sequences (Moore and MST). Our effort is also to minimize both two criteria simultaneously.

Keywords: Genetic algorithm, Bicriteria scheduling.

Presenting Author's biography

Maryam Dehghanbaghi. Received her BSc degree in textile engineering in 2002. She is currently a MSc. student in industrial Engineering Department at University of Tehran and a research Assistant and PhD candidate. Her research interests contain, decision making, performance measurement, data mining, simulation, scheduling and outsourcing.

THE SYNTHESIS TECHNOLOGY OF COMPLEX SYSTEMS' IMITATING MODELS BASED ON CONCEPTUAL PATTERNS

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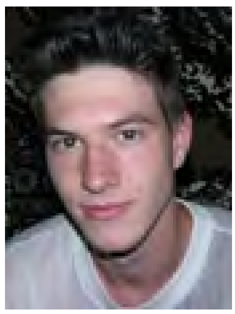
Abstract

At present modelling is the basic method for learning and predicting behavior of complex systems. At last years the complication of systems is followed by the integration process. In other words, the systems of different fields are joined in the whole. A large integrated system is appeared as a result, which has large functional abilities and complex hierarchical structure with big set of elements and subsystems. For developing models of such systems the efforts and knowledge of one specialist is not enough. So it is necessary a group of experts of different fields of sciences to do it. As a consequence of it, the complex macrosystem's model's development process is reduced to decomposition of the model-based object on subsystems and for each of them an expert or experts' group are selected which are responsible for developing model of separated subsystem. After the completing of each submodel development the process of synthesis is started. This work is aimed at developing a technology of synthesis of complex systems' imitating models through the technology of conceptual patterns and developing the tools of automation synthesis' process of such models which must support the work of experts' group. As a result, the developed tools significantly increase the developing models' correctness and decrease the period of their constructing.

Keywords: Conceptual patterns, Imitating models, Complex systems, Synthesis, System dynamic.

Presenting Author's biography



Kodema Vyatcheslav Alexandrovich. I graduated from the Kola branch of the Petrozovodsky State University the faculty of Informatics and Applied Mathematics. At present, I am a first-year post-graduate student of the IIMM KSC RAS at speciality 05.13.18 – Mathematical modelling, numerical methods and program systems.

SIMULATION OF A MOBILE ROBOT WITH A LRF AND MAP BUILDING

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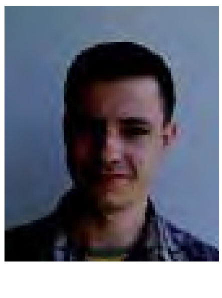
Abstract

This article deals with the modelling and simulation of a mobile robot with a laser range finder and map building. The simulator is built in the Matlab Simulink environment, thereby taking advantage of the powerful Matlab toolboxes for developing mapping, localization, SLAM and navigation algorithms. The simulator includes the models of a mobile robot, a laser range finder (LRF) and the environment. The purpose of the modelling is to create a simulation model where different algorithms for mapping can be tested. We assume a two-dimensional environment and that the robot knows its own pose. The two-dimensional model of the environment is built with line segments. The line segment is defined with two points on the line and the normal line equation. The laser range finder model in each time step gives the set of distances to obstacles (e.g., a wall) at angles $0°$ to $180°$. We assume that the influence of the LRF's noise is proportional to the distance of reflection point from the robot. In this way we can test the robustness of mapping algorithms without knowing the real noise distribution. In an S-function the 2D environment model and the LRF model is simulated and in another S-function the map-building algorithm is implemented. The robot with its LRF is also animated with Matlab's Virtual Reality toolbox in a 3D environment. A map-building algorithm is developed and tested with a simulation. The line segments, extracted from the LRF's output in each scan, are made up of polylines, which are merged with the existing global map to form a new global map. The global map of the environment is represented by unions of line segments, where each union represents an object in the environment. In this way the search strategy to find pairs of line segments for localization purposes could be faster than with an environment map, which is composed of only one set of line segments.

Keywords: mobile robot, simulation, map building

Presenting Author's Biography

Luka Teslić. I received B.Sc in electrical engineering from the University of Ljubljana, Slovenia in 2006. My current research interests are mobile robot localization and mapping.



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MODELLING OF DYNAMIC WATER QUALITY CHANGES BY MEANS OF TIME SERIES METHODS

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Abstract

Water quality indicators are used to capture physical, chemical and biological changes occurring in freshwater bodies. These dynamic changes result from activities of internal and external driving forces which may be natural or anthropogenic. Modeling of water quality dynamics is of importance in understanding the underlying network structure of water quality changes and to forecast their general tendency within reasonable limits. For modeling and simulation of water quality processes it is necessary that all data sets are based on regularly time grids. The dynamics captured reveals changing amplitudes and variances across time. This paper examines the applicability of three approaches (the autoregressive moving average method, the Fourier polynomial, and digital filter algorithm methods) for modeling water quality changes by time series methods. The different types of indicators namely physical (water temperature), chemical (dissolved oxygen) and biological (chlorophyll-a) are taken from rivers of different hydraulic structures in Germany, namely the River Havel, the Elbe River and the Oder River. The autoregressive moving average method gives acceptable results, but is not helpful for forecasting. The Fourier polynomial is useful for approximating physical indicators and gives unacceptable results for chemical and biological indicators while the filter algorithms give acceptable approximations for all indicators and possibilities for forecasting.

Keywords: ARMA, Fourier polynomial, Filter algorithm, Water quality time series.

Presenting Author's biography

Jean Duclos Alegue. The presenting author is a Cameroon national. After an M.Sc. in Environmental and Resource Management at BTU Cottbus, Germany (2002-2004), he commenced a PhD at the Department of Ecosystems and Environmental Informatics at the same university where he teaches Modeling of Ecosystem and Data Analysis with Matlab. He is expected to present his dissertation before winter 2007. The author is very familiar and comfortable with ecosystem modeling, environmental data analysis, GIS / remote sensing and Java programming language.

FEM MODELING VS. RANDOM WALK MODELING FOR POLLUTION SPREAD IN GROUNDWATER FLOW

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Abstract

Reasonably pure water is one of the most important resources of the 21st century, and the increasing demand as well as the climate change make it increasingly difficult to satisfy the demand with surface water. Groundwater is a suitable alternative, but anthropogenic changes have much more impact, so modeling and simulation is used to a great extend to forecast the possible results of such human interferences. As the basics physical laws governing the flow and transport of groundwater lead to PDE's, in geohydrology simulation almost always leads to the numerical solution of PDE's. The well known Finite Element Method and the less known Random Walk Method are the two far ends in the possible numeric techniques available for the mixed hyperbolic-parabolic PDE resulting from the attempt to model the transport of substances, and sometimes lead to fundamentally different results on the same problem, especially when used in conjunction with other stochastic and statistic modeling techniques usually applied in modeling the groundwater bearing geological strata, which basically provide the data for the flow model the transport is based on. In this paper the merits and shortcomings of these techniques in their application in groundwater modeling and simulation are discussed, compared and illustrated in a few examples.

Keywords: FEM, FD, Groundwater modeling

Presenting Author's Biography

Florian Judex studied applied mathematics at the Vienna University of Technology, an wrote his master thesis on system identification. At the moment he is working on his PhD thesis on groundwater modeling for the ARC Seibersdorf Research Center, as well as for the research unit "Numerics and Simulation of Differential Equations" at the Institute for Analysis and Scientific computing at the Vienna University of Technology.

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INTELLIGENT AGENT CONTROLLED SIMULATION WITH THE CASSANDRA SYSTEM

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Abstract

An alternative approach to the conventional ones is presented and its application for problem solving outlined. Usually a model is built, the dynamic simulation is executed and the results obtained are used. In case of ill defined or soft systems however the model of the system is only vaguely determined and first the model representing the system to be investigated adequately has to be determined. Such cases can be found in the fields of micro- and macro-economy. The development of regions and sustainable development taking also problems of environmental control into consideration poses similar problems. The solution proposed is to use the methodology of identification by reconstruction. As a first step a preliminary model is built and the simulation is undertaken using "historical" data as inputs. The performance of the model during the simulation run is monitored continuously by intelligent agents (demons) and the model is reconstructed by them to obtain a model the behavior of which represents adequately the system to be investigated by simulation. After having identified the model; its behavior under various conditions can be investigated by simulation in the conventional way. The approach described can be applied using the CASSANDRA simulation system developed at the McLeod Institute of Simulation Sciences Hungarian Center. This methodology has already been used with success in various fields. In the present paper after describing the method an application illustrating it is presented.

Keywords: intelligent agents, identification by reconstruction, Knowledge Attributed Petri Nets, sustainable development of regions, transdisciplinary models

Presenting Author's Biography

András Jávor holds the degrees MScEE, PhD and DSc in computer science. He is director of the McLeod Institute of Simulation Sciences (MISS) and also director of the MISS Hungarian Center. He is professor at the Budapest University of Technology and Economics. He is chairman of the Hungarian Simulation Society and of IMACS/Hungary, member of the Board of Directors of EUROSIM and the editorial boards of 4 international scientific journals. His publications exceed 170 items. He was visiting professor 3 times at the Aachen Technical University and invited lecturer several times at various universities in Austria, the Netherlands, Japan and China. In 2006 he was awarded the Gold Cross of Merit of the Hungarian Republic for his internationally acknowledged scientific results in simulation sciences.

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FULLY AGENT BASED MODELLINGS OF EPIDEMIC SPREAD USING ANYLOGIC

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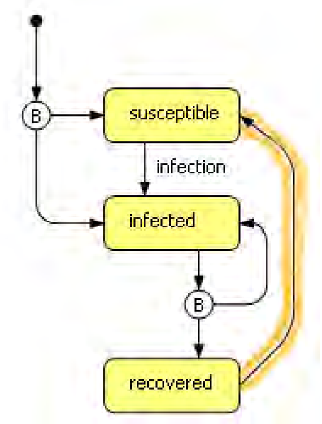
Abstract

The question how to model the spread of epidemics has been approached countless times. The number of different methods used on this problem is not too small either. Ordinary differential equations (ODE) and Partial differential equations (PDE) have dominated this field for several decades, if not centuries. In the second half of the last century two alternative techniques appeared on the stage, namely cellular automata (CA) and agent based (AB) models, also called multi agent systems (MAS). The difference between the approach with differential equations and the latter two methods is big. CA and MAS are so called "bottom-up" approaches, focusing on the smallest unit of the system – a cell or agent, whereas ODEs try to model the system via causal connections on the macroscopic level. Setting up a SIR-type model using the AB approach one can take advantage of state charts to control the behavior of agents. Using AnyLogic as implementation platform agents and especially state charts can be programmed very conveniently. Especially modifications and/or extensions of the final model can be handled in an elegant way. The right figure does show all necessary adjustments to expand the SIR- to a SIRS-type epidemic (additional state transition highlighted). The results obtained by simulation with such an MAS are comparable to those of the ODE- and CA-approach, although AB modeling offers a higher degree of freedom and thus more possibilities of adjustment.



Keywords: Epidemic Spread, SIR, SIRS, Agent-based modeling, AnyLogic.

Presenting Author's biography

Štefan Emrich was born on June 30th 1981 in Vienna, Austria. After finishing high school and his social service, he went on to study technical mathematics at the Vienna University of Technology. He became project assistant at the Institute for Analysis and Scientific Computing in February of 2007. He finished his studies 4 months later. Currently he is continuing his studies towards a PhD.

HYBRID SIMULATION OF TUMOR GROWTH COMBINING CELLULAR AUTOMATA WITH CONTINUOUS STATE DYNAMICS

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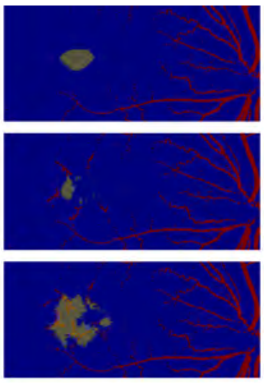
Abstract



Cellular Automaton theory has proved to be an innovative and reliable tool in describing complex processes such as tumor growth. The concept is extended with special interest on the extrusion of tissue with regard to angiogenesis. The model is divided into different components where the discrete states of the cellular automaton interact with the continuous states from the description of the nutrient supply. Computation of such models can be compared with clinical data from oncology and can provide a deeper understanding of tumor dynamics. The model under observation bases on an inhomogeneous nutrient supply and is able to simulate different supply scenarios. Therefore an arterial tree serves as input for the nutrient distribution. The supply is described by a diffusion process. The nutrient supply on the other hand serves as input for the cellular automaton which governs the growth of the simulated tumor. Angiogenesis is introduced by subsequent modification of the vascular network. The parameters are tuned to attain exponential growth with fixed growth factors in homogeneous environments. The model can be used to simulate tumor growth with a special focus on the effects of angiogenesis.

Keywords: Cellular Automaton, Alternative modeling, Tumor dynamics, Angiogenesis

Presenting Author's Biography

Daniel Leitner graduated in mathematics at the Technical University of Vienna. Currently he is working on his doctoral thesis about mesoscopic simulation of blood flow at the Austrian Research Centers. His research interests are numerical modeling, fluid dynamics in general, especially lattice Boltzmann methods and its application to biofluids.

A HYBRID MODELLING APPROACH FOR INFLUENZA EPIDEMICS BASED ON CELLULAR AUTOMATA AND AGENT BASED TECHNIQUES

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Michael Gyimesi[3]

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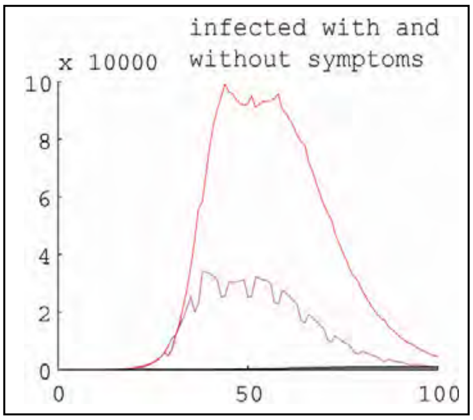
Abstract

The classical tools for modeling epidemics are ODEs and PDEs, but they have some shortcomings. It is extremely complex to expand the model onto heterogeneous populations (age-groups, sex, infection risk, etc.) or to add time dependend effects (e.g. daily routines or vaccination after infection). Thanks to electronic data processing there is also much more data available nowadays than 100 or even 30 years ago, making it possible to create new kinds of models. Cellular automata (CA) and agent-based (AB) computing allow a different approach of the problem. CA by definition introduce spatial structures to a model. AB systems even take it a step further, they are based on agents that may hold various characteristics (age, sex, membership of a certain family or neighborhood, etc.). Because of their distinct strengths and drawbacks a combination of both methods seems promising and therefore was implemented for the simulation of influenza outbreaks in urban populations. An AB framework was created allowing the population to be heterogeneous, within it CA are introduced for timeconsuming computation of small units such as schools or neighborhoods. The framework allows it to steer the daily routine of the population and control its movement from one unit to another. The results of the model are fairly interesting as they show a behavior similar to real influenza patterns.



Keywords: Epidemic Spread, SIR, SIRS, Agent-based modeling, AnyLogic.

Presenting Author's biography

Štefan Emrich was born on June 30th 1981 in Vienna, Austria. After high school he went on to study technical mathematics at the Vienna University of Technology, where he graduated in June 2007 at the Institute for Analysis and Scientific Computing. Currently he is continuing his studies towards a PhD.

VIRTUAL CITY AND TRAFFIC SIMULATION GAME BASED ON SCIENTIFIC MODELS

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Abstract

This paper is about the development of the traffic simulation game MOBILITY and the forthcoming extended version “virtual city simulation dein|t|o|w|n|” and their usage in education. In 1998 the German BMBF (Federal Ministry of Education and Research) has supported the development of a computer game called “MOBILITY” within the framework of the research programme "Better understanding of mobility and traffic". With the assistance of this kind of software teenager and young adults should learn about traffic related connections, urban development and new concepts of mobility. The experience, which the user gains while playing MOBILITY or dein|t|o|w|n|, should set new impulses for his own mobility behaviour in “real life”. The pedagogical idea behind is that the actor learns by experimentation what works and what doesn't. With this requirement it was necessary to model the virtual world as realistic as possible. So the integration of scientific algorithms from traditional traffic based modelling into a game-based environment was the mission to be solved. On the base of the classical urban transportation planning system model or also known as the “four-step model” the overall simulation model of MOBILITY was extended in particular by a network of interactions. This network of interactions describes realistic situation of the traffic in a typical German city.

Keywords: mobility, computer game, effect structure, traffic, deintown.

Presenting Author’s biography

Raimo Harder is a traffic and transportation engineer based in Weimar, Germany. Since his study at the University of Hanover the main concentration has been on the alliance of traffic engineering and the helpful usage of computer and software in this field. In the late 80’s he was involved in the development of a traffic assignment software called AVUS. Since 1998 he is employed at the Bauhaus-University Weimar mainly as a project manager for the traffic simulation game MOBILITY and the virtual city simulation dein|t|o|w|n|. He is involved in some smaller projects of the EU and since 2001 he heads the engineering office for transport planning and software development called JAVIDO.

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DEVELOPMENT OF WEB ACCESSIBLE MEDICAL EDUCATIONAL SIMULATORS

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Abstract

One of our main goals is to incorporate the usage of computers into the process of education. The great part of our e-learning activities lies in the development of applications that would demonstrate non-trivial physiological systems behavior, their dynamics and regulation. Students of medicine generally differ from students of engineering and technical universities; being less used to purely abstract mathematical thinking. Therefore it is necessary to transfer the mathematically expressed pathophysiological concepts into more schematic, easily understandable, yet still precise manner. Best results are achieved, when the students find the form familiar, e.g. similar to illustrations from the textbooks. In the process of the development of e-learning simulators, our main focus is creating the model and creating high quality animations to visualize the simulation results. In this paper, we describe our approach to usage of simulators in e-learning, the development of these applications, their layered architecture and technologies we use. We use the Matlab Simulink for creating physiological models, .NET framework or Control Web as the main platforms and Adobe Flash for controllable animations. We describe our original tools for accessing Simulink models from the .NET framework or Control Web and we introduce our approach to maintaining the simulator state based on statecharts.

Keywords: e-learning, Simulation games, Simulators, Statecharts, Flash, Simulink, .NET, Control Web

Presenting Author's biography

Pavol Privitzer, M.Sc., MD graduated in 2001 from the Faculty of Mathematics and Physics, Charles University in Prague, his major being Computer Science. In 2007 graduated as Doctor of Medicine, Charles University in Prague. Currently, he is a Ph.D student of Computer Science in Biomedicine supervised by Jiří Kofránek, M.D.

THE DIGITAL FACTORY A NEW COURSE FOR UNIVERSITARY EDUCATION

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Abstract

To enforce innovation and to keep production costs as low as possible automotive industry created the idea of the digital factory. The objective of the digital factory is to simulate and to optimise the complete chain from the design of a vehicle to mass production. This new idea will penetrate gradually in all areas of mechanical and electrical engineering, causing significant changes of organisation, structure and working methods. It will have strong effects on the future sphere of work of students, who study mechanics, mechatronics, productronics and partially computer science. Since globalisation will enforce more and more the digital factory paradigm in the automotive industry, our idea was to develop a common teaching framework for students of Germany and Brazil, which are two countries representing the typical globalisation aspects in automotive industry. Within this framework, students and lecturers are exchanged, and the students are encouraged to not only study in the partner university but also do their practical work in an automotive factory of the foreign country. We developed a new teaching module consisting of the following three components: a set of lectures, which introduce into the modelling and simulation of discrete systems, a series of lectures, which explain the characteristics and objectives of a digital factory, and a laboratory session, during which the students get acquainted with the use of a simulation tool and have to realize a simulation project. In this article we explain the structure and the content of this new module.

Keywords: Digital factory, Simulation, Education, Automotive industry, Global manufacturing.

Presenting Author's biography

Wolfgang Arndt. Studies of Electrical Telecommunication at the University *Rheinisch-Westfälische Technische Hochschule Aachen*, PhD in Engineering at the *Faculté des Sciences* of the University of Paris, assistant professor at the University of Konstanz, department of chemistry, full professor at the University of Applied Sciences, HTWG Konstanz, director of Transfer Centre for System and Software Engineering Konstanz, director of the laboratories for Real-time and System Software of the HTWG.

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A PHP/MATLAB BASED E-LEARNING SYSTEM FOR EDUCATION IN ENGEINEERING MATHEMATICS AND IN MODELING AND SIMULATION

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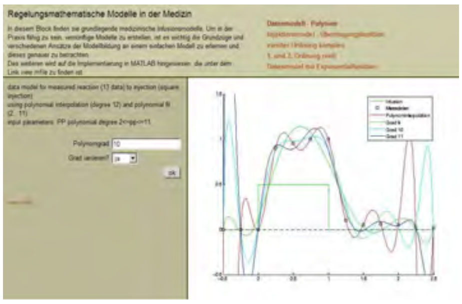
Abstract

The goal of this work is to present an e-learning tool based on the MATLAB Webserver technology. We offer an adaptive PHP framework which can be used for interactive learning in lessons and in project practices, as well as for web presentations of computer algebra solutions made in MATLAB (e.g. nonlinear fit problems for medical data). All mathematical/numerical solutions of the tasks are done in MATLAB. Another basic of the concept is not only to show the students the solution of a problem via internet for several different functions or parameters, but also to offer them the source code. The students can download the code and test other features and learn programming of mathematical solutions with a computer numeric/algebra package. An explanation of the detailed structure of the PHP – framework is given.



The main focus of this paper lies on model attempts for physiological systems. An example of a simple infusion model is used for interactive learning and system testing.
In several parts the way from a poor data interpolation to a data model with exponential functions up to a solution with transfer functions and parameter optimization is described. The outlook concerns the expandability of the defined framework, and will also focus on the restrictions of the system and how to deal with them.

Keywords: e-learning, MATLAB, open code fragment, interactive learning.

Presenting Author's biography

Günther Zauner. He has earned a degree in mathematics with specialization in "mathematical computer science". With an interdisciplinary background based on higher technical school he has experience in the application and the development of numerical methods and different modeling approaches.
Current work focuses on simulation and modeling techniques, in this context especially model structure dynamics. Another main field of interest is the development of e-learning systems based on simulation environments.

A DYNAMIC APPROACH TO THE EDUCATION-INVESTMENT DECISION STRATEGY USING OPTIMAL CONTROL THEORY

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Abstract

An important aspect to expand the production of human capital is the properly investment decision strategy in educational matters. Thus, a foregone income of thousands of euros per individual are fluently spent both by him and by public government into that specific direction. The purpose of this study is to analytically determine the optimal lifetime path of education (or equivalently, let us say: the stock of knowledge) for an average individual (particularly someone with limited income) and the public policy implications of his decision. Thus, an optimal control theory model to the education – investment decision strategy that maximizes the present value of future earnings for an individual is fully developed. The formulation of this model is quite general including several inputs variables, assuming only the rate of schooling as the control variable. Finally, an illustrative application is presented. In that application, it is considered a special case of the famous Cobb – Douglas production function.

Keywords: Modelling, Deterministic Optimal Control Theory, Allocation of Resources; Human Capital, Education – Investment decision.

Presenting Author's biography

Grigoris Kalogeropoulos: Professor of Mathematics, at the University of Athens, Greece. He has received Phd from City University, U.K.. He has more than 50 research papers in the field of control theory, matrix pencil theory and (multidimensional) linear algebra, and education.

Athanasios Pantelous: Phd student at the department of Mathematics, at the University of Athens, Greece. He has 5 research papers in the field of (stochastic) control theory, matrix pencil theory, financial and insurance mathematics.

THE MEANS AND MOTIVATION FOR ANIMATING GRAPHICS IN ENGINEERING APPLICATIONS

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Abstract

The paper deals with animating the results of simulations of the dynamics of different engineering systems in the Mathworks' MATLAB development environment. It first reviews the basics of the handle graphics allowing accessing and dynamically changing any property of any graphics object the user-defined two- or three-dimensional plot might be composed of. It further introduces two methods available in MATLAB to animate these plots. The first one simply redraws the entire plot at each instant of time, captures it and adds to the movie, available to play with later on. The second one might involve more programming but it allows to dynamically vary only the portion of the plot, which is actually changing, leaving the rest of it untouched. If standalone versions of the created movies are needed, the paper presents a way MATLAB suggests to convert them into the standard audio/video interleave files playable outside MATLAB. The paper capitalizes upon pretty basic examples and then advances to several more complex cases, where both methods for creating movies were employed to animate graphics and virtual scenes. Four appendices contain complete professionally-written scripts emphasizing both techniques and teaching some programming tricks. The paper advocates using animations to prove feasibility of simulations and debug user-created programs and is thought to be useful for engineering students and researchers.

Keywords: Animation of systems' dynamics, MATLAB, Handle graphics.

Presenting Author's biography

Oleg Yakimenko received his MS degree in computer science from Moscow Institute of Physics and Technology, Russia in 1986, and his MS degree in aeronautical and astronautical engineering from Air Force Engineering Academy, Moscow, Russia (AFEA) in 1988. He received his first PhD degree in aeronautical and astronautical engineering from the same academy in 1991 and his second PhD degree in operations research in 1996. Dr. Yakimenko has progressed through all professorial ranks at AFEA and is currently teaching and conducting research for the U.S. Navy at NPS. His research interests include fight mechanics; guidance, navigation and control of manned and unmanned vehicles; high-fidelity modeling and real-time applications. He is an author of over 200 publications including several textbooks on programming and digital computations (numerical methods). Prof. Yakimenko is an Associate Fellow of American Institute of Aeronautics and Astronautics and Russian Academy of Sciences of Aviation and Aeronautics.

MODELING AND SIMULATION OF FRACTIONAL SYSTEMS USING ORTHOGONAL FUNCTIONS

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Abstract

In this paper, a new method for modeling linear fractional order systems is proposed. the developments are carried out in the Laplace domain using the transfer function representation. In fact, the main idea here is to approximate a fractional transfer function by an integer one with appropriate order. Obviously, this result would be useful thereafter for simulation and analysis of such dynamic systems. This technique uses the generalized operational matrices of integration and differentiation of orthogonal basis which computes rigourously the analytical Riemann-Liouville integral and derivative. Generally, the main advantage of using this mathematical tool is that it allows to transform the analytical fractional differential calculus into an algebraic one relatively easier to solve. Particularly in this paper, the well known Block Pulse orthogonal functions are used. Their remarkable upper triangular operational matrices of both fractional integration and differentiation, unlike those of orthogonal polynomials, reduces considerably the calculus with no significant loss of precision. Indeed, the wanted transfer function parameters are found algebraically simply with a least square algorithm formulation. The effectiveness of this method is shown through a set of numerical examples. Comparison study with some rigorous works in literature, namely the recursive poles and zeros approximation technique, is also presented.

Keywords: Modeling, Fractional systems, Linear systems, Orthogonal functions, Generalized matrices of integration and differentiation.

Presenting Author's Biography

Mohamed karim Bouafoura was born in Tunis in 1980. He received the diploma in Electrical Engineering from the National School of Engineers of Sfax (ENIS) in 2003 and the master degree in Automatic Control and Signal Processing from the National School of Engineers of Tunis (ENIT) in 2005. He is currently working toward Ph.D. degree in Electrical Engineering at National School of Engineers of Tunis. His research interests include robust control, fractional systems and controllers, orthogonal functions and generalized operational matrices.

ON SIMULATION OF A BIVARIATE UNIFORM BINOMIAL PROCESS AND ITS USE TO SCAN STATISTICS

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Abstract

Scan statistics studies maximal clusters of random points on an interval (or a *map*) $I \subset \mathcal{R}^n, n \geq 1$, determined by a *scan window* which is moving on the whole I.This paper considers the problem of simulating a bivariate uniform binomial process (BUBP) on I, with the purpose of estimating the *critical value* of a *scan test.* The first section defines and studies BUBP in analogy with the bivariate uniform Poisson process (BUPP) and introduces the bivariate scan statistics on a rectangle. The second section presents details on simulating a BUBP, based on known algorithms for simulating binomial and normal variates. The third section gives the implementation of algorithms and compares estimated distributions of the scan statistics for BUBP and BUPP, concluding that these distribitions are approximately the same for a large I. Finally is presented a practical application of the simulated bivariate scan statistics to a problem of healthcare.

Keywords:Simulation of discreete stochastic processes, Scan statistics,Binomial process.

Presenting Author's Biography.

Ion C. Văduva. Professor of the University of Bucharest (see the address), Chair of Informatics. Fields of interest: Computer Simulation; Stochastic Modeling; Monte Carlo Methods; Multivariate Statistics; Software Reliability; other related fields. Published more than 100 scientific papers in international journals or proceedings; published also 21 books and lecture notes (in Romanian). Is a member of AMS and IASC.

STOCHASTIC MODELLING OF INSURANCE

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Abstract

From ancient time one of the most important problem in non-life insurance companies has been how to calculate incurred but not reported claim provisions (IBNR). When accounting period ends, premiums have received, but there is always situation that claims have incurred but still not reported because it is not always possible to report them in the same day of occurrence. To have right accounts money from received premiums have to be reserved for such claims. There are many classical methods how to do that. All these methods are based on different coefficient calculations and deal with classical development triangle. Nowadays new stochastic methods actual have become to calculate the mentioned reserves (Charpentier, 2004 [1]). Every claim relates with loss adjusted expenses which are needed for insurance company to be able to pay out claim. We have gone further to look on each claim in non-life insurance like event consists from three important characteristics: the claim size, the allocated loss adjusted expense and the development time (time from the moment of claim occurrence until its settlement). Our interest is concentrated to the joint study of all three random variables what is very important for IBNR claim provision calculations. Using multivariate distributions with different dependence structures, we statistically evaluated IBNR claim provision.

Keywords: Non-Life Insurance, Insurance, Copula, Modelling, Algorithm.

Presenting Author's biography

Vladimirs Jansons was born in Daugavpils, Latvia and is a graduate of the University of Latvia, where he studied mathematical science and obtained his degree in 1970. For eight years he has worked in the University of Latvia Computing Centre. Since 1978, he has been lecturing at Riga Technical University, in 1983 was awarded the doctoral degree in the mathematical science. The main field of research pursued is statistical modelling and optimization of technical and economic systems.

STIFF SYSTEMS IN THEORY AND PRACTICE

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Abstract

The words ”stiff system” are used frequently in this work as it is the top topic of it. In particular the paper deals with stiff systems of differential equations. To solve this sort of system numerically is a diffult task. In spite of the fact that we come across stiff systems quite often in the common practice, it was real challenge even to find suitable articles or other bibliography that would discuss the matter properly.
On the other hand a very interesting and promissing numerical method of solving systems of ordinary differential equations based on Taylor series has appeared. The question was how to harness the said ”Modern Taylor Series Method” for solving of stiff systems.
The potential of the Taylor series has been exposed by many practical experiments and a way of detection and solution of large systems of ordinary differential equations has been found.
Generally speaking, a stiff system contains several components, some of them are heavily suppressed while the rest remain almost unchanged. This feature forces the used method to choose an extremely small integration step and the progress of the computation may become very slow. However, we often need to find out the solution in a long range. It is clear that the mentioned facts are troublesome and ways to cope with such problems have to be devised.
There are many (implicit) methods for solving stiff systems of ODE’s, from the most simple such as implicit Euler method to more sophisticated (implicit Runge-Kutta methods) and finally the general linear methods. The mathematical formulation of the methods often looks clear, however the implicit nature of those methods implies several implementation problems. Usually a quite complicated auxiliary system of equations has to be solved in each step. These facts lead to immense amount of work to be done in each step of the computation.
These are the reasons why one has to think twice before using the stiff solver and to decide between the stiff and non-stiff solver.

Keywords: Stiff systems, Modern Taylor Series Method, Differential equations, Continous system modelling

Jiří Kunovský graduated at Brno University of Technology, in 1967. During most of his time at BUT he has taught and directed research in Computer Science, specially in simulations of ”Security-Oriented Research in Information Technology”. He has created the simulation language TKSL (II-2007/TKSL is available now).

ADAPTING POWER-SERIES INTEGRATION TO REAL-TIME SIMULATION

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Abstract

Simulation of physical systems using digital computers continues to play an ever increasing role in all aspects of today's technological society. In general the basis for simulation resides in mathematical models of the systems being simulated. In the case of continuous dynamic systems these models consist of either nonlinear ordinary or partial differential equations. The simulation of these systems and hence the simulation of the corresponding mathematical models can be accomplished by numerical integration of the differential equations.
An original mathematical method which uses the Taylor series method for solving differential equations in a non-traditional way has been developed. Even though this method is not much preferred in the literature, experimental calculations have shown and theoretical analyses have verified that the accuracy and stability of the Taylor series method exceeds the currently used algorithms for numerically solving differential equations.
It is the aim of the paper to adapt power-series integration (Taylor series) to real-time simulation. In real-time digital simulation the numerical integration step size h is almost always fixed. The same is expected from corresponding power-series integration.
Actually, it may be difficult to apply the power series method to real time simulation, since the required higher derivatives of the real-time inputs will not in general be available. Furthermore, many real-time simulations involve derivative functions that are represented by multi-dimensional data tables rather than analytic functions. In this case the required state-variable derivatives do not exist.
Adapting power-series integration to real-time simulation in this paper is based on a model representation. The real system is driven by the model and all the control is specified in the model. Next step how to speed up simulation is to use a special digital hardware.

Keywords: power-series, real-time simulation, diferential equation, controller

Presenting Author's Biography

Jiří Kunovský graduated at Brno University of Technology, in 1967. During most of his time at BUT he has taught and directed research in Computer Science, specially in simulations of "Security-Oriented Research in Information Technology". He has created the simulation language TKSL (II-2007/TKSL is available now).

ESTIMATION OF BURN INJURIES FROM TEMPERATURE MEASUREMENT USED IN EVALUATION OF FIRE PROTECTIVE GARMENTS

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Abstract

The overall performance of thermal protective clothing can be evaluated either by means of bench scale test or by exposing a dressed mannequin to real-life flame conditions. In this paper an automated system for evaluation of fire protective clothing based on the use of a flame mannequin is presented. The mannequin is equipped with an array of temperature sensors which provide the information about the temperature on the mannequin surface. The level of burn injury is evaluated using the estimated heat flux entering the material at the surface and thermal skin model. A particular attention in this paper is focused on the issue of heat flux reconstruction, with special focus on the computational demands of the algorithms. Two appropriate algorithms for heat flux reconstruction are presented and evaluated on calibration measurement. The estimated heat flux is later used in the skin thermal model which calculates the temperature profiles inside the skin. The process of skin burn evolution is represented as a first order chemical reaction at two points inside the skin profile. The degree of burn is determined using well established empirical rules. A special attention is again given to the issue of computational load of the solution resulting in an efficient algorithm for calculation of skin temperature profile. The effectiveness of the solution is demonstrated on experimental data and an example of experimental run is provided.

Keywords: Modeling, inverse heat conduction problem, Burn prediction, Parameter estimation, Mannequin test

Presenting Author's Biography

Matej Gašperin got his BSc degree from the Faculty of Electrical Engineering, University of Ljubljana in 2006. He is now a PhD student at Jožef Stefan International Postgraduate School and working at the Jožef Stefan Institute, Department of Systems and Control as a junior researcher. His current research areas are Simulation and modeling of thermal processes and environmental ergonomics.

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SIMULATION OF REAL TIME SYSTEMS BEHAVIOR CONSIDERING HUMAN-MACHINE INTERFACE

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Abstract

In this paper it is shown, as it is possible, and desirable, the use of a simulation technique in the development and analysis of industrial controllers, mainly to assure, to them, more robustness and less errors. In particular, the use of digital controllers has been proven that small errors in their design may lead to catastrophic failures. Simulation is used in the design process of dynamic systems. The results of simulation are employed for validating a model, and they are helpful for the improvement of the design of a system with respect to both, qualitative and quantitative properties. The paper concentrates on these aspects and applications of simulation, presents building modules blocks for modelling and simulation with respect to both, contents and methods, and discusses the requirements for simulation and validation. Modelling and simulation is almost necessarily based on modelling languages with precise semantics. In this paper the modelling was performed by using the object-oriented language Modelica and the library for hierarchical state machines StateGraph. The simulation used to evaluate the controller and plant behaviour has been developed and proposed in this paper. The present research proved to be successful using the Modelica programming Language to obtain plant models. Also it will be proved that is adequate the use of the Dymola software with the library for hierarchical state machines StateGraph for the analysis of industrial controllers.

Keywords: Real-time systems, Simulation, Systems models, Object-Oriented Language

Presenting Author's biography

Eurico Seabra. Is an assistant professor in the Department of Mechanical Engineering at the University of Minho in Portugal. His research and teaching interests include simulation modelling and analysis, data acquisition systems, industrial automation, mechanical design and biomechanics. In the year of 2005 he has obtained his Phd in Mechanical Engineering in the University of Minho (Portugal).

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HIERARCHICAL DIFF-EDF: AN AGENT BASED SCHEDULER FOR HETEROGENEOUS REAL-TIME PACKET NETWORKS

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Abstract

Packet networks are currently enabling the integration of heterogeneous traffic with a wide range of characteristics that extend from video traffic with stringent QoS requirements to best-effort traffic requiring no guarantees. QoS guarantees can be provided in packet networks by the use of proper packet scheduling algorithms. Similar to the trends of computer revolution, many scheduling algorithms have been proposed to meet this goal. The First-Come-First-Served (FCFS), which is mostly used in conventional networks, has been widely adopted for best-effort traffic. In addition, many scheduling algorithms have also been proposed to provide different schemes of QoS guarantees. Among which include the Earliest Deadline First (EDF) and the Differentiated-EDF (Diff-EDF). In this paper, we propose a new priority assignment scheduling algorithm, Hierarchical Diff-EDF, which can meet the real-time needs while continuing to provide best effort service over heterogeneous real-time network traffic. The Hierarchical Diff-EDF service meets the flow miss rate requirements through the combination of single step hierarchal scheduling for the different network flows (video, audio, and text), and the admission control mechanism that detects the overload conditions to modify packets' priorities. The implementation of this scheduler is based on the multi-agent simulation that takes the inspiration from object-oriented programming. The implementation itself is aimed to the construction of a set of elements which, when fully elaborated, define an agent system specification. When evaluating our proposed scheduler, it was extremely obvious that the Hierarchical Diff-EDF scheduler performs much better than both EDF and Diff-EDF schedulers.

Keywords: EDF, Hierarchical Scheduling, Real-Time Packet Networks, Multi-Agent.

Presenting Author's biography

Moutaz Saleh. received his bachelor degree in computer engineering from Yarmouk University, Jordan, in 2002, his master degree in distributed computing from University Putra Malaysia, Malaysia, in 2004, and now he is doing a PhD in computer science at University Kebangsaan Malaysia, Malaysia. Currently, he is a lecturer at the Department of Computer Science & Engineering in Qatar University. He worked before in Networking Department at the Ministry of Justice, Saudi Arabia. He also was the network engineer at UBM, Jordan. His research interests include real-time network scheduling, and multi agent systems.

REAL-TIME SIMULATION FOR DISTRIBUTED GENERATION IN POWER SYSTEM

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Abstract

Real-time simulation for power systems has been developed firstly on analogic platforms for testing actual equipments such as protection relays and power plant controllers. Since real-time simulator performances have followed the evolution in computing technology, it is now possible to have reliable and efficient solutions to achieve 'Hardware in the Loop' test benches. The purpose of this publication is to introduce the simulation setup based on a fully-digital real-time simulator. We present briefly in this paper different possible solutions in this specific field of application for real-time simulation. Initially, these simulators were developed for high or extra high voltage power systems. Nowadays testing small equipment dedicated to distribution network is a new challenge since the dynamic involved are much higher. First, we present an application of real-time simulation to the test of a small gas turbine connected to a distribution network. The application of real-time simulation is then widen to the control of distributed generators connected to a weak distribution network where real-time simulation is used to test advanced control strategies based of multiagent systems. The controllers for these distributed generators are located outside the real-time simulator. The interface with the simulator is based on IP network and complies with the new standard of communication in electrical substations.

Keywords: real-time simulation, electrical engineering, hardware-in-the-loop, agent-based systems

Presenting Author's biography

Philippe Venne received the M.Sc. degree from Rimouski University, Canada in 2006. He completed the program with a specialization in wind energy. He is enrolled as a Ph.D. student with the Institute of Energy Technology of the Aalborg University, Denmark. The title of his PhD project is "Agent-based distributed management infrastructure for high penetration of wind energy in a weak grid".

REAL-TIME PROCESS CONTROL WITH CONCURRENT JAVA

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Abstract

This paper presents examples from a student course on Bachelor level in real-time programming and dynamic process control. A main part of the course comprises a project with the goal of designing a control system for a dynamic process. The chosen process may be either a real physical system or a simulated model. Three examples of these projects with different applications of real-time control of dynamical systems are presented in the paper. The design and programming have been performed with the use of the Java Concurrency Model (JCM) and with the aid of the Real-Time Specification for Java (RTSJ). Dynamic process control in real-time is considered as a complicated field in engineering education, especially at the Bachelor level. This paper intends to show that with appropriate simulation tools and programming languages it is fully possible to achieve satisfactory results. The three examples presented here comprise the balancing of a flexible inverted pendulum by an autonomous vehicle, the direction control of a ship search light, and the control of a heave compensated winch over a distributed network. The projects have been chosen in cooperation with local industry partners and have been accomplished as student projects in groups of 2-3 students under surveillance of the teachers responsible for the real-time course. The course was originally taught using C/C++ and a real-time kernel, but has now been completed twice for about twenty students using the JCM. The experience is that in almost all cases the project groups succeed in building a complete control system.

Keywords: The Java Concurrency Model, embedded process control, distributed real-time simulation.

Presenting Author's biography

Webjørn Rekdalsbakken is MSc. in Physics from the Norwegian Institute of Technology. He has been head of the med. tech. dept. at a general hospital, and a senior engineer in process control at Hydro Aluminium. He has been Assistant Professor in computer science at Aalesund University College (AUC), and also rector at AUC. Now he is Assistant Professor/program leader of the Cybernetics program at AUC.
He has been doing research on nautical simulators and published papers on the dynamic control of motion platforms. He is a member of the Norwegian Automation Society.

CONTROL OF SCANNING PROBE MICROSCOPES USING QUARTZ TUNING FORKS

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Abstract

We present a simulated controller of a scanning probe microscope using tuning forks. In scanning probe microscopy, a new technology has been developed in the last years, exploiting a skew force which results from friction between the probe tip and the smooth surface of the sample. This force can be detected at a distance of several nm above the surface. It affects the parameters of oscillation of a vibrating optical fiber positioned above the surface with forcing frequency induced by quartz tuning forks. The distance from the surface sample can be determined by measuring the shift in resonance frequency and amplitude of the oscillation. This can therefore be used for precise positioning of the probe tip above the sample surface, and for reconstruction of the surface form. The simulation is based on an efficient and robust theoretically-based algorithm. The algorithm is devised to control the tip within a specified distance above the sample, at which a precise reconstruction of the form of the sample surface can be made. It was made for the purpose of developing a digital scanning probe controller which could substitute analogue controllers that are currently in use in scanning probe microscopy. This would enable improved precision, faster response and would reduce the cost of production of the controller.

Keywords: scanning probe microscopy, scanning probe control, resonance

Presenting Author's Biography

Neža Mramor Kosta is associate professor of mathematics at the Faculty of Computer and Information Science of the University of Ljubljana, and a researcher at the Institute of Mathematics, Physics and Mechanics in Ljubljana. Her research interests range from theoretical mathematics, in particular topology, to applications of mathematical methods in computer science.

SIMULATION-AIDED PROCESS COVERAGE FOR DELIVERY RELIABILITY UNDER SHORT DELIVERY SCHEDULES USING REAL-TIME EVENT BASED FEEDBACK LOOPS

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Abstract

This paper describes an approach for collaborative, automated process coverage for event handling in supply networks, based on the integration of an artificial intelligence method, simulation techniques and change planning strategies within an integrated force-feedback loop. The artificial learning system, based on Q-Learning and state abstraction, is introduced, learning state based rule sets for controlling application of change planning algorithm in an event situation. The state abstraction is using k-means clustering evaluating the discrete production plans using a combined weighted quantitative and structural distance function. Using the rule set the relevant scenarios, gained from possible alternative change planning strategies, can be selected automatically for simulation based process coverage. These scenarios will be analyzed through a material flow simulation. According to the specific requirements of real-time reaction to events, it will be discussed whether a dynamic simulation model, scaling based on the selected scenarios, could be used to optimize simulation time to speed or result reliability. Therefore actual research activities will be discussed. A Production Control Center architecture is introduced to integrate all components into a vision of a future control system. To position this paper and future work on one basis, the upcoming and here partly stressed problems of foresight and real-time event handling, implemented by a combined simulation-learning-optimization system, will be classified and structured into a system matrix.

Keywords: Supply chain management, Process coverage, Event handling, Simulation

Presenting Author's biography

Dipl.-Inform. Andre Döring studied informatics with special focus on automatic language processing, machine learning and risk assessment at the University of Bielefeld. Since 2004 he is research assistant at the University of Paderborn, business computing esp. CIM.

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MODELING AND SIMULATION OF A COPPER ELECTROLYSIS CELL GROUP

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Abstract

Increasing demands for energy efficiency and high quality of products advice to use computer aided modeling, simulation and optimization in product development. In this paper the modeling of the copper electrolysis is in the focus. The energy consumption of the copper electrolysis is high. Electrical disturbances – like contact failures and short circuits – even increase the energy consumption and also decrease the quality of produced copper. To gain better understanding and to be able to improve the process a computationally feasible and reliable model of copper electrolysis cell group is of great importance. In this paper a multiphysical FEM model of copper electrolysis cell group is presented. Due to the high complexity of the cell group geometry and physical phenomena, several simplifications and approximations are necessary in order to make the model computationally feasible. A number of simplifications are proposed. Simulation results depend substantially on disturbance location in the cell group. A statistical approach is proposed such that different cell group designs could be compared regardless the disturbance location.

Keywords: FEM, modeling, simulation, copper electrolysis.

Presenting Author's Biography

Juha T. Tanttu was born in Tampere, Finland, on November 25, 1957. He obtained his M.Sc. and Doctor of Technology (Ph.D.) degrees in Electrical Engineering from Tampere University of Technology in 1980 and 1987, respectively. From 1984 to 1992 he held various teaching and research positions at the Control Engineering Laboratory of Tampere University of Technology. He currently holds professorship of Information Technology at Tampere University of Technology, Pori. His research interests are mathematical modeling of dynamic systems and applications of signal processing in bioacoustics.

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IMPROVING THE USAGE OF PROCESS DATA COLLECTED IN PROCESS INDUSTRY AND POWER PLANTS

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Abstract

Five years after the introduction of two classes of advanced control systems for continuous pulp digesters, only one of the classes is still in use after 5 years of operation. The five systems in current use are simple Excel sheets which the operators report are very satisfactory. The use of the six model-based systems has been discontinued even though they had the potential to increase the production by 2% compared to 0.5% for the Excel sheet based system. The current challenge is to develop a system that combines the benefits of the model-based system with the robustness of the Excel sheet based system. It is vital for the system to be robust in the sense that it is transparent and easy for the operator to maintain. Robustness is essential in many parts of the system, including measurement, process model validation, the ability of the model to adapt to changes in the process, optimisation algorithms, and of course the model itself. The optimisation algorithm here is a model predictive control algorithm that returns set-points for the PI controllers. The challenges when constructing such a system are in instilling operator confidence, filtering of misleading measured data, adaptation of process parameters when the process parameters change, and combined validation of measurements and process models. These challenges are met by using a combination of physical and statistical models and methods based on them such as model predictive control (MPC) and parameter estimation. The model should be maintained by a qualified engineer who should be able to explain the system to the operator so that it is understood and confidence is maintained in the system.

Keywords: statistical models, physical models, robustness, adaptation, process industry

Presenting Author's biography

Christer Karlsson (PhD Student and Licentiate Engineer, Master of Science in Energy Engineering) focuses on handling degeneration in first principle process models and on-line sensor measurements. Has developed applications for diagnostics on steam turbines, gas turbines, heat and power boilers using first principle models, artificial neural networks, and Bayesian networks in combination with optimization algorithms.

DYNAMIC OPTIMIZATION OF ACETYLENE HYDROGENATION UNIT USING A HYBRID GA-SQP ALGORITHM

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Abstract

Dynamic simulation and dynamic optimization of an industrial hydrogenation reactor system were developed and investigated in the present work. The process consists mainly of three adiabatic fixed bed hydrogenation reactors in series in addition to one heater before the first reactor and three coolers after each reactor for interstage cooling. The feed flow rate to the unit, the feed temperature or the carbon monoxide content of the feed may change and causes variations of the outlet temperature of reactors. Therefore, it is essential to control the inlet temperature of each reactor. There is a temperature controller before each reactor and also one after the third reactor. The tuning parameters of the controllers were optimized dynamically in three different cases, taking into account the process constraints and catalyst deactivation. In each case, a special disturbance is forced to the process. Optimization of the process was done by the use of a hybrid GA-SQP method. The new hybrid method was developed to overcome the difficulties of both methods. The genetic algorithm (GA) which is a stochastic method, is relatively slow, but is not sensitive to the initial point. In contrast, sequential quadratic programming (SQP) method is a deterministic method which is fast, but very sensitive to the starting point and gets trapped in local optima. In the newly developed hybrid method, the SQP method speeds the solving procedure, while the GA enables the algorithm to escape from local optima. An industrial acetylene hydrogenation system is used to provide the necessary data to adjust kinetics and to validate the approach.

Keywords: Hydrogenation, Dynamic optimization, Process control

Presenting Author's biography

Navid Mostoufi is an Associate Professor of Chemical Engineering at the University of Tehran. His research interests are in the fields of multiphase reactors, process modeling and optimization and numerical methods. He holds a B.Eng. and M.S. degrees in Chemical Engineering from the University of Tehran, Iran, plus a Ph.D. in Fluidization from Ecole Polytechnique de Montreal, Canada. He is the co-author of the textbook Numerical Methods for Chemical Engineers with MATLAB Application, published by Prentice Hall PTR in 1999. He is also editor of the journal of Chemical Product and Process Modeling, published by Berkeley Electronic Press (www.bepress.com/cppm).

INDUSTRIAL APPLICATION OF REAL-TIME SIMULATON MODEL OF WALKING-BEAM REHEATING FURNACE

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Abstract

This paper presents industrial application of real-time simulation model for determination of temperature fields of steel billets in continuous reheating furnace, which was recently implemented in production process in steel industry. Simulation model is capable of simultaneous real-time calculation of temperature fields of all products charged in the furnace. Basic concepts of modeling heat exchange in gas-fired continuous furnaces are presented. The thermal radiation heat transfer in models is considered using the exact geometry of the furnace enclosure, including the geometry of billets inside the furnace. The heat conduction in the stock is calculated in three-dimensions by using finite-difference method. The algorithms of simulation model are optimized in terms of speed in order to achieve real-time operation. Validation procedure on the base of measurements on furnace during the normal production process is described. For real-time operation in the production process the simulation model needs additional modules which are used for its integration into information system of the plant. The organization of database system for storing the database results is presented. The graphical user interface was developed for simulation model in order to achieve user-friendly presentation of simulation model results.

Keywords: Real-time simulation, Continuous reheating furnace, Radiative heat transfer, Monte Carlo, View-factor.

Presenting Author's biography

Anton Jaklič is a researcher at the Institute of Metals and Technology (IMT) in Ljubljana Slovenia. He graduated in electrical engineering at the University of Ljubljana in 1994, he received M.Sc. in 1998 and PhD. in 2002. He has worked at IMT since 1994. He has been a Head of Heat engineering laboratory at IMT since 2005. His main research interests are simulations and data mining in steel industry.

ESTIMATION OF THE EDGER'S INFLUENCE ON THE STRIP-WIDTH WITH THE DEFORMATION ENERGY AND THE IMPLEMENTATION IN THE ACRONI STEELWORKS

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Abstract

The production of hot-rolling strips of prescribed dimensions requires planning and tracking of the steel's dimensions along the production line. This paper is focused on a determination of the edger's influence on the final strip width on the basis of existing measurements on the edger. Steel slabs are rolled (top and bottom) several times on reversing rougher mill (RM) to prestrips, while edger synchronously with RM rolls slab widths (left and right). Beside initial slab width, edger provides additional influence on final strip width. Edger's influence on final strip-width is estimated by combination of energy consumed for slab-width rolling (the deformation energy) and edger's roll gap, observed through all the passes through RM and edger.

In order to calculate the deformational energy for the slab-width rolling a mathematical model of an unloaded edger was built, which uses velocity as an input. Model of unloaded edger provides estimation of power needed for accelerations of edger's rolls and other rotating parts. The edger total power is measured by current and voltage on the driving motor. Subtraction of unloaded edger power, obtained by simulation of mathematical model, from measured total power, yields power used for rolling (deformation) of slab width. Integration of this power yields deformation energy. Deformation energy is determined for every pass through the RM and edger. The acquired information is instantly written in a database and, at the same time, is used in a charge-width report. The generated charge-width reports are stored in pdf file format, and are then distributed to the end-users using a web server.

Keywords: edger model, strip width, deformation energy, rolling, report

Presenting Author's biography

Franci Vode. He is a Ph.D candidate in the Faculty of Electrical Engineering, University of Ljubljana, Slovenia. He received his B.Sc degree from the Faculty of Electrical Engineering in the Process Control Department in 2002. His main research interest is control and optimization of complex multivariable processes. Currently he is working on continuous reheating furnace control systems and optimizations as a young researcher at the Institute of Metals and Technology, Ljubljana, Slovenia. He is a member of the SLOSIM society.

SIMULATION MODEL OF THE THERMODYNAMIC CYCLE OF A THREE-CYLINDER DOUBLE-ACTING STEAM ENGINE

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Abstract

Today, steam engines are used for special purposes only, for example to reduce steam pressure in pressure reduction stations, where they replace the traditional and inefficient throttling process. Throttling is the most used way to control the pressure in steam reduction stations. This way is unsatisfactory from the economical point of view, because the exergy is lost uselessly. It is a part of heat energy that can perform a work. The better way of the pressure reduction is an expansion in a backpressure turbine or in a steam engine by simultaneous transformation of the heat energy into electricity (cogeneration). This article describes the design and implementation of the mathematical model of the thermodynamic cycle in a steam engine used as pressure regulator in a pressure reduction station. The present model is a part of a comprehensive mathematical model of a cogeneration unit and also a part of the author's doctoral thesis. The model assumes detailed mathematical description of physical processes in a steam engine and implementation in an MATLAB-SIMULINK software environment. Follow-up mathematical models (electrical generator, mechanical model) were presented in other articles that are listed in references.

Keywords: Steam engine, Modeling, Simulation, Cogeneration

Presenting Author's Biography

Evžen Thöndel is a PhD student at the Department of Mechanics and Materials Science, Faculty of Electrical Engineering, Czech Technical University in Prague. He deals with the problematic of modeling and optimization of cogeneration units. The main goal of his work is a mathematical model implementation of cogeneration unit driven by a steam engine and design of optimization methods. Presenting article covers a part of his dissertation thesis. Author cooperates with the Technical University in Munich, where he researched one year into cogeneration technology. Author is supported by a German foundation (Deutsche Bundesstiftung Umwelt).

RANKED MODELING ON TIME-DATA WITH INEXACT TIMING[1]

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Abstract

Ranked linear models can be designed on the basis of time-dependent data with inexact timing. Such data has the form of a sequence of multivariate feature vectors representing subsequent states of dynamical objects or development of events in time. The ordering relation between selected pairs of feature vectors (e.g. "a given feature vector appeared later than another one") is defined on the basis of an observed sequence. The same relation can be designated for a variety of observed sequences, even when the moment of appearance of a given vector is not defined precisely. A set of ordering relations between selected feature vectors allows for designing a ranked linear model. The ranked model has the form of linear transformation of multidimensional feature vectors into points on a line which preserves a set of ordering relations in the best possible manner. The ranked regression models can be designed by means of minimization of the convex and piecewise linear (*CPL*) criterion functions defined on differences of such feature vectors that are related by an ordering relation. The linear ranked model reflects all ranking relations between feature vectors if and only if two sets of the positive and negative differences between these vectors are linearly separable. This way the problem of ranked modeling can be transferred into the problem of linear separability of two sets of feature vectors. Ranked regression models can have many applications. Among others, the problem of different dynamical systems comparison can be addressed in this way.

Keywords: temporal data, inexact timing, ranked relations, convex and piecewise linear (CPL) criterion functions, linear separability.

Leon Bobrowski: Research interests include data mining, pattern recognition, neural networks, and medical diagnosis support. The main results concern basis exchange algorithms, designing of hierarchical neural networks, multivariate decision trees and visualizing transformations based on convex and piecewise linear functions.
Prof. Bobrowski is currently the Dean of the Faculty of Computer Science, Bialystok University of Technology and, additionally, works in the Laboratory of Biomedical Data Analysis at the Institute of Biocybernetics and Biomedical Engineering PAS in Warsaw.

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SIMULATION ENVIRONMENT FOR MANUFACTURING CELL TO SUPPORT FULL PRODUCTION PERFORMANCE AT PRODUCT LAUNCH

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Abstract

It is now important to reduce lead-time from the manufacturing system design stage to the manufacturing system implementation stage and support full production performance at the product launch, because manufacturing industries face various problems such as shorter product life cycle. Before a manufacturing system is implemented, it is difficult to complete all the facility control programs for several pieces of equipment used in the manufacturing system currently. Before the real manufacturing system runs, methods to confirm implementation of production management applications, which need to evaluate and improve manufacturing systems at the product launch such as a facility behaviours record application, have not been developed. These difficulties stopped precise and rapid support of a manufacturing engineering process.
In order to solve these difficulties, it is necessary to develop a method to mix and synchronize real equipment, virtual factory models on the computers, and production management applications.
In our research, in order to reduce the lead-time from the design stage to the implementation stage, a manufacturing engineering environment (MEE) is proposed. MEE consists of a manufacturing cell simulation environment (MCSE) and a distributed simulation environment (DSE). MCSE, which is used to create and evaluate facility control programs while mixing and synchronizing real equipment, virtual factory models, and production management applications before manufacturing systems are implemented, is emphatically proposed in detail. MCSE consists of a manufacturing cell simulator, a soft-wiring system, and ORiN. The manufacturing cell simulator simulates facility behaviours by using data from the soft-wiring system. The soft-wiring system connects real world data, simulation world data on the manufacturing cell simulator, and data on manufacturing management applications without hard-wiring. The soft-wiring system also connects manufacturing cell and production management applications. ORiN is a standard distributed network system for manufacturing systems. Finally the case was carried out to evaluate MCSE.

Keywords: Manufacturing cell, simulation, PLC, robot, production launch.

Author's biography

Dr. Eng. HIRONORI HIBINO is a Senior Researcher of the Technical Research Institute of Japan Society for the Promotion of Machine Industry (JSPMI), which is an affiliate of the Ministry of Economy, Trade and Industry in Japan. He is a guest professor at the Tokyo University of Agriculture and Technology concurrently. His research fields are distributed simulation, manufacturing system design using simulation, manufacturing cell simulation for combinations of real world and simulation world. He is an academic member of JSME, JIMA, and JSPE. He is also a director of the Scheduling Society of Japan.

MULTILEVEL PROCESS DIMENSIONING REGARDING CONTRARY TARGET VALUES

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Abstract

The result of a machining process is determined by input, process and output parameters. The adjustment and optimisation of these parameters regarding technological, economic and ecological criteria is defined as process dimensioning. Local process optimisation can be considered as state-of-the-art in dimensioning manufacturing processes. Technological interfaces as well as multi-criteria characteristic of decisions in manufacturing are often not considered. However, this type of configuration is not sufficient to optimise the entire manufacturing process which consists of sequential manufacturing steps. Instead, new comprehensive approaches towards dimensioning multi-level processes under consideration of technological interfaces and taking multiple criteria into account are required to achieve global optima. In this paper, a methodology for dimensioning multi-level processes is introduced. One of the main benefits of the proposed approach is that the contrary manufacturing targets which generally are classified according to quality, economy and ecology, are considered. The resulting overall target function consists of preference multipliers and standardised sub-criteria functions. High values of the target function point out combinations of process parameters that yield to multi-criteria optimised processes. Multilevel processes are depicted in parallel target trees which are combined in one assessment value. This approach was implemented in manageable software. The software, programmed in JAVA, HTML and SQL, contains the implementation of the algorithm. The user is able to implement individual processes, targets and criteria. This allows a software-based, holistic dimensioning of manufacturing processes regarding individual preferences.

Keywords: Multilevel Processes, Process Dimensioning, Multi-criteria Optimisation.

Presenting Author's biography

Aleksander Rabinovitch. After studying industrial engineering and management with focus on production engineering and controlling, Aleksander Rabinovitch works as scientific assistant at Leibniz Universität Hannover at the Institute of Production Engineering and Machine Tools. His research within the German Collaborative Research Centre 489 (SFB489), „Process chain for the production of high performance components based on precision forging technology“, is focused on the development of new methods for holistic optimisation and dimensioning of processes as well as entire manufacturing process chains.

DEVELOPMENT AND APPLICATION OF HUMAN RESOURCES TRANSITION SIMULATION MODEL IN SLOVENIAN ARMED FORCES

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Abstract

Present paper describes development of continuous and discrete simulation models of human resources transitions in Slovenian Armed Forces. The model is developed in order to: a) Forecast the future manpower requirements, b) Perform the analysis of the impact of proposed changes in policy, c) Test different historical policies, d) Perform the feasibility analysis, e) Understand the structure and the dynamics of the system, f) Optimize the system performance. In the development phase, the comparison of both models was performed with the purpose of structural and quantitative validity. Both models were developed in MATLAB/Simulink/SimEvents and included eight different ranks providing important information about structural dynamics. The calibration of the model was performed where the historical data was used to determine time constants of transitions and fluctuations. Simulation runs were performed in order to complete predictive validation of the model. Target response of the system was determined for five ranks. Optimization according to the stated criteria functions by the application of pattern search algorithm was performed. Here the key parameters of transitions and fluctuations with boundaries were considered. By this means the target strategy of the system could be determined. The models enable the user to identify potential manpower shortfall and determine the impact of a chosen policy and examine possible corrective policies or rationalizations by simulating the operations in a real-world system. System dynamics methodology proved to be appropriate tool for initial development of the model and structural validation reference. Hybrid approach to the problem provided higher level of confidence.

Keywords: system dynamics, manpower, optimization, strategy, HRM

Presenting Author's Biography

Andrej Škraba obtained his Ph.D. in the field of Organizational Sciences from the University of Maribor. He works as a researcher at the Faculty of Organizational Sciences in Cybernetics and Decision Support Systems Laboratory. His research interest covers modelling and simulation, decision processes and system theory. His work is focused on experiments with decision groups applying system dynamics simulators in experimental and real environments. As a coauthor he has published papers in the following journals: Simulation, System Dynamics Review and Group Decision and Negotiation.

DYNAMIC VALIDATION OF MODELS: A CASE STUDY ON PLUG-FLOW REACTOR

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Abstract

Simulators are important components of operational decision support systems (ODSS). By running a simulator in parallel with the real process more accurate information of the process state can be achieved for the ODSS. However, in continuous use the properties of the system may change which may cause parameters to drift and thus cause inaccuracy to the simulator estimates and forecasts. In this paper we introduce a systematical method to update model parameters through reference measurements, such as laboratory analyses, of the output state. Updating is based on Bayesian estimation of parameters. Information about parameters is described as probability densities and thus takes into account also the uncertainty of the information. For linear models parameter updating is a well-known and rather simple operation because all the relevant probability densities are Gaussian and updating is Bayesian tracking of their means and covariance matrices. For nonlinear models the distributions are non-Gaussian which makes the task more complex. In this work we have approximated nonlinear distributions with Gaussian mixture models (GMM). GMM is a linear combination of several Gaussians and enables to describe more complex distributions keeping still the calculations manageable. We demonstrate the method in this paper with a plug-flow reactor which is an example of a dynamic and nonlinear process. We have simulated a bleaching tower process in papermaking as an example of the plug-flow reactor.

Keywords: Uncertainty, Decision support, Bayesian methods, Gaussian mixture model.

Presenting Author's biography

Aino Ropponen. Research scientist and PhD student at Tampere University of Technology, Finland. Master of Science in Technology, graduated in January 2007.

A DECISION SUPPORT SYSTEM FOR FORENSIC ENTOMOLOGY

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Abstract

This paper presents a multiagent-based model of insect development on a dead body and a three layers Decision Support System architecture able to perform retrodictive (abductive) reasoning from multiagent-based models or more generally, complex systems models. This architecture is used in order to compute post-mortem intervals from entomological data sampled on cadavers. Knowing the exact time of a death is fundamental in criminal investigations. Thus, it is necessary for experts to guarantee the reliability of their results. We show that post-mortem interval estimated with traditional entomological methods can lead to important overestimations. Indeed, these methods do not take into account all the interdependent processes involved in the development of insects such as fly population dynamics in the ecosystem or the gregarious behavior of insect larvae that can lead to local temperature increases on the body. Forensic Entomology is widely used in several countries; it is then important to develop new methodologies and tools to improve the efficiency and reliability of entomological expertises. ForenSeek – the implementation of the model and Decision Support System architecture – aims to be a software program that can be used as a post-mortem interval estimation tool and as a virtual laboratory, to simulate colonization and development cases.

Keywords: forensic entomology, multiagent-based simulations, decision support systems, retrodictive reasonning.

Presenting Author's biography

Gildas Morvan. Ph.D. Student at LGI2A, Faculté des Sciences Appliquées, Université d'Artois. Graduate of IG2I, department of Ecole Centrale de Lille.

DYNAMIS-P - DEVELOPMENT OF NEW METHOD FOR DYNAMIC DIMENSIONING

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Abstract

This lecture refers to the contents of the research project "Development of a method for dynamic dimensioning of flexible production systems". The project is funded by the DFG, German Research Foundation and processed by the Institute of Science of Management and Plant Systems at the Technical University Chemnitz.

The basic conditions of plant design have changed radically in the last years. The installation of a high flexibility in static structures is normally not to be realized from the financial point of view. Arranging a capacity according to the requirement is one possibility of manufacturers both to respond immediately to fast movements in the product range and to deal with the increasing cost pressure. Thus flexible planning procedures and planning methods are equally needed whereon the research project approaches. The overall objective of the research project is to develop a method for the dynamism of the structure of production systems and is based on the "DynamisP" method by Ms Prof. Kobylka. Dynamism of the structure of production systems means that depending on the capacity requirement of a production system its structure is time-variant. This method is the only existing approach that applies dimensional and structural changes of the production system as significant control unit for an optimal workflow. Therefore the demand of increasing production flexibility is met without a cost explosion.

Within the research project new procedures are developed for simulation based dynamic dimensioning which are integrated in the overall methodology and tested referring their effectiveness.

Keywords: dynamic dimensioning, Digital Factory; production planning, planning method, simulation.

Presenting Author's biography

Andreas Krauss studied industrial engineering at the Chemnitz University of Technology. Since 2005 he is working in the Department of Factory Planning and factory Management at Chemnitz University of Technology. Andreas Krauss is specialized in production planning, simulation und virtual reality.

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SIMULATION AND PRODUCTION PLANNING, A SPECIAL CASE IN SHORT SERIES PRODUCTION

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Abstract

The idea of digital factory was created by automotive industry with the aim to be able for simulation, process analysis and cost reduction. The simulation must begin with model building, the processes of a production chain or a cell could be very complicated. Therefore while we make a model of an analysed system, we have to follow the rules of simulation and model building. In this paper are the steps of a research process on a short series press line highlighted. The difficulties of system modelling and differential case handling are detailed. This work introduces first the used modelling program, and the main points of simulation rules. Then we are going to learn more about the modelled physical system, how it works, which processes are used while production, which cases of runs has to be taken into account. After the structure of the machines is detailed, we will see how this functions could be modelled, which programming steps were needed. In the last part the difficulties of programming and methodology are described. The system works with set-up times, failures and parallel control, while object oriented programming and modelling was used. The paper shows an example for practical application in the field of digital factory - process simulation.

Keywords: digital factory, simulation, industrial production, automotive industry

Presenting Author's biography

Jósvai János, graduated in 2004 from Budapest University of Technology and Economics, specialisation for Industrial and Transport Logistics. Working at the Széchenyi István University since 2005, as phd student. Member of the University-based Regional Knowledge Centre for Vehicle Industry with simulation oriented research field.

FULLY EMBEDDED SIMULATION MODELS IN MANUFACTURING PROCESSES

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Abstract

This paper presents the concept of using simulation as a fully embedded tool.

Simulation is an often used tool for planning and optimizing. The possibility to pursue different scenarios without actually risking a lot of money and time is one of the biggest advantages of modeling and simulation. But simulation still holds the impression of being usable to only those people that possess a vast knowledge of its basics and dynamics. The results given by a simulation can be easily presented in a way that everyone familiar with the topic can interpret them. But to create a new simulation model even using a specialized simulator usually holds no appeal for those who are manly interested in the results. One step towards enhancing user friendliness was developing database driven models that are automatically created according to the information stored in the external database.

But still it is time consuming to prepare this data; Simulation as a fully embedded tool is designed to do all this automatically, using the fact that the data needed for a simulation run could often be provided by other software tools that are already in use in most companies: An Enterprise Resource Planning System (ERP) contains a huge amount of information already structured and always up to date. An interface with such a software tool can provide the information needed to create a model of the system, thus reducing the complexity to a one time expense to develop the interface between such a system and the model database. Of course one must not underestimate the complexity creating such an interface but the result is a simulation tool that can be used at any time to analyze the current situation; the potential of benefits that can be achieved here easily outbalances the effort.

Keywords: Enterprise Dynamics, Interactive, Embedded Simulation.

Presenting Author's biography

Shabnam Michèle Tauböck works for Profactor Research and Solutions since March 2007. From Dezember 1999 until March 2007 she worked for the business area Process Optimization, Division Environment and Life Science at ARC Seibersdorf research. From June 1998 until April 2000 she worked for PSE SIEMENS in Vienna.

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A MODELING AND OPTIMIZATION TOOL FOR THE EXPANDABLE POLYSTYRENE BATCH PROCESS

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Abstract

The Expandable Polystyrene (EPS), material of the insulation productions and packages, is commonly produced in a batch process. The control of the batch process is based on predefined process recipes and the process parameters such as mixing properties. The EPS production has to be able to satisfy the aims and quality requirements of the markets, which causes additional demands on process control. In this paper we demonstrate the optimization and modeling application for the EPS-batch process. The application consists of a production optimization tool and a simulation tool for the process parameters based on the Multi-Layer Perceptron network (MLP) with retrain properties. The software can be used at the operational level as well as at the process management level. The features are programmed into standalone software built up in the Matlab environment and it is tailored for the needs of the EPS production company StyroChem Ltd. The results show that the application can offer an efficient tool to economize production and storage costs.

Keywords: batch process, modeling, simulation, process optimization, Multi-Layer Perceptron (MLP).

Presenting Author's biography

Mikko Heikkinen, born in Sotkamo, Finland, November 24, 1975, graduated from the University of Oulu, Finland, as M.S. (eng.) in 2003. His main research interest includes process engineering, process modeling, industrial data processing, and data mining. He is currently preparing the Ph. D. degree in process informatics.

DEADLOCK DETECTION IN HIGH LEVEL ARCHITECTURE FEDERATIONS USING AXIOMATIC DESIGN THEORY

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Abstract

In this study, we propose a method to translate the design matrices to Communicating Sequential Processes (CSP) codes in order to detect deadlocks in federations. Deadlock is an important problem to consider during the integration of systems. Both simulation and Component Oriented Software Engineering communities are considering the easier development of complex systems by integrating existing federates (components). Interfaces are the most important part of federate searching and standard interfaces do not include sufficient information about the internal behaviors of federates. Since interfaces should consist of design concepts, they should be created during design of federates. Axiomatic Design Theory (ADT) is a general design methodology that guides developers to decompose systems utilizing independence and information axioms. The Design matrix, which is a tool of axiomatic design, includes functional requirements, solutions, and dependencies among them. Since design matrices includes the internal behaviors of federates and it is a product of design, we applied the ADT to design Component Oriented Simulation systems. In our previous study, we proposed a method to find deadlocks using the design matrix. However, detection was left to the developer utilizing design matrices and it is very difficult to detect such deadlocks in complex systems. Deadlocks in federations can be figured out by utilizing Communicating Sequential Processes (CSP) formalism. We have used a CSP tool namely Failures-Divergence-Refinement (FDR2).

Keywords: Component Oriented, HLA, Deadlock Detection, and Communication Sequence Processes.

Presenting Author's biography

Cengiz Togay. He is doctoral candidate in the Middle East Technical University's Computer Engineering Department. He has worked on component-oriented simulations techniques, software engineering, Web Services, Semantic Web issues, and distributed systems. He obtained his MS in computer engineering from the Canakkale Onsekiz Mart University.

REQUIREMENTS ANALYSIS FOR MODEL-BASED SIMULATION PROCESSES

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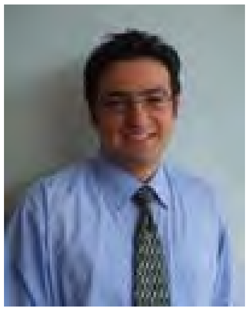
Abstract

The focus of the current lifecycle research is set on system effects across the full product realization. With the increasing complexity of engineering applications, they have developed into the focus of lifecycle research. Computer-based modeling and simulation have been established as a powerful alternative to the theoretical and experimental methods of engineering. The growing complexity and diffusion of computer aided engineering (CAE) processes motivate to optimize CAE workflows from a holistic point of view.
This contribution is based on the results of a survey, which has been conducted by the Department of Computer Integrated Design of TU-Darmstadt. The survey aimed at investigating the requirements for an integration of high performance computing (HPC) processes into the PLM-environment. HPC processes are intrinsically placed within the overall CAE. Hence, a major result of the survey pointed out the missing process management within the CAE workflows. Furthermore patterns of architectures have been observed despite of the diverging product and company types.
These two results gave clues about a unified approach following the contemporary lifecycle strategies. Based on these result, this contribution is considered with a requirement analysis of CAE processes and architectures. CAE processes show a multi-X characteristic regarding applied domains, methods, physics and scales. Requirements for a CAE reference architecture and CAE process model are investigated. Finally a proposal is made towards a unified concept, which regards the multi-X characteristics of the contemporary CAE research.

Keywords: PLM, Simulation Integration, Process/Data Integration, Process Model, Reference Architecture

Presenting Author's biography



Orkun Yaman. Graduated from the Middle East Technical University (METU) in Ankara with a degree of "Bachelor of Science in Mechanical Engineering", Orkun Yaman obtained his Masters Degree in Mechanical and Process Engineering from the Technische Universität Darmstadt in the field of Numerical Methods in Mechanical Engineering. He has been working since 2004 at the Department of Computer Integrated Design as a research assistant and doctoral student. He is responsible for the CAD/CAE education. His research activities involve data and process integration of computational methods and tools into the product creation process.

BIFURCATIONS AND CHAOS IN AUTOMATIC CONTROL SYSTEMS

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Abstract

The dynamics of power electronic system with pulse width modulation (PWM) control is studied in this paper. Behaviour characteristic for a nonlinear dynamical system is observed and theoretically explained. The set of system parameters influenced on periodic and chaotic oscillations existence are established and presented. For periodic motions, the regularities of their origin are studied and their possible bifurcations are established. A DC-DC buck converter controlled by a voltage feedback is taken as a representative system. The studied system is described by a system of piecewise-smooth nonautonomous differential equations. The research are focused on chaotic oscillations analysis and analytical search for bifurcations dependent on parameter. The most frequent route to chaos by the period doubling is observed in the second order DC-DC buck converter. Other bifurcations as a complex behaviour in power electronic system evidence are also described. The system sensitive dependence to initial conditions variation is studied and a positive largest Lyapunov exponent as a chaos indicator calculated. Appropriate methods of analysis are applied and used to observe chaotic phenomena. In order to verify theoretical investigation the experimental DC-DC buck converter was build. The results were obtained from three sources: mathematical model numerical calculation, electrical circuit computer simulation and experimental verification from the practical buck converter circuit. A very good agreement between theory and experiment was reached.

Keywords: Bifurcations, Chaos, Buck, Converter.

Presenting Author's Biography

Łukasz Kocewiak was born in Grójec, Poland, in 1983. He studies Electrical Engineering at Warsaw University of Technology. Within the confines of Socrates-Erasmus Programme he is a student of Department of Energy Technology at Aalborg University.
The main direction of his research is related with nonlinear dynamics in power electronics. Issues from scope of measurement and identification of power quality, identification and system parameter estimation, power electronics and drive and digital signal processing are also connected with his specialisation.

CONFIGURATION OF UAV AUTOPILOTS' DYNAMICS USING A 3 DOF AIRCRAFT MOTION SIMULATOR

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Abstract

The paper presents the role of Autopilots in Unmanned Aerial Vehicles (UAVs) and the process of their configuration before flying can occur. The common autopilot architecture, emphasising the control module, is given shortly and the functionality of the commercially available UAV autopilot "Micropilot MP2028", used for initial flights of the first Slovenian UAV "Karantanija", is summarised in a table. Furthermore, the development of the 3 degrees-of-freedom aircraft motion simulator is presented.. The motion simulator was developed and used as a test bench in attempt to tailor autopilot's flight dynamics to "Karantanija" UAV even before the actual first unmanned flight. The author presents the evolution of the motion simulator which was first used in open-loop configuration and later adapted for Hardware-in-the-Loop simulations using actual autopilot hardware. Once completed, the equipment was used to evaluate UAV's (autopilots) capability to carry-out the required mission in case of various sensor failures in different stages of flight. The paper also presents the anticipated behaviour of the aircraft following an engine failure in two different autopilot altitude handling modes, based on the experiment with the 3 degrees-of-freedom motion platform. Benefits, future possibilities of use and further development of the aircraft motion simulator are discussed in the conclusion.

Keywords: UAV, Autopilot configuration, Aircraft Motion Simulator

Presenting Author's biography

Tine Tomažič graduated from grammar school “Veno Pilon” in Ajdovščina in 2002 with highest honors. He is presently a 5th year student in pursue of degree in Automation at University of Ljubljana’s Faculty of Electrical Engineering. He published several conference papers and received a student competition award at AIG'07 conference in Maribor, Slovenia. Besides college engagements, Tine is a qualified flight instructor and test pilot for Slovenia’s largest light aircraft producer.

MODELLING AND SIMULATION OF SUPPRESSION VIBRATION MECHANICAL SYSTEMS

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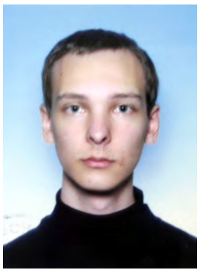
Abstract

By attaching the absorber to the mechanical system, which is modelled as a one degree of freedom system, the new system becomes a two degree of freedom system. Depending on the driving frequency of the original system, the absorber needs to be carefully tuned, that is, to choose adequate values of the absorber mass and stiffness, so that the motion of the original mass is a minimum. The tenable vibration absorber is advantageous primarily in that it reduces the amplitude of vibrations in the mechanical system. The control vibration absorber is advantageous primarily in that it reduces the amplitude of the vibrations in the system by an oscillating force $F_{(t)}$. A vibration absorber is basically a spring-mass-damper system that is added to any vibrating system with the aim of reducing the amplitude of vibrations. The present article will discuss the method of online suppression of the vibration control LQR (Linear Quadratic Control) for a mechanical system by using a vibrating tuneable absorber. Several analyses and Matlab m-file for the auto-tuning control have been used. The aim of the paper is to acquaint the reader with the design of the incorporated absorber into the vibration system, which makes the suppression of the vibration of the mechanical system to a minimum possible.

Keywords: Absorber, Vibration, Modelling, Simulation, Matlab, Simulink

Presenting Author's biographies



Jakub Hruška is a Bachelor student in the Department of Computer Science and Engineering and interested in computational modelling with Matlab. Jiří Vondřich is an Assistant Professor in the Department of Mechanics and Materials Sciences and interested in modelling, simulation and numerical solution mechanical systems. Evžen Thőndel is a PhD student on the Department of Mechanics and Materials Sciences and interested in computational modelling and control of the dynamic systems with Matlab and Simulink.

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MODELING FREEWAY TRAFFIC FLOW: AN LPV APPROACH

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Abstract

The problem of modeling the complex behavior of freeway flow leads to a nonlinear macroscopic model. Since this high dimensional non-linear characteristic the control and estimation problems could not be performed easily. From this purpose the paper introduces a new, general modeling formalism for freeway traffic flow. It is well-known form the theory of Linear Parameter Varying (LPV) systems that such models represent a numerically tractable class of complex nonlinear systems. The main idea is to derive some arbitrary time dependent parameters by capturing the nonlinearities in the system. Transformation of the full nonlinear model to affine and quasi Linear Parameter Varying (LPV) system is presented. The paper investigates the problem of selecting the adequate scheduling variables, endogenous parameters and some linear approximations giving a novel way to describe freeway traffic systems. An important aspect of the model selection is the feasibility of the resulted system throughout the controller and observer design. The paper describes the problem of quadratic stabilizability and detectability for LPV flow models. The Linear Matrix Inequality (LMI) conditions are developed to verify these important properties. Finally, a numeric example suggests the application of the LPV structure for a general freeway section with on- and off-ramps. The comparison of the simulation response of the non-linear and the derived nominal LPV model has also been investigated.

Keywords: quasi-LPV, freeway modeling

Presenting Author's Biography

Tamas Luspay. He is finishing his undergraduate studies at the Faculty of Transport Engineering, on the Department of Control and Transport Automation. His research interest is modeling, estimation and control of freeway and urban road traffic systems.

MODELING OF THE DYNAMICAL BEHAVIOR OF POWER PLANTS WITH A COMMERCIAL SOFTWARE SHELL

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Abstract

The demands on modern power plants increase continuously. Highest efficiency is to be combined with high flexibility for load changes. Due to these constraints manufacturers are faced opposite demands in the layout of the power plants. Utilities are faced a similar discrepancy.
To find an optimal solution, numerical simulation of steady-state and dynamical behavior of power plants has become indispensable. Modern simulation platforms no longer depend on programming skills but enable any engineer to use them after short training courses. Most programs for the simulation of plant dynamics use one-dimensional discretization, so the plant geometry can not be modeled in detail. Resulting inaccuracies can be avoided by adjusting the discretization scheme and default model parameters manually.
In the following paper, at first the basic principles of simulation of steady-state and dynamics are presented. In the second chapter, the discretization scheme of APROS, the used system shell is introduced. After that, common plant components are discussed that differ significantly from the draft approach proposed by the simulation software. Finned pipes and finned tubes are presented in detail. Approaches to deal with the special characteristics of the simulation software and the validation comparing to operation of a coal fired power plant end the report.

Keywords: coal, power plant, modeling techniques, validation.

Presenting Author's Biography

Wolfgang Zehtner works as a PhD student at the Institute of Energy Systems at the TU München. He completed his degree on Electrical Engineering at the TU München in spring 2004. His studies were already focused on power engineering. Currently, his doctoral studies are concentrated on improving startup and load change phases of coal-fired power plants. As his research work contains the behavior of lots of different power plant components, a sophisticated simulation program package is used.

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SEVERE ACCIDENT SIMULATIONS IN APROS NUCLEAR PLANT ANALYSER FOR VVER-440/213 REACTORS AND THE VISUALIZATION OF THE RESULTS

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Abstract

PC-based NPP basic principle simulators have been developed for over 15 years at Budapest University of Technology and Economics Institute of Nuclear Techniques (BME NTI) with two main goals: to provide the nuclear engineering education with tools capable to illustrate the fundamental physical processes of an NPP and to serve the regular basic retraining of the technical personnel of the NPP Paks (VVER440/213).

Our latest plant analyser is based on APROS which is a commercially available system code for modelling one-dimensional, two-phase flow processes in nuclear power plants and other industrial facilities. Numerical models for one- and three dimensional reactor kinetics, automation and electrical systems, containment processes and core degradation are also available. The code package contains a graphical user interface (GRADES) and pre-built component modules (pressurizer, steam generator etc). APROS is developed by VTT and Fortum in Finland.

A detailed APROS model of Paks Unit 3 (VVER-440/213) is under development at the BME NTI since 2000. The model contains the primary and secondary circuit with the emergency systems, the essential control and protection signals and the containment. The model was extended within the frame of a PHARE project, thus making capable to calculate beyond design basis accidents. The system code used for the modelling is the latest version of the APROS-SA software package.

Keywords: nuclear power plant, plant analyser, loss of coolant accident, severe accident.

Presenting Author's biography

Dr. Attila Aszódi. Director of BME NTI and Head of Department of Nuclear Energy. Main research and teaching areas are: nuclear energy; thermal-hydraulics; Computational Fluid Dynamics (CFD), 3D flow simulation; simulation and system analysis of nuclear power plants; investigation of the transmutation of high level radioactive wastes; safety analysis of nuclear reactors and new design nuclear power plants; development of simulation programs for education purposes.

VIRTUAL COMMISSIONING OF A LARGE LNG PLANT WITH THE DCS „800XA“ BY ABB

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Abstract

In Norway one of the largest Liquid Natural Gas (LNG) plants worldwide is under construction (Hammerfest, Natural gas field Snøhvit). The control and automation of the plant is done with the digital control system (DCS) “Industrial IT System 800xA” manufactured by ABB.

The complexity of the plant is very high and additionally some processes were newly introduced. That is why it was decided to perform the testing, training and virtual commissioning with a high fidelity simulator. The simulator used consists of a process simulator manufactured by Kongsberg Process Simulation, Sandvika (formerly Fantoft) and an emulator of the AC 870P / Melody system which is the active control part of the System 800xA. The original human system interface is used so that an overall test of the complete system is achieved.

One of the various challenges of this project is that the engineering, testing (virtual commissioning) and operator training is done simultaneously in different places in Norway: the engineering is done in the facilities in Bergen, testing is done in Oslo, training is performed in Hammerfest. Measures had to be taken to ensure the integrity of the data involved.

This affects the whole workflow. It had to be assured that diverging data may be harmonized again and that already achieved solutions do not get lost.

Keywords: DCS, Emulation, Virtual commissioning

Presenting Author’s biography

Herbert Krause was born in Wilhelmshaven, Germany. He studied Mechanical Engineering at the Technical University of Braunschweig where he obtained his degree in 1982. He worked for a couple of years for Hartmann & Braun in the area of advanced control algorithms and the development of simulation and power plant management software. In 1995 he won two awards for papers dealing with the simulation and optimization of MSF desalination plants. In 2001 he developed the AC 870P / Melody Emulator. In 2006 he founded a company dealing with the development and support of high valued technical software.

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SIMULATION FOR VIRTUAL COMMISSIONING

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Abstract

Due to the rising complexity of industrial production plants, the commissioning phase becomes more and more critical with respect to costs and time. In order to avoid costly physical correction measures during real plant commissioning, a virtual commissioning phase may be introduced in the plant engineering workflow after completion of plant engineering and before the plant is built. This paper describes the concept of virtual commissioning for production plants and discusses the realization tasks involved. Different approaches for the realization of virtual commissioning systems are reviewed with respect to modelling and simulation requirements. The efficient generation of simulation models based on the engineering data available from a plant CAE system is discussed in general. A prototype realization demonstrates how a simulation model for virtual commissioning can be generated automatically using plant CAE data. The concept is illustrated at a fresh cheese production plant: it is shown how the virtual commissioning system can be executed in the context of a plant CAE system and how it can be used to check the appropriate positioning of a quality sensor. Finally the actual development state is discussed and future tasks are identified which have to be solved to make virtual commissioning simulation applicable in an industrial engineering environment.

Keywords: Production Processes, Process Control Systems, Virtual Commissioning.

Presenting Author's biography

Reimar Schumann received the Dipl.-Ing. degree in Technical Cybernetics from the University of Stuttgart in 1976, and the PhD degree in Control Engineering from the Technical University Darmstadt in 1982. From 1983 to 1989, he was head of the process control system R&D department at the VDO Measurement and Control company in Hannover. In 1989, he joined the Hannover University of Applied Sciences and Arts as professor for control engineering and process control systems. His current research interests include computer aided control engineering (CACE) and the design of virtual commissioning environments for industrial production processes. As member of the VDI/VDE Society for Measurement and Automatic Control (GMA) he is chairing the German technical committee VDI/VDE GMA FA 6.11 on CACE.

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A FULL-SCOPE APROS-BASED SIMULATOR FOR HUMAN-MACHINE STUDIES

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Abstract

The Institute for Energy Technology (IFE) is a Norwegian-based energy research institute operating within the nuclear and petroleum domains. IFE is the host of the OECD Halden Reactor Project (HRP), an international research project funded by more than 100 nuclear organizations in 17 countries. The overall aim of the HRP is to enhance safety and efficiency when operating nuclear power plants, through research activities such as fuels and material performance and human-machine and control room studies.

The main research tool for the activities within the human-machine area is a simulator-based experimental facility called HAMMLAB (Halden Man-Machine Laboratory). HAMMLAB is equipped with three full-scope simulators, operated through a flexible control room and experimental infrastructure. The nuclear simulators of HAMMLAB are the French Fessenheim 1 PWR and the APROS-based Swedish Forsmark 3 BWR. Forsmark 3 is one of the largest nuclear power plants in Sweden with 3300 MW thermal power and 1200 MW electrical power. HRP's Forsmark 3 simulator, HAMBO, was developed in close cooperation with VTT in Finland, and was installed in HAMMLAB in 2000. HAMBO has since then been continuously updated, and has been the main vehicle of numerous human-machine experiments and studies within the Halden Project.

Keywords: APROS, experimental simulator, human-machine studies.

Presenting Author's biography

Christer Nihlwing. Has worked fifteen years in the Swedish BWR power plant Oskarshamn 3 as an operator and shift supervisor. After that, ten years on IFE as a process expert on BWR's and responsible for the BWR simulator HAMBO.

FORECASTING BATCH COOKING RESULTS WITH INTELLIGENT DYNAMIC SIMULATION

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Abstract

Intelligent dynamic simulator has been developed with linguistic equations *(LE)* for a *SuperBatch* coking process. The LE models consist of two parts: interactions are handled with linear equations, and nonlinearities are taken into account by scaling with membership definitions. Data-driven modelling was done by *FuzzEqu* toolbox on the basis of the measurements of the cooking liquor analyser *CLA 2000*: the concentrations of alkali, total dissolved solids and lignin are measured on-line during individual cooks in a batch digester house. Effective delays depend on the working conditions. Universal approximators for fuzzy functions can be constructed as extension principle extensions of continuous real-valued functions which continuously map fuzzy numbers into fuzzy numbers. LE models can be extended to fuzzy inputs with this approach if the membership definitions are replaced by corresponding extension principle extensions of these functions. The argument of the model function is obtained by fuzzy arithmetics. Fuzzy extension of the classical interval analysis suits very well to these calculations. According to extensive on-line tests in an industrial pulp mill, dynamic *LE* models are well suited for forecasting the cooking result: residual alkali, lignin and dissolved solids. The models are adapted to the changing operating conditions with configurable parameters. Uncertainty of the results is clearly seen when the resulting residual alkali, final lignin and final solids are presented as fuzzy numbers. The width of the fuzzy numbers depends on the length of the calculation period. The fuzziness of the result is smaller for the simulations performed later during the cooking sequence as the accuracy of the prediction is improved when the cooking progresses.

Keywords: batch cooking, intelligent methods, dynamic models, forecasting.

Presenting Author's Biography

Esko K. Juuso has M.Sc. (Eng.) in Technical Physics from University of Oulu. He is currently a senior assistant in Control Engineering at University of Oulu, Oulu, Finland. He is active in Finnish Simulation Forum (FinSim), Scandinavian Simulation Society (SIMS) and EUROSIM, currently he is chairman of FinSim. His main research fields are intelligent systems and simulation in industrial applications, including software sensors, control and fault diagnosis. For these applications he has introduced the linguistic equation (LE) methodology.

OPTIMIZATION OF MODELS: LOOKING FOR THE BEST STRATEGY

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Abstract

When parameters of model are being adjusted, model is learning to mimic the behaviour of a real world system. Optimization methods are responsible for parameters adjustment. The problem is that each real world system is different and its model should be of different complexity. It is almost impossible to decide which optimization method will perform the best (optimally adjust parameters of the model). In this paper we compare the performance of several methods for nonlinear parameters optimization. The gradient based methods such as Quasi-Newton or Conjugate Gradient are compared to several nature inspired methods. We designed an evolutionary algorithm selecting the best optimization methods for models of various complexity. Our experiments proved that the evolution of optimization methods for particular problems is very promising approach.

Keywords: Continuous Optimization, Ant Colony Optimization, Particle Swarm Optimization, Genetic Algorithm, Quasi-Newton Method

Presenting Author's Biography

Pavel Kordík works as an assistant professor and researcher at the Department of Computer Science and Engineering, FEE, Czech Technical University in Prague, where he obtained his master's and Ph.D. degree in 2003 and 2007, respectively. He is the co-author of more than 20 publications. He is coordinator of Automated Knowledge Extraction research project and member of research team of Transdisciplinary Research in the Area of Biomedical Engineering II research programme. His research interests are data mining, knowledge extraction, inductive models, neural networks, evolutionary computing, optimization methods, nature inspired continuous optimization, visualization of black-box behaviour and ensemble techniques.

SPEECH RECOGNITION BY USING ASRS_RL

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Abstract

Speech recognition is a research domain with a long history, but despite this fact, still open for new investigations and answers to the not yet finally solved questions. This situation can be explained by the difficulty of the task, underlying on the fact that speech is a human product, with a high degree of correlation in content and with a great variability in the formal manifestation as an acoustic signal.
Currently, the best ranked technology in speech recognition is based on hidden Markov models (HMM) as classifiers, of course there are other alternative like artificial neural networks (ANN) or support vector machine (SVM) in the classifier domain.
In the first part of the paper, a classifiers based on HMM is compared in the simple task of vowel recognition with a classifier based on the multilayer perceptron (MLP). In this situation, we have obtained better results for the last classifier, fact which highlights the advantage of the discriminative training of the perceptron versus the maximum likelihood training of the HMM. In the second part, a hybrid structure HMM/MLP is compared with the simple HMM in a digit recognition task. The hybrid structure improved with 2% the recognition rate. And in the last part, the continuous speech recognition experiments for Romanian language are describes by using HMM. The progresses concern enhancement of HMM by taking into account the context in form of triphones, improvement of speaker independence by applying a gender specific training and enlargement of the feature categories used to describe speech sequences.

Keywords: HMM, MLP, vowel, digit, continuous recognition.

Presenting Author's biography

Inge Gavăt. received the M.S. and Ph.D. degrees in Electronics and Telecommunications from the University "Politehnica" of Bucharest, Romania. She is currently a Professor at the Department of Applied Electronics and Information Engineering, Faculty for Electronics, Telecommunications and Information Technology and also at the German Branch of the Faculty of Engineering in Foreign Languages. She is teaching courses in Information and Estimation Theory, in Communication Theory and in Signal Processing and Artificial Intelligence for Man – Machine Communication. She is involved in advanced research projects and programs in pattern recognition with the Romanian Academy of Sciences, with the Military Technical Academy, with the Romanian Space Agency, with the Ministry for Education and Research. She is developing algorithms for pattern recognition with Markov models, neural networks and fuzzy systems.

NEURAL NETWORK BASED QUALITY INCREASE OF SURFACE ROUGHNESS RESULTS IN FREE FORM MACHINING

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Abstract

This paper concerns with free form surface reorganization and assessment of free form model complexity, grouping particular surface geometrical properties within patch boundaries, using self organized Kohonen neural network (SOKN). Neural network proved itself as an adequate tool for considering all topological non-linearities appearing in free form surfaces. Coordinate values of point cloud distributed at a particular surface were used as a surface propertie's descriptor, which was led into SOKN where repersentative neurons for curvature, slope and spatial surface properties were established. On a basis of this approach, surface patch boundaries were reorganized in such a manner that finish machining strategies gave best possible surface roughness results. The patch boundaries were constructed regarding to the Gaussian and mean curvature, in order to achieve smooth transition between patches, and in this way preserve or even improve desired curve and surface continuities, (C2 and G2). It is shown that by reorganization of boundaries considering curvature, slope and spatial point distribution, the surface quality of machined free form surface is improved. Approach was experimentaly verified on 22 free form surface models which were reorganized by SOKN and machined with finish milling tool-path strategies. Results showed rather good improvement of mean surface roughness profile Ra for reorganized surfaces, when comparing to unorganized free form surfaces.

Keywords: Neural network (NN), Self organized Kohonen neural network (SOKN), free form surface, CAM, index of surface complexity (ISC)

Presenting Author's biography

Marjan Korošec. He received his Master degree in 1997 in Faculty of Mechanical engineering - Ljubljana in an area of of Automation of production systems. From 1998 to 1999 he was employed as an assistant in metal cutting Laboratory in Faculty of Mechanical Engineering in Ljubljana. From 1999 to 2001 he was a leader of research and development group in tool – shop company Saturnus – Ljubljana. From 2001 to 2003 he was an independent entrepreneur in an area of representation of CAD/CAM systems and solutions of environmental problematics. He received his Ph.D. degree in 2003 in Faculty of Mechanical Engineering Maribor, in an area of intelligent machining He works as an assistant in Laboratory for Computer added design – Lecad in Faculty of Mechanical engineering Ljubljana.

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NONLINEAR PCA IN FAULT DETECTION AND ISOLATION

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Abstract

When dealing with nonlinear systems, linear fault detection and isolation techniques are sometimes inadequate. To describe nonlinearity of the system often we try to find the optimal fitting function. Many known methods have been developed where multivariate statistical methods are becoming popular in FDI practice as they offer good results according to data processing complexity. One of such is Principle Component Analysis, which is easy to implement, however not always accurate enough as it offers only linear transformation of process data. Therefore in this paper a derivation and implementation of nonlinear PCA for fault detection and isolation is demonstrated on a most popular case study, namely the three-tank laboratory plant using on-line data acquisition and the Matlab/Simulink environment. Derived NLPCA models are based on auto-associative neural network (AANN) with different combinations of encoding and decoding layers, and trained by back-propagation algorithm. Fault detection and isolation scheme is realized in Matlab/ Simulink and was designed to recognize predefined faults that can be introduced into the system. Results at the end show that drift or small shift faults, such as 4% of measured variables, can be identified by the FDI scheme in the system.

Keywords: Neural networks, nonlinear principal components, fault diagnosis.

Presenting Author's biography

Božidar Bratina graduated in 2004 at the Faculty of Electrical Engineering and Computer Science from the University of Maribor. Later that year he started his Ph.D. study at the same faculty in Maribor. His field of research includes Modeling of processes, Fault detection and isolation, Fault diagnosis and Fault recovery.

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TEXT ENCODING AND RECALL SPEEDUP FOR CORRELATION MATRIX MEMORIES

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Abstract

In this article we describe a part of our search engine based on Correlation matrix Memories. We focus on a part (we refer it as a letter-word matcher) of our search engine that takes a single word from an input query and looks for its word representative (word label). Words are searched within a static lexicon that is trained from a collection of documents. Although our letter-word matcher provides exact matching, approximate matching and stemming, we pay here attention on the exact matching only. Our search engine is based on the Correlation Matrix Memories (CMMs). CMMs are type of binary neural networks. They are capable of both exact and approximate matching. An advantage of CMMs is its very fast learning process. We proposed two encoding methods of input patterns designed to reduce memory consumption of CMMs. Both methods give some level of error rate in comparison with a standard approach. The first method allows to reduce memory more than 7 times. There is a tradeoff between memory requirement and error rate value. We also tested an n-gram approach for memory consumption and the error rate. We suggest three methods of speeding up a software simulation of the CMM recalling process. Combining all three we achieved a significant speedup of a standard method.

Keywords: Correlation matrix memory, Binary neural networks, Text searching, N-gram approach, Speedup of recall.

Presenting Author's Biography

Tomáš Beran. He finished his MSc degree in 1999 at the Czech Technical University in Prague on the topics of languages and translations. His interest in artificial neural networks leads to the implementation of an optical music recognition system based on binary neural networks, presented in his MSc thesis. He continued to use such neural networks in his doctoral study on text processing. He joined the IBM T. J. Watson Research group in Prague in 2002 where he has been part of the team developing the speech recognition engine for embedded devices.

MATHEMATICAL MODELS OF THE AUJESZKY DISEASE IN THE CUNEO PROVINCE FARMS, ITALY.

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Abstract

This work has been carried out in strict collaboration with the veterinarians studying the Aujeszky disease (A.D.), [1]. This disease is caused by the Herpevirus 1 suis (ADV or SHV-1). Field data concerning the blood samples collected according to the law (D.M. April 1st, 1997) in 1997-2004 for the serologic exam for A.D. of breeding animals of the Cuneo province have been examined. For each breeding farm birth rates have been determined. Also, mortality rates have been subdivided into those connected with Aujeszky disease and those which were not. The Villafalletto and Vottignasco towns where the farms are located has a swine density exceeding 3200 units per Km^2 and a total number of 90000 units. These facts allow to take the area as a single giant raising farm. On the basis of these assumptions we have formulated and analyzed mathematical models for the description of the disease evolution, to determine strategies for its desirable if at all possible control, and also indirectly for simulating the human intervention, which if inappropriate may adversely affect the disease spread. In this context, the effects of biosafety measures, together with the vaccination policy according to the regulations in effect, are also considered. The ultimate goal would be the realisation of a disease eradication plan with nonprohibitive costs. We started from a well-known and accepted epidemics models for realistic situations, [2], in which also the total population is not constant, [3, 4], contrary to the basic assumption of the classical epidemiological model, [5]. We then modified these models to take into account the possible fluxes between susceptible, "vaccinated" and infected animals, incorporating the lack of biosafety measures and possibly mimicking also the farmer's behavior who does not fully comply with correct vaccination policies. We discuss the outcomes of our analysis in terms of possible policies to contain the epidemics.

Keywords: epidemics, Aujeszky disease, biosafety, vaccination.

Presenting Author's Biography

Ezio Venturino: Professor of Numerical Analysis. M.Sc. and Ph.D. in Applied Mathematics from SUNY at Stony Brook, USA. Broad international experience in numerous higher research and educational institutions in USA, Europe, Australia. Winner of several research grants. Research interests in numerical analysis: integral equations, approximation theory; in mathematical biology: population theory, epidemiology, ecoepidemiology.

A VIRTUAL ENGINEERING APPROACH FOR CHATTER PREDICTION

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Abstract

The prediction of machine behavior becomes more important for the development of machine tools because due to demand for shorter development phases. The concept of virtual engineering enfolds the holistic computational development of a product, which allows the evaluation of the machine design in early stages of development. The consequent application of this method for modeling and analyzing the behavior of a machine tool is described in the paper. As an example, a milling and drilling machine for workpieces with large dimensions is introduced and the most important parts for the analysis of machine dynamics were identified. Two models were built to represent the machine tool. The first one is a complex finite element model with volume elements, which needs a low number of assumptions related to the geometry and therefore it can be used to validate simplified models in the absence of a physical prototype in early design stages. The second one is a simplified beam model which is used to evaluate the dynamic behavior due to force excitation during machine operation and chatter prediction. The force functions for typical milling processes on the described machine are calculated and the conditions for the appearance of chatter are analyzed for the computation of stability lobes in time domain which help to identify the machining parameters yielding stable or unstable processes.

Keywords: Virtual Engineering, machine tool, milling, chatter, finite element analysis

Presenting Author's biography

Corinna Barthel studied mechanical engineering with emphasis on applied mechanics and graduated in August 2006. In her diploma thesis she investigated the methods and possibilities of the virtual development of a machine tool. Since September 2006 she is working as a researcher at the Institute of Mechanics in the area of computational mechanics.

FEM MODELING OF PIEZORESISTIVE FORCE SENSOR FOR MEDICAL RETRACTOR AND DESIGN VERIFICATION

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Abstract

In this paper the numerical modelling of medical retractor for lumbar discectomy is presented. Lumbar discectomy is the most common operative procedure performed by neurosurgeons. During the surgery the retractor is used to alter the position of spinal nerve root in order to optimize surgical exposure. The force and time of retraction monitoring is the essential step in the improvement of surgical procedure. The medical retractor was equipped with silicon based piezoresistive sensors and the prototype was manufactured. The numerical analysis done with ANSYS Finite element analysis software was used to evaluate the design, characterize force sensor used and provides design modifications to improve the retractor usability. The characterization method is explained and the numerical model of the retractor is built using the measured values for mechanical and electrical properties. The mechanical properties were measured and compared with calculated values. The optimal position of piezoresistive force sensors is determined by stress distribution in the retractor, where the uniformity of stress and the stress magnitude was under the consideration. The numerical model also serves as a basis for extending force measurement in two dimensions. The 2-axis force measurement is required to sufficiently monitor the force during the surgery and it is thus essential in the design.

Keywords: force sensor, stress, strain, ANSYS, finite element method, retractor, medical application, piezoresistivity, modeling, silicon

Presenting Author's Biography

Samo Penič was born in 1980 in Celje, Slovenia. In 2006 he received his B. Sc. degree at the Faculty of Electrical Engineering, University of Ljubljana and became a junior researcher at the Faculty of Electrical Engineering in the Laboratory for microsensors structures and electronics (LMSE). He is continuing his postgraduate studies. He is interested in coupled-field modeling of MEMS structures, especially sensors and actuators.

THREE–DIMENSIONAL FINITE ELEMENT ANALYSIS OF OSSEOINTEGRATED DENTAL IMPLANTS

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Abstract

In this paper the biomechanical interaction between osseointegrated dental implants and bone is investigated by numerical simulations. The influence of some mechanical and geometrical parameters on bone stress distributions is highlighted and some risk–measures relevant to critical overloading are furnished. Load transfer mechanisms of several dental implants are analyzed by means of linearly elastic finite–element analyses, when static functional loads occur. For a given implant the variation of its performance with the placement is investigated, considering insertions both in mandibular and maxillary molar segments. The mechanical properties of the bone regions (cortical and cancellous) are approximated with those of a type II bone and the geometry of crestal bone loss after a healing period is modelled. Five commercially-available dental implants are analyzed, demonstrating as the optimal choice of an endosseous implant is strongly affected by a number of shape parameters as well as by anatomy and mechanical properties of the site of placement. Numerical results clearly proof as a given implant device exhibits very different performance on mandibular or maxillary bone segments, resulting in higher compressive stresses when maxillary placement is experienced. Finally, the effectiveness of several multiple–implant restorative applications is investigated. The first one is related to a partially edentulous arch restoration, based on a double-implant device involving a retaining bar. Other applications regard single–tooth restorations based on non–conventional devices consisting in a mini-bar supported by two mini endosteal implants, possibly reproducing the natural roots orientation of a multiple–root tooth.

Keywords: dental biomechanics, osseointegrated implants, finite–element analysis.

Presenting Author's Biography

Giuseppe Vairo. Born 1974, he achieved his Mechanical Engineering degree cum laude in 1998 and PhD degree in Structural Mechanics in 2002 at University of Rome "Tor Vergata", Italy. From 2004 he is Assistant Professor of Structural Engineering at the Department of Civil Engineering, University of Rome "Tor Vergata". Main fields of interest are: finite–element structural analysis, mechanics of composite structures, wind–structure interaction, long–span bridges, dental biomechanics, vascular stent analysis.

MODELLING AND SIMULATION OF DIFFUSION IN CHROMATOGRAPHIC RESIN USING SPATIALLY STRUCTURED RANDOM MEDIA AND A PARALLEL CELLULAR AUTOMATON

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Abstract

In liquid chromatography, effective diffusion coefficients are important parameters for the rational design of stationary phases and purification schemes. Common methods for the quantification of hindered diffusion in chromatographic media base on the analysis of dynamic data from experimental observations of protein migration. In contrast, stochastically driven approaches utilizing static data on matrix geometry and spatial hindrance structure allow studying this effect for arbitrary concentration profiles at the matrix boundary. A cellular automaton is implemented and applied for the analysis of hindered diffusion in spatially structured domains. A parallel 64 bit architecture enables calculation of large and densely populated automata. System states are stored in octrees in order to reduce both computing time and memory consumption. This automaton is used to quantify the deceleration of diffusion processes by different domain geometries, where obstacles are modeled by inaccessible cells. Random hindrance geometries are generated using clipped Gaussian fields that share macroscopic and microscopic properties with the chromatographic media, such as density, porosity and connectivity, which can be identified from measurement data. Although based on a stochastic characterization of random media, this simulation approach reveals information on the dynamics of chromatographic processes.

Keywords: Cellular automata, hindered diffusion, liquid chromatography, porous media, Gaussian fields.

Presenting Author's Biography

Katharina Nöh received her doctorate in Mathematics from Siegen University in 2006. In her thesis she generalized mathematical methods for the evaluation of metabolic flux experiments to non-stationary systems. She currently holds a position as post-doctoral researcher at the Research Centre Jülich, where she also applies high performance computing to various biotechnological systems.

MEDICAL AND ECONOMIC BURDEN OF HYPERTENSION ASSESSED BY MODELLING AND SIMULATION

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Abstract

Hypertension is the most common chronic condition in humans and should be considered a major risk factor for cardiovascular and related diseases. Because of its high prevalence, long-term consequences and lifelong treatment, hypertension is a heavy burden for the healthcare systems and the society.
The aim of this study was to demonstrate clinical and economic effects of untreated versus ideally treated hypertension in a population of all hypertensive patients in Slovenia, with particular attention to congestive heart failure, stroke and myocardial infarction. The course of hypertension and the costs of its management were simulated for a period covering the total lifetime of the patients.
The highest treatment costs were associated with medications, followed by sick leave. According to the modelling results, hypertension practically begins at the age of 30 and its prevalence increases with age.
Severe complicating diseases were shown to occur after the age of 60, mainly after the age of 70.
A favourable cost-effectiveness of antihypertensive treatment became apparent after 12 years of treatment in the prevention of myocardial infarction and after 15 years of treatment if congestive heart failure and stroke were considered.

Keywords: burden of hypertension, modelling and simulation

Author's biography

Martin Bruderman graduated in 2004 from the Faculty of Pharmacy, University of Ljubljana, Slovenia. He is employed in the Sales Division of the company Krka, d. d.

A SIMULATION OF THE FORMATION OF MELANOCYTIC NEVI

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Abstract

Melanocytic nevi (moles) are common, and can be found anywhere on the skin. Their number has been shown to be associated with a greater risk of cutaneous melanoma. Also, the knowledge of their natural evolution is important in the understanding of the development of melanoma. The aim of this study was to incorporate available knowledge about melanocytic proliferation and the role of immune system and to create a simulation model which will be able to explain the changes in number of melanocytic nevi during lifetime and to elucidate the importance of the immune system in their formation and regression (i.e. eruptive benign melanocytic nevi). The results were presented graphically and visually analyzed. Because of the great number of possible numerical solutions only approximately results that satisfy some basic criteria were take into account. A created system dynamics model proved to be able to simulate the appearance and disappearance of melanocytic nevi during lifetime and the eruption of nevi after immunosuppression in a way that mimics their changes reported in epidemiological studies. There are limitations in model assumptions due to many uncertainties regarding model parameters and thus much more detailed epidemiological data would be required for the creation of a more reliable model.

Keywords: Melanocytic nevi, Mutation, Immune system, Simulation model, System dynamics

Presenting Author's biography

Jadranka Božikov graduated in Mathematics and earned MSc and PhD degree in field of Biomedicine and Health Sciences at Zagreb University. Since 1978 she works in Department for Medical Statistics, Epidemiology and Medical Informatics at Andrija Štampar School of Public Health, Medical School, University of Zagreb, currently as associated professor. She introduced simulation modeling methods and applications as teaching subject for medical students and graduates and supervised several MSc theses obtained by young researchers who employed system dynamics approach and continuous simulation techniques in their investigation of the phenomena in medicine and public health. URL: www.snz.hr/~jbozikov.

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NUMERICAL MODELING OF ELECTRIC FIELD DISTRIBUTION IN SUBCUTANEOUS TUMORS TREATED WITH NEEDLE ELECTRODES

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Abstract

Electrochemotherapy (ECT) is an effective antitumor treatment employing locally applied high electric pulses in combination with chemotherapeutic drugs. As a response to the high electric pulses delivery, a local electric field (E) is established within the treated tissue. The antitumor treatment outcome is directly related to the electric field distribution over the tumor tissue. For successful therapy the entire tumor tissue needs to be subjected to the local electric field strength above the reversible threshold E_{rev}. This value is the critical reversible threshold value of the local electric field (E_{rev}) which causes structural changes in the target tissue. Namely, it initializes electropermeabilization of cell membranes, which allows for increased entrance of the drug into the cell and thus allows for improved effectiveness of chemotherapy. The local electric field distribution depends on parameters of electric pulses delivered through electrodes to the treated tissue, the shape and position of the electrodes with respect to the treated tissue, as well as the structure of the tumor and its surrounding tissue. The objective of this study is to calculate and compare the local electric field distribution in the 3D numerical model of subcutaneous tumor obtained with needle electrodes by means of finite element method. We demonstrate that by appropriate number, depth of insertion and arrangement of electrodes as well as amplitude of electric pulses a better coverage by sufficiently high electric field ($E \geq E_{rev}$) can be achieved over the entire target tissue (i.e. the tumor) while being minimized in the surrounding healthy tissues.

Keywords: electropermeabilisation, electrochemotherapy, finite element method, subcutaneous tumor, needle electrodes.

Author's biography

Selma Čorović received the B.A.Sc. and M.Sc. degrees in electrical engineering from the University of Ljubljana, Ljubljana, Slovenia. Currently, she is Assistant Researcher at the University of Ljubljana. Her main research interest is in the field of numerical modeling of electric field distribution in biological tissue, experimental work on visualization of electropermeabilization process *in vivo* and development of web-based e-learning applications aimed at providing the knowledge on electropermeabilization of biological tissues.

BORDER FLUX BALLANCE APPROACH TOWARDS MODELLING ACID-BASE CHEMISTRY AND BLOOD GASES TRANSPORT

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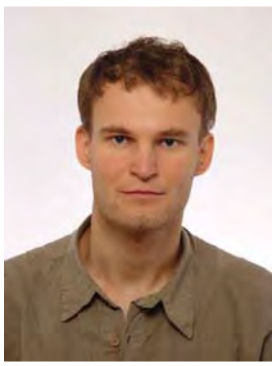
Abstract

Two widely discussed approaches to acid-base chemistry (classical vs. modern one) are not in contradiction with one another. Most of the misunderstanding originates when people don't realize they are defined for different conditions – classical theory is valid for blood of various hemoglobin content but with normal plasma only while the modern theory describes plasma under general conditions, but not full blood. The two theories are complementary when both limiting conditions are met. Our border flux approach to acid-base and blood gases chemistry, together with the newly defined set of state variables form a logically consistent general theory. We are able to describe, identify and simulate blood gases transport as well as a wide array of acid-base disorders, e.g. respiratory alkaloses and acidoses, metabolic acidoses and alkaloses, hypo- and hyperalbuminemias (phosphatemias), hemodilution/ hyperhydration, hemoconcentration/dehydration, situations of abnormal body temperature etc. Complex simulation model based on our approach (Golem) is for several years successfully used in medical student education. Underlying mathematical relationships are as a part of a MATLAB/Simulink library "Physiolibrary" at your free disposition on site http://patf-biokyb.lf1.cuni.cz/wiki/projekty/physiolibrary . Lately, we have completed on-line version of simple plasma buffering system simulation model, which is available at http://www.physiome.cz/atlas/acidobaze/02/ABR_v_plazme1_2.swf .

Keywords: Acid-base chemistry of blood, Modeling, SID, BB, BE

Presenting Author's biography



Stanislav Matoušek, M.D. Author is a Ph.D. student of Jiří Kofránek, main focus of his work being modeling of ventilation, blood gases transport and acid-base chemistry in humans. He studied Medicine at Charles University in Prague. He combined his studies with several years of mathematics and physics at Charles University and with some subjects regarding control theory at Czech Technical University. Stanislav Matoušek is a member of multidisciplinary team of laboratory of biocybernetics lead by Jiří Kofránek. He also teaches Pathological Physiology to medical students.

PHYSIOLOGICAL FEEDBACK MODELLING IN MEDICAL EDUCATION

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Abstract

Regulations are an ever-present element of each life process, determining its diverse behaviour depending upon various physiological or pathological effects. Textbooks and lecture notes represent the static and lexical overview of these systems. However, the practical education provides almost no means how to experiment with biological signals, thus examine the system‘s dynamical characteristics and relations to it‘s parameters in detail. We try to pass this limitation through the use of simulation experiments, which provide interactive methods for understanding feedback system behaviour, its basic features, stability conditions and process of parameter influences under certain external conditions. Also, examples of several physiological models are included. The aim of our educational application is to provide an interactive tutorial that explicates the behaviour of basic control systems and their dependencies on input signal and inner structure. The definitions and conceptions needed for control system description as well as methods for system characteristics determination, graphical and analytical expressions are introduced in necessary extent. All topics are structured into succession of tabular frames, thus creating one complex executable from the Internet using the ClickOnce technology (part of the .NET framework). We suppose the application to be an interactive opportunity for students to gain some virtual experience with simple control models along with basic knowledge of computer modelling and regulation theory. In this manner, the application may be thought of as a part of biocybernetics methodology, whose topics cover not only simple control systems, but also every complicated and complex dynamical system of living organisms that contain control circuits, including those with emergent properties.

Keywords: Educational software, Simulation models, Physiological control models, Interactive animation, MS .NET framework

Marcel Matúš. Postgraduate student at The Laboratory of Biocybernetics and Computer Aided Teaching with the Institute of Pathophysiology of the 1st Faculty of Medicine, Charles University in Prague. Graduated as MSc. in technical cybernetics engineering at Czech Technical University in Prague (graduated in 2007). The scope of his studies covers regulation in physiology, its modelling and utilization in education.

MODELING ARTERIAL AND LEFT VENTRICULAR COUPLING FOR NON-INVASIVE MEASUREMENTS

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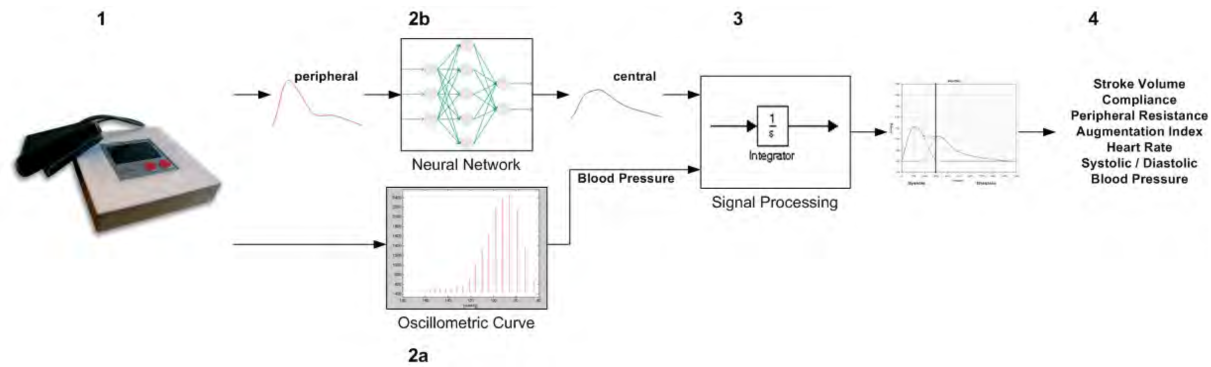
Abstract

Aim of the presented work has been the development of an algorithm for a non-invasive, portable, easy to use, and affordable device (1) for measuring systemic cardiovascular parameters like cardiac output and peripheral resistance. The data acquisition is based on a common oscillometric measurement using an occlusive blood pressure cuff (2a) and no additional calibration is necessary. The introduced novel algorithm combines several simulation techniques like neural networks (2b) or differential equations (3), which will be explained briefly. The determination of the hemodynamical parameters is based on the idea that the ejection work of the left ventricle is subject to an optimization principle (4). Finally we present some results that justify our approach. This kind of model needs no additional external parameters to work and opens therefore good perspectives for non-expert use.



Keywords: Cardiac Output, Embedded Simulation, Differential Equations, Neural Networks

Presenting Author's biography

Christopher Mayer has graduated in mathematics at the Technical University of Vienna. Currently he is working on his doctoral thesis about cardiac output measurement at the Austrian Research Centers. His research interests are pulse wave analysis and embedded simulation using Matlab Simulink and digital signal processors.

DYNAMIC MODEL OF A THERMAL SOLAR COLLECTOR

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Abstract

In the paper a dynamic model for simulating the behavior of a thermal solar collector is presented. The collector is unglazed with a metal receiving pipe thermally linked to fins and presents thermal insulation in the back side and surface. The main characteristic of the proposed model is its capability of simulating the thermal performances for any given time discretization or collector axial discretization. The routine implemented is such to generate the system of partial differential equations (in matrix form) which dimension depends on the number of axial nodes assumed (n_x); the system is then numerically integrated upon the imposed discretization time (Δt). The model realized is *"White Box"* (all phenomena occurring within the component are studied referring to physical equations) and *"State Determined"* (state variables can be defined: energy storage is possible and heat can be accumulated both in the metal absorber and in the Heat Transfer Fluid).
The collector pipe is split up into n_x segments (axial discretization) with length Δx; for each of the segments energy conservation equations are applied to both the metal pipe and the Heat Transfer Fluid flowing within it. The component therefore presents a 2 node distribution in the longitudinal direction. The model is realized within Simulink® and is based on a Matlab® S-Function where all the equations are implemented in parameterized form and integrated.
Results of are proposed from dynamic simulations with different degrees of axial discretization of the system and with time varying inputs.

Keywords: Solar Collector, Dynamic model, Discretization, PDE integration

Presenting Author's biography

Iacopo Vaja received his Master Degree in Mechanical Engineering at University of Parma in 2004, after a thesis at ENEA (Italian National Agency for New Technologies, Energy and the Environment) where he worked at the R&D unit "Plant Control and Automation" of the "Solar Thermodynamic Project" – "Archimede Project". He is currently pursuing a Doctorate in Industrial Engineering at the University of Parma; the research activity is concerned to modeling and analysis of energy systems and networks for energy efficiency purposes.

GAS-LIQUID SEPARATOR MODELLING AND SIMULATION WITH GAUSSIAN PROCESS MODELS

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Abstract

The Gaussian process model is an example of a flexible, probabilistic, nonparametric model with uncertainty predictions. It can be used for the modelling of complex nonlinear systems and recently it has also been used for a dynamic systems identification. Gaussian process models have become an emerging, complementary method for a nonlinear system identification. The output of the GP model is a normal distribution, expressed in terms of mean and variance. The mean value represents the most likely output and the variance can be interpreted as the measure of its confidence. The modelling case study of gas-liquid separator is presented in the paper. The emphasis of the paper is on the comparison of three methods for dynamic model simulation based on Gaussian processes in the phase of model validation. All three presented methods are approximations. The 'naive' simulation is feeding back only the mean values of model predicted values. The Taylor approximation approach and 'exact' approach approximate the model predicted distribution with Gaussian distribution, but in different ways. The level of computational burden associated with each approach rises with the complexity of computation necessary for approximation of uncertainty propagation. Therefore a trade off between the level of uncertainty propagation approximation and computational burden is present.

Keywords: Dynamic system models, System identification, Gaussian process models, simulation.

Presenting Author's Biography

Jus Kocijan received the B.Sc., M.Sc., and Ph.D. degrees in electrical engineering from the Faculty of Electrical Engineering, University of Ljubljana. He is currently a senior researcher at the Department of Systems and Control, Jozef Stefan Institute and Professor of Electrical Engineering at the School of Engineering and Management, University of Nova Gorica. His main research interests are: applied nonlinear control and multiple model and probabilistic approaches to modelling and control. He is a member of SLOSIM - Slovenian Society for Simulation and Modelling, Automatic control society of Slovenia and IEEE.

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DYNAMIC SIMULATION AND OPTIMIZATION OF A PLUG-FLOW REACTOR WITHIN THE MINLP SYNTHESIS OF OVERALL PROCESS SCHEMES

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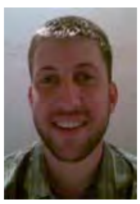
Abstract

This contribution describes the development of a mixed integer nonlinear programming (MINLP) model for a differential non-isothermal plug-flow (PFR) reactor network, based on experience gained when developing a nonlinear programming (NLP) model for batch reactors. Each PFR was modelled as an NLP train of differential segments (final elements) rather than an MINLP train. This model was then applied to a process synthesis example regarding the production of allyl chloride.
In the first step of the NLP model's development, simulation has to be performed in order to analyze the preliminary behaviour of a given kinetic system, and to provide a good initial point for optimization. PFR reactors in the allyl chloride example are currently modelled using mixed-integer nonlinear programming (MINLP) models, where differential-algebraic equations (DAE) are converted into an algebraic system of equations by the use of an Orthogonal Collocation on Finite Element (OCFE), which can be combinatorially very expensive, especially when the reactor network is part of an overall process scheme. The efficiency of MINLP process synthesis can be improved, using the NLP model for the train of differential segments. The length of each final element is then declared as variable, and optimal residence time is shifted to the end of the final element. In this way, some equations become linear and the combinatorics of the model is significantly reduced. This is especially emphasized when the reactor network model is a part of the entire process superstructure. Results show the considerable impact of the decrease in combinatorial burden, nonlinearity, and the effects of nonconvexities, on the efficiency and success of the optimization.

Keywords: PFR reactor, orthogonal collocation, NLP, MINLP, process synthesis.

Presenting Author's biography

Marcel Ropotar. Since 2005 he is a PhD student at the Faculty of Chemistry and Chemical Engineering at the University of Maribor, here he graduated in 2004. He is currently a young researcher and employee of Tanin Sevnica, kemična industrija d.d..



ISBN 978-3-901608-32-2

MODELLING A FOOD INDUSTRY PROCESS BY DECISION TREE

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Abstract

Food safety is not only an issue concerning human health and business profit, but it is a political issue as well. Classical retroactive approach to food safety based on control of final product and governmental inspection survey is being changed to producers and distributors' self-control approach. In that respect, there are a number of new tools that are in force: ISO, HACCP, IFS, BRC, Hygieneomic. The main obstacle of technology production are variations in different steps of the process. Our aim is to develop a mathematical model which would contribute to a better understanding of technology process in ought to decrease risks present in it.

Subject of our paper is fresh cheese - product made from very unstable raw material: cow milk and starter cultures (Genus Lactobacillus). Variables measured during the cheese production are first analyzed by principal component analysis to detect the most relevant components in the technology process. The quality of the fresh cheese is measured by two variables: quantity of cfu/ml of Escherichia coli and quantity of cfu/ml of Yeasts and Moulds in the final product. These quantities are regulated by Ministry of helth. The technology of cheese production is modelled by decision tree which classifies final products in two classes according to their quality.

Modelling of a technological process by decision tree classifier, information about the most relevant variables in cheese production can be revealed and boundary values for some of the observed variables dividing positive from negative examples can be obtained. These boundary values could be compared against existing standards in cheese production technology.

Keywords: Technology of cheese production, standards in food technology, principal components, decision tree classifier.

Presenting Author's biography

Jasminka Dobša. Jasminka Dobša teaches statistical courses at the Faculty of organization and informatics, University of Zagreb. She received her bachelor's degree and master's degree at University of Zagreb in Mathematics and PhD at University of Zagreb in Computer Science. Her fields of interest are data and text mining.

SIMULATION MODEL OF THE HYDRO POWER PLANT SHKOPETI

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Abstract

The energy sector is one of the most important sectors of the Albanian economy. Over 90% of the electric power is produced by hydro power plants, mainly by five important power plants in Northern Albania. Some of these power plants already have been rehabilitated with financial support of the World Bank and other donors. The situation in the Albanian transmission grid is characterized till this day by frequent interruptions every day. For planning of a safe and reliable operation in the future it's very important to have current simulation models, which can describe the static and dynamic behavior of the whole network including any elements. This contribution presents the most important steps for creation of a reality oriented model of the hydro power plant Shkopeti. Therefore in the hydro power plant measurements were performed to obtain step response time signals of all important functional parts. The setpoint for active power and the setpoint for generator voltage were changed stepwise during the power plant was working in interconnected mode. The transient behavior of the power plant was measured and recorded by a PC-based LabVIEW system with 16 channels. On the basis of available technical documentations and commissioning reports a general model including different submodels of the power plant was developed. Using the software MATLAB/Simulink it was possible to identify all the needed parameters of the mathematical model. The entire model of the hydro power plant consists of separate models of hydraulic part (water tunnel, surge chamber, penstock), turbine regulator, Kaplan turbine, voltage regulator with power system stabilizer, network model and generator. The simulation results show a good correspondence between measured and simulated values. The created model can be implemented as a part of an Albanian dynamic grid model realized for example with the software DIgSILENT.

Keywords: hydro power plant, modeling, identification, simulation, power system.

Presenting Author's biography

Fred Prillwitz. He was born 1960 in Teutschenthal, Germany. He received his Ph.D. degree from the University of Rostock in 1992. He made his doctoral thesis on the subject "Operating conditions of ship networks with variable frequency". Now he belongs to the scientific staff of the Institute of Electrical Power Engineering at the University of Rostock. His area of interests includes dynamic modeling and simulation of power systems and High Voltage Techniques.

TRANSIENT STABILITY SIMULATION OF COMBINED POWER PLANT DURING FAULTS ON 400 AND 110 KV TRANSMISSION LINES

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Abstract

The paper presents simulation of transient stability of a 56.25 MVA generator and two 22.5 MVA generators in the combined steam-gas power plant "TE-TO" Osijek synchronized with a 110 kV transmission network. This power plant is electrically very close to the recently reconstructed substation 400/110 kV Ernestinovo. Three phase and single-line-to-ground faults were simulated at 400 kV and 110 kV transmission lines using DIgSILENT software for electromagnetic transients (EMT) to simulate transient stability during the fault and switching process. All input data for transmission lines, transformers, synchronous machines and switching devices are obtained from HEP databases. The analysis of dynamic behavior of generators during the single-line-to-ground faults and three phase faults on the closest associated 110 kV line to the power plant and on 400 kV line associated to TS 400/110 kV.
Operational variables such as generator speed, electrical and mechanical power, excitation voltage, frequency, currents and voltages in transmission lines were observed. Modeling of the system components by considering a very large number of relevant parameters and constants, as well as using real operational values for each model has enabled the relative accuracy in representing of all the states. Furthermore, the control system together with the protection system protects the plant from hazardous states thus allowing safe, good and long-life operation of all the plant components. Waveforms of transients on the 400 kV and 110 kV transmission lines, generator speeds and rotor angles deviation caused by faults have also been presented.

Keywords: Transient stability, transmission network, synchronous generator, short circuits, computer simulation.

Presenting Author's biography

Predrag Marić was born on December 11, 1979 in Osijek. He obtained his diploma degree in 2004 in the field of Electrical Power Engineering from the Faculty of Electrical Engineering in Osijek. His graduation thesis was awarded two prizes: "Hrvoje Požar" of the Croatian Energy Institute as a specially noticed thesis in field of power engineering. He works as a research assistant in the Power System Department at the Faculty of Electrical Engineering in Osijek. His main interests are modeling, simulation and analysis of transient phenomena in power systems.

DYNAMIC SIMULATION OF A STUDENT E-LEARNING PERFORMANCE PROFILE THROUGH WEB-BASED DATA-LOG MINING

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Abstract

The purpose of this paper is to present a web-based method for simulating the educational performance and the overall educational track-path of a student who takes part in e-learning courses. Various e-learning courses that were organized at the Multimedia Technology Laboratory of NTUA, were used, including over 200 student records. The data logs from the LMS platform (Moodle MySQL database) were being used as a primary data mining source and by using an advanced web-based information system with data mining algorithms and relevant information about the course modules with some difficulty indexes, the educational simulated profile of the students is extracted. Data are correlated and clustered over specific central numerical values, representing course difficulty or other educational parameters and some statistical graphs are generated. The simulation results can be really helpful for e-learning teachers and professors, since by comparing the resulted curves and the difficulty metrics from the simulation, they can estimate and visualize the overall performance of the student during a time-depending e-learning procedure and can create a complete educational simulation of a class and its effectiveness. By comparing an optimal fused traversal path, generated by the professor with the one obtained by the evaluation tool, learning efficiency and comprehension of the student can be extracted and simulated Weak educational points throughout the course, difficulty parameters and causes that are invisible to the professor, can be detected and focused additional help and support can be realised.

Keywords: e-Learning Simulation, Student Paths, Web-Based Simulation, Educational Visualization, Data Fusion.

Presenting Author's biography

Nikolaos V. Karadimas graduated from Glasgow Caledonian University, Scotland with a BEng (Hons) and a MSc in 1997 & 1998, respectively. He also received a MSc in Distributed and Multimedia Information Systems from Heriot-Watt University, Scotland in 1999.and his PhD from National Technical University of Athens in 2007. He is teaching in Hellenic Army Academy, TEI of Piraeus, TEI of Chalkida and in Technical NCO Academy. He is a member of the Greek Chamber of Engineers, member of IEEE and member of IEE.

PERFORMANCE MODELS FOR LIQUID BOND PORTFOLIO MANAGEMENT

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Abstract

Financial traders play in a really mature market where competition makes the availability of up-to-date information essential for managers to make the correct decisions when the portfolio policies are set. This paper proposes intelligent models of trader's performance under variable market conditions to support the effective hedging of the portfolio and ensure the overall profitability of the trading desk. The research examines liquid bond trading in a London-based investment bank and develops intelligent models to assess and improve the performance of their trading team. Intelligent models based on AI techniques have been widely used in financial applications to forecast financial indices over time. This research differs from the existing work in that it takes these indices as input and uses this information to estimate traders' performance, based uniquely on their individual history of performance. Furthermore, this is not a forecasting task, it is a correlation/association task, as the range of possible market conditions is defined and the model is built and trained on data available over the entire range. Another novel aspect is the idea of using AI to model the behaviour of a particular individual while the existing work ranging from ANNs to agent-based simulation targets the behaviour of the average individual within a category, so the idea is not to model the behaviour of an average trader, but the behaviour of one trader in particular. Agent-based simulaton offers the opportunity to model the evolution of individuals through their interaction with the environment and with other agents, however the rules of evolution have to be predefined and coded into the agent upon creation, in this research instead the behavioural pattern of the individual is extracted directly from his/her own history. Finally, the possibility to model the adaptability/evolution of the individual trader and his/her ability to learn from experience is accounted for in the modular design of the ANNs, as ANN modules may be regularly re-trained on recent data or even continually trained to keep up with the individual changes in trading performance.

Keywords: intelligent systems, decision support, financial models, liquid bond trading.

Presenting Author's biography

ALESSANDRA ORSONI is a Senior Lecturer in the School of Business Information Management at Kingston University (Kingston, UK). She received both her MS in Mechanical Engineering and her ScD in Engineering Systems Design and Innovation from the Massachusetts Institute of Technology (Cambridge, MA). Prior to joining Kingston University she was a research associate in the Department of Materials Science and Metallurgy at the University of Cambridge (Cambridge, UK) and worked as an assistant professor in the Department of Production Engineering at the University of Genova (Genova, Italy).

SELECTION OF THE SIMULATION SOFTWARE FOR THE MANAGEMENT OF THE OPERATIONS AT AN INTERNATIONAL AIRPORT

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Abstract

A new airport in Ciudad Real, Spain, is looking for tools that will help with the management of resources. Operations in this airport will start in late 2007 or early 2008. The selection of the software applications to be used is crucial to the success of the development of the real-time tool that will be implemented for daily operations. The selection process requires a study of the capabilities in the commercial and general-purpose simulation and visualization tools available. Three alternatives have come out of an initial screening process: Witness to simulate and MsExcel as the interface, Arena with Excel, and Visual Basic to simulate and to show Gantt charts and JAVA to visualize the airport in real time. A model that reflects the operations that take place at a parking position has been developed in each of these three platforms to better assess their possibilities. It has been necessary to define the individual criteria, and relative weights of different capabilities, that will help with the ranking of the alternatives: user related (ease of use and decision making capabilities) and developer related (connectivity, maintenance and cost). Analytical Hierarchy Process has been used to quantitatively select the Specific tool that includes a simulation model developed with VisualBasic on the spreadsheet and a graphical visualization screen developed in JAVA, which will allow in the future to automatically update the data.

Keywords: Discrete-Event, Software Selection, AHP.

Presenting Author's biography

Javier Otamendi. Received the B.S. and M.S. degrees in Industrial Engineering at Oklahoma State University, where he developed his interests in Simulation and Total Quality Management. Back in his home country of Spain, he received a B.S. in Business Administration and a Ph.D. in Industrial Engineering. He is currently a simulation and statistics consultant and university professor at the Rey Juan Carlos University in Madrid. He collaborates with Autolog Group at Univ. Castilla - La Mancha, http://autolog.uclm.es. (franciscojavier.otamendi@urjc.es)

GRAPHICAL VISUALIZATION FOR THE MANAGEMENT OF SPREADSHEET SIMULATIONS

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Abstract

The development of a tool for the allocation of resources to flights and airplanes at an airport is presented. The tool must have an interface in the widely available and used spreadsheet to exchange information with the user and present the results, specifically the required Gantt chart. The MsExcel spreadsheet is able to read the data about flights and available resources, simulate the operations using VisualBasic in order to find the best possible assignment of resources to the parking positions and show the utilization ratios and the time-based Gantt chart using a colour coding for the resources. The major contribution of this article is a second interface in the form of a visual environment so that both the static Gantt chart might be dynamically animated over part or the totality of its time horizon and the status of the airport is liable to be photographed at any point in time. A JAVA screen is added so the operations and the state of the resources might be dynamically visualized at four parking positions simultaneously when scheduling and programming the resources. The validation of the tool is being performed at a new international airport in Ciudad Real, Spain, which will begin operations by the end of 2007.

Keywords: spreadsheet simulation, resources allocation, Visualization, JAVA.

Presenting Author's biography

JAVIER OTAMENDI received the B.S. and M.S. degrees in Industrial Engineering at Oklahoma State University, where he developed his interests in Simulation and Total Quality Management. Back in his home country of Spain, he received a B.S. in Business Administration and a Ph.D. in Industrial Engineering. He is currently a simulation and statistics consultant and university professor. He collaborates with Autolog Group at Univ. Castilla-La Mancha, http://autolog.uclm.es.

MODELING SMART MARKET PRICING MECHANISM IN PACKET-SWITCHED COMMUNICATION NETWORKS

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Abstract

A considerable amount of research has been done recently into the successful QoS provisioning. One of the ways to achieve a better network service provisioning is the implementation of congestion pricing. In this paper, we are focusing on the open issues of Smart Market approach. This approach is considered to be technically inefficient and weak in the way the price is aggregated and the information about users' willingness to pay is distributed between network resources. We propose a relatively plain solution, where users express their willingness to pay for their traffic from end to end, probably differently for each Internet service they use. This information represents a bid price throughout the network, where each network resource subtracts its share of value from packet's bid price. Our conceptual study has shown that the proposed scheme is feasible and that it establishes a direct relationship between the expressed willingness to pay and the gained QoS level. To study the concept, we developed a simulation model using the systems dynamics approach, where data traffic is represented as a flow. The economic dimension of the proposed solution is represented by value flows within the simulation model. The conceptual model was then implemented in Goldsim simulation environment. The stability tests have shown that the proposed solution is feasible, and that the achieved QoS level for each network user is dependent from his willingness to pay for the traffic. The paper concludes with the discussion about implementation possibilities and future research challenges.

Keywords: Internet pricing, Congestion control, Quality of Service, Smart Market, Systems dynamics simulation, Goldsim

Presenting Author's biography

Tomaž Turk is an economist and has a PhD in information sciences. He is an assistant professor and researcher at the Universtity of Ljubljana, Faculty of Economics. He teaches Development of Information Systems, Economics of Information Technology, Economics of Telecommunications, and Business Simulations. Currently his research work includes themes from communication networks management, internet society issues and economics of information systems. Besides being an active researcher in several research projects, he is also a Vice Chair of COST Action 298 - Participation in the Broadband Society, funded by European Science Foundation.

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A SIMULATION OF THE MACROECONOMIC EFFECTS OF INTRODUCING THE EURO IN SLOVENIA

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Abstract

On 1 January 2007, Slovenia adopted the euro as the first of the ten new EU member states that entered the union in 2004 and as the first transition country. By means of simulations with SLOPOL6, a macroeconometric model of the Slovene economy, this paper examines which macroeconomic effects can be expected from this event. It is shown that the introduction of the euro brings about temporarily higher real GDP growth, a permanently higher GDP level, more employment, temporarily lower inflation and a permanently lower price level. On the other hand, both public finances and the current account deteriorate. Costs arise primarily from the loss of the monetary policy instrument (and the nominal exchange rate in particular). As long as the business cycle is only loosely correlated to those of the other Euro Area member countries, monetary policy can serve as a useful instrument for coping with idiosyncratic shocks hitting the economy. Benefits of joining the Euro Area are rooted in the supply-side productivity increases. The benefits stem in particular from transaction cost savings resulting from the elimination of the bilateral exchange rate with the 12 incumbent Euro Area members, trade expansion due to the removal of exchange rate uncertainty, and reductions in the country risk premium contained in the interest rates.

Keywords: Euro Area, Macroeconometric model, Slovenia.

Presenting Author's biography

Klaus Weyerstrass. Klaus Weyerstrass is with the Economics and Finance department of the Institute for Advanced Studies, Vienna, Austria. He obtained his Master's degree in economics from the University of Osnabrueck (Germany), and his PhD from Klagenfurt University (Austria). In his dissertation thesis, he estimated a macroeconometric model for Slovenia and applied it to determine optimal macroeconomic policies for that country. His research interests cover macroeconomic modelling, business cycle analysis and forecasting, as well as fiscal and monetary policy aspects of European economic integration.

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ANALYSIS OF MULTI-SERVER QUEUEING SYSTEM WITH SEMI-MARKOVIAN INPUT FLOW AND NEGATIVE CUSTOMERS ACTED UPON QUEUE END

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Abstract

The multi-server queueing system with a finite of an infinite buffer, with semi-Markovian input flow (for positive and negative customers) and with Markovian Service Process (for positive customers) whose the number of the states of the process and the intensities of the transitions between phases depend on the number of the customers in the system is considered. An arriving negative customer kills the one positive customer at the end of the queue. The relations and algorithms for computation of the steady-state probabilities and for calculation of the steady-state distribution of waiting time of positive customer are received. It is shown how the multi-server queueing system with semi-Markovian input flow, the servicing of the phase type and the above mentioned order of act of the negative customers can be bring to the general queuing system.

Keywords: Queuing systems, Negative customers.

Presenting Author's Biography

Alexander V. Pechinkin was born in Moscow, Russia. He graduated from the Lomonosov Moscow State University in 1968. D. Sc. (Phys.-math.), Professor, author of more then 150 publications in the field of probability theory and its applications. At present he is Principal Scientist of Institute of Informatics Problems RAS.

SIMULATING ACTIVITY NETWORKS IN JAVA

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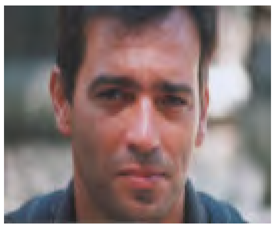
Abstract

In order to evaluate the performance of several scheduling policies for multiclass queuing networks we felt the need to develop a general purpose software package where different networks and policies can be tried, either from a set of pre-defined systems and policies or for user-defined systems and policies. In this paper we present a package to perform discrete event simulation of a manufacturing system with different configurations specified by the user, according to the framework of activity networks as introduced by Harrison in [1]. The package uses an object oriented modeling technique. The language in question is Java.

The architecture of the system to be simulated is described in file format, where the resources, routing patterns for customers and other parameters are specified. The user may choose the decision policies from a library of methods or can add new policies to this library. The modeling flexibility permitted includes standard multiclass queuing networks to be modeled, where there are a few types of customers, each characterized by a unique routing, at each stage of the routing customers wait in a specific buffer for the next service, and each server works on a customer at a time. The activity networks allow other configurations, where a given service may take more than a customer from different buffers. Some preliminary studies on the performance evaluation of distributed scheduling policies for queuing networks are presented as a means to provide insights on the type of utilization this package can have.

Keywords: activity networks, java simulation package, scheduling policies, performance evaluation

Presenting Author's biography



Carlos F. Bispo obtained the degrees of "Licenciatura" and MSc. on Electrical and Computer Engineering at the Instituto Superior Técnico, the engineering school of the Technical University of Lisbon, Portugal in 1985 and 1988, respectively. He obtained the degrees of MSc. and PhD on Industrial Administration, in 1993 and 1997, at the Carnegie Mellon University, Pittsburgh, USA.

He is currently a tenured Assistant Professor at the Department of Electrical and Computer Engineering of the IST and conducts his research activities at the Instituto de Sistemas e Robótica.

His main research interests are in the area of Operations Management, with particular emphasis on Scheduling for Queuing Networks, and Inventory Control.

A SIMULATOR FOR A GENERAL PACKET NETWORK DEVICE - SIMULATING A NEW SCHEDULER

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Abstract

When developing new network protocols, new functionalities of network devices, new traffic models and other novelties, we face the problem of non-existing tools. If we want to simulate the behavior of the network with a newly developed feature we have to develop a new simulator or add a new functionality to an existing simulation tool. Both options can be quite complex and/or time consuming. To facilitate the testing and simulation of a new packet scheduler that we developed during our research we have developed a simulator for a general model of a network device. For this purpose we have used the Modular Simulation language, MODSIM III. It is a general-purpose, modular, block structured language that provides support for object-oriented programming, discrete event simulation and animated graphics. The simulator includes modules for the most important elements and functions of a packet network device, modules for collection of results, and modules for writing the results into a standard format files. We have tested and validated the operation of the simulator with analytically verifiable settings. The simulation and analytical results were practically the same. Encouraged with that we have then simulated newly developed packet schedulers and network device functionalities. Some of the simulation results are presented in this article, more you can find in corresponding references.

Keywords: network device simulator, simulation, packet network, Modsim III, DRR

Presenting Author's Biography

Anton Kos has finished his graduate, masters and Ph.D. studies, in the fields of electronics and telecommunications, at the Faculty of Electrical Engineering, University of Ljubljana. Presently he is a researcher and a teaching assistant at the Laboratory of Communication Devices, Department of Telecommunications, Faculty of Electrical Engineering, University of Ljubljana. His research and teaching work is connected mainly to communication networks, especially IP networks. Inside this field he is focused primarily on the ways and techniques of Quality of Service assurance. He has been involved in the simulation of communication networks for more than ten years. During that time he has been using different network simulation tools and developing simulation models of network devices.

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EXPERIMENTAL EVALUATION OF CUMULATIVE LOOKAHEAD IN CONSERVATIVE PARALLEL SIMULATION

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Abstract

This work deals with performance improvement of parallel discrete event simulation. In parallel simulation, it is reasonable to focus on large scale models consisting of large number of entities. Such models are usually partitioned for parallel execution so that submodels contain multiple entities. The performance of a conservative parallel simulator is significantly influenced by the lookahead ability of the submodels. The key issue we study is how to combine the lookahead abilities of individual entities residing in a submodel thus enhancing the lookahead of the submodel. The study is conducted in the context of the synchronous time window based synchronization method. The lookahead for this method is constituted by two actions, in particular message pre-sending and future timestamp prediction. Given these actions at the level of model entities, we provide concepts and methods for their combining to get the corresponding cumulative abilities for the level of submodels. In this way the lookahead of the submodels can be enhanced and, consequently, simulation performance increased. We set up a series of experiments to evaluate the performance contribution of this approach. As benchmark models we use a variation of the parallel hold model and queuing networks. The results show that the proposed methods can significantly increase the average size of the time windows, and thus reduce the synchronization overhead.

Keywords: Parallel Simulation, Conservative Synchronization, Lookahead, Compound Submodels, Cumulative Lookahead.

Presenting Author's Biography

Viliam Solčány was born in Handlova, Slovak Republic and went to Slovak University of Technology, where he studied informatics and obtained his M. Eng. degree in 1991. He works part time as researcher at Faculty of Informatics and Information Technologies of Slovak University of Technology in Bratislava, Slovak Republic, and also at Austrian Academy of Sciences in Vienna, Austria. He is a member of ACM since 2004.

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A GENERAL PROGRAMMING MODEL FOR DISCRETE-TIME DISTRIBUTED SIMULATION

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Abstract

This article presents a general programming model for discrete-time distributed simulation. The model uses a shared memory interface that can be used by simulation applications. It allows for a description of the whole distributed simulation to be written in XML and compiled, generating code that can be used directly by the simulation application, requiring only small modifications to parallelize a single computer simulation program into a distributed one. The model is language and system independent and does not restrict to a single scheme of communication and model time synchronization. It makes use of the CORBA framework to achieve inter-operability. The model also enables to incorporate already existing simulation programs as well as real-time programs and computer systems. A review of time-stepped algorithms for distributed simulations and their possible applications, and another review about distributed barrier algorithms are included in the article. A time-stepped implementation of the model was developed, and a case study included, which uses a queuing networks example. The performance and precision of the developed model were evaluated through tests, using the provided case study, and the results were satisfactory, showing that by using the proposed model is possible to achieve high parallelization performance without loss in precision.

Keywords: Distributed simulation, time-stepped, discrete-time, CORBA

Presenting Author's biography

JOÃO DUARTE was born in Castelo Branco, Portugal in 1981 and went to the Faculty of Science of the University of Lisbon where he studied Computer Science and obtained his degree in 2004. After he moved to the University of West Bohemia in Pilsen, Czech Republic where he pursues his PhD degree. He is a member of the DSS research group and his interests include distributed computing and distributed simulations. His email address is duarte@kiv.zcu.cz and his web page can be found at http://home.zcu.cz/~duarte .

SIMULATION STUDY OF A PRIVATE DIAGNOSTIC CENTER

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Abstract

Decision making and management of health care in Greece is based mainly on financial assessment. The partial privatization of Greek health care led to increased competition and health providers are now searching for methods to facilitate decision making on qualitative and cost-related issues at an operational level.
This study is filling the gap in discrete event simulation of diagnostic health centers, and aims at outlining and disseminating the impact of simulation in the managerial decision taking process in health care management. A privately owned diagnostic center is modeled and the results are disseminated to the stakeholder company, a leader in private health care in Greece.
The center was in the process of relocating to a new location and three issues were addressed according to management inquiries: (i) current status assessment, (ii) modeling of the new center and performance assessment, and (iii) performance test in situations of increased service demand.
The project was implemented according to a precise action plan and stepwise methodology. Three scenarios were modeled and tested yielding the following main results: (i) the original format was efficient in serving current demand; (ii) the new setting improves performance and will be capable of handling increased demand; (iii) administrative staff cannot be reduced without serious performance deterioration. These findings were communicated to the center's management, they were accepted and some suggestions are implemented in the new setting by the diagnostic center management.

Keywords: Discrete Event Simulation, Health care management, Diagnostic center simulation.

Presenting Author's biography

Efthymios Altsitsiadis. Mr Altsitsiadis is a graduate of economics from the University of Macedonia, and post-graduate of two master degrees (Marketing in Katholieke Universiteit Leuven and IT and Management in Aristotle University of Thessaloniki, AUTH). He is currently enrolled in the second year of his PhD in the AUTH Medicine faculty studying health care management. He has served as a business analyst in a leading private Greek health organization, and is currently involved as a project manager in European funded health projects. He is also employed by AUTH as a lecturer of Health Care Management, and collaborates as an outsourcing consultant with a private consultancy firm.

START-UP SIMULATION FOR A SOLAR DESALINATION PLANT

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Abstract

AQUASOL project ("Enhanced Zero Discharge Seawater Desalination using Hybrid Solar Technology"), developed by CIEMAT (National Lab of the Education and Science Spanish Ministry), is a technological development in desalination with solar energy. The objective of this project is to improve the cost and energy efficiency of the process combing a solar field with a double effect absorption heat pump for continuous water production. With the aim of applying the technological innovations developed in this project to industrial applications, it is necessary to minimize production costs keeping the system in safe operation points. For this reason, this paper shows an automatic discrete operator that governs the start-up procedure for the whole system using *Modelica* language and *StateGraph* library. But also, for the start-up simulation it is necessary to describe the process dynamic that includes the models of each component as solar field, storage water system and distillation unit, developed with *Thermal* library components. On the other hand, control loops that optimize the process are included in order to obtain maximum system efficiency. This method makes possible to test an automatic system that can be useful to find the best conditions for operation, but also can be used as assistance to operate the real plant in the most autonomous way despite disturbances.

Keywords: solar desalination, control, modeling

Presenting Author's Biography

Lidia Roca obtained the degree in Electronic Engineering from the University of Granada, Spain, in 2004. She spent part of the academic year 2003/04 in the Plataforma Solar de Almería collaborating with studies related with the modeling of distributed solar collectors. Now is developing her PhD in modeling and control of a solar desalination plant, supervised by Manuel Berenguel (University of Almería) and Luis J. Yebra (CIEMAT).

SYSTEM DYNAMICS SIMULATION MODELLING OF THE VESSELS SYSTEMS AND PROCESSES

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ABSTRACT

The paper deals with dynamic analysis of automatic ship steering gear systems utilising complex controls that function according to the principle of proportional, integral and derivation regulators. The analysis involves a system dynamic simulation modelling methodology as one of the most suitable and effective means of dynamic modelling of complex non-linear, natural, organisational and technical systems.
The paper discusses system dynamics simulation models being used in qualitative (mental-verbal, structural) and quantitative (mathematical and computer) simulation models on ships equipped with trailing steering systems and PID regulator.
Authors suggest using the presented models for designing and constructing new steering systems, for diagnosing existing constructions and for education in Universities.

Keys words: System Dynamics, continuous model, simulation, ship direction.

Presenting Author's biography

Ante Munitić was born in Omis, Croatia. He received a double BS in 1. Electro-Energy Engineering and 2 Electronic Engineering, and a MS in Electronic-Operating Research at the University of Split, Croatia, and a Ph.D. degree in Organization Science (System Dynamics) at the Belgrade University, Yugoslavia. All degrees were earned while actively engaged in teaching at the university. He is now Full Professor Doctor of the Computer & Informatics Science and is a Maritime-Faculty University Professor of the following courses: 1. Computer science, 2. Marine Systems and Processes Management Modeling (System Dynamics) and 3. Marine Integral Information Systems. His research interests are 1. Researching System Dynamics Methodology, 2. Relative System Dynamics (optimization), 3. System Dynamics Analogizes, and 4. Dynamics of Chaotic System. He is a member of the Society for Computer Simulation and the System Dynamics Society.

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SYSTEM FOR INTERACTIVE 3D VEHICLE DYNAMICS ANALYSIS

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Abstract

The 3D vehicle dynamics simulation system combines the simulation model of a road vehicle and the display subsystem into a software application for scientific interactive driving simulation. The vehicle simulation model includes a fully parametric multibody-based model of driving dynamics that can simulate wheeled vehicles with four to eight wheels. Also included are mathematical models of powertrain elements, braking system and steering as well as models of interaction of vehicle with terrain and foreign objects. All the relevant parameters regarding the vehicle, the terrain and simulation system intrinsics, are accessible through graphical user interface. The terrain geometry can be imported from files in various formats and can be acquired from different sources. A separate software application has been developed for converting road surveying data to geometrical models of road sections for use in simulations. The results of simulations are presented in virtual 3D environment in real time. The user can navigate the virtual environment independently of simulated vehicle. The real-time input of vehicle control parameters is accomplished through a control device that can range from standard computer keyboards to real vehicle cockpit mock-ups. The simulation results can be exported as numerical data or digital video in real time. Part of the system is a library of 3D geometrical models of wheeled vehicles that can be used in various aspects of vehicle dynamics analysis. The entire system is used for preparing simulations, the results of which can be used for vehicle performance testing, vehicle – terrain interaction analysis, vehicle operator training etc.

Keywords: driving dynamics, vehicle simulation, virtual 3D display

Presenting Author's biography

Miha Ambrož is a researcher and Ph. D. student at the Department of Modelling in Engineering Sciences and Medicine, Faculty of Mechanical Engineering, University of Ljubljana. His main field of work is development of software for vehicle dynamics simulation and analysis.

DYNAMIC MODEL OF ELECTRICAL WHEELCHAIR WITH SLIPPING DETECTION

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Abstract

A power wheelchair was designed and built to faciliate the mobility for disabled people. Past few decades, the number of electric wheelchair users has increased as a result of an aging poplations, health care and technological advances. A dynamic model for power wheelchair taking into account the slipping effect that takes place while driving under non-normal conditions is presented in this paper. The parameters of the slipping will be also estimated. The wheelchair that considered in this paper is composed of two independently driven rear wheels and two castors. Electric wheelchairs have always very heavy weight. This makes them easy to slip under unfavorable road conditions. It is estimated that there are many serious accidents annually because of this problem. A method for detecting wheelchair slipping is also introduced. Simulated results are given demonstrating the applicability of the proposed method. Unlike other methods, the proposed scheme is based on only wheel speed measurements and does not require any information on the work space or wheelchair acceleration. Another advantage of this method is that its implementation cost is low.

Keywords: dynamic modeling, slipping, acceleration, wheelchair.

Presenting Author's Biography

Hamed Emam is a PhD student at the University of Versailles Saint Quentin in Yvelines, Systems Engineering Laboratory of Versailles (LISV). His thesis subject is"Dynamic modeling and control design for electrical wheelchair". This work is registered within the Assistance and Handicap (AH) team of LISV. This team aims to develop the evaluation methodology and adaptation processing of assistive technology for disabled people.

MATHEMATICAL MODELING OF CLOSED-CIRCUIT HYDROSTATIC TRANSMISSION

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Abstract

Besides the efficiency, the control ability and the fast response of a hydrostatic transmission are very important. In this regard, a DC servomotor can be applied as an actuator of the variable displacement mechanism of hydrostatic units. In this way, fast responses and favorable control ability can be accomplished. This paper gives a mathematical model of the closed-circuit hydrostatic transmission, with the DC servomotor actuated variable displacement swash-plate pump and a fixed displacement motor. The dynamics response of the swash-plate angle, and consequently of the pump flow, mainly depends on torques acting on the swash-plate. Relatively large torque is required to move the swash-plate quickly to a new position. Here the second order model of the swash-plate dynamics is given. The total model of the closed-circuit hydrostatic transmission is given in a form suitable for the experimental parameterization, since most of the required parameters are unavailable at producers' data, and they should be verified experimentally. The presented model will be experimentally validated on the experimental setup of the hydrostatic transmission, which is designed at our Laboratory. The model will provide a necessary basis for the development and application of advanced control methods.

Keywords: Hydraulic actuator, Nonlinear model, Servomotor

Presenting Author's biography

Joško Petrić received the B.S., M.S. and Ph.D. degrees, all in mechanical engineering, from the University of Zagreb, Zagreb, Croatia, in 1987, 1991, and 1994, respectively. He is currently an Associate Professor in the Faculty of Mechanical Engineering and Naval Architecture at the University of Zagreb. His areas of teaching include automatic control, mechatronics, robotics, and fluid power. His current research interests include modeling and control of automotive systems. Prof. Petrić is a member of the ASME.

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LINEAR AND NONLINEAR MODELING FOR AN ELECTRONIC THROTTLE BODY

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Abstract

An electronic throttle body is an important part of the automotive powertrain of modern passenger vehicles with spark ignition engines. This component should regulate the air mass flow into the intake manifold of the engine. A precise control of the throttle plate position is critical to drivability, fuel economy and to fullfill strict emission constraints. Cost, material and packaging regulations of the automotive industry let the throttle open-loop dynamics become rather complex, exhibiting numerous nonlinearities like e.g. friction and limp-home effects. Furthermore, nonlinear effects of the electronic throttle's electric drive augment this complexity again. Hence, the design for the position controller of the throttle plate becomes difficult and robust model-based control design strategies have to be applied. The aim of this paper is to give an overview of modeling approaches for an electronic throttle body. With a validated simulation model it would be much easier to develop a robust position controller for the throttle plate. This could be used as an inner loop in a complex control framework of an engine electronic control unit of a modern passenger vehicle. For the electronic throttle body several modeling approaches are discussed and compared. Hereby the main focus lies on an exact model description of the electric drive, the spring mechanism and the friction torques. The resulting simulation models are validated on a test rig and conclusions are drawn.

Keywords: Automotive applications, electronic throttle, permanent magnet actuator, friction modeling, limp-home effects

Presenting Author's Biography

Benedikt Alt received his diploma in aeronautical engineering and space technology from the University of Stuttgart, Stuttgart, Germany in 2005. Since 2006 he works as a research assistant in the control engineering group at the Department of Aeronautical Engineering at the University of the German Armed Forces, Munich, Germany. His research interests are modeling challenges for automotive and mechatronic applications and nonlinear and robust control design methods. Especially, his interest tends to sliding mode control theory.

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ROBUST OPTIMIZATION UNDER UNCERTAIN FACTORS OF ENVIRONMENT FOR SIMPLE GAIT OF BIPED ROBOTS

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Abstract

Many biped robots have sensing devices and actuators to control their body. And they can walk stably to apply pressure sensor, gyro sensor or acceleration sensor with walking control methods. If a biped robot has no sensors, it would slip or can not walk. However, it is worth pointing out, some biped robots can walk without sensors. They have only servo actuators to move their body or legs. In such a case, walking biped robots is affected environmental factors. There are restitution and friction between bottoms of its feet and floors. These affects are changed by the floor's surface or materials. And, these also depend on the location on the floor. Thus, biped robots can walk if they use the gait for them including friction and restitution coefficients as the environmental factors. In this paper, we study to optimize the gait for biped robots by using Simulated Annealing (SA), and robust optimization considered random values as floor's friction and restitution. In addition, the generated gait is simple for biped robots which have lately responding actuators or sensors. Thus, this method needs control system is very easy, and this simulation model is made by small and low cost a robot which has been selling at the hobby shops.

Keywords: Biped Robot, Gait, Simulated Annealing, Robust Optimization, Uncertain factors

Presenting Author's biography

Naoya Ito received his BE from Shibaura Institute of Technology, Japan, in 2007. He works in the Division of Mechanical Engineering, at the Graduate School of Engineering, in Shibaura Institute of Technology. His research interests are optimization methods and robotics technologies.

HUMAN-INSPIRED JUMPING ROBOT - DEVELOPMENT AND CONTROL OF DYNAMIC MODEL

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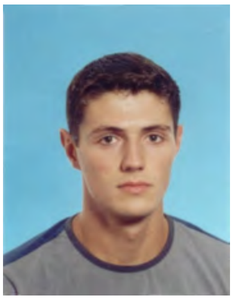
Abstract

In the paper we describe the complete design process of a real robotic system inspired by the anatomic properties or the human body. At the beginning we describe the starting points and the requirements that we wanted to achieve. Then we describe the CAD model of the robot and the construction of the real robotic system. The CAD model data were compared to the data of the manufactured robot parts and the final mechanical properties of the robot were derived.
In order to simulate and to control the real robot we have set the dynamic and the kinematic model of the robot. To obtain dynamic equations of the system we have used SD/FAST tool for modeling of mechanical systems, which is very computationally efficient and provides dynamic equations of the system. Since the robot behaves differently when it touches the ground and when it is in the air, we have derived two models. One for the cases, when the robot is in the air and has six DOF and one for the cases when the robot is on the ground and has four DOF. Using dynamic equations that we obtained using SD/FAST we have developed Simulink blocks for direct and inverse dynamics for both model types.
Afterwards, we have shown in the paper the development of the dynamic model of robotic systems with some uncontrollable joints, these are the joints, where it is not possible to apply any torque by a motor, e.g. in the x and y direction when the robot is in the air.
The derived dynamic model(s) are used for simulation of the jump and for the control of the real robot. In the last section of the paper, the controller of the robot is described and the results of the vertical jumps are presented.

Keywords: robot modeling, dynamic model, robot control, human-inspired robot, control of balance and stability

Presenting Author's biography

Damir Omrčen received his B.Sc. degree in automatics from the University of Ljubljana, Ljubljana, Slovenia, in 2000. From the same University he received in 2005 the Ph.D. degree in electrical science. He is currently a research assistant at the Jozef Stefan Institute, Department for Automatics, Biocybernetics and Robotics. His research interests include robot control, modeling and simulation, especially in bio and mobile robotics, redundant systems, mobile manipulators and robot assistants.



MODELING AND CONTROL OF AUTONOMOUS SKIING ROBOT

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Abstract

This paper presents development of the tools needed for simulation and control of a skiing humanoid robot. The goal of the overall project leads to an autonomous acting robot performing a ski-run based on the carving technique. For the simulation purposes, three main models were developed: model of the robot, model of interaction between skier and environment and the corresponding visualization. Dynamic model of the robot receives information about motion and local inclination from model of environment. Interaction between the skier and an environment consists of the turn of the ski dependent on the edging angle, direction of skiing and calculation of velocity. Information of the robot movement in the environment and the motion of robot itself is sent to the visualization module. Real-time visualization is used for testing of control algorithms for obstacle avoidance and path tracking. We developed also a simplified model of the robot skier for the real-time control. Furthermore, we dealt also with the dynamic stability of the skier based on zero moment point (ZMP). To simplify the calculation algorithm of ZMP on inclined surface we used the Newton-Euler formulation where ZMP is derived directly from the computation of the dynamics equations. Based on ZMP evaluation real-time control of stability for robot is proposed. Finally, simulation on the test course is demonstrated. Two runs are presented. First one has locked torso while second one has a controlled upper-body in order to increase stability. In both cases trajectory of the skier in environment is the same. Increase in lateral stability is shown with proper motion of upper-body.

Keywords: model of skiing robot, interaction between skier and environment, visualization, ZMP stability, simulation

Presenting Author's biography

Leon Lahajnar received his B.Sc. degree in automatics from the University of Ljubljana, Slovenia, in 2003. He is currently PhD Student at the Jozef Stefan Institute, Department for Automatics, Biocybernetics and Robotics. His research area is control of robotic systems based on sensors information similar to human in order to imitate human motion at defined activities.

MODIFIED BROYDEN METHOD FOR NOISE VISUAL SERVOING

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Abstract

Uncalibrated, model free, robot visual servoing has been widely applicable in robot vision due to minimal requirements related to calibration and robot kinematic's parameters. The numerical quasy-Newton methods offer a theoretical background for problem solving, which has been proven hard as the real system has been influenced with the noise. Consequently, additional attention has to be paid which assured stability and the robustness of the proposed method. In this paper we have introduced a new, modified Broyden method for nonlinear optimization problem solving. Modified Broyden method has been achieved applying the variable parameter, which values depend on the Broyden matrix convergence condition. In this paper the standard nonlinear optimization technique (Broyden methods for nonlinear equation solving) has been adopted according to Broyden matrix convergence condition and applied for visual servoing control problem which, due to the noise regularly present in the real systems, could be hardly control by the pure Broyden itself. The developed algorithm is verified by simulations for uncalibrated vision-guided robotic control and compared with four methods from literature, which have usually been used for the similar purpose. Modified Broyden method shows performance improvement over previous methods and is more robust in the presence of noise.

Keywords: Uncalibrated visual servoing, Jacobian estimation, Broyden matrix convergence

Presenting Author's biography

Mirjana Bonković received the B.S., M.S., and PhD. Degrees in electrical engineering from the University of Split, Split, Croatia, in 1990, 1994, and 200, respectively.
Since 1991, she has worked at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split, where she currently serves as associate professor. She was a visiting student at Robotics Research Group, University of Oxford, U.K., in 1995, and Visiting Research Fellow at the Institute of Robotics, University of Maribor, Slovenia, in 2004. Her research interests are image processing, pattern recognition, robot vision and bio-mimetic systems.

WRIST EXERCISER - EXERCISING FOR MODELING AND SIMULATION

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Abstract

Powerball®, Dynabee®, and Gyrotwister® are commercial names of similar gyroscopic devices that are marketed as a wrist exercisers. The device has rotor with two unactuated DOF and can be actuated with suitable motion of additional human or robot wrist axis [1]. After substantial initial rotor's spin, the properly applying torque and motion about wrist axis lead to spin-up of the rotor. Finding this torque intuitively is easy job for most peoples, but not so easy for technical consideration for example in robotics.

In the paper, a modeling of different modes of the device is presented. A dynamic model with nonholonomic rolling connection which appear in normal operate mode is discussed. With rotor and housing connection the additional friction effect is observed . When the nutation reaction torque M_N is to low, only dissipation of energy is observed. But when the reaction torque causes normal forces on a connection in a degree that the friction is high enough, the rotor shaft begins to roll. The connection with the housing takes place in a gap so two connecting pairs are possible. One is up-down for left precession and another is down-up for opposite precession rotation. Simulation results of spin-up considering variable structure dependence from friction effects of device is shown and experimenting with robot is discussed.

Keywords: gyroscopic device, modeling, simulation, robotics.

Presenting Author's biography

Peter Cafuta was born in Maribor, Slovenia, on February 1, 1951. He received the B.S. and M.S. degrees from Faculty of Electrical Engineering, Ljubljana, in 1974 and 1976, respectively, and the Ph.D. degree from Faculty of Technical Sciences, University of Maribor, in 1987. Since 1976, he has been with the Faculty of Electrical Engineering and Computer Sciences of Maribor, in the field of modeling, simulations, servodrives, and robotics.

PATH PLANNING FOR ELECTRICAL WHEELCHAIR, ACCESSIBILITY AND COMFORT FOR DISABLED PEOPLE

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Abstract

In today's residential and industrial environment, adapting the space to handicapped persons is an important condition that has to be fulfilled. The accessibility of space to wheelchairs is a subject that has gained extensive attention. The problem that has to solved is similar to that of the mobile robot path planning case. In this case, the conditions are more stringent than the mobile robot path palnning. However, the planner has to produce trajectories of better quality. In this work, the authors address this problem and start from the mobile robot case to benefit from the experience in this field. A large number of techniques has been developed. Nowadays researchers are improving new techniques in order to carry out efficient robot path planning. Avoiding obstacles is a basic requirement present in almost all mobile robots planning methods. In the second stage, these trajectories are used as initials solutions for functions to evaluate and improve accessibility and comfort for disabled people. A study on different path planning methods such as, roadmaps, cell decomposition, mixed integer linear problem model, potential field and medial axis was done. A potential field method (directed potential field) is developed in order to improve this category of methods. The result of the various path-planning methods produced an initial trajectory. This trajectory is used as input to the second stage: 'Evaluation and Improvement of Accessibility and Comfort'.

Keywords: Accessibility, Disabled people, Comfort, Path planning, Potential field, Wheelchair.

Presenting Author's Biography

Fadi Taychouri is a PhD student at the University of Versailles Saint Quentin in Yvelines, Systems Engineering Laboratory of Versailles (LISV). His thesis subject is "Evaluation and improvement of accessibility for disabled persons based on modelling tools and Virtual Reality". This work is carried within the Assistance and Handicap (AH) team of LISV. This team aims to develop evaluation methodology and adaptation processing of assistive technology for the disabled.

MARKDOWN MANAGEMENT IN PRACTICE

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Abstract

Price is a key element for retailing because it communicates information about the brand, product, value proposition and overall strategy of the retailer. A permanent price reduction of an item over time is known by definition as 'markdown'. Markdown is a pricing strategy, found in nearly every retail store including apparel retail, consumer products, fashion style goods or just any products with a limited life cycle. It is often used to make up for buying errors resulting from demand unpredictability and to clear out stock over time. While discounts increase sales on the one hand they erode profits on the other hand. Thus optimizing the timing and magnitude of markdowns is crucial for liquidating a specified inventory quantity at the maximum profit over a set amount of time. Presently retail buyers do this balancing mainly based on intuitive experience and 'rules of thumb'.
In this work we use a mathematical model for markdown industries with the aim of maximizing total expected profits over the end of season sale. In order to provide a powerful DSS (decision support system) for retailers we have to understand the customer-demand patterns and price sensitivities and we have to forecast consumer demand. A major part of this procedure is parameter estimation for gaining valuable demand data. Once the selling season begins, there is an opportunity of revising prior demand estimates using actual sales data. In our model we implement an adaptive learning mechanism such that we can expect the estimates of demand to get better tuned as the season progresses. Based on these results we calculate an optimal markdown-pricing policy via a dynamic programming approach. Furthermore we give results of a case study which is conducted at a renowned Austrian fashion retailer.

Keywords: Retail Management, Markdown Pricing, Adaptive Learning, Dynamic Programming

Presenting Author's Biography

Wolfgang Weidinger. Master of Science in Technical Mathematics (Modelling and Simulation, Numerical Mathematics, OR) at Vienna University of Technology. Working experience in indemnity insurance and aviation industry. Currently at the R&D department of Prolytic - Marketing Engineering, Consulting & Software GmbH.
Research interests: Pricing models, Dynamic Programming, Adaptive learning methods.

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TRANSITION TO PARENTHOOD: THE ROLE OF SOCIAL INTERACTIONS AND ENDOGENOUS NETWORKS

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Abstract

In this paper we present an agent based simulation model to explain an individuals transition to parenthood and higher levels of parity, respectively. Our simulation is based upon empirical research carrying out in-depth interviews regarding fertility and family choices. The qualitative findings of these empirical studies constitute the decision rules of our quantitative approach. This allows us to explain the patterns of age specific fertility and their changes over time which have been observed on the macro level from the bottom-up. Our hypothesis is that an individuals fertility preferences are influenced by the parity distribution within the individuals peer group. Therefore, our agent based simulations take into account how social interaction creates interdependencies in the individual transition to parenthood and its timing. We build a one-sex model and provide agents with four different characteristics. Based on theses characteristics agents endogenously form their individual network of relevant others. The set of relevant others is exposed to a continuous fluctuation during the simulation (dynamics of the network). Moreover, network members may influence the agents' transition to higher parity levels (dynamics on the network). The agents compare the share of agents with a higher parity than their own within their peer group with the same share on the aggregate level in order to adapt their individual age and parity specific birth probability. Our numerical simulations indicate that accounting for social interactions is important to explain the shift of first birth probabilities in Austria over the period from 1984 to 1994.

Keywords: agent based modelling, social networks, network dynamics, fertiliy, social learning.

Presenting Author's Biography

Thomas Fent is a research fellow at the Vienna Institute of Demography of the Austrian Academy of Sciences. His research interests include ageing, productivity, human capital investment, economic growth, social networks, and social interactions. He has a PhD in applied mathematics from the Vienna University of Technology.

USING ANYLOGIC AND AGENT-BASED APPROACH TO MODEL CONSUMER MARKET

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Abstract

In the highly dynamic, competitive and complex market environments (such as telecom, insurance, leasing, health, etc) the consumer's choice essentially depends on a number of individual characteristics, inherent dynamics of the consumer, network of contacts and interactions, and external influences that may be best captured within the Agent Based modeling paradigm. The Agent Based modeling is especially advantageous in the consumer market domain as it allows to leverage the full amount of individual-centric data from the CRM (Customer Relationships Management) systems highly available these days. Although there are no universal straightforward instructions for building Agent Based models, there are certain common steps and patterns. The goal of this paper is to introduce the patterns in consumer market modeling most frequently met in our consulting practice. The modeling language of AnyLogic is used throughout the paper.

Keywords: Agent Based Modeling, Market modeling, Strategist games, AnyLogic

Presenting Author's biography

Andrei Borshchev, Co-founder and CEO, XJ Technologies. Andrei received his MSc in 1989 from Technical University of St.Petersburg, Russia in Computer Science & Complex Systems Modeling. In early 1990s he worked for Hewlett-Packard Labs applying verification and simulation techniques to a number of HP products. Co-founded XJ Technologies in 1992. Completed PhD in Simulation Modeling in the TU of St.Petersburg in 1995. From 1998 led the design and development of an innovative multi-method simulation tool AnyLogic, and then its launch in the commercial simulation tool market. Andrei is a member of the System Dynamics Society and a constant contributor to the International System Dynamics Conference, the Winter Simulation Conference and other major events in the worldwide simulation community. Andrei has published over 50 papers and conducted numerous lectures, workshops, and training sessions on simulation modeling and AnyLogic.

A HYBRID SIMULATION OPTIMIZATION APPROACH FOR SUPPLY CHAINS

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Abstract

The main idea of our approach is to combine discrete-event simulation and exact optimization for supply chain network models. Simulation models are constructed in order to mimic a real system including all necessary stochastic and nonlinear elements. Such simulation models are used as proving grounds for analyzing and improving a real situation on a trial-and-error basis. A traditional optimization method on top of a simulation model has major disadvantages: The optimization method uses the simulation model as a black-box. Information about the structure of the problem is not available and cannot be used for an intelligent optimization strategy.
On the other hand pure optimization models used for planning scenarios are usually built on a very abstract level neglecting possibly important nonlinear and stochastic properties. This is necessary, because otherwise the resulting complex optimization models cannot be solved and are therefore of no use.
We present a possible way out of this dilemma by combining the use of a simple optimization model within the framework of a complex simulation model. The embedded optimization model is used to improve the overall performance by adapting decision rules. Based on the idea of a fixed-point iteration we couple a discrete-event model and its linearized deterministic representation and solve it alternately. Already after a few iterations we can gain convergence to good quality solutions within much less computational time than traditional optimization approaches.

Keywords: discrete-event simulation, optimization, supply chains, improvement strategies, decision support systems

Presenting Author's biography

Christian Almeder works currently as an assistant professor at the Institute for Business Administration at the University of Vienna. He made his Ph.D. in Applied Mathematics at Institute for Analysis and Technical Mathematics and worked several years as a research assistant at the Department of Operational Research at the Vienna University of Technology. His publications stretches from mathematical simulation in the fields of biomedical engineering and epidemiology to operations research in production and logistics.

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MODELLING ADVERTISING AND PRODUCTION STRATEGIES USING CELLULAR AUTOMATA

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Abstract

In this paper we describe a simulation approach to explore different advertising strategies in a heterogeneous consumer market. The main focus is to model the dynamic of two competing advertising channels and their dynamic advertising effects. Here one advertising channel effects all consumers at the same time representing traditional large-area advertising instruments like broadcasting or print media, and the second represents the dispersion of post-purchase information in the customers' social circle - called word-of-mouth advertising. Here a model of an artificial consumer market has been used to provide an experimental environment for the simulation and optimization task - modelling typical stylized facts of software business. So the stylized facts are modeled using a hybrid approach of combining a continuous process described by an ordinary differential equation linked with discrete update processes of cellular automata. The stability of the model is shown by comparing a homogeneous and a heterogenous market scenario. Additionally the amount of exaggeration of the product features has been varied to figure out the influence of the resulting dissatisfaction to sales and profit of the companies. This fact is related to product development decisions and production processes. It is shown that some exaggeration generates a higher outcome, but due to the word-of-mouth effects too much exaggeration destroys the market at all.

Keywords: Artificial consumer market, Cellular Automata, Advertising strategies

Presenting Author's Biography

Jürgen Wöckl studied "Physics and Economics" and received a doctoral degree in mathematics at the Technical University of Vienna (Institute of Analysis and Scientific Computing, Prof. Breitenecker). Since his participation in a research program at the University of Economics called "Adaptive Information Systems and Modelling in Economics and Management" and funded by the Austrian Science Foundation (FWF) - his interests are focused on mathematical modelling and simulation in economics. Since 2006 he is assistant professor at the Vienna University of Economics and Business Administration (Institute for Production Management, Prof. Taudes).

UNDERSTANDING RETAIL PRODUCTIVITY BY SIMULATING MANAGEMENT PRACTICES

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Abstract

Intelligent agents offer a new and exciting way of understanding the world of work. In this paper we apply agent-based modeling and simulation to investigate a set of problems in a retail context. Specifically, we are working to understand the relationship between human resource management practices and retail productivity. Despite the fact we are working within a relatively novel and complex domain, it is clear that intelligent agents could offer potential for fostering sustainable organizational capabilities in the future. Our research so far has led us to conduct case study work with a top ten UK retailer, collecting data in four departments in two stores. Based on our case study data we have built and tested a first version of a department store simulator. In this paper we will report on the current development of our simulator which includes new features concerning more realistic data on the pattern of footfall during the day and the week, a more differentiated view of customers, and the evolution of customers over time. This allows us to investigate more complex scenarios and to analyze the impact of various management practices.

Keywords: Agent-Based Modeling and Simulation, Retail Productivity, Management Practices, Shopping Behavior, Multi-Disciplinary Research.

Presenting Author's biography

Peer-Olaf Siebers is a Research Fellow in the School of Computer Science & IT at the University of Nottingham. His main research interest is the application of computer simulation to study human oriented complex adaptive systems. Complementary fields of interest include distributed artificial intelligence, biologically inspired computing, game character behavior modeling, and agent-based robotics. His webpage can be found via <www.cs.nott.ac.uk/~pos>.

SIMULATION HELPS EVALUATE AND REDESIGN SEAT ARMREST ASSEMBLY

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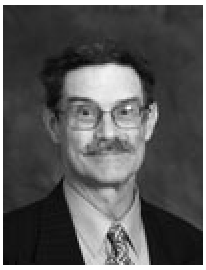
Abstract

A multifaceted industrial engineering approach, using simulation, ergonomic analyses, facility layout and material handling assessments, and quality control and enhancement, was applied to the assembly of personal-vehicle passenger seats. The company assembling these seats is a Detroit [Michigan]-area company with a checkered history dating back nearly a century; the company is now a Tier I automotive supplier. In this paper, we describe the role played by simulation in process improvement, particularly the utilization of operators, and the collaborations between simulation analysis and the other analytical techniques of industrial engineering used.

Keywords: discrete-event simulation, manufacturing simulation, Arena®.

Presenting Author's biography



EDWARD J. WILLIAMS holds bachelor's and master's degrees in mathematics (Michigan State University, 1967; University of Wisconsin, 1968). From 1969 to 1971, he did statistical programming and analysis of biomedical data at Walter Reed Army Hospital, Washington, D.C. He joined Ford Motor Company in 1972, where he worked until retirement in December 2001 as a computer software analyst supporting statistical and simulation software. After retirement from Ford, he joined Production Modeling Corporation, Dearborn, Michigan, as a senior simulation analyst. Also, since 1980, he has taught evening classes at the University of Michigan, including both undergraduate and graduate simulation classes using GPSS/H™, SLAM II™, SIMAN™, ProModel®, SIMUL8®, or Arena®. He is a member of the Institute of Industrial Engineers [IIE], the Society for Computer Simulation International [SCS], and the Michigan Simulation Users' Group [MSUG]. He serves on the editorial board of the International Journal of Industrial Engineering – Applications and Practice. During the last several years, he has given invited plenary addresses on simulation and statistics at conferences in Monterrey, México; Istanbul, Turkey; Genova, Italy; Riga, Latvia; and Jyväskylä, Finland. He has just served as Program Chair of the 2004, 2005, and 2006 Summer Computer Simulation Conferences, and for the 2005 IIE Simulation Conference. E-mail address and university web pages: ewilliams@pmcorp.com and http://www-personal.umd.umich.edu/~williame.

CONTROL OF MANUFACTURING SYSTEM BY AGENTS OF MATERALS, PARTS AND PRODUCTS

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Abstract

This paper deals with a new multi-agent approach to control a manufacturing process system where agents represent materials, parts and products, thus allowing increased reactivity and flexibility. It is based on bionic manufacturing paradigm, where raw materials carry information about possible processing. The Manufacturing System (MS) is made up of a set of autonomous and intelligent agents as in a society. The simulation of the control system, of discrete-event type, is based on agents of materials and products. An experimental platform was built for this purpose. An agent, able to negotiate operations that the product must undergo on the stations in manufacturing, is attached to it. This agent has all the necessary information on production environment, objectives, constraints and rules. A Product Model (PM) for production based on a social approach with a decentralized architecture is presented. The PM was introduced into a common experimental platform developed by the partners of the SPACS Project. The latter integrates all the elements necessary for the management of the production in interaction with the Electronic Data Interchanges (EDI) amongst clients and subcontractors.

Keywords: Flexible Manufacturing Systems, Product Model, Scheduling algorithm, Multi-agent System.

Presenting Author's biography

Peter MITROUCHEV graduated from Technical University of Sofia, Bulgaria in 1983, Degree M.Sc. in Mechanical Engineering. He obtained his Ph.D. degree in Automation and Computer Sciences from the University of Besançon, France in 1992. Since September 1993 he has been working as Associate Professor at Grenoble University "Joseph Fourier-1" in the Department on Mechanical Engineering. Performing research at the Laboratory G-SCOP. Member of the European network of excellence VRL-KCiP. The research area addressed covers: Modeling and design of mechanisms and multi-body systems, Assembly Disassembly simulation, Digital mock-up, Self-scheduling for flexible manufacturing systems and Mechatronics.

OPTIMAL SELECTION OF INFORMATION TERMINALS FOR DATA ACQUISITION IN MANUFACTURING PROCESSES

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Abstract

Information terminals are devices used in manufacturing industries for registering relevant events such as start and end of operations, emergence of a fault or breakdown, the amount of manufactured items as well as the amount of scrap. The data collected by the terminals serve to fully monitor the manufacturing process. In addition, data are archived in the business information system thus allowing the overview on system performance and costs. The problem treated in this paper is to select the optimal number of the terminals needed to accommodate the needs of a manufacturing process. This implies minimization of a cost function which combines investment costs and eventual losses caused by waiting times during busy sessions. The events that have to be registered appear at random times. To simulate the performance of a certain number of installed terminals a suitably long realization of random events is needed. Without terminals, the events acquisition can be done only by hands, which not only takes effort but is also vulnerable to erratic entries. In order to avoid manual acquisition of long events records we propose to use the model of random events.The solution we suggest employs prior distribution of events recorded during the production process. This information is then used for estimation of the probability density function (pdf) of time intervals between two consecutive events. The pdf, in turn, serves for generating statistically significant number of realizations of events records (Monte Carlo simulation) that provide the distribution of waiting times under various configurations of information terminals. A case study dealing with optimal selection of terminals in a real production process is presented in detail.

Keywords: production systems, optimization, production monitoring, production control.

Presenting Author's Biography

Jani Kleindienst graduated in computer science, Faculty of Computer and Information Science, University of Ljubljana, in 2000 and completed his MSc. degree in information managemet at the Faculty of Economics in 2004. Since 2000 he has been affiliated with company Synatec, serving as software developer, project manager and chief software architect. He has been involved in the design and development of information systems for on-line production monitoring. He is now employed as a R&D project manager in a newly founded company Kolektor Sinabit and PhD student at the Jožef Stefan International Postgraduate School.

ADMISSIBLE BEHAVIOUR BASED ANALYSIS OF DEADLOCK IN PETRI NET CONTROLLERS

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Abstract

The paper addresses the problem of verification of discrete control logic that is typically implemented by programmable controllers. To make the results of such a verification approach useful for the control, an adequate model of the process under control is needed, which is not readily available in many cases. To facilitate the derivation of the process model an approach is proposed in the paper, which combines the calculation of safety oriented interlock controllers in terms of supervisory control theory (SCT), the corresponding calculation of admissible behaviour of the system, and specification of desired system operation by Petri nets. The interlock part of the logic is designed by SCT while operational procedures are specified by a Petri net, extended by input and output mappings. A potential deadlock in the controlled system is then verified taking the admissible behaviour model as a process model. The analysis of the simultaneously operated supervisory control based interlock controller and Petri net based sequential controller is based on the C-reachability graph. The paper is focused on the calculation of the graph. A corresponding algorithm is presented and some remarks about computational complexity are given. The application of the algorithm is illustrated by a simple manufacturing cell example.

Keywords: Petri nets, modelling, manufacturing systems, logic controllers.

Presenting Author's Biography

Gašper Mušič received B.Sc., M.Sc. and Ph.D. degrees in electrical engineering from the University of Ljubljana, Slovenia in 1992, 1995, and 1998, respectively. He is Associate Professor at the Faculty of Electrical Engineering, University of Ljubljana. His research interest are in discrete event and hybrid dynamical systems, supervisory control, and applications in industrial process control.

MODELING AND SIMULATION OF MANUFACTURING SYSTEMS

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Abstract

In this paper we present a methodology for modeling and simulation of dynamical discrete event systems (DDES), predominantly flexible manufacturing systems (FMS). Proposed technique is based on the matrix representation of a manufacturing system. Although prerequisites that are required for an event to start are given by static model of DES, we are not able to tell in which particular moment these prerequisites are met, i.e. we do not know when the event actually starts. In real applications on actual manufacturing processes, we will be sensing the completion of prerequisite jobs by either using sensors (e.g., proximity, tactile, etc.) or via notification from the machines or resources. On the other hand, for the purpose of computer simulation, we must find a way to keep track of time lapsed in the processing of jobs. To keep track of jobs time durations, we incorporated the system dynamics into the matrix model in a form of an *extended lifetime*. That is, a real number d_i, called a lifetime, is associated with each task in an MS. Problem that we analyze in the paper is that when described as a bill-of-material (BOM), or in some other engineering form, the job sequence does not disclose potential difficulties that might develop when the structure of an MS, which executes this particular sequence, is determined. In the paper we show how two of these potential difficulties, conflict and deadlock, can be exposed by using static and dynamic simulations of an MS. Based on the matrix model, these simulations provide a complete insight in the system performance.

Keywords: Manufacturing Systems, Matrix-algebra, Modeling, Simulation

Presenting Author's biography

Stjepan Bogdan received his Ph.D.E.E. in 1999, M.S.E.E. in 1993, and B.S.E.E. in 1990 at the University of Zagreb, Croatia. He is currently an assistant professor at the Department of Control and Computer Engineering, Faculty of EE&C, University of Zagreb. His areas of interest are robotics, discrete event systems, and autonomous and intelligent systems. He received a Fulbright scholarship in 1996/97 and worked as a visitor researcher in the Automation and Robotics Research Institute, University of Texas at Arlington, with research group of Prof. Frank L. Lewis. He is a principle investigator and a project leader of several R&D projects founded by industry and government. He is a coauthor of three books and numerous papers published in journals and presented at conferences. He is a member of KoREMA, the IEEE, Sigma Xi, and a vice-president of Croatian Robotics Society.

TRANSPORT OPTIMIZATION IN JOB-SHOP PRODUCTION USING LINEAR PROGRAMING

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Abstract

In the medium-size factory in production of finally plastics products for household use the reconstruction plan was made to improve the utilization of the central automatic pallet storehouse using intermediate storage facilities. The locations and capacities of this additional storage places should be established considering the existent floor layout, the number and capacity of forklifts, the possibility of inter-process storage of half-products and restoring the pallets after the production cycle.

Linear programming (LP) was used to resolve the machine assignment problem for a set of characteristic production plans. Supported with non-delay scheduler program the group of human experts then produced the series of Gantt charts as they would be used in job shop production environment. The analysis of Gantt charts, with the production plan partitioned into appropriate time sections, was made with the optimization program. LP here was used to calculate optimal costs for transport alternatives, to locate the storage areas, to determine their capacity and in particular the inter-process storage possibilities were taken into account. In addition the circular flow of pallets was included into formulation. The results were the part of documentation for restructuring the factory.

The LP algorithm itself is a variant of transport algorithm, using time sections which correspond with the distinct vertical cross-sections of Gantt-charts. The specific task was the inclusion of partially full pallets into the way of transport and the treating of emptied pallets as well.

Keywords: Production layout, Machine assignment, Inter-storage calculation, Transport way alternatives, Linear programming.

Presenting Author's biography

Lado Lenart. Received his Ph.D. degree in Chemical Engineering by the Technical University Clausthal (Germany) in 1972 and his Ph.D. degree in Electrical Engineering by the University in Ljubljana (Slovenia) in 1993. He was with the ISKRA-Avtomatika R&D Institute and is now working in robotics field at "Jožef Stefan" Institute in Ljubljana (SI). He was assistant Professor at the University in Maribor (Sl) for 'Real Time Systems'. His interests are embedded systems and operational research.

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SOPHISTICATED REAL-TIME TESTS ON PROTECTION RELAYS AND TURBINE CONTROLLERS WITH DINEMO-II AND PSS^{TM}NETOMAC

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Abstract

The DINEMO-II (Digital Network Model) is an intelligent signal treating device that works as a real-time transceiver between protection relays or turbine controllers and simulation programs for electrical power systems like PSS^{TM}NETOMAC, running on a standard Windows-PC. DINEMO-II allows real-time simulation with up to 16 in PSS^{TM}NETOMAC continuously calculated analog output signals and the treatment of four analog or sixteen digital feed back signals of the equipment under test, thus allowing a closed-loop interaction between protection relays or controllers and the simulation program. This reaction in real-time with round-trip times of up to 0.15 ms, depending on the network traffic, is possible using PSS^{TM}NETOMAC with its high speed calculation algorithms together with Dual Core CPUs under Win XP. DINEMO-II is used for tests with analog controllers with input voltages of max. ±10 V and with frequencies of up to 5 kHz. With additional power amplifiers close-to-reality tests can be accomplished with standard protection relays. The test networks can be easily designed using the graphical editor Netdraw which comes with PSS^{TM}NETOMAC. This allows to make extensive tests on protection relay configurations using detailed models of all network elements.

Keywords: DINEMO-II, PSS^{TM}NETOMAC, Power System Simulation, Protection Relays, Real-time Tests

Presenting Author's biography

Georg Duschl-Graw was born in 1959 in Backnang, Germany. He studied Electrical Engineering in Stuttgart and Berlin, where he got his diploma and in 1992 his PhD. He works with SIEMENS since 2002 and is Professor for Electrical Machines and Renewable Energies at the University for applied Sciences TFH Berlin since 2007.

BLACK-OUT PREVENTION BY DYNAMIC SECURITY ASSESSMENT FOR LARGE ELECTRICAL POWER GRIDS

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Abstract

In the last 10 years the number of severe fault situations and black outs world wide is increasing. The classical static security assessment is used to monitor the system situation after contingencies, but is not able to take into account the complex dynamic behaviour of an electrical system together with the control of generators and grid equipment like switched capacitors or FACTS together with the protection reaction in unforeseeable situations after severe system faults. The paper describes a modern dynamic security assessment (DSA) system which allows handling predefined dynamic contingencies in real-time and intelligent proceeding and evaluation. The base of the system is the system simulation tool PSS™NETOMAC, which can simulate the dynamic behaviour of large electrical systems including control and protection. A contingency builder allows the user to define the interesting contingency scenarios. The events can be calculated in real time which means, that about 100 cases can be handled in about 5 minutes, depending on the system size. The DSA-system analyses the events using an intelligent and flexible criteria editor which gives the opportunity to select criteria for critical system time behaviour. The information about severe cases is available in a protocol for easy recalculation of critical cases in details with more parameters checked and monitored. The results can be used to monitor the overall situation of a system periodically. The paper will show the main structure of the DSA-system and the capability of handling real time contingency calculations in a large electrical system.

Keywords: Black-Outs, System Dynamics, Dynamic Security Assessment

Presenting Author's biography

Olaf Ruhle received his Dipl.-Ing. and his Ph. D. degree in electrical engineering from the Technical University of Berlin in 1990 and 1994 respectively. Since 1993 he is a member of Power Transmission and Distribution Group and the system planning department at Siemens in Erlangen, Germany. He is working as a Senior Consultant / Senior Product Manager on power system stability, dynamics of multimachine systems, control, optimization and identification problems in electrical power systems. He is responsible for the program system PSS™NETOMAC support, sale and training worldwide. He is visiting professor at several universities.

SIMULATION OF LARGE WIND FARMS USING COHERENCY APPROACH

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Abstract

The penetration of wind turbines (WT) connected to the power system has increased enormously in recent years. As a result, they can no longer be neglected during power system planning and analysis. However, with over 18500 units in Germany alone, considering all of the individual wind turbines during the preparation of a power system model is not possible [1]. It could lead to an enormous burden of the simulators on the one hand and cause problems with the numeric stability of the simulation on the other hand. Therefore, an alternative method for aggregated representation of large wind farms for power system analysis is needed that would retain their dynamic characteristics. Such an approach is especially conceivable for the off-shore wind farms, which usually consist of a high number of wind turbines placed in similar distance to each other that are concentrated in one location. The aggregation method presented in this paper is based on the coherency analysis of the input wind speeds for individual wind turbines in a wind farm. The input wind speeds for individual wind turbines results from the farm's incoming wind profile and the mutual interactions between wind turbines; the so-called wake effect. In general, the intensity of the wake effect depends on the type of wind turbine, farm structure, wind direction and wind speed. Modern wind turbines vary their angular speed in order to find an optimal operation point according to the present wind conditions. Since wind turbines represent non-linear systems, their dynamic reaction for system faults depends strongly on the point of operation, and this should be considered in the aggregated simulation of wind farms.

Keywords: Power System, Wind Energy, Wind Park Simulation, Model Reduction.

Presenting Author's biography

Krzysztof Rudion studied electrical engineering at the Wroclaw University of Technology, Poland and the Rostock University of Technology, Germany. He graduated in 2003 from the Wroclaw University of Technology with a Dipl.-Ing. degree. He then joined the Chair of Electric Power Networks and Renewable Energy Sources at the Otto-von-Guericke-University Magdeburg, Germany as a research engineer. His primary field of interest is dispersed generation with a focus on wind energy.

MODELLING OF FACTS DEVICES FOR TRANSIENT-STABILITY ASSESSMENT USING DIRECT METHODS

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Abstract

To analyze the behaviour of electric-power systems (EPSs), the simulation on the base of the proper model is the only practical solution. Variouos models of an EPS are used for various types of the analysis. The paper deals with the phenomena of the transient stability, i.e., the stability of an EPS when subjected to large disturbance. While a typical method for transient-stability assessment is the repetition of numerical integration of EPS's nonlinear differential equations, in this paper we focus on an alternative, simplified method, i.e., the Lyapunov direct method. Using this method, an EPS should be presented with an energy function, i.e., with the set of nonlinear algebraic (non-differential) equations. The energy function for the EPS was already constructed. However, with the introduction of new devices like FACTS devices this energy function should be supplemented in order to consider the effect of these devices. The paper presents how to model FACTS devices and how to supplement the existing energy function for the case of a STATCOM with an energy function (STATCOM-ESS). An injection model of a STATCOM-ESS is constructed and according to this model the energy function for the EPS that includes a STATCOM-ESS is constructed. The energy function is developed for the EPS with preserved structure, therefore the effect of the STATCOM-ESS is described by an additional term that can be added to the existing energy function. This approach enables a simultaneous consideration of multiple FACTS devices connected at various nodes of an EPS. The adequacy of newly constructed energy funtion was proved by numerical examples of transient-stability assessment using the Lyapunov direct method. The proposed energy functions proved to be adequate and the results show an improvement of transient stability.

Keywords: Power-system control, power-system stability, FACTS devices.

Presenting Author's biography

Valentin Ažbe received his B.Sc., M.Sc. and Dr.Sc degrees from The University of Ljubljana, Slovenia, in 1996, 2003, and 2005, respectively. After receiving his diploma he worked with IBE, consulting engineers, Slovenia, as a project manager in the Department for Overhead-Lines design. In 2000 he joined the Department of Power Systems and Devices at the Faculty of Electrical Engineering, The University of Ljubljana, where he has since worked as a junior researcher. In 2005 he became a Teaching Assistant. His areas of interest include system analysis, FACTS devices, power-system protection and DC power-system analysis.

MODELLING OF POWER ELECTRONICS BY PSCAD: FREQUENCY SCANNING METHOD

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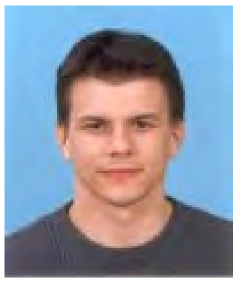
Abstract

Devices based on power electronics play an important role in modern power systems. They are already used in transmission and distribution networks for ensuring continuity of supply and for increasing quality of power supplied to the customers. Simulations are an essential part of design and operation analysis of power systems; as such systems are usually too large and complex for analytical solutions. The paper presents guidelines for modelling power electronics in power engineering applications and concentrates on the PSCAD program. PSCAD is a simulation tool for studying transient behaviour of electrical power networks. A basic description of the program is given in the paper and modelling of power electronics systems is also described.
As a simulation case the frequency scanning method is presented. The method is used to identify the frequency characteristic of a static compensator (STATCOM), which shows the frequency dependence of the device impedance. Simulation results are also compared with analytical calculations. When the device control algorithm is not taken into account the simulation results agree well with theoretical results and show that STATCOM is a frequency dependent device. Its frequency characteristic also depends on the device operating point. When the device control algorithm is included the results change and depend heavily on the used control scheme. The system also becomes quite complex which makes analytical formulation difficult. However, the simulation model can be efficiently used, which shows the usefulness of simulation programs.

Keywords: FACTS, STATCOM, Frequency scanning, Frequency characteristics.

Presenting Author's biography

Boštjan Blažič received the B.Sc., M.Sc. and Ph.D. degrees, all in electrical engineering from the University of Ljubljana, Ljubljana, Slovenia, in 2000, 2003 and 2005, respectively. Currently he is a researcher with the Faculty of Electrical Engineering, Ljubljana, Slovenia. His research interests include power quality, distributed generation, mathematical analysis and control of power converters.



DEVELOPMENT OF NONLINEAR TRANSFORMER MODEL APPROPRIATE FOR LOSS CALCULATION WHEN HIGHER HARMONICS ARE PRESENT

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Abstract

This work proposes a nonlinear transformer model appropriate for calculating the transformer losses when higher order harmonics in currents and voltages are present. Higher order harmonics in currents and voltages are produced by nonlinear loads. Today, by far of the majority of nonlinear loads are power electronic devices, which are massively used in computer equipment and peripherals. In order to calculate increase of hysteresis and eddy currents losses due to higher order harmonics in currents and voltages, the magnetically nonlinear model of the transformer is derived. The derived transformer model is based on lumped parameters model. It is obtained by coupling the electric and magnetic equivalent circuits. Eddy currents effects and nonlinear behavior of the iron core are accounted for using short circuit winding and Jiles-Atherton (J-A) hysteresis model. The J-A hysteresis model parameters are identified using stochastic search algorithm called differential evolution (DE). The J-A hysteresis model parameters are identified by DE in such a way, that the best possible agreement between the measured and by the model calculated $B - H$ hysteresis loops of the iron core is obtained. Inclusion of eddy currents and hysteresis into the magnetically nonlinear transformer model makes this transformer model appropriate for calculation of eddy currents and hysteresis losses when higher order harmonics in currents and voltages are present. To assure that the calculated losses reflect real eddy currents losses and hysteresis losses, the obtained transformer model was confirmed though the comparison of measured and calculated transformer currents.

Keywords: Nonlinear transformer model, Hysteresis, Higher order harmonic components, Transformer losses.

Presenting Author's Biography

Matej Toman received his B. S. degree from the Faculty of Electrical Engineering and Computer Science, University of Maribor, in 2003. Since then he has been employed with the Faculty of Electrical Engineering and Computer Science as a junior researcher. His field of interest is modelling and control of electromechanical systems. He is currently engaged in research of additional transformer losses due to higher harmonic components in currents and voltages.

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CAD-BASED OPTIMIZATION AND APPLICATIONS IN AUTOMOTIVE ENGINEERING

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Abstract

The product development in automotive industry is more and more based on computer simulations. Such a development is an iterative process with the following main steps in the loop: modeling of the product with some computer aided design (CAD) tool and then its analysis, which is often of multidisciplinary nature and done typically with a computational fluid dynamics (CFD) or finite element analysis (FEA) software. Based on the results of the analysis, the decision on the CAD model for the next iteration can be done heuristically or by an optimization algorithm. Up to now these steps are comitted separately, typically by separate groups or departments of the team involved in the development. In this paper we introduce our automated optimization method to solve industrial product development problems. This clearly requires first the process integration of several software components and the use of an optimization algorithm and code as the frame of the whole process. One of the main characteristics of our method is the use of parametrized CAD models which enable us to define the design variables as the parameters of the CAD model. Another point is the process integration which requires black-box applications of the CFD or FEA tools, which is still uncommon in traditional engineering. In this paper we introduce the integrated commercial software components and examine their features from the process integration point of view. Then we discuss the characteristics of the optimization methods applied under the circumstances. Finally, we present some results of applications of our method to two problems of automotive engineering, namely to shape optimization of the intake port of a Diesel engine and tolerance analysis of assemblies.

Keywords: multidisciplinary design optimization (MDO), computer aided design (CAD) modeling, computational fluid dynamics (CFD), global optimization, stochastic simulation.

Presenting Author's Biography

Zoltán Horváth received PhD degree in the field of numerical mathematics from the Eötvös Loránd University (ELTE) Budapest, Hungary, 1995. Besides working on numerical analysis for differential equations and optimization methods, he is involved in many applied mathematical projects for industry, particularly on computational simulation of complex fluid flow processes in automotive engineering and global optimization. He is working for Széchenyi István University, Győr and, since 2006, he is the head of Department of Mathematics and Computational Sciences.

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OPTIMIZATION ISSUES IN MODELING IPMC DEVICES

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Abstract

The increasing pressure on the development time of new materials and devices has changed the modeling and design process over the years. In the past, they mainly consisted of experimentation and physical prototyping. Clearly, it is hard to incorporate changes in finished prototypes, while producing a variety of different prototypes at once may be very expensive. At this aim, computer simulation models such as circuit design models and continuous systems simulation models are widely used in engineering modeling, design and analysis. In this context, the search for a better understanding of complex systems calls for quantitative model development, and optimization tools and model fitting to observed data play an important role. In this framework, this paper deals with the optimization issues arising in the model calibration for a particular IPMC-based actuator in air. The considered formal model of the device is a nonlinear dynamical one, with lumped parameters, able to estimate the IPMC actuator absorbed current, together with the mechanical quantities of interest, which, in the case under study, are the free deflection and/or the blocked force. Two optimization problems have been formulated, focussing on different stages of the model parameters identification. The strategies adopted to solve the problems allow to achieve some promising — although preliminary — results.

Keywords: Model Identification, Simulation-Optimization, IPMC Devices, Multidisciplinary Design Optimization.

Presenting Author's Biography

Gabriella Dellino graduated cum laude in Computer Science Engineering at Politecnico di Bari, Italy, in 2005; since 2006 she starts a Ph.D. program in Applied Mathematics at University of Bari. She took part in research projects promoted by academic organizations and companies. Her main research interests include optimization models and methods, computer simulation methodologies, and Multidisciplinary Design Optimization. She is member of INFORMS society.

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MULTI-OBJECTIVE OPTIMISATION OF AUTOMOTIVE COMPONENTS

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Abstract

In this paper the multi-objective design environment modeFRONTIER is applied to the design of automotive components.
This approach allows the integration of different computational codes, including parametric CAD systems like SolidWorks, FEM codes like Abaqus and Femfat fatigue tool, into a common design environment.
In this environment, the complete logic flow from CAD parameterisation to performances evaluation (in terms of safety factors, maximum stresses, global mass, etc.) is defined by the user, have to select the optimisation algorithms accordingly to the defined objectives; these algorithms drive automatic series of simulations, allowing also distributed and parallel computations to fully exploit the available computational resources, until the objectives are met.
At the end of the multi-objective optimisation, the designer can select the definitive solution among several alternatives as the best compromise among different and often contrasting criteria. The influence of all the parameters in the process can be analysed in detail by the use of statistical analysis and response surface methods.
In the paper, after a first simpler application to the design of a connecting rod, that is used to describe the CAD parameterisation techniques and the Abaqus and Femfat integration with modeFrontier, a more complex application to modal and harmonic analysis of a crankshaft is presented, to show the efficiency of the optimisation methodology.

Keywords: multi-objective optimization, automotive, fatigue analysis, harmonic analysis, CAD parameterization, distributed and automatic computational environment.

Presenting Author's biography

Alberto Clarich. Date of birth 11/02/75, Trieste. Msc degree in Mechanical Engineering, University of Trieste, February 2000. PhD degree in "Innovative Parameterisation and Optimisation Methodologies in Aeronautic Field", University of Trieste, March 2003, in collaboration with Dassault Aviation. Presently, he is working at ESTECO srl on multi-objective optimization and robust design with modeFRONTIER, collaborating with companies like Toyota, Ferrari, Honda, BMW, Motorola. He has published more than 30 papers in journals and conference proceedings

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MODELS FOR THE DESIGN AND OPTIMIZATION OF CNG INJECTION SYSTEMS

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Abstract

The need of improved performances in mechatronic systems calls for the integrated design of the mechanical, electronic and control subsystems. In this framework, simulation can help in attaining the optimal solution, as it allows to evaluate the effect of changes even at early stages of the design process. In this paper, we tackle the problem of a proper choice of a model for the integrated design and optimization of a mechatronic system, i.e. the injection system for a Compressed Natural Gas Engine. In particular, two models that are obtained by using different approaches and characterized by different level of details are compared. The first one is developed within the AMESim® environment, an advanced multi-domain modelling/optimization tool for the virtual prototyping of the physical/geometrical characteristics of fluid-mechanical systems. The resulting model can be regarded as a virtual prototype, as similar as possible to the actual final hardware, and is assumed as a reliable representation of the real system. Then, with reference to this prototype, a reduced order state space model is determined, which is more suitable for designing a controller or to speed up the design optimization process. A comparison study involving the proposed models is performed in terms of fidelity, range of validity and computational efficiency, showing that the system development can take advantage of a proper choice of the system model at different stages of the design optimization processes.

Keywords: MDO, Modeling Injection System, CNG, AMESim®

Presenting Author's Biography

Carlo Meloni received the degree in Electronics Engineering from the Università La Sapienza (Rome) in 1997. He received a Ph.D. in Operations Research from the same university in 2000, then he joined the Università Roma Tre as post-doctoral fellow in Operations Research. In July 2002 he became Assistant Professor of Systems Engineering at the Politecnico di Bari. He took part in research projects promoted by academic organizations and companies. Recently, he has been involved in a research project for the design and optimization of common rail engine parts, in co-operation with Fiat Research Center, Valenzano Branch, Bari, Italy.

MULTIFORMALISM MBS MODELS FOR AN HIL APPLICATION IN VEHICLE DYNAMICS

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Abstract

In automotive engineering detailed multibody system (MBS) models are increasingly being employed. For the modelling process, various tools are available that typically generate the equations in the shape of differential-algebraic ones.
This sort of equations is not suitable for HiL applications, e.g., on test beds of vehicle components, because an iterative solution of the equations cannot comply with hard real-time conditions. For an alternative, there are multibody system formalisms that generate the equations on the basis of the nonlinear state-space representation. These equations can be solved at a fixed stepwidth; thus we can make sure that the time it takes to evaluate the differential equations is less than the sampling rate of the HiL system.
In this paper we will present and explain three different MBS formalisms that have different advantages and drawbacks – especially with regard to the complexity of the generated equations – and discuss the typical applications that the individual formalisms are suited for in particular.
Detailed vehicle models comprise submodels having different characteristics that one particular MBS formalism is especially suited for.
One development system allowing to use all three MBS formalisms is CAMeL-View. It is an object-oriented tool for the model-based design of mechatronic systems that provides components for the multibody system dynamics and the information-flow-based representation of elements from control engineering. One of the strong points of CAMeL-View is the physical-topological modelling that is suitable especially for MBS systems. Internal representation on the basis of modular-hierarchical graphs has made the implementation of different MBS formalisms possible. However, for an entire system just one MBS formalism could be employed so far.
In this paper we will demonstrate the way all three MBS formalisms are employed in a complex MBS vehicle model and then discuss the advantages this procedure has to offer.

Keywords: MBS Models, MBS Formalisms, HiL Application, Vehicle Dynamics

Presenting Author's biography

Dr.-Ing. Martin Hahn. Born in 1965. Studies in Mechanical Engineering at the University of Paderborn. PhD in 1999. Founder and CEO (since 1998) of iXtronics GmbH, manufacturer of the CAMeL-View simulation environment.

NUMERICAL ANALYSIS OF MASONRY WALLS OUT-OF-PLANE LOADED

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Abstract

Masonry is a composite material constituted by the assemblage of bricks and mortar joints. It is commonly accepted that the mortar joints have a much lower strength than that of the bricks. As a consequence, there are preferential planes of weakness along which cracks propagate. This is particularly true in case of masonry panels out-of-plane loaded, where experimental evidences often show that failure lines follow the disposition of the bricks. Out-of-plane failures are mostly related to seismic and wind loads and the lack of out-of-plane strength is a primary cause of failure in different forms of masonry. In this paper, a heterogeneous approach for FE upper bound limit analyses of out-of-plane loaded masonry panels is presented. Under the assumption of associated plasticity for the constituent materials, mortar joints are reduced to interfaces with a Mohr-Coulomb failure criterion with tension cut-off and cap in compression, whereas bricks are supposed infinitely resistant. At each mortar interface, plastic dissipation can occur as a combination of out-of-plane shear, bending and torsional moment. In order to test the reliability of the model proposed, several experimental tests of dry-joint panels out-of-plane loaded have been carried out at the University of Calabria (Italy). Numerical results are compared with experimental evidences for three different series of walls at different values of the in-plane compressive vertical loads applied. The comparisons show that reliable predictions of both collapse loads and failure mechanisms can be obtained by means of the numerical procedure employed.

Keywords: Masonry, Heterogeneous Approach, Out-of-Plane Loads, FE limit analysis.

Presenting Author's biography

Renato Sante Olivito. He is Full Professor of Structural Engineering at the Department of Structural Engineering - Faculty of Engineering of the University of Calabria. His main research interests are Mechanics of Materials and Structures, with particular reference to Composite Materials and to non destructive techniques (ultrasonic and acoustic emission techniques) for the damage study and monitoring of civil structures. Further research interests concern: the study of the mechanical behaviour of masonry structures subjected to in-plane and out-of-plane loads; the study of durability of masonry and reinforced concrete structures reinforced by FRP materials.

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RULE-BASED CLASSIFIERS FOR THE ACUTE ABDOMINAL PAIN DIAGNOSIS – COMPARATIVE STUDY

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Abstract

The inductive learning algorithms are attractive methods generating hierarchical classifiers. They generate the hypothesis of the target concept on the basis of the set of labeled examples. These methods are typical for the medical decision support systems because for many cases the physicians can not formulate the rules, whose are used to make decision or the formulated set of rules is incomplete. Therefore if we can not obtain high quality original expert knowledge we can generate knowledge base on the basis of learning set.
This paper presents the comparative study of classification quality of heuristic classifier (given by experts) and popular inductive methods: C4.5, FID and AQ, and their boosted versions. Algorithms C4.5 and FID are the modifications of ID3 method generating decision tree. The AQ algorithm bases on the sequential covering strategy, which removes elements of learning set covered by any generated rule in each iteration. Metaclassifier like boosting is general method of improving quality of weak and unstable classifiers. The idea of boosting has its root in PAC theory. The underlying idea of boosting is to combine simple classifiers to form an ensemble which makes better decision than any simple classifier.
Evaluation of presented concepts were made on the basis of computer experiments. All tests were done for the acute abdominal pain decision problem. The superiority of the obtained results for the inductive learning classifiers over heuristic one demonstrates the effectiveness of the proposed concept in such computer-aided medical diagnosis problems. Advantages of the proposed methods make it attractive for a wide range of applications in medicine, which might significantly improve the quality of the care that the clinicians can give to their patients.

Keywords: boosting, machine learning, decision tree, medical decision support

Presenting Author's biography

Michal Wozniak is Assistant Professor of Computer Science in the Chair of Systems and Computer Networks, Faculty of Electronics, Wroclaw University of Technology, Poland. He received an M.S. degree in Biomedical Engineering from the Wroclaw University of Technology in 1992 and Ph.D. degrees in Computer Science, from the Wroclaw University of Technology in 1996. Dr. Wozniak has published over 80 papers and edited book "Computer Recognition Systems", Springer 2005. His research focuses on multiple classifier systems, machine learning, data and web mining, Bayes compound theory and teleinformatics.

PHYSIOLOGY BASED MODEL OF CHOLESTEROL METABOLISM AND ITS INTERACTIONS WITH XENOBIOTICS

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Abstract

In 2000, nearly half of all death causes in EU were related to problems with cardiovascular system, while 10-15% of population has elevated levels of cholesterol, which is know to be a risk factor for cardiovascular diseases. Statins have been developed to lower cholesterol levels, however, in some people they are known to produce serious adverse effect, especially in combination with some other drugs that are usually administered in parallel with statins. In order to investigate the cholesterol metabolism and its interactions with xenobiotics, a mathematical model of cholesterol has been designed. Since it is a very complicated system, model development is still under way, but the model is showing similar characteristics as have been observed in human and mouse hepatocites. The modelling started with cholesterol pathway that can be found in KEGG database. Next, using Pathway Studio, the literature items in PubMed were searched to extract latest knowledge on the cholesterol metabolism, thus the model structure was updated with the latest findings. Next, the model was reduced to show only basic characteristics of the system. Model simulations show good agreement with experimental data and introduce some new structural elements to the system.

Keywords: Modelling, Simulation, Cholesterol, Systems Biology, Functional Genomics

Presenting Author's Biography

Aleš Belič received B.Sc and Ph.D. degrees in electrical engineering from the University of Ljubljana, Slovenia in 1994, and 2000 respectively. He is currently Associate Professor at the Faculty of Electrical Engineering, University of Ljubljana. Main areas of his professional interest are artificial intelligence modelling techniques in bio-medical areas. Currently he is involved in modelling of cholesterol pathways in human in the frame of 6th European Framework project STEROLTALK, and in functional analysis of EEG signals.

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SELF-ASSEMBLED DNA COMPUTING FOR DIRECTED GRAPH PROBLEM MODELLING

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Abstract

This paper presents modeling of a directed graph problem for Boolean matrix operation using self-assembled DNA computing. In this experiment, we show how a Boolean matrix product operation may be represented by a directed graph problem and solved using DNA computing. The directed graph problem which consists of vertices and paths are recreated using DNA oligonucleotides and it will be proven in this experiment that these yield the same results as the actual directed graph problem. The algorithm to model the self-assembled DNA into directed graph is based on Adleman-Lipton architecture. However, unlike the Adleman-Lipton's, restriction enzymes which are used to cut the DNA into unique sequences representing vertices and paths are replaced by Parallel Overlap Assembly (POA) method. Polymerase Chain Reaction (PCR) method is later used as test of reaction to identify the existence of paths to validate the accuracy of results which can be visualized through gel electrophoresis and UV process.

Keywords: DNA computing, self-assembled, POA, directed graphs, PCR.

Presenting Author's biography

Nordiana Rajaee received her master degree from University of Newcastle upon Tyne, United Kingdom and is currently a postgraduate student in Institute of Applied DNA Computing, MEIJI University, Japan.

ANALOG SIMULATION OF CARDIOVASCULAR PHYSIOLOGY: EXERCISE IN MAN

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Abstract

A computer analysis of an equivalent electronic circuit is developed. Thus it is possible to simulate the human cardiovascular system (including the negative intrathoracic pressure), and the negative feedback loops (control of venous tone, of myocardial contractility, and of heart rate). In this investigation exercise is simulated by decreasing the peripheral resistance. If negative feedback loops are operative, sympathetic tone is increased simultaneously. Sympathetic tone and negative feedback then stabilise the system, the final outcome is an increased blood flow. The extent of negative feedback action can be assessed only if a simulation is repeated in conditions, when negative feedback is not operative. Despite pronounced venoconstriction left atrial pressure is slightly decreased. There is little change in diastolic arterial pressure. Despite peripheral resistance is decreased mean arterial pressure is slightly increased and cardiac output almost doubled. In second condition if feedback mechanisms in exercise are not operative, heart rate is constant, 60/min. A profound decrease in arterial and mean arterial pressure occurs. Transiently cardiac output is markedly increased but in steady state condition the increase is almost negligible. Venous volume is slightly increased and there is almost no change in left atrial pressure. It is clear that in exercise feedback mechanisms are essential in increasing and maintaining arterial pressure and cardiac output. In experiments in which single loops are set out of action not simultaneously, but one after the another, it can be observed that the most effective homeostatic mechanism is venoconstriction. It is venoconstriction, by increasing the filling of both ventricles, *the mechanism* which allows the increased ventricular contractility and increased heart rate to display full action and increase the blood flow.

Keywords: Computer simulation, Cardiovascular physiology, Homeostasis in exercise.

Presenting Author's biography

Tomaž Podnar received the M.D and Ph.D. degrees in 1989 and 2001, respectively, from the Faculty of Medicine in Ljubljana, Slovenia.He is currently paediatric cardiologist at the Cardiology Unit, University Children's Hospital Ljubljana. Slovenia. His research interests includes transcatheter treatment of congenital heart defects, cardiovascular physiology and pathophysiology of congenital heart defects.

MODELING AND SIMULATION RESULTS ON HIGH SENSITIVITY SCATTERED GAMMA-RAY IMAGING

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Abstract

Emission gamma ray imaging is widely used in numerous fields such as medical imaging, non-destructive testing, gamma astronomy and environmental survey. In conventional nuclear imaging, a collimated gamma camera rotates in space to collect primary emitted radiation by an object under investigation. In this case Compton scatter radiation behaves generally as noise hindering image quality and consequently correction to scatter should be applied.
However recently an interesting new imaging concept, which uses precisely scattered radiation by the object medium (instead of primary radiation) as imaging agent, has been advocated. The camera records now images labeled by scattered photon energy or equivalently scattering angle. Then it is shown that the three dimensional image reconstruction from scattered radiation data detected by a conventional collimated camera is feasible [1, 2, 3, 4]. However, the image sensitivity is considerably low because of the presence of the collimator. Therefore in order to record a larger amount of scattered radiation, we extend the working of the previous imaging principle to a camera without collimator. But this move brings up new computational difficulties due to summations over allowed directions entering the detector.
A novel analysis of photon propagation from emission to detection is modeled and validated by Monte-Carlo simulations. This permits to compare signals received by a camera with or without collimator. Then, we show results of two dimensional numerical reconstruction of the object radiation activity from simulated scattered radiation recorded by an uncollimated camera. These encouraging results are a necessary step before a future extension to three dimensional imaging.

Keywords: Biomedical imaging modeling, Sensitivity, Monte-Carlo simulations

Presenting Author's Biography

Clémence Driol graduated in 2005 from the Ecole Nationale Supérieure de Physique de Strasbourg, France, in photonic engineering. She is currently working on a PhD thesis at the University of Cergy-Pontoise, France. Her research interest is in the fields of the scattered gamma ray imaging, optical imaging, inverse problems, Monte-Carlo simulation.

MODEL BASED INERTIAL SENSING OF HUMAN BODY MOTION KINEMATICS IN SIT-TO-STAND MOVEMENT

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Abstract

In this paper the design and validation of three-segment human body model is presented. The model is aimed at reconstruction of motion trajectories of shank, thigh and HAT (Head-Arms-Trunk) segments in sit-to-stand transfer. For this purpose the Extended Kalman filter (EKF) is applied for fusion of model data and data acquired through measurements with low cost inertial motion sensors (consisting of accelerometers and rate gyroscopes). The simplifications, like motion constraint to sagittal plane, symmetry of movement, assumption of ideal joints, etc., are introduced in the model. Three-segment human body model is constructed using principles of Lagrangian dynamics resulting in three nonlinear, highly coupled second order differential equations. From these equations human body model in Matlab- Simulink environment is constructed and implemented. In conjunction with classical definition of angle, angular rate of change and angular acceleration one can get complete set of data describing human sit-to-stand movement. The inputs that were used in the modeling phase include moments at three joints (ankle, knee and hip joint) by using inverse dynamic approach and free-body diagram technique. Calculated moments include both active and passive joint moments. Several EKF architectures were tested in search for optimal performance. Model validation (in conjunction with EKF) was performed on simulated data using Matlab-Simulink environment, and on actual measurements data acquired with Optotrak optical motion analysis system. Obtained results are presented and discussed, and conclusions are drawn.

Keywords: lagrangian dynamics, sit-to-stand, extended kalman filter

Presenting Author's biography

Josip Musić. Received the Electrical Engineering diploma in 2004 from the Faculty of Electrical Engineering and Naval Architecture, University of Split, Croatia, where he is currently employed as a research/teaching assistant. He is currently a postgraduate student at Faculty of Electrical Engineering, University of Ljubljana, Slovenia. His current research interests include human motion analysis and inertial sensing.

A COMPANY SPECIFIC SIMULATOR OF A DRINKING WATER TREATMENT PLANT

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Abstract

Fully automated operation is introduced in drinking water treatment plants. This will open the possibility of model based process control but will cause erosion of skills and knowledge of daily operation supervisors as well. For training of supervisors of fully automated drinking water treatment plants a simulator is developed. In future the same simulator will be used by process engineers for offline and online process optimization.

A pilot simulator has been developed for the softening plant of drinking water treatment plant Monster. A Stimela water quality model for softening using fluidised pellet reactors was defined and validated. When the need for simulating hydraulic behaviour of the plant was identified, an EPAnet hydraulic model was defined and validated basically. Simulator training functionality was identified and partly realised in the pilot project. The economical and technical feasibility of a simulator was studied. The pilot simulator is operational and inspired nine Dutch companies to start the WATERSPOT project.

Keywords: Drinking water treatment, simulator, training, model, operator

Presenting author's biography

Ignaz Worm was born in 1974. In 2000 he graduated as a MSc Civil Engineering from Delft University of Technology with the thesis "Airflush for ultrafiltration membranes". This thesis was rewarded with the Faculty Award for best graduation.

At present Ignaz works for PWN Waterleidingbedrijf Noord-Holland as a consultant in process engineering research.

In November 2006 Ignaz and Luuk Rietveld initiated the WATERSPOT project which has the objective to develop a drinking water simulator for proactive operation and training.

SIMULATION AS A MEANS TO TEST ADVANCED CONTROL ALGORITHMS IN SUPPRESSING ROTOR VIBRATIONS IN ELECTRIC MACHINES

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Abstract

Active control of rotor vibrations in electrical machines is considered. The objective of the research described in the paper is to diminish unwanted forces generated by rotation and unbalanced mass of the rotor in an electrical machine. These forces, dependent of rotational speed, cause vibration that, when occurring in the natural frequency (or critical speed) of the rotor, cause severe problems. A new actuator (an extra winding) was designed to be installed in the stator of the machine, and it was controlled with frequency converter to create an opposite force to the vibration. The main task was to develop a controller for the system. The system was first modeled by first principles electromechanical equations, and based on FEM simulations more simplified state-space models were identified. The new models were analysed, and the model giving the best fit with regard to FEM simulations was chosen for controller design. Different controllers were then designed utilizing the identified model, and their performance was tested by using an accurate FEM model of the system. The results showed that the developed controller can be used for vibration control in electric machines operating near the critical speed. The next step in the research is to test the vibration suppressing controller in a real test machine.

Keywords: Electrical machines, Rotor dynamics, Active vibration control, Model-based control, LQG control, Convergent control.

Presenting Author's Biography

Kai Zenger was born in Helsinki, Finland, in 1958. He received the M.Sc., Lic.Sc. and D.Sc. degrees in electrical engineering, computer technology and automation and systems technology in 1986, 1992 and 2003, respectively. After an industrial career he has had different positions at Helsinki University of Technology, where he currently works as a Senior Researcher in the Department of Automation and Systems Technology. His main research areas are Control Engineering and System Theory generally, with applications in chemical process engineering, power electronics and mechanical engineering. He has specialized in the research of time-varying linear systems, periodic systems and adaptive and robust control methods. He has authored or co-authored more than 70 scientific publications.

DECISION SUPPORT AND SIMULATION METHODS FOR ASSEMBLY SYSTEM SALES ENGINEERS

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Abstract

This article presents decision-support methods and tools for assembly system sales engineers using 3D visualisation, component-based simulation, other equipment efficiency analysis and novel cost analysis methodology. The objective of modern assembly processes is to produce high-quality, low-cost products. To ensure that an assembly system is appropriately designed, system measurement schemes should be established for determining and understanding design effectiveness. Measurements can be classed in two categories: cost and performance. Understanding manufacturing costs is the first step toward increasing profits. The authors have developed an analysis method that integrates factory simulation, Overall Equipment Efficiency (OEE), and economic analysis methods. Advanced cost calculation includes Cost of Ownership (COO), commonly used investment evaluation methods, discounted cash flow techniques, Net Present Value (NPV) and Internal Rate of Return (IRR). The idea is to integrate these methods with simulation analysis to be used in the assembly system sales process. These methods can also be used to improve the design of flexible, modular reconfigurable assembly systems. The development of the Total Cost of Ownership (TCO) analysis tool is based on industrial standards and the authors' own experience in modular assembly system design, economic analysis and production simulation. The TCO methodology is useful in system supplier and end-user communication and helps in trade-off analysis of the system concepts.

Keywords: Decision support, component based simulation, system performance, economic and life cycle analysis

Presenting Author's biography

Juhani Heilala is a senior research scientist at VTT, the Technical Research Centre of Finland, with 20 years of experience in industrial robotics, production system development and various simulation techniques. The current research interest includes expanding simulation and modelling from system design and analysis methods to simulation based manufacturing operation planning and integration of production system simulation with other analysis methods.

DYNAMIC SIMULATION OF PRODUCT PROCESS

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Abstract

During 90's Nokia utilized Concurrent Engineering (CE) process in mobile phone business successfully. Strong growing of the company, more complex technologies, maturing markets and changes in competition has increased the need to develop the Product Process of the company to keep its position as an agile, innovative and productive product developer. Dynamic simulation approach has been one of the activities among other Product Process re-engineering efforts in the company.

This paper describes the approach and "Product Process Decision Simulation" (PPDS) solution as the first implemented application of the approach. A dynamic model of product development has been created and applied to manage Product Process complex dynamic behavior on system level in order to reduce product development cycle times, slippages and costs as well as improve perceived product quality. The key contribution of the simulation solution is to provoke facilitated discussion in order to gain shared understanding of interdependencies and dynamic causes and effects in Product Process.

The implementation and frequent simulation workshops have started in June 2006 and over 300 R&D people have already participated.

Keywords: Management flight simulators, System dynamics, Product process, Decision making, Training.

Presenting Author's biography

Dr. Lasse T. Pesonen is working as a Senior Manager in Product Process Architecture Solutions team for Nokia. His work experience covers 10 years in Steel Industry automation and past 13 years he has worked for Telecom Industry manufacturing and product development. He has earlier published conference papers in the field of Production Control, Activity Based Management and Production Automation. He has Ph.D (Tech.) from Department of Process and Environmental Engineering, University of Oulu. Address: Nokia, Yrttipellontie 6, 90230 Oulu, FINLAND.

VIRTUAL PRODUCTION FOR INDUSTRIAL MANUFACTURING PLANTS WITH TRANSPORT SYSTEMS

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Abstract

Automated industrial manufacturing plants are complex systems which are planned, built and operated by many different people in sequent phases. Virtual Production can help to obtain a plant of higher quality at earlier time by optimizing the workflow in the planning and building stages and by parallelizing phases. In this paper, we suggest an approach to implement Virtual Production and present the 3-D modeling and simulation system COSIMIR® which supports the whole lifecycle of a plant from planning to shop floor operation. We introduce the different phases of Virtual Production and analyze the benefits of each stage. As manufacturing plants with carrier based transport systems are especially complex because of their above-average usage of sensors and actuators, we will focus on the integration of these. Engineers can produce and verify control programs with the digital model of the plant long before the real plant is set up. These control programs are written in the native language of the employed robot or PLC and thus can be directly loaded into the real controller. Furthermore, methods of Virtual Reality enhance the digital model to ease communication among engineers, to intuitively present the plant and the processes, and to train operating personnel without occupying the real plant. Finally, we describe applications together with gained benefits and discuss future potentials of Virtual Production.

Keywords: Automation, Virtual Commissioning, Simulation, Transport, Virtual Reality

Presenting Author's biography

Roland Wischnewski studied applied computer science with focus on engineering technology at the University of Dortmund. From 1999 to 2005 he worked as a scientific assistant at the Institute of Robotics Research (IRF) of the University of Dortmund. Since April 2005 he works at the Department of Robot Technology at RIF e.V. in Dortmund as head of the team Industrial Simulation Systems.

UTILIZATION OF DYNAMIC SIMULATION IN THE IMPROVEMENT OF A PULPING PROCESS

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Abstract

This paper present results of modelling and simulation studies at a CTMP mill (chemi-thermomechanical pulp). The aim of the study was to improve the quality of the screened pulp and in overall improvement of the screen room's runnability. Simulation, in addition to other advanced mathematical methods, was used as a tool in this. The simulation model presented in this paper is a combination of dynamic mechanistic conservation laws and empirical pulp quality models. The quality models integrated to the Apros Paper simulator were screen freeness (CSF) and screen shive fractionation models. Also the changes in freeness and in pulp fibre length distribution were modelled for the reject refiner. These quality models were semi-empirical models whose parameters were estimated based on data from several mill trials. The integrated process model was validated with logged process measurement data. The final use of the model was threefold. Firstly it was used to generate data for testing the applicability of a data clustering algorithm to fault diagnosis. Secondly the simulator was used as a test bench for the effects of process modification on the end product quality. Thirdly the model was used in the development of new DCS application. During the studies it was shown that a high fidelity dynamic simulation model could be used for several applications ranging from a test bench of process and control changes to data generation for new applications and all way to development of user interfaces.

Keywords: CTMP, screening, refining, dynamic simulation, pulp quality modeling.

Presenting Author's biography

Jouni Savolainen. Savolainen works as a senior research scientist at VTT Technical Research Centre of Finland. He is also the team leader of the System Dynamics team at VTT, specializing in modeling and dynamic simulation of large scale systems. He received his Master's degree from Helsinki University of Technology in 1999 and has been working at VTT since.

DYNAMIC MODELING OF MAINTENANCE STRATEGIES

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Abstract

Maintenance strategy formulation is difficult because different systems, such as production control and maintenance, are integrated and highly interdependent. Thus, the system has to be studied in a systemic way. Dividing the problem into smaller sub-problems helps only in short term and may be even harmful in long term. The longer the time span the more significant are the interactions between maintenance and other parts of the organization. Considering the whole system, the problems of maintenance strategy formulation are complex. This paper presents a system dynamics simulation model for the maintenance of a generic process plant. The model was created in order to facilitate understanding the complex system and the strategy formulation. The model describes the maintenance activity and its interactions with other parts of the organization. It includes equipment degradation and different maintenance policies, maintenance workforce allocation, maintenance's effects on production process etc. With the help of the simulations and the causal diagram of system's feedback structure it is possible to find the shared view to the maintenance process and clarify maintenance's role in the organization. When the role is clear, it is easier to set goals and to plan maintenance strategy so that they serve best the needs of the company. The simulated maintenance strategies were evaluated with different performance measures i.e. financial measures, equipment related measures and process related measures. Additionally, strategies' sensitivities to different uncertainties were tested.

Keywords: System dynamics, maintenance strategy, simulation

Presenting Author's Biography

Tero Jokinen works as a research scientist at VTT's (Technical Research Centre of Finland) System dynamics team. He completed recently his master's thesis which discusses dynamic modeling of maintenance strategies. His focus areas are system dynamic modeling of maintenance systems and of special product production.

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MODELLING AND SIMULATION OF ALUMINIUM COILS PRODUCTION PROCESS USING COLOURED PETRI NETS

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Abstract

Production planning and scheduling are essential for achieving efficient resource allocation, in meeting end-customer demands and in determining the production-loading plan. Effective scheduling is a key issue for modern manufacturing production systems since it can improve throughput rates and machine utilisation. Manufacturing systems exhibit high complexity and are expected to manipulate huge amounts of data. Therefore, the need for appropriate models and efficient simulation tools to represent, analyse and evaluate such systems has long been acknowledged. This paper presents the modelling and simulation of a complete aluminium coils production plant, with the use of Hierarchical Coloured Petri Nets (HCPN). These nets provide an efficient representation for such production processes and can be used for their extensive analysis and performance evaluation with the aid of appropriate metrics. In particular, this work addresses the implementation of an overall model, capable of integrating the various aspects of the specific production processes. The proposed HCPN model provides information about throughput rates, makespans, machine occupancy and work in process inventory. The model was successfully validated using actual production data and it was found that CPN are suitable for the modelling, analysis and performance evaluation of the complex aluminium coils production process. With the aid of the model various scenarios were investigated via extensive simulation runs, such as installing additional machine centres, increasing buffer sizes and reducing pre-set times the products spend in intermediate storage areas. Results show that production managers can strongly benefit by the proposed model in gaining important knowledge about the system and performing better decision-making.

Keywords: Aluminium coils production system, Production scheduling, Coloured Petri nets, Performance analysis.

Presenting Author's biography

Professor Panagiotis Tzionas holds a B.Eng. in Electrical & Electronic Eng., Imperial College, Univ. of London, a M.Sc. in Digital Electronics, King's College, Univ. of London and a Ph.D. in Elec. & Comp. Eng., Democritus Univ. of Thrace, Greece. He teaches subjects on Intelligent Control in the Dept. of Automation, Technological Educ. Institute of Thessaloniki, in the Dept. of Mathematics, Aristotle Univ. of Thessaloniki and in the Dept. of Product & Systems Design Eng., Univ. of Aegean. His research interests include computational control techniques, intelligent systems and their application to manufacturing.

TEMPORAL PERFORMANCE EVALUATION OF CONTROL ARCHITECTURE IN AUTOMATION SYSTEMS

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Abstract

The performances of automation systems are strongly linked to the performances of their control architecture. These architectures are the merger of a hardware structure – industrial computers and logic controllers connected to networks and fieldbuses – and of software components – implantation control functions. To manage these performances, the control engineer must evaluate them at each stage of the life cycle: from the project requirements to the setup stage, including the detailed design.
In this paper, we present a method which evaluates timed performances of networked automation system and which guides the engineer throughout the control architecture development. A modular design has been retained to model the dynamic behaviour of the control architecture using Timed Coloured Petri Nets. To begin we present the design of generic modular models and we explain how these modules are instantiated and assembled to build the dynamic model of a whole control architecture. Next we present some enrichments of the assembled model in order to simulate the behaviour of the control architecture. These complements are some event generators – to excite the models – and some event observers – to detect, to date and to log the relevant events. Then we present the simulation results of four different timed performances on the same architecture. These results take the form of histograms of 10,000 simulated delays for each evaluated performance. Finally, the method suggested for the model construction is validated. by confrontation between the results of model simulation and the measurement of the real control architecture.

Keywords: Control architecture, temporal performance, evaluation, simulation, timed coloured Petri nets.

Presenting Author's biography

Bruno DENIS obtained his Ph.D. in the field of control and automation system in 1994 at the University Nancy I. He currently holds the position of Associate Professor at the "Ecole Normale Supérieure de Cachan" close to Paris in France. His main research interest is the dependable control in automation system using approaches like simulation or formal method such as model-checking.

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SIMULATION AND DESIGN OF SYSTEMS WITH OBJECT ORIENTED PETRI NETS

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Abstract

Software engineering is a science discipline dealing with methods and techniques of the system design. Increasing complexity of developed systems makes the design process more exacting. The need for better quality of the development processes is growing up too. As an answer to these requirements, new software engineering methods are raising. They are commonly known as *Model-Driven Software Development* or *Model-Based Design* (MBD). An important feature of these methods is the fact that they use executable models, for instance, the most popular one is *Object Management Group's Model Driven Architecture* (MDA) based on Executable UML. The designer creates models and checks their correctness by simulation so that there is no need to make a prototype. The development methods allow for semi-automatic translation of checked models to implementation language (i.e. the code generation). Unfortunately, the resulting code is not final, the code is supposed to be adapted and these changes are usually not moved back to models. Consequently, the models can become outdated and in most cases loose their value – models do not correspond to the final implementation, possible changes are more and more demanding and it may consequent less productivity in the complex systems design. We base our approach to the system development on simulation models which have a proper formal background and can be integrated into target application with no need to generate a code. Thus, we start with simulation models but during the development process we are obtaining more and more adequate application. The models we use are based on Object-oriented Petri nets formalism. Presence of models in final implementation opens a possibility to make maintenance and adaptation to changing requirements more productive.

Keywords: Modeling, Simulation, Object-Oriented Petri Nets, Model-Based Design

Presenting Author's Biography

Radek Kočí is an assistant professor at Brno University of Technology, Faculty of Information Technology, Czech Republic, and is concerned in the education of Software engineering, Operation Systems, and Java courses. His research interest includes modeling and simulation in the context of software engineering, especially an application of Petri nets, DEVS [1], statecharts [2], and other formalisms in the system design methodology. He also cooperates on modeling and simulation of agent and multi-agent systems using Object Oriented Petri Nets. He defended his Ph.D. thesis *Methods and tools for Implementing Open Simulation Systems* in 2004.

IMPROVEMENTS FOR A COLOURED PETRI NET SIMULATOR

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Abstract

This paper presents recent developments of a Coloured Petri Net Simulator tool. This tool integrates some principles taken from constraint logic programming as well as some search algorithms in order to make the performance of the tool as efficient as possible, some improvements have been obtained for the reduction of time for the transition evaluation task, as well as the search method trough the states space. The tool has been coded in an interface which makes the Coloured Petri Net easy to implement, as well as the results generated during the exploration easy to being evaluated and presented.

Keywords: Coloured, Petri Nets, Search, CLP, Coverability Tree, Simulation, VBA, Excel.

Presenting Author's biography

Miguel A. Mújica Mota was born in Mexico City. He studied chemical engineering at Autonomous Metropolitan University in Mexico City, and a Master's in Operations Research in the National Autonomous University of México, actually he is a pH Student at Autonomous University of Barcelona. His professional activities are in manufacture and production planning fields. His research interest focus on optimization techniques for Coloured Petri Nets aimed to solve industrial problems.

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MODELLING AND SIMULATION OF THE CMS TIER0 INPUT BUFFER WITH YASPER

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Abstract

The CMS (Compact Muon Solenoid) experiment at CERN will produce large amounts of data in short periods of time. Because the data buffers at the experiment are not large enough, the data needs to be transferred from the experimental area to the multi-tier computing system for storage and processing. The first tier is the CMS Tier0, an enormous job processing and storage facility at the CERN site. One part of this Tier0, called the Tier0 input buffer, will have the task to readout the experimental data buffers. It has to make sure that no data is lost. This paper describes the modelling and simulation of the Tier0 input buffer to compare different scenarios involving a set of disk servers that can accomplish the Tier0 input buffer tasks. To increase the performance per disk server, write and read actions on the same disk server take place in separate phases. A critical issue then is to determine when a disk server should change from accepting and writing items to supplying items to other tasks. The combination of various parameters, such as the usage of a particular queuing discipline (like FIFO, LIFO, LPTF and SPTF) and the state of the disk server has been studied. We have used Yasper for modelling and simulation of the various scenarios. Yasper uses Petri Net models as its input. We find an LPTF (Largest Processing Time First) based queuing discipline to give the best performance.

Keywords: Read/Write buffer system, time extended Classical Petri Net, modeling, simulation

Presenting Author's biography

Dr. Ad Aerts holds a doctorate in Mathematics and Science from the University of Nijmegen, the Netherlands (June 1979). After working as postdoctoral researcher at the international laboratories in Los Alamos, and Brookhaven, USA and as a senior fellow at CERN, Geneva, Switzerland, he joined the Department of Mathematics and Computing Science of the Eindhoven University of Technology in 1985. His research interests include methods, tools and techniques for engineering information systems. Recent research activities focus on performance of information systems, adaptive Web-based systems and Semantic Web technology. He is (co) author of more than 100 scientific publications.

PERFORMANCE ANALYSIS OF SYSTEM MODELS WITH UML AND GENERALIZED NETS

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Abstract

Functional correctness and verified performances of automation solutions are mandatory system requirements to guarantee a certain quality of service. Performance verification in the early design phases can reduce considerably the project costs. The current paper presents a new approach for performance evaluation of automation systems using UML for system modeling and performance specification and applying Generalized Nets (a variant of timed Petri Nets) for a simulation based performance evaluation. Standard UML modeling techniques are used to specify the basic automation system functions, their hardware/software allocation and the interaction with the technical process. Specific performance parameters and the interaction with the human operators are incorporated in the UML models through the standardized Profile for Schedulability, Performance and Time (SPT-profile). The resulting annotated UML models are automatically transformed to Generalized Nets via XML style sheets. Monte Carlo type time simulations can be performed with the Generalized Nets system models to derive representative performance measures. The paper gives an overview on the used UML and SPT-profile properties for performance modeling and specification, it introduces briefly the Generalized Nets concept and it describes thoroughly the transformation approach and the implementation in an XML-based framework. Results from a case study show the practical potentials of the proposed approach.

Keywords: system design, performance analysis, UML, Petri nets

Presenting Author's biography

Klaus Janschek is managing director of the Institute of Automation and holds the chair of Automation Engineering in the Department of Electrical Engineering and Information Technology at Technische Universität Dresden. Main research topics: automation systems design, tele-automation, mobile robotics, navigation, optical data processing.

DISCRETE EVENT SYSTEMS – PETRI NET-BASED MODELING AND SIMULATION IN THEORY AND PRACTICE

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Abstract

The theory of modeling formalisms for Discrete Event Systems has a long history and is well developed, many algorithms for modeling and efficient analysis of the modeled systems exist. However in many practical applications or commercial software, the theory is not used. The reasons are manifold. The question is, whether the theoretical concepts are not suited for practical applications, or whether the problem lies in the proper transfer to practice. Other problems lie in the sometimes missing flexibility of theoretical models, to some extend in missing good software that would enable the practical use of such models. In this work we review Petri net based methodologies with regard to their applicability in practice, and try to understand why many aspects of the theory of modeling and simulation do not find their way into practice. We identify crucial factors such as support of complex models and hierarchic modeling capabilities. These factors not only concern the modeling methodology, but also need to be implemented in a software tool. The availability of a software supporting a modeling concept is another important factor. The software should also have an adequate and appealing graphical representation because at the end, the practitioners have to be convinced to 'buy' the theoretical concept, and that will only be the case, if decision makers can recognize 'their' system easily. Furthermore we survey a number of papers about application of Petri nets to find out to which extend these applications are practical ones, i.e. whether the applications are of academic nature, proof of concept, toy size or inside a productive environment.

Keywords: Modeling, simulation, theory, practice

Presenting Author's Biography

Matthias Becker is involved in both practical applications and fundamental research in the area of modeling, simulation and optimization of discrete event systems.

MODELING, SIMULATING AND EXPERIMENTAL VALIDATION OF THE AC ELECTRIC ARC IN THE CIRCUIT OF THREE-PHASE ELECTRIC ARC FURNACES

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Abstract

In this paper, was performed a study regarding the modeling and simulating the electric arc in the electrical installation of the electric arc furnace. The electric arc is a nonlinear element and from this reason it give rise to negative effects on the electric power quality, especially in case of the UHP electric arc furnaces. In this paper are presented the measurement results made on the UHP electric arc furnace on an industrial plant in Romania. This measurement demonstrates the negative effects of the nonlinearity of the electric arc in the electric supply. For the purpose to make a study for improving the electric power quality it was necessary to find a model of the electric arc, model that approximate the nonlinearity of the electric arc. It was analyze by simulation several models of the electric arc. All the simulation was performed using the PSCAD EMTDC simulation program. The simulation results were compared with the measurements made on the industrial plant with a view to validate the electric arc model. Following these comparisons it was selected the most appropriate model for the real electric arc. For this purpose it was analyze several quantitative and qualitative parameters both in the real installation and in the simulating installation. It was compared the waveforms of the three phase arc currents and voltages, the electric powers in distorting work condition and the total harmonics distortions, THD, of the currents and voltages.

Keywords: electric arc modeling, simulation, PSCAD EMTDC program.

Presenting Author's biography

Manuela Pănoiu was born in 1965, graduate the Computer Science Faculty, Polytechnic University of Timisoara in 1989. She receives his PhD degree in Electrical Engineering in 2001 and is currently Assistant Professor at the Electrotechnical Department of Engineering Faculty of Hunedoara, Polytechnic University of Timisoara, Romania. His research interests focus on advanced computer programming, modeling and simulating systems, and artificial intelligence.

ANALYTICAL CALCULATION OF SKIN AND PROXIMITY EFFECTS IN THE PRIMARY WINDING OF A PULSE TRANSFORMER

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Abstract

This article deals with the analytical modelling of skin and proximity effects present in windings of the electric machines. The selected application is the primary winding of a pulse transformer. An example of a real pulse transformer is studied. The analytical expression giving the space-time distribution of the flux density, in the case of an idealized winding layer of semi-infinite plane geometry, has been established first. The current density calculation based on the established formula giving the flux density makes it possible to estimate the primary winding DC resistance, and then the Joule losses in the transformer primary winding. The losses found in the primary winding of the studied transformer using the established formula are quite higher than what they would be if the current was distributed uniformly in the conductors. In fact, the effective resistance of the transformer primary winding calculated using our model is about 40% higher than the calculated continuous resistance. This result has also been verified indirectly experimentally. The analytical model is validated thereafter by a discrete modelling methodology which consists in an electrical equivalent circuit [1]. The results given by the analytical modelling are perfectly identical to those of the discrete modelling presented in [1] for the same example studied.

Keywords: Pulse transformer, Skin and proximity effects, Transformer Joule losses

Presenting Author's biography

Yves Mulet Marquis was born in France in 1946. After more than 20 years of experience in the fields of power electronics and low power electric motor drives, he joined LACME SAS as chief engineer in 1993. Then he works on the various design aspects of electric fence energizers and lead acid battery chargers. He also becomes an active member of electrical safety standardization committees at the UTE, CENELEC and IEC level. Mr. Mulet Marquis holds several French and international patents on low power electric motor drives, fence energizers and battery chargers.

THE POG TECHNIQUE FOR MODELLING MULTI-PHASE PERMANENT MAGNET SYNCHRONOUS MOTORS

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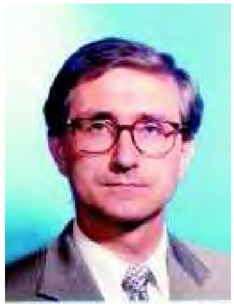
Abstract

In the paper the Power-Oriented Graphs (POG) technique is used for modelling n-phase permanent magnet synchronous motors. The POG technique is a graphical modelling technique which uses only two basic blocks (the “elaboration” and “connection” blocks) for modelling physical systems. Its main characteristics are the following: it keeps a direct correspondence between pairs of system variables and real power flows; the POG blocks represent real parts of the system; it is suitable for representing physical systems both in scalar and vectorial fashion; the POG schemes can be easily transformed, both graphically and mathematically; the POG schemes are simple, modular, easy to use and suitable for education. The POG model of the considered electrical motor shows very well, from a “power” point of view, its internal structure: the electric part of the motor interacts with the mechanical part by means of a “connection” block which neither store nor dissipate energy. The dynamic model of the motor is as general as possible and it considers an arbitrary odd number of phases and an arbitrary number of harmonics of the rotor flux waveform. Generalized orthonormal transformations allow to write the dynamic equations of the system in a very compact way. The model is finally implemented with Matlab/Simulink software. The Simulink structure of the motor clearly reflects its POG representation. Simulation results are then presented to validate the machine model.

Keywords: Modelling, Simulation, multi-phase synchronous motors, arbitrary rotor flux, Graphical modelling techniques, Power-Oriented Graphs.

Presenting Author’s Biography



Roberto Zanasi. He graduated with honors in Electrical Engineering in 1986. Since 1998 he has been working as Associate Professor of Automatic Control at University of Modena and Reggio Emilia. In 2004 he became Professor in Automatic Control. He held the position of Visiting Scientist at the IRIMS of Moscow in 1991, at the MIT of Boston in 1992 and at the Universit Catholique de Louvain in 1995. His research interests include: mathematical modelling, simulation, automotive, control of variable-structure systems, integral control, robotics, etc.

COMPARISON OF RESPONSES OBTAINED BY THE MAGNETICALLY NONLINEAR TRANSFORMER MODEL USING VARIABLE DYNAMIC AND STATIC INDUCTANCES

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Abstract

This work deals whit the magnetically nonlinear dynamic model of a transformer. In order to achieve the best possible agreement between measured and calculated responses the transformer model is completed by the magnetically nonlinear iron core model. The iron core model is given by the magnetically nonlinear characteristic of flux linkage versus magnetizing current, where the magnetizing current represents the sum of magnetomotive forces. The characteristic is used to define two variable and magnetizing current dependent inductances. The so called dynamic inductance is defined as a partial derivative of the flux linkage with respect to the magnetizing current while the static inductance is defined as a ratio between the flux linkage and the magnetizing current. This paper shows that responses obtained by the magnetically nonlinear dynamic transformer model substantially differ in the cases when variable dynamic and static inductances are used. The derivation presented in the paper and the comparison of measured and calculated results clearly show that only use of dynamic inductances gives acceptable results. The comparison of the measured and the dynamic model calculated results is given for the case of transformer steady state operation at rated load and for the case of switch–on of unloaded transformer.

Keywords: Transformer, dynamic model, iron core model, static inductance, dynamic inductance

Presenting Author's biography

Sebastijan Seme received B.Sc. degree in electrical engineering from University in Maribor, Faculty of Electrical Engineering and Computer Science in year 2006. He is currently involved in postgraduate study at the same institution where he is employed as a junior researcher.

ON THE MODEL OF A COMPACT FLUORESCENT LAMP AS LOAD OF A MIXED LV NETWORK

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Abstract

The need of an optimal integration of dispersed generation (mainly based on renewable sources, which are usually intermittent and provide electricity in DC form) led to a new distribution system, which includes DC layer as an active network (generation, storage and loads are all interconnected at direct voltage by means of uni- or bi-directional power electronics converters). At a first stage, these DC networks should operate interconnected with the AC distribution system. One main application in the near future is considered to be the use of a DC layer in office buildings. Therefore, models of the system components have to be developed, as to accurately simulate the network behavior for various states. In this paper, firstly a PSpice model of a CFL lamp was derived, as to allow different simulations conditions when supplied with DC at various voltage levels. Then a set of experiments conducted both in DC and AC enabled the model validation. For various CFLs, the I(U) characteristics were obtained and appropriate numerical model of the corresponding CFL impedance for DC supply were derived, as to be further implemented in complex grid models developed within Matlab workspace. Finally, conclusions regarding the efficiency of a DC supply grid are drawn, together with an assessment within the power quality frame.

Keywords: CFL, DC supply, Simulation, Experimental validation.

Presenting Author's biography

Mihaela Albu is from Craiova, Romania. She graduated from "Politehnica" University of Bucharest in 1987 and holds the Ph.D. degree (1998) from the same university. Since 2002 she is a Professor of Electrical Engineering. Her research interests include active distribution networks, DC grids, power quality, instrumentation, and remote experimentation embedded within on-line laboratories. Dr. Albu was spending a leave at Arizona State University as a Fulbright Fellow 2002 - 2003.

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FFT BASED COMPUTATIONAL MODEL FOR EM FIELD DEVELOPMENT ANALYSIS IN LASERS WITH ELECTRO-OPTICAL Q-SWITCH

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Abstract

Computational model, which treats EM field evolution inside an actively Q-switched laser, is presented in details. The EM field is represented by a 2D matrix and influence of the resonator elements on the EM field is described in five effective planes. The first plane represents out-coupling mirror, the second and the fourth plane laser rod ends, the third plane a center of the laser rod and the fifth plane the Q-switch element and the back resonator mirror. The matrix of the EM field is propagated between computational planes by use of a Fourier transform approach. The model is suitable for a treatment of a stable as well as for an unstable laser cavity and takes into account the lensing effect of the laser rod. Amplification of the laser light is described in terms of rate equations. Model can predict pulse energy, pulse temporal width, beam divergence, beam diameter and its intensity profile at different distances inside and outside a laser cavity. Computational time needed for a simulation of one pulse formation is of the order of minutes. Experiments performed on a ruby laser operating with a stable as well as with an unstable cavity configuration were compared to calculations and a good agreement was found.

Keywords: computer model, fast Fourier transform, laser cavity

Presenting Author's Biography

Dejan Škrabelj was born in Slovenia in 1981. In the year 2005 he has become B. Sc. in physics at the Faculty of Mathematics and Physics, University of Ljubljana. Since November 2005 he has been working at the Fotona laser company as an associate researcher and a Ph. D. student. He is cooperating with the department of Complex Matter at Jozef Stefan Institute, Slovenia.

NUMERICAL SIMULATION AND EXPERIMENTAL INVESTIGATION OF THE PULSE FORMATION IN PASSIVELY Q–SWITCHED Nd:YAG LASERS

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Abstract

We present a theoretical and experimental study of the development of the EM field in pulsed, passively Q–switched solid–state lasers. The rate equations are solved with the Runge–Kutta method separately for the gain medium and a passive Q–switch. In this way, we take the beam propagation and profile variations between the two elements into consideration. With our model, we are able to follow the pulse formation from a randomly generated seed EM field. In the rate equations used, we include excited–state absorption in saturable absorber as well as the pumping term. The latter proves to be important when analyzing the beam profiles when passive Q–switching is used. The formation of the laser afterpulse is observed in the case of stronger pumping. Its intensity profile shows mode structure characteristic of higher order Laguerre–Gaussian beams. Theoretical results are compared with experiment for three different types of laser resonators. In order to obtain a top–hat beam profile, positive–branch unstable resonators with an ordinary and a super-Gaussian output mirror were investigated. Their operation was compared to a plano–concave stable resonator. The calculated beam profiles and temporal developments are in good agreement with the experimental results.

Keywords: computer model, laser beam profile, passive Q–switch, unstable resonators.

Presenting Author's Biography

Janez Žabkar. Janez Žabkar graduated from University of Ljubljana, Faculty of Mathematics and Physics in 2001. Presently he is working in a R&D department at Fotona company, Ljubljana, Slovenia. His main fields of work include nonlinear optics, passively Q–switched lasers and computer modeling. He is working his way towards a PhD in nonlinear optics at University of Ljubljana, Faculty of Mathematics and Physics.

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CHALLANGES OF CONVENTIONAL EQUIPMENT ON MODEL BASED CONTROL CONCEPTS

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Abstract

In this paper experimental results of the so called IDOB control approach are presented for the example of a single axis linear electric drive control. In this concept an inverse nominal plant model is required, which is composed and inverted based on the simulation tool Dymola in Modelica language. The inverse model is used as Block within a Simulink environment to take advantages from the real-time abilities of RTW/xPC-Target. For the arrangement of a hardware-in-the-loop scenario, the usual drive communication interface Sercos was developed for this environment. By the simulation and experimental results an impressive performance can be demonstrated of the presented control approach as well as of the concept of methodical tool-based model processing by means of Dymola.
However on the one hand, herewith a closed workflow is established for the formation of overall control concepts of multi-axes kinematics systems. This emerges as an approach for a qualified control design for such robotic systems with controller based motion performance. On the other hand considerable remaining limitations appear in case of decentralized architectures. Single axis controllers, which are integrated in advanced control loops by digital communication systems, are characterized by destructive delays. To that effect new requirements are derived for future generations of such interfaces.

Keywords: Object oriented modelling, realtime simulation, inverse disturbance observer, multi-axeis drive control, decentralized architectures

Presenting Author's Biography

Markus Krabbes studied 1991-1996 electrical engineering at Leipzig university of technology. He began work as scientific assistant at the Ilmenau university of technology in the field of cognitive robotics. 1998-2001 this research was continued at the Magdeburg University with research on dynamics modeling and control of industrial robots by means of neural networks and was finished with PhD. From 2001-2003 Mr. Krabbes worked as group leader at the Fraunhofer institute on machine tools and forming technology in Chemnitz focused on control of parallel kinematics. Since 2003 he is Professor for information systems at the Leipzig university of technology, department of electrical engineering and information technology. Main research interests are simulation based tool chains for control design and motion control of mobile and robot systems.

COMPLEX SCHEMES OF FILTERING IN EXPERIMENTAL DATA ESTIMATION

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Abstract

Scope of the work is the decision of a high accuracy experimental data reception problem in medical, ecological and chemical data processing software. There will be reviewed techniques for sensor fusion in gas concentration control system, emphasizing algorithms for safety control in chemical industry. These find use when the sensor suite of a chemical treatment comprises several different sensors with vary stochastic properties. The review describes integration techniques for various categories of stochastic processes. The review provides an arsenal of tools for achieving maximum likelihood conditions in estimation problem solutions, including varieties of Kalman filters.
Using complex schemes of filtering improves reception of experimental data with high reliability. Approach of data acquisition about random parameter with a required degree of reliability is investigated. The approach is used for control of experimental stochastic parameter on the basis of the found interval estimations regression dependences [1, 2].
Results using this new method indicate that the complex scheme of filtering accurately estimates the concentration of dangerous pollutant (is the stochastic parameter) by determining actual sensors instrumental errors. The described technique also can be used in many other areas, including: noise reduction of signals, trajectory tracking of moving objects, etc. It points to several further-research needs, including: scaling; robustness of decision rules; using other types of filters.

Keywords: Complex scheme, Control system, Data fusion, Filtering, Kalman filter, Rate of convergence, Robustness, Sensor.

Presenting Author's biography

Alexander Zorin.
a) Studies: Information systems control, mathematical modeling, real-time control systems, adaptive estimation.
b) Academic Positions: St. Petersburg State University, Faculty of mathematics and mechanics, assistant, PhD candidate. The D.V. Efremov Scientific Research Institute of Electrophysical Apparatus (NIIEFA), research engineer.
c) Scientific Activities: My current scientific interests closely related with robustness of control systems and probabilistic analysis.
Working under parts of "Design of the Hybrid Fastest Computers and System Programming", "Stochastic Methods of Optimization in Computer Science" with co-authors.
d)Participation in a number of research projects.

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MATHEMATICAL MODELLING OF AN AUTONOMOUS VEHICLE FOR NAVIGATION CONTROL

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Abstract

The problem of modelling and control for autonomous vehicles is considered. Mutual interactions among vehicle motion dynamics are evaluated. It is proposed the mathematical model suitable for describing and simulating the whole motion of autonomous passenger vehicles. The passenger vehicles are evaluated from many points of views, such as riding comfort, vehicle position, stability, manipulability and so on. The performance of vehicle control in technically is seperated into several control items and considered to each item independently. The mathematical model for steering control of an autonomous vehicle has usually two degrees of freedom, which consider the lateral motion and the yawing motion. The model for suspension dynamics, which is deeply related to riding comfort, has also two degrees of freedom, which consider the bouncing motion and the pitching motion. The above mentioned models are not enough to treat the problem of total motion control of autonomous vehicles. The specifications of tires must also be considered in the whole motion control of vehicles and they have strong nonlinearity. There are, furthermore, mutual interactions among them, which are inevitably considered when the problem of the whole motion control of autonomous passenger vehicles.

Keywords: Autonomous vehicle, Motion dynamics, Navigation, Guidance control, Robust control.

Presenting Author's Biography

Katsumi Moriwaki. He received the B.E. degree in Mechanical Engineering from Kyoto Institute of Technology in 1975, both of the M.E. degree in Precision Mechanics and the Ph.D. degrees in Applied Mathematics from Kyoto University in 1977 and 1996. He was with the Department of Mechanics, Osaka Municipal Technical Research Institute from 1980 to 1989. From 1989 to 1995, he was with the Department of Mechanical Engineering, Shiga Prefectural Junior College. In 1995, he joined the Department of Mechanical Systems Engineering, School of Engineering, The University of Shiga Prefecture, where he is currently working in the areas of automatic control and robotics.

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BOND GRAPH COMPONENTS FOR MODELLING AN ELECTRICALLY POWERED VEHICLE

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Abstract

The wealth of Bond Graph applications is used in this paper to build a simulation test bed of an electric vehicle. The aim of this work is to interface a dynamic system model with a field network simulator. It is expected to be used as a tutorial and as a support study in current networked control system research. The major constitutive functionalities, of this simplified electric vehicle, are developed to build a complete model. Driving, braking and steering functions are modeled and provided with a set of electric actuators. More precisely five electric actuators compose this modular system. Four of them are located at the rear of the vehicle. Two of which are used for the electromotive power and the two others for the electric braking subsystems. The braking subsystems are modelled as DC actuators based on a ball and screw mechanisms. The electric steering system is located at the front wheel. Its Bond Graph is built around a DC motor and a rack and pinion mechanism. All subsystems make use of a DC motor model, widely covered in the Bond Graph modelling literature. State space models and state feedback control loops are used. The most useful measurements, state variables, control signals and their link with a real time networked system stem from the bond graph junctions. These models are proposed to be used as a support for the implementation of real time scheduling and algorithms of distributed control tasks. Simulation results are presented to evaluate the Bond graph models.

Keywords: Bond Graphs, Electric vehicle modelling , Networked Control Systems.

Presenting Author's biography

Abdennasser FAKRI was born in Casablanca, Morroco, he want to Université de Toulon where he studied Mechanics, next he want to the Unité d'Etude et de Recherche de St Etienne where he studied Physical techniques and electronic instrumentation and obtained his Master degree in 1980. He took his PhD in 1985 from the INSA de Lyon. He worked has Teacher in the Engineers School ENSEM of Casablanca before to join in 1990 the Ecole Supérieure d'Ingénieurs en Electronique et Electrotechnique (ESIEE) where he is now part of the group of Modelling COSI Lab. His email address is: fakria@esiee.fr and his web page can be found at http://www.esiee.fr/~fakria.

PIEZOELECTRIC FUNCTIONALLY GRADED LAYERS IN VIBRATION CONTROL OF LAMINATED PLATES

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Abstract

The aim of this study is to develop the modelling of active laminated plates with conventional piezopolymer sensor layers and newly proposed actuator layers made of a piezoelectric functionally graded (PFG) material. The electromechanical properties of the PFG layers can be tailored by a smooth variation of piezoelectric material fraction across the thickness direction to achieve the satisfactory operational efficiency of the actuator while minimizing the interlaminar shear stresses and also a risk of delamination. The exponential and parabolic functions are used to describe volume fractions of constituents. The dynamic analysis is based on the classical laminated plate theory and concerns a steady-state out-of-plane vibration, which is actively reduced due to the constant gain velocity feedback control. In order to model inner energy dissipation the elastic-viscoelastic correspondence principle is applied to predict complex moduli for composite components. The effects of the applied transversal distribution of the PFG actuator properties on the structural response of the plate including the changes in natural frequencies and resonant amplitudes are numerically examined and discussed. It is also shown that a sufficient control effectiveness of the considered active system with the PFG actuator layers can be obtained.

Keywords: Laminated plate, Piezoelectric control, Functionally graded actuator.

Presenting Author's biography

Marek Pietrzakowski is an assistant professor at the Faculty of Automobiles and Machinery Engineering of Warsaw University of Technology. He received his PhD and ScD degrees in mechanical engineering. His main fields of interest are: dynamics of discrete and continuous systems, smart materials applications and intelligent structures. His recent papers are devoted to vibration control of laminated plates with piezoelectric layers of a monolithic or composite form i.e. piezoelectric fiber composites and functionally graded materials.

STATISTICAL MODELING OF MULTI-DIMENSIONAL FIELDS

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Abstract

An efficient control of laser welding process requires a reliable prediction of process behavior. For this purpose representative variables have to be chosen, which can effectively describe the welding process. Our prediction is based on a record of surface optical activity in the heated zone, known as the melt pool. The spatiotemporal dynamics of surface optical activity is successfully predicted using non-parametric statistical modeling, which is based on assumption that statistical properties of deterministic chaotic fields remain unchanged as the field evolutes with time. An analysis of field patterns in the past enables us to extract relations between values of field in neighboring points in space as well as in time. Based on similarities between the present field pattern and field patterns extracted from the past data, the field value in the next time step can be successfully predicted. In this presentation we show how to optimize field pattern sampling in order to maximize prediction quality. A special attention is paid to the structure of sample vectors, which represent the bridge between the past and the future field distributions. Presented time prediction method, which was applied to the surface optical activity in the heated zone, represents the first step towards the optimal control of laser welding process.

Keywords: Nonlinear dynamics, control, prediction, spatiotemporal data analysis.

Presenting Author's Biography

Anamarija Borštnik Bračič obtained her Ph.D. in Physics at University of Ljubljana. She investigated properties of confined liquid crystals at temperatures above the nematic-isotropic phase transition, which are partially ordered due to the influence of the surface. The research was carried out in collaboration with Institute for theoretical and applied physics at University of Stuttgart. Later on she became involved in research and development projects in the field of industrial automation. She was a leader of automation projects in automobile industry (DaimlerChrylser) and industry of porous concrete building material (Xella). Lately, Anamarija Borštnik Bračič became a member of Laboratory of Sinergetics at Faculty of Mechanical Engineering. Her research is focused to statistical modeling and prediction of time evolution of multi-dimensional fields.

MODELING AND SIMULATION OF THE PRIMARY CIRCUIT OF THE PAKS NUCLEAR POWER PLANT FOR CONTROL AND DIAGNOSIS

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Abstract

Two related but different dynamic simulators of the primary circuit of the Paks Nuclear Power Plant in Hungary are described in this paper that have been built from a simple dynamic model based on first engineering principles. For dynamic analysis and controller design purposes a simple continuous time discrete-continuous hybrid state-space model has been developed that is implemented in the MATLAB/SIMULINK environment. This model has been extended by the fault models of non-compensable major leaking faults, and has been discretized to obtain a discrete event system model in the form of a coloured Petri net (CPN). The CPN model has been used to verify a safety procedure that initiates the draining of the liquid in the primary circuit when a non-compensable primary-to-secondary leaking fault occurs.

Keywords: process modeling, dynamic simulation, energy systems, discrete event simulation, safety procedures

Presenting Author's Biography

Gábor Szederkényi is a senior researcher in the Process Control Research Group of the Computer and Automation Research Institute of the Hungarian Academy of Sciences. He received his M.Sc. (Eng) in Information Technology and his Ph.D. in Information Science from the University of Veszprém in 1998 and 2002, respectively. His research interests include the analysis and control of nonlinear dynamical systems and system identification.

A GRADUATE-LEVEL MULTI-PURPOSE EDUCATIONAL CASE STUDY ON MODELLING AND SIMULATION OF THE NEUROMUSCULAR SYSTEM

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Abstract

Case studies provide an excellent and well established way of linking theory and practice in advanced-level teaching. The biological control systems involved in the regulation of posture and the control of movement in mammals are complex and highly non-linear. This case study is concerned with the modelling of elements of these neuromuscular systems and with the application of simulation methods to investigate some of the properties of their control loops. The case study is designed to be used in more than one taught module, possibly within different degree programmes and is therefore aimed at groups of students with different backgrounds and different prior knowledge. It is believed that e-learning techniques offer an increased level of flexibility that can be used to overcome problems associated with bringing students in different areas to a common level of understanding. The preparation of e-learning material for a multi-purpose case study also ensures that gaps in the knowledge and understanding of individual students within each course are more readily dealt with. The paper provides an outline of the case study, discusses educational issues associated with preparation of the case-study material for use in an integrated simulation and e-learning environment and presents some results from project work and assignments.

Keywords: Education, E-learning, Neuromuscular system, Simulation.

Presenting Author's biography

David Murray-Smith is an Emeritus Professor of the University of Glasgow . Until October 2005 he was Professor of Engineering Systems and Control in the Department of Electronics and Electrical Engineering, where he is still actively involved in research. His current research interests are in system modeling and control techniques applied to a range of engineering and biomedical systems.

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MODELLING OF THE RESPIRATORY SYSTEM FOR EXERCISE CONDITIONS: A CASE STUDY IN PHYSIOLOGICAL SYSTEM SIMULATION

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Abstract

This paper provides a brief review of respiratory control system models and associated computer simulations for human subjects during exercise. It also describes the development of a model of the human respiratory system for a range of exercise intensities. This dynamic model, which is compartmental in form and is based on ordinary differential equations and algebraic relationships, puts particular emphasis on the representation of the individual tissue compartments and especially the skeletal muscle compartment, which is considered in particular detail. The structure of the model is described and variables of the model are discussed, highlighting those that are readily measurable in contemporary exercise experiments. The form of the model is used to help to identify possible reasons for the relative lack of success of modelling and simulation methods in this particular field of research in the past. Suggestions are also made, with illustrative examples, of ways in which experimentation and model-related activities could be more closely integrated to the benefit of future research on exercise physiology. Conclusions are presented regarding the present status of modelling and simulation methods in respiratory physiology during exercise and proposals are made for a strategy that might allow researchers to use available modelling and simulation tools more effectively.

Keywords: Respiratory system, Control, Exercise, Simulation model, Validation.

Presenting Author's biography

Husni Thamrin is a research student at University of Glasgow. He is also a member of staff at the Universitas Muhammadiyah Surakarta, Indonesia. His main research activity is in control system modelling and simulation, especially in the context of biomedical systems applications.

COMPUTER-BASED SURGICAL SIMULATION SYSTEM FOR STUDENTS TRAINING

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Abstract

Computer-Based surgical simulation systems are one of the most recent technologies in virtual reality development. These systems have changed the traditional medical training and the surgical certification scenarios. They have become a training method and an effective tool to acquire valuable information and skills for many medical students and practitioners. The aim of this paper is to introduce a functional prototype of a computer-based surgical training and assistance simulator for medical students. The system allows students as well as surgeons to interact with anatomical and biological structures by modeling and operating on virtual objects displayed on the computer screen. The system consists of: a personal computer, graphical monitor and a haptic feedback device. A 3D virtual representation of the bones constituting the wrist of a patient is shown. Also, algorithms that model objects using the convex hull approaches and simulate real time exact collision detection between virtual objects during the training on the surgical operation are presented. In addition, a force feedback device is used as a haptic interface with the computer simulation system. This leads in the development of a low cost system that is used by students with the same benefits as professional devices. In this regard, the wrist arthroscopic surgery can be simulated and students can easily acquire the system and can learn the basic skills required with safety, flexibility and less cost.

Keywords: Virtual Reality, Computer-Based Simulation, 3D modeling and Visualization, Convex Hull, Collision Detection, Haptic Feedback.

Presenting Author's Biography

Fadi Yaacoub received his Bachelor degree (B.Sc.) and his Master degree (M.Sc.) in Electrical Engineering from the University of Balamand Lebanon in 2003 and 2005 respectively. He is currently a PhD student at Université Paris-Est and A^2SI laboratory of ESIEE-Paris France. He works on the development of a virtual reality simulator for arthroscopic surgical training. His research areas of interest include: Virtual Reality, Computational Geometry, Signal and Image Processing, Medical Imaging, Modeling and Biomedical Instrumentations.

TWO APPROACHES TO MOBILE ROBOTS SIMULATOR DESIGN

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Abstract

This paper presents the design of a mobile robots simulator which is applicable for robot soccer or for general use. The simulator consists of a group of mobile robots, the ball and includes knowledge of their dynamic behavior modeling, collisions modeling and visualization. Two different approaches to the design of this simulator are given and compared. By the first approach the simulator physics background was completely developed by our team, which enabled us to get a better insight into the problem domain and gave us the possibility to efficiently solve some simulator specifics. First the model of ball and robot motion was derived and then complex approximate collisions models, where the real robot shape is taken into consideration. Some new ideas of collision formulation, realization and real robot shape inclusion are used. By the second approach the simulator was developed using freely available physics engine ODE – Open Dynamics Engine. This engine already includes physical background for rigid bodies dynamic; it is up to the user to define mechanical and physical parameters of the objects to simulate e.g. dimensions, masses, friction, joints and the like. The implementation of both simulators are described and a comparisons of their reality description, computational efficiency, effort and knowledge needed to built the simulator, advantages and disadvantages are given.

Keywords: Robot Simulator, Modeling, Collision Detection, Physics Engine.

Presenting Author's biography

Gregor Klančar. He received his B.Sc. and Ph.D. degrees in 1999 and 2003 from the Faculty of Electrical Engineering of the University of Ljubljana, Slovenia, where he is currently employed as a researcher. His research interests are in the area of fault diagnosis methods, multiple vehicle coordinated control and mobile robotics.

THE TRAINING SIMULATOR FOR THE GHAZI-BAROTHA HYDRO-POWERPLANT

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Abstract

The paper presents the modelling of the 1450 MW hydro-powerplant (HPP) Ghazi-Barotha, Pakistan. The purpose of the modelling is to design and built the training simulator for the operator personnel. The paper focuses on the hydrodynamic model of the plant. The most complex subsystem is the power channel. It was initially modelled by a system of partial differential equations that can be solved by the method of characteristics in order to obtain discretised (in length and time) model of the channel. After the simplification, the model was realised as a combination of the admittance model and the hybrid model that is very well suited for the simulation purpose. Four types of gates are used in the system and each type is modelled in the paper. The hydrodynamic model is completed by describing the barrage and the forebay ponds. The electrical part of the model includes the model of five turbines and corresponding units and the model of the high-voltage switchyard. Electrical models are much faster and are therefore drastically simplified. The main problem is huge amount of signals that have to be calculated in real time. Most components are modelled as simple automata. There are also some continuous-time subsystems that were discretised and simulated as discrete transfer functions.

Keywords: training simulator, hydrodynamic model, electrical model

Presenting Author's biography

Sašo Blažič received the B.Sc., M. Sc., and Ph. D. degrees in 1996, 1999, and 2002, respectively, from the Faculty of Electrical Engineering, University of Ljubljana. Currently, he is Assistant Professor at the same faculty. His main interests include adaptive, predictive and fuzzy control with a stress on the robustness issues of adaptive control.

HYDROELECTRIC POWER DAMS NETWORK SIMULATION

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Abstract

A simulation system was developed to build simulation models for evaluating and testing control rules and personal training in the operation of sets of interdependent hydroelectric power dams under flood conditions. The project was developed for the company Electricity of Portugal (EDP) by three members from the University of Porto (Guimarães, R. C., Moreira da Silva, C., Brito, A. C.). A discrete event simulation approach was used based on numerical methods to model the system state variables. A configuration stage allows the user to define the hydroelectric power dams network and to enter the required data to characterize each of the power dams. Graphics were used to show the hydroelectric power dams network so that the user could easily check the input data. After defining all the required data the user can generate the simulation model. For running the simulation the user needs also to choose one of the downstream water flow data series previously defined. These series were based on historical data from the most significant floods registered by EDP. During the simulation run the user can interactively control the turbines power and the floodgates aperture. During the model execution icons are used in a pictorial representation of the dams. A zoom interaction allows to observe the functioning of a particular dam. At this level of detail it is possible with special conceived dynamic XY graphics to follow the behavior of some of the most important state variables. This was essential for the analyst to be able to control the dams under flood conditions. The simulation system can be used for training purposes and to test control rules without any risk, that can be used later in severe flood conditions allowing a better use of the water resources.

Keywords: Simulation, Modelling, Hydroelectric power dams simulation

Presenting Author's biography

António Carvalho Brito. Was born in Porto, Portugal and went to Universidade do Porto, where he studied mechanical engineering and obtained his degree in 1981, staying in the same institution as Lecturer where he did his M.S. thesis in 1985. He obtained his Ph.D. in Simulation from the School of Management at the University of Cranfield (U.K.) in 1993. Currently he is a Professor at Universidade do Porto, where he leads research in the field of Simulation and Information systems.

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HIGH PERFORMANCE CLUSTER COMPUTING ON A FLYING SIMULATOR

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Abstract

The article covers a design of parallel computing in information systems of a simulator. The concept is based on computers that create a distributed computer system of a flight simulator. This information system is created by computers and program applications of mathematic models. An important part of this article describes high performance computing with tasks, a compute cluster, a job scheduler and parallel execution. It explains job admission by a command line interface and creation of these jobs, mathematic models of a flying simulator. Mathematic modeling is the art of transformation of a problem from an original application into a theoretic area to mathematical formulations for a numerical analysis.
A significant part of this article describes the implementation of aircraft computation speed depending on fuel supply and an elevator, high performance computing implemented by single-processor architecture. Simulation of a horizontal and vertical flight is defined by the angles and angular velocities around axises of the aircraft. This is accomplished by some computers, which are able to create a distributed computer system for a flight simulator. The programme loop for calculation parameters of mathematic model is created on the high performance cluster. This distributed mathematical model of an aircraft in longitudinal direction speed computes in real time. Flying simulator modeling processes on these computers also create a time benefit in a parallel system.

Keywords: high performance computing, cluster, parallel task, mathematic model, flying simulator.

Authors' Biographies

Peter Kvasnica. He has been spending several years by researching mathematical models of flying objects and programming virtual reality applications. He publishes in the area of application of mathematical methods of flying objects, in scientific programs with the emphasis on modelling of such systems. He graduated in Technical University of Brno (VUT Brno), and was awarded by Doctor of Philosophy (PhD.) of M. R. Štefánik Military Academy of Aviation in Košice. He is involved in the development of adapted mathematical models and use of distributed computer system in flight simulators for real-time applications.

A COMPARISON BETWEEN EQUIDISTANT PWL APPROXIMATIONS AND FUZZY CLUSTERING APPLIED TO THE INITIAL VALUE PROBLEM FOR ODES

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Abstract

This paper document several experiments and improvements made on the basis of an ODE solver using Piecewise Linear Approximations and the impact when Fuzzy Clustering is used to decide the allocation of the simplex divisions. A comparison is analyzed in order to compare the potential applicability of the Fuzzy clustering for a stable and unstable ODEs using different number of simplices and number of points to produce the Piecewise Linear (PWL) approximation. The case with stable ODEs is considered first focusing in the reduction of a predefined global error when decreasing vector fields are used. The less smooth nature of the Fuzzy approximations when compared to the classic Equidistant basis is researched using two different number of points and analyzing the changes into the PWL slopes from simplex to simplex. The asymptotic behavior of the error bounds in the case of stable ODEs is also considered showing the tightness of the bounds as t goes to infinity. This is of crucial collaborative importance for existent techniques like validated interval methods, etc. Unstable ODEs can be also integrated with the methodology in this paper but the analysis of the required predefined domain and number of points for the PWL approximate vector field is not so straight as in the case of stable ones. Finally some conclusions and future directions for further improvements in such a methodologies applying PWL approximations for ODEs are depicted.

Keywords: Nonlinear Vector Fields; ODE system, ODE solver, Interval Methods, Validated Methods.

Presenting Author's Biography

Osvaldo Enrique Agamennoni was born in Bahía Blanca, Argentina on December 21, 1953. He received the Electrical Engineering degree and the Doctorate in Control System both from the Universidad Nacional del Sur (UNS), Bahía Blanca, Argentina, in 1979 and 1991 respectively. His research interest include nonlinear system modeling, identification and control, piecewise linear approximation and robust control of nonlinear systems.

A HIERARCHICAL FUZZY APPROACH TO TEMPORAL PATTERN RECOGNITION

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Abstract

In this contribution an approach for modelling and recognition of complex patterns in multivariate time series is being presented. Spatial, temporal and predicate logical elements are integrated into a model and may be built upon each other hierarchically. Integration of uncertainty and fuzziness as well as seamless interpretability are particularly emphasised. The focus of interest lies on the treatment of temporal expressions. For this purpose several options for describing and measuring the fulfilment of temporal requirements are introduced. Finally a novel generalised temporal measure emerges from these, offering a comprehensive parameterisable method to express temporal expectations. The classification of multivariate spatial information by means of the established Fuzzy Pattern methodology forms the basis of the model presented in this article. Temporal aspects can then be incorporated by analysing the development of fuzzy truth values over time. For the formulation of temporal requirements a so-called expectation function is introduced. In conjunction with a novel parameterisable measure which is employed to assess the expectations, this enables the model to describe a wealth of temporal expressions. The degree of fulfilment of a temporal expectation itself constitutes a new fuzzy truth value that evolves over time, therefore it can be processed likewise in subsequent steps. In this way, spatial and temporal elements of the model of a temporal pattern can be nested hierarchically. Since this approach relies on fuzzy truth values throughout the model, all elements can be arranged arbitrarily according to the requirements of the user, whilst maintaining interpretability and transparency. It is shown that verbal knowledge about a temporal pattern can be transformed to such a model in a straightforward way.

Keywords: Multivariate time series, temporal pattern recognition, fuzzy systems, decision support systems.

Presenting Author's Biography

Gernot Herbst received his diploma degree (Dipl.-Ing.) in Electrical Engineering from Chemnitz University of Technology in 2006. Afterwards he joined the faculty of Electrical Engineering at Chemnitz University of Technology, where he works as scientific research and lecturing assistant. His current research interests focus on the incorporation of fuzziness into the representation of time series and temporal phenomena.

MULTIOBJECTIVE PREDICTIVE CONTROL BASED ON FUZZY HYBRID MODELLING

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Abstract

In this paper, a multiobjective predictive control based on fuzzy hybrid modeling and solved by Evolutionary algorithm is presented. At every instant, a genetic method is used to find the Pareto optimal front. Provided that only one input can be applied to the system, different criteria are used to explore ways of using Pareto Optimal front. Besides, EMO solution allows obtaining a new tuning method for the weighting factor of the typical Model Predictive Control. An illustrative experiment on a hybrid tank system is conducted to show the benefits of the proposed approach.

Keywords: Predictive Control, Hybrid Predictive Control, Fuzzy Model, Evolutionary Multiobjetive Optimization.

Doris Sáez. She received the M.Sc. and Ph.D. degrees in electrical engineering from the Pontificia Universidad Católica de Chile, Santiago, in 1995 and 2000, respectively. She is currently an Assistant Professor at the Electrical Engineering Department, Universidad de Chile. Her research interests include fuzzy systems control design, fuzzy identification, predictive control, control of power generation plants and control of transport systems. Dr. Sáez is President of the IEEE Chilean Section and a Co-Founder of the Chilean chapter of the IEEE Neural Networks Society. Dr. Sáez has authored and coauthored more than 40 technical papers in international journals and conferences, and is author of the book Advanced Control of Solar Plants (New York: Springer-Verlag, 2001). She has acted as a Reviewer for such journals as the IEEE Transactions on Power Systems, IEEE Transactions on Power Delivery, IEEE Transactions on Energy Conversion and IEEE Transactions on Neural Networks.

THE ROLE OF APPROXIMATION IN ANALYTICAL CONTINUOUS-TIME WIENER-MODEL PREDICTIVE CONTROL

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Abstract

The paper investigates the role of the nonlinear-function approximation in the case of Wiener-model predictive control for nonlinear time-delayed systems. As the control law is derived in a closed analytical form, it is important that the open-loop prediction of the process output is as accurate as possible. In this sense we studied three different approximations of the static function in the Wiener model, the piecewise-linear (PWL), fuzzy-system (FS) and spline approximation. In the FS case we also considered the cases with triangular and exponential membership functions, and 1st- and 2nd-order consequent functions of the fuzzy system. The main scope of the study was to analyze how the optimizing the static-function approximation affects the derivative of the function, which plays the key role in the control law. The results show that the best results can be achieved with the FS approximations. The only problem can be seen in the possible discontinuity of the derivative function for a low number of approximation segments. In the PWL case we get consistent results in terms of the approximation for any number of the segments; however, the overall results are worse than in the FS case. In the spline case it can be clearly seen that for good performance one needs more segments than in the FS case. However, due to a continuous derivative function, good results are obtained in terms of the energy of the control signal.

Keywords: Wiener system, time-delayed systems, predictive control, function approximation, pH neutralization

Presenting Author's Biography

Simon Oblak received a B.Sc from the Faculty of Electrical Engineering, University of Ljubljana in 2003. Currently he is working in the same institution as junior researcher. His research interests primarily include applications of fuzzy systems, especially in the fields of nonlinear control and fault detection. For his work he received many awards, including Prešeren scientific student award in 2003 and the first prize in the Baltic olympiade in automatic control in 2006.

FUZZY MODEL OF BIRD FLOCK FORAGING BEHAVIOR

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Abstract

We present a fuzzy logic based model for the simulation of bird foraging behavior. The core of the model is based on the fuzzy model for the computer simulation of bird flocking presented by Lebar Bajec et al. The later was extended in such way that allows the simulation of bird foraging. In order to upgrade the original model it was necessary to advance the artificial world and the synthetic bird (synbird). The former was expanded with the introduction of feeding areas - circular regions containing food. Similar to the synbirds they were implemented as animats, i.e. by means of a three stage transition function. The first stage of this function is responsible for the selection of information about the synbirds that are currently within the area, the second for computing the change of the available food and the third for computing the new state of the feeding area. In addition to the introduction of feeding areas we upgraded the synbirds with the notion of hunger. In order to do this two drives were added to the model's basic drives and the synbird's internal state was changed as well. To support the attraction of the feeding areas a new perception function was added and the action selection was upgraded so as to take into account the influences of the newly introduced drives. The behavior of the synbirds is governed by their behavior type, which can be feeding, take off, flying or landing. While the behavior type drive is responsible for the transition between behavior types, the feeding drive, with respect to the current behavior type, influences hunger, flight altitude, speed and flight direction. With the extensions made we moved the model a step closer to a more naturalistic simulation of bird behavior.

Keywords: fuzzy logic, animat, boid, foraging, flock.

Presenting Author's Biography

Miha Moškon received a BSc degree in Computer Science from the Faculty of Computer and Information Science, University of Ljubljana in 2007, where he is currently working as a researcher in the Computer Structures and Systems Laboratory. His research interests include fuzzy logic, artificial life and communication protocols.

STAGE-DEPENDENT FUZZY LOSS FUNCTION IN MULTISTAGE CLASSIFIER – RESULTS OF SIMULATIONS

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Abstract

The work deals with a recognition problem using a probabilistic-fuzzy model. The model is based on the notion of fuzzy random variable and also on the Bayesian theory. The Bayesian hierarchical classifier is based on a decision-tree scheme. For given tree skeleton and features to be used, the optimal (Bayes) decision rules (strategy) at each non-terminal node are presented. The globally optimal Bayes strategy (which minimizes the overall error probability) has been calculated for stage-dependent loss function. This fuzzy loss function means that the loss depends on the stage at which misclassification is made. The loss function in our case is fuzzy-valued and is described by a fuzzy triangular or trapezoidal number. In order to rank fuzzy mean values, we have selected the subjective method defined by Campos and Gonzalez. This method is based on the λ-average valued of a fuzzy number where λ parameter is a subjective degree of optimism-pessimism. In the end, some results of simulation investigations of this case of pattern recognition are presented. This results presented influence of parameter λ on separation point for decision regions at the first stage. This paper contribute to a better understanding of the impact of the choice of a fuzzy numbers which describe stage-dependent loss function in multistage classifier.

Keywords: Fuzzy loss function, Bayes rule, Multistage classifier.

Presenting Author's biography

Robert Burduk received an MSc degree in Electronic Engineering and a PhD degree in Computer Engineering from the Wroclaw University of Technology in 1998 and 2003, respectively. His PhD dissertation dealt with multistage pattern recognition with fuzzy-probabilistic model. Currently he is a lecturer at the Wroclaw University of Technology. He teaches pattern recognition, data mining and databases.

FUZZY VECTORIAL DIRECTIONAL PROCESSING IN DENOISING OF MULTICHANNEL IMAGES

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Abstract

We propose a fuzzy logic recursive scheme using gradients and vectors (directional processing) for motion detection and spatial-temporal filtering to decrease a Gaussian noise corruption. The usage of the spatial-temporal information is considered to be more efficient compared with the use of only temporal information in the presence of fast motion and low noise that is common for different algorithms that can be found in literature. We introduce novel ideas that employ the differences between images. That permits to connect images using angle deviations, obtaining several parameters and applying them in the robust algorithm that is capable to detect and differentiate movement on background of noise in any way. The proposed method takes into account several characteristics inherent in the images. We can separate them and improve processing time consuming, having only the robust process with those samples that demonstrate that their corruption and movement are in a high level. It has been demonstrated that taking into account, both characteristics (gradients and vectors) and connecting them together, we can realize the algorithm with better performance, improving the techniques that use such characteristics in a separate form. During the simulations it has been investigated two different video sequences to qualify effectiveness of this filter. Both sequences: "Miss America" and "Flowers" present different image texture to provide a better understanding in the robustness of the fuzzy logic algorithm and have shown the effectiveness of proposed fuzzy logic algorithms.

Keywords: Fuzzy Logic, Video Sequences, Motion, Vectors.

Presenting Author's biography

Volodymyr I. Ponomaryov: Ph.D. (1974), Doctor of Sciences (1981), Full Professor (1984). He is working as Professor at National Polytechnic Institute of Mexico (Mexico-city). Main research activity: signal/image processing, real time filtering, medical sensors, remote sensing, etc. He is author more than 100 scientific papers, 250 conference papers, and also 22 patents of exUSSR, Russia and Mexico, and several scientific books.

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PRACTICAL OPTIMIZATION BY OR AND SIMULATION

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Abstract

Should we pool capacities or not? This is a question that one can regularly be confronted with in operations and service management. It is a question that necessarily requires a combination of queueing (as OR discipline) and simulation (as evaluative tool) and further steps for '*optimization*'.

It will be illustrated that a combined approach (SimOR) of Simulation (techniques and tools) and classical Operations Research (queueing, linear programming and scheduling) can be most beneficial.

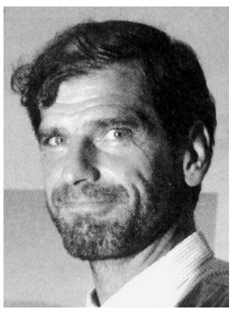
First, an instructive example of parallel queues will be provided which shows the necessary and fruitful combination of queueing and simulation. Next, the combined approach will also be illustrated for the optimization of:

- call centers,
- checking-in at airports,
- blood platelet production.

Whether we should pool or not is thus just one simple question for which this SimOR approach can be most fruitful if not necessary for 'practical optimization'.

Keywords: Optimization, call centers, check-in, blood platelet production, simulation.

Presenting Author's biography



Professor Nico M. van Dijk is responsible for the Operations Research and Management Program at the University of Amsterdam and principal consultant of the simulation company: Incontrol Enterprise Dynamics.

As a scientific researcher, he has a strong research interest in the area of stochastic operations research, most notably queuing and simulation. Beyond his scientific activities, he has also taken up the mission of popularizing the potential of OR for business environments and general public. Accordingly, he has written articles for Dutch magazines and national newspapers.

He has supervised and been involved in a variety of practical projects, among which for the Dutch railways, the Dutch airport, the Dutch Triple A, the Dutch ministry of health, hospitals and industry.

MINIMUM STOCK COSTS AT GIVEN TIMES FOR DELIVERY WITH SIMULATION AND OPTIMIZATION

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Abstract

High complex optimization problems regarding production planning could often not be achieved with standard planning methods, because they are not able to solve practical problem sizes. This makes the usage of mathematical optimization methods and dynamically validation features of simulation necessary. As a result of high complexity and lots of interdependencies between the different targets, optimization has many degrees of freedom. Competitive objectives are minimal cycle times, maximal workload of resources, minimal stock sizes, minimal set-up costs (sequence dependent) and high order fulfilment. Resulting runtimes of computation are not bearable in industries, because near- and medium-term planning assignments are recurring rapidly. The case study describes the solution on the basis of a practical example, which was implemented at Erne Fittings in Austria. The challenge was to solve a high parametric, complex, and dynamic optimization problem below twelve hours computation time and nevertheless guarantee high quality of output. The optimization part was solved with *ISSOP 2.0*©, an optimization tool, which uses many parallel working metaheuristics, composed of deterministic, stochastic, evolutionary, and genetic algorithms that are controlled by an intelligent learning method, which spreads calculation time ideally. The simulation model programmed in *Flexsim*© has three main assignments. One is to emulate the calculation methods and interfaces of Erne's ERP software *Brain*© and to test the cooperation with optimization. Second task is to simulate the whole information and material flow in production, stock keeping and order processing over two year time periods, to analyse optimization suggestions regarding stock sizes and customer satisfaction. Third task is to adjust optimization and to check resulting effects. Additionally the simulation is used to convince Erne of optimization quality and to check the impact of different possibilities in production planning (e.g. high or low order-fulfilment against stock size).

Keywords: Simulation and Optimization. Simulation for Optimization Validation.

Presenting Author's biography

Philipp Thurnher is software engineer at V-Research GmbH and PhD student in the department of production management and logistics at the University of Innsbruck in Austria. He received his degree as DI (FH) at the Fachhochschule Vorarlberg (University of applied Sciences) in Austria in 2004. His research interests include software development, simulation modeling and computer-aided optimization.

AUTOMATIC CREATION OF SIMULATION MODELS FROM DATA MODELS OF LOGISTIC AND MANUFACTURING PROCESSES

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Abstract

More and more simulation projects are no longer designed as single solutions but for longer and repeated use. The aim is not to simulate one specific scenario but to compare different approaches, even varying system parameters. The idea is based on the arising need for simulation in logistics as well as supply chain management. The most difficult aspect therein lies in the gap between need and knowledge. The users are mostly not familiar with the concept of modeling and simulation and have no prior knowledge of using a simulation tool. Their main interest is not the simulation itself but the results calculated.
To minimize the effort of redesigning the simulation model the approach of self constructing simulation models proves itself to be the most convenient. It enables even users with no knowledge of the simulation tool to change the simulation model by altering the according parameters. Such self constructing models need longer to develop but are a lot more convenient in usage.
The simulation environment is ‘hidden’ behind a GUI, enabling the user to enter all data specific for the simulation model as well as the simulation run in a certain, user friendly way. The same GUI can be used to start a simulation run and to analyze the results.
This approach implies the split between a simulation environment and a data model; The user only needs to interact with the GUI that stores the data in the structure defined by the data model. The simulation environment imports the data at the start of the simulation run and automatically creates the model. This enables fast and easy comparison of different scenarios while minimizing the effort of parameterization.

Keywords: Enterprise Dynamics, Automatic Model Buildup, Data Model.

Presenting Author’s biography

Shabnam Michèle Tauböck works for Profactor Research and Solutions since March 2007. From Dezember 1999 until March 2007 she worked for the business area Process Optimization, Division Environment and Life Science at ARC Seibersdorf research. From June 1998 until April 2000 she worked for PSE SIEMENS in Vienna.

OPTIMISATION OF SCHEDULING PROBLEMS BASED ON TIMED PETRI NETS

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Abstract

This paper deals with modelling and simulation of scheduling and sequencing problems based on Petri Nets. In particular, Timed, Coloured, and Stochastic Petri Nets are used to model and implement specific scheduling problems in the field of production processes and other discrete event systems. The Petri Net models are simulated over the time domain and a simulation-based optimisation is implemented to optimise the input sequences. In this work a new conflict resolution is implemented and a sophisticated way of defining firing sequences is developed. This new approach offers the possibility to model queuing, sequencing or scheduling problems being independent of the appearance of any conflicts. The optimisation of sequencing and scheduling problems works by automated changing and evaluating of the used sequences and parameter specifications. This kind of optimisation problem is too complex to be solved to optimality. A promising alternative is to use heuristics, like genetic algorithms, simulated annealing or threshold accepting. All these methods are implemented in the so called MATLAB PetriSimM toolbox which offers the capability of modelling, simulation, and optimisation of Timed, Coloured, and Stochastic Petri Nets. In case of stochastic processes the comparison of alternative system configurations is a highly sophisticated problem. In this work a sequential paired t-test and variance reduction techniques are used and implemented to solve the stochastic optimisation for sequencing and scheduling problems. All the implemented features, functionalities and capabilities are compared and tested in two case studies including the modelling, simulation and optimisation of a production cell and the well-known travelling salesman problem.

Keywords: Petri Nets, Optimisation, Manufacturing, Scheduling

Presenting Author's Biography

Thomas Löscher was born in Horn, Austria and went to the Vienna University of Technology, where he studied technical mathematics and obtained his degrees in 2004 and 2007. He worked for the ARC Seibersdorf research company in the field of discrete event simulation. He is member of the ARGESIM group and his PhD thesis deals with the simulation-based optimisation of scheduling problems based on timed Petri Nets. His e-mail address is: tloescher@osiris.tuwien.ac.at.

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MACRO-REACHABILITY TREE EXPLORATION FOR D.E.S. DESIGN OPTIMIZATION

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Abstract

Discrete event systems, such as manufacturing facilities or logistic systems, can be improved by the optimization of their models, which can be based on the exploration of the reachability tree (RT) of the Petri net (PN) used to model them. Thanks to this technique it is possible to obtain a sequence of decisions that leads to an optimal behaviour of the system, according to one or several cost or benefit functions and a set of restrictions. Sometimes the original system is not completely defined, since it contains some undetermined parameters, and then several decisions should be taken in order to assign precise values to all these parameters, and so to define the system in a right way. These decisions can be seen as design-decisions(the location of warehouses of a logistic system or the number, the type and distribution of machines, manufacturing cells, transport devices and products storage of a manufacturing facility can be considered, etc.), different from the decisions taken in order to optimise the behaviour of a determined system, which could be seen as operation-decisions. Those design-decisions could lead to completely different systems, related to diverse models, in this work based on PN. Each one of these PN has associated a specific RT, which can be explored and provide particular solutions. This paper describes and explores a general method to afford this kind of problems. The technique is based on the concept of macro-RT, built up from the different RTs related to the different PN solutions of the considered decision making procedure. The aim is to present a systematic treatment of the optimization process of certain problems related to models based on PN, by means of the exploration of a macro-RT, as well as to show some application examples of this technique to manufacturing processes.

Keywords: Modeling & Simulation (M&S), Discrete event systems (DES), Petri nets (PN), Reachability tree, Design optimization.

Presenting Author's biography

Dra. Mercedes Pérez de la Parte. PhD in telecommunication engineering from the University of Seville, Professor at the *Mechanical Engineering Department* of the University of La Rioja, where she is main researcher of the research project *Modeling and simulation of automatic systems*, as well as main researcher of the national research project "*artificial intelligence and acoustic emission for optimization of the automated process of welding and analysis of stability*".

MODEL MIXING FOR LONG-TERM EXTRAPOLATION

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Abstract

Reliable extrapolation – simulation or prediction – of system output is an invaluable departure point for the control system design. For application of model-based techniques, the knowledge of the model structure is essential. It can be based purely on the physical point of view or estimated from process data while the system is considered as a *black box*. Mixing of both methods results in *grey box* modelling. Often, modelled systems are governed by several known physical laws and each of these laws implies a model, which should match the data. Nevertheless inevitable uncertainties often make simulated outputs of respective models unreliable. The problem is especially pronounced for systems with a significant time delay. This motivates search for methods, which utilize all available models at once and mix their outputs with the aim to get better results. In the paper, four variants of mixing are considered, discussed and their performance compared on industrial data. Seeming alternative – a simple complex model is discussed as well. Data for experiments came from a cold rolling mill.

Keywords: Simulation, modelling, estimation, multiple models.

Presenting Author's Biography

Pavel Ettler received the doctor degree in cybernetics from the University of West Bohemia in Plzeň. He worked as researcher at Škoda (Rolling Mills branch) for eleven years. In 1993 he joined COMPUREG, a company oriented to industrial control systems. His interests include identification and control of systems subject to uncertainties with application to metal processing and machine control. His involvement with research includes participation in several international and national research projects, mainly in co-operation with UTIA.

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DEVELOPMENT OF SIMULATION-BASED ENVIRONMENT FOR MULTI-ECHELON CYCLIC PLANNING AND OPTIMISATION

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Abstract

This paper focuses on the development of simulation-based environment for multi-echelon cyclic planning and optimisation in the product maturity phase. It is based on integration of analytical and simulation techniques. Analytical techniques are used to obtain initial planning decisions under conditions of stochastic demand and lead time, whereas simulation techniques extend these conditions to backlogging and capacity constraints. Simulation is used to analyse and improve cyclical decisions received from the analytical model. The proposed environment includes four components, such as database, process, optimisation and procedural one. Database component defines a supply chain network and its input parameters. Procedural component generates cyclic schedules using analytical calculus. Process component performs automatic generation of a supply chain simulation model and simulates cyclic schedules in multi-echelon environment while controlling inventory levels and estimating the performance measures. Optimisation component defines optimal cyclic schedule for each of the supply chain stages in order to minimize the sum of inventory holding, setup and ordering costs while satisfying customer service requirements defined by a target customer service level. The paper provides examples of different network type simulation models generated for multi-echelon cyclic planning and optimisation. The present research is funded by the ECLIPS Specific Targeted Research Project of the European Commission "Extended Collaborative Integrated Life Cycle Supply Chain Planning System".

Keywords: Multi-echelon cyclic planning, supply chain simulation, automatic programming.

Presenting Author's biography

Liana Napalkova holds an MSc degree in Computer Science from Riga Technical University (2006). Currently, she is a PhD student and a research assistant at the Department of Modelling and Simulation, Riga Technical University.

AUTOMATED BEHAVIORAL MODELING AND ANALYTICAL MODEL-ORDER REDUCTION BY APPLICATION OF SYMBOLIC CIRCUIT ANALYSIS FOR MULTI-PHYSICAL SYSTEMS

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Abstract

The aim of symbolic analysis that has its origin in the design of analog circuits is the extraction of dominant system behavior by automated derivation of approximated symbolic formulas. Since exact symbolic analysis will yield exceptionally complex expressions even for rather small systems a class of symbolic approximation techniques have been developed that allow a reduction of the complexity of symbolic equations and their later solution by means of mixed symbolic and numerical strategies. Hence, it becomes possible to reduce the underlying nonlinear differential-algebraic systems of equations (DAE systems) of component-based networks and systems to a behavioral description of a predefined accuracy. It is a major advantage of the approach that the model simplification is performed by an automatic error control and that the simplified model is physically interpretable again. The contribution will give an overview of the symbolic tool Analog Insydes (www.analog-insydes.de), algorithms for extraction of dominant behavior of linear systems, e.g. formulas for poles and zeros as well as algorithms for generating behavioral models from nonlinear DAEs. Moreover, the underlying methodology has been extended to the application of analysis and modeling of gas-pipeline nets and mixed electrical and mechanical systems. For the latter a library was developed in cooperation with the Fraunhofer IIS/EAS for symbolic models of micro-mechanical elements that can be connected to networks, even together with electrical components.

Keywords: symbolic analysis, model reduction, behavioral modeling, multi-physical modeling.

Presenting Author's biography

Ralf Sommer received his diploma and Ph.D. in electrical engineering from Technical University of Braunschweig, Germany. In 1993 he was with the Technical University of Kaiserslautern and the Fraunhofer ITWM where he managed the developing of Analog Insydes. In 2000 he joined Infineon Technologies AG, Munich, Germany, where he was a group leader in the central CAD department with responsibility for analog design flow development and research projects. In 2006 he became professor at Technical University of Ilmenau as well as the scientific director of the Institute for Microelectronic and Mechatronic Systems gGmbH

A TOOL-BOX APPROACH TO COMPUTER-AIDED GENERATION OF REDUCED-ORDER MODELS

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Abstract

Technical systems can be characterized very often as being very complex and heterogeneous. Many simulators exist for the analysis of continuous, discrete, and hybrid systems. However, the first *modeling* steps in physical domains are not yet sufficiently assisted by CAD tools. Multi-ports and generalized KIRCHHOFFian networks proved to be powerful concepts in a physically oriented modeling methodology. If the physical system is described by partial differential equations, discretization algorithms are applied to construct models described by ordinary differential equations or equivalent lumped network models. Their parametrization can be supported by various algorithms for numerical order reduction in frequency and time domain, symbolic and semi-symbolic analysis, approximation, and optimization which are comprised in a tool box. Modeling languages as VHDL-AMS, Verilog-AMS, SystemC-AMS, and Modelica will support the practical application of these approaches.

Keywords: Model generation, Order reduction, Symbolic analysis, Modeling languages, Multi-ports, KIRCHHOFFian networks.

Presenting Author's biography

Peter Schwarz was born in Berlin, Germany. He received the diploma and the Ph.D. degree in electrical engineering from the Dresden University of Technology in 1964 and 1967, respectively. Then he worked in a CAD department of the Robotron Computer Company in Dresden. From 1982 to 1991 he was the leader of the research group "Simulation" at the Central Institute for Cybernetics and Information Processes of the Academy of Sciences in Dresden. Since 1992 he has been working at Fraunhofer IIS / EAS Dresden. He led the Modeling and Simulation department with about 30 engineers, mathematicians, and physicists before his retirement in 2006. His special interests are multi-level, mixed-signal modeling and simulation of complex heterogeneous systems (e.g., integrated circuits, MEMS, mechatronic and automation systems), methods and algorithms for model generation, web-based simulation, and knowledge transfer in life-long learning.

STRUCTURE OF SIMULATORS FOR HYBRID SYSTEMS - GENERAL DEVELOPMENT AND INTRODUCTION OF A CONCEPT OF EXTERNAL AND INTERNAL STATE EVENTS

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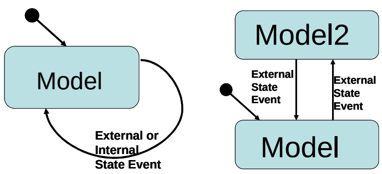
Abstract

New trends for the structure of simulation systems support hybrid modelling and structural dynamic systems. The paper first discusses discrete elements in the CSSL Standard, and - in more detail - classification of 'classic' state events. There, structural-dynamic systems are generated by state events, changing the dimension of the state space. The paper continues with recent developments caused by Modelica and VHDL-AMS, which introduce non-causal modelling on a high level, including implicit models and state events associated with boundary conditions. Both new standards extend the CSSL standard, with emphasis on continuous systems; but especially Modelica allows defining pure discrete model constructs based on events, state charts, and Petri nets.

The main chapters concentrate on further extensions for the CSSL frames, mainly in order to handle hybrid and structural-dynamic systems properly. There, features of two competing 'philosophies' are sketched, maximal state space versus hybrid decomposition. In order to allow a high flexibility at modelling level, state events are characterised as 'internal state events' (I-SE) or 'external state event' (E-SE). An I-SE is handled in a classic way: detecting, localising, event handling, and restart of integration. An E-SE is detected and localised, but then it terminates the simulation of the (previous) model; the event itself is managed outside the model(s), and simulation of the same or of another model is started. Both types of event can be described by state charts (se at left); implementation is the simulator's task. Finally, simulators being able to implement both state event types are reviewed: Modelica/Dymola, Mosilab, AnyLogic, ModelVision, and MATLAB/Simulink/ Stateflow.



Keywords: CSSL Standard, Hybrid Modelling, State Events, State Charts

Presenting Author's biography

Felix Breitenecker studied 'Applied Mathematics' and acts as professor for Mathematical Modelling and Simulation at Vienna University of Technology He covers a broad research area, from mathematical modelling to simulator development, from DES via numerical mathematics to symbolic computation, from biomedical and mechanical simulation to process simulation. He is active in various simulation societies: president and past president of EUROSIM since 1992, board member and president of the German Simulation Society ASIM, member of INFORMS, SCS, etc. He has published about 250 scientific publications, and he is author of two 3 books and editor of 22 books. Since 1995 he is Editor in Chief of the journal editing the journal Simulation News Europe.

NUMERICAL SIMULATION OF CONTINUOUS SYSTEMS WITH STRUCTURAL DYNAMICS

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Abstract

In this paper, "continuous systems with structural dynamics" shall be understood as dynamical systems consisting of components with continuous and/or discrete behaviour. (This notation should not be confused with the term "structural dynamics" in the context of Finite Element simulation). Continuous systems with structural dynamics – or so-called "hybrid systems" – can often be investigated only by a so-called "hybrid simulation" which means a simultaneous simulation of continuous-time dynamics (modelled by differential equations or differential-algebraic equations (DAE)) and discrete-event dynamics (modelled e.g. by Boolean equations, finite state machines, or statecharts). To this end, an algorithm for numerical simulation of hybrid systems must be able to both solve a DAE system within a "continuous" time progression as well as to deal with event-driven phenomena.
In the paper, the point of view is emphasized that the structure of a continuous system is closely combined to the structure of the DAE system which describes the continuous system's dynamical behaviour. In this context, discrete-time events are considered as phenomena which may cause a change of the DAE system's structure. Furthermore, a distinction between *systems* with variable structure and *models* with variable structure is explained. The main part of the paper deals in detail with a simulation algorithm suitable for hybrid systems. This algorithm consists of a "continuous phase" (for numerical integration of the DAE system) and a "discrete phase" (for interpreting the event, establishing the new valid DAE system, calculating the new initial values). Some simulation results dealing with selected models and using the multi-physics language Modelica will complete the paper.

Keywords: Structural dynamics, Hybrid systems, Discrete-continuous simulation, Simulation algorithm, Modelica

Presenting Author's biography

Olaf Enge-Rosenblatt received the Diploma in automation engineering and the Ph.D. degree in electrical engineering from the Chemnitz University of Technology, Chemnitz, Germany, in 1986 and 2005, respectively. From 1992 to 2004, he was with the Institute of Mechatronics in Chemnitz mainly working on unified mathematical descriptions of electromechanical systems and on modelling of systems with structural variability. Since 2005, he has been with the Fraunhofer Institute for Integrated Circuits in Dresden, Germany. His research interests include modelling of heterogeneous – especially mechatronic – systems using multi-physics or multi-domain approaches.

DISCRETE HYBRID AUTOMATA APPROACH TO STRUCTURAL DYNAMIC MODELLING AND SIMULATION

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Abstract

The paper presents the discrete hybrid automata (DHA) modelling formalism and related HYSDEL modelling language. The applicability of the framework in the context of modelling of structural-dynamic systems is discussed. High level and partially modular modelling capabilities of HYSDEL are presented and the possibility of modelling structural-dynamic systems is shown and illustrated by a simple example. To model structural dynamics, standard HYSDEL list structures are employed, and additional dynamic modes are introduced when state re-initializations are necessary at mode switching. For the derived DHA models an efficient simulation algorithm is presented. The main features of the framework are compared to characteristics of other modelling and simulation tools capable of capturing structural dynamics. Although DHA modelling framework only permits the simulation of a corresponding maximal state space model, and the simulation precision is limited, it offers other advantages, e.g. straightforward translation of the model to various optimization problems that can be solved by standard linear or quadratic programming solvers.

Keywords: Discrete hybrid automata, structural-dynamic systems, modelling, simulation.

Presenting Author's Biography

Gašper Mušič received B.Sc., M.Sc. and Ph.D. degrees in electrical engineering from the University of Ljubljana, Slovenia in 1992, 1995, and 1998, respectively. He is Associate Professor at the Faculty of Electrical Engineering, University of Ljubljana. His research interest are in discrete event and hybrid dynamical systems, supervisory control, and applications in industrial process control.

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CLASSICAL AND STATECHART – BASED MODELING OF STATE EVENTS AND OF STRUCTURAL CHANGES IN THE MODELICA – SIMULATOR MOSILAB

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Abstract

Mosilab (*MO*delling and *SI*mulation *LAB*oratory) a new simulation system developed by Fraunhofer understands Modelica, offers different modeling approaches, and supports structural dynamic systems. This will be discussed on the basis of a main example, the classical constrained pendulum. We show how the solution can be done using only standard Modelica components, where the benefits are and which kind of switching the states can be done. As we will see there is no possibility to define separate submodels with different state space dimensions and switch between these systems during one simulation run.

The next point of view lies on an extension of the Modelica framework. The most important new feature of this model description language is the definition of a statechart framework. With this construction the next three solutions of the constrained pendulum are done. The first approach is mathematically similar to the Modelica solution and defines poor parameter events within the statechart construct. This approach cannot handle events of higher order. The second approach for the model is done with two different submodels, one for the case that the rope of the pendulum is short and one for the case it is long. In the statechart the two models are then connected and disconnected to the main program and thereby switched between active and off. A third approaches with only one submodel but two instances of the system will conclude our model inspection.

We focus on how the numerical approaches are done in general and where are the benefits comparing to the other solutions. A final step is to look at the numerical quality of the output of the different approaches. This is done by validation with another example for which an analytical solution exists.

Keywords: Mosilab, state event, statechart, Modelica, constrained pendulum.

Presenting Author's biography

Günther Zauner. He has earned a degree in mathematics with specialization in "mathematical computer science". With an interdisciplinary background based on higher technical school he has experience in the application and the development of numerical methods and different modeling approaches. Current work focuses on simulation and modeling techniques and coupling of different approaches.

MODELING OF STRUCTURAL-DYNAMIC SYSTEMS BY UML STATECHARTS IN ANYLOGIC

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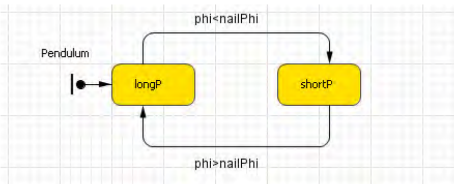
Abstract

With the progress in modeling dynamic systems new extensions in model coupling are needed. The models in classical engineering are described by differential equations. Depending on the general condition of the system the description of the model and thereby the state space is altered. This change of system behavior can be implemented in different ways. In this work we focus on AnyLogic and its ability to switch between different sets of equations using UML statecharts. Different possibilities of the coupling of the state spaces are compared. This can be done either using a parallel model setup, a serial model setup, or a combined model setup. The analogies and discrepancies can be figured out on the basis of three classical examples.



The first is the constrained pendulum as defined in ARGESIM comparison C7, where the dimension of the state space is unaltered. Second is the free pendulum on a string, where the dimension of the state space changes. The third example is a thermal storage model at which between different accuracies of the discretization is switched.

Keywords: Structural dynamics, UML, Statecharts, AnyLogic

Presenting Author's Biography

Daniel Leitner graduated in mathematics at the Technical University of Vienna. Currently he is working on his doctoral thesis about mesoscopic simulation of blood flow at the Austrian Research Centers. His research interests are numerical modeling, fluid dynamics in general, especially lattice Boltzmann methods and its application to biofluids.

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UNIVERSITY TIMETABLING IN MINIMUM AREA OF CLASSROOM USING EVOLUTIONARY COMPUTATION BY VIRUS EVOLUTIONARY THEORY

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Abstract

A genetic algorithm using a virus evolutionary theory (GAV) was developed and applied to a class schedule.
The minimum number and area of classrooms for classes conducted in the six undergraduate school departments and the three graduate school departments in the faculty of science in our university were sought and it is tried to obtain the most efficient class schedule for them. The maximum number of subjects is 640.
The class schedule was created by GAV under the condition of the minimum number and area of classrooms and that of well-balanced required subjects. GAV was carried out by attacking a chromosome by a number of viruses. The genes of the chromosome were recombined by the attack. The infection was admitted when the evaluation value went up, but it fell into local minima immediately. In order to escape from these local minima, an infection which made the evaluation value worse in a small rate (AR) under a low probability (PR) was recognized as well. In this case, AR and PR were made smaller as the evaluation value went up, whereby it escaped from the local minima and optimum condition was obtained. The parameters for AR and PR are very important to obtain the optimum solutions and the best parameters were sought. The main purpose of this study is to obtain the data of the minimum number and area of classrooms for the construction of the new building. For this aim, this method is useful.

Keywords: Virus Evolutionary Theory, Class Scheduling, Combinatorial Optimization

Presenting Author's biography

Susumu Saito is a Professor of School of Management, Tokyo University of Science. He received B.S. from Tokyo University of Science and Dr. of Engineering from Keio University.
His research interests are in production engineering, combinatorial optimization and simulation of economical time series.
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ON VISUALIZATION OF DIVERSITY IN EVOLUTIONARY ALGORITHMS BASED ON SIMULATION OF PHYSICAL SYSTEM

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Abstract

Evolutionary Computation is a popular soft-computing approach to solve problems in a nature-inspired way. Evolutionary Algorithms (EAs) are well-known optimization methods that belong to this domain. All EAs work with population of organisms which represent solutions of optimized problem. Organisms compete for survival and gradually evolve to higher fitness. EAs can be seen as algorithms which traverse the search-space in a parallel way. Diversity is an essential aspect of each EA. It describes the variability of organisms in the population. The lack of diversity is a common problem. It means that all organisms are very similar to each other and that they are located around a single point in the search-space. Diversity should be preserved in order to evade local extremes (premature convergence). Niching algorithms are modifications of classical EAs. Niching is based on dividing the population into separate subpopulations - it spreads the organisms effectively all over the search-space and hence making the overall population diverse. Using niching methods also requires setting of their parameters, which can be very difficult. This paper presents a novel way of diversity visualization based on physical system simulation. It is inspired by intermolecular forces and employs overall energy minimization. This minimization is done via known unconstrained optimization numerical methods, namely, Steepest Descent, Conjugated Gradients or Quasi-Newton. The visualization is helpful when designing and tuning niching algorithms, but it has also other uses. The visualization will be presented on NEAT - the evolutionary algorithm which optimizes both the topology and the parameters of neural networks. We compare our approach with a related method of dimension reduction devised by Sammon.

Keywords: Diversity, Evolutionary algorithms, Niching, Visualization.

Presenting Author's Biography

Jan Drchal is a postgradual student and a research worker on Czech Technical University, Faculty of Electrical Engineering in Prague. His main interest in computer science is soft computing, particularly neural networks and evolutionary computation. He is a member of Neural-Computing Group (NCG) led by his tutor doc. Miroslav Šnorek.

CONTINUAL EVOLUTION ALGORITHM FOR BUILDING OF ANN-BASED MODELS

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Abstract

The Continual Evolution Algorithm (CEA) for building of models is presented in this paper. We chose an artificial neural networks (ANN) based models in our applications to show properties of CEA algorithm. During CEA evolution process a continual (in time) gradient learning algorithm is combined with a classical genetic (evolutionary) approach. Thus in this application a structure of models is constructed separately from particular parameters optimization in such models (e.g. weights in neural networks). These two optimizations are running at the same time but using different methods. As a platform for our experiments the universal neural network topology implementation based on the fully recurrent neural network has been chosen. This implementation allows the evolution algorithm to create any network structure with no limitations for a usage of gradient real time recurrent learning algorithm. An advantage of using evolutionary algorithms for neural network construction is in finding its optimal structure (number of neurons and connections among them). Splitting the construction process into structure finding part and the particular weight values setting (finding) has an advantage in reduction of the problem dimension. Number of reproduction operation calls is reduced and a part of optimization process is done separately. Results of these two parts are then combined before the next reproduction operation is needed. Individuals in our algorithm contain an age parameter, so the CEA allows for the number of gradient based algorithm steps for the individual quality assignment. The CEA is a universal optimization algorithm with no limitations for neural network construction and evolution. Neural networks created using this algorithm can be used for example in classification, prediction, etc. In this paper we will focus mainly on benchmark tasks showing a function and principles of the novel evolution algorithm in relations to other methods, pure gradient learning algorithm and differential evolution method.

Keywords: Continual Evolution Algorithm, Genetic Algorithm, Neural Networks.

Presenting Author's Biography

Zdeněk Buk works as a postgraduate student and researcher at the Department of Computer Science and Engineering, FEE-CTU. He got his master degree in Electronics and Computer Science & Engineering from FEE-CTU in Prague in 2005. He joined the CIG – Computational Intelligence Group (former known as NCG – Neural Computing Group) in 2002. His research focuses on methods of computational and artificial intelligence, mainly on artificial neural networks and evolutionary techniques.

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HYBRID GENETIC-ALGORITHM / BRANCH & BOUND TECHNIQUE TO SOLVE A TIME-DEPENDENT TRANSPORTATION PROBLEM

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Abstract

This paper deals with the solving of transportation problem in which a vehicle moves along a hamiltonian path with a decreasing charge for supplying the demands of a given set of consumers. The transportation cost is an affine function depending of the carried charge. The order to reach the consumers that minimizes the transportation cost must be found. This problem is NP-hard. It is proposed a heuristic method that combines a genetic algorithm with embryonic chromosomes with a branch and bound technique. In this way, the evolving mechanism operates with subsets of solutions rather than individual ones. The hybrid genetic algorithm explores a population of embryonic and adult chromosomes. The exploration of the state space tree organizations of solutions, that is specific to branch & bound, interleaves with the exploring of total solutions as a standard genetic algorithm does. A specific growing operator acts with a given probability in order to transform the embryonic chromosomes into adult ones. When geographic coordinates of the locations are available, the mutation and growing operators act on vicinities of the nodes. The size of these vicinities is smaller as the evolution advances and an effect similar to that of simulated annealing is induced. When the fitness function is applied to an embryonic chromosome it behaves like the estimate function used by the branch & bound techniques with the least cost strategy. A mechanism able to capture the intrinsic clustering information existing in the set of consumers is used in order to take benefit of the phase transition effect. The performance of the hybrid genetic algorithm regarding the solutions quality and the required computing time is experimentally investigated and reported.

Keywords: genetic algorithm, branch & bound, transportation problem, hamiltonian circuit.

Presenting Author's biography

Octav Brudaru is professor of computing at Technical University ''Gh. Asachi'' Iasi, and a researcher at Institute of Computer Science, Romanian Academy Iasi Branch. His scientific interests and research activity include soft computing techniques, distributed genetic algorithms for combinatorial optimization, methods and tools for data clustering and approximation, design of hyperheuristics, operation management and the design of systolic algorithms.

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ADAPTIVE PLAN SYSTEM WITH GENETIC ALGORITHM BASED ON SYNTHESIS OF LOCAL AND GLOBAL SEARCH METHOD FOR MULTI-PEAK OPTIMIZATION PROBLEMS

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Abstract

The product design is becoming more and more complex for various requirements from customer needs and claims. As a consequence, its design problem seems to be a multi-peak problem with multiple dimensions. It is necessary to solve the multi-peak optimization problems. In this paper, a new evolutionary algorithm (EA) has been proposed to solve the multi-peak optimization problems with multiple dimensions. The proposed algorithm is a stochastic global search heuristics in which EAs-based approaches are combined with local search method. It has been named by author the Adaptive Plan system with Genetic Algorithm (APGA) in GA-based combination algorithms. APGA uses the Adaptive Plan (AP) to control its optimization process for the local search process. APGA differs in handling design variable vectors (DVs) from GAs. GAs encode DVs into genes, and handle them through GA operators. However, APGA encodes control variable vectors (CVs) of AP, which searches to local minima, into its genes. CVs decide on a global behavior of AP, and DVs are handled by AP in the optimization process of APGA. APGA is applied to many benchmark functions to evaluate its performance, and has been confirmed to improve the calculation cost and the stability of convergence towards the optimal solution.

Keywords: Memetic Algorithms, Evolutionary Computation, Genetic Algorithms, Local search method, Multi-peak problems.

Presenting Author's biography

Hiroshi Hasegawa. He received his BE and ME from Shibaura Institute of Technology, Japan, in 1992 and 1994, respectively. He received his PhD in Mechanical Engineering from Tokyo Institute of Technology, Japan, in 1998. He worked for CRC Research Institute Inc. from April 1994 to March 2004. From April 2004, he has been working at Shibaura Institute of Technology, and is currently an Associate Professor. He is member of Japan Society for Simulation Technology, Japan Society of Mechanical Engineers and American Society of Mechanical Engineers. His research interests include computer-aided exploration, especially multi-peak optimization, robust design, multi-disciplinary optimization, shape and topology optimization.

MODELING THE LASER DROPLET-FORMATION PROCESS AND OPTIMIZING WITH GENETIC ALGORITHMS

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Abstract

A numerical model of laser droplet formation (LDF) from a metal wire was built for the purpose of process optimization. In the LDF process three laser beams placed around the circumference of the wire are used to melt the wire tip. The basic equation of the quasi-symmetrical model is the heat equation, including nonlinear material properties and phase transitions. Numerical solutions of the model make possible the calculation of the time development of the temperature field of the wire for different sets of process parameters. We considered the LDF process in two phases: pendant-droplet formation and droplet detachment. In order to obtain the desired droplet properties the time course of the laser-pulse power was optimized for the first phase of the process. Based on the calculated temperature field and the selected objective function the optimization of the LDF process was carried out using a genetic algorithms method. In the second phase the laser-beam "key-hole" phenomenon is used to detach the pendant droplet. To determine the pulse for droplet detachment, a simplified key-hole model was used. The models of droplet formation and detachment were applied to determine the optimal laser pulses. Theoretically determined laser pulses for the case of nickel wire were verified experimentally. The experimental results of the LDF process were characterized by the variability of the droplet size and the radial scattering of the position of the deposited droplets. Experiments showed that in comparison with heuristically selected pulses, the model-based optimized pulse yields the lowest variability of the process and a small number of undesired splashes of metal during the LDF process.

Keywords: Droplet formation, Modeling, Optimization, Experimental verification.

Presenting Author's biography

Tadej Kokalj. Bachelor degree in Physics at the Faculty of Mathematics and Physics, University of Ljubljana. Ph.D. degree in "Modeling and optimization of laser droplet formation from metal wire" at the Faculty of Mechanical engineering, University of Ljubljana. Presently, a researcher at the Institute of Metals and Technology (www.imt.si) in the Laboratory for Measurements in Heat Engineering, Ljubljana, Slovenia.

DYNAMIC SIMULATION OF LARGE SCALE HELIUM REFRIGERATOR: THE 400 W @ 1.8 K TEST FACILITY

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Abstract

The aim of this study is to simulate the dynamic behavior of a large cryogenic refrigerator using the software Aspen Hysys®. A dynamic model of the refrigerator located at the CEA-Grenoble : the 400 W @ 1.8 K test facility, has been realized. One of the advantages of this installation is to be particularly well instrumented, thereby providing many experimental data which allows comparison between simulation and experimentation. The refrigerator comprises all the typical equipments of cryogenic systems: plate-fin counter-current heat exchangers (one of them is a liquid nitrogen pre-cooler), cold turbine expander, helium phase separators, wet pistons expander and centrifugal cold compressors. The software used is Aspen Hysys® which is provided by the company AspenTech. This is a process simulation environment first designed to serve processing industries especially Oil & Gas and Refining. Cryogenic companies already use it to simulate steady-state process in order to improve the performance of their equipment. This paper describes the model development and shows possibilities and limitations of the dynamic module of Aspen Hysys®. Thus, an experimental study has been performed to investigate the dynamic behavior of the Brayton Cycle of the 400 W test facility. Results obtained by the simulation were compared to the experimental data and have led the validation of the dynamic behavior of the model.

Keywords: Cryogenic systems, dynamic simulation, helium refrigerator.

Presenting Author's biography

ROUSSEL Pascal. Born in 1965. Diploma from ENSIEG-INPG (electrical engineer school in Grenoble) in 1988. Joined CEA-Cadarache in fusion department (TORE SUPRA) in 1990. Since 1995 works in cryogenic department: Service des Basses Temperatures at CEA–Grenoble. Involved in study design and specification of large scale cryogenic facilities (CERN-LHC, ITER, JT60SA).

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A DYNAMIC SIMULATOR FOR LARGE SCALE CRYOGENIC SYSTEMS

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Abstract

This paper presents a real-time simulator for large scale cryogenic systems of CERN (European Organization for Nuclear Research) using helium refrigerators controlled by Programmable Logic Controllers (PLC). The results of the first tests carried out on the cold-box used in the CMS (Compact Muon Solenoid) experiment at CERN are also described. It is worth to mention that the CMS experiment is a particle detector used in the future CERN accelerator (the LHC) where a superconducting magnet of 225 tons must be maintained at 4.5K. The work objectives are threefold: first, to provide a tool to train the operators, second to validate new control strategies before their implementation and, third, to improve our knowledge of cryogenic systems. In order to respect the real system architecture, the simulator is composed of different modules sharing data through a standard protocol. The modelling of the process makes use of EcosimPro©, a standard modelling and simulation commercial software for industrial systems. Each cryogenic component is represented by a set of differential and algebraic equations (DAE) and the helium properties are taken from a dedicated helium library. Finally, the control system is simulated with a PLC-simulator provided by the PLC manufacturer. These modules are connected to the real supervision system used to operate the cryogenic plant. Thus, the existing control policy and supervision systems can be fully reused in simulation.

Keywords: Cryogenics, helium, dynamic simulation, EcosimPro, process modelling.

Presenting Author's Biography

Benjamin Bradu. Graduated by the engineering degree of the Graduate School of Electronic and Electrical Engineering of Amiens (ESIEE-Amiens) and by the Master degree of the University of Compiègne (UTC) in 2006, he is specialized in electrical systems and in the control theory. He is currently doing his PhD at the UTC in the CNRS Heudiasyc laboratory working as doctoral student at CERN in Geneva, Switzerland.

FROM IDENTIFYING AND MODELING TO CONTROL: THE MULTICONTROLLER, AN ADVANCED CONTROL LOOP STRATEGY FOR CRYOGENIC SYSTEMS AT CERN

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Abstract

CERN's (the European Organization for Nuclear Research) new challenge, the Large Hadron Collider (LHC) will produce particles collisions inside four dedicated experiments with which they will carry out physics research. Cryogenic controls have developed a framework named UNICOS (Unified Industrial COntrol System). It is an object oriented development for industrial process control technologies based on PLC-SCADA solutions (Programmable Logic Controller). The MultiController object has been integrated in the latest UNICOS framework to offer various advanced control loop strategies. It gives to the user a series of advanced control algorithms: Smith Predictor, PFC, RST and GPC. Additionally the MultiController offers full tuning possibilities via a Human Machine Interface (HMI). Process identification is a key point to elaborate the control signal. An advanced tool suite named 'Advanced Automation Tool Kit' allows several control functionalities to work in a PLC environment. It provides PLC objects for system simulation, online system identification, and online system recording processes. The MultiController combined with the 'Advanced Automation Tool Kit' gives to the process engineer a complete solution to tune a system with advanced controllers.

Keywords: Model Identification, Advanced Control Algorithms, Programmable Logic Controller, Human Machine Interface.

Presenting Author's biography

Sébastien Cabaret is a PhD student at CERN for the IT-CO (Information Technology – COntrol) group. Sébastien Cabaret has first been graduated in an Engineering French school and has worked for the RAL (Rutherford Appleton Laboratory) in the U.K. as a control engineer for the Proximity Cryogenic System of an Experiment named ATLAS at CERN. Since 2005, he is attached at CERN laboratory to accomplish its doctorate in advanced control applied for Programmable Logic Controllers.

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PROCESS IDENTIFICATION THROUGH TEST ON CRYOGENIC SYSTEM

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Abstract

UNICOS (UNified Industrial Control System) is the CERN object-based control standard for the cryogenics of the LHC and its experiments. It includes a variety of embedded functions, dedicated to the specific cryogenic processes. In this standard the current object used for control loops is a PI controller (no derivative term). This is a not mere coincidence , in the cryogenic "industry", operators are apprehensive about derivative action and its response to noise, especially when the actuators involved are valves. The UNICOS controller is suitable most of the time for cryogenic processes and it is optimized by the operation team with "try & error" methodology. This procedure is common for industrial control engineers who do not use any identification guideline, although an urgent need for efficient and effective identification methods is required. To enlarge the capabilities of the standard it is proposed to integrate the parametrical identification step in the control system of large scale cryogenic plants. SISO and MIMO parametrical identification have been tested and the results were combined to obtain a better model. The main objective of the work is to find a compromise between an easy-to-use solution and a good level of process identification model. The study focuses on identification protocol for large delayed system, the measurement consistency and correlation between different inputs and outputs. Furthermore the paper describes in details, the results and the tests carried out on parametrical identification investigations with large scale systems.

Keywords: Parametrical Identification, Cryogenics, Large scale solution, Controller Tuning.

Presenting Author's Biography

Marco Pezzetti. Graduated in Mechanical Engineering at Politecnico di Milano (Italy), Automation specialization, in the academic year 1995/96. He is working at CERN in the control section of the cryogenics for experiments since 1998, specialized in large scale cryogenic system. He is currently doing a PhD at the Picardie Jules Verne University and ESIEE-LMBE, Amiens.

MODELLING WORKSTATION FOR A KRYPTON CONDENSER SYSTEM

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Abstract

This paper describes the design and the implementation of a Modelling WorkStation (MWS), which integrates a model of a cryogenics process. Its aim is to solve with adaptive control strategy non linearity and operating scenario's problems. This solution is developed at CERN on the NA48 experiment, started in the 90's. The slow control for the cryogenic detector is operated by Programmable Logic Controller (PLC). It will be changed in the current year, maintaining the liquid krypton thermal stability. The system components modeled are a krypton condenser based on an argon bath and a liquid nitrogen two phase heat exchanger. The First Principle model consists of mass and energy balances equations to represent the cryogenics dynamics of two phase flows. To face the limitations of the actual PI controller, a state space model with unknown terms, linked with a "cryogenic fluid library" to determine thermal coefficients, is developed to show the improvements possibilities in terms of thermal stability. In a second time, an extended model is presented, in order to optimize later, transient periods and to obtain prescribed behavior during the different operating ranges. It provides observation of the liquid nitrogen evaporation within the two phase heat exchanger resulting in a better efficiency for the use of cryogenic fluids. Model validation is based on measurements and on dynamic response analysis. The final part develops the model integration approach and the OPC communication between the MWS and the PLC to discharge the latter from the dynamic model and the controller coefficients calculation.

Keywords: Modelling, Cryogenics, TDC, Observation, PLC.

Presenting Author's Biography

Alexandre Moraux. Graduated by the engineering degree of the Graduate School of Electronic and Electrical Engineering of Amiens (ESIEE) and by the Master degree of the Technological University of Compiègne (UTC) in 2006, he is specialized in electrical systems and in Control Theory. He is currently doing his PhD at the LTI laboratory (Amiens) on cryogenic modelling and control, working as project associate at CERN in Geneva, Switzerland.

VIRTUAL PID TOOLBOX (VPT)

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Abstract

The paper deals with the development of a program system for modeling, control, simulation and animation of various controller and control loop types (feedback, feed forward, ratio and combination of individual structures). The program system enables the user to generate optimal controller structures and compute optimal controller parameters based upon more than 30 tuning methods with and without knowledge of the mathematical model. In the first stage based upon measured data or the known mathematical model, the program system performs optimal identification and possible reduction of the mathematical model (10 etalon model types). The second stage is the controller structure design (PID, LQ, LQR, generalized polynomial,....). Using the VPT it is possible to choose arbitrary theoretical or industrial controller (considering different controller vendors); for the chosen controller the program system computes optimal parameters and realizes graphical and numerical performance and stability tests in both time and frequency domains. In the modular form the Virtual Toolbox was applied for the modeling and tuning controller parameters in power and gas industries. The program system VPT presents an effective extension to the existing Toolbox Control in Matlab and can be used e.g. as a supporting system in education and practical industrial controller tuning.

Keywords: Control methods, Complex systems, PID control, Deadbeat control, Algebraic polynomial control, MPC control, Virtual reality, Animation.

Štefan Kozák was born in Velaty, Slovak Republic, in 1946. In 1970 he obtained the Diploma in Electrical Engineering from the Slovak Technical University in Bratislava and in 1978 the Ph.D degree in Technical Cybernetics from the Slovak Academy of Sciences. Since 1976 he has worked at the Institute of Technical Cybernetics in the field of control algorithms design. He has led a research group in the Institute of Applied Cybernetics in Bratislava (1981-1984). Since 1998 he was Head of the Department of Automatic Control Systems, Faculty of Electrical Engineering and Information Technology in Bratislava. In 1989, he received pedagogical degree Assoc.Prof. In 2004 he was appointed professor (prof.). He chairs doctoral study in the field of Control Engineering at the FEI STU in Bratislava. His research interests include system theory, linear and nonlinear control methods, numerical methods and software for control and signal processing. He published over 200 research papers in conference proceedings and international journals, and organized several international IFAC conferences held in 1994, 1997, 2000, 2003 in the Slovak Republic.

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IDENTIFICATION TECHNIQUES IN VNAV AUTOPILOT DESIGN FOR A LIGHT SPORT AIRCRAFT

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Abstract

This paper describes the application of identification techniques in the design and optimization of a vertical navigation (VNAV) autopilot for a light sport aviation (LSA) high performance aircraft (Flight Design CT 2K). The whole design has been based, to reduce global costs, weight and complexity, on the control of the stabilator trim instead than, as is more common, on the direct control of the stabilator by means of a dedicated servo actuator. This solution, despite the above mentioned advantages, is characterized by some critical aspects due to the introduction of additional delays in the control chain and also to potential safety problems that must be carefully considered. The first design step has seen the construction of an accurate model concerning the aircraft response to the stabilator trim. This model has been obtained by means of identification techniques applied to data sequences collected in specific flights and has been validated by means of simulations performed on data sets concerning different flights. The model has then been used to design and optimize a PID controller whose performance has been tested first in simulation contexts and subsequently, after its implementation into the autopilot, in flight conditions. This design approach has allowed, on the one hand, a sensible reduction of inflight tests and of trial and error procedures and, on the other hand, to obtain a good final autopilot behavior confirmed by all inflight validation tests.

Keywords: System identification, Aircraft models, Autopilots, PID controllers.

Presenting Author's Biography

Roberto Guidorzi holds the chair of System Theory at the University of Bologna since 1980. He has, besides, been Director of the Computer Centre of the Engineering School of Bologna University from 1987 to 1992 and has been, from 1997 to 2006, Director of CITAM (Interfaculty Center for Advanced and Multimedia Technologies). He has been visiting professor and invited speaker in European and American universities and has collaborated with several industries in the development of advanced projects. He is the author of some 200 publications dealing with subjects of a methodological nature as well as applications of system theory methodologies. His present research interests concern errors-invariables identification and filtering, blind channel equalisation, aircraft modeling and control and development of e-learning environments.

THE COMPARISON OF UNMANNED UNDERWATER VEHICLES' CONTROL STRATEGIES

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Abstract

The need for unmanned underwater vehicle services is increasing steadily in recent years. In order to complete their task satisfactorily these type of vehicles need control algorithms with very good performances for their guidance. This is especially true for a special kind of unmanned underwater vehicles which don't have real time connection with the operator. This type of vehicles are called autonomous underwater vehicles. This paper makes a comparison of two common type of control algorithms (sliding mode control and PID) which use different type of thrusters. Thrusters with propellers driven constant speed electric drives and variable speed electric drives have been considered.

Keywords: sliding mode control, PID, unmanned underwater vehicles, thrusters.

Presenting Author's Biography

Primož Podržaj. He was born in Ljubljana, Slovenia in 1972. He received BSc, MSc and PhD from the Faculty of Mechanical Engineering, University of Ljubljana in 1996, 2000 and 2004 respectively. He is currently working as the teaching assistant in the same institution. His main research interest is Control theory, but he is also working in the are of Resistance Spot Welding Control and Intelligent Space.

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SIMULATION OF SINGLE INPUT DISTRIBUTED PARAMETER SYSTEMS VIA VIRTUAL CONTROLLER DESIGN

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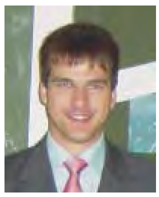
Abstract

For the analysis of dynamic systems and model-based controller design highly accurate models are required. They often consist of partial differential equations. Furthermore, in most cases an analytical solution of these equations cannot be found and a numerical method (e. g. finite element method etc.) has to be applied to obtain an adequate approximation. For the purpose of model-based controller design the resulting high dimensional state space models (systems of first order ordinary differential equations) are not convenient. Therefore, an order reduction scheme has to be applied, yielding a suitable low order description. In this report, an alternative way of numerical modeling and simulation of single input systems, described by linear partial differential equations, is presented. The exact solution is approximated using low order polynomials by means of the mean weighted residual method. These polynomials are defined only at a small part of the domain and the problem is divided into many different subproblems. The coupling of the subproblems is achieved by introducing constraints. The global solution is described by a differential-algebraic matrix equation (descriptor system). It can be solved by introducing a proportional state feedback, using pole assignment with output coupling. The concept will be evaluated by application on a beam equation.

Keywords: Pole Placement, Output Coupling, Order reduction, Distributed Parameter Systems, Partial Differential Equation.

Presenting Author's Biography

Jan Schlake received his Diploma in mathematics from the Technical University of Clausthal, Germany, in 2004. Currently he is working toward his Ph.D. degree in numerical modeling and model based control theory of distributed parameter systems at the electrical engineering department of the Technical University of Darmstadt, Germany.



CONSTRAINED POLE ASSIGNMENT CONTROL FOR SECOND ORDER PLANT WITH STABLE ZERO

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Abstract

This paper discusses the design of the control for the second order plant with stable zero. The control combines the approaches of the minimum time control and the pole assignment control. The dynamical classes of PID controllers are introduced in the paper. The designed control, the P-P controller, is applied to a real plant to verify the control design. The thermal plant is used as the real experiment. It is modeled as the plant with slow and fast mode corresponding to different ways of heat transmission, i.e. second order plant with stable zero. The designed control respects input constraints and can be easily tuned by one parameter, the closed loop poles (we use double closed loop pole). When choosing proper closed loop poles one has to take into account parasitic time constants, etc. Nevertheless, the designed controller is able to give the dynamics from the minimum time control to pure linear one according to the chosen poles. The desired control signal has one interval at the saturation then it converges to steady value with the dynamics given by the closed loop pole.

Keywords: Constraints, Pole assignment control, Zero dynamics, Real experiment.

Presenting Author's biography

Mikuláš Huba received the MSc. and PhD. Degrees in technical cybernetics from Slovak University of Technology in Bratislava in 1974 and 1982, respectively. From 1989 he is a Senior Lecture and Head of the Control Theory Group of the Institute of Control and Industrial Informatics at the Faculty of Electrical Engineering and Information Technology. From 1996 he is also Head of the university Distance Education Centre. He is author of more than 180 papers, monographs on Constrained Control and Constrained PID Control and co-author of two monographs on Flexible and Web-Based Learning.

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ROBUST CONTROL DESIGN METHODS FOR REDUCED ORDER MODELS

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Abstract

The quality of a controller is not only dependent on the design method. Rather the correspondence between a model and a plant is an important criteria as well. In practice models are often adequate or the controller is a priori robust to model errors. Usually no additional considerations concerning robustness are necessary. But especially mechanical system tend to have a very high system order. For example by replacing the distributed parameters structure by point masses especially high order modes are missing in a model. Also models generated by finite element methods (FEM) have a high order that makes the controller design more demanding. In this case an order reduction is used to get a lower order than the original system. In general the correlation between model and plant is better in the lower frequency range. But also here the exact position of the poles is not known. Additional poles can be found in the upper frequency range. Especially pole placement is difficult for such systems. The unconsidered poles of the plant and the not exact position of the considered poles in the model can move to the right s-domain using a model based state space controller. This article presents different methods to deal with such reduced order and not exact models using state space theory. All techniques excel as *easy* compared to modern concepts like H_∞ or μ-synthesis [1]. In addition the complete design process of the controller is highly automated and could be a method to introduce state space theory in an industrial environment. The design methods will be compared and tested by simulations at a power train of a CNC-machine tool.

Keywords: Pole placement, Pole region assignment, Robustness, Model errors, Output feedback control.

Presenting Author's Biography

Ulrich Ahrholdt received his Master's degree in mechanical engineering from the Georgia Institute of Technology, Atlanta, GA, United States in 2002, the Diploma in mechanical engineering from the Technical University of Clausthal, Germany, in 2003. Currently he is working toward his Ph.D. degree in model based control theory of machine tools using state space methods at the electrical engineering department of the Technical University of Darmstadt, Germany. The project is funded by *Siemens, Automation & Drives (A&D)*.

HIERARCHICAL CONTROL FOR CONTINUOUS FLOW SIMULATION OF MANUFACTURING SYSTEMS

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Abstract

This paper aims at developing hierarchical control architecture for continuous-flow simulation in order to regulate production in multiple-part-type flow shops. The approach uses a continuous-flow approximation to model the discrete flow of parts in a manufacturing system. The control strategy specifies how to allocate limited system capacity among all the part types to follow the solution of the continuous-flow model as closely as possible. The control objectives are to keep the actual production close to the demand, while maintaining the average work-in-process inventory and lead time to satisfactory levels. The control architecture is hierarchical. It allows combining different decisions into a unified model. This architecture is composed of basic-level distributed fuzzy logic controllers supervised by a higher level decision-maker. At the bottom level of the hierarchy, individual decisions are based on local information and expert's knowledge to adjust the machine's processing rate. At the top level of the hierarchy, the supervisory controller combines both local information and global performance indicators in order to tune the action of the lower distributed fuzzy controllers. The global performance indicator used in the supervisory level evolves in a tolerance interval defined by the normal operating conditions of the process. When a performance indicator value is outside of the predefined tolerance interval, an abnormal behaviour occurs. In this case, the supervisor allocates the production capacity or reduces the production throughput according to the aggregated global performance indicators. Simulation results through continuous-flow simulator of production network are presented to illustrate the feasibility of the proposed approach.

Keywords: Manufacturing system, fuzzy control, supervisory control, performance indicators, aggregation operator, continuous-flow simulation.

Presenting Author's biography

Karim Tamani is PhD candidate in Automatic and Electrical Engineering at the University of Savoie. The main subject of his thesis includes the development of fuzzy control methodology based on the fusion of performance indicators in the simulation of manufacturing systems.

AN AUTOMATED APPROACH TO INPUT DATA MANAGEMENT IN DISCRETE EVENT SIMULATION PROJECTS: A PROOF-OF-CONCEPT DEMONSTRATOR

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Abstract

Despite the fact that Discrete Event Simulation (DES) is claimed to be one of the most potent tools for analysis and optimization of production systems, industries worldwide have not been able to fully utilize its potential. One reason is argued to be that DES projects are not time efficient enough due to extensive time consumption during the input data phases. In some companies, input data is totally missing, but even in projects where data is available it usually takes a considerable amount of time to analyze and prepare it for use in a simulation model. This paper presents one approach to the problem by implementing a software that automates several steps in the input data process such as extracting data from a database, sorting out the information needed and fitting the data to statistical distributions. The approach and the software have been developed based on a case study at Volvo Trucks in Gothenburg, Sweden. The work presented in this paper is part of a more comprehensive project called FACTS. The project scope is to develop methods and IT-tools for conceptual plant development.

Keywords: Discrete Event Simulation, Input data, Data management, Distribution fitting, Conceptual Factory Development.

Presenting Author's biography

Jean-Patrick André was born in Grenoble, France, 1984. He is studying at the IFMA (French Institute for Advanced Mechanics), France, at the Advanced Manufacturing Systems Department with the aim of obtaining a diploma of engineering in 2008. He is currently working as a guest research student in the field of DES at the Department of Product and Production Development, Chalmers University of Technology, Sweden. His email is <Jean-Patrick.Andre@ifma.fr>.

COMBINING SIMULATION AND ARTIFICIAL NEURAL NETWORKS: AN OVERVIEW

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Abstract

Artificial Neural Networks (ANNs) attempt to mimic the massively parallel and distributed processing of the human brain. They are generally used for learning or optimization purposes. Simulation models are frequently utilized to evaluate given possible configurations or organizations of complex systems. Combining ANNs and simulation allows a variety of complex decision problems to be addressed, where intelligent and simulation types of knowledge are used. Although many researchers have studied particular benefits of such a combination, no global analysis of the related literature seems to have been published. We propose to analyze the different publications involving simulation and ANNs. Through the relative literature study, several general types of approaches are pointed out and characterized. Typical approaches include learning from simulation experiments and the inclusion of intelligent modules in models. The concrete application of these combined utilizations is mentioned in a variety of areas, ranging from production to ecology or economics. These approaches are discussed and further research directions are suggested.

Keywords: Simulation, Artificial Neural Networks, Metamodel, Decision Support.

Presenting Author's biography

Anne-Lise Huyet has studying at the "Moulin de la House" University, Reims, France, and at the Blaise Pascal University, Clermont-Fd, France where she passed a PhD in 2004. She is currently working as associate professor at the Advanced Manufacturing Systems Department in the French Institute of Mechanical Engineering, France. Her research interests are connected to the decision aid through simulation and computational intelligence for manufacturing systems. Her email is <Anne-Lise.Huyet@ifma.fr>.

SIMULATION OF ATTITUDE TRANSFORMATION BY USING AUTOMATA NETWORKS

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Abstract

We will show how automata network models can conceptualize and simulate human attitudes faced with a new "offer" which can be weight up according to different formal attributes. From a first presentation of the classical representations of the attitude concept using a cognitivist inspiration, we will propose a new connectionist approach based on automata networks. Then, we will show how this kind of models can represent in term of conceptual and formal unification - by integration in the same movement based on the Gestalt and cognitive perspectives, the human attitudes forming and transforming processes. For example, our work could be useful for a R&D manager who already selected different 3D CAD softwares (i.e. the "offers") according to technical specifications and who would like to choose which offer will better match the future user's perceptions. Thanks to our model, the attitude forming and transformation dynamics can be simulated for each engineer according to the values and weights he allocates to each attribute like the software ergonomics, the estimated learning difficulties, the ability of rethinking in three dimensions,… More generally, these connectionist models aim to improve the human perceptions dynamics faced with technological changes

Keywords: Social Sciences, human behaviour representation techniques, discrete automata networks, technological changes, attitudes forming, attitudes transformation.

Presenting Author's biography

Daniel Thiel, Ph D, Eng., is full professor in Industrial Management and Operational Research at ENITIAA. He is the coordinator of a Food Economics and Industrial Management Research Laboratory at ENITIAA composed by six professors, five PhD students and two permanent staff. This lab is associated with the Economics and Management Laboratory of the University of Nantes which is composed by 68 professors and 60 PhD students. Previously, he worked more then ten years in different industrial companies. A short professional biography of the presenting author should be put here, starting with the presenting author's name.

INTELLIGENT SHORT TERM SCHEDULING OF A PRODUCTION CELL WITH PARALLEL FACILITIES

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Abstract

For production planning and scheduling, optimization is the basis of the decision making: the number of possible alternatives is reduced by comparing alternative fuzzy values of the objective function. For the mid term scheduling, an aggregate optimization problem is handled by an optimization-based inference engine. Decision making in the short term scheduling has usually several feasible alternatives, and therefore, some preference criteria can be used as well. The main idea is to select clusters and items in such a way that the risk of delay in the end of the scheduling period is minimised. The scheduler consists of three phases: (1) allocation, (2) selecting clusters to the active queue and (3) selecting items for processing. Factory topology, resource requirements and product demand may change within the scheduling period, and the scheduler returns to the previous phases if significant changes take place. Allocation is performed for *clusters* in each subset by LPT (longest processing time first) rule. For detailed scheduling, the linguistic equation approach provides a method for a smooth adaptation of scheduling rules to the changing operation conditions and an efficient method in representing the preferences and priorities from process requirements and available resources. The fuzzy scheduler expands the ideas of the knowledge-based scheduler in a flexible way by using fuzzy reasoning in selecting cluster to the active queue and then items for processing. According to test runs with combined fluctuating problems, the intelligent scheduling approach is a robust solution for short term scheduling.

Keywords: scheduling, linguistic equations, fuzzy set systems, manufacturing, discrete event simulation.

Presenting Author's Biography

Esko K. Juuso has M.Sc. (Eng.) in Technical Physics from University of Oulu. He is currently a senior assistant in Control Engineering at University of Oulu, Oulu, Finland. He is active in Finnish Simulation Forum (FinSim), Scandinavian Simulation Society (SIMS) and EUROSIM, currently he is chairman of FinSim. His main research fields are intelligent systems and simulation in industrial applications, including software sensors, control and fault diagnosis. For these applications he has introduced the linguistic equation (LE) methodology.

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APPLICATION OF STOCHASTIC PROGRAMMING FOR SUPPLY CHAIN INVENTORY OPTIMIZATION UNDER UNCERTAIN DEMAND AND LEAD TIME

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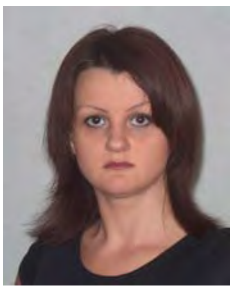
Abstract

Supply chain management deals with the management of information and material in a network of producers, retailers and customers. This task is rather complex since a high degree of uncertainty occurs in reality due to the fact that key factors such as product demands, stock availability, prices, facilities reliability, all have significant stochastic components. Stochastic programming is main representative approach to capture some aspects of the uncertainty due to the limited knowledge of the model input parameters. Although it has many contributions in supply chain management, they are mainly focused on the strategic decision level, where there is not enough concrete information about the features of uncertainties on which to base long-term decisions. Within a current research, it is supposed that the most of the uncertainty could be handled adequately using a stochastic modeling approach precisely at the tactical planning level, mostly employing stochastic values for customer demand, supplier lead times, production costs and/or price fluctuations. The paper illustrates the application of stochastic programming approach for inventory optimization under uncertain demand and lead time. The mathematical model is created and tested by using the algebraic modeling language AMPL, which uses the large-scale optimization solver CPLEX. The developed inventory model is tested, leading to the conclusion that stochastic programming provides superior planning decisions in comparison with deterministic equivalent. The effect of the scenario number on the model performance is evaluated. The conclusion is that the optimal number of scenario exists and it is not necessary to make the model work under all possible scenarios.

Keywords: supply chain, tactical planning, stochastic programming, uncertainty, inventory model.

Presenting Author's biography

Oksana Soshko. Graduated with excellence from Riga Technical University Department of Modelling and Simulation, she holds M.Sc.Ing. At the moment, continues doctoral studies at the Department of Modelling and Simulation of Riga Technical University. Since 2003, a teaching assistant at the Department of Modelling and Simulation of RTU. Member of Latvian Simulation Society.



A SURVEY ON RECENT DEVELOPMENTS IN SECOND-ORDER INTEGRATION METHODS FOR J_2 PLASTICITY MODEL

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Abstract

In this paper we propose a survey on recently studied integration methods for elasoplasitc constitutive models. In particular, the von-Mises elastoplastic constitutive model in the realm of small deformations is considered. The model takes into account both linear isotropic hardening and linear/nonlinear kinematic hardening. The aim of the work is to present and compare a set of quadratically accurate integration algorithms based on different numerical strategies. Namely, we present two sets of algorithms: The first set is related to algorithms based on classical backward-Euler and midpoint integration schemes in conjunction to a standard return map procedure. The second set refers to newly developed integration schemes based on an ad hoc rewriting of the constitutive model by means of an integration factor governing the evolution process, coupled with the use of exponential maps for the time integration. The two class of methods analyzed above apply both to linear kinematic hardening model and nonlinear kinematic hardening models. The comparison of the different methods is then carried out by testing accuracy and precision using different time discretizations on mixed stress-strain loading histories adopting an overkilling reference solution computed via return map method. A technical problem solved through a finite element approach is presented in order to compare algorithms performance on a typical boundary value problem.

Keywords: Plasticity, Integration algorithm, Midpoint rule, Exponential map.

Presenting Author's biography

Edoardo Artioli took his master in Civil Engineering and PhD in Structural Mechanics from the University of Bologna, Italy. Now he is a post doc at the Institute for Applied Mathematics and Information Technology of Pavia, Italy and a member of the research group in Advanced Materials and Computational Mechanics at the EUCENTRE, Pavia.

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A TIME DISCONTINOUS PROCEDURE FOR THE HYDRAULIC CRACK SIMULATION IN COHESIVE POROUS MEDIA

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Abstract

Traditional phenomenological constitutive relationships sometimes fail in the description of mechanical behavior of plain concrete. In such circumstances more refined models are necessary, which takes into account the multiphase structure of the material. This paper presents a generalized finite element formulation, which incorporates solid and fluid phases together with a temperature field. The model is developed to obtain time-dependent solutions of 2-D cases, such as concrete gravity dams subjected to loading-unloading cycles, non-homogeneous specimens subjected to thermo-mechanical effects, etc. A fully coupled cohesive-fracture discrete model, which includes thermal and hydraulic loads, is adopted to describe crack nucleation and propagation. The evolution of fractures leads to continuous topological changes of the domain and these are handled by systematic local remeshing of the domain and by a continuous change of fluid and thermal boundary conditions. In the adopted approach, cracks may nucleate everywhere depending only on the stress field and propagate along paths and with a velocity of the tip that is a priori unknown. An adaptive remeshing technique for the spatial domain coupled with an adaptive procedure in time, based on the use of time-discontinuous finite elements, is used. The solution procedure is discussed in particular as far as the projection of the solution between two successive meshes is concerned.

Keywords: Hydraulic fracture, Discontinous Galerkin, Adaptive Remeshing.

Presenting Author's biography

Stefano Secchi obtained a Structural Engineering degree at the Engineering Faculty of the University of Padova, Italy, in 1993, with a thesis on computational methods for the numerical simulation cohesive materials. He had a PhD degree in Structures Mechanics in 1997, discussing a thesis on computational methods for crack simulation in porous materials. From 1998 he works in the field of computational mechanics of porous media. He is currently researcher at ISIB CNR, Padova, Italy.

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SIMULATION OF STRAIN LOCALIZATION IN MULTI-PHASE MEDIA BY A MULTI-SCALE APPROACH

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Abstract

We consider discontinuities in displacements and fluid flow to simulate localized failure and corresponding fluid accumulation in multiphase porous media. Localized dissipation inequalities obtained from a three-phase poro-plastic model (Callari and Abati, 2007a) are employed in a multi-scale approach, thus extending the results presented for the fully saturated case by Callari and Armero (2002,2004). For the appearance of aforementioned strong discontinuities, we re-obtain the same condition characterizing fully saturated porous solids (Armero and Callari, 1999). Singular dilatancy and singular small-scale contents of liquid and gas are related by localized mass balances on the discontinuity.
The numerical formulation is based on the connection between large and small scale fields by a weak equation relating local stresses with traction vector on the discontinuity (Armero, 1999). The proposed multi-scale finite element method employs the formulation presented by Callari and Abati (2007b) for the large scale fields, locally enhanced by unregularized discontinuous interpolations of small-scale displacements and fluid flow.
The plane strain compression of a porous sample is simulated with a proper treatment of interface between specimen and atmosphere (Abati and Callari, 2007). Numerical solutions are practically indifferent to mesh size and alignment, in terms of discontinuity path and propagation history, pore pressures, saturation degree, reaction, relative permeability.

Keywords: coupled problems, enhanced finite elements, multi-phase media, porous solids, strain localization.

Presenting Author's biography

Carlo Callari. Associate Professor in Continuum and Structural Mechanics at University of Molise (since 2006). Assistant Professor in Geotechnical Engineering at University of Rome "Tor Vergata" (1999-06). Research Fellow at UC Berkeley (1997-98). PhD in Structural Engineering at University of Rome "Tor Vergata"(1994-96).
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COLLISIONS AND FRACTURES: A PREDICTIVE THEORY

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Abstract

We investigate collisions of solids which can fracture. Equations of motion and constitutive laws provide a predictive theory. Assuming the collisions instantaneous, the equations of motion in a damaging collision are derived from the principle of virtual work introducing new interior forces which describe the very large stresses and the very large contact forces resulting from the cinematic incompatibilities. They are interior volume percussion stresses and interior surface percussions both on the unknowns fractures and on the colliding surfaces. In order to approximate these equations, we assume solids are damageable. In this point of view, we may assume the velocity is continuous with respect to space but its strain rate is very large in a thin region where the material is completely damaged, so approximating a fracture. When the velocity before collision is very large, the damaged zone may be large accounting for parts of the solid completely transformed into powder. The constitutive laws result from dissipative functions satisfying the second law and able to model the fracturation phenomenon at the macroscopic engineering level. Representative numerical examples confirm that the model accounts for the fracturation and fragmentation qualitative properties. In particular, the model is able to reproduce real experimental tests.

Keywords: collision, principle of virtual work, fracture, damage.

Presenting Author's Biography

Francesco Freddi. He graduated in Civil Engineering at the University of Parma in 2000 and he received a Ph.D in Structural Mechanics at the University of Bologna in 2004. He had been Post-Doctoral Associate at the Laboratoires des Ponts et Chaussées in 2004 and 2005. He is member of the Laboratoire Lagrange since 2005. In 2006 he became Research Associate at the Department of Civil-Environmental Engineering at the University of Parma. His research interests lie in the area of computational and solid mechanics. Specifically, his research focuses on cohesive fracture mechanics, damage of glued materials, collision and fracture, FRP-concrete debonding, singular problem of elasticity, sulphation of porous stones, fracture of glass and related numerical methods.

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INFLUENCE OF MICRO-CRACKING ON THE EFFECTIVE PROPERTIES OF COMPOSITE MATERIALS

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Abstract

In the present work the influence of micro-cracking on the effective properties of composite materials with heterogenous micro-structure is investigated by using the finite element method in conjunction with interface models. Non-linear macroscopic constitutive laws are developed by taking into account for changes in micro-structural configuration associated with the growth of micro-cracks. Damage evolution is simulated by micro-mechanical considerations using fracture mechanics. The strong non-linearity of the macroscopic constitutive response results in a progressive loss of stiffness and may lead to failure for homogeneous macro-deformations associated with unstable crack propagation. Both the cases of a brittle matrix composite with micro-cavities and of a fiber-reinforced composite with imperfect interfacial bonding are considered, loaded along extension and compression uniaxial macro-strain paths. In the context of deformation controlled micro-structures, three types of boundary conditions are studied, namely linear deformation, uniform tractions and periodic deformations and antiperiodic tractions. These conditions, which can be incorporated by means of Lagrangian multiplier methods, generate three constrained minimization problems of homogenization which define the micro-to-macro transition and determine the state of the micro-structure in terms of the fine-scale fluctuation field. Micro-crack propagation is modeled by using the *J*-integral methodology in conjunction with an interface model taking into account for contact between crack faces. The proposed damage model is able to provide constitutive laws for the microstructure with evolving defects and may provide a failure model for a composite material undergoing micro-cracking and contact.

Keywords: Micro-cracks and interfacial debonding, Macroscopic properties, Composite material, Contact, Finite elements

Presenting Author's biography

Fabrizio Greco. Born in Catanzaro (Italy) the 2nd September 1973. *Position*: from January 2005 Associate Professor of Structural Engineering at the Department of Structural Engineering of University of Calabria. *Teaching Activities*: Statics, Dynamics of Structures, Strength of materials. *Current research activities*: Composite materials, Damage, Fracture, Stability, Homogenization, Long span bridges.

SELECTING A NEW ROBOT FOR THE CLINICAL LABORATORY BY USING A SIMULATION MODEL

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Abstract

When Health Clinics, Hospitals and Emergency Departments are optimizing their operations in order to reduce costs, clinical laboratories must also improve their operations. The most common solution is to hire more staff or reconsider the everyday activities. However, all problems can not be solved by using these methods. The actual analysis phases in a laboratory are performed by certain machines, and the capacity of those machines usually defines how efficient the process is (how many samples it is possible to analyze within a certain period of time). If the situation changes, and some other units start to deliver their samples to the laboratory in question as well, the only way to keep the operation as efficient as it was before is to purchase new equipment with enough capacity to handle it all within certain timelines. However, the selection of new equipment is very difficult if there are several choices with almost equal capacities. This is where a simulation model like the model described in this study can become very useful. This paper presents a simulation model which describes the operations of the clinical laboratory at the Central Hospital in Jyväskylä, Finland. We use the developed model in selecting a new robot by using the amount of handwork as the main target variable. By defining different machine candidates in the model as a resource and studying the operations (activities) around them, it is possible to arrange the different machines in order of superiority. The results showed that different robots require various amounts of handwork around them although they were efficient enough to handle all the specimens.

Keywords: Health care, clinical laboratory, robot, simulation

Presenting Author's biography

Toni Ruohonen is a senior researcher at the University of Jyväskylä. Mr. Ruohonen holds a bachelor's degree in Information Technology (telecommunication) from Satakunta University of Applied Sciences, Finland. He has successfully defended his doctoral thesis on simulation in health care as well and currently holds a PhD degree (University of Jyväskylä).

EVALUATING THE EFFECTS OF A PNEUMATIC TUBE DELIVERY SYSTEM ON THE PATIENT'S LENGTH OF STAY IN AN EMERGENCY DEPARTMENT BY USING A SIMULATION MODEL

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Abstract

Collaboration between emergency departments and clinical laboratories is not as effective as it could be. At this moment the specimens are delivered to the laboratory mostly by a nurse who has to walk constantly between an emergency department and a laboratory. It slows down the turnaround time of results and thereby increases the total throughput time of patients in the ED. In this study, which is a part of approved doctoral thesis, the main objective was to study the effects of a pneumatic tube delivery system on the patient's average throughput time in the Emergency Department. Simulation was used as a research method. A pneumatic tube delivery system scenario was developed and compared the results of the scenario to the results of the simulation model of present operation. The results showed that the average throughput time of patients decreased significantly (13,4 %) when the specimens were delivered to the laboratory by a pneumatic tube delivery system. The use of a pneumatic tube delivery system can significantly reduce the total throughput time of patients in the Emergency Department. It also eliminates tiring back and forth trips for nurses and makes it possible to take more blood tests and see more patients in the Emergency Department.

Keywords: Tube delivery, health care, simulation, clinical laboratory.

Presenting Author's biography

Toni Ruohonen is a senior researcher at the University of Jyväskylä. Mr. Ruohonen holds a bachelor's degree in Information Technology (telecommunication) from Satakunta University of Applied Sciences, Finland. He has successfully defended his doctoral thesis on simulation in health care as well and currently holds a PhD degree (University of Jyväskylä).

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SIMULATING THE EFFECTS OF SCHOOL CLOSING INTERVENTIONS AGAINST PANDEMIC INFLUENZA

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Abstract

InfluSim is a deterministic, compartmental model of pandemic influenza. A basic SEIR model has been adapted for Influenza and extended such that the effects of interventions can be investigated. The model subdivides the population into age- and risk groups and implements interventions like antiviral treatment, prophylaxis and social distancing. This results in a system of more than 3000 differential equations. In this paper the model has been used to address the question whether and under which time schedule day care centers and schools should be closed during a pandemic influenza. The effect of school closing is modeled by reducing contacts within the child age groups and by partially redistributing these contacts to child-adult and child-elderly contacts. It is shown that these changes to the contact matrix do not necessarily contribute to containing the pandemic and it is therefore necessary to look at the effects of the intervention to each age group of the population. A similar argument applies to the optimal scheduling of the school closing intervention: A given schedule can be beneficial for some age groups while disadvantageous for others.

Keywords: Deterministic Simulation, Epidemiology, Pandemic Influenza, Intervention Planning, Social Distancing.

Presenting Author's biography

Markus Schwehm studied mathematics and computer science in Karlsruhe & Munich, presented a doctoral thesis on parallel optimization algorithms in Erlangen, worked as a postdoc on parallel databases in Cupertino, USA and on mobile agents in Stuttgart. Then he worked as research assistant in bioinformatics and systems biology in Tübingen, and is currently working in the medical biometry department on the simulation of the spread of infections for optimal intervention planning.

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IDENTIFICATION OF WIENER MODELS USING OPTIMAL LOCAL LINEAR MODELS

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Abstract

The Wiener model is a versatile nonlinear block oriented model structure for miscellaneous applications. In this paper a method for identifying the parameters of such a model using optimal local linear models is presented. The linear model part is represented by a discrete-time transfer function and the non-linear characteristic is represented by piece-wise linear functions. Parameter estimation as well as partitioning of the local linear models is simultaneously accomplished by the identification procedure. The optimality of the proposed algorithm is threefold: First, each local model is linear in the parameters and therefore optimal parameter estimation methods like Recursive Least-Squares can be applied, thus leading to a robust solution. Second, the region of validity of each local model is adaptively optimized using the Chi-squared distribution of the estimated residual. This approach not only enables an automatic choice of the model size but it also incorporates the measurement noise level of the output variable into the result. And third, the resulting global model has a minimum of local models while guaranteeing optimal performance. A simulation of the pharmacological Propofol model is included, which documents the ability of the algorithm to balance the output noise with the systems nonlinearity.

Keywords: nonlinear identification, Wiener model, optimality, local linear models.

Presenting Author's biography

Martin Kozek was born in Vienna, Austria. He received the Diplom-Ingenieur in mechanical engineering from Vienna University of Technology, graduating with distinction in 1994. From 1995 on he was University Assistant at the Institute for Machine and Process-Automation. Between 1997 and 1998 he was visiting researcher at the University of Utah, USA, with a Kurt Gödel scholarship. He received his Doctorate from the Vienna University of Technology in 2000.

He is currently Assistant Professor at the Institute for Mechanics and Mechatronics at the Vienna University of Technology. His theoretical areas of research interests are primarily non-linear systems modeling and identification together with active control of structural vibrations. He has application emphasis on biomedical problems, vehicle dynamics, and process control.

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REALISTIC SIMULATION OF AN INSECT CHORUS BASED ON COUPLED SONG OSCILLATORS

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Abstract

In several insect species, choruses are formed where many individuals interact acoustically. Particularly interesting are assemblies of males which synchronize (or alternate) their cyclically occurring song elements (chirps) during acoustic interactions. Song synchrony is imperfect, however, since some males (leaders) begin their chirps some tens of milliseconds earlier compared to their counterparts (followers). Leaders are more likely to be chosen by females as mates. We have shown previously, that male-male song interactions in the insect *Mecopoda elongata* (*M. elongata*) could be successfully simulated by coupling two limited-cycle oscillators, which respond to perturbations by a phase shift known from experimentally derived phase response curves (PRCs). Further, the difference between the free-run cycle lengths of two males in a duet mainly determines the establishment of either the leader or follower role. The aim of the current study was to develop a model which allows the simulation of acoustic interactions between many signalers in a large chorus, taking into account an inhomogeneous spacing of individuals and a variability of model parameters observed in nature.

Keywords: Chorusing, coupled oscillators, ecological modeling, multiagent simulation, insect swarm.

Presenting Author's biography

Manfred Hartbauer. I am interested in the acoustic interaction of insects. Our group investigates the fascinating behavior of acoustically synchronizing insects on both, a behavioral as well as neurophysiological level. In order to better understand the mutual interaction resulting in an almost perfect signal synchrony, apparent in some chorusing insect species, I am programming multiagent simulations, which are based on experimentally obtained simulation parameters. In turn, the results of such simulations lead to new hypothesis which we successfully test in the biological system.

MIMICKING THE SPATIAL SELF DEFENSE EFFECT IN A TOXIC PHYTOPLANKTON - ZOOPLANKTON SYSTEM

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Abstract

Plankton dynamics is a fascinating and interesting subject of research. There are lots of aspects influencing plankton dynamics. Approximately 7% of the phytoplankton species are known to form large-scale blooms, dramatically affecting marine communities [1]. These blooms are formed because of the formation of different patches/ colonies by the phytoplankton population. Various studies have demonstrated that the formation of colonies/ patches by green alga offers considerable protection against grazing by zooplankton [2]. The potent neurotoxin production by many microalgal species may have some direct or indirect effect in forming a patch and might be perceived by its grazer as group defense. The defense strategy and patch formation of toxin producing phytoplankton (TPP) may give a possible answer to the evergreen crucial ecological question of why do many microalgal species produce neurotoxins. In the present paper we propose a simple model of TPP-zooplankton interactions in which the former is assumed to be able to detect the presence of zooplankton and counteract it by forming colonies or patches and releasing some toxic chemicals in the surrounding water. We observe that the fraction of TPP population that aggregates to form colonies or patches, and the number of colonies or patches they form, plays an important role in the recurrent bloom phenomenon. We also observe that the formation of patch by the TPP decreases the grazing pressure of zooplankton resulting in stronger coupling between the interacting species determined by the fraction of the phytoplankton population that aggregates to form colonies or patches and also on the number of patches.

Keywords: Phytoplankton-Zooplankton, toxic chemicals, patch, recurrent bloom, coexistence.

Presenting Author's Biography

Samrat Chatterjee. He has submitted his Ph.D thesis in Jadavpur University, Kolkata, India, under the supervision of Dr. Joydev Chattopadhyay. Presently he is doing post doc under Prof. Ezio Venturino in the University of Torino, Italy. He has already published 7 papers in peer-reviewed international journal and 4 more papers are revised, awaiting for acceptance. For details please visit his web-page, www.isical.ac.in/∼samrat_r.

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THE INFLOW BOUNDARY CONDITION IN LBGK BLOOD FLOW SIMULATIONS

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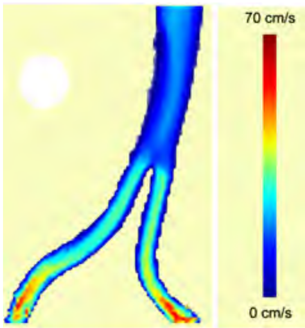
Abstract



Recently the Lattice Bhatnagar-Gross-Krook (LBGK) method has been applied to hemodynamical simulations in 3D, giving a powerful tool to investigate blood flow in realistic settings. The geometrical boundary conditions which describe the artery wall can be easily obtained from tomographic images. The choice of reasonable boundary conditions at the in- and outlets is more demanding. To a certain degree the development of self-consistent boundary conditions is as important as the description of the model itself. In LBGK blood flow simulations inflow boundary conditions are of great importance, because pressure boundary conditions must be handled extremely carefully due to the quasi- incompressibility of the method. The problem with these boundary conditions is that the exact velocity profiles at the in- and outlets are not known beforehand and therefore must be guessed in a realistic way. Different choices of inflow velocity profiles can be made and their influence on the simulation can be analyzed. As an example flow through the abdominal aorta is simulated with time dependent inflow with different velocity profiles. The resulting flow fields, pressure fields and shear stress at the vessel walls are compared and the influence of the different inflows to the overall simulation can be observed.

Keywords: Boundary conditions, Lattice Boltzmann Method, LBGK, Hemodynamcis, CFD

Presenting Author's Biography

Daniel Leitner graduated in mathematics at the Technical University of Vienna. Currently he is working on his doctoral thesis about mesoscopic simulation of blood flow at the Austrian Research Centers. His research interests are numerical modeling, fluid dynamics in general, especially lattice Boltzmann methods and its application to biofluids.

MODELLING THE RADIOACTIVE GROUND POLLUTION BY TRANSURANIUM ELEMENTS USING CELLULAR AUTOMATA

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Abstract

In the course of decommissioning the former ASTRA Research Reactor, the Seibersdorf site has to be surveyed for possible contamination by radioactive materials, including transuranium elements. The site survey encompasses measurements of both, the site's area and soil. In the case of remediation measures, the exact boundaries of the contamination and the activity concentration have to be determined. To limit costs due to systematic sampling and time consuming laboratory analyses, a mathematical model that describes the migration of transuranium elements and that includes the local topography of the area where deposition has occured, was established. The concept is to find a mathematical function that determines the contamination by modelling the pathways of Transuranium elements. The model approach chosen is cellular automata (CA). For this purpose, a hypothetical acitivity of transuranium elements is released on the ground in the center of a simulated area. Under the assumption that migration of these elements only takes place by diffusion, advection and sorption, these equations are modeled in the CA-model by a simple discretization for the existing problem. The radioactive decay of the transuranium elements of concern has to be considered in this model, just like the different migrational behaviour of these elements (e.g. sorption). The CA-model was compared to measurment and up to now the simulated migrational behaviour appears to describe the migration of transuranium elements rather well.

Keywords: Cellular Automata, Migration in Soils, Radioactive Pollution, Transuranics

Presenting Author's Biography

Katharina Breitenecker studied Technical Physics at the Vienna University of Technology. She did her Master's at the Atomic Institute of the Austrian Universities, currently she is working as research and teaching assistant at the Atomic Institute of the Austrian Universities, where she is also enrolled as a PhD graduate student. Besides, she works part-time at Nuclear Engineering Seibersdorf GmbH and contributes in operational radiation protection. Her major scientific interrests are nuclear environmental analytics and nuclear forensics.

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COMPARING THE EFFICIENCY OF PARALLELISATION TECHNIQUES FOR SIMULATION TASKS BY MEANS OF THE ARGESIM BENCHMARKS FOR PARALLEL SIMULATION

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Abstract

In 1994, ARGESIM has set up the ARGESIM Comparison on Parallel Simulation Techniques (CP1). There, three test examples have been chosen to investigate the types of parallelisation techniques best suited to particular types of simulation tasks. From 1994 until 2003, 12 solutions of the CP1 benchmark have been published in *EUROSIM – Simulation News Europe*. Primarily, these contributions differed with respect to applied hardware and software and, of course, runtime results. Regarding the implemented solving algorithms and parallelisation strategies, there were almost no differences between published solutions. The new ARGESIM Benchmark on Parallel and Distributed Simulation (CP2) extends the previous comparison, addressing not only simulation software and predefined given algorithms, but also allowing use of different algorithms for solving the tasks and comparing different strategies for parallelisation or distribution of the tasks. In this paper, the 1994's ARGESIM Comparison on Parallel Simulation Techniques (CP1) is discussed and regarding *EUROSIM – Simulation News Europe* contributions are summarized. Out of this summarization, drawbacks of the CP1 showing the need of a new benchmark's design are discussed. Finally, the new 2006's ARGESIM Benchmark on Parallel and Distributed Simulation (CP2) is presented.

Keywords: Parallel Simulation, Distributed Simulation, ARGESIM Benchmark.

Presenting Author's Biography

René Fink. The author is originated from Wismar University's Research Group Computational Engineering and Automation. From 2000 until 2006 he worked on a research project regarding SCE based Parallel Processing, also being the topic of his dissertation. Since 2007 he is employed as development engineer at the IAV GmbH, department Powertrain Mechatronics Gasoline Engines Systems.

MODELLING SIR-TYPE EPIDEMICS BY ODES, PDES, DIFFERENCE EQUATIONS AND CELLULAR AUTOMATA – A COMPARATIVE STUDY

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Abstract

We give a comparative overview over some different approaches towards modelling spatial spread of epidemics and present methods for identifying these approaches respectively. The basis of this study is the classical Kermack-McKendrick susceptible-infected-recovered (SIR) ordinary differential equations (ODE) model. In order to introduce a spatial component in the spread of diseases, we extend the classical model in a first step by using lattice gas cellular automata (LGCA) and stochastic cellular automata (stochastic CA). These approaches are based on motion respectively distributed contacts of individuals and permit to observe simple strategies for confining epidemic outbreaks and to develop provisional methods towards an identification. We proceed with the introduction of a partial differential equations (PDE) model for simulating spatial spread. Like the stochastic CA model this approach is based on distributed contacts among individuals and uses a probability density function to describe the interaction behaviour. We can develop an universal relation between those two approaches by using the central limit theorem. Further we observe random motion as a scaling limit of Brownian motion in the LGCA model and the diffusion distribution, which we derive from the Gaussian semigroup (Brownian motion), in the PDE and stochastic CA approach on the other side. A Fast Fourier Transform (FFT) frequency analysis with susceptible-infected-recovered-susceptible (SIRS) extensions of these three model approaches shows that our identification methods deliver very good correspondence.

Keywords: epidemic spread, susceptible-infected-recovered model, lattice gas cellular automata, stochastic cellular automata, partial differential equations.

Presenting Author's Biography

Günter Schneckenreither studies mathematics at Vienna University of Technology and joined the Modelling and Simulation Group of the Institute for Analysis and Scientific Computing in 2006 where he currently works on models for SIR-type epidemics.

A CLASSIFICATION OF MODELLING AND SIMULATION APPROACHES BASED ON THE ARGESIM BENCHMARKS

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Abstract

The paper presents a classification of modelling and simulation problems and approaches with emphasis on and exemplified with the ARGESIM Comparisons. The change of modelling and simulation over the years, the rapid developments in the field as well as the new approaches made it necessary to create a framework to classify and bring order into the multitude of approaches in modelling and simulation. The problems in the creation, the final result as well as the benefits of such a classification are presented. In the end a multi-dimensional landscape emerges where the different approaches to modelling and simulation, how the problems are posed and the different ways of solving them are mapped. In the end what can be seen and deduced from that new classification and what the future might bring will also be discussed. The ARGESIM Comparisons are of great use in teaching modelling and simulation to students as well as to people who are already advanced in the subject and with the new classification even more can be learned. Finally they have been and are also excessively used to test new simulation software and are therefore also of interest to simulation software designers.

Keywords: classification, education, ARGESIM comparisons, modelling approaches.

Presenting Author's biography

Stefan Pawlik is a student of applied mathematics at the Vienna University of Technology. Having spent the last few years in various fields of simulation with the aim to acquire the knowledge to do a comparison of the approaches, methods and possibilities as well as passing that knowledge on to others he is now approaching the end of his master studies. He has done work in the field of System Dynamics as well as classical modelling and claims to know bits and pieces of nearly all other modelling and simulation approaches.

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WHEN SIMULATION IS AS COMPLEX AS REALITY: VISUALIZATION AS A DATA EVALUATION TOOL FOR MANY-PARTICLE MODELS

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Abstract

This contribution deals with an event discrete many particle simulator for high energy milling processes. The simulator generates flight trajectories for several thousand particles. Although the simulation is built on a simplified model of the real system, it produces a huge amount of data that – at first glance – is equally hard to evaluate as data from the real system. This makes the design of simulation experiments, parameter estimation for ball mills and the generation of meaningful and reliable results a challenging task.
Particularly, the simulation results are much harder to evaluate than this is the case for standard granular gas simulations, because the motion and trajectories of the milling balls are highly sensitive to changes in the process and model parameters and the particles are accelerated by an external energy source – the rotor. In some states the statistical distributions of particle attributes have no equilibrium, not even locally. Additionally it is possible that the system is oscillating, but becomes rapidly stable at certain thresholds of the model parameters.
The development of tailored visualization tools turned out to be an extremely useful method for generation practically useful information from such milling simulations. In fact, visualization efforts turned out to be more important and time consuming than the simulation implementation itself. It will be shown how different types of visualizations can be used for debugging the simulation code, analyzing the motion of the complete ball mill population, single particle tracking, statistical analysis of local distributions, estimation of physical parameters, and the analysis of oscillation phenomena. Some details on the implementation of the visualization tools will be given.

Keywords: many particle system, nonlinear dynamics, visualization, statistical output analysis, particle tracking,

Presenting Author's biography

WOLFGANG WIECHERT studied mathematics and computer science at the University of Bonn and obtained his PhD in 1991. From 1991 to 1996, he worked at the Jülich Research Center. In 1996, he became a full professor for simulation at the Institute of Systems Engineering at the University of Siegen.

A DEVICE FOR ESTIMATING THE FOOTWEAR QUALITY AND PHYSIOLOGICAL SIMULATION OF THE HUMAN FOOT

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Abstract

A sweating thermal foot manikin was developed for evaluating the thermal and evaporative resistance of footwear. The sweating thermal foot manikin can be programmed to simulate physiological patterns of conductive, convective and evaporative heat loss. Using algorithms developed in parallel human studies, the manikin can simulate the initiation and magnitude of non-evaporative and evaporative heat loss based on core and skin temperatures. The system comprises a computer controlled system for regulating the heaters in each of the 16 segments of the foot, as well as the sweating function provided by peristaltic pumps. Each of the 16 segments is autonomous; its heating and sweating responses are controlled independently, thus the calculation of the heat exchange can also be determined for each segment separately. Segments are composed of one temperature sensor, which measure the segment skin temperature, heaters for the segment temperature control and artificial sweating glands, which simulate the human sweating. The segment thermal and evaporative resistance values are calculated from the segments temperature sensors data, segments control algorithm calculated power data and the ambient temperature sensor data. With segments we can find which part of the footwear are worse qualities, what is the base information for the manufacturer and user. Results of the footwear evaluation were compared with the results obtained for identical footwear with other foot manikins. Foot manikin characteristic studies with an infra-red camera show some construction and control drawbacks, which we will tray to improve.

Keywords: Thermal foot manikin, Evaluation of footwear, Physiological simulation, Evaporative resistance, Thermal resistance.

Presenting Author's biography

Mitja Babič was born in 1981 in Koper, Slovenia. He attended Faculty of Electrical Engineering, University of Ljubljana, Slovenia, where he obtained the B.Sc. degree in Electrical Engineering in 2005. He is currently a junior researcher at the department of Automation, Biocybernetics and Robotics, at the "Jožef Stefan" Institute of Ljubljana, Slovenia. His research interests include humanoid robotic shoulder complex and parallel robots.

MULTI-ZONE MODELING AND SIMULATION OF INDUSTRIAL LARGE-LENGTH CONTINUOUS FURNACES FOR BRICK PRODUCTION

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Abstract

The dynamic behavior of an industrial tunnel-type furnace is of the fundamental importance for the quality of the processed products. The knowledge of the furnace dynamics can make the control of the system easier as well as it can eliminate certain operational problems. The various subsystems existent in a long continuous furnace are usually controlled by conventional techniques and independent controllers offering simply an acceptable operation of the whole system. This paper describes the development of a multi-zone dynamical model for an industrial tunnel-type continuous furnace used in brick and tile production. The model is based on fundamental principles of heating process although a degree of empiricism has been introduced to model relationships where the real mechanisms are either too complex to be modeled or the corresponding differential equations can not be solved. An important objective of developing this model is to ensure that it can be used within a supervisory and control framework. The overall control task is to drive the process to the desired thermodynamic equilibriums and to regulate the temperature profile through the plant. The validity of the model is demonstrated by comparing the predicted results with the experimental data. Furnace's parameters estimation is carried out using industrial data and the model performance is illustrated through simulation studies.

Keywords: Industrial Furnaces, Heat process, System Modeling, Simulation

Presenting Author's biography

Stamatis Manesis received his Ph.D. from University of Patras, School of Engineering, Greece, in 1986. He is Associate Professor in Division of Systems & Control of the Electrical & Computer Engineering Dept. in the same university. In 1998-99 he was with the Industrial Control Centre of the Strathclyde University as academic visitor. He designed various Industrial Automation Systems for Hellenic Industries. He has published over 70 conference and journal papers. He has written 3 textbooks. His research is oriented on the introduction and use of the Intelligent Control concepts and tools in Industrial Systems. Main research interests: Industrial Control, Industrial Automation, Industrial Networks, Programmable Logic Controllers, Expert-Fuzzy Control Systems-Intelligent Controllers and SCADA Systems.

MODELLING AND SIMULATION OF TRANSPORTATION SYSTEMS: PLANNING FOR A BUS PRIORITY SYSTEM

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Abstract

Increasingly it is realized that building more roads does not solve the traffic congestion problem but could even make it worse. Instead of adding capacity to our roads there should be an effort to find ways in order to enhance the level of service of the public transport mode especially with the use of technology, such as applying computer and information technology to transportation systems. Advanced technologies such as intelligent transportation systems require though rigorous testing and evaluation that is not possible with the current analytical methods and techniques. As a result of advancements in computer technology simulation modeling becomes a viable alternative. This paper presents an overview on traffic simulation and the microscopic simulation model development process of a major highly congested traffic network of Nicosia, Cyprus. The validated simulation model gives transportation planners and traffic managers the capability to test various Bus Rapid Transit scenario solutions involving the use of intelligent transportation systems prior to their implementation.

Keywords: Modeling, Simulation, Transportation Systems, Bus Rapid Transit.

Presenting Author's biography

George Papageorgiou received a First Class Honours Bachelor of Engineering Degree and a Doctor of Philosophy Degree from the City University of London, UK, in 1992 and 1997 respectively. He is a Post-Doctoral Fellow at the Department of Mathematics and Statistics of the University of Cyprus, and he is a member of the Networks Research Laboratory (NetRL). He has published and presented papers in international Journals and Conferences and has carried out consultancy work. His research interests concentrate on systems modeling and simulation, traffic flow and car following models.

MODELLING THE STRUCTURED AND COMPLEX DECISION SITUATIONS

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Abstract

The paper deals with modelling and simulation of complex intelligent systems where the modelled entities have to make certain decisions in conditions of for example competitive market. We base this paper on our experiences in making models of competitive markets with electricity and other auxiliary services in area of Czech republic and Central Europe. The studied problem is certainly an excellent example of multi–player competition on multi–market with multi–commodity (a player has to decide what commodity is going to offer at which market in competition to other players). In this paper, we are more focused on theoretical analysis of the problem and its effective implementation in simulation models. We transform these situations of strategic decisions of one or more intelligent entities to so called structured and complex decisions. We are going to present a rather general solution to these systems built from elementary decisions with a special emphasis on their effective simulation. We use a special mathematical formalism called Automated Information Net (AIN) to model relations between elementary parts of the AI model. AIN can predict these computing iterations which would not bring new information to simulation of our models. We save some simulation time by this principle. As our background is mostly in area of economics modelling, we oftenly use market and production examples to demonstrate rather theoretical problems. The use of our ideas is hopefully wider.

Keywords: Modelling and simulation, game theory, decision making, complex systems, market models

Presenting Author's Biography

Martin Hrubý[1] (born 1976 in Olomouc, Czech Republic) received his MSc. in Computer science in year 2000 and Ph.D. in year 2004. His Ph.D. thesis was oriented to heterogeneous modelling and simulation. Last few years he is more focused to artificial intelligence and mathematical game theory. His professional interest is in bringing theoretical disciplines like game theory to practical use. As a coauthor, he cooperated in research and development of models of market with electricity and auxiliary services. He uses his practical experience in modelling AI to formulate more general conclusions. He is also interested in GIS systems and computer games. He speaks english and spanish.

A SYSTEM DYNAMICS MODEL FOR THE DIABETES PREVALENCE IN AUSTRIA

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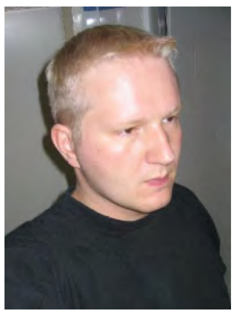
Abstract

In this paper we present a System Dynamics model for the incidence of type-2 diabetes in Austria based on a model developed by A. Jones, J. Homer et al. [1] for the United States of America. The main influencing factors incorporated in the model are obesity, age and disease management. This model is developed further to better represent the health care organization in Austria as well as to include a distinction by sex. While most control circles are very similar to the USA model the input parameters differ radically, making an adaptation necessary. This results in large deviations in the disease prevalence relative to the total population. A thorough stability analysis is carried out and the question of sensitivity to input parameters variation is investigated. A comparison with available historical data shows the applicability on the real world system. A test run is made and compared with the standard scenario of no change in health care politics after 2007. This test run is in accordance with the WHO recommendation of half an hour of physical exercises per day and it is shown to be effective in the prevention of type-2 diabetes mellitus. Further developments and test runs are suggested.

Keywords: system dynamics, health care modeling, socioeconomics, complex data, large scale modeling.

Presenting Author's biography



Peter Kristöfel. He is a theoretical physics master who has also earned a degree in mathematics. With an interdisciplinary background he has experience in the application and the development of numerical methods. Past work included high performance computing and classical and quantum chaos. Current work focuses on simulation and modeling techniques.

SIMULATOR FOR MULTI-SCALE MUSCULOSKELETAL MODELS WITH REFLEX CIRCUITS

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Abstract

A simulator for multi-scale musculoskeletal models is presented that realizes a multi-scale model of the musculoskeletal system. Each level of the multi-scale model corresponds to a characteristic anatomical parts of the real system. The simulator integrates coherently the different types of partial models with different time and size-scales and can solve the problem of stiffness. The simulator is implemented in MATLAB such that each level is realized as an object. The simulator satisfies the modularity condition, i.e. the partial models can be changed in a user friendly way. The model and the simulator has been extended by models of receptors, their feedbacks and reflex loops. The extended model can be applied to investigate, e.g. the gamma-loop. Some other applications are also presented.

Keywords: Musculoskeletal model, receptor, multi-scale model, feedback, gamma-loop

Presenting Author's Biography

Csaba Fazekas. He is a young researcher in the Process Control Research Group of the Computer and Automation Research Institute of the Hungarian Academy of Sciences. He received his M.Sc. (Eng) in Information Technology from the University of Veszprém in 2002. His research interest is modeling and model calibration of musculoskeletal and energetic systems.

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CONCEPTUAL MODELLING OF CONTINUOUS - DISCRETE PRODUCTION SYSTEMS

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Abstract

Complex system dynamic, structure and behaviour performances asks wide range of methods, algorithms and tools to reach model capable for searching optimal performing parameters. In the modelling process, it is up to analyst to select appropriate combination of methods, algorithms and tools to express significant system performances. Such methodology for designing complex systems should be based upon conceptual modelling to perform sensitive analyse of different system levels and views, allowing system representations for developing computer models.

Complex systems, such as business systems with continuous-discrete production process are demanding well organised supply chain highly reactive to production assortment changes. Aligning two different production components, distinctive in their behaviour, is especially sensitive in production parameters transition point. Such system performances request distinctive designing methods that could follow double behaviour nature of production process according to their entities dynamics, caused by assortment changes. Consequently, such systems need different conceptual presentations to realise its purpose from different views and aspects. Paper is based on results derived from project of parameters optimalisation in glass industry.

Simulation modelling principles, methods and tools are solid environment for wide range of conceptual models developing to improve system performances. They offer qualitative and valuable results based upon large quantity of processed and verified data, as well as on the large number processed and checked possible problem solution variants. Upon those facts, choosing optimal processing parameters is done more qualitatively, and following implementation of new solution take benefits and leads to expected business results.

Keywords: Complex production systems, Conceptual modelling

Presenting Author's biography

Nenad Perši is Senior Assistant of Simulation Modelling and Operations Research at Faculty of Organization and Informatics, University of Zagreb, Croatia. He received his M.Sc. and Ph.D. in simulation modelling at University of Zagreb. His main research is in aspects of complex manufacturing systems but also in aspects of genetic algorithms, expert systems and practical use of simulation. His e-mail address: nenad.persi@foi.hr

NETWORK-INDUCED DELAY MODEL USING HMM FOR CAN-BASED NETWORKED CONTROL SYSTEMS EVALUATION

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Abstract

In control systems a representation of the physical process which is to be controlled is needed in order to calculate control signals and keep the system stable. Networked Control Systems (*NCS*) are a special case of control systems where network-induced delays make the system stochastic and hard to predict. Pattern recognition techniques have been extensively used in learning the behavior of processes that present a certain degree of stochastic behavior. The Quality of Control (*QoC*) of each closed-loop system in a Networked Control System is strongly affected by the network-induced delay produced by sensors and control signals. Controller Area Network (*CAN*) is a popular real-time field-bus used for small-scale distributed environments such as automobiles. In *CAN* the delay exhibits a stochastic behavior and varies according to the network load. Since *QoC* is affected by delays, designing and evaluating a controller must take into account the effect of network-induced delays. A continuous Hidden Markov Model (*HMM*) for *CAN* network-induced delays is illustrated. The model plays the role of a classifier and an estimator; based on delay observations, the model can estimate the network load and predict future time delay values. The model was trained/tested using experimental data taken from a real *CAN* system with excellent results.

Keywords: Networked Control Systems, Controller Area Network, Hidden Markov Model.

Presenting Author's Biography

Ruben Morales-Menendez is PhD in Artificial Intelligence. He is a full professor in the Center for Innovation in Design and Technology, and a consultant specializing in the analysis and design of automatic control systems. His research interests include artificial intelligence techniques for continuous control processes, manufacturing technology, mechatronics systems and educational systems. Currently, he is member of the Mexican National Researchers System.

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GRID-INDEPENDENT METROPOLIS SAMPLING FOR VOLUME VISUALISATION

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Abstract

We propose a method of sampling regular and irregular-grid volume data for visualisation. The method is based on the Metropolis algorithm that is a type of Monte Carlo technique. Our method enables 'importance sampling' of local regions of interest in the visualisation by generating sample points intensively in regions where a user-specified transfer function takes the peak values. The generated sample-point distribution is independent of the grid structure of the given volume data. Therefore, our method is applicable to irregular grids as well as regular grids. We demonstrate the effectiveness of our method by applying it to regular cubic grids and irregular tetrahedral grids with adaptive cell sizes. We visualise volume data by projecting the generated sample points onto the 2D image plane. We used three rendering models: an X-ray model, a simple illuminant particle model, and an illuminant particle model with light-attenuation effects. We also demonstrate that our method is suitable for parallel processing, since it realizes computation speed almost proportional to the number of processors. The grid-independency and the efficiency in the parallel processing mean that our method is suitable for visualizing large-scale volume data. The former means that the required number of sample points is proportional to the number of 2D pixels, not the number of 3D voxels. The latter means that our method can be easily accelerated on the multiple-CPU and/or GPU platforms.

Keywords: Metropolis algorithm, importance sampling, volume visualisation, grid-independent sampling, regular/irregular grid

Presenting Author's Biography

Satoshi Tanaka. In 1987, he took a Ph.D at Waseda University, Japan, majoring in theoretical physics. In 1992, he moved to Fukui University, Japan, and started research activities on visualization of high-energy-physics simulation, point rendering with Monte Carlo simulation, etc. Since 2002 he has been a professor of Ritsumeikan University, Japan. His current research fields are Monte Carlo simulation, shape modeling, computer graphics, and computer visualization. He is a member of Japan Society for Simulation Technology (JSST) and Eurographics.

PERFORMANCE MODELLING OF A COMPUTER INTEGRATED MANUFACTURING AND MANAGEMENT SYSTEM

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Abstract

This paper presents a predicted target architecture of an integrated manufacturing and management system, based on a metropolitan-type infranet and an industrial process control and monitoring network. Such systems are severely required by prospective users, especially large-scale manufacturing enterprises. Nevertheless, neither big manufacturers of computer integrated manufacturing systems nor big manufacturers of computer integrated systems are apt to develop combined computer integrated manufacturing and management systems. Considering that, a team of volunteer design and research workers initiated some work oriented toward facilitating future development of such combined systems. Since the combined systems will be novel ones, prior results of research work conducted for the manufacturing systems or the management systems separately will not be valid, since the actual requirements will have to cover the needs of both manufacturing and managerial applications. This refers to, among other things, to performance evaluation. To evaluate performance, a method developed for packet switching networks with end-to-end acknowledgement was applied. The network is modelled as a set of closed routes consisting of a user and a series of service stations (communication links, switches, host processes). The paper describes the investigations carried out for the case study. Some consideration is given to the performance evaluation accuracy, basing on the validation work results obtained from analytical work, simulation and measurements on the Polish pilot wide area network.

Keywords: manufacturing, management, network, performance, modelling

Presenting Author's biography

Jozef Bohdan Lewoc. He graduated in Electronic from the Wroclaw University of Technology and in Mathematic (with high honour) from the University of Wroclaw. He chose the engineering carrier and, soon, he became a very successful leading designer of Polish large-scale pioneering computer system and networks. He applied analytical and event-driven simulation methods to investigate performance of the systems he designed. Though the tools available to him were obsolete of 5-10 years with respect to those available in the West, there never were any problems with performance of the systems he designed.

MODELLING UNCERTAINTY IN JOINTS USING COMPONENT MODE SYNTHESIS AND A STOCHASTIC REDUCED BASIS METHOD

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Abstract

There are often uncertainties in the properties of joints, which subsequently produce uncertainties in the dynamic response of built-up structures. Line joints, such as glued or continuously welded joints, have spatially distributed uncertainty and can be modelled by a discretised random field. Simulation techniques such as the commonly used direct Monte Carlo simulation (MCS) can be applied to approximate the output statistics to an arbitrary degree of accuracy, provided that a sufficient number of samples is used. Unfortunately, the computational cost of this technique can be prohibitive for large-scale models. This paper addresses how spatially correlated uncertainties in joints might be included straightforwardly in a mechanical finite element model, with particular reference to approaches based on fixed interface (Craig-Bampton) component mode synthesis and a stochastic reduced basis method. The methods are reviewed and an efficient way of implementation based on an exact matrix identity is proposed with a significantly lower computational cost. Unlike perturbation-based methods, good accuracy can be achieved even when the coefficients of variation of the input random variables are large. A numerical example of two line-coupled plates is investigated to benchmark the accuracy and calculation time. For the problem considered, the proposed formulation is an efficient and effective implementation of a stochastic reduced basis method. It is seen that the method can be up to orders of magnitude faster than direct Monte Carlo simulation, while providing results of comparable accuracy. Furthermore, the proposed implementation is more efficient the fewer joints are affected by uncertainty.

Keywords: Uncertainty in joints, Random field, Component mode synthesis, Stochastic reduced basis method, Stochastic Krylov subspace.

Presenting Author's Biography

Fadi Dohnal. He is currently a Research Fellow at the Institute of Sound and Vibration Research, University of Southampton, UK. He received his Dipl.-Ing. and PhD in Mechanical Engineering from Vienna University of Technology, attended research visits to Virginia Polytechnic Institute, Utrecht University and Nihon University and is about to finish his Dipl.-Ing. in Applied Physics from Vienna University of Technology. His scientific interests presently cover uncertainty in structural dynamics, amplification of system damping by parametric anti-resonances and functional electrical stimulation of denervated muscles.

CROP PLANNING UNDER RISK AND ENVIRONMENTAL CONSTRAINTS

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Abstract

In the paper is presented an overview of the research in mathematical modeling in agriculture and a mathematical model for crop planning which includes climate risk, market risk and environmental risk. The model is a multi-objective stochastic programming model that contains two types of levels for the application of fertilizers/pesticides: a maximum admissible level and a desirable level. It is based on portfolio theory. The above mentioned levels are introduced in order to find crop plans that comply to environmental constraints. The model considers penalties proportional to the overcoming of the desirable environmental levels and several classes of land quality. Safety-first type constraints on the quantity of crops are considered. If they are approximated with the help of empirical distribution functions of the crop yields then one obtains a problem with cardinality type constraints. The land productivity coefficients are random variables that incorporate weather risks. The crops market prices are random variables that incorporate the market risk. Simulations starting from the historical data or from scenarios randomly generated on land productivity coefficients and crops market prices are performed. Several variants and special cases of the multi-objective model are formulated: the minimum environmental risk problem, the minimum financial risk problem and the maximum return problem.

Keywords: sustainable agriculture, mathematical models, crop planning, risk, portfolio theory, multiobjective programming model.

Presenting Author's biography

Radulescu Marius was born in Bucharest, Romania. He graduated from Faculty of Mathematics, University of Bucharest in 1977. He holds a PhD in mathematics from Centre of Mathematical Statistics, Bucharest in 1985. At present he is a senior research worker at the Institute of Mathematical Statistics and Applied Mathematics "Gheorghe Mihoc-Caius Iacob" in Bucharest. His scientific interests are connected with: mathematical modelling, risk management, multiple criteria decision making, mathematics of finance, optimisation theory, nonlinear functional analysis and its applications to boundary value problems for differential equations, real analysis, numerical analysis, approximation theory. In 1991 he was awarded a prize of the Romanian Academy for contributions to global inversion theorems and applications to boundary value problems.

DYNAMICS IN THE MUTATION-SELECTION BALANCE IN HAPLOIDS: AN APPROACH TO THE FITNESS COMPOSITION OF INDIVIDUAL GENES IN AN INFINITE ASEXUAL POPULATION

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Abstract

The paper presents an original approach to the whole genome treatment of an asexual haploid population under mutation and selection.
The genes are partitioned into short stretches of nucleotides, the *elements*, which have different degrees of intolerance toward mutations. In the first step of the analysis a genome is considered as a finite set of elements deprived of their association with genes. In particular, the *fitness composition of the genome*, i.e. the partition of the deleterious elements into different fitness classes, can be described in each generation and the equilibrium.
The second and third steps describe a novel effect: A displacement of the fitness composition in individual genes, which also continues in the mutation-selection balance. Together with the finiteness of the genome this allows for the retrieval of the information abandoned in the first part: sets of elements which are classified with respect to fitness can be re-associated with genome components and finally with individual genes. Hence, the most probable fitness composition of individual genes in the equilibrium can be determined.
In the second part of the present paper an algorithm is described which allows to simulate genomes using the model outlined above. The program accepts as input the description of a genome by the declaration of its genes (its length and the tolerance towards mutations of its elements). Using the model and additional methods like dynamic programming, the algorithm predicts the fitness composition of individual genes in the equilibrium. Examples show in particular, that a change in one gene has an effect on the other genes which remain unchanged.

Keywords: population genetics, whole genome microevolution, mathematical modelling, fitness, mutation-selection equilibrium.

Presenting Author's Biography

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Born in St Petersburg, Russia.
Diploma in Mathematics, University of Freiburg, Germany 1992.
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HOW WELL IS FREE SOFTWARE ABLE TO REPLACE MATLAB IN SOLUTION OF COMMON CONTROL PROBLEMS? (SURVEY)

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Abstract

Nowadays it is hardly possible to imagine solution of control engineering problems without a high-quality computational and simulation software. A large amount of computation (both numerical and symbolic) as well as simulation is required at almost every step of control analysis and/or design. Although there are several other candidates, a vast majority of control engineers will most likely agree that from all software dedicated to solution of control problems MATLAB is the most suitable – it provides a large scale of control-related toolboxes, the Simulink module for an easy simulation of control systems and (last but not least) it has a large community of users and a long tradition of usage in the field. And yet, there is something which makes many control engineers consider using for their purposes software different from MATLAB – the high price for the licence. At the same time, however, they would like to keep the comfort MATLAB gives them and to use the other software in the same way as MATLAB. The aim of this paper is, therefore, to "map the territory" of available freeware packages that are generally regarded as MATLAB substitutes and to judge their ability to replace MATLAB in solution of everyday control engineering problems. Unlike most of similar comparison studies, it does not describe the basic mathematical and/or graphical functions of the software. Instead, it looks for features that facilitate control system analysis and design within each particular package and tries to compare them with those of MATLAB, Simulink and Control System Toolbox. Five different MATLAB alternatives are introduced, two of them – Scilab and Octave – are discussed in detail.

Keywords: control engineering, MATLAB, free software, Scilab, Octave.

Presenting Author's biography

Mikuláš Huba received the MSc. and PhD. Degrees in technical cybernetics from Slovak University of Technology in Bratislava in 1974 and 1982, respectively. From 1989 he is a Senior Lecturer and Head of the Control Theory Group of the Institute of Control and Industrial Informatics at the Faculty of Electrical Engineering and Information Technology. From 1996 he is also Head of the university Distance Education Centre. He is an author of more than 180 papers, monographs on Constrained Control and Constrained PID Control and co-author of two monographs on Flexible and Web-Based Learning.

REAL TIME SIMULATION EXPERIMENTS WITH SELF TUNING CONTROL ALGORITHM

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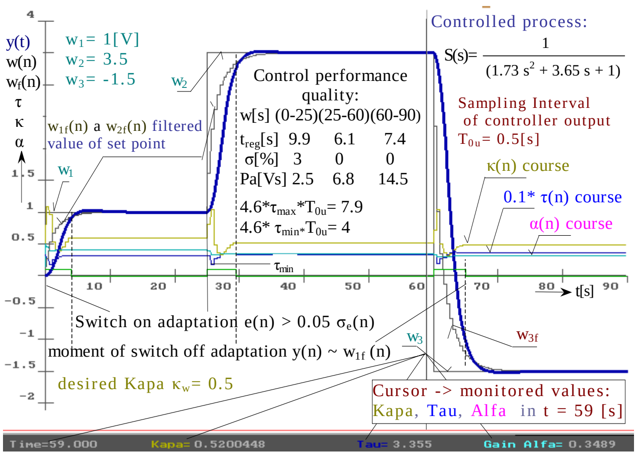
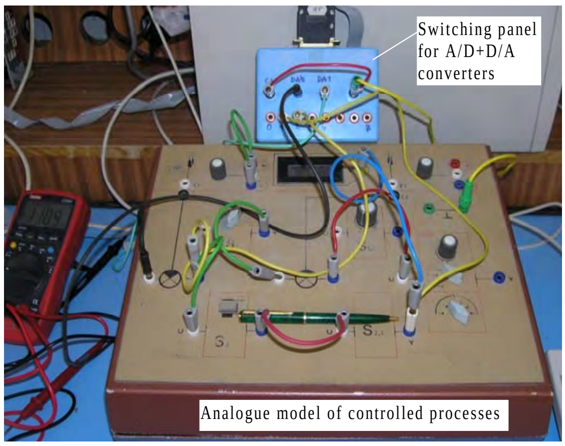
Abstract

This paper introduces self-tuning identification free PSD control algorithms. On the basis of detailed analysis of algorithm function made by simulation experiments, several modification of original algorithm have been proposed, realized and checked. These were executed in simulation environments created by real time operating analogue models of controlled processes, connected with PC through A/D and D/A converters. Verification of control loop performance quality was executed with proportional second to five order controlled processes for step responses on set point and disturbances. Simulation experiments documented robustness of algorithm. These were executed in real time, while parameters and order of transform function were changing. Loop responses were characterized with numeric data quality of control loop step response behaviour.





Keywords: simulation experiments, real-time, self-tuning control, control performance.

Presenting Author's biography

Prof. Ing. M. Alexík, PhD. has been working at the University of Žilina, Slovak Republic at the department of Technical Cybernetics for more than 30 years. He is one of leading scientist in the area of modeling and simulation in Slovak republic as well as member of several national and international societies and editorial boards of scientific journals. He is a board member of Czech and Slovak Simulation society and EUROSIM board member. Areas of his scientific interest are: modeling and simulation of dynamic systems, especially in *biomedicine* – eye-hand and eye-leg dynamics when driving a vehicle; *dynamics of transport means and processes;* optimal trajectory of train, underground, trolleybus, etc, *self-tuning control* - real time simulation of self tuning identification free algorithm and self tuning algorithm with continuous identification.

MODELING AND CONTROL OF WIND TURBINE GENERATOR CONNECTED TO INFINITE BUS

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Abstract

In this paper a wind turbine generator model is discussed. This model is obtained by using Park's equations of asynchronous generator and a wind turbine model. We are interested in the control strategy; so the electronic power converter is not taken into account. The objective is to operate and control a wind generator at variable speed in order to extract the maximum kinetic power of wind. Generally electromagnetic torque controls speed generator. As described in this paper, the useful torque allows controlling the speed of generator. So, useful torque feedback is needed to complete closed loop of torque regulation. Normally useful torque is not easily measurable or is very expensive to measure; it is equal to the sum of both electromagnetic and mechanical torques. This problem of useful torque measurement is resolved by using an estimator of torque signal. This paper provides a new approach to estimate the useful torque signal by a closed loop estimator. Such an estimator is based on the swing equation of the turning part of the wind generator and a Proportional Integral regulator. The results of simulation confirm the utility of this simple and useful approach.

Keywords: Wind turbine, Asynchronous generator, torque estimator.

Presenting Author's biography

Nesmat Abu-Tabak. He was born in Lattakia in Syria, on January 5, 1975. He received the Engineer degree in Electrical Engineering from the University of Damascus in Syria, Electric Power Department, in 1997. He worked as assistant of teaching at the University of Tishrine in Lattakia in Syria during two years. He actually prepares a thesis on modeling, simulation and control of electrical power systems and networks. He is also interested in modeling and control of wind generators.

SELF-ADAPTIVE PREDICTIVE FUNCTIONAL CONTROL OF TEMPERATURE IN AN EXOTHERMIC BATCH REACTOR

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Abstract

In this paper we study a self-adaptive predictive functional control algorithm as an approach to control of temperature in an exothermic batch reactor. The batch reactor is situated in a pharmaceutical company in Slovenia and is used in the production of medicines. Due to mixed discrete and continuous inputs the reactor is considered as a hybrid system. The model of the reactor used for the simulation experiment is explained in the paper. Next, we assumed an exothermic chemical reaction that is carried out in the reactor core. The dynamics of the chemical reaction that comply with the Arrhenius relation have been well documented in the literature and are also summarized in the paper. Furthermore, the online recursive least-squares identification of the process parameters and the self-adaptive predictive functional control algorithm are thoroughly explained. We tested the proposed approach on the batch reactor simulation example that included the exothermic chemical reaction kinetic model. The results suggest that such implementation meets the control demands, despite the strongly exothermic nature of the chemical reaction. The reference is suitably tracked, which results in a shorter overall batch-time. In addition, there is no overshoot of the controlled variable T, which yields a higher-quality production. Finally, by introducing a suitable discrete switching logic in order to deal with the hybrid nature of the batch reactor, we were able to reduce switching of the on/off valves to minimum and therefore relieve the wear-out of the actuators as well as reduce the energy consumption needed for control.

Keywords: Self-adaptive control, Predictive functional control, Batch reactor, Exothermic chemical reaction, Hybrid systems.

Presenting Author's Biography

Gorazd Karer received a B.Sc. in electrical engineering from the University of Ljubljana in 2004. He is currently a Ph.D. student at the Faculty of Electrical Engineering, University of Ljubljana. His research interests are in hybrid systems and model predictive control.

A NOE MODEL IDENTIFICATION ALGORITHM USING PIECEWISE LINEAR FUNCTIONS

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Abstract

In this paper we propose a Nonlinear Output Error (NOE) identification algorithm based on High Level Canonical Piecewise Linear (HL CPWL) functions. Starting from a linear Output Error (OE) model, the proposed model structure allows the implementation of an identification algorithm in which the degrees of freedom (flexibility) of the model can be easily increased during the identification process, retaining the achieved approximation. This is done by increasing the number of divisions of the HL CPWL simplicial domain until obtaining a given approximation error. The parameters of the HL CPWL functions are updated using a simple algorithm based on a modified steepest descent method with an adaptive learning rate that also allows controlling de BIBO stability of the model. Taking into account the simplicity of the HL CPWL VLSI realization, we are interested in the hardware implementation of the identification algorithm. We also derive sufficient conditions for BIBO stability of the identification algorithm. Taking into account this condition, we derive minimum and maximum bounds that preserve BIBO stability of the model during the optimization of the parameters of the HL CPWL functions. This model structure is well suited for control applications that need a large simulation horizon. This is the case of different optimal control applications like, for example, Model Predictive Control (MPC).

Keywords: Nonlinear systems, identification, piecewise linear techniques.

Presenting Author's Biography

Liliana Castro received a bachelor and a Master in Mathematics and the Doctorate in Control Systems at the Universidad Nacional del Sur (UNS), Argentina. Since 1999 she is Associate Professor at the Departamento de Matemática, UNS and she is also with the Instituto de Investigaciones en Ingeniería Eléctrica "Alfredo Desages". Since 2000 she is head of the Modeling Group at the Laboratorio de Investicación y Desarrollo en Visualización y Computación Gráfica, Departamento de Ciencias e Ingeniería de la Computación, UNS. Her research interests include nonlinear system modeling, identification, piecewise linear approximation of nonlinear systems and geometric modeling using wavelets.

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COMPUTER SIMULATION OF DISTRIBUTED THERMAL CONTROL FOR POLYMERIC COMPOSITE SPAR CURING PROCESS

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Abstract

The development of mould heating distributed control model for polymerization of the helicopter main rotor blade’s composite spar is presented in this work. Obligatory working conditions of such system control were considering of exothermal heat at polymerization of epoxy resin matrix, and change of a thermal capacity at transition from fluid to solid state. The kinetic model of cure epoxy resin designed on basis of the differential scanning calorimetry (DSC) experiments is proposed. This kinetic model is a component of the control system synthetic model which includes also heat transfer finite element (FE) based model of a mould with composite spar, and proportional-integral-differential (PID) controller model equipped by forecasting module for compensation of a mould thermal inertance. For speed up of linked controller and FE models simulation the reduction technique were proposed. Developed model was shown the good conformity with measured dynamic temperature field in full-scale setup, having allowed to optimize a composite spar cure conditions and to supply its required quality.

Keywords: Helicopter, Composite, Distributed Control, Computer Simulation.

Presenting Author’s biography

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SMART CONTROL PARAMETER SETTING FOR THE SIMULATION OF ELECTRIC DRIVE SYSTEMS

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Abstract

Trend analyses show an increasing demand for electrified vehicle components due to economic and technical requirements for tomorrow's vehicles. The challenge for developing innovative electrical vehicle components is the successful exploitation of new technologies and drive concepts, the consideration of the total system in the development process as well as a high degree of fail safety. For shortening the period of development and reducing costs, simulation is a crucial step in the continuous design process.

Special software tools are necessary for this development process because the conventional simulation and calculation programs do not meet interdisciplinary and dynamic demands. Dynamically applicable and real-time capable models are required to simulate real operating conditions in a vehicle and to design the components according to real requirements.

In this contribution a simulation library, the SmartElectricDrives (SED) library [1] developed by arsenal research with focus on automotive applications will be presented. This simulation tool provides the easy and robust controllability of electric machines in order to meet the ever increasing demand regarding efficiency, flexibility and accuracy in a wide range of applications. Moreover, the implemented controller parameter estimation functions for easy controller handling will be presented.

Keywords: Electrified vehicle components, Simulation of electric drive systems, Shortening the period of development, High machine performance, High control precision.

Presenting Author's biography

Hansjörg Kapeller was born in 1978 in Italy. He received the Dipl.-Ing. degree in electrical engineering from Vienna University of Technology, Vienna, Austria, in 2004. Since October 2004, he has been an engineer of the business unit Monitoring, Energy and Drive Technologies with Arsenal Research, Vienna, Austria. His main research interests are monitoring of faulty induction machines, simulation and control of electric drives.

SIMULATION AS LOGISTIC SUPPORT TO DEVELOPMENT PROCESSES (PROBLEMS IN APPLICATION)

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Abstract

If it is accepted that simulations are the most modern tools for optimization, then the application of simulations in the logistic processes is a must with daily use. The development processes also can be analyzed in the framework of logistics, since it includes rules (algorithms) which lead towards solution in analyses of complex Supply Chain system. Here is emphasized a system approach starting from the need of something in the global SC all the way to intralogistics and development of node in SC. On the case of container terminal used as the SC focal point, will be presented the application and connection of simulation within the development process from the planning up to the designing of the equipment operating there, with particular emphasis of the problems present in application of high-valued software (ex. Enterprise Dynamics and ADAMS), in the ways solved here and proposals for improvement. During analysis of power or possibilities of high valued software as tools for simulation, one must have in mind that the complexity of simulation models must be in function of the goal that one wishes to attain by simulations. The processors and memory powers of the contemporary computers encourage users towards huge models which almost ideally describe real processes, but at the same time they are permanently ascertained that in offered options there lack some new details, what is also a motivation for further modularizing of software with special features.

Keywords: Simulation, Logistic support, Optimization, Development

Presenting Author's biography

Milosav Georgijevic was born in 1949. Research for master's and doctoral dissertation, till 1989, performed at the TH Darmstadt, TH Magdeburg, TU Dresden. Afterwards he paid many visits to Germany (TU Munich, University of Dortmund). In 2000 was elected a professor, University of Novi Sad. For simulation uses, from 1986, a software ADAMS and published, in German journals, a number of papers in the field of dynamic and automation of cranes.

The lecturing by invitation:

- Nagaoka University of Technology and Tokyo Eng. University, 1998,
- Technische Universitaet Dresden, 1999,
- Universitaet Dortmund, 2000 and 2002,
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AN EFFICIENT CPN MODELLING APPROACH TO TACKLE THE PALLET PACKING PROBLEM

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Abstract

There is a lack of commercial decision support tools that could help to deal with the best configuration of decision variables to optimize or quasi-optimize the performance of a system with a stochastic, dynamic and synchronous behavior. Simulation models have proved to be useful for examining the performance of different system configurations and/or alternative operating procedures for complex systems. It is widely acknowledged that simulation is a powerful computer-based tool that enables decision-makers in business and industry to improve operational and organizational efficiency. However, when applying simulation techniques to increase the performance of those systems, several limitations arise due to its inability to evaluate more than a fraction of the immense range of options available. In this paper a new approach to integrate evaluation (simulation) methods with search methods (optimization) based on not only simulation results, but using also information from the simulation model will be presented.

Keywords: Coloured Petri Nets, Constraints, Coverability Tree, Simulation..

Presenting Author's biography

Miquel Àngel Piera received his MSc (Control Engineering) from the University of Manchester Institute of Technology in 1990 and his PhD degree from the Autonomous University of Barcelona (Spain) in 1994. He participates in industrial research projects in the logistics and manufacturing field and at present he is Co-director of LogiSim, a Modelling and Simulation Institution sponsored and founded by the local government of Catalonia. Recently, he has published a modelling and simulation book that is being used for teaching in many Spanish universities.

ANALYSIS OF VARIOUS FORECASTING APPROACHES FOR LINEAR SUPPLY CHAINS BASED ON DIFFERENT DEMAND DATA TRANSFORMATIONS

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Abstract

Supply Chain Management (SCM) has become a popular topic in recent years. One of the main discussion points is the effective management of inventories along the supply chain. Several inventory policies have been analyzed and compared to overcome the traditional tradeoff between high service levels and high inventory costs and vice versa.
This paper describes how different demand data aggregation affects reorder point calculations in continuous inventory review systems and analyzes the impact on inventories, safety stocks, and service levels of the supply chain members. Based on a linear three-stage supply chain, four different forecasting scenarios based on simple means and variance calculations as well as moving average and moving variance estimations have been tested. To analyze potential effects for different supply chain settings, four demand patterns were implemented (stationary, season, trend, trend and season).
The simulations reveal different effects depending on demand data aggregation and customer demand structure. Since the assumption of normally distributed demand data is violated for upstream suppliers in linear supply chains, difficulties arise particularly in calculating safety stocks. Aggregating order data can mitigate some of the biases in several cases. It is shown that forecasting monthly aggregated orders outperforms the other strategies in terms of lower mean inventories and safety stocks, but may lead to slightly lower service levels.

Keywords: simulation, supply chain management, forecasting, inventory policies, safety stocks.

Presenting Author's biography

Roman Schmidt is working as research and teaching assistant at the University of Bern. His PhD research focuses on the application of simulation models in Supply Chain Management, with particular emphasis on the analysis of inventory policies.

CONTINUOUS-REVIEW REPLENISHMENT WITH CAPACITY CONSTRAINTS AND BREAKDOWNS

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Abstract

This study examines the logic and performance of continuous-review replenishment systems. Specifically, the two-bin, single-card Kanban and reorder point systems are compared. A simple capacity-constrained supply chain with independent, time-varying customer demand is modeled. Material inputs come from a supplier, based on replenishment orders. These inputs are processed in batches at a machine that is subject to breakdowns, allowing the effects of potential inventory buildup to be examined. Experiments are conducted using discrete-event simulation and performance is monitored in terms of inventory levels and delivery performance. Performance tradeoff curves are generated to compare the replenishment systems over a range of service levels. These curves are generated on the basis of near optimal decision variable settings, such as lot sizes, Kanban cards and reorder points. Results show that the two-bin system performs poorly. Large lot sizes are required to provide sufficient inventory to meet demand during the replenishment cycle. The performance differences between the Kanban and reorder point systems are small. For the scenario modeled, the Kanban system benefits incurred through restricting the maximum inventory during machine breakdowns appears to approximately match the reorder point system benefits incurred as a result of using backorder information.

Keywords: Inventory Replenishment, Supply Chain, Two-Bin, Kanban, Reorder Point

Presenting Author's biography

SILVANUS T. ENNS is an Associate Professor at the University of Calgary, Canada. His research interests lie in job shop, batch production and supply chain modeling and analysis.

IMPROVEMENT OF DELIVERY TIMES BY DYNAMIC VEHICLE ROUTING IN AUTOMATED MATERIAL HANDLING SYSTEMS FOR SEMICONDUCTOR INDUSTRY

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Abstract

In the last couple of years, a high level of automation was integrated in the factories of semiconductor industry. This implies the whole production process as well as the material delivery process. An automated material handling system (AMHS) is such an integrated automated transport solution of today's 300mm semiconductor waferfabs. These AMHS are based on a direct delivery approach (unified model) with alternative flexible storage systems to handle surges of lots in process or unplanned events. As the 300mm fabs are very large and the number of process and handling steps is rising, a fast and reliable transport system with short delivery times is required which, in addition, minimizes its footprint inside the expensive clean room. Currently, the implemented transport solutions are based on overhead hoist vehicles (OHV) which have to cope with several problems. On one hand there is an increasing traffic on the whole track system caused by the increasing number of process steps. On the other hand there is a higher number of hoist-actions as a result of new storage strategies. Instead of large central stockers, distributed tool assigned Under Track Storages (UTS) are used. Both issues mentioned can result in vehicles blocking track sections frequently. This can cause accumulations which lead to high variances in delivery times and make the delivery time for loads in this system less predictable. An additional effect might be the increased idle times of expensive process equipments, which need to be minimized.
This paper describes an approach of dynamic vehicle routing and identifies simulation based improvements of the AMHS performance. Furthermore different vehicle routing strategies are presented and compared.

Keywords: Dynamic Vehicle Routing, Fastest Path, Delivery Performance, AMHS Simulation, Transport Optimization.

Presenting Author's biography

Fabian Böttinger is working as a scientist at Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart. His key activities are automated transport systems and the simulation of processes in logistics and automation in the semiconductor and photovoltaic industry.

THE SIMULATION ANALYSIS OF MULTI-SHUTTLE AUTOMATED STORAGE AND RETRIEVAL SYSTEMS

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Abstract

Technological developments in warehouses have changed processes of storage operations, which reflect in short response times of the storage or retrieval of goods, the reduction of stocks and the volume of storage work as well as the automation of the entire warehouse management. Numerous companies are replacing costly and lasted traditional warehouses with automated storage and retrieval systems, which can be classified into unit-load and mini-load systems.

In this paper the simulation analysis of mini-load multi-shuttle systems is discussed and evaluated. Multi-shuttle systems are based on the quadruple and sextuple command cycle and could therefore achieve higher throughput capacities due to single-shuttle systems. Different analytical models are used by practitioners for designing multi-shuttle systems. The problem arises with the selection of the appropriate analytical model for which the condition of minimal differences with actual circumstances in practice is fulfilled. For the evaluation of the two well-known analytical models, the discrete event simulations have been used. Beside the evaluation of analytical models, the results of simulation analyses showed throughput improvements for triple-shuttle systems according to dual-shuttle systems.

The main objective of this paper is to determine the performance of presented models (analytical and simulation models) of multi-shuttle systems, which represents the main share and support in design process of multi-shuttle automated storage and retrieval systems.

Keywords: Mini-load AS/RS, Multi-shuttle systems, Discrete event simulation, Performance analysis.

Presenting Author's biography

Tone Lerher is an assistant professor, holding a Ph.D. degree, employed at the Faculty of Mechanical Engineering, University of Maribor. His field of research refers to the pedagogical topic of "Technology in the logistics" and "Devices, systems and constructions for transport". As a senior researcher he has taken part in applicable and fundamental projects in his career. He is also a member of the professional association European Association for Traffic, Transport and Business Logistics. Last but not least, he is the author and co-author of original scientific, scientific and technical papers in his field of research.

VIRTUAL REALITY FOR A HUMAN-CENTERED DESIGN METHODOLOGY

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Abstract

Simulation tools, which are set in Virtual Prototyping (VP) techniques, have been implemented in recent years in engineering design fields, such as in industrial design, manufacturing, maintenance, reliability or ergonomics. Concerning the human factor, by studying product or workplace, engineers can forecast usability problems by means of 3D human model simulation. Indeed, these simulation tools offer great possibilities for designing and evaluating product usability features. However, they also meet drawbacks such as a lack of interaction and of immersion with the Digital Mock-Up (DMU). Now, thanks to Virtual reality (VR) engineers can have sensory-immersion and high interaction level with the DMU during the whole product design process. It makes it possible to solve problems that can not be detected with a 3D human model. In this context, our research interest is Design For Usability (DFU) methodologies based on VR and their impact on product or workplace design process. Our goal is to provide methods and simulation tools for product usability definition and optimization. Based on a review of current VR applications for usability studies, we present our method for integrating VR technique in a human-centered design process. Thus, we introduce "Virtual Reality Aided Design for Use" which consists in three overall VR design tasks that can be performed in product design process. We apply a 3D digital human associated with parametric CAD models and a virtual reality platform to the design process.

Keywords: Virtual Reality, simulation tools, manufacturing systems, mechanical engineering, human factors.

Presenting Author's biography

Morad Mahdjoub. Currently 3rd year PhD student at UTBM in Mechanical Engineering, he graduated in mechanical engineering in 2004.

DEVELOPMENT OF TERRAIN SIMULATION APPLICATIONS WITH VRML-WEB3D AND GRAPHIC LIBRARIES

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Abstract

Terrain visualization applications are widely used in very diverse type of applications (geophysical systems, training simulators, etc.), with many different uses: development of roads, mines, dams, and general building works, establishment of water behavior in rivers or dams, visual impacts, real military strategy simulation, simulation of natural phenomena such as floods, volcanic eruptions, landslides and avalanches, etc.

These applications usually require a high computational power, and then must be executed in local computer systems; but they also require sometimes the capability of network utilization (for instance in distributed simulation, in public access terrain visualization, in distributed or multi-user simulation, etc.)

The recent developments of three-dimensional visualization systems can be naturally applied to terrain visualization targeted to the web, which traditionally had been implemented with 2D systems due to the huge data volume involved.

This work shows the steps and the methodology to follow in order to develop a virtual interactive terrain visualization system, taking into consideration the different uses that can be interesting to include in the practical applications for terrain visualization, and illustrating the explanations with some real applications.

The paper also includes the analysis of two of the possible technologies to achieve this objective: VRML as an exponent of Web3D technology, and open source three-dimensional graphic libraries. Their fundamental characteristics are considered, and their methodologies, pros and cons are illustrated, based on the different applications that are presented.

Keywords: Web3D based simulation, virtual reality (VR), terrain visualization, graphic libraries (GL), Virtual reality modeling language (VRML).

Presenting Author's biography

Dr. Emilio Jiménez Macías. PhD in Electrical Engineering (with *Computer science, electronics and automation* specialty), from the Universities of Zaragoza and La Rioja, Professor at the *Electrical Engineering Department* of the University of La Rioja, where he is coordinator of the *System Engineering and Automation Group*, and main researcher of the *Modelling, simulation and optimisation of industrial automated and logistics systems* Group.

COMPARISON OF DIFFERENT 3D (STEREO) VISUALIZATION METHODS – EXPERIMENTAL STUDY

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Abstract

3D (stereo) visualization is a fast developing topic in mechatronic simulation, design, and teleoperation. Plenty of methods are in the experimental stage.
Although the stereo techniques using anaglyph, liquid crystal shutter or polarizer glasses, or the auto-stereoscopic lenticular displays are directly stimulating the binocular human cues, they can also have characteristic influence on the monocular ones. We would like to emphasize the importance of motion parallax phenomenon, which creates an illusion of depth when the observer has a relative motion to the sight, and the location / coverage of perceived points is changing according to this motion. The resulting effect can be different and it is not a trivial task to choose the optimal solution for a given problem.
The main goal of our research was a systematic comparison of the subjective perception of depth delivered by the aforementioned 3D techniques extended with dynamic motion. We developed an experimental cell, where we projected a given show with various methods for a group of voluntary people without informing them about the actual technology. We asked the test persons to evaluate questionnaires looking at various static or dynamic 3D scenarios presented in the cell using these techniques, concerning their subjective impressions on their spatial sight while either wearing anaglyph / LCS / polarizer glasses or not.
In this article we report the partly surprising results, that visual depth sensation delivered by motion parallax technique compares to the efficiency of traditional 3D visualization techniques. The achieved results can be integrated in planning of simulation and teleoperation systems.

Keywords: 3D, Stereo, Visualization, Teleoperation, Experiment

Presenting Author's biography

Tamás Urbancsek is a research assistant at Department of Control Engineering and Information Technology, Budapest University of Technology and Economics since 2004. His interests and main research fields include telerobotics, multi-agent robotics, image processing and virtual reality. He has published more than 15 lectured articles in these research areas.

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VIRTUAL TUTORS IN VIRTUAL ENVIRONMENTS

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Abstract

Virtual human models are used in many areas such as planning of production processes, ergonomics studies, planning of maintenance tasks, etc. An Advantage of computer-based drafts of such tasks is the early availability of the virtual manufacturing plant. Before building the real plant, the virtual one can already be used for feasibility studies, solving Integration problems and also for the employee's training. In today's software solutions, it is noticeable that the real trainer is still required. Virtual scenarios are prepared, the trainer explains, illustrates and leads the training. E-Learning based approaches are rarely used, because on the one hand, the integration with the CAD datasets is difficult, on the other hand, the creation of contents with human models is very expensive. Therefore the project "Interactive Content System" (ICS) of Fachgebiet Technische Informatik at the University of Kassel aims to provide CAD-based virtual tutors for simulated scenarios. ICS is a system for the creation of interactive 3D-contents. Many ranges of application are covered, like teaching and training simulations or also visualizations in the "Digital Factory". The present paper gives an overview of the state of the art in the area of virtual people and introduces some usage areas of such digital humans, like for example digital factories, military training and road safety education for children. Afterwards, the ICS-System is presented, which offers some tools that can be used in several application areas, like e.g. teaching and training simulations or also visualizations in the "digital factory".

Keywords: virtual human, virtual tutoring, virtual training, avatar, CAVE

Presenting Author's Biography

Lars Holbein graduated as a Dipl.-Ing at the Universität Kassel, Germany, where he studied Telecommunication and Computer Engineering. Since 2007, he's a research associate at Fachgebiet Technische Informatik (Universität Kassel), where he's doing a Ph.D in the area of AI-methods in simulated environments.

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INITIALIZATION OF 3-D ITERATIVE IMAGE REGISTRATION TECHNIQUES USING POINT MARKERS

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Abstract

Numerous techniques are developed to bring into spatial coincidence two sets of monomodal/multimodal 3-D images acquired by the same/different imaging modalities. Some techniques are based on estimating the transformation parameters using iterative optimization techniques. Since the positioning of the patient is different during each acquisition procedure, the selection of initial values becomes of greater importance so that the minimization algorithms converge to the desired transformation parameters. In other words, if the initial values are not selected appropriately, the registration algorithms could converge to a secondary minimum. In this work, the registration is parameterized in terms of nine parameters, 3 magnifications, three rotation angles (Euler) and three translations. They are estimated by minimizing a chi-square function defined in terms of distances weighted by localization measurement errors of the extracted fiducial external markers using a sequence of non-linear optimization techniques namely, simplex algorithm followed by a gradient approach. The registration approach is initialized using the values estimated by minimizing a cost function in the least square sense. The approach is validated using Monte-Carlo simulation techniques. That is, the residuals (errors) along x, y and z directions and the residuals of distance of regions of interest in the simulated images are evaluated quantitatively and analyzed to study the precision of the registration. The results show that the approach is successful and yields the desired optimum parameters to align the two sets of 3-D data.

Keywords: Registration, Optimization, Multimodal, Imaging modalities, Simulation.

Presenting Author's biography

Antoine Abche. He received the BS degree and MS degree in Electrical Engineering from the University of Toledo (USA) in 1984 and 1986, respectively. He received the PhD degree in Biomedical Engineering from Rutgers The State University (USA) in conjunction with the University of Medicine and Dentistry of New Jersey (Robert Wood Johnson) in 1996. Currently, he is an associate professor in the department of electrical Engineering at the University of Balamand. Dr Abche's research interests are: Virtual Reality, DSP, Image Processing, Analysis and Classification, Telemedicine, Image Registration, Neural Network, Fuzzy Logic, Modeling and System Identification.

MODELING AND BISTATIC SIMULATION OF A HIGH RESOLUTION 3D PMD-CAMERA

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Abstract

To reduce the extent of the bistatic and other negative effects caused by the spatially separated illuminator and receiver positions in real 3D cameras, noiseless reference camera data are necessary. Such bistatic reference 3D data can be very helpful and in some applications indispensable for adaptive correction of the bistatic deformation. Due to the fact that the bistatic deformation effects cannot be individually separated from the total noise path (superposition of many noise types like thermal noise of the sensor, pixel size inequalities, etc.), such reference noiseless data can be generated only by means of simulations.
This paper presents a bistatic modeling and simulation approach for a high resolution 3D PMD camera.

At first, the paper describes a simulator for the monostatic case, which hat been developed at the University of Siegen's Center for Sensor Systems. The simulator allows the user to calculate the theoretical response of a PMD sensor for a given 3D scene, referenced an absolute coordinates, so that the output of the simulator is comparable to real PMD sensor data. An advantage is that dynamic and static sensor parameters such as resolution, modulation frequency, fill factor, lens characteristics, sensor inclination and tilt, etc. can be at any time modified by the user.

The second part is concerned with the modeling and simulation of bistatic reference 3D data in the case of different positions of illuminator and sensor. The results of the simulated scenario including an error analysis are discussed.

Keywords: PMD; Photonic Mixing Device; Simulation; Modeling; Bistatic

Presenting Author's biography

Valerij Peters received the Diploma degree in electrical engineering from the University of Siegen in 2002. He is currently scientific assistant in the Center of Sensor Systems (ZESS) at the University of Siegen. His current research interests include 3D Vision, mono- and bistatic signal theory, multi sensor data fusion, computer based 2D and 3D sensor simulations.

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REALISTIC ENVIRONMENTS FOR ONLINE MARITIME SIMULATORS

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Abstract

This paper presents the 3D and network principles and methods for graphical development in realistic naval simulation.
The aim of this project is to achieve a good simulation quality in large networked environments using open source solution approach for educational purposes. Realistic rendering of maritime environments requires that the sunlight and skylight illumination are correct and the water surface is modeled accurately.
For online simulators the problems that you have to deal with depend a lot on the type of network you are using. Whatever the platform is, you have to deal a multiprocessing situation. LANs make a very easy platform for writing networked simulators, but unfortunately it means that the participants have to have their computers connected to high speed network in order to be able to run the software. This limits the number of workstations in use. The Internet has one thing going for it: there are a lot of potential participants (students, instructors) on it at all times. TCP is a full duplex connection-based reliable transport protocol. It offers reliability at the cost of increased latency variance. Network errors cause automatic retransmissions from the TCP protocol, so at times connection latency can be several times higher than optimal. Obviously, the main advantage of networked simulators is that you get to participate with new people and possibly even make new teams. To achieve this goal, the simulator should be as accessible as possible.

Keywords: realistic simulation, online participants, maritime environments, networked environments.

Presenting Author's biography

Gabriel Raicu. The main author activity as lecturer at Faculty of Navigation and Naval Transport in Constanta Maritime University consists in large scale online educational developing services and electronic navigation aid teaching.
Also all the co-authors are maritime lecturers, associate professors or assistant professors at Faculty of Navigation and Naval Transport in Constanta Maritime University.

MODEL-DRIVEN SOFTWARE DEVELOPMENT AND DISCRETE EVENT SIMULATION

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Abstract

Model-driven software development (MDSD) is a current direction in software engineering that stresses the importance of models in contrast to program code. Since models have always been of large importance in simulation, some aspects of MDSD are especially helpful to support discrete event simulation (DES) studies. In this paper we present a case study concerning the development of an MDSD-compliant domain architecture for DES. This includes code generation facilities for the object oriented simulation framework DESMO-J based on a new UML profile for DES. The approach is supported by techniques and tools from MDSD such as the generator framework openArchitectureWare and the test frameworks JUnit and FIT. On this foundation, a larger teaching example from the domain of harbor logistics has successfully been implemented as a reference model. On the basis of the gained experiences we discuss general prospects and drawbacks of applying MDSD to the development of simulation models as well as interactive simulation tools. In particular, we identify MDSD as an intermediate level between code-centric simulation approaches and domain-specific graphical tools. On the one hand, MDSD can ease the testing and implementation of large simulation programs. On the other hand, it provides techniques and tools that aid the development and prototyping of graphical simulation systems.

Keywords: DES, MDSD, UML, process-oriented simulation, software engineering

Presenting Author's Biography

Dipl.-Inform. Thomas Sandu received a diploma degree in Computer Science from the University of Hamburg in 2007. The subject of his diploma thesis is the model-driven development of discrete event simulation programs. He currently works as a software developer for itemis GmbH, a German software development and IT consulting company, which is specialized on model-driven software development.

ALGORITHM FOR DEVS STRUCTURE CHANGES

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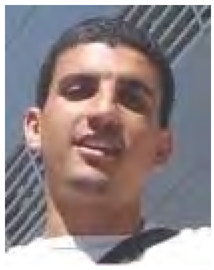
Abstract

Several dynamic complex systems are too complex to be represented through only one modelling formalism (Petri nets, bond Graph, etc.) like military systems. Vangheluwe analyses some wide utilized formalisms and presents DEVS (a mathematically sound framework) as a common denominator for multi-formalism hybrid systems modelling. The main objection against the use of DEVS (and derived formalisms) in agent based simulation was their static nature. We proposed a dynamical hierarchical structure modelling approach. It preserves the DEVS formal model in order to take advantage of its experience and its demonstrated capabilities (closure under coupling, hierarchy, modularity, etc.), and propose a dichotomy between the structure and the behavioural model. This paper proposes a collapsed view of our approach focused on the structure changes boundaries described through algorithms.

Keywords: Discrete event modelling, DEVS, Variable/Dynamic structure, hierarchical structure.

Presenting Author's biography



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AN INSTRUMENTATION FRAMEWORK FOR COMPONENT-BASED SIMULATIONS BASED ON THE SEPARATION OF CONCERNS PARADIGM

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Abstract

This paper presents the authors' ongoing work in applying the "Separation of Concerns" (SoC) software design paradigm to the Instrumentation Framework of a new component-based simulation platform called OSA (Open Simulation Architecture). The SoC paradigm emerged recently from the research in Component Based Software Engineering (CBSE). It consists in enforcing the strict separation of the instructions of a program as soon as these instructions have different functional goals. The first expected benefit of this approach is to improve the re-usability of the resulting software. In our particular case, applying the SoC paradigm to the Modeling and Instrumentation concerns means that several instrumentations can be developed for a given model without any change to the modeling code. Following, the same modeling code may be reused in various computer simulations and with possibly very different instrumentations, depending on the goals of the study. The second expected benefit of applying the SoC approach to the Instrumentation Framework of OSA, as shown in this paper, is to gain a better control on the instrumentation overhead.

Keywords: Instrumentation, **Framework**, **Discrete-Event Simulation**, **Component Based Software Engineering**, **Aspect Oriented Programming**.

Presenting Author's Biography

OLIVIER DALLE is *Maître de Conférences* (Associate Professor) in the C.S. dept. of Faculty of Sciences at University of Nice-Sophia Antipolis (UNSA). He received is BS from U. of Bordeaux 1 and his M.Sc. and Ph.D. from UNSA. From 1999 to 2000 he was a post-doctoral fellow at the the french space agency center in Toulouse (CNES-CST), where he started working on component-based discrete event simulation of complex telecommunication systems. In 2000, he joined the MASCOTTE project, a common team of the I3S-UNSA/CNRS Laboratory and the INRIA Research Unit, in Sophia Antipolis. His web page can be found here: `http://www.inria.fr/mascotte/Olivier.Dalle/`.

CONSTRAINT-BASED SIMULATION OF OUTFITTING PROCESSES IN SHIPBUILDING AND CIVIL ENGINEERING

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Abstract

Currently, in shipbuilding as well as in civil engineering outfitting planning is not sufficiently investigated. A multitude of requirements such as technological dependencies, resource and work space assignment have to be considered. Outfitting processes in both domains are distinguished by interferences, disturbances, great interdependencies and different surrounding area requirements. In consequence, on production site an extensive coordination effort is necessary to handle these problems. A realistic planning and detailed analysis will help to reduce the on-site coordination effort and not to overrun the projected costs and time. Appropriate tools have to be implemented to support planners and improve the outfitting planning. Within the cooperation SIMoFIT (Simulation of Outfitting Processes in Shipbuilding and Civil Engineering) a discrete-event simulation framework is developing to support outfitting planning in shipbuilding and civil engineering. This paper focuses on using a constraint-based simulation approach to detail outfitting tasks and their corresponding restrictions and requirements. Typical outfitting restrictions and requirements are specified as hard and soft constraints. This approach guarantees a high flexibility in modeling processes. Further, outfitting processes can be specified more realistically. Thus, different practical schedules can be simulated and evaluated in terms of work and material flow organization, utilization of space and worker's efficiency as well as process costs. The framework was lab tested by both cooperation partners and proves its suitability to support the outfitting planning process in shipbuilding and civil engineering.

Keywords: constraint satisfaction, discrete-event simulation, outfitting processes, shipbuilding and civil engineering

Presenting Author's biography

Markus König is assistant professor for Theoretical Methods of Project Management in the Department of Civil Engineering at the Bauhaus-University Weimar, Germany. His research activities include simulation in production and logistics, workflow and knowledge management, process modeling, graph theory as well as mathematical aspects of project and risk management.

THE ROLE OF KNOWLEDGE THROUGHOUT THE SIMULATION LIFECYCLE: WHAT DOES A SIMULATION MODEL KNOW?

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Abstract

A simulation model is more than just a tool necessary to achieve certain objectives of experimentation and cognition. In the course of a simulation project the simulation model is developed, modified, used, evaluated and extended within an ongoing process. Therefore, it is also a kind of dynamic repository containing knowledge about parameters, causal relations and decision rules gathered through purposeful experiments. In the end, knowledge stored in the simulation model can be considered proven, independently of whether it was developed by the domain expert him- or herself or by a consultant simulation expert. Unfortunately, this knowledge is usually not very well documented and therefore does exist implicitly only inside the simulation model. To be used when the results of the simulation project are put into practice, it needs to be explained in such a way as to be accessible to the domain expert in the subject-specific terminology and to be applicable without any loss of information or misrepresentation. Against this background the paper proposes a formalizable documentation framework (in terms of both structure and procedure), specifies a detailed, but consistent sub-structuring of relevant simulation knowledge categories, and analyzes which simulation knowledge precisely comes in which form and way from where, which knowledge is implicitly represented by the simulation model and how a particular component-based simulation package allows access to it.

Keywords: knowledge-based simulation, simulation knowledge, knowledge management, discrete event simulation.

Presenting Author's biography

Gaby Neumann received a PhD in Logistics from the University of Magdeburg. Since 2003 she has been Junior Professor in Logistics Knowledge Management there. She also has been part-time consultant in logistics simulation since 1991. Her current activities and research interests are mainly linked to fields like problem solving and knowledge management in logistics, logistics simulation and planning, but cover also technology-based logistics learning, didactics of teaching logistics as well as logistics competence profiling and assessment. She has widely published in these fields and has been or is being involved in a couple of respective projects. Her e-mail address is gaby.neumann@ovgu.de.

A PETRI NET BASED SIMULATOR FOR ACTIVE DATABASE SYSTEMS

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Abstract

Active database systems were introduced to extend the database functionality. As well as a repository of data, active database can detect the occurrence of events in a database system and react automatically to that event occurrence and execute certain actions either inside or outside the database. This behavior is specified by means of ECA (event-condition-action) rules, i.e., when an event has occurred, if the condition is evaluated to true, then an action is executed. The development of a set of ECA rules involve the knowledge of the database structure and the relationships that can exist among the ECA rules, which may produce an inconsistent state in the database. Therefore, it is so important to verify a rule set before its implementation in the active database, and one method to determine if a rule set will produce consistent states of the database is through the simulation of ECA rule firing. In this paper a simulator for active databases, named ECAPNSim, is described. ECAPNSim uses the definition of ECA rules like a structure of an extended Petri net model, the Conditional Colored Petri Net (CCPN). Conditional Colored Petri Net definition involves the knowledge and execution model, which describe the features that an active database system must have. Furthermore, in order to simulate the occurrence of database events, ECAPNSim has been enhanced with the addition of distribution functions for each place that denote events of the ECA rule set. An example has been developed in order to show the ECAPNSim applicability in a certain study area.

Keywords: Petri net, Active Database, ECA rules, Simulation.

Presenting Author's biography

Joselito Medina-Marín. He received the M.S. and Ph.D. degrees in electrical engineering from the Research and Advanced Studies Center of the National Polytechnic Institute at Mexico, in 2002 and 2005, respectively.
He is presently a Professor of the Advanced Research in Industrial Engineering Center at the Autonomous University of Hidalgo State at Pachuca, Hidalgo, México. His current research interests include Petri net theory and its applications, active databases, simulation, and programming languages.

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A FLOW REGULATION BY GENERALIZED PETRI NET

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Abstract

We suggest a model representing the regulation of flow on production site, composed of two parallel production lines. After a comparison of flow, the model is able to modify, in real time the coming in flow of each line, in order to counterbalance the loads of production. Then we show that it is possible to carry out a plan of regulation with uncolored Petri nets (PN) using modules (gauge, sequencer) which could be used for others applications.
The regulator takes the informations of flow from the two lines and generates a sequence through the sequencer, depending on these informations. This sequencer orientates two products towards one of these two lines. Our choice will be the using of ordinary Petri nets to obtain these models.
We propose a model of gauge (composed by six elementary cells) able to give, when he is requested, a number of tokens in one of two places Psup0 or Psup1 depending on the difference between the quantities of tokens initially in places "Pf0" and "Pf1".

Some simulations have been carried out to verify the functioning of the model. These simulations have confirmed the theoretical aspect. However, we have tested the good functioning of a reduced model, with a gauge of only two cells. The number of cells decreases the number of dispatched objects before the end of transient behaviour.

Keywords: Petri Net, Complex Sequencing, Flow Regulation.

Presenting Author’s biography

Marc Bourcerie obtained the PhD in 1988. His work was about the aging of N-MOS transistor. In 1989, he joined the University of Angers, where he obtained, in 1996 "HDR" degree. In LISA laboratory, he works on the modelling of complex systems by generalized or coloured Petri Nets.

NUMERICAL MODELING OF THERMAL EXPANSION OF AL-BASED METAL MATRIX COMPOSITES REINFORCED WITH SIC PARTICLES

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Abstract

The coefficient of thermal expansion (CTE) is one of the most important physical properties of metal matrix composites (MMCs). The expansion behavior is correlated to the microstructure, the deformation of the matrix, and the internal stress conditions. During the present study the instantaneous CTE of Al-based metal matrix composites reinforced with 70 vol. % SiC particles is analytically computed in order to explain abnormalities in the thermal expansion behavior obtained experimentally. The numerical modeling was carried out from room temperature (RT) to 500^{o}C using finite element analysis (FEA) combining the effects of microscopic voids and phase contiguity. The FEA are based on a two-dimensional unit cell model. The used unit cell models consider the composites as a continuous rigid phase infiltrated with the ductile Al matrix. The obtained thermal expansion behavior is strongly influenced by the presence of voids and a comparison of instantaneous CTE with the experimental results shows a good agreement.

Keywords: Al-based metal matrix composites, Particle reinforced metals, Thermal expansion, CTE, Unit cell model.

Presenting Author's biography

Tran Huu Nam is a postdoctoral research assistant of Institute Materials Science and Technology at Vienna University of Technology. He received his Ph.D from Technical University of Liberec in Czech Republic. He is now a postdoctoral fellow of ÖAD. He is also a researcher-lecturer at Department of Material and Structure Mechanics of Hanoi University of Technology. His research interests encompass the micromechanics of composite materials, modeling and simulation of advanced materials. He is also interested in large strain materials, nonlinear properties of hyperelastic and viscoelastic materials. His present interest is thermoelastoplastic behavior of metal matrix composites.

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ON ELASTIC-RIGID COUPLING IN MODELLING OF MOTION OF ELASTIC LINKAGES BY FEM

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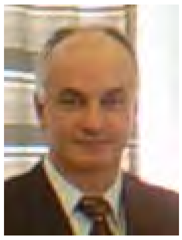
Abstract

In the paper the discussion on elastic-rigid coupling in finite element analysis of flexible mechanisms is presented. The planar case is consider and the Euler-Bernoulli beam finite elements are used. It is commonly assumed that the shape function of elastic motion can represent rigid body motion. In this paper, in opposite to this assumption, the model of a shape function specially dedicated for the rigid-body motion is presented and its influence on elastic motion appears in equations of motion - the inertia matrix standing by rigid body acceleration depends on both shape function of beam and rigid elements. The assumed shape function for rigid motion is also useful for analysis of high-speed mechanisms when the mutual dependence between the rigid-body motion and elastic deformation of links is needed. In this case the displacement vector contains both rigid body and elastic displacements and is substituted as generalized coordinate to Gibbs-Appel equations of motion. The rigid body components are separated from elastic ones in the displacement vector. Thus the dimension of the displacement vector of a finite element is larger compare to the previous studies on this field but equations of motion are obtained by solving one set of system equations. The numerical calculations are conducted in order to determine the influence of the assumed shape function for rigid body motion on the vibration of links in the case of two examples: a four-bar linkage representing the closed-loop mechanisms, and the open-loop example of two link planar manipulator. The results of numerical simulation show that for transient analysis and for some specific conditions (e.g. starting range, open-loop mechanisms) the influence of assumed shape functions on vibration response can be quite significant.

Keywords: Flexible mechanism, Rigid body motion, Elastic-rigid coupling.

Presenting Author's biography



Michał Hać. Received the M.S. and Ph.D. in Mechanics and Machine Structures from the Faculty of Automotive and Construction Machinery Engineering, Warsaw University of Technology (WUT), Poland in 1978 and 1986, respectively. Since 2001 he is a Professor of WUT in the Institute of Machine Design Fundamentals. His research contribution include the usage of the finite element method in machine design. His research interests are directed towards dynamics of flexible mechanism and analysis of multibody systems. He is a member of Polish Society of Computer Simulation.

EXPERIMENTAL ANALYSIS OF BUBBLE PUMP WATER-BASED WORKING FLUIDS

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Abstract

A conventional vapour absorption cycle requires mechanical energy to circulate the refrigerant–absorbent solution from the low-pressure absorber to the high-pressure generator. For pumping working fluid from low pressure to high pressure in absorption cycles mechanical pumps which work with electrical force are used. Using these pumps caused increasing cost & noise. This research used the bubble pump instead of mechanical pumps for solving these problems. Bubble pump is a kind of pump which works with thermal energy instead of electricity and works based on two-phase flow. An experimental research on the performance of bubble pump with two working fluid (water and Lithium Bromide) has been done. In this study the effect of various parameters such as heat input, submergence ratio (H/L), diameter of lift tube on the operation of bubble pump are analyzed. Increasing the power of internal and external heater increases the liquid flow rate, where increasing the diameter of tube reduces the liquid flow rate. It has seen that that the submergence ratio has a positive impact on liquid flow rate so that increasing the submergence ratio (H/L) increases the liquid flow rate

Key words: bubble pump, diameter of tube, submergence ratio,

Presenting Author's biography

Mohammad Naghashzadegan. I am an assistant professor in mechanical engineering in Guilan University in Iran. My major interested area is air-conditioning, refrigeration and heat-transfer where I involve with several research projects including the design a pump-less absorption system, build a computer simulation program, modeling and simulating cooling and heating load calculation for Iranian climate.

EXPERIMENTAL ANALYSIS OF BUBBLE PUMP LiBr SOLUTION WORKING FLUIDS FOR ABSORPTION SYSTEM

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Abstract

The bubble pump provides the drive for moving the solution in an absorption refrigeration system where the. low cost energy for moving solution is its advantage. An experimental research test rig to study the performance of the bubble pump for absorption refrigeration units was made. The characteristics of bubble pump determine the efficiency of the absorption refrigeration system. Different diameter tube of bubble pumps was selected. Two internal and external heaters gave the energy to the solution, where the first is in the container of bubble pump and the other around the tube. The LiBr was selected as the tested liquid. The effects of changing the quantities such as submergence ratio (H/L), diameter of tubes and the power of internal heater were studied. The experimental results show that the performance of the bubble pump depends mainly on the power of internal heater and diameter of tube. It was also seen that for the same input power for larger tube diameter the vapor flow rate is increased where the liquid flow rate is decreased. The results show that as the power of internal heater increases, the liquid flow rate increase too. It can be seen that the vapor flow rate increases to a maximum value as the power of the internal heater increases, where finally it reaches a steady value (slug flow).

Keywords: absorption refrigeration system, bubble pump, LiBr, Submergence ratio

Presenting Author's biography

Mohammad Naghashzadegan. I am an assistant professor in mechanical engineering in Guilan University in Iran. My major interested area is air-conditioning, refrigeration and heat-transfer where I involve with several research projects including the design a pump-less absorption system, build a computer simulation program, modeling and simulating cooling and heating load calculation for Iranian climate.

ELIMINATION OF CYBERNETIC IMPERFECTIONS OF THE FATIGUE TESTING MACHINE

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Abstract

In the production of the elements which are supposed to be subjected to dynamic loading different methods are used for proving their fatigue resistance. One of the most reliable methods is testing of such elements in the laboratories under conditions equal or similar to the real life conditions. For such tests a specially designed large scale testing machines are used which must generally produce a high dynamic loadings at as great frequencies as possible with the aim of ensuring short testing times. Therefore the elements of such machines are subjected to high dynamic loadings too. Besides that also the dynamic properties of the mechanisms used are very important and each imperfection in the design can result in vibrations, additional dynamic loading and in the fatigue of the machine parts. In the paper a design of an existing testing device is presented and the problems in its operation are described. For the solution of the problems the changes in the design of the machine are proposed. Before the application of these changes the proposed solution was confirmed by means of simulations. For this reason a mathematical dynamic model of a machine was developed and the computer program was written for the purpose of numerical integration. After the confirmation the proposed solution was used for enhancement of the design of the problematic machine. The machine is now fully operational and it operates without problems for several years which prove that cybernetic imperfections were eliminated effectively.

Keywords: Fatigue, Testing machines, Dynamic loadings, Numerical models.

Presenting Author's biography

Boris Jerman. He received the M. Sc. and PhD. degrees in Mechanical Engineering from the Faculty of Mechanical Engineering, University of Ljubljana, in 1999 and 2005, respectively. He is currently a teaching assistant at the Faculty of Mechanical Engineering in Ljubljana in fields of steel structures, cranes and other material handling equipment and pressure vessels and a senior lecturer at the Faculty of Chemistry and Chemical technology in Ljubljana in field of Safety of Machinery. His research interests include load carrying structures and non-linear dynamical systems. He is a member of Technical Comities for Cranes and Material Handling Equipment and for Safety of Machinery at Slovenian Institute for Standardization. He is also a member of Slovenian Society of Mechanical Engineers and of Slovenian Society of Occupational Safety Engineers.

AUTOMATIC SLEEP SCORING BASED ONLY ON ELECTROCARDIOGRAM RECORDS

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Abstract

The technique used in the most sleep laboratories for the diagnosis of the sleep disorders is the polysomnography. This technique is of great discomfort for the patient (hospitalisation, sleeping in a non familiar environment, connected to many sensors and cables). The fundamental signals for assessing the quality of sleep can be recorded. Evaluating these signals in 30 seconds interval is time consuming even for experience physician. Because that these signals are recorded in real time and in digital form, and because that the diagnosis is made directly from these records, they can thus be used for automatic processing. One of the most important problems in ECG analysis is the extraction of appropriate features, and this can be tackled in various ways. The aim of this work is to automatically classify sleep stage using only the electrocardiogram (ECG) records and using the conventional R&K classification criteria. The feature extraction stage of the work described in this paper was performed using methods of Detrended Fluctuation analysis and Heart Rate Variability analysis. All these methods are based on analysis of a Tachogram (record of RR intervals). Feature-spaces formed using these two methods were used as input to a Artificial Neural Network (ANN). Our approach has been tested on a real ECG records from different patients demonstrating the feasibility of the proposed method. The capability to differentiate sleep stages in predefined categories (wake, light sleep, deep sleep, REM) was successful in 65%. The Classification performed on data set containing only deep sleep and REM categories had 83.4% reliability.

Keywords: Electrocardiogram, Sleep scoring, Heart rate variability, feature extraction, Classification, Neural networks.

Presenting Author's Biography

Dr. Tarik AL-ANI received his Bachelor of Science (B.Sc.) in Physics (1973), Electrical Engineering Diploma (1975) from the University of Baghdad then PhD from the University Paris XI in 1984. He is currently Associate Professor in the high Engineering school ESIEE-ASI Laboratory and Associate researcher in the University of Versailles-LISV Laboratory in France. His research area of interests include: Stochastic modeling approaches, Artificial Intelligence, Identification, Control and Biomedical Engineering.

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NEW TRENDS IN SIMULATION OF NEURAL NETWORKS

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Abstract

In this paper actual simulation techniques and simulation systems for artificial neural networks are compared. We focus on neural network simulators that allow a user easy design of new neural networks. There are several simulation strategies that can be exploited by modern neural network simulators described. We considered the synchronous simulation as the most effective for parallel systems like artificial neural networks. Examples of general simulation systems that can be used for simulation of neural networks are mentioned. Current neural network simulators commonly depend on a type of neural network simulated and cannot be easily extended to simulate a different or a neural network with a brand new architecture and function. Universal simulation tools seem to be suitable for network design but do not support connectionism natively. The missing language constructions and tools for native support of connecting objects in the simulation lead us to design a new simulation tool SiMoNNe - Simulator of Modular Neural Networks, which allows easy design and simulation of neural networks using a high level programming language. The language itself is object oriented with weak type control. It supports native connection of simulated neurons, layers, modules and networks, matrix calculations, easy control of simulation parameters using expressions, re-usability of the result as a source code and more. The language is interactive and allows connection of a GUI to the SiMoNNe core.

Keywords: Artificial Neural Networks, Simulation, SiMoNNe, Programming Languages

Presenting Author's Biography

Jan Koutnik works as a teacher and researcher in Computational Intelligence at Department of Computer Science and Engineering at Faculty of Electrical Engineering at Czech Technical University in Prague. His research is focused on artificial neural networks, self-organization, temporal sequences processing and other methods of computational and artificial intelligence applied in various tasks.

APPLICATION OF LOCAL ANN CONTROLLERS FOR POWER SYSTEM SECONDARY VOLTAGE CONTROL

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Abstract

The paper presents a new and efficient concept of local secondary voltage control (LSC) of a power system that is based on artificial neural networks (ANN). For its operation it requires only local information on power system operation that it collects by measuring the controlled variables in the controlled node and reactive power flows on the connecting lines with the neighboring nodes. All generators in the system participate in the secondary voltage control, each of them equipped with its own secondary controller. The correct response of the controller to the input data is calculated using ANN. Each ANN is trained separately using the same set of power system operating states. The set has to be large enough to encompass many different operating scenarios, with the optimal power flow (OPF) results used as the training reference. The local ANN controllers operate independently without coordination and free of the unwanted controller interaction. Although their adaptive local control action results in system-wide effect on voltage profile, they require no supervisory reference signal from the power system control center for their operation.

The performance of the control concept was tested on a Slovenian power system model with 22 generators and eight tap changing transformers. Test results show that the new local secondary voltage control successfully supplies reference voltages for generators and tap changing transformers based only on local measurements. Using the local ANN secondary voltage control we achieved local control of power system voltage profile and a notable reduction of power system losses.

Keywords: Power System, Local Secondary Voltage Control, Artificial Neural Network, Optimal Voltage Profile.

Presenting Author's biography

Andrej F. Gubina received his Diploma Engineer degree, M.Sc. and Dr. Sc. in 1993, 1998 and 2002, respectively, from the University of Ljubljana, Faculty of Electrical Engineering. In 2000, he spent a year as a Fulbright Visiting Researcher at the Massachusetts Institute of Technology. From 2002 - 2005 he headed the Risk Management Dept. at HSE d.o.o., Ljubljana. Since May 2006 he is an Assistant Professor and since March 2007 the Head of the Laboratory for Energy Policy at the above Faculty. His main interests are in the field of power system analysis and control, renewable energy sources, power economics and risk management.

ARTIFICIAL NEURAL NETWORKS FOR OPTIMISATION OF TABLET PRODUCTION

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Abstract

Pharmaceutical industry is one of the most regulated industries. Quality by design is a contemporary approach in pharmaceutical development and production.Tablet is the most common pharmaceutical dosage form prepared by compression of dry mixture of powders consisting of active ingredient and excipients into solid compacts. The process of tabletting consists of three stages: a) powder mixture is filled into die; b) compaction, when powder is compressed inside a die by two punches, resulting in plastic and elastic deformation and/or particles fragmentation, and c) ejection, when tablet is ejected from the die and elastic recovery of tablet may occur. Intensive elastic recovery can lead to separating upper part of tablet from the tablet body (capping). Mechanical behaviour of powders during tableting and quality of tablets depend on powder characteristics (formulation) and tableting parameters on tablet press machine.The aim of present study was optimisation of tableting process in order to diminish capping occurrence and variation of tablet mass and crushing strength. Optimisation was performed for the product where 70% of the tablet weight represent active ingredient, on the high capacity rotary-tablet press, in the standard production environment. Artificial neural networks (NN) were used to model the relation between quality and process parameters. It can be concluded that NN can be used to describe relation between raw material characteristics, process parameters and quality of tabletting process. Therefore, it is also possible to find optimal set of process parameters with modelling and simulation, considering the raw material characteristics. Modelling and simulation indicates that it is possible to find process settings for tabletting of non-preprocessed powder such that sufficient quality of tablets can be achieved.

Keywords: tabletting, optimisation, modelling, simulation, artificial neural networks.

Presenting Author's Biography

Aleš Belič received B.Sc and Ph.D. degrees in electrical engineering from the University of Ljubljana, Slovenia in 1994, and 2000 respectively. He is currently Associate Professor at the Faculty of Electrical Engineering, University of Ljubljana. Main areas of his professional interest are artificial intelligence modelling techniques in bio-medical areas. Currently he is involved in modelling of cholesterol pathways in human in the frame of 6th European Framework project STEROLTALK, and in functional analysis of EEG signals.

APPLICATION OF SELF-ORGANIZING MAPS IN ANALYSIS OF WAVE SOLDERING PROCESS

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Abstract

This paper presents an overview of a data analysis method based on self-organizing maps (SOM), a well-known unsupervised neural network learning algorithm, which was applied to a lead-free wave soldering process. The aim of the study was to determine whether the neural network modeling method could be a useful and time-saving way to analyze data from a discrete manufacturing process, such as wave soldering, which is a widely used technique in the electronics industry to solder components on printed circuit boards. The data variables were mostly various process parameters, but also some solder defect numbers were present in the data as a measure of the product quality. The data analysis procedure went as follows. At first, the process data were modeled using the SOM algorithm. Next, the neuron reference vectors of the formed map were clustered to reveal the desired dominating elements of each territory of the map. At the final stage, the clusters were utilized as sub-models to indicate variable dependencies in these sub-models. The results show that the method presented here can be a good way to analyze this type of process data, because interesting interactions between certain process parameters and solder defects were found by means of this data-driven modeling method.

Keywords: Neural Networks, Self-Organizing Maps, Wave Soldering, Process Analysis.

Presenting Author's biography

Mika Liukkonen, born in Jyväskylä, Finland, August 22, 1979, graduated from the University of Oulu, Finland, as M.S. (eng.) in 2007. His main research interest includes process engineering, process modeling, industrial data processing, and data mining. He is currently preparing the Ph. D. degree in process informatics.

AUTOMATIC PARALLELIZATION OF OBJECT ORIENTED MODELS ACROSS METHOD AND SYSTEM

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Abstract

In this work we report preliminary results of automatically generating parallel code from equation-based models together at two levels: Performing inline expansion of a Runge-Kutta solver combined with fine-grained automatic parallelization of the resulting RHS opens up new possibilities for generating high performance code, which is becoming increasingly relevant when multi-core computers are becoming common-place.

We have introduced a new way of scheduling the task graph generated from the simulation problem which utilizes knowledge about locality of the simulation problem and the structure the task graph gets due to the inlined Runge-Kutta solver. The scheduling is done in a way that limits communication, to the greatest extent possible, to neighboring processors and expensive global synchronization is avoided. Communication is pipelined in such a way that during the calculation of a simulation step messages are only sent from lower ranked processors to higher ranked processors. Backwards communications are collected to a single message passing step at the end of the step. Since the solver is not centralized to a single processor we avoid a situation were all processors communicate to a single target at the end of each simulation step. Preliminary tests on a Linux PC-cluster show speedup that is somewhat better than what was achieved in previous work were parallelization was done on the system only.

Keywords: Modelica, automatic parallelization.

Presenting Author's biography

Håkan Lundvall got his masters degree in Computer Science and Engineering from Linköping university in 1999, has since been working in the software industry as a consultant. Since 2003 he combines his work as a consultant with part time studies towards a phd at the Programming Environments Laboratory at the computer science department of Linköping University. Håkan's interests lies within modeling and simulation, high performance computations and parallelization.

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A TWO-DIMENSIONAL SNOW PACK MODEL

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Abstract

The investigation of snow pack properties aims to one of the main topics of snow science. Consequently a number of different snow pack models have been developed, world wide. The most sophisticated models are able to calculate snow temperatures, settlement, densification, snow metamorphism and weak layers within the snow pack. Among all these models there exists no two-dimensional approach for arbitrary shaped cross sections of a slope. SnowSim, developed by the Institute of Mountain Risk Engineering, is the first model which allows the calculation of two-dimensional temperature profiles on arbitrary cross sections of the snow pack. Additionally to the calculation of snow temperatures the model handles snow settlement and densification. Snow settlement, densification and temperature calculation are associated very close with each other. Therefore an accurate modeling of these properties is essential for receiving reliable simulation results. The required input data for the model are measured by automatic snow and weather measurement sites which are placed on representative locations in the alpine area. Two different exposed measurement sites in about 2000 meter sea level are collecting all necessary data for operating the snow pack model. An extrapolation of the measured values to the area allows the expansion to the second dimension. The two-dimensionality helps to localize small scaled temperature deviations along possible avalanche tracks and respites the discovery of weak zones along endangered zones. Furthermore the modeling of snow settlement can be enhanced to calculate occurring forces within the snow pack and between obstacles but latter will not be dealt in this paper.

Keywords: snow pack modeling, Finite Element Method, heat transfer, snow settlement

Presenting Author's biography

Harald Teufelsbauer studied technical mathematics at the Vienna University of Technology and did his PhD in January 2007. Till now he is employed as Postdoc at the University of Natural Resources and Applied Life Sciences. The main topics of his research are focused on snow cover modeling and avalanche dynamics.

WAVEGUIDE MODEL OF WIRELESS COMMUNICATION CHANNELS INSIDE BUILDINGS

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Abstract

A plenty of wireless data transmission networks now works inside of buildings.
Specifics of electromagnetic waves propagation of in these conditions are:
Presence of possible obstacles in a propagation path of a signal;
Multiple propagation paths of a signal because of numerous reflections.
The models communication channels offered at present time inside of buildings do not fully consider these specifics therefore do not possess satisfactory accuracy of calculation. Besides disadvantage of these models is their "instability" to amount of initial data. Initial data for creation of mathematical model of radio channels inside buildings is the plan of this building. The "steady" model allows to estimate roughly a level of a signal using the minimal amount of initial data about a building or city and leads to improvement of accuracy in the process of data specification. Models applied at the present moment start to work only after initial data about a lay-out of a building or city are full enough and these models do not give substantial improvement of accuracy at their updating.
The analysis of existing radio waves propagation models is performed in this paper.
The task of signal transmission between transmitter and receiver located in the random points inside the building is resolved.
New developed mathematical model of radio waves propagation inside buildings is called wave model.

Keywords: Mathematical model, propagation, radio channels.

Presenting Author's biography

Yelena Chaiko. In 2004 – Doctor of Science in Telecommunication " Mathematical models of radio wave propagation in woodland for mobile communication systems". From 2006.01.10. Riga Technical University as head researcher, Institute of Industrial Electronics and Electrical Drives. Research interests: Telecommunication systems, Electronics. Riga Technical University, 1, Kalku Street, LV-1658, Riga, Latvia, e-mail: krivcha@inbox.lv .

JOINT DYNAMICS OF FLUID AND STRUCTURE

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Abstract

The joint dynamics of fluid and structure, also known as Fluid-Structure Interaction, considered in this study, refers to piping systems conveying fluid transients. The question what is the influence of the flexible piping system on a fluid transient is not fully answered yet although it has been theoretically and experimentally widely investigated. This question is especially important for industries where transient appearance is feasible or even anticipated during the normal operation of the particular system and where failure of the piping system can cause severe accidents, releases of rare or dangerous substances or jeopardize human lives. The objective of this paper is to report new approach to simulations of the Fluid-Structure Interaction in piping systems filled with single-phase fluid (water). The basic four equations model for description of the two-way interaction between the fast transient in the fluid and axial movement of the pipe, are improved with additional four Timoshenko beam equations for description of the flexural motion (rotation and deflection). The proposed model enables simulations of any arbitrarily shaped piping system in plane. The considered coupling procedure enables full two-way Poisson and junction coupling of the fluid and structure i.e. it is possible to analyze and evaluate influence of the flexible pipe on the single-phase fluid transient. Special attention is given to applied high resolution characteristic upwind numerical method, which is based on Godunov's method. The proposed method is verified with single-phase rod impact benchmark experiment.

Keywords: Fluid-Structure Interaction, Transient Structural and Fluid Dynamics, Numerical Modeling, Nonlinear System.

Presenting Author's biography

Janez Gale. Bachelor of Science in hydrology, 2001 (Faculty of Civil and Geodetic Engineering, University of Ljubljana). Since December 2001 employed at Jožef Stefan Institute – Reactor Engineering Division, involved in research of Fluid-Structure Interaction, fast transients and fluid thermal and hydro dynamics in piping systems of nuclear power plants (thermal and mechanical relaxation), metastable states, water hammer. Ph.D student since 2003 (Two-phase flow transients and interactions with piping systems).

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IDENTIFICATION OF EXTERNAL LOAD MODELS TO SYSTEMS WITH INEXACT DESCRIPTION

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Abstract

The problem of correct choice of mathematical model of external load to dynamic system arises often at mathematical modeling of real motion of open dynamic systems. Direct measurements of these external loads are impossible as a rule. However an important question remains open if the function of external load obtained by experimental way is going to be the best model of external load. Besides that the goals of mathematical modelling are different: the modelling of selected motion of dynamic system, different evaluations of response of dynamic system (from below, from above), the modelling of the best forecast of motion of dynamic system with account of inaccuracy of the mathematical description, the modelling of the guaranteed evaluations of system responses, the maximal stable model to small changes of experimental conditions and so on. The choice of model of external load depends from goals of the use in the future.

In the given work the problem of construction (synthesis) of mathematical model of unknown external load to open dynamic system for different goals of the use at mathematical modeling in the future by the identification method is considered [1,2,3,4]. These problems are ill-posed by their nature and so the method of Tikhonov's regularization is used for its solution. For increase of exactness of problem solution of synthesis for models class the method of choice of special mathematical models is offered.

Keywords: external load, mathematical model, identification, regularization.

Presenting Author's biography

Yuri Menshikov. He is working under incorrect problems of identification of external loads on dynamic systems since 1975 year. He has a scientific degree of the Dr. of Science. He is published about 200 scientific works. The monograph "Identification of Models of External Load" (together with Prof. Polyakov N.V.) was prepared for printing by Dr. Menshikov Yu.

DISTRIBUTED AND COMPONENT ORIENTED TOOLS FOR COMMUNICATION NETWORKS USING WEB SERVICES

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Abstract

Modern communication networks are reaching a high level of complexity. As their global dimensioning and performance evaluation are very hard tasks, a multi-layer approach is generally applied to divide them in smaller problems easier to tackle. Within this approach, tools only address one or two network layers. To perform an enhanced analysis encompassing more layers, several tools, not necessarily available in the same place when the problem arises, are often required. This paper shows how to allow a remote access to various existing tools using Web Services paradigm. In this way, software components modelling network elements, layers, or computing specific functions are turned into Web Services, which are available to remote users over the internet. Accessed through a simplified interface, they can be used sequentially or in parallel to solve a specific task. This dispenses the user to perform a local implementation, allows better code reuse, and offers an easy way to confront results from distinct models. A tool accessed via a web service can be beneficial for either research or educational purposes. Moreover, making tools available on the web increases credibility and visibility of their authors. Calls to Web Service require transmitting and retrieving all input and output data in a specific format. In our approach, the Multilayer Network Description (MND) format is used to describe both input data and computed results. It offers common basic structure while guaranteeing a large extensibility, and thus eases the interactions between related but different tools. The viability of this approach in the context of network planning is illustrated through two examples.

Keywords: Communication networks, Web Service, Component Oriented design, Network planning, Collaborative Work.

Presenting Author's biography

Sébastien Rumley received M.S. degree in telecommunications engineering from the Swiss Federal Institute of Technology of Lausanne (EPFL) in 2005, after undergraduate studies in Lausanne and Zurich (ETH), and graduate studies in Lausanne and Santiago de Chile (PUC). Since 2006, he is working as research assistant at the Telecommunications Laboratory of the EPFL. His current research focuses on mechanisms improving the collaborations between geographically distributed research institutes, in the context of COST actions 285 and 291.

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SIMULATING DISTRIBUTED APPLICATIONS IN AN ACTIVE NETWORK

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Abstract

Continuous development of network architectures emphases two related characteristics: dynamic protocol deployment and utilization of free resources. Active networks present such network architecture. Unlike tradition networks, packets are superseded by capsules, which contain a custom code performing specific activities, each time a capsule visits a node. The dynamic protocol deployment involves a custom code injection at remote nodes and its subsequent execution to implement desired behavior of the network. As the custom code executes, it consumes resources such as processor, memory, bandwidth, etc. In this paper, we present a simulator of active network in use with a computation-intensive distributed application and a heterogeneous hardware. The simulator provides a virtual active network, where no application-specific behavior is coded into the network and each node closely models a behavior of a scheduler of a real, non-simulated, operating system. Into such network, we inject a virtual distributed application and observe utilization of resources available in the network. It is possible to enter a number of parameters, which affects the size of simulated network including the variety of used hardware, behavior of the distributed application comprised of thinking and waiting times, code branching probabilities, communication, migration rules and random number generators. As an example, we give an output of the simulator with input parameters, which we measured on a real, non-simulated, distributed application.

Keywords: active, network, simulator, distributed computing, heterogeneous environment.

Presenting Author's Biography

Tomas Koutny. He started his PhD on Faculty of Applied Sciences at University of West Bohemia, at the Department of Computer Science and Engineering. Nowadays, he has a full time contract at the department. His research activities are oriented toward distributed systems. His PhD thesis addresses the load redistribution in a heterogeneous environment. His current research focuses on active networking, development of active server, deployment and development of new services and protocols. This paper represents a part of his current research.

STORING AND EXCHANGING SIMULATION RESULTS IN TELECOMMUNICATIONS

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Abstract

Though storing and exchanging simulation data is a rather simple task done by simulation practitioners, it is quite often a challenge as huge quantities of data are not uncommon, and conversion between different formats can be much time consuming. After examining some of the needs of the telecommunications simulation community, we describe the architecture of a working prototype – CostGlue – to be used as a general-purpose archiver and converter for large quantities of simulation data. The software architecture of the CostGlue tool is modular therefore allowing further development and contributions from other research sphere of activity. The core of the tool – CoreGlue – is responsible for communicating with the database. It acts as a unified interface for writing to the database and reading from it. Specific functions like import and export of data and different mathematical calculations are represented as a set of self-described modules, which are loaded as necessary. The graphic user interface is introduced as a web application for the simplicity of use and effective remote access to the application. The software package CostGlue is going to be released as free software with the possibility of further development.

Keywords: simulation, measurements, data, archiving, HDF

Presenting Author's biography

Dragan Savić received his B.S. degree in electrical engineering from Faculty of Electrical Engineering, University of Ljubljana, Slovenia in 2004. He is currently a Ph.D candidate in the Laboratory for communication devices. His research interests include simulation of communication networks and data mining in the field of Telecommunications. He is a an IEEE member and a president of the IEEE student branch of Ljubljana.

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USING ADAPTIVE MULTIMEDIA MOBILE AGENT IN HETEROGENEOUS WIRELESS NETWORKS

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Abstract

The new developed mobile network generations are expected to support multimedia applications (such as video, audio stream). As such, it is important that these networks provide Quality of Service (QoS)-guarantees. QoS-availability varies from network to network. Also, QoS may vary over time on the same system, due to the need to share resources among variable number of other users. Therefore, it is important, before or during the operation of an application, to be aware of the processes by which QoS can be determined, negotiated and varied. For 4G, we introduce a concept that considers the Quality of Service requirements for multimedia communication systems, as the use of source characterization in resource allocation and the characteristics of multimedia traffic. The concept is based on multimedia mobile agent (MMA) which operates autonomy. This autonomy makes an increase in flexibility to deal with new situations in traffic load and with non-regular network, as well as, it makes a decrease of the information load on the network. This increases the robustness of the network as a whole, distributes the knowledge and allows negotiations when conflicts occur. Furthermore, the multimedia mobile agent play a major task in next mobile generation in order to overcome the wireless networks heterogeneous, and the difference in attributes between the present Generation and NextG.

Keywords: Multimedia Mobile Agent, Mobile Management, QoS-Negotiation.

Presenting Author's biography

Jamal Raiyn received the MS degree in mathematics and computer science from Hannover University in Germany, in 2000. From January 2001 to April 2002, he worked in institute for Data Communications System at the University of Siegen in Germany. Since September 2002 till now, he is a lecturer in computer science department at the Al-Qasemi Academy in Israel and he is working toward PhD degree at Leibniz Hannover University in Germany.

CROSSTALK MODELING FOR CALCULATION OF ADSL2+ DOWNSTREAM BIT RATES

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Abstract

Crosstalk is the main limiting factor in DSL (Digital Subscriber Line) transmission services; especially in cases when number of DSL transmission systems in a cable binder increases. Successful methods for decreasing crosstalk will improve reach, and bit rate of DSL systems. As well, from the spectrum management point of view, it is very important to have convenient positions of transmission systems in a cable binder, because of the way they generate crosstalk on a given DSL transmission system.

In this paper we provide calculation of downstream bit rate on ADSL2+ local loops limited by crosstalk noise. Two parameters are crucial for our calculation method: number of active ADSL2+ systems in a cable binder, and their positions inside the binder.

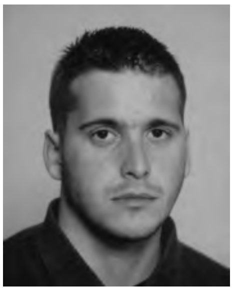
In order to calculate bit rate on ADSL2+ loops we have provided an in-depth analysis of a local telecom operator's cable infrastructure in terms of crosstalk. On the basis of measurements carried out on twisted quad cables in the frequency range from 20 kHz up to 2.2 MHz, and on twisted pair lengths between 300 m and 1700 m, we have derived theoretical models of far-end crosstalk (FEXT) and insertion gain. The measurements were performed on cables that are part of operating infrastructure, not on cables on a reel, thus providing a true insight into the situation telecoms worldwide are facing today.

Simulation results indicate that number and selection of active loops in a cable binder have a great impact on a bit rate. Presented bit rate calculation method and crosstalk models are a useful tool for planning of access network and ADSL-based services.

Keywords: ADSL2+, star quads, FEXT, insertion gain, spectrum management.

Presenting Author's biography

Vedran Mikac received the B.Sc.degree in electrical engineering in 2006 from the Faculty of Electrical Engineering and Computing, University of Zagreb at Zagreb, Croatia. Currently, he is working as a Ph.D. student and research assistant at the Department of Telecommunications, Faculty of Electrical Engineering and Computing. His interests include signal processing in communications, information theory and access telecommunication networks.



BIORID II- TOOL FOR ANALYSING REAR IMPACTS

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Abstract

In rear impacts, the risk of injuries is two times higher than in frontal impacts [1].The most frequent injuries affect the cervical spine, called whiplash. To develop car seats concerning whiplash, a dummy is required, that can show the behavior of the spine. Standard dummies for frontal crashes like the Hybrid III are not able to copy the behavior of the human spine accurately. So Denton ATD and the Chalmers University developed a crash test dummy with an articulated spine, the BioRID II Dummy. In 2006 tests with car seat had been done. The result showed that lots of seats are not able to prevent whiplash injuries. In our project a numerical model of the BioRID II was developed to improve the protective characteristics of car seats. Therefore, the whole dummy was disassembled to capture its geometry. Based on the geometrical data our BioRID II model was created. Additionally, component tests have been done to improve the behavior of the model. For Sled tests, pelvis, arms, legs and jacket have been removed so the movement of the whole spine could be showed without influence of parts connected directly to the spine. Material tests of bumpers, flesh and other parts have been used to build up adequate material definitions.

Keywords: Rear Impact, BioRID, Simulation, Whiplash

Presenting Author's biography

Andreas Rieser. He was born on April, 21st, 1979 and has studied engineering (mechatronics) at the Technical University of Graz (1999 – 2004). Then he was engaged at the Vehicle Safety Institute VSI (Technical University of Graz; 2004 - 2005). Now, he is employed at the "Competence Center- The Virtual Vehicle" in Graz (VIF) and does his PHD (in cooperation with the Technical University of Graz, VSI), that will estimated be finished in autumn 2007.

FINITE SPOTWELD ELEMENT – HYBRID TREFFTZ FORMULATION

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Abstract

It is a well known fact that the load bearing capacity of spotwelds in car bodies has a considerable impact on the deformation behaviour under crash loads, especially on the ability of energy dissipation. Therefore it is necessary to predict spotweld failure in the crash-simulation, but there is one thing, which makes it difficult. Theoretically founded stress-/strain based failure criteria are only reasonable for a sufficiently high resolution of the local stress-/strain field of the spotweld. But unfortunately the smallest dimension of finite elements in the simulation model, limited by the conventional critical time step (explicit time integration), is far from this demand.
This paper shows a way, how the local requirements can be achieved without loss of computational performance, by the development of a finite spotweld element based on the hybrid Trefftz method. The treatment is elasto-plastic, whereas the linear elastic part as well as the rigid/perfectly-plastic part is based on a special hybrid Trefftz element representing the entire spotweld, the cylindrical nugget, heat affected zone and an annulus made of base material. These two distinct models, the linear elastic and the rigid/perfectly plastic one, are combined by a rheological approach. The linking to the residual finite element mesh, consisting of bilinear standard shells, is accomplished via a displacement frame, an arbitrary polygon. By definition the Trefftz-type solution satisfies a priori all governing differential equations within the element area and fulfils inner boundary conditions. The modeling of plastic deformation accounts for geometrically nonlinear behaviour (stress stiffening) within the metal sheet annulus and permits the forming of plastic hinges along the circumference of the comparatively rigid nugget. Isotropic hardening is considered by a piecewise perfectly-plastic cascaded flow curve, leading to a high resolution of the stress/strain field in the vicinity of the spotweld nugget, and enables the introduction of accurate stress/strain-based failure criteria; especially instability due to the onset of local necking.

Keywords: Trefftz, hybrid Trefftz, spotweld modeling, spotweld failure

Presenting Author's biography

Georg Scharrer. He finished his studies of Technical Mathematics at the University of Technology Graz in 10/2006. In 08/2005 he started doing research on a Trefftz approach for steady state acoustics at ACC Graz. Since 09/2006 he is working on enhancing a model for plastic deformation of a spotweld using a Trefftz formulation at The Virtual Vehicle Competence Center.

THE DEVELOPMENT OF A 3D-NAVIER-STOKES CODE FOR THE SIMULATION OF AN AIRBAG INFLATION

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Abstract

In the field of vehicle development, numerical simulations are essential due to the complexity and the high costs of full scale crash tests. Hence, numerical methods are used for the development and optimization of restraint systems (belt pretensioner, airbags, etc.). The numerical simulation of an airbag inflation is very time consuming because the volume enclosed by the airbag is dynamic and such complex surfaces are generated. The aim of this work is to develop a robust, stable and fast algorithm for handling the fluid structure interaction problem in airbag inflation. The mechanical structure problem is solved with commercially available finite element software. A three dimensional Navier-Stokes-Code for compressible fluids is developed to solve the fluid mechanic problem. For this purpose, an explicit TVD upwind method by Roe is implemented. For reasons of stability, a fixed rectangular grid is used. The outer contour of this grid adjusts automatically to the surface of the airbag during the calculation. The contour adjustment is achieved by blocking off the outer cells, which can be switched on or off as the airbag surface passes by. To provide a conservative system during the contour adjustment, a special method for the handling of the boundary was developed. For the validation of the developed method, analytically solvable examples were used. These analytically solved solutions were compared with the numerically calculated solutions. To verify the suitability of the developed method, an airbag inflation was simulated.

Keywords: airbag, fluid-structure interaction, fixed rectangular grid, moving boundary, 3D Navier-Stokes-code.

Presenting Author's biography

Wolfgang Sinz was born on the 28th December of 1976 in Bregenz (Austria). He studied mechanical engineering at the Graz University of Technology, graduating in June 2003 with honours. In working toward his diploma thesis at the Vehicle Safety Institute, he became acquainted with fluid structure interaction. Continuing his research in the field of fluid structure interaction, Wolfgang Sinz finished his PhD on the numerical simulation of airbags in February 2007 with honours. Currently he is working as an assistant lecturer at the Graz University of Technology.

NEW DEVELOPMENTS FOR MODELING CONNECTED PARTS OF THE BODY IN WHITE: SPOT WELDING AND ADHESIVE BONDING IN CRASH SIMULATIONS WITH LS-DYNA

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Abstract

The increasing demands with regard to the predictive capabilities and the exactness of crash simulations require more and more investigations into numerical models in order to capture the physical behavior reliably. Steps towards this goal are the usage of finer meshes which allow for a better geometrical representation and more sophisticated material models which allow better prediction of failure scenarios. Another important playground towards improved crash models is the area of connection modeling. Validation in this area is usually closely related to very detailed models which cannot be easily translated into a crash environment due to time step restrictions. Therefore, representative substitute models have to be developed and foremost validated. Different test setups are used for verification and validation. For validation of the developed procedure T-section component tests are generally used. The aspect that failure of the connections has to be considered as well adds another dimension to the complexity of the task. Here a new failure envelope has been developed and implemented into LS-DYNA.
The present paper highlights the conflict between predictive capability, capture of physical reality and numerical manageability. Another aspect of the paper is the attempt to raise the awareness of the topics verification and validation of numerical models in general. This concept is illustrated using latest developments for modeling of spotwelds and adhesive bonding in LS-DYNA.

Keywords: LS-DYNA, Crash Simulation, Spotwelds, Adhesives, Failure, Explicit Finite Element Method.

Presenting Author's biography

André Haufe studied civil engineering at the Universities of Stuttgart, Germany, and Calgary, Canada. He holds a Ph. D. of the University of Stuttgart in the field of computational mechanics and is lecturer at the Institute of Statics and Dynamics for Aeronautical Structures (ISD) at the same University. After a one year post-doctoral research in Canada he joined DYNAmore in 2002. His interests are in the fields of constitutive models, modeling techniques and the forming-to-crash simulation process chain. Dr. Haufe is currently appointed the position of Manager Process Engineering at DYNAmore GmbH.

A NOVEL VIRTUAL DEVELOPMENT PROCESS FOR SIDE IMPACT AT MAGNA STEYR BASED ON NUMERICAL SIMULATIONS VERIFIED BY COMPONENT TESTING

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Abstract

Increasing demands for reduced development costs and timeframes have resulted in a growing need for numerical simulations to facilitate the vehicle development process. The use of simulations is shifting towards the early design phases, a practice also known as "frontloading." This reduces the need for expensive, complete-car prototypes.
Previous complete-vehicle development projects at MAGNA STEYR included one or more generations of prototype vehicles. In terms of side impact requirements, each prototype generation was developed using numerical simulations and knowledge gained from crash tests performed on previous prototype generations.
For a recent project the company decided to cancel prototypes, especially for side impact, and to develop the car using virtual design tools. The challenge was to release parts and serial tools based on results from numerical simulations. Since the accuracy of the numerical simulations would no longer be verified by crash tests, there was a serious risk that serial parts and tooling would require subsequent, high-cost modifications if crash tests with pre-production cars did not show the same results as the simulations.
For this reason, a new development approach based on previous R&D projects was introduced. It consists of a single, numerical Finite-Element-Method (FEM) model, used for both the design of the Body-in-White (intrusion characteristics of the side structure) and the optimisation of the restraint (occupant simulation); relevant experiments on prototype parts and parts from other car models with similar designs and materials; and simulation models of these component tests, which are validated against the test results.

Keywords: Side Impact, Crash Simulation, Virtual Development Process, Sled Test, Impactor Test

Presenting Author's biography

Arno Eichberger is assistant at the Institute of Automotive Engineering, where he is preparing his habilitation thesis. Prior to this appointment he was employed at MAGNA STEYR, where his duties included involvement in several car development projects, especially in the design of side impact protection restraints using CAE methods.

ON AN ONTOLOGY OF SPATIAL RELATIONS TO DISCOVER OBJECT CONCEPTS IN IMAGES

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Abstract

This work tackles the problem of object concept detection in the domain of robot vision. Autonomous robots are supposed to navigate in unknown environments, facing objects that have appearances the robot has never seen before. As a concept of an object we define the collection of necessary properties (philosophically speaking, the thing-in-itself), which is often *not* (only) its appearance but could be any combination of properties (e.g. shape, function, etc.). As a first implementation, we therefore use only a qualitative description of the spatial relations of the parts that make up an object concept. This qualitative information is stored in an ontology that is used for checking relations of object parts found in the robot's camera images. An additional technique used in this approach is abstraction: Abstracting several connected parts to a bigger one leads to a reduction of the overall number of participating objects. Therefore, the specific instance of the object concept found in the image is reduced to its defining high-level shape, which in turn complies to the definition stored in the ontology. One of the tackled questions is therefore how specific the object concept is to be defined in the knowledge repository. We show that with this approach we can discover a column or an arch that is made up of an arbitrary number of parts.

Keywords: Object Concept Detection, Part Ontology, Perceptual Grouping, Robot Vision, Abstraction

Presenting Author's Biography

Matthias Schlemmer. Born in 1979 in Vienna, Matthias Schlemmer studied electrical engineering at the Vienna University of Technology with focus on computer science. Since 2002 he is also studying philosophy at the University of Vienna. After receiving his master's degree in electrical engineering in 2004, he started working on his PhD at the Institute of Automation and Control as a project assistant. His research interests comprise robotics and computer vision as well as related cognitive and philosophical aspects.

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DESIGN OF EXPERIMENT FOR QUALITATIVE EQUATION DISCOVERY: A COMPARISON

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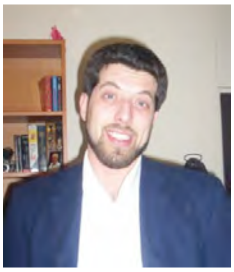
Abstract

In the latest years, the research in the field of equation discovery focused from quantitative to qualitative model discovering. This requires a different design of experiment and only a few techniques are currently available to learn qualitative models. Among them random design is still the most adopted for qualitative analysis. This work proposes a methodology to adapt effective experiment design techniques for quantitative discovery to the qualitative field. The proposed methodology can be described as an incremental design technique, where the learning of the qualitative model is a cyclic refinement process. At each cycle, the methodology focuses the new experiment in those areas of the design space which are less covered by the previous experiment and where the current model exhibits a lower performance.
In this work, the proposed methodology is applied to alphabetic optimal and latin hypercube designs. An evaluation of the efficacy of the proposed solution applied to the two design techniques with respect to a random design is proposed within a robotic application. The performance of the design are assessed by means of a new index called E-Index based on the qualitative model extracted from the full design space. This new index is able to distinguish between the performances of the experiment design and of the learning algorithm.

Keywords: Qualitative Equation Discovery, Design of Experiment, Optimal Design, Coverage Design

Presenting Author's Biography



Federico Di Palma received the Laurea degree in Computer Engineering in 2002 and the PhD degree in 2006 from the University of Pavia. He was the recipient of the 2006 Best Doctoral Thesis Award from the IEEE Test Technology Technical Council. He is currently collaborating with the Universities of Pavia and Verona (Italy). His research deals with fault diagnosis for semiconductor manufacturing, neural networks, model predictive control and experimental design.

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Q-POLE: A QUALITATIVE PREDICTION-OBSERVATION LOOP FOR LEARNING BY EXPERIMENTATION

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Abstract

An agent that learns by experimentation is bound to have a model of the physical world based on a set of hypotheses that allow to predict the future state of the world, or the result of certain actions. Significant deviations or contradictions between predicted and observed results can be used to refute the model and trigger a revision of the hypotheses.
For detecting these deviations we propose a mechanism called *Q-POLE* which stands for Qualitative Prediction-Observation loop for Learning by Experimentation. The *Prediction Engine* of this loop uses a qualitative model of the world to predict temporal states of the system. For this, attributes and their domain, start state, elementary behaviors and the stop criteria of the model are defined by using Qualitative Differential Equations (QDEs). These QDEs are then used to generate a qualitative state tree called *behavior tree* which consist of the possible temporal states that the system can attain. The Prediction Engine uses these behavior trees for generating the qualitative prediction, while the *Observation Engine* performs an online comparison of this prediction and the observed numerical data. The data used by the observation engine is supplied by a visual sensor which monitors the environment and thus reflects the results of the agents actions.
In this paper we present and discuss the results of first experiments with Q-POLE that established and tested the thresholds for some simple real-world setups with a rolling and bouncing ball.

Keywords: Learning by experimentation, prediction, observation, qualitative simulation, Qualitative Differential Equations, behavior trees, temporal abstraction, surprise.

Presenting Author's Biography

Timo Henne was born in 1974 in Kiel, Germany. He received his diploma in computer science from the University of Bonn in July 2005. In his diploma thesis supervised by the Division of Neuroinformatics he developed an adaptive action selection mechanism based on an internal value system for an autonomous mobile robot. He is currently employed by the University of Applied Sciences Bonn-Rhein-Sieg. The current focus of his work within the EU project XPERO (FP6-IST-29427) includes internal value systems, hypothesis revision, knowledge representation and design of experiments.

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AUTOMATED MODELING IN A ROBOT-OBJECT DOMAIN

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Abstract

Obtaining a useful model in a given domain depends on the complexity of the model, the learning algorithm, and on the input data. While a specific task limits the choice for the model and the algorithm, the required quantity and distribution of the data could be less well defined, and may in turn be dependent on yet to be determined model parameters. To explore the weak points of an unreliable model, we introduce a data collecting agent, guided by the model. The agent must be able to cope with little data and unreliable model, to collect new data required to improve the model. This paper presents an algorithm, inspired by adaptive robot controllers, that uses local models and strategy search based on measured progress to efficiently collect data required to improve the model of the domain. The algorithm is tested in a simple robot-object domain used in the European project XPERO, which is about autonomous discovery through robot's experiments in its environment.

Keywords: Modeling robot environment, Robot-object domain, Shifting setpoint algorithm, Locally weighted learning, Action planning.

Presenting Author's biography

Sunil Sah. Sunil Sah is a student at the Faculty of computer and information science. He is interested in AI and machine learning, and has been doing research in the Faculty's AI Lab within the European project XPERO.

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DISCRETE EVENT SIMULATION OF THE PHARMACEUTICAL SYSTEM

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Abstract

This paper presents a new framework for simulation and modeling of pharmaceutical system. Discrete event simulation was employed. Discrete event formalism, one must specify basic models from which larger ones are built and how these models are connected together in hierarchical fashion. The basic models are defined by the structure of the set of external input event types, the sequential state set, the set of external event types generated as output, the internal transition function dictating state transitions due to internal events, the output function generating external events at the output, and the time advance function. To specify modular discrete event models requires that adopt a different view than that fostered by traditional simulation languages. As with modular specification in general a model should be viewed as possessing input and output ports through which all interaction with the environment is mediated. As a case study the medicine transport in the human body was used. An effective model for medicine transport simulation was developed and corresponding parameters were defined. Operation was simulated with derived simulation models. Simulation was carried out for various conditions. Steady state and unsteady state metabolite behaviors were simulated. The obtained results in this paper can be applied in the others engineering domain.

Keywords: Internal transition, Medicine, Biotransformation, Metabolite behavior.

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COMPLEX SYSTEM FOR COGNITIVE PRODUCTS MODELLING

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Abstract

A many number of modelling and simulation systems have been developed to aid in process and product system engineering. In this paper on the model development side, the issues of knowledge representation in the form of systematic composition, ontology, and quantity representation were derived. On the model analysis side issues involving the automatic evaluation and presentation of simulation results. As case studies several networks plant-services-products-markets were used. Simulation was carried out for various distribution centers self organization. Uncertainly materialization objectives were defined and than simulation and evaluation were performed. Input data bases are linked with routines which realized heuristic algorithms and scenarios for customer satisfaction. The results are stored in a database for further use. In the analysis and products planning simulation various models and conditions were included. The cognitive model forecasted the future behavior of the product and services system. This work is illustrated network products management system with decision product design and operation support system interface develop methods, tools, and techniques for developing the overt user interface, user knowledge, help of a facilities, coordinating interface event with its functionality events. The obtained simulation results have shown advantages cognitive models with semantic networks. The obtained results in this paper can be applied in the others domain.

Keywords: Semantic networks, Products manager, Meta models, Interface system.

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PROCESS PLANT KNOWLEDGE BASED SIMULATION FOR DESIGN AND MANUFACTURING

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Abstract

This paper presents an integrative framework describing concept techniques to particular knowledge engineering problems to be ivolved for process simulaton. Modelling the production of many products can be used as a valuable design and manufacturing tools. One of the most interesting and ecouraging trends in process simulation is its use in many more of the total range of activities concerned with process plant design and operation. This paper describes multipe model purposes to simulate reality. It many years since process simulation become a standard tool for design work in most companies. They need technology which at the design stage allows them to evaluate operating strategies, perform optimization, evaluate control system performance and subsequently gain full benefit in manufacturing. The best feed for for the plant considerring issues such as feed cost, product quality and current product value in the market were analyzed to design of the plant. As a case study a plant of sweet slurry for aromatiziring drinks, from starch was used. The obtained results of the sequential modular approach simulation from unit operation to unit operation were illustrated of the best quality for slurry using for different products.

Keywords: Designer, Optimizer, Multipurpose simulation, Knowledge based technology.

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PROCESS ESTERIFICATION AND PRODUCT QUALITY SIMULATION

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Abstract

A process model for esters production was developed and corresponding parameters were determined. The synthetic esters production with apple and lemon smelts: ethyl-acetate and three-ethyl-citrate are simulated. The system approach which permits the evaluation of feasibility and operations integration, always for predicted behavior of the process was used. Generic data of kinetic parameters was developed as a relational data base which linked kinetic models and operation simulation. The integration procedure was generated and ranked data base kinetic parameters and kinetic models which define product quality changes. Reaction operation with distillation operation were simulated with derived mathematical models. The product quality object function was examined to find the best feed of reactants. Simulation was carried out for various operation regions, conditions and product quality. Operation makes history data of manipulates and object variables, and performs dynamic simulation. Steady state and unsteady state process behaviors were simulated. The startup and product process period were examined. The operation of the process esterification was analyzed to identify optimum conditions. The obtained simulated results have shown high quality of the product and with in a good agreement with experimental data.

Keywords: Simulation model, Analyzer, Product quality simulation, Advanced numerical methods.

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INTEGRATED SOFTWARE ENVIRONMENT FOR BIOPROCESS SIMULATION

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Abstract

In development of the software applications object oriented transformation method was used. The objects of complex bioprocess are modeled by heterogeneous program packages. This development dynamics of the engineering program packages directly incorporated in software applications. Program components were generated with MathCAD program package. The new generating program components were integrated in MathConnex environment. MathConnex is a stable explorer for visual integration of heterogeneous program packages at creation the continual simulation. MathConnex totally integrates components generated by program packages MathCAD, Matlab, Excel and Axum and use program languages ConnexScript, VBScript and Jscript. The integration level may be enhanced with decreasing of a number used program packages. As a case study ethanol fermentation with free and immobilized cells *S.Cervisae* were simulated. In this paper, the bioprocess of ethanol production was simulated simultaneously with designing software applications. The complex bioprocess was decomposed to the object level by combination of the operational, transformational, and objection access. The complete plant model was then used to perform supply optimization, in which alternatives were evaluated. Several strategies were examined to find the best feed for the plant considering issues such as feed cost, product quality, and current product value in the market, and to analyze the operation of the plant to identify the optimum conditions under which to operate the plant. A simple economic objective function was defined. The obtained examples demonstrated there is a growth in the application of simulation as part of plant management. To perform on-line simulation the simulator needs to be interfaced to the plant to receive and transmit data.

Keywords: Object-oriented approach, Software development, Simulation model, Integrated environment.

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MODELING OF COUNTERCURRENT HEAT EXCHANGERS

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Abstract

A heat exchanger is a device in which energy is transferred from one fluid to another across a solid surface. The base for elaboration of control systems is knowledge of static and dynamic characteristics of heat exchangers. This paper includes equations described heat exchange in countercurrent flow heat exchangers. The first Law of Thermodynamics, in rate form, applied to a control volume (CV) between crosses 1 – 1 and 2 – 2 is used. Taking the energy balance formula as a basis and dividing the heat exchanger into sections, the thermal balances of the cooled fluid, plate and heated fluid are prepared and pertinent system of three differential equations is derived. The ε -NTU method is used in the analysis.
Exemplary temperature profiles in steady state conditions are presented in a graphic form. Transfer functions and dynamic characteristic are determined. Values of temperatures in individual sections countercurrent flow exchangers could be computed using presented method of calculations. Response on step disturbance of inlet temperature is found. Responses on step or on sin disturbance of inlet temperature in steam condensation heat exchangers are found too.

Keywords: countercurrent heat exchanger, thermal balance, temperature profile.

Presenting Author's biography

Mariusz Adamski is a Doctor of Technical Sciences. He has finished Post Graduate Studies at Polish Academy of Sciences, Institute of Fundamental Technological Research in Warszawa. He works as senior lecturer at Faculty of Civil Engineering and Environmental Engineering, at Białystok Technical University, Poland.
Mariusz Adamski is member of Polish Society for Computer Simulation. His main area of interest is numerical modeling and optimization of heating and hot water systems.

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SIMULATION OF POWER FLOWS IN CROATIAN POWER SYSTEM

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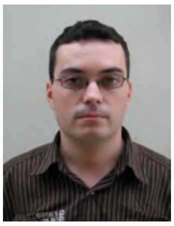
Abstract

This paper presents a practical and valid computer model of the Croatian electric power system using PowerWorld Simulator 11.0. The complete Croatian electric power system is plotted in the PowerWorld single line diagram. Required parameters for transmission lines, transformers, generators and loads are entered in the computer model. All input data are obtained from the Croatian electric company HEP. The power system is divided into five control areas: control area 1 (Croatia), control area 2 (Hungary), control area 3 (Slovenia), control area 4 (Bosnia and Herzegovina) and control area 5 (Serbia). In this way, the created computer model is used to simulate power flows in the Croatian electric power system for 2005.

Two sample cases are simulated. The first is the single solution of power flows when electric system is at its peak load (March 2 2005 in 8:00 PM). The second case is the time step simulation of power flows for every hour in 2005 year. Simulation results are presented as charts for all relevant elements of the Croatian electric power system. In order to evaluate credibility of the electric power system model, the computer model is compared with real measured values for energy losses in the model and energy losses that are measured in the real system. Consumed electric energy, peak load, losses that are obtained from the simulation are comparable with those from the official HEP web pages. The Croatian electric power system created in this paper can be used for further research such as fault analysis, energy interchange, power system planning etc.

Keywords: Computer model, power system, Time step simulation, power flows

Presenting Author's biography



Krešimir Fekete (kfekete@etfos.hr) was born on August 28, 1983. in Osijek. He obtained his diploma degree in 2006. in field of Electrical Power Engineering from the Faculty of Electrical Engineering, J.J. Strossmayer University in Osijek, Croatia. His graduation thesis was ˝Simulation of power flows in Croatian power system using PowerWorld 11.0 software˝. Currently he works in the Power System Department within the Faculty of Electrical Engineering, University in Osijek.

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SIMULATION STUDY OF A PULSED CORONA DISCHARGE BY MEANS AN ELECTRICAL MODEL

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Abstract

A model, structured as an equivalent electric circuit and its application in the simulation study of a pulsed corona discharge in the pre-arcing regime are presented. The discharge is actually produced within a coaxial cylinder reactor by means of a system based upon 1 kHz plasma discharges intended for water treatment. The proposed computational model takes into consideration the three main mechanisms of the process: (a) the relevant physical characteristics of water, (b) the ionisation and expansion phases in the spark channel, which includes the near-breakdown electric current generated by the change of the effective capacitance and resistance, and (c) the energy associated with this initial spark in the water. Considering this, a coaxial reactor and an inexpensive and compact high voltage pulsed power supply system were designed and constructed with the purpose of producing the pulse corona discharge experimentally. The coaxial reactor is constituted by a cylindrical chamber endowed with a straight central rod, the system operating within the 100-2000 Hz frequency and 0-30 kV amplitude ranges. The experimental outcome is compared with the simulation results in order to validate the model and to approach the evolution of the pulsed discharges experimentally observed. The measurement of the simulated discharge current turns to be fundamental in establishing the external networking requirements. This current value is also particularly useful to determine the design characteristics of water purification system components.

Keywords: Plasma modelling, pulsed corona discharge, streamer, plasma.

Presenting Author's biography

Samuel R. Barocio received his PhD degree in Physics from the University of Manchester, UK, in 1997. He has specialised in Plasma Physics modelling and data interpretation with particular interests in near integrable systems and frequency analysis.

MATHEMATICAL MODEL OF A DIELECTRIC BARRIER DISCHARGE IN ATMOSPHERIC PRESSURE HELIUM SUPPLIED BY A MULTICELL INVERTER

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Abstract

A dielectric barrier plasma discharge (DBD) in helium at atmospheric pressure is modelled in the case of a parallel plate reactor supplied by a multicell voltage source inverter, which, in this case, is composed by three commutation cells, whereby it is called a three cell inverter (TCI). The novelty of the present study lies in simultaneously simulating: (a) the power supplied by a static converter distinct from a linear amplifier, (b) the coupling transformer response and (c) the discharge behaviour itself. The main aim of such a simulator is developing a comprehensive MATLAB®/Simulink model of the archetypal discharge within two flat parallel electrodes separated by a narrow gap. These are covered with a thin dielectric coating which is electrically represented by a capacitor. The plasma discharge is simulated by a voltage controlled current supply that is activated as soon as the gas breakdown voltage is surpassed. The discharge is modelled by a *V-I* exponential dependence characterised by a factor α, in turn, dependent on the Townsend ionisation coefficients. Specifically produced experimental results validate the theoretical predictions of the model which can be adjusted in order to include discharges in other gases, predicting the respective optimised experimental conditions.

Keywords: DBD, multicell VSI, plasma system model, voltage controlled current source, voltage current exponential dependence.

Presenting Author's biography

Samuel R. Barocio received his PhD degree in Physics from the University of Manchester, UK, in 1997. He has specialised in Plasma Physics modelling and data interpretation with particular interests in near integrable systems and frequency analysis.

FINITE ELEMENT ANALYSIS OF CRACK INITIATION IN PARTIALLY ELECTRODED PZT TRANSDUCERS

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Abstract

Piezoelectric transducers have been used in wide applications range. The transducers frequently fracture under high electric fields in many applications. The most efficient geometry for some transducers has the disadvantage of electrodes ending inside the ceramic. There are maximum magnitudes of electric field on the electrodes boundary and it cause a stresss concentration. A stress concentration due to boundary of electroded and nonelectroded parts is the consequence. High mechanical stresses at these regions lead to crack initiation and crack propagation and finally to the fault of the transducer. An initiation of cracks by stress concentration during the first poling cycle in partially electroded PZT's is investigated. There was chosen a circular partially electrode specimen. The focus is laid on the electrode shape and placement influence to crack initiation. The most interesting part is optimization of electrode shape to minimizing a stress concentration. Mathematical analysis of electric and elastic fields is very efficient tool for improvement of parameters of piezoelectric transducers. This work is based on finite element method, possibilities of ANSYS package are used. Our results show, that the proportions of electrodes are very important parameters of partially electroded transducers. Important parameters are placement of electrodes and their shape. These results are based only on electric field analysis. Piezoelectric effect and spontaneous deformation are neglected.

Keywords: finite element method, piezoelectric transducers, crack initiation, optimization

Presenting Author's Biography

Josef Novak. He obtained PhD degree in Electrical Engineering from Technical University of Liberec, Czech Republic. He is currently Research and Educational Secretary of Institute of Advanced Technollogies at Technical University of Liberec. His research is focused on modelling of technical processes and systems.

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TRAINING SIMULATOR FOR ANALYSIS OF ENVIRONMENTAL CONSEQUENCES OF ACCIDENTAL RADIOACTIVITY RELEASES

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Abstract

The paper presents software system HARP designed for fast assessment of radiological consequences of accidental releases of radionuclides into the living environment. Transport of activity is studied from initial atmospheric propagation, deposition of radionuclides on the ground and spreading through food consumption towards human body. Corresponding model of atmospheric dispersion and advection based on segmented Gaussian plume approach is formulated which can approximately account for release dynamics and short term meteorological forecast. Implemented numerical difference scheme enables to approximate simulations of important parent-daughter pairs formation. Subsequent deposition processes of advected admixtures and food chain activity transport are modeled. The deterministic estimation based on radiation doses resulting from external irradiation and internal activity intake is applied. The product is presented here from viewpoint of its utilization such a training tool for decision support staff. User-friendly interface for input definitions of the task is offered both for atmospheric dispersion and ingestion parts. Interactive graphical subsystem enables to present wide range of results. The algorithm is logically partitioned to time-consuming early stage analysis of accident and interactive late stage consequence estimation. The concept of alternative options and accounting for variability is implemented in the deterministic version described here. Alternative options are offered to user for testing the effect of variability of some input parameters thus providing decision-making staff to improve their perception of the problems.

Keywords: Harmful releases, model predictions, irradiation pathways, user-friendly SW

Presenting Authors' biography

Petr Pecha: Senior researcher. Experience in modeling of random temperature fields in fast reactor fuel assemblies. Development of software tool for PSA LEVEL 3 analysis. Cooperation on customization of the RODOS system. Author or coauthor about 50 reports.

Radek Hofman: Graduated in informatics on the Faculty of nuclear sciences and physical engineering in Prague (2006), now PhD student in the field of assimilation of model predictions with observations in terrain.

Emilie Pechova: Safety analysis in Nuclear Research Inst., division Energoprojekt. She cooperates on HARP architecture development, code verification and application in the fields of radiation protection.

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BOND GRAPH-BASED FAULT DIAGNOSIS STRATEGY APPLIED TO THE THREE-PHASE INDUCTION MOTOR

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Abstract

Bond Graph has been used extensively in engineering applications for modeling and simulation of many kind of dynamical systems. Interaction between different domains can be explicitly expressed and cause-effect (causality) is well established by using this modeling tool. In this work, Bond Graph is employed for fault diagnosis in order to precisely find the fault on the system and at the same time, to well simulate the system dynamics. The methodology utilizes three principal stages (topographic search): causal graph, fault tree, and temporal causal graph. These stages are activated by qualitative values from the fault detection module when the fault appears. In order to obtain an effective fault diagnosis strategy, behavioral information about the parametric faults is employed for locating the specific fault. Sets of observations representing the abnormal state of the system are used as search templates to find a matching set in a library of known symptoms related to different abnormal system conditions (symptomatic search). In this way, an integrated strategy for faults diagnosis is proposed. All this information can be obtained from the same Bond Graph model, which allows an effective way for simulation of the treated system. The application is on the three-phase induction motor, six faults related to the winding phases are considered (short-circuit and open-circuit faults). Simulation results are presented in order to show the satisfactory results obtained.

Keywords: Fault detection, fault diagnosis, Bond Graph, three-phase induction motor, modeling and simulation.

Presenting Author's Biography

Brian M. González-Contreras. Was born in México, D.F. in 1976. He received the M.Sc. degree in Electronics Engineering from the National Center of Research and Technological Development (CENIDET), México. From 2003 he was appointed permanent lecturer at the Autonomous University of Tlaxcala. Currently he is pursuing the Ph.D. degree in the Centre de Recherche en Automatique de Nancy at Nancy University, France. Research interests are currently focused upon the design of fault tolerant control systems, fault diagnosis and modeling of engineering systems.

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FROM PSEUDO-MOS TRANSISTOR TO A SOI-MOSFET WITH A NANO-CAVITY

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Abstract

The devices miniaturization pushes the SOI (Silicon On Insulator) technologies to some ultimate manufacturing techniques: buried oxides with a thickness spectrum from 400nm in the standard HTA SIMOX, down to tens of nm in Unibond technique. The paper comparatively presents the simulations of the electrical characteristics for a pseudo-MOS transistor and finally for an ultra-thin SOI transistor with a cavity. The influence of interface charges is accounted. If this charge is more important at upper interface in classical transistor with 200nm Si-film in insulator, the simulations reveal a higher contribution of the bottom interface charge in the nanotransistor case. The I_D-V_{DS} characteristics with minimum, provided by specialty software, describe a transition way from SOI devices toward Semiconductor On Insulator nanotransistors. A SOI nanotransistor with a cavity was proposed. The global current is a superposition of a tunnel current through the cavity and an inversion current at the film bottom. The tunnel source-drain current prevails in sub 1-nm film thickness and provides the I_D-V_{DS} characteristics with a minimum. For film thickness comprised between 200-10nm, the I_D-V_{GS} curves preserve similar shapes with a classical MOS/SOI's transfer characteristics.

Keywords: Transistors simulations, tunnel modeling, SOI, electrical characteristics

Presenting Author's biography

Cristian Ravariu. A short professional biography. Mr. Cristian Ravariu was born in Bucharest, Romania, in 1968. He studied in Bucharest, where he obtained the engineer degree in 1993, at Politehnica University of Bucharest, Faculty of Electronics and Telecommunications, Microelectronics Department.

He worked from 1993 to 1998 as Researcher at Institute of Microtechnology, Bucharest and from 1999 to this moment as Lecturer at Politehnica University of Bucharest.

In the last two years, due to the increasing interest in the nanotechnologies and stable and unstable quantum matter fields and due to his links with semiconductor physics, microtechnologies he researched these domains. A special passion for devices with biomedical applications, possible modeling in the living cells, he focused the efforts toward nanodevices and biodevices.

TESTING OF OPTIMAL FISHING EFFORT FOR SARDINE IN THE EASTERN ADRIATIC USING SYSTEM DYNAMICS

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Abstract

In this paper Schaefer production model of sardine in the Adriatic Sea is presented using System dynamics methodology. Production models are very simple but they can be good approximation for complex behavior dynamics of biological systems. Sardine population is chosen due to its great economic importance to Croatian fishing. In this paper, Schaefer (1954) production model was used due to lack of appropriate biological data for any other model. The qualitative and quantitative models of observed sardine population have been developed. Different scenarios are made; using available biological data for sardine in the Adriatic Sea. Total fishing effort in relation to stock under exploitation is an essential parameter in the policy of sustainable marine resources management. Using Schaefer and Fox production models (Alegria–Hernandez, 1983), gave some optimal value for the fishing effort for sardine in the eastern Adriatic. Those values are tested using System Dynamics and obtained results are compared. Modeling and simulation enables testing of different exploitation scenarios without endangering sardine real population. The results of testing lower and upper limit for fishing effort (Scenario 1a and 1b) are shown in this paper. Although, available biological data give range of optimal fishing effort it is evident that upper limit reduce sardine biomass below initial state, while lover limit enables increase of sardine biomass.

Keywords: Schaefer production model, sardine population, The Adriatic Sea, System dynamics

Presenting Author's biography

Gorana Jelić-Mrčelić was born on January 24th 1973, Croatia. In January 1996 she acquired the degree of Bachelor of Science in Fishery Sciences at Marine Faculty Split. In June 1996 she acquired the degree of Engineer of Maritime Traffic – Nautical Studies. In July 2000 she acquired the degree Of Master of Sciences at Faculty of Agriculture, University of Zagreb. In November 2004 she acquired PhD in fishery science at Faculty of Agriculture, University of Zagreb. She works at Faculty of Maritime Studies Split, University of Split from June 1996. Now she is senior assistant.
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ALGORITHM FOR THE REFERENCE TEMPERATURE CALCULATION IN BUILDINGS

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Abstract

In the paper an algorithm for the reference temperature calculation in building rooms is presented. Algorithm works in such a way to changes the reference temperatures and start times for cooling or heating of the rooms when they are not occupied and before the occupancy. Algorithm is tested on the simulated building model by using the well-known TRNSYS software. The building model consists of six thermally coupled rooms with different occupancy and considers the most important thermal characteristics. Simulations are performed for the cooling and heating of the rooms using the weather data of the city of Portorož. Results obtained with the proposed algorithm are also compared with the results that are achieved with the constant reference temperature changes and start times. Comparison is made with regard to the energy consumption for cooling and heating of the rooms and according to the violations of the maximal temperature rise time and occupancy times. Results show that the main advantage of the proposed algorithm is its ability to automatically adjust the reference temperatures and start times to the optimal values in contrast to the manual setting, which is hard to perform in practice.

Keywords: Buildings, Simulation, Temperature control, Energy consumption, Thermal comfort.

Presenting Author's biography

Darko Vrečko is a postdoctoral associate at Jozef Stefan Institute, Department of Systems and Control. He received a B.Sc. degree in 1998 and Ph.D. degree in 2003, all at University of Ljubljana, Faculty of electrical engineering. Since 1998 he is employed at Jozef Stefan Institute. His expertise includes modelling and simulation of wastewater treatment processes, feedforward-feedback control, Smith predictor, model predictive control, benchmark simulation model. Recently he has been involved in projects dealing with scheduling of batches in a production process and control design for energy savings in buildings. He participated in COST 624 and 5th Framework project SMAC. Within European Community's Human Potential Programme WWT&SYSENG project he spent six months at Lund University of Technology as a postdoctoral researcher. He is author or co-author of 12 papers in international scientific journals.

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LARGE SCALE TRAFFIC NETWORK SIMULATION - A HYBRID APPROACH -

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Abstract

In this article an extension of a hybrid model is presented. Up to date, hybrid models offer good theoretical solutions but are not able to simulate real road network. Indeed, all simulation scenarios are done on a hybrid section composed of two macroscopic sections and a microscopic one. The aim of this paper is to adapt the previously developed hybrid model in order to consider a wide area network including many macroscopic and microscopic sections. Thus, a real flow data will be tested and reliability of hybrid model will be proved. After being validated, one can profit from hybrid approach advantages like; combined traffic flow control (microscopic and macroscopic regulation), simulation of wide area network without taking into account the data processing resources, resolve problem of scale representation in the traffic flow domain and so on. This paper present a hybrid approach founded on the paradigm agent. Each section (macroscopic or microscopic) is represented by an agent that communicates with others in order to ensure conservation and continuity principles of traffic flow. To validate this approach, the results of a hybrid section simulation are compared with those of macroscopic section. Thus, we can show that the actual scheme transmits simultaneously the boundary conditions between the coupled models and translates correctly the information at interfaces.

Keywords: Paradigm agent, traffic flow, hybrid approach, simulation.

Presenting Author's Biography

Mohamed Saïd EL HMAM has received his Ph.D. degree in Computer Science and Automatic in December 2006, from the University of Artois in Béthune, France. He is actually Research Engineer with the Computer Science and Automatic Control Laboratory (LGI2A) of University of Artois. His research interests include multiagent systems as simulation tool applied to transportation systems.

SIMULATING TRACTOR'S STATIC STABILITY IN RELATION TO ITS POSITION ON A SLOPE

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Abstract

Agricultural machinery, tractors in particular, is one of the main causes for fatal accidents in the agriculture. Despite a decrease in the number of fatal accidents during the last 15 years, it is still high, with the average of 34 fatalities per year. Most accidents happen when a tractor overturns. Safety systems to protect the tractor driver in case of an overturn have softened the consequences to a certain degree, however, they have not reduced the number of accidents. A detailed analysis of problems and causes, leading to a tractor overturn have revealed that by improving tractor's static stability we can positively influence the safety as early as during the concept phase. We designed a mathematical model and a numerical simulation for the static stability of a tractor with an oscillating front axle in relation to its position on a slope. It was followed by analysing the changes of individual parameters, such as the position of the centre of gravity, the wheelbase, the wheel track width and the height of the oscillating axle mounting point, and their impact on tractor's static stability in relation to its position on a slope. Results show that manipulating these parameters can significantly increase tractor's static stability. A better static stability is directly proportional to improved dynamic stability, resulting in a better safety in view of a tractor overturn, particularly while working on a sloping terrain.

Keywords: Static stability, tractor, analysis, mathematical model, simulation.

Presenting Author's Biography

Ivan Demšar was born in Kranj, Slovenia, on April 12, 1978. He received a BS in mechanical engineering design from the Faculty of Mechanical Engineering in Ljubljana in 2002. Since September 2002 he has been a research assistant at the Faculty of Mechanical Engineering's LECAD laboratory. His research work is mostly oriented towards image processing and model building. His interests also include agricultural machinery.

A FUNDAMENTAL STUDY FOR ACUPUNCTURE TECHNIQUE ANALYSIS

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Abstract

It is believed in oriental medicine that there are some special points called acu-points, and meridians connecting acu-points, existing in the human body. Accordingly, acupuncture is such to cure or keep the human body healthy by stimulating related acu-points. Acupuncture was originated from ancient China with the typical Chinese thinking and special philosophy, and recently has been accepted as a useful curing method, attracting quite much interest and being studied by many medical institutions world wide.

The basic motion of stinging into the skin in acupuncture is called insertion. A precise insertion with little pain requires high techniques, obtained only by repeated training and experience. That is, the insertion technique has been learnt mainly from experience, so there has hardly been quantitative analysis in the literature. In this study, a training computer simulation system for acupuncture training was proposed for the purpose of a quantitative characterization of the traditional oriental technique. A measurement system using a high-speed camera was constructed to record and analyze the basic motion data of insertion such as velocity, angle, and trace. The characterization of insertion was done, and fundamental data for the development of such an education computer simulation system was obtained.

Keywords: Acupuncture, Training system, Insertion, Quantification of technique.

Presenting Author's biography

Dr. Chen obtained the degree of Doctor of Engineering in 1994 in the Department of System Engineering, Nagoya Institute of Technology (NIT) Japan. She has been working as a teaching stuff in NIT since 1994, and is presently an associate professor of NIT. Dr. Chen's research interests include such as medical engineering, human interface, virtual reality technology, and computer education/training systems.

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NUMERICAL SIMULATION OF A PLATE-GAP BIOSENSOR WITH AN OUTER POROUS MEMBRANE

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Abstract

A plate-gap model of a porous enzyme doped electrode covered by a porous membrane has been proposed and analyzed. The two-dimensional-in-space mathematical model of the plate-gap biosensor is based on the reaction-diffusion equations containing a nonlinear term related to the Michaelis Menten kinetics of the enzymatic reaction. The developed model involves four regions: the enzyme layer where the enzymatic reaction as well as the mass transport by diffusion take place, the porous membrane as well as a diffusion limiting region where only a mass transport by diffusion takes place, and a convective region, where the analyte concentration is maintained constant. Assuming the porous membrane as the periodic media, the homogenization process was applied to the domain of the membrane and it was modelled as a homogeneous diffusion layer with an averaging diffusion coefficient. Using numerical simulation of the biosensor action, the influence of the geometry of the outer membrane on the biosensor response was investigated at wide range of analyte concentrations as well as of the reaction rates. The numerical simulation was carried out using the finite difference technique. The mathematical model as well as numerical solution were validated using analytical solutions existing for very specific cases of the model parameters. The behaviour of the plate-gap biosensor was compared with that of a flat electrode deposited with a layer of enzyme and covered with the same outer membrane.

Keywords: Simulation, Modelling, Reaction-diffusion, Biosensor, Porous membrane.

Presenting Author's Biography

Feliksas Ivanauskas. He graduated from the Moscow State University in 1969, where he received his PhD in mathematics in 1974. In 1992 he received the Doctor Habilitus degree from the Institute of Mathematical Modelling, Russia. Now he is a professor (1992), a corresponding member of the Lithuanian Academy of Sciences, the head of the Department of Computer Science II at the Vilnius University and a principal researcher at the Department of Numerical Methods at the Institute of Mathematics and Informatics. His research interests are numerical methods for nonlinear PDE and mathematical modelling.

FUZZY ELLIPSOIDAL TECHNIQUES TO INVESTIGATE NECKING PHENOMENA IN METALLIC SHEETS

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Abstract

Non-Destructive Testing in the field of defects identification in metallic elements plays a remarkable role with special regard to those sectors where the integrity of the material is strictly required. As a consequence, the detection of defects and discontinuous deformations in metallic plates and bars, together with the relevant shape classification, provides to the operator useful information on the actual mechanical integrity of the specimen. When solid-solid-phase transformations are being studied, the loss of uniqueness in the solution, together with the relevant fragmentation of the strain fields inside the solid can be observed, the equilibrium coming out as a solution represented from a fine mixture among phases. In this paper, firstly, a theoretical characterization of a mono-dimensional model with respect to the computational aspects are presented. Then, a comparison is done with data from an experimental non-destructive investigation technique based on the eddy current principle. Finally, a novel approach to solve the inverse problem by means Fuzzy Ellipsoidal Inference Systems is proposed. In particular, Mamdani's Inferences have been taken into account to investigate the local discontinuities of the metallic specimen subject to plastic deformations due to phase transformations when applying experimental mono-axial traction. After that, the stress field, which wouldn't be otherwise measurable, can be calculated just applying the relevant constitutive law.

Keywords: Phase transformation, interfacial energy, fuzzy approach, eddy currents.

Presenting Author's biography

Michele Buonsanti. Degree in Architecture, and specialized in Computational Mechanics of Materials and Structures, is Research with The Department of Mechanics and Materials of the Faculty of Engineering at the University of Reggio Calabria. He is author and co-author of many scientific papers in the field of mechanics of materials particularly, biomechanics, microstructure and variational elasticity.

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SIMULATION OF ENERGY DEVELOPMENT SCENARIOS IN LATVIA ON REGIONAL LEVEL

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Abstract

Up to now the development scenarios of Latvian energy and fuel balance were mainly designed for the national level. However in the regional level there are significant differences both in energy consumption and fuel resources used. For the simulation and comparison of different energy development scenarios, MESAP (Modular Energy System Analysis and Planning) software, allowing making calculations at national and regional level without changing the structure of the model, was used. To perform a detailed regional modelling, Latvia was split in 6 regions, each having a separate forecasted electricity, thermal energy and fuel final consumption. For the regional modelling, similar RES structure to overall Latvian energy balance development options simulation was used. Three development scenarios in the regional level have been simulated: base scenario (I), scenario of maximal use of renewable energy resources and domestic energy resources (II) and maximum production of electrical energy and fuel diversification scenario (III). The choice of scenarios can be substantiated with a necessity to promote usage of renewable energy resources, as well as with decrease of electricity imports proportion in the energy balance of Latvia. The simulation results show, that the increasing demand of energy can be covered in several ways – by continuing to import power, maximally using the renewable and local energy resources, as well as using coal and biomass mix for the production of electricity.

Keywords: Modelling, Simulation, Energy, Regional.

Presenting Author's biography

M.sc.ing. Sergejs Vostrikovs obtained the engineer honours degree on the specialization power system in 1998 and the scientific degree of the master of engineering sciences in the field of mechanics and engineering (in 2001) at the Riga Technical University (RTU) in Latvia. Sergejs Vostrikovs is currently an explorer of RTU Department of Heat and Power Engineering. The research interests include analysis and prognosis of consumption of energy and fuel sources in Latvia.

DETERMINING THE OPTIMAL OPERATING POINT OF AN INDUCTION GENERATOR

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Abstract

The work deals with a wound rotor induction machine operating as a generator. A wind or water turbine is normally mounted to its shaft. The rotor winding is fed by a voltage source inverter while the stator winding is connected to the electric grid. Optimal operating points of the system consisting of an induction generator and voltage source inverter are evaluated by a stochastic search algorithm called differential evolution. The optimization objective is to find operating points with the best efficiency of the system as a function of the shaft speeds and delivered mechanical power. In order to perform the optimization a magnetically nonlinear two-axis induction machine model oriented with the magnetizing current vector is applied. The same mathematical model of induction machine and the same optimization method is used for determining the optimal operating points of the same machine operating as an induction motor. The proposed method is appropriate to be applied in the systems, where the same induction machine feed by the voltage source inverter is applied as a generator and also as a motor. The magnetic nonlinear behaviour of the discussed induction machine, operating as a generator and as a motor, is accounted for by the current dependent flux linkage characteristic. Voltage and current limits of the induction machine and voltage source inverter are used as optimization bounds. The optimization is performed in the program package Matlab.

Keywords: Induction machine, generator, Nonlinear two-axis model, Optimization, Differential evolution.

Presenting Author's biography

Silvo Ropoša received his diploma degree in Electrical Engineering from the University of Maribor, Faculty of Electrical Engineering and Computer Science, in 2004. Since 2004 he has been working as network planner in public company for electricity distribution Elektro Maribor d.d. Currently, he is a postgraduate student at the University of Maribor, Faculty of Electrical Engineering and Computer Science. His research interests include electromagnetic phenomena in nonlinear circuits, optimization of generators for small power plants and connecting small power plants to the public networks. He is involved in the research work of the research group for Electromechanical systems control at the Faculty of Electrical Engineering and Computer Science in Maribor.

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MODELLING REAL-TIME RISK MANAGEMENT SYSTEM

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Abstract

This paper addresses modeling real-time risk management system. Risk assessment is a very important decision tool for investments to support business. When it comes to money no business wants to pay for anything that it does not need, that's why risk assessment has it's significance. If organization analyzes risks, it has to employ a very experienced people which may lead to excessive expenses.

To make risk management effective a solution proposed is real-time risk management system that collects alerts and log files from different systems and based on experience, gained from the previous analysis, analyzes risks. To improve overall security, risks must be analyzed at least once a day for an important systems, but as the matter of fact risk management is time and recourse consuming, usually it is done once a year for each information system. An automated real-time risk management system will solve the problem and there will be no unnoticed vulnerabilities.

A proposed solution for real-time risk management is using unified threat management system which provides alerts and log files for analysis and decision making.

If all possible vulnerabilities and threats are put in count, system will be able to make right decisions how to minimize risk very quickly, which will save information systems from threats exploiting vulnerabilities and will save money.

Keywords: Risk, risk management, real-time risk management, effective risk management, neural networks.

Presenting Author's biography

Vladislavs Minkevics. Working in Ministry of Finance of Latvia as a security manager for five years. Studying information technology. At the moment working on dissertation project. A member of ISACA (Information Systems Audit and Control Association). Have a CISA (Certified Information Systems Auditor) recognition.

ENABLING TOOLS AND TECHNIQUES FOR THE OPTIMIZATION OF THE HERACLES SIMULATION PROGRAM

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Abstract

Simulations conducted on high-performance, massively parallel mainframes have become a central tool in the study of astrophysical plasmas. HERACLES is a radiation hydrodynamics program used in particular to investigate turbulences in interstellar molecular clouds. In the framework of the COAST engineering project conducted at Saclay, a special effort has been undertaken to provide enabling tools and techniques for the HERACLES program, including the development of a multiple-grid approach to overcome spatial resolution limitations, optimization and parallelization methods, data handling facilities and visualization tools. COAST (for Computational Astrophysics) is a CEA/DAPNIA project dedicated to high performance computing in astrophysics. The originality of the project is the collaborative work of astrophysicists and software engineers with the aim to develop common tools and techniques for different independent astrophysical simulation programs. In particular, the techniques of multiple-grid and interlocked meshes are being developed in the finite volumes HERACLES program; these developments rely on parallelized algorithms for which optimization is pursued. The SD*vision* graphical interface, implemented in the framework of IDL object programming, is also presented, as the visualization tool for analysis of the computation results.

Keywords: Simulation, Data handling, Astrophysics, Visualization.

Presenting Author's biography

Valérie Gautard. Doctor in Applied Mathematics, Valérie Gautard launched her career on shape optimization in aeronautics at Aerospatiale and ONERA, before joining in 1999 the DAPNIA 'Laboratory of research into the fundamental laws of the universe' at CEA/Saclay as a research engineer. She was involved in the LHC/ATLAS experiment at CERN, as a developer of the muon detector software. She is now member of the COAST project (Computational Astrophysics), committed to the development of numerical methods in finite volumes astrophysical simulation codes. Furthermore, she is a teacher in computing at the University of Marne-la-Vallée for Master degree students.

A DYNAMIC NUMERICAL MODEL OF TRANSMEMBRANE VOLTAGE INDUCEMENT AND ELECTROPORATION ON IRREGULARLY SHAPED CELLS

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Abstract

We recently presented a method for constructing realistic three-dimensional numerical models of irregularly shaped cells from their cross-section fluorescence images. The model enables the calculation of the steady-state value of the induced transmembrane voltage (ITV) on the same cells on which an experiment was carried out. This model was now extended to allow also the calculation of dynamic changes of the ITV. The results of calculations were first verified by comparison to the dynamic analytical solution for the ITV on a spherical cell, and a good agreement was obtained. To model the process of electroporation, the model was modified to allow also the changes of electric conductivity of the cell membrane. The calculations were performed on a model of a spherical and an irregularly shaped cell. In both cases, a time dependent increase of membrane conductivity was observed, but only in the regions of the membrane where ITV exceeded a threshold value. In the regions of elevated membrane conductivity the ITV decreased with time and its spatial distribution was changed, and these changes are in agreement with literature. The regions of increased membrane conductivity, calculated for the model of irregularly shaped cell, corresponded to experimentally observed regions of molecular transport. Both models, the dynamic model of the ITV and the model of electroporation, can be exploited further to study the behavior of more complicated cell systems.

Keywords: finite elements modeling, induced transmembrane voltage, irregularly shaped cells, electroporation

Presenting Author's biography

Gorazd Pucihar was born in Ljubljana, Slovenia in 1976. He received the Ph.D. degree in Electrical Engineering from the University of Ljubljana, Slovenia, and the Ph.D. degree from the University Paul Sabatier, Toulouse III, France.
His research work is focused on experimental investigation and numerical modeling of the process of electroporation. He is currently employed as a Research Associate at the Faculty of Electrical Engineering, University of Ljubljana.

AUGMENTED REALITY BASED TECHNOLOGIES FOR SUPPORTING ASSEMBLY WORK

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Abstract

This paper presents a methodology and a system for augmented reality aided assembly work. We concentrate in particular on the requirements on information processing and data flow for implementing augmented assembly systems in real life production environments. A pilot case with an augmented assembly task at the Finnish tractor company Valtra is described. The system is emulated with a simplified assembly task, a 3D puzzle, as a demonstrator and as a test-bed to evaluate different means for augmented assembly setups.

The growing number of product variants, shorter life-cycles, smaller lot sizes and accelerated time to market of products has increased demands on production equipment and concepts. In order to master these challenges, innovative approaches and technologies are required. The performance of existing production techniques is often insufficient. As a solution to this problem human integrated approaches are proposed. The idea is to combine human flexibility, intelligence and skills with the advantages of sophisticated Augmented Reality systems. Such systems have many benefits for human workers and enterprises. The 3D puzzle emulates a simplified assembly task in a factory, and is used to study how to implement the augmented assembly system to a real setting in a factory. Preliminary system evaluation results are presented, the user experience is discussed and some direction for future work are given.

Keywords: Augmented reality, assembly work, assembly instruction, CAD/CAM

Juha Sääski (Lic. Tech) is a research scientist at VTT, where he has been working since 1989. He received Master degree in 1987 and Licenciate of Technology degree in 1994 at Helsinki University of Technology in Mechanical Engineering. He has been working in many areas of product development methodologies and tools. He contributed both as a researcher and/or project manager to a number of national, and international projects involving product data management and CAD/CAM-systems. His special interests are product data standards and simulation based design process. Juha Sääski has authored or co-authored over 50 publications.

VERIFICATION OF CONTACT MODELING WITH COMSOL MULTIPHYSICS SOFTWARE

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Abstract

Contact analysis is a major concern in many applications such as metal forming, projectile impact, electrical relay, and addresses often multi-field effects (thermal, electromagnetic…). Due to the nonlinearity and difficulty in predicting the behaviour of the bodies coming into and go out of contact, we need software able to simulate a structural contact problem and couple it with other physics. The last version 3.3 of COMSOL Multiphysics allows the analysis of multiphysics contact problem and appears to be interesting. Being new and under development, COMSOL 3.3 needs therefore to be validated in terms of contact modeling. Only the cases of frictionless problem are considered. A static contact Hertz model and a model containing a rigid-flexible contact and a flexible-flexible contact are studied and describe the capabilities, advantages, originalities and drawbacks of COMSOL. A good user interface and the capabilities to couple all physics with facilities make attractive the software. However, contact algorithm implemented in COMSOL doesn't allow the resolution of all contact problems. The more evident, like a Hertz contact can be solved efficiently with a reduced computational time. A problem containing an initial gap between two deformable surfaces requires more computational costs and solver fails to find a solution easily. The user has to spend enough time to set up the contact parameters. But it isn't always evident to check these parameters to optimise the solution accuracy and the time of resolution. More investments have to be provided to improve the contact algorithms and to facilitate the user to choose the contact parameters.

Keywords: Mechanical Contact, Augmented Lagrangian method, penalty factor, Hertz contact, convergence

Fabienne Pennec received the mechanical degree engineering from ENSMM, Besançon, France in 2005 and is currently pursuing the PhD degree in LAAS-CNRS and in collaboration with the CNES, in reliability of low actuation voltage RF MEMS switches.

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NUMERICAL SIMULATION OF NEWTONIAN AND NON-NEWTONIAN FLUIDS IN CHANNEL GEOMETRIES

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Abstract

This paper deals with a numerical solution of laminar incompressible steady flows of Newtonian and non-Newtonian fluids. Geometrically different parts of the cardiovascular system are taken into account, for instance bifurcations of vessels or a bypass of a restricted vessel. Only channel geometries with rigid walls are used to model previously mentioned parts of the cardiovascular system. Blood flow is considered to be Newtonian in the case of vessels of large diameters as aorta. On the other hand, with decreasing diameter of a vessel the non-Newtonian behavior of blood can play a significant role. One could describe these problems using Navier-Stokes equations and continuity equation (see [1]). In the case of Newtonian fluids one considers constant viscosity compared to non-Newtonian fluids where viscosity varies and can depend on the tensor of deformation. The model used for non-Newtonian fluids is a variant of power-law. In order to find numerical solution, the system of equations is completed using artificial compressibility method. Its principle is based on addition of the time derivative of pressure divided by a specific constant into the continuity equation (see [2]). The space derivatives are discretised using the cell centered finite volume method. An arising system of ordinary differential equations is solved using explicit multistage Runge-Kutta method with given steady boundary conditions. This way one can find steady solution of unsteady system. The numerical results for two and three dimensional cases of Newtonian and non-Newtonian fluid flows in different geometries are presented and compared.

Keywords: Finite Volume Method, Navier-Stokes equations, Newtonian fluids, Non-Newtonian fluids, Runge-Kutta method.

Presenting Author's Biography

Vladimír Prokop. Postgraduate student at the Czech Technical University (CTU), Faculty of Mechanical Engineering, Department of Technical Mathematics. He achieved master degree in mechanical engineering specialization in applied mechanics at CTU in 2002. His graduation thesis was engaged in numerical solution of flows in bypass geometry. He has attended Diploma Course in the Von Karman Institute in Belgium in 2006/07.

SEISMOMETER CALIBRATION: REMOTE NUMERICAL PROCEDURE APPROACH

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Abstract

A typical seismic station of the Slovenian National Seismic Network is equipped with a Quanterra Q730 data- logger and a broadband Güralp CMG 40T seismometer. While the producer of the seismometer guarantees long term stability of the sensor transfer properties a question regarding this guarantee arises. That is the reason why the calibrations of sensors need to be performed periodically. Typical parameters for broadband seismometers are damping and its natural period. For CMG 40T seismometer the natural period is 30s and the damping factor is 0.707. In order to control the stability of the seismometer it is sufficient to evaluate these two parameters only. A computer software tool has been developed which starts calibration on request and automatically analyzes the seismometer`s output signal. This task is performed telemetrically using the step calibration signal built in Quanterra 730 data-logger. A reconstruction filter used to set up a smooth analogue signal from the output of a DAC causes that step-type excitation function rises to its maximum value in a finite length of time τ, having a value around half of a second. The rise time affect the result. Another disadvantage using the built-in calibration signal is that start time of the calibration signal is unknown.

The algorithm for the precise determination of the corner period and damping for seismometer using step calibration pulse is developed which does not require the exact data regarding the start time and amplitude of the calibration pulse and also allows non-ideal step calibration signal with unknown rise time, e.g. much lover than sampling time. The algorithm is not very sensitive in the high-frequency range of the seismic noise and in the presence of the long-period portion of seismic noise the error can be estimated as well. The above procedure is useful in modern digital seismological system and allows fast and simple regular verification of the stability of seismometer`s transfer properties.

Keywords: seismometer, step calibration.

Presenting Author's biography

Izidor Tasič is currently working at the Environmental Agency of the Republic of Slovenia, at the Office of Seismology and Geology. He received the MSc degree in 2000 from Faculty of Mechanical Engineering and university degree from Department of Physics, Faculty of Mathematics and Physics, both at the University of Ljubljana.

PLASTIC DEFORMATION OF ALUMINUM BONDING WIRE IMPRESSED BY WEDGE BONDING TOOL

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Abstract

Plastic deformation of aluminum bonding wires during the bonding process is investigated using the Finite Element Method (FEM) and compared to experimental results. The analysis is focused on the wedge bonding process of 250μm diameter aluminum wire. This study is performed on a three-dimensional (3D) FEM model using ANSYS, which includes the bonding wire, bonding tool and the underneath bonding pad. In the simulation setup, high emphasis is put on the wire modeling, however the bonding tool and the underneath pad are simplified. The overall geometry has a quarter dihedral symmetry which leads to reduced simulation time. The bonding tool is made up of carbide material, which is very stiff and therefore is considered as a rigid body. The considered material properties include the available plastic behavior for aluminum. In order to simulate the bonding process, a displacement constraint is applied to the bonding tool. The change of the bonding wire shape, the material displacements in the wire, and the distribution of plastic strain were investigated. The simulation results agree well with the experiments. The results of current study help us toward further understanding in reliability of power semiconductor products. They are also to be used in further thermo-mechanical simulations of power semiconductors.

Keywords: FEM, bonding process, aluminum wedge, plasticity

Presenting Author's biography

Vladimír Košel. 2003 graduated in electrical engineering at Slovak University of Technology (STU) in Bratislava. He started his PhD in 2003 at STU, and worked on reliability of Smart Power Switches at Infineon Technologies in Villach, Austria. Since 2006, he is continuing his PhD project at Kompetenzzentrum Automobil- und Industrie-Elektronik in Villach, Austria

MODELLING DAMPING EFFECTS IN VEHICLE-TRACK INTERACTION

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Abstract

It is a well-known fact that railway activities inevitably generate vibrations in the track structure and the sub-ground, which may have negative effects on the surrounding environment and constructions.
Because of the very serious effects that unwanted vibrations can have on dynamic system, it is essential that vibration analysis be carried out as an inherent part of their design; when necessary modifications can easily be made to eliminate vibration or at least to reduce it as much as possible. It is usually much easier to analyze and modify a structure with undesirable vibration characteristics after it has been built.
However, it is sometimes necessary to be able to reduce the vibration of existing structures brought about by inadequate initial design, by changing the function of the structure or by changing the environmental conditions, and therefore techniques for the analysis of structural vibration should be applicable to existing structures as well as to those in the design stage.
In general present-day structures often contain high energy sources which create intense vibration excitation problems. The level of vibration in a structure can be attenuated by reducing either the excitation, or the response of the structure to that excitation or both. It is sometimes possible, in the design stage, to reduce the exciting force or motion by changing the equipment responsible, by relocating it within the structure or by isolating it from the structure so that the generated vibration is not transmitted to the support.
In this paper we analyze the effect of the vertical damper on the global system vehicle-wheel-track when, load and empty conditions appear in vehicle. A final comparison is carried-out among damping and undamping vehicle systems.

Keywords: railway track, damping, vibration.

Presenting Author's biography

Michele Buonsanti. Degree in Architecture, and specialized in Computational Mechanics of Materials and Structures, is Assistant Professor with the Department of Mechanics and Materials of the Faculty of Engineering of the University of Reggio Calabria. He is author and co-author of many scientific papers relative to mechanics of materials particularly, biomechanics, microstructure and variational elasticity.

MODEL-BASED PRODUCTION CONTROL

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Abstract

Business environment demands an instant replay to different influences that appear in the production process and in the global market. The synthesis of plant-wide control structures is recognized as one of the most important production-management design problems in the process industries. To develop a production control system, an appropriate model of the production process is needed to evaluate the various control strategies. Within the model different production Key Performance Indicators (KPIs) can be identified which are used to extract the relevant information about the state of the production process. The control systems in production plants are structured hierarchically into several levels. Closed-loop control at the production-management level using production KPIs as controlled variables was implemented. In this article, the procedural model of a polymerization production plant is presented. The plant can be controlled by its input variables, which are *Production speed*, *Raw materials' quality* and *Batch schedule* and the efficiency of the production is determined based on three characteristic KPIs: *Productivity*, *Mean product quality* and *Mean production costs*. These KPIs are used to control the process of the procedural model. To help the manager with the decisions a model predictive controller (MPC) was used. With the controller it is assured to keep *Productivity* and *Mean product quality* indicators at the defined set-points. Preliminary results show the usefulness of the proposed methodology.

Keywords: Production management, Performance measurement, Production control, Closed-loop control, Model predictive control.

Presenting Author's biography

Dejan Gradišar. Dejan Gradisar received his B.Sc. and Ph.D. degrees in electrical engineering from the University of Ljubljana, Slovenia in 2001 and 2006, respectively. He is currently working as a researcher at the department of Systems and Control, Jozef Stefan Institute, Ljubljana. His currently research interests are in the area of information technology in control systems.

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MODEL-BASED DESIGN OF EMBEDDED SYSTEMS USING MATHWORKS TOOLS – A CASE STUDY

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Abstract

A model-based development environment for simulation and automatic code generation had been developed using the MathWorks' products *Simulink* and *Real-Time Workshop Embedded Coder*. The main goal of the work was to create an environment for seamless integration of simulation and real-time operation. The simulation target is the MITMOT, a modular platform consisting of a 32-bit ARM-based microcontroller and some custom I/O peripherial developed at the Dept. of Measurement and Information Systems of the Budapest University of Technology and Economics.
The eCOS embedded real-time operating system has a MITMOT ARM target specific version. In this project, our aim was to present an easily usable graphical modeling environment which can be used to model the MITMOT target, and the C code automatically generated from the model would run under eCOS.
The development consisted two main parts: the first was to create models of the different I/O units in the Simulink environment using S-functions, while the second was to write the TLC (target language compiler) files which are responsible for the C-code generation. With our tool the time to develop embedded software for the MITMOT target has been reasonably reduced, and since the environment is fully graphical, the C programming skill requirements for software development to this target became unnecessary.

Keywords: Model-Based Design, Simulink - Real-Time Workshop, code generation, modeling embedded system, eCOS.

Presenting Author’s biography

Laura Fábián was born in Budapest, Hungary, in 1983. She received the M.S. degree in technical informatics from the Budapest University of Technology and Economics (BUTE), Budapest, Hungary, in 2007. Currently, she is a Software Developer at Ericsson Hungary Ltd. Her research interests are in the areas of embedded systems and sensor networks.

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NEURAL MECHANISMS ON SELF-OTHER DISCRIMINATION BASED ON VISUAL AND PROPRIOCEPTIVE FEEDBACKS

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Abstract

How we discriminate self from others is crucial for social cognitive psychology, as well as for real-world technological applications, such as interactive robots. We consider that co-occurrence of proprioceptive and visual feedbacks is important in this process. The parietal cortex in the human brain has often been considered to be the region where proprioceptive and visual information of one's own body are integrated. In this study, we conducted neuroimaging experiments to investigate parietal role in self-other discrimination. Further, based on the obtained results, we proposed a neural model for self-other discrimination. In the experiments, we examined the parietal cortical activity during a visual-proprioceptive synchrony judgment task in which visual feedback of passively moving one's hand was delayed (86-319 ms, at 33 ms intervals). The subject judged whether there was a delay between visual and proprioceptive feedbacks or not. The parietal cortical activity was measured by a 48-channel near-infrared spectroscopy (NIRS) apparatus. The threshold of delay for the synchrony judgment (50% point) was about 190 ms. Neuroimaging results demonstrate that the activity in the parietal cortex was modulated by the delay between visual and proprioceptive feedbacks of passively moving one's own hand and was consistent with subjective judgment. We then proposed a model for self-other discrimination, where visual and proprioceptive feedbacks are integrated into the self-body representation in the parietal cortex based on the temporal consistency between these feedbacks.

Keywords: Neural mechanism, Neuroimaging, Self-other discrimination.

Presenting Author's biography

Sotaro Shimada. My current research interest focused mainly on the neural mechanisms of social cognition. I use neuroimaging techniques to investigate brain activity related to social cognition. Topics of my interest include self-other discrimination, imitation, multi-sensory integration, self-consciousness, theory of mind and communication. I am also specialized in computational modeling, especially in machine learning. Now I apply computational modeling techniques to human higher cognitive functions to understand its mechanisms more precisely.

IMPLEMENTATION OF SIMULATION PROCESS UNDER INCOMPLETE KNOWLEDGE USING DOMAIN ONTOLOGY

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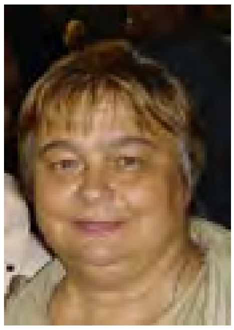
Abstract

The problem of complex systems (information systems, computer networks, for example) analysis under uncertain conditions is discussed. This situation arises because of model incompleteness. Usually the behavior of some simulation model elements is unknown. The paper considers an ontology-based approach for the incomplete simulation model analysis and its automatic completion. A behavior procedure for the undefined element is searched for in special database and included in simulation model. The paper considers the method of model completion, namely, introduces the concept of a “semantic type” and some conditions that should be fulfilled for an appropriate behavior procedure to be chosen. The base ontology of simulation model representation is discussed and the choice of language OWL is explained. The presented example shows the process of simulation model automatic completion, illustrates the use of semantic type and additional conditions. The paper is concluded by describing the programming tools which provide an ontology-based automatic completion of partly described simulation model in simulation system Triad.

Keywords: Simulation, ontology, simulation model uncertainty, automatic completion, Triad.

Presenting Author’s biography



Elena Zamyatina is an Associated Professor of Computer Science at Perm State University, the lecturer of Mathematical Department. Her research interests include simulation as well as parallel and distributed systems. She received a Ph.D. degree in Information and Computer Science in 1993. She has over 25 years of professional experience in programming tools design, particularly in simulation domain. She is the author of over 60 papers in the area of simulation, distributed simulation, parallel and distributed systems.

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