EUROSIM 2010

7th EUROSIM Congress on Modelling and Simulation

September 6–10, 2010, Prague, Czech Republic

Edited by
Miroslav Šnorek
Zdeněk Buk
Miroslav Čepek
Jan Drchal

CSSS

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Vol.1: Book of Abstracts

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Preface

EUROSIM Congress, the most important modelling and simulation event in Europe, is taking place this year in Prague, the capital of the Czech Republic. Local Organizing Team made an effort to prepare the event, which would be at least as successful as those in the past: Capri (1992), Vienna (1995), Helsinki (1998), Delft (2001), Paris (2004) and Ljubljana (2007).

The EUROSIM Congress is organized every three years by a EUROSIM society member. Czech and Slovak Simulation Society has been honoured to organize the Congress in 2010.

The International Programme Committee is happy to present to the modelling and simulation scientific community 182 contributions from more than 250 submitted extended abstracts. This proves that although modelling and simulation is a traditional discipline, it is permanently interesting and attractive. The presented contributions show wide range of applications and research possibilities and they are closely connected with many of modern and the most developed disciplines.

Invited Plenary Talks will be presented in Prague by 5 outstanding experts. They will open the scientific program every morning.

The scientific programme of the EUROSIM Congress will run in 4 parallel tracks. This allows that 178 contributions to be presented in oral form and organisation 1 poster session. All contributions were assigned by the International Programme Committee to one of 37 sessions (including 11 Special Sessions). Congress Proceedings consists of two volumes Vol. 1: Book of Abstracts and Vol. 2: Full papers (CD).

Local Organizing Committee would like to express its gratitude to all who helped in the congress preparation. Special thanks deserve session organizers and reviewers.

We hope that your participation at the 7th EUROSIM Congress will be unforgettable. Let our Congress will be both scientifically and socially productive.

Miroslav Šnorek
Chair of the EUROSIM Congress

Mikuláš Alexík
President of EUROSIM

Miroslav Čepek
Chair of the Local Organizing Committee

Prague, August 2010

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The Chairs of the 7th EUROSIM 2010 Congress want to gratefully thank to:

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Borut Zupančič

and many others for contribution to organisation of the EUROSIM 2010 Congress by reviewing of papers, advices and support.

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Abstracts

DEVELOPMENT OF THE SIMULATION SOFTWARE PACKAGE TEST POERF RAW

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Abstract

In contributions [1, 2, 3] there are presented the basic possibilities of simulation program Test POERF. This program serves to simulate functions of the range channel core of the passive optoelectronic rangefinder (POERF). It allows verifying the quality of algorithms for a target slant range finding from taken stereo pair images of the target and its surroundings. These images are generated by a special images generator in the program as a virtual reality. The actual contribution presents consequential simulation software package Test POERF RAW which works with taken images of a real scene. The package presently consists of three separate programs: the editing program RAWedi, the main simulation program RAWdis and the viewer RAWpro. The editor RAWedi allows editing of stereo pair images of individual targets and supports the creation of a Catalogue of Targets. The simulation program RAWdis serves for testing algorithms for estimation of horizontal stereoscopic disparity which are convenient for the use in POERF. Simulation experiments can also help to solve problems in the development process of the software for a future POERF prototype.

Keywords: Passive optoelectronic rangefinder, target slant range, stereo pair images, stereoscopic disparity, simulation software package Test POERF RAW.

Presenting Author's biography

Vladimír Čech. He was born in 1953. In 1977 he graduated from the Brno Military Academy; Ph.D. – the Brno Military Academy 1983, associate professor – the Brno Military Academy 1989; habilitation in the field: the Military Technology – the Weapons and Ammunition – the Brno Military Academy 1993. Since 1983 – teacher at the Brno Military Academy; since 1991 – head of the department; since 1994 – Vice-Rector – at the Military Academy in Brno, since 1998 – General Director of the Personnel and Social Policy Department of CR DoD, since 2002 – Management and Consultancy Services in the field the Weapons Systems, Educations and Personnel Systems. Since 2003 he has worked on the projects of the POERF research and development.

IDENTIFICATION OF LONGITUDINAL AND LATERAL DYNAMICS OF AN ULTRALIGHT AIRCRAFT

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Abstract

Most aircraft can be considered as rigid bodies whose motion is determined by a set of forces due to aerodynamic effects, propulsion and gravity. Their dynamics can thus be described by computing the position and velocity of the center of gravity as well as the orientation and angular velocity of body-fixed axes with respect to a set of earth reference axes. The dynamic equations of motion are well–known so that aircraft modeling leads to very accurate results provided that an equally accurate knowledge of the aircraft parameters and of the acting forces is available. This information is, however, seldom available particularly for light or ultralight aircraft. The alternative to modeling is identification; the practical application of identification techniques is however conditioned by the choice of the class of models (often linear), the design of suitable data–gathering experiments and by the final validation of the obtained model i.e. by the evaluation of the degree of approximation of its description of the real process. This paper describes the identification of the longitudinal and lateral dynamics of an ultralight aircraft and shows that the consistency of the obtained descriptions can heavily depend on the considered class of models. In particular, it is shown that traditional equation-error approaches relying on ARX or those relying on Output Error models can prove unreliable while the less known ARX+noise models can give very consistent results.

Keywords: Identification, Aircraft dynamics, ARX+noise models.

Presenting Author's Biography

Roberto Guidorzi. Roberto Guidorzi holds the chair of System Theory at the University of Bologna since 1980. He has been visiting professor 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. His present research interests concern errors–in–variables identification and filtering, blind channel equalization, aircraft modeling and control and development of e–learning environments.

GENERAL DESCRIPTION OF WRF-FIRE MODEL, APPLICABLE TO BULGARIAN FOREST FIRE DATA

Nina Dobrinkova, Mariana Vassileva

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Abstract

Wildland fires are dangerous phenomena that wipe out vast areas with forests every year and can cause loss of life. The final result is miles of burned area, some of which protected zones with rare species of the flora and fauna. The known methods are mostly focused on different aspects of fire propagation, with seldom incorporation of weather influence on the fire spread. The WRF-Fire model is giving the opportunity of combining the meteorological and environmental factors responsible for full description of the fire behavior. A wildland fire interacts with the atmosphere dynamics through fluxes of momentum, water vapor, and heat, as well as with the soil through moisture and heat retention. Data do not come as exact coefficients and initial and boundary conditions for the model variables. Instead, various quantities only indirectly linked to the model variables are measured at discrete points spread over time and space, and the data are burdened with errors.

Keywords: Environmental modeling, Wildland fires, WRF model, WRF-Fire module.

Presenting Author's Biography

Nina Dobrinkova is a PhD student in the Institute of Mathematics and Informatics and a researcher in the Institute of Information Technologies, Department Decision Support Systems, and both institutes are part from the Bulgarian Academy of Sciences. Nina is doing her research in the field of Environmental modeling with main focus on systems for early warning in case of natural hazards like forest fires, flood events and landslides.

Mariana Vassileva is an associate professor in the Institute of Information Technologies, where she is head of the Decision Support Systems Department. Her main field of investigation is systems with multicriterial analysis with affiliation to early warning systems with application in dissastermanagement.

EVIDENCE-BASED MATHEMATICAL MAINTENANCE MODEL FOR MEDICAL EQUIPMENT

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Abstract

Measuring the availability of medical equipment based on various maintenance types has been a major concern for hospitals. Most of methodologies used were either theoretical proposals or empirical and very little has been done using mathematical modelling. A mathematical model is developed using a mixed integer based approach for maintenance operations schedules for medical equipment. A preliminary proposed model to analyze the probability of failures was developed and used to analyze data from hospitals in South Africa and the United States of America. A greedy algorithm was used to measure availability of anaesthetic machines using maintenance data available and a promising results regarding optimisation of maintenance schedules was found using simulations on Matlab. More data on maintenance of other equipment is being collected and the mathematical model that was developed using a mixed integer approach will be tested.

Keywords: maintenance, mixed integer, availability, reliability, failures.

Presenting Author's Biography

Abdelbaset Khalaf is a senior lecturer in clinical engineering at Tshwane University of Technology (TUT). He earned his first degree B.Sc. in Biomedical Engineering from METU in Turkey in 1984 and MTech in Clinical Engineering from TUT in 2004. Abdelbaset is a consultant in Healthcare technology Management and advisor to the World Health Organisation (WHO) and department of health in South Africa and the Sub-Saharan African Region.

PERFORMANCE OF ITERATIVE EQUATION SOLVERS FOR CONVECTION-DIFFUSION-ADSORPTION-PROBLEMS IN THREE-DIMENSIONAL SPHERE PACKINGS IN COMSOL

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Abstract

Packed bed chromatography is commonly applied for the separation of large molecules in biopharmaceutical industry. A technical chromatography system is typically composed of a cylindrical column that is filled with porous spheres. Particularly in small columns, the impacts of inhomogeneous packing and wall effects on separation performance can be quite significant. We hence study convection, diffusion and adsorption in three-dimensional sphere packings. Random packings are externally generated and imported into COMSOL where the model equations are easy to implement. However, the COMSOL algorithms for automatic meshing and for iteratively solving the resulting equation systems fail to work with default settings. We have previously established a semi-automated and half-manual meshing procedure that works with the direct PARDISO solver. The present contribution addresses the evaluation and optimization of the iterative equation solvers that are provided by COMSOL for the given spatial geometry with up to six million degrees of freedom. The given results illustrate that we can iteratively solve systems with up to 600 instead of only 150 spheres using less memory and less computational time.

Keywords: sphere packing, convection-diffusion-adsorption, equation solver, COMSOL

Presenting Author's biography

Birgit Stute received her engineering diploma from the Bonn-Rhine-Sieg University of Applied Sciences in 2010. She is currently a technical assistant for modeling and simulation at the Research Center Jülich, Germany.

FUZZY-BASED MODELLING OF AN MR DAMPER

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Abstract

A Magneto-Rheologial (MR) damper exhibits a hysteretic and non-linear behavior. This behavior makes it a challenge to develop a model for this system. The present research is centered on proposing and analyzing two different fuzzy models of an MR damper based on experimental data. The first model uses an Adaptive Neuro-Fuzzy Inference System ($ANFIS$) and the second combines fuzzy methods with semi-phenomenological models. The results showed that fuzzy modelling can be a powerful framework to capture the behavior of highly non-linear systems. Among the various input patterns analized, stepped electric current signals allowed a better training of the $ANFIS$ model. Both proposed structures obtained Error to Signal Ratio (ESR) values of less than 0.1 for the majority of the experiments. This intensive experimental study confirmed previous theoretic work done for MR damper model fitting.

Keywords: MR Damper, Modelling, Fuzzy, ANFIS, Non-Linear Systems.

Presenting Author's Biography

Ruben Morales-Menendez holds a PhD Degree in Artificial Intelligence from Tecnológico de Monterrey. From 2000 to 2003, he was a visiting scholar with the Laboratory of Computational Intelligence at the University of British Columbia, Canada. For more than 23 years, he has been a consultant specializing in the analysis and design of automatic control systems for continuous processes. He is a member of the National Researchers System of Mexico (Level I) and a member of IFAC TC 9.3.

NUMERIC MODELLING OF HYBRID SYSTEMS WITH THE SECOND ORDER L-STABLE (2,1)-METHOD IN ISMA INSTRUMENTAL ENVIRONMENT

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Abstract

The class of (m,k)-methods is described. A second order L-stable method is created for resolving stiff autonomous problems. An algorithm for hybrid systems is developed that takes into account the guard condition when selecting the integration step. To show how the algorithm works a hybrid system of two oscillating masses on springs is considered.

Keywords: (m,k)-method, L-stability, accuracy monitoring, freezing of Jacobi matrix, hybrid problems.

Presenting Author's biography

Yury V. Shornikov. Works in Novosibirsk State Technical University (NSTU), department «Automated control systems», a Dr. Sci. Tech., the professor of department «Automated control systems» NSTU. The general scientifically-pedagogical experience (without including 6 years of postgraduate study and doctoral studies in NSTU) – 31 years.
Has more than 70 printing works, from them 16 in leading reviewed magazines Higher Certifying Commission, 9 works are registered in Russian Patent Bureau and Branch Fund of Algorithms and Programs, seven manuals and the textbook «The theory and practice of language processors», 2004 recommended to interuniversity use.
Scientific specialty is Mathematical and the software of computers, complexes and computer networks, a scientific direction is computer modeling, scientific interests are programming languages, program tool means, mathematical and the software.

ADEQUATE MATHEMATICAL DESCRIPTION OF DYNAMIC SYSTEM: STATEMENT PROBLEM, SYNTHESIS METHODS

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Abstract

The main problem of mathematical simulation is the construction (synthesis) of mathematical model (MM) of motion of real dynamic system which in aggregate with model of external load (MEL) give the adequate to experimental observations the results of mathematical simulation. It was shown that the criterions of choice of good MM of dynamic system separately from choice of right MEL do not exist. Two basic approaches to this problem are selected. Within the framework of one of these approaches some algorithms are offered which allows receive adequate results of mathematical simulation. The different variants of choice model which are depending from final goals of mathematical simulation (simulation or modeling of given motion of system, different estimation of responses of dynamic system, simulation of best forecast of system motion, the most stable model to small change of initial data, unitary model) are considered. These problems are incorrect problems by their nature and so for their solution are being used the regularization methods. For increase the exactness of approximate solution the method of choice of special mathematical models was suggested. The test calculation was executed.

Keywords: Mathematical simulation, Adequacy, Inverse Problem, Regularization.

Presenting Author's biography

Yuri Menshikov. He received the degrees of Ph.D. in Applied Mathematics at Kharkov Polytechnical University, Ukraine on 1979. He is working in Dnepropetrovsk University (Mechanics and Mathematics Faculty) from 1970. Dr. Yuri L. Menshikov is reviewer of conference Mathematical Modeling and he is member of Germany Society for Industrial and Applied Mathematics (GAMM). Research interests of Yu.L.Menshikov include system control, differential equations, variation methods, inverse problems. He is an author and coauthor of two monographies and more than 270 scientific papers in international journals and conference proceedings.

DEVELOPMENT PROCESS FOR MULTI-DISCIPLINARY EMBEDDED CONTROL SYSTEMS

Sune Wolff[1,2], Peter Gorm Larsen[2], Tammy Noergaard[1]

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Abstract

Developing hybrid systems which combines software, electronics and mechanics is very complex and can lead to delayed projects and erroneous products. By utilizing system-level models, a more complete picture of the system can be produced very early in the development process, and thereby reducing the possibilities of errors due to misunderstandings across domains. In addition, this approach focuses on system-level optimization, instead of super-optimizing the individual sub-systems, which will lead to overall better performance. Many research projects have attempted to tackle the challenges in hybrid systems development, but few have gained acceptance in industry. This paper describes a new project called "Development Process for Multi-Disciplinary Embedded Control Systems", which aims at describing a model-driven development process, attempting to bridge the gap between academia and industry needs. The methodology under development will describe how continuous-time and discrete-event models are to be combined in a co-simulation of the entire system, for use in the early design phases of embedded systems. The developed methodology will be tried out on several safety-critical embedded system case studies from the industry, in order to make sure it fits into existing development processes.

Keywords: Hybrid systems, Model-driven development, Methodology, Co-simulation.

Presenting Author's Biography

Sune Wolff holds a M.Sc. (2009) in Distributed Real-time Systems from Aarhus School of Engineering, Denmark. After working as a research assistant for at year, he initiated an industrial Ph.D. in collaboration with Terma A/S beginning of 2010. His main field of research is modeling and simulation of embedded systems using formally defined models, with special focus on co-simulation of continuous-time and discrete-event models. This paper gives a description of this industrial Ph.D. project.

HETEROGENEOUS MODEL INTEGRATION AND VIRTUAL EXPERIMENTATION USING XMOD: APPLICATION TO HYBRID POWERTRAIN DESIGN AND VALIDATION

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Abstract

The design, development and validation of vehicle powertrains is performed in concurrent cycles, involving various teams, working on a wide range of fields, and relying on modeling and simulation. However, there are still limitations that reduce models exchange and exploitation. After reviewing the main limitations of current simulation tools and methodologies, this paper introduces a new software platform, code named xMOD, and ambitioning to improve models exchange and exploitation. The main idea of xMOD is to combine in the same platform, a heterogeneous model integration environment, as well as a virtual instrumentation and experimentation laboratory. xMOD allows model developers, on one hand, to make their models easily understandable and exploitable, thanks to its virtual instrumentation functionalities, and to protect any confidential know-how. On the other hand, xMOD makes it possible for engineers and scientists, regardless of their experience and proficiency in a given modeling language or environment, to rapidly and easily integrate and exploit heterogeneous models. xMOD enables an increase of simulation speed due to its ability to exploit multi-core processors. Finally, the application of xMOD to the design and validation of a hybrid vehicle is presented, illustrating its functionalities and demonstrating its effectiveness.

Keywords: Model integration, virtual prototyping, virtual experimentation, co-simulation

Presenting Author's Biography

Mongi Ben Gaid received the Dipl-Ing. degree in electrical engineering from the National School of Engineers of Tunis, Tunisia, in 2002, the M.S. degree in distributed computing from the University of Paris XI, Orsay, France, in 2003, and the Ph.D. degree in control and computer engineering from the University of Evry Val d'Essonne, France, in 2006. He is currently with the Technology, Computer Science and Applied Mathematics Division of Institut Français du Pétrole (IFP). His research interests include real-time and multi-domain simulation, control and process monitoring.

APPLICATION OF THE MODERN TAYLOR SERIES METHOD TO A MULTI-TORSION CHAIN

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Abstract

In this paper the adoption of a novel high accuracy numerical integration method is presented for a practical mechanical engineering application. It is based on the direct use of the Taylor series. The main idea behind it is a dynamic automatic order setting, i.e. using as many Taylor series terms for computing as needed to achieve the required accuracy. Previous results have already proved that this numerical solver is both very accurate and fast. In this paper the performance is validated for a real engineering assembly. The chosen experiment setup is a multi-torsional oscillator chain which reproduces typical dynamic behavior of industrial mechanical engineering problems. Its rotatory dynamics are described by linear differential equations. For the test series the system is operated in a closed-loop configuration. An analytic solution of the linear differential equations of the closed-loop system for the output variable is obtained with the mathematical software tool Maple and validated by comparison to measurements at the experiment. The performance of the Modern Taylor Series Method is demonstrated by comparing its results to simulation results from conventional fixed-step numerical integration methods from the software tool Matlab/Simulink. Furthermore, the improvement in numerical accuracy as well as stability is illustrated.

Keywords: Simulation, Taylor series, Numerical integration, Matlab/Simulink.

Presenting Author's Biography

Georg Fuchs received the M.S. degree in Mechanical Engineering in 2008 from the Vienna University of Technology. He is presently research assistant at the Institute of Mechanics and Mechatronics at the Vienna University of Technology, pursuing his Ph.D. degree in automatic control engineering. His current research interests are internal combustion engine modeling, simulation and control, numerical linearization and integration methods, and real-time hardware applications.

EFFICIENT EVENT-DRIVEN PROXEL SIMULATION OF A SUBCLASS OF HIDDEN NON-MARKOVIAN MODELS

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Abstract

The paper introduces a new event-driven state space-based analysis algorithm for hidden non-Markovian models (HnMMs). HnMMs have been developed recently to enable the analysis of hidden discrete stochastic systems based on their observable output, e.g. to determine the unobserved causes of observed defects. There are currently two known approaches for analyzing HnMMs: Proxel-based analysis is generally applicable, but very time consuming and therefore infeasible for most realistic models; the modified Forward solver is very fast, but restricted to models of Markov regenerative type, which is a harsh restriction. The approach presented here bridges the gap between these two algorithms. It adapts the constant time steps of the Proxel algorithm to the time intervals between two output symbols and on the other hand encodes history into the modified Forward solver, thereby eliminating the need for the models to be of Markov regenerative type. However, the event driven Proxel algorithm requires every transition to produce observable output. Performance experiments show that the algorithm can generate a speed-up of up to factor 50 compared to the general Proxel solver for this restricted class of models. This paper extends the range of HnMMs that can be analyzed feasibly. It is another step toward practical feasibility of HnMM analysis, making them more useful for practitioners in the industry.

Keywords: Discrete stochastic system, hidden model, HnMM analysis, simulation algorithm

Presenting Author's Biography

Robert Buchholz obtained a Bachelor's degree in Computer Information Systems from the University of Wisconsin - Stevens Point (USA), and a Bachelor's as well as a Master's ("Diplom") degree in Computer Science from the Otto-von-Guericke University Magdeburg (Germany). He is currently a Ph.D. student at Magdeburg University and conducts research on practical applications of new discrete simulation techniques.

MODELLING OF AGE FROM THE TEETH DEVELOPMENT

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Abstract

The age estimation is very important in archeology or forensics as well as in human medicine. In the archeology and forensics the age estimation is useful for the examination of the skeletal remains. In the human medicine is important to estimate the development of individual which can be very different from his/her chronological age. In this paper we will process collection of 1393 Czech female and male children between 3 and 20 years of age. To determine development stage of teeth we will utilise method presented by Moorrees, Fanning and Hunt. The aim of this paper is to identify significant teeth by methods well known in data mining field. After this we will present results of several modelling methods and also formulas which may be immediately used. Models will be created from the full set of teeth and then later from several subsets.

Keywords: Dental Age Estimation, Teeth Mineralization, Feature Selection and Ranking, Age Modelling

Presenting Author's Biography

Miroslav Čepek is a PhD student and since 2010 he is Assistant professor at the Department of Computer Science and Engineering of the Czech Technical University in Prague. He graduated in 2006. He is interested in biological data mining and data preprocessing.

SIMULATION OF ANT COLONIES WITH HINTS GENERATED BY PARALLEL HEURISTICS

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Abstract

In this paper we present a new approach for combining discrete optimization algorithms, which resulted from a simulation of several scenarios of information exchange between algorithms running in parallel. We show that a group of parallel metaheuristics can create probabilistic "hints" for colony of artificial ants, which solves the same instance of a Traveling Salesman Problem (TSP). These "hints" are realized by creating intersections of solutions from fast independent solvers and they can be used to improve optimization process. A convergence speedup is shown for a group of Simulated Annealing algorithms together with Max-Min Ant System (variant of Ant Colony Optimization) on non-geometric TSP and for a given time window. This effect holds for random instances of sizes in of order of magnitude of 10^3. Presented model of cooperation between algorithms is a first step on the path to a complex metaoptimization system based on combinations of heuristics. We show, that the cooperation of diverse optimization algorithms can in some sense give better results than a homogeneous set of algorithms.

Keywords: Ant Colony Optimization, Traveling Salesman Problem, parallel metaheuristics, algorithm combination

Presenting Author's Biography

Oleg Kovářík is currently a Ph.D. student at the Faculty of Electrical Engineering, Czech Technical University in Prague. His research interest is a simulation of artificial ant colonies for solving optimization problems. The topic of his concern are mainly improvements of existing algorithms inspired by behavior of ants, that are used for combinatorial and continuous optimization. Last results lead to application of metalearning principles in optimization which corresponds to the topic of his thesis: "Ant Algorithms in Metalearning and Metaoptimization".

CONTINUOUS OPTIMIZATION ALGORITHMS: PERFORMANCE ON BENCHMARKING FUNCTIONS AND MODEL PARAMETERS

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Abstract

Estimation of continuous parameters is frequent task in modelling and simulation. There are several general purpose algorithms available for this task. We benchmarked these algorithms in order to recommend an appropriate algorithm for our model identification problem. We present results of optimization algorithms for standard benchmarking functions and show the importance of proper parameter setting. When these algorithms are applied to the estimation of model parameters, results are quite different. For this task, the gradient (quasi-Newton) and the nature inspired method (CMAES) can be efficiently combined, achieving the best optimization performance.

Keywords: Continuous Optimization, Neural Network, Modelling, Parameter Estimation

Presenting Author's Biography

Pavel Kordík works as an assistant professor and researcher at the Department of Computer Science, Faculty of Information Technology of the 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 40 publications. Recently, he was a 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.

ROAD MESH MODELLING USING THE SPATIOTEMPORAL CLUSTERIZATION

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Abstract

The GPS navigation is widely used aid for travelers. However, good navigation depends on good maps, which are sometimes hard to get. In this paper we explore a method to model a road mesh using self-organizing spatiotemporal data clustering of collected GPS data. The resulting road mesh model is obtained from simulated self organizing neural network, which clusters the individual data vectors and infers the time dependencies between the clusters. This allows to detect one way roads, or slow traffic automatically. To achive this goal we model the road mesh with the Temporal Hebbian Self-organizing map (THSOM). This paper presents a novel training method for the simulated THSOM neural network, which reduces training period and improves model the convergence of original THSOM neural network. The road mesh model is obtained from real GPS data as well as from simulated data set.

Keywords: Neural Networks, Self-Organizing Maps, Computational Intelligence

Presenting Author's Biography

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

GAME MODEL UTILIZATION FOR FEATURE RANKING AND FEATURE SELECTION

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Abstract

Majority of feature ranking and feature selection methods are designed for categorial data only and utilize statistical measures in order to rank or select features. Some of them can be used or modified for regression problems too. In this paper we present a different approach for feature ranking based on analysis of a model produced from data of interest. The main advantage of this approach is that the data mining algorithm (GAME) produces models for numerical data as well as it can be applied to categorial data. Therefore we are able to compute feature ranks for both categorial and regression problems without output discretization, which is often problematic. In this work we extract the ranking from the model topology by using statistical measures. In contrast to previous work, the rank of each feature selected by model is now computed by processing the mutual information (instead of the correlation measure) of outputs between neighboring model's neurons. The results of ranking methods were obtained from tests on artificial data sets and on well known real world data set. Our methods produce ranking consistent an in almost all cases better than in recently published studies. As an advantage these methods are applicable for numeric and categorial data as well.

Keywords: Feature Ranking, GAME, Mutual Information, Fuzzy logic, Certainty factor

Presenting Author's Biography

Aleš Pilný. After the master degree (in 2008) as a Ph.D. student joined the Computational Intelligence Group (CIG) at the Department of Computer Science and Engineering, Faculty of Electrical Engineering, Czech Technical University in Prague, Czech Republic. His research is focused on Feature Ranking and Feature Selection methods and its application in Data Mining. Currently he passed the doctoral exam and is working on the dissertation thesis. Author is also a member of research team of the internal grant on CTU Prague "Improvement of data preprocessing module in FAKE GAME project".

FAST SUPERVISED FEATURE EXTRACTION FROM STRUCTURED REPRESENTATION OF TEXT DATA

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Abstract

Classification of text documents is challenging problem not only when browsing the web. Structure representation of documents is necessary to build up appropriate classifier. Unfortunately the document-term matrices are usually so sparse and of high dimensionality due large number of terms representing usually smaller number of the documents. Thus the suitable dimensionality reduction technique is required to be able to develop the classifier. The article deals with supervised extraction method that results to small number of sensitive features derived from the initial document-term matrix. The extraction process simulated by neural network is remarkably fast and utilizes all available supervised information from training data.

Keywords: Dimensionality reduction, Document representation, Fast network learning.

Presenting Author's biography

Ondřej Háva. Part-time postgraduate student. He primarily focuses on text mining and machine learning.

ACCELERATED LEARNING OF 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 offers a range of advantages for modelling from data and has been therefore used also for dynamic systems identification. One of the noticeable drawbacks of the system identification with Gaussian process models is computation time necessary for modelling. The modelling procedure involves the inverse of covariance matrix which is as large as the length of input samples vector. The computation time for this inverse regardless of the use of efficient algorithm is rising with the third power of input data number. Intensive research is going on for finding algorithms that would accelerate the training of Gaussian process models. The purpose of this paper is to show approach from the used hardware point of view. The assessment of computational efficiency of two different hardware platforms for GP model identification are given in the paper. These are: single core personal computer and personal computer with graphic card used for computations. The assessment has been done with comparison of computational load on a toy case study of nonlinear dynamic system identification. The assessment reveals that the parallel computation solutions are efficient for larger amount of data when the initial and communication overhead of parallel computation becomes sufficiently small part of the whole process.

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

Presenting Author's Biography

Dejan Petelin received the M.Sc. degree in computer science and informatics from the Faculty of Computer Science and Informatics, University of Ljubljana. He is currently a Ph.D. student at the Department of Systems and Control, Jozef Stefan Institute in Ljubljana. His main research interests are machine learning methods and their application for dynamic systems modelling.

COMPUTATIONAL SPEED ON THE MULTIPROCESSOR ARCHITECTURE AND GPU

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Abstract

The article deals with the design of parallel computing in computer's systems of a simulator. The concept is based on computers that create a distributed computer system in the network and on the other side computer with support GPU. In both cases this information system is created by computers and the program applications of the mathematical models. The important part of this article describes time scheduling of simulation. The first time is scheduling time of the simulation processes running on the computer. The second time is interrupt latency for control signals in computer. The third time is latency over the network that means transfer n-bytes from one computer to the other one computer. It explains the benefits GPU computing with tasks, scheduling and parallel execution mathematical models of simulator. Mathematical modeling is the art that is able to transform a point from original application into theoretic area to mathematical formulations for numerical analysis. The significant part of this article describes the implementation of distributed mathematical model with computation implemented by single-processor architecture in network, the cluster computing and single-processor architecture with support GPU. Modeling processes of simulator computer with GPU in opposition to cluster's computers, create a time benefit.

Keywords: Computation resources, Parallel computing, Processor - CPU, Graphic processor unit – GPU, Mathematical model.

Presenting Author's biography

Peter Kvasnica. Is the deputy director of the Centre of Information Technologies at Alexander Dubček University of Trenčín. He has been involved in research on mathematical models and programming virtual reality applications. He graduated from University of Technology in Brno (VUT Brno), in the field of study: digital computers. He was awarded the degree of Doctor of Philosophy (PhD.) at M. R. Štefánik Military Academy of Aviation in Košice, in the specialization in computer science application. He has been involved in the development of special adapted mathematical models of objects from the point of view of programming and use of distributed computer system in flight simulators for real-time applications. He is interested in software tools for parallel programming MPI, Open MP and information about Open CL for creation GPU software application.

BUILDING PARALLEL RAYTRACING SIMULATION MODEL WITH PETRI NETS AND B-METHOD

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Abstract

In this paper we deal with a process of building a Coloured Petri net model of a parallel raytracing implementation, developed at the home institution of authors. The model has been used to evaluate possible parallel raytracing strategy improvements by means of simulation-based performance analysis. Here we present a basic Place-Transition net model, which captures all crucial properties of the raytracing implementation. We demonstrate how structural properties of Petri nets, namely place and transition invariants, and proof obligations of B-Method can be used to verify that the basic model has desired properties and is deadlock free. The verification is performed using available tools, including our original ones and uses original theoretical results regarding transformations between Petri nets and specifications in B-Method. Finally, we show how the CPN model can be designed on the basis of the Place-Transition net model.

Keywords: Petri nets, B-Method, deadlock freeness, simulation-based performance analysis, raytracing

Presenting Author's biography

Štefan Korečko was born on July 13, 1978. In 2001 he graduated (MSc.) with honours at the department of Computers and Informatics of the Faculty of Electrical Engineering and Informatics at Technical University (DCI FEEI TU) in Košice. He defended his PhD thesis in the field of computer devices and systems in 2006. The title of his thesis was "Integration of Petri Nets and B-Method for the mFDT Environment". Since 2004 he is working as an assistant professor at the DCI FEEI TU in Košice. His scientific research is focused on formal methods, Petri nets and B-Method in particular, their integration and use in software development and modelling and simulation.

DEVELOPING DEEP SIMULATION SYSTEMS TO STUDY WIRELESS NETWORK PERFORMANCE

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Abstract

There is an abundance of literature that present simulation studies of wireless networks, includ- ing IEEE 802.16 or WiMAX. The focus in such papers is invariably on the results and never on the simulation itself, which is seen merely as a means to determine numerical values. The reason for this may be that, with very few exceptions, the simulations use one or other well- known simulation platform. In this paper we argue that, with the complexity of a system such as WiMAX, one needs to develop a simulator from scratch by implementing the basic simu- lator components using a programming language, such as Java. This ensures that every detail of the standard is understood and represented and that all system parameters and their values are accessible to the modeller. Moreover, the performance metrics one wants to access may not necessarily be those offered by the simulation platform nor is it always clear whether the statistical methods follow those that the user has confidence in. This paper does not deal with the performance of a wireless network per se but instead explains a general simulation method- ology for determining the QoS and performance management of wireless networks that support differentiated traffic services.

Keywords: Simulation, Wireless systems, IEEE 802.16, WiMAX, system performance model, network of queues.

Presenting Author's Biography

Paolo Pileggi is a PhD student at the University of Rome II Tor Vergata, Italy. He obtained his Bachelors, Honours and Masters degrees with distinction in Computer Science from the University of Cape Town, South Africa. Currently, his work focuses on performance of wireless networks, particularly 4G technology.

STOCHASTIC MARKOV MODEL FOR TCP THROUGHPUT

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Abstract

The paper presents a stochastic model that predicts the throughput of the short and long lived Transmission Control Protocol (TCP) flows. Analytical model for each TCP stage are derived and combined with discrete time Markov chain, with round trip time granularity, in order to describe TCP throughput behavior during the TCP connection life time. Model accuracy is improved by the detailed analysis whether the packets are lost or received after the first packet loss.
While deriving the model described in this paper, assumption that the packet loss function is known was made. The model accuracy has been tested on the simple network topology created in the packet level simulator ns-2. The proposed model can be used for TCP connection performance analysis, reducing computation complexity compared to the packet-level simulators.

Keywords: TCP modeling, Stochastic models, Markov chain.

Presenting Author's Biography

Asmir Gogić is teaching assistant on the Faculty of Electrical Engineering at the University of Tuzla, where he received his B.Sc degree in 2007 and M.Sc. degree in 2009. His research interests are in modeling and simulation of communication networks and protocols.

TEMPERATURE DYNAMIC OF HEAT EXCHANGERS IN BOILERS

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Abstract

This paper presents the possibilities of developing the temperature dynamic simulation models of water heating, steam generation and steam superheating in boilers of power plants. There are two basic methods considered for solving the problem of temperature dynamics. The first method is built on the lumped parameters, the second on global balances of nonisothermal system. The description of differential equation creating process is presented in this paper. The result is the nonlinear dynamic simulation model, which is prepared to work in wide range of operation parameters. Some results from both method models are shown, too. The comparison of model and real system dynamic behavior is demonstrated.

Keywords: steam generator, superheating, temperature model.

Presenting Author's biography

Lukáš Hubka graduated from Technical university of Liberec with his Master's of Science degree in Automatic Control and Computer Engineering. Currently, he is pursuing his PhD degree in Technical Cybernetics at Technical University of Liberec. His research interests lie in advanced technologies, control systems and modeling with the special focus on the power engineering. His current interests are in energetic/energy area and he is participating in monitoring and remote control of a biomass power plant and in developing a model and control system of temperatures in power plant rebuilding program. Lukáš Hubka is working closely with major energy producers in the country and is giving lectures at the Technical university of Liberec.

DYNAMIC SIMULATION OF A SOLAR POWER PLANT STEAM GENERATION SYSTEM

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Abstract

In the frame of the development of new exploitation technologies for renewable energy sources, a steam generation system for a solar power plant has been designed in Germany by Balcke-Duerr. In order to assist the construction of this innovative system, a dynamic simulation of the thermal oil heated boiler has been built by the Vienna University of Technology. Aim of this work is to assess the time needed for the natural water circulation to start and to check if it behaves properly. After a short description of the heat exchanger design, the principles and possibilities of the 2 phase-flow dynamic simulation program APROS are presented. The different stages of the simulation build-up are then described, especially how the discretization of the system has been chosen and which dimensions influence the simulation results most. Further on the different simulated cases are defined as well as the relevant parameters of the system (water circulation direction and rate, oil temperatures, steam mass fraction in water/steam circuit) that are observed during a start-up phase. Eventually the findings related to the simulation build-up and the dynamic behavior of the steam generator are exposed and commented. A design optimization can be carried out with this method.

Keywords: 2-phase flow, dynamic simulation, oil heat exchanger, solar power plant.

Presenting Author's biography

Thibault Henrion was born in Nancy (France) in 1981. In 2004 he graduates at the École nationale supérieure des mines de Saint-Étienne graduate School of engineering his studies focused on process engineering and energy techniques. After one year further studies in Energy economy and engineering, he moves to Vienna (Austria) where he works two year for OMV as an energy efficiency specialist for the refineries of the group. In September 2008, he starts a PhD project at the Institute of Energy Systems and Thermodynamics in cooperation with Voest Alpine Stahl (Linz-Austria), at the technical University of Vienna. He follows works on one- and two-phase flow in steam boilers as well as in steam distribution systems of iron and steel works.

EXTENDED MATERIAL PROPERTIES IN APROS FOR DEPENDABLE EVALUATION OF NEW COMBUSTION POWER PLANT CONCEPTS

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Abstract

Sustainable power production requirements call for extended ranges and more detailed accuracy in calculation of material properties in dynamic simulation of new designs of combustion power plants. Better thermal efficiency may be gained from increasing the steam temperatures to the over critical region. More detailed calculation in condensers requires also non-condensable gases to be considered in the steam and water circuits. Carbon capture and storage (CCS) concepts require that the flue gas circuits can include liquid carbon dioxide calculation. Oxy fuel concepts require separation of oxygen and extension of the material properties of air with liquid nitrogen and oxygen. Versatile use of dynamic simulation in design evaluation of such novel power production concepts require fast and accurate calculation of the material properties. The APROS thermal hydraulic solvers provide information on pressure, specific enthalpy, and mass fractions of mixture in each control volume as input for the material property calculations. The material properties calculated include the temperatures and void fractions of each control volume as well as the properties needed for each phase such as the mass fractions, densities, viscosities, specific heat coefficients and specific enthalpies. Extended range calculations of the material properties, as well as example applications, are presented.

Keywords: modelling, dynamic simulation, power plant, material properties, APROS.

Presenting Author's biography

Dr. Kaj Juslin studied Electrical Power Engineering at Helsinki University of Technology (HUT) for his master's degree. His postgraduate interests concerned Control Theory and Electrical Engineering Theory. He has held many different positions at VTT Technical Research Centre of Finland, already since 1970. His present titles are Customer Manager and Chief Scientist. He has been responsible for the co-ordination of several research initiatives related to dynamic simulation of industrial processes. He is the main architect of the APROS software, now in extensive use world wide. He has promoted international cooperation acting as president of SIMS and EUROSIM.

FPGA-BASED REAL-TIME SIMULATION OF POWER ELECTRONIC SYSTEMS

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Abstract

Modern power systems depend on power electronic components that use high-speed switching controllers to provide improved stability, flexibility and conditioning of power supplies. The key components are switching circuits (converters) that convert alternating current to direct current (rectification) and vice versa (inversion). As switching speeds are increased in order to reduce low-order harmonics and improve controllability, the duration of the time steps used in simulations of these power systems must be reduced to avoid significant timing errors. This is particularly critical for real-time simulations because the required frame times have now become shorter than can be delivered by conventional real-time simulators based on available real-time operating systems. This developing need for high-speed real-time simulation has resulted in research into alternative methods of achieving frame times for real-time simulation of 1 microsecond or even less. The paper describes research that uses field-programmable gate arrays (FPGAs) in real-time simulations with frame times of less than one microsecond. A complete real-time simulator based on these techniques needs to be integrated with a conventional computer platform that can provide a user interface and also host those parts of the simulation that do not need the speed of the FPGA in a real-time, multi-rate, distributed simulation. The user interface on the host system is required to support development, implementation, setup and control of the simulation. Graphical display of results is also required. The paper describes a number of possible configurations including one in which the FPGA and a Windows system can be combined to produce such a simulator at an affordable cost that would be very suitable for installation in university teaching laboratories.

Keywords: Real-time simulation, power electronics, FPGA.

Presenting Author's biography

Roy Crosbie is a Professor Emeritus at California State University Chico. He has a Ph.D. degree in Electrical and Electronic Engineering from the University of Liverpool and is a Chartered Engineer (UK), a Fellow of IET and a Fellow of SCS. Prior to joining CSU, Chico in 1983 he held appointments at Marconi, Bell Canada, and University of Salford. He was the first Chair of the Dept of Computer Engineering. He was President of SCS from 1988-90. In 2001 he initiated a research program on high-speed real-time simulation aimed initially at power electronic systems which has been supported by the Office of Naval Research since 2004.

SIMULATION FOR MULTIPROCESSOR REAL-TIME SCHEDULING EVALUATION

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Abstract

The increasing complexity of the hardware multiprocessor architectures as well as of the real-time applications they support makes very difficult even impossible to apply the theoretical real-time multiprocessor scheduling results currently available. Thus, so as to be able to evaluate and compare real-time multiprocessor scheduling strategies on their schedulability performance as well as energy efficiency, we have preferred a simulation approach and are developing an open and flexible multiprocessor scheduling simulation and evaluation platform called STORM ("Simulation TOol for Real-time Multiprocessor scheduling"). This paper presents the simulator on which STORM relies and that is able to simulate accurately the behaviour of those (hardware and software) elements that act upon the performances of such systems. An example is given to illustrate such a performance evaluation.This work has been supported by the french Agence Nationale de la Recherche through the PHERMA project (Contract ANR ANR-06-ARFU06-003). See http://pherma.irccyn.ec-nantes.fr.

Keywords: Real-time systems, Multiprocessor global scheduling, Simulation

Presenting Author's Biography

Urunuela Richard is a research engineer of the IRCCyN laboratory in the "Real-Time Systems" group. Since 2003 he is interested in the design of real-time systems and more particularly: operating systems, power management for such systems, and real-time scheduling. At present, he is in charge of the implementation of STORM, a Simulation TOol for Real time Multiprocessor scheduling. He is also focusing on the development of engineering tools for helping to the design of power management policies. Previously he worked around scheduling and power management in the OBASCO research group at the Ecole des Mines of Nantes.

NUMERICAL METHODS OF STRUCTURE OPTIMIZATION OF HOMOGENEOUS QUEUING NETWORKS

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Abstract

An approach to an implementation of the numerical optimization for a structure of homogeneous queuing networks is considered. The restrictions on optimizing parameters of different nature is embedded into the algorithm. Examples for using the method for efficiency and fail-safety of networks are presented. The usage of optimization for network degradation is included.

Keywords: Queuing networks, numerical optimization, restrictions, efficiency, fail-safety.

Presenting Author's biography

BORIS V. SOKOLOV was born in Leningrad (now Saint-Petersburg), Russia in 1951. He obtained his main degrees in Mozhaisky Space Engineering Academy, Leningrad. MS in Automation Control Systems of Space Vehicles in 1974. Candidate of Technical Sciences subject the area of planning automation and decision making in 1982. Doctor of Technical Sciences subjects the area of military cybernetics, mathematical modeling and methods in military research. Professional Interests: Basic and applied research in mathematical modeling and mathematical methods in scientific research, optimal control theory, mathematical models and methods of support and decision making in complex organization-technical systems under uncertainties and multi-criteria. At present he is a Deputy Director for research of St.-Petersburg Institute for Informatics and Automation. His e-mail address is: sokol@iias.spb.su and his Web-page can be found at http://www.spiiras-grom.ru.

THE RESEARCH OF COMPONENT BASED INTEGRATED MODELING AND SIMULATION ENVIRONMENT

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Abstract

In this paper, an component based integrated environment for centralized/distributed/parallel simulation (CISE) is proposed which is built upon advanced technologies such as Component, MDA, DEVS etc. Firstly, the comprehensive analysis on deficiencies of the HLA based simulation is presented. Accordingly, the primary goals of CISE are given which realize the reusability and interoperability in M&S, also support both the evaluation style simulation and the process demonstration style simulation. The key concept of CISE is component based modeling in which communication among components is achieved via ports. CISE provides a normative description system based on the advanced theory separate model from experiment, and use platform independent description criterions to realize the integrated environment. The functions of CISE: graphic modeling management, model component description, simulation management, adapter management, public resource management are all in detailed explained. Finally, the progress of key technologies and classic application are introduced, and the advantages of CISE are summarized.

Keywords: model component, integrated modeling and simulation environment, experiment framework, simulation adapter.

Presenting Author's Biography

Du-zheng Qing(1970-). Male, born in HuNan ,China. Professor, Research on System and Weapon System Simulation, Simulation Support Software etc.

ITERATIVE SYSTEM FOR SIMULATION OF E2E TRANSPORT PROTOCOLS IN HETEROGENEOUS NETWORKS

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Abstract

The Internet is characterized by the ever-increasing number of connections, nodes and places of presence, kinds of topologies, transmission media technologies, the yearly growth in user communities by magnitudes, the variety and the potential of innovative applications, combined with the economic, social, cultural and political ramifications. While constantly being measured and evaluated, explored and studied, the Internet is arguably impossible to be used for experimentation and investigations in order to test and validate the modifications of the existing network protocols or the introduction of new ones. Studies are commonly done using laboratory conditions through tests beds or simulation environments. The ns-2 network simulator is a well-known open source tool extensively used and extended by the academia, who also needs a standardized set of topologies, traffics, and metrics to validate and verify the results of their efforts. The tcpeval is one of these tools tool designed to provide a standard starting research framework. The goal of the paper is twofold: using ns-2 and tcpeval as tools for creating a simulation platform enriched with data gathering system and evaluation of the performance of an end-to-end transport scheme based on an original TCP modification.

Keywords: Simulation, E2E Protocols, Transport Protocols, ns-2, tcpeval, Heterogeneous Networks

Presenting Author's biography

Biljana Stojcevska is a teaching assistant at the School of Computer Science and IT at the University American College Skopje and a PhD student. She received her MCs degree in area Data Communication Networks and currently is a PhD student. Her academic interests are heterogeneous networking environments, Internet technology with emphasis on the E2E behavior of transport protocols and their role in congestion management, and Operating Systems.

WEB SIMULATION FOR THE MANAGEMENT OF THE OPERATIONS AT AN INTERNATIONAL AIRPORT

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Abstract

A new airport in Spain is looking for tools that will help not only with the scheduling of resources but also with their real time control during normal operations. The tool developed provides a graphical interface using both Gantt charts that will help visualize the future programs obtained by simulation and a real-time visualization of the online situation at the parking positions. The graphical interface runs a simulation model in multiple web browsers that are synchronized in the same database for the input and output data, using a Java server. The collaborative system aims at the improvement in the management of the resources allowing users to dynamically modify the Gantt chart bars as delays and other disturbances occur and immediately assess the impact in the future programs and make better decision accordingly.

Keywords: web-based simulation, resources allocation, visualization, JAVA.

Presenting Author's biography

Miguel Poyatos was born in Cuenca, Spain. He received the Telecommunications Technical Engineer Master, from the University of Castilla-La Mancha (UCLM) in 2009. In 2009 he begins his doctoral research in simulation systems. His research interests include RF Identification and tracking, factory automation, intelligent manufacturing systems and systems simulation and optimization. He works in Autolog group since 2007, where he developed his interests in J2EE applications orientated to analysis of resource allocation for incoming flight and RFID luggage tracking for Central Airport at Ciudad Real. His e-mail address is: miguel.poyatos@uclm.es and the Web-page of the Autolog association is: http://autolog.uclm.es.

SERVICE WORKFLOWS AND DISTRIBUTED COMPUTING METHODS FOR ^{13}C METABOLIC FLUX ANALYSIS

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Abstract

In the field of Metabolic Engineering and Systems Biology, a plenitude of modeling and simulation tools have recently emerged that aim to shed light on processes in living cells. ^{13}C Metabolic Flux Analysis (13C-MFA) is an evolved, model-based approach for the quantification of intracellular fluxes, the key functional output of metabolism. To increase flexibility in 13C-MFA application design, the automation of repetitive tasks and the management of computational resources based on a scientific workflow framework entails many advantages.
In this contribution, we present two important aspects regarding the integration of 13C-MFA applications into a generic Scientific Workflow System (SWS). The first aspect addresses the unification of the various data formats involved in a typical 13C-MFA application, namely experimental data, models, model parameters and simulation results. Secondly, existing simulation tools need to be extended by a web service interface to make workflow orchestration possible. Hence, by making use of service-orientation, SWS technology offers many benefits for 13C-MFA as a major tool for Metabolic Engineering.

Keywords: 13C-MFA, Scientific Workflows, BPEL, SOA, Distributed Computing

Presenting Author's Biography

Tolga Dalman received the diploma degree in computer science from Bielefeld University in 2005. His main research interests include Scientific Workflows, Grid Computing, applications in the field of Systems Biology and statistics.

PERFORMANCE OPTIMIZATION FOR ENTERPRISE WEB APPLICATIONS THROUGH REMOTE CLIENT SIMULATION

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Abstract

Contemporary enterprise web applications provide complex user interface functionality to attract users with desktop-like features. Naturally, such increasing UI complexity and user expectation results in greater application resource demands, which may degrade performance. System performance is measured by application responsiveness for end users in service delivery. Web application performance optimization occurs at all levels of the application, from server hardware, to database, etc. In this paper, we focus on the network delivery of application assets, identify bottlenecks in the service delivery, and provide suggestions for optimization. To accomplish this, we provide tools to simulate a variety of remote user communication scenarios and identify the application assets with the greatest impact on application performance. Based on the simulation results for the production application, we provide optimization options, which may be iteratively applied and simulated until the desired application performance is achieved.

Keywords: Web page load time optimizations, Performance evaluation, Network emulation, Remote client simulation.

Presenting Author's Biography

Tomas Cerny. Research in networking and simulation, specializing in web application optimization with a recent publication at MOSIS 2010. Other research interests include software engineering and model-driven development with publications at ICISA 2010, TechEd 2010 and ISD 2010.

ALGORITHMIC EVALUATION OF TRUST IN MULTILEVEL MODEL

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Abstract

Artificial agents are autonomous entities that should behave rationally by their own control. They should have also some social abilities that enable them to make strategic decision inside a multi-agent community. One of such decision is to select proper partner which it believes that its behaviour will be reliable and trustworthy. We address area of trust which may be important for improving agent's reasoning capabilities and by this also rationality of its behaviour within an agent or multi-agent system. This paper introduces specification of the model which is used for representation of trusts and their hierarchy in agent's beliefs. In fact this is a part of agents's belief base and it is used when decision about some system element trustworthy takes part in agent's reasoning process. For these purposes, we develop Hierarchical Model of Trust in Context which is represented by multilevel graph, where each node of the graph represents different aspects (contexts) of trustee and each edge of the graph represents correlation between different aspects. This is useful to modelling trust in respect to context-aware environment.

Keywords: trust evaluation, multilevel graph, agent reasoning, context trust

Presenting Author's Biography

Jan Samek received an MSc degree in Electrical Engineering and Computer Science in Brno University of Technology. In this same school, he is a postgradual student on Faculty of Information Technology in Brno, Czech Republic. His main interest in computer science is artificial intelligence area, especially multiagent systems and trust and reputation principles modelling for virtual agent communities.

CONNECTING JADE WITH PN AGENT

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Abstract

Since Foundation of Intelligent Physical Agent (FIPA) is one of the biggest organizations that handles standardization in the field of agent-based technologies we have chosen their reference implementation called JADE and in this paper we are describing possibility to interconnect it with other platform that is not FIPA compliant. Second agent platform, we have chosen, is PN agent platform, which is BDI agent based on formalism of Object Oriented Petri nets. PN agent was chosen for the reason of Object Oriented Petri nets used in its base because when we make PN agent FIPA compliant we open whole new world of possibilities how to use Petri nets inside of it.

Main purpose of this paper is to show how to interconnect two different platforms where one is build upon FIPA standards and the other is not. This scenario is hardened by the fact, that JADE is developed in Java language, while PN agent framework is created in smalltalk, concretely in its squeak implementation.

Other topic of our interest is FIPA compliance in agent platforms. This topic partially covers our effort to bring more openness to the PN agent platform because when we find out, which agent platforms support FIPA standards then we will acquire knowledge of who are we compatible with.

Keywords: Agent platform, Connecting agent platforms,Object oriented Petri Nets, PN agent, JADE, FIPA, FIPA compliance.

Presenting Author's biography

Leading author is student of PhD study program on Faculty of Information Technology on Brno University of Technology. He is studying his first year of his PhD studies and this is his first paper. Among his interests belongs all related to agent oriented technologies and modeling systems.

INCREASING PROFIT IN AGENT BUSINESS MODEL WITH TRUST

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Abstract

Development of new technology also brings new areas where it would be appropriate to automatize or simulate human activity. One way to achieve this is to use agent systems. In these cases the agent as a software component represents the human decision-making process and acting on his behalf. To achieve its goals often needs to cooperate with other agents. Trustworthiness of these agents may play a key role in efforts to achieve these goals. In real life in these cases is decisions made based on the experience with that partner. How to handle with these experiences and how they determine the risk of cooperation is one of the topics of artificial intelligence. A possible solution is to use the principles of trust and reputation. There are many studies in different objectives. This article aims to propose a model of trust and reputation based on the standard human decision-making, with application mainly in the field of e-commerce.

Keywords: Trust and reputation, Multi-agent systems, Simulation model.

Presenting Author's Biography

Ondřej Malačka graduated in 2009 at the Faculty of Information Technology, Brno University of Technology. Later that year he started his Ph.D at the same faculty in Brno. His research interests are in simulation of multi-agent systems and artificial intelligence.

ENSEMBLES IN FETAL WEIGHT PREDICTION MODELING

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Abstract

Model Ensemble has been shown to provide a high level of performance for regression problems. Overall error can be smaller since ensembling method can also reduce both bias and variance of the model. We present several ensembling algorithm tested on fetal weight prediction on sonography data. All ensemble method has shown better result compared to other best single estimation model usually founded by linear and non linear regression.

Keywords: Ensemle, fetal, weight, prediction

Presenting Author's Biography

Tomáš Siegl graduated in Computer Science from Czech Technical University in Prague and in Management and Economy from Colleage of Banking in Prague. He is currently a PhD student in Computational Intelligence Group at Faculty of Electrical Engineering in Czech Technical University in Prague supervised by Miroslav Šnorek. He is interested in developing a new ensembling algorithms based on negative correlation technique.

DETECTOR SETTINGS FOR REAL-TIME TRAFFIC SIGNALS

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Abstract

The effectiveness of real time traffic signals depends to a great extent on the number and the location of the installed detectors. The primary objective of this paper is to develop a framework to identify the best detector placement mostly suitable for different operation conditions of real time traffic signals. The paper presents a heuristic-based real-time responsive signal control system for green time splitting. It studies the effect of detector setting on the system performance (captured by travel time and delay) under various operational conditions of link speeds, traffic flows and approach lengths. Several scenarios of real-time and pre-timed controllers are studied and analyzed using a microscopic simulator.

Keywords: Traffic signal control, pretimed, real time, detector settings, microscopic simulation.

Presenting Author's biography

Yaser Hawas currently serves as a professor at the department of Civil and Environmental Engineering at the UAE University. He also serves as the Director of the Roadway, Transportation and Traffic Safety Research Center (RTTSRC) at the UAE University. He obtained his Ph.D. from the Civil Engineering Department at the University of Texas at Austin in 1996, and joined UAE University in 1998.

Prof. Hawas has published more than 50 international journal papers, and conference papers. He carried out several professional studies and consultancy works for several local and international agencies including the Texas Department of Transportation (US), The Federal Highway Administration (US), Holden vehicle manufacturers (Australia), and United Nations (ESCWA) among many others in UAE.

ACQUISITION OF INPUT DATA FOR TRANSPORTATION MODELS

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Abstract

Simulations serve to experiment with a model to explore system behaviour and to test and/or design suitable control methods. Simulation model must be correct and supported with accurate input data to achieve these desired goals.

Input data on transportation system represent a substantial part of the simulation model. The input data are unique for each simulated project and that is why an efficient acquisition of input data is an important task. The paper deals with data acquisition methods based on pattern recognition supposed to be suitable for these needs.

The infrastructure data can be acquired from drawn plans and maps or from images. Even if infrastructure might be already available, rarely are complete with all necessary attributes for microsimulation models. Such attributes can be recognised and added to available data sets.

Data on vehicles and transportation flows can be extracted from video sequences of real traffic. Processing of video data seems to be the only effective method to get detailed information on vehicle behaviour in a transportation flow.

Acquisition of input data by pattern recognition methods may deliver complete data for microsimulation models quick and easy.

Keywords: simulation, transportation, pattern recognition, input data acquisition.

Presenting Author's biography

Petr Cenek. Born in Prague, graduated in Mechanical Engineering at the Czech Technical University, Prague. Since 1973 he has worked with University of Žilina (former University of Transport and Communications) in Žilina, Slovakia. His main professional interests are in Computer Science, Optimisation Methods, Simulations and Computer Graphics applied in Transports.

STUDIES OF EFFECTS INFLUENCING THE TRANSMISSION OF UDP DATAGRAMS BETWEEN RAILWAY VEHICLES AND INFRASTRUCTURE

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Abstract

This research applies to the quality of GSM signal cover on railways. On the map of Czech Republic we try to display and color-highlight places where there is reduced probability of delivery of UDP datagrams carrying information on the current train position. These messages are sent periodically from a GPS module placed in a train after satisfying certain conditions. We are monitoring if all sent messages are received or if some are missing and why. We aim to detect some effects which can cause losses of UDP datagrams. The effect of speed and daytime was explored.

Keywords: UDP datagram, GSM network, transmission, railway, current position.

Presenting Author's biography

Zuzana Kleprlíková – Master's in the field of information technology at the University of Pardubice (2004, 2009). Ph.D. student at the University of Pardubice Faculty of Electrical Engineering and Information Technology (since 2009). Main research interests is in software engineerng.

David Žák – Master's and Ph.D. in the field of Information Technology and Experimental Physics at the Palacky University in Olomouc (1993, 1998). He has been employed at the University of Pardubice since 2006, lecturing courses in Database Systems, Database Architecture and Techniques of Database Systems. Main research interests are related to intelligent network solutions for mobile communication within railway vehicles and telematics applications.

THE NEED OF COMBINING DIFFERENT TRAFFIC MODELLING LEVELS FOR EFFECTIVELY TACKLING COMPLEX PROJECT

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Abstract

This paper makes reference to the debate currently existing in the transport modeling community about which is the most adequate traffic flow representation for tackling traffic simulation studies. Instead of answering this question, the present article underlines the benefits of each of the existing modeling level and, instead of comparing them, suggest an integrated solution where all levels could be used in a unique environment in order to get the best benefits of them.

Keywords: Integrated framework, Traffic Modeling, Aimsun.

Presenting Author's biography

Josep M. Aymamí received a Master Degree in Civil Engineering in 2007 by the Polytechnic University of Catalonia, specialized in Transportation and Urban Planning. He also studied a Post-graduated diploma in transportation planning and management. From 2003 to 2006 he collaborated in master plans for the villages of Sitges and Mont-Roig del Camp, Spain, as well as for projects for Ports de la Generalitat, related to harbour planning. Since 2006 he joined TSS' Consultancy Department, where he worked as a projects engineer at TSS, in charge of planning, traffic management and public transportation optimisation projects. From 2006 he also participated in the TSS contributions on the 6th. Framework Program European Research Projects (INTRO: Intelligent Roads and eMOTION: Europe-wide multi-Modal On-trip Traffic InformatiON), and in the National Research Project MARTA. Since 2009 Josep M. is Project Manager at TSS.

DIVISION OF TRAFFIC NETWORK FOR DISTRIBUTED MICROSCOPIC TRAFFIC SIMULATION BASED ON MACROSCOPIC SIMULATION

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Abstract

Computer simulation of the road traffic is a very important tool for analysis and control of traffic networks. Since the simulation of a large traffic network (e.g. an entire city and larger) can be computationally intensive, many simulators have been adapted for distributed computing environment. Using this approach, the combined computing power of several computers connected via a computer network is utilized. Nevertheless, an important issue, which must be solved, is the division of traffic network into the required number of traffic sub-networks. A good division method should equalize the load of the simulation processes and/or minimize the inter-process communication. Both of these issues affect the performance of the distributed simulation. In this paper, we present a new method for division of road traffic network. The method is focused on uniform load of the simulation processes, which simulate the resulting traffic sub-networks. Using multiple macroscopic simulation runs, the particular traffic lanes of the network are assigned by weights. Based on these weights, the traffic network is divided into sub-networks with similar numbers of vehicles moving within them. The method is fast and enables to divide a traffic network with hundreds of crossroads in matter of seconds on a standard desktop computer.

Keywords: Distributed traffic simulation, network division, macroscopic simulation.

Presenting Author's biography

Tomas Potuzak was born in Sušice, Czech Republic. He went to University of West Bohemia (UWB) where he studied software engineering and obtained his degree in 2006. Then, he entered Ph.D. studies at the Department of Computer Science and Engineering (DCSE) at the same university and has worked on issues of distributed simulation of road traffic. He obtained his Ph.D. in 2009. He is now teaching assistant at the DCSE UWB. His research is focused on the issues of distributed simulations and component-based simulations.

CONTROL OF DISCRETE EVENT SYSTEMS MODELLED BY PETRI NETS

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Abstract

The control of a discrete event system implies the process of making the appropriate decisions to lead the DES to a desired behaviour that permit to achieve a set of objectives (usually related to financial profit, process time, utilization rate of the equipment, etc). Some of the decision problems that can be stated on industrial DES are associated to solution spaces whose size is determined by a combinatorial explosion. In these cases the computing time to solve the problem is a critical issue when a real application of the solution algorithm is searched. In this paper, it has been performed a systematic analysis on the characteristics of a DES where a decision problem can be stated, its translation into an undefined Petri net model and its representation by means of compound Petri nets and simple alternative Petri nets. As a result of this analysis, a promising research field is envisaged, which may permit to increase the efficiency of optimization algorithms developed so far, by means of the choice of the best representation of the Petri net model of the DES.

Keywords: Discrete event systems, undefined Petri nets, compound Petri nets, simple alternative Petri nets.

Presenting Author's biography

Emilio Jiménez Macías studied Industrial Engineering (Computer Science, Electronics and Automation specialty) by the University of Zaragoza. After working several years in the industrial private sector (Researching and Developing Department head position), returned to the university, at the University of La Rioja, in 1997, where he works presently in the Electrical Engineering Department (Coordinator of the System Engineering and Automation Group). In 2001 he presented his PhD thesis about Industrial Automation. His research areas include factory automation, modeling and simulation, and industrial processes.

CONTROL SOLUTIONS, SIMULATION AND EXPERIMENTAL RESULTS FOR A MAGNETIC LEVITATION LABORATORY SYSTEM

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Abstract

The paper presents two control solutions for the position control of a sphere in a Magnetic Levitation System with 2 Electromagnets. The nonlinear state-space mathematical model of the controlled plant was linearized around several operating points to enable for a low-cost control system design. Both control systems which are discussed, the state feedback control and the cascade control, are simple to design and easy to implement. Simulation and real-time experiments referring to the sphere's position and speed were conducted to validate the performance of the two control systems.

Keywords: Cascade control solution, Magnetic Levitation System with 2 Electromagnets, State feedback control solution, Simulation, Real-time experiments.

Presenting Author's biography

Claudia-Adina Dragoş. She received the Dipl.Ing. degree in systems and computer engineering and the M.Sc. degree in control systems from the "Politehnica" University of Timisoara (PUT), Romania, in 2007 and 2009, respectively. She is currently working toward the Ph.D. degree in systems engineering at the PUT. Her research interests include control structures and algorithms with focus on fuzzy, predictive and adaptive control. She is the coauthor of several papers published in journals and refereed conference proceedings. Ms. Dragos is a member of the Romanian Society of Control Engineering and Technical Informatics.

APPLICATION OF NEURAL NETWORKS FOR DYNAMIC MODELING OF ROBOTIC MECHANISMS

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Abstract

Nowadays the robots must be able perform more and more complex tasks at higher velocities and they must be able to interact with the environment. This can be achieved by using advanced control algorithms, which require exact cancellation of nonlinearities and coupling. For that, exact robot dynamic models are needed. Hence, accurate modeling of the robot manipulator dynamics has remained one of the important issues in robotic. Robot manipulators are highly coupled nonlinear systems and in practice we have to deal also with model parametric uncertainties and obtaining. So, accurate dynamic model is a challenging task. Direct measurements of the robot characteristics are usually impractical or even impossible in many cases. This fact complicates the modeling and identification. The idea is to employ neural networks (NN) for model based control, i.e. to use the ability of neural networks (NN) to represent the non-linear relationship for modeling the robot and to include NN in the control strategy. The proposed model is evaluated in a simulation as well as in real world experiment.

Keywords: Dynamic modeling, neural network, friction effects, gravity compensation.

Presenting Author's Biography

Tadej Petrič attended the Faculty of Electrical Engineering and Computer Science at the University of Maribor, Slovenia, where he obtained the B.Sc degree in Electrical Engineering in 2008. His B.Sc. covered modeling and robotic control of underactuated dynamic system. For his work, he received the prof. dr. Vratislav Bedjanič award in 2008. He is currently a researcher at the Department for Automation, Biocybernetics and Robotics at the Jožef Stefan Institute and a PhD student at the Faculty of Electrical Engineering at the University of Ljubljana.

MODELLING, SIMULATION AND CONTROL OF GAS METAL ARC WELDING

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Abstract

The objective in this paper is to combine the simulation of Gas Metal Arc Welding (GMAW) process models with the simulation models of inverter based power machines. The main goal of proposed approach is enhancing the hardware and software design of welding devices and research of new welding technologies. The GMAW process is considered as an electrical circuit and the mathematical model is based on physical descriptions of several parts of GMAW process, as are the electric circuit of power supply, the arc dynamics, and the electrode melting process. To establish the validity of the proposed GMAW model, a simple welding application was simulated in MATLAB SIMULINK. Welding parameters ware derived from several experimental conditions. Next, the dynamic behavior of full-bridge DC-DC converter is described and suitable discrete PI controller for welding current feedback control is proposed. Both models, the GMAW model and the inverter power supply model, are combined into simulation model of the GMAW process application together with the inverter based welding machine. Presented simulations are useful for study and research of new welding technologies, and for the rapid development of new control algorithms and design of new inverter control units as are power source circuits, and welding current or voltage controllers

Keywords: modeling, simulation, gas metal arc welding process, welding power source, inverter power supply.

Presenting Author's biography

Marjan Golob received his M.Sc. degree in electrical engineering from the University of Maribor, in 1991 and Ph.D. in electrical engineering from the University of Maribor, in 2000. In 1990 he joined the Department of Automation, Faculty of Electrical Engineering and Computer Science, University of Maribor as a Research Assistant and he is currently an Associate Professor. His research area of interest includes process modeling and control, fuzzy logic theory, and industrial automation. Currently he is involved in application research project Embedded intelligent systems for gas metal arc welding process.

PROCESS HISTORY BASED MULTIVARIATE STATISTICAL MODEL OF HEAT TREATMENT FURNACE FOR CONTROL OPTIMIZATION

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Abstract

Systems for supervisory control and data acquisition are being constantly upgraded to be able to satisfy production and customer needs. Lately, improvements are towards trend monitoring, fault detection, diagnosis and prognostics, where monitoring software includes advanced signal processing methods such as simple statistic analysis tools, sensor fusion, soft computing methods, etc. Since SCADA systems emerged many industrial processes have been collecting process data while monitoring the process operation. These process history databases are great source of information for data based modeling techniques such as multivariate statistical analysis. Furthermore, the model can be used for control optimization or fault detection and diagnosis tasks. In the paper some interesting modeling aspects are overviewed and tested by using process history data sets, multivariate statistical methods, neural networks, etc. By comparison of commercial SCADA system and Matlab we wish to test, if and how far modern SCADA systems are suitable for development and realization of data based process models and optimization tasks. Case study models used for testing are heat treatment furnace model, combustion chamber of biomass boiler, and tree tank system.

Keywords: modeling, neural networks, fault detection and isolation, prognostics, multivariate statistical analysis, SCADA.

Presenting Author's biography

Božidar Bratina, is currently working as researcher at the Faculty of Electrical Engineering and Computer Science, University of Maribor. In 2009 he finished PhD thesis from the field of automation and treatment of fault detection and diagnosis in industrial systems. Beside fault detection, isolation, diagnosis and prognosis, he is also interested in system modeling, identification and simulation, SCADA systems, intelligent buildings.

MODELLING AND FUZZY CONTROL OF BIOMASS STEAM BOILER SYSTEM

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Abstract

Use of biomass in industrial boilers requires more efficient control systems. In order to keep constant and undisturbed technological steam production for large changes in the operating conditions more process knowledge must be incorporated into the system. Control of the biomass steam boiler system often needs an experience operator intervention. In the particular case the operator based on presented process data manually controls the supply of the biomass and change primary air temperature and flow in to the combustion chamber. Local control loops increase the degree of automation and assure safety technological steam production. In order to minimize operator intervention and to stabilize technological steam production a Fuzzy controller seems to be ideal solution.
The paper shows an implementation of the Fuzzy control system that improves and optimizes a technological steam production of the biomass steam boiler system. The analysis and identification of real process data give promising mathematical model that was used for the development of an appropriate control algorithm in simulations. Recurrent auto-associative neural network model improves state space model in wider range of measured data. After small adjustments a Fuzzy controller was successfully implemented on real Biomass Steam Boiler System.

Keywords: Fuzzy Control, Neural Network, Biomass Steam Boiler System.

Presenting Author's biography

Nenad Muškinja. Graduate in electrical eng. in 1988 from the Techical Faculty of the University of Maribor (UM), in 1992 received M.Sc. degree from the Technical Faculty, UM, in 1997 received D.Sc. degree from the UM, FERI, in 1998, 2008 assistant professor, associate professor. For the present Prof. Nenad Muškinja is employed at the University of Maribor, FERI, Institute of Automation in the Laboratory of process automation. He has participated as a researcher in over 35 scientific research and R&D projects. Bibliography of Nenad Muškinja consists of more than 200 units, 12 in scientific journals and books, more than 50 presented on conferences, and number of project reports, diploma works, etc.

PHENOMENAL TRUST INTERVENTION MODEL

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Abstract

The paper deals with impersonal trust modeling focusing on intervention effect. Terms as trust, trust representation, phenomenal trust as a modification of impersonal trust, and trust representation are introduced. Brief description of extended trust model covering several factors effecting phenomenal trust forming is presented. Proposed model covers following basic factors: initial trust, product reputation, number of product recommendations, and trusting disposition as a representation of non rational part of human factor. With respect to trust forming, the method of intentional intervention on trust modeling is proposed. The model of trust evolution is extended in this way. The comparison of trust model with and without using intervention effect is discussed. The parameter values of trust intervention, i.e. intervention power, and intervention distribution are modified and the effect of these modifications on trust is demonstrated. Evaluation of intervention effect by entropy, relative entropy, and symmetric relative entropy is proposed. The model of intentional intervention on trust is applied to real data. The data deal with social trust in Czech Republic acquired by the Institute of Sociology of the Academy of Sciences of the Czech Republic. Results of this study are presented too.

Keywords: Trust, Trust modeling, Impersonal trust.

Presenting Author's biography

Arnoštka Netrvalová. She was born in Plzen, Czech Republic. She is senior lecturer in Department of Computer Science and Engineering at Faculty of Applied Sciences of University of West Bohemia. She holds a M.Sc. in Computer Science from University of West Bohemia in 1977 and a Ph.D. in Computer Science from the same university in 2010. Her research in modeling and simulation covered simulation of temperature homeostasis in an environment with increased temperature, and trust modeling.

A SIMULATION STUDY OF THE ORGANIZATION FOR EMPLOYMENT OF WORKFORCE IN GREECE

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Abstract

The principal aim of this paper is to depict the consequences of the current sociopolitical situation in Greece, on the functions of a crucial organization of public sector. This was feasible through a simulation study of a branch of the Organization for Employment of Workforce (OEW), which is the organization of the public sector responsible for employment. OEW was selected for the present study because of the functional problems that faces, due to both international and national economic crisis. The objective was to study and model the long waiting queues and the time delays during the allowances given. Discrete event simulation implemented with the simulation software SIMUL8, offered a comprehensive and flexible framework for modeling and experimentation. The system was divided into separate and parallel subsystems, some of them interdependent with each other, that were described by Activity Cycle Diagrams. Statistical analysis of the results obtained from the SIMUL8 model was performed, as well as for validation and verification techniques were applied on the model. Finally, hypothetical scenarios concerning the operations of the organization were conducted. The simulation model provided strong justification that waiting queues were dependent on the number of employees, the number of days waiting for the allowance and the arrival rates of citizens.

Keywords: Simulation, Modeling, Simul8, Organization for Employment of Workforce, Economical Crisis.

Presenting Author's biography

Aikaterini Spyropoulou got her Diploma as an Electrical and Computer Engineer from Polytechnic University of Democritus University of Thrace and the M.Sc. in Informatics and Management. She worked for 1.5 years in the Organization for Employment of Workforce and she is currently collaborating with the Department of Informatics, Aristotle University of Thessaloniki. Her research interests include operational research and simulation techniques in management.

MULTIMODAL OPTIMIZATION OF SIMULATED SYSTEMS

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Abstract

Many approaches have been suggested to solve simulation optimization problems. In classical problems, these approaches provide only one solution (optimal or "near optimal"), which is the one that gave the best results on a given performance criterion, on the basis of the simulation experiments performed. In such types of problems as design problems, this "best solution" may not be considered as the most suited for design makers. Indeed, other considerations as the measured performance can have to be taken into account (e. g., certain solutions can be more difficult to implement, or may induce supplementary costs); the simulation model cannot incorporate all the elements that are important to the decision maker. To provide decision makers with sufficient flexibility in their final choice, we suggest to provide several efficient solutions (the best found and some other local optima with acceptable performance) instead of only one. Then, the decision makers can make their choice based on other considerations than only the performance evaluated by simulation. To address this problem, we propose to combine a multi-modal evolutionary algorithm with a simulation model. We show how such an approach can be implemented by adapting the recently published Crowding Clustering Genetic Algorithm (CCGA) and connecting it with ARENA. The benefits of this multimodal simulation optimization approach are illustrated with a supply chain problem where several parameters have to be optimized.

Keywords: Multimodal optimization, simulation optimization, supply chain.

Presenting Author's biography

Ahlem Baccouche is preparing her Ph.D. in computer science within a collaboration between LIMOS-UMR 6158 (Laboratory of Computing, System Modeling and Optimization) in France and UTIC 02/UR/14-03 (Research unit of technologies of information and communication) in Tunisia. She is interested in simulation optimization of such systems as manufacturing systems under uncertainty.

ON THE USE OF RFID FOR SUPPLY CHAIN SCHEDULING AND EXECUTION CONTROL

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Abstract

In this paper, we investigate the issues of establishing adaptive feedbacks between supply chain (SC) scheduling and execution from the perspectives of modern control theory. In using optimal control for scheduling stage, feedback adaptive control for the execution stage, and attainable sets for the analysis of the achievement of the planned performance in a real execution environment, we provide mathematically unified framework for SC scheduling and execution control. The proposed frame-work makes it possible to analyze the correspondence of RFID (Radio Frequency Identification) functionalities and costs to the actual needs of execution control and support problem-oriented SC adaptation for the achievement of the desired performance. The developed framework can be applied as an analysis tool for the decision support regarding the designing and applying RFID infrastructures in supply chains.

Keywords: Supply Chain, RFID, Optimal Control, Feedback, Adaptation.

Boris Sokolov's biography

Prof. Dr-Eng. Boris Sokolov, born in 1951, is a Deputy Director for research in Saint Petersburg Institute of Informatics and Automation the Russian Academy of Science (SPIIRAS). He received his M.Sc., PhD, Dr. Sc. Eng. and Prof. in 1974, 1983, 1993 and 1994 respectively. From 1966 to 1999, he has developed his military career at the A.F. Mozaisky Academy in Leningrad/St Petersburg, from a cadet to a colonel. Since 1999 he has been a professor in St Petersburg State University of Aerospace Instrumentation. In 2008, he became an honoured scientist of Russia. He is the author and co-author of 3 books on systems and control theory and of more than 200 scientific works published in various academic journals. Professor B. Sokolov supervised more over 50 research and engineering projects.

GLOBAL EXPLORATION OF OPTIMIZATION LANDSCAPES FOR NONLINEAR ILL POSED PARAMETER ESTIMATION PROBLEMS

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Abstract

Current approaches to parameter estimation concentrate on finding the global optima of the least squares problem of likelihood functions. Due to poorly determined parameters and noisy experimental data only finding the optimum does not meet the requirements of life science researchers. The shape of the optimum and the possibly other local optima which are almost as good as the global optimum are of key interest.

The algorithm described in the present contribution explores the parameter space of the objective function and produces a piecewise approximation of the objective function by quadratic functions, whereas the approximation quality can be adjusted at the cost of higher computational effort. In this way it is possible to gain more information on the global optimum, its shape and its neighborhood. On the other hand the algorithm is not able to guarantee the best solution and arbitrary fine details of the objective function get lost.

Keywords: Nonlinear Parameter Estimation, Global Function Exploration, Branch and Bound Algorithm, Ill posed Problems

Presenting Author's biography

OLIVER SCHWEISSGUT studied computer science at the University of Siegen and obtained his diploma in 2006. In 2000 he founded the software engineering company os-cillation in Siegen. Beside the position as CEO of os-cillation, he is a part-time Ph.D. student at Research Center Jülich since 2006.

A NEW SCHEDULING METHOD BASED ON DISPATCHING RULES AND APPLICABLE BY SIMULATION MODELS

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Abstract

Scheduling and sequencing problems are an important part of production planning problem and usually many assumptions are considered in order to simplify these problems. Simulation models are used because simplifier assumptions can be put aside and so the models reflect reality more precisely. In this paper a method which performs scheduling by combining different dispatching rules has been presented. It means that when deciding on a specific machine some different dispatching rules are used to determine the best candidate on that machine. The model is run for various combination of dispatching rules and the best observed result is reported. Since dispatching rules are easily executed by simulation engines this method can be generally used as a simulation based scheduler module for production systems. Finally, some suggestions for improving the model are presented.

Keywords: Sequencing and Scheduling, Simulation, Dispatching Rules.

Presenting Author's biography

ALI RAZZAZI is a master simulation consultant. He received his MSc in Industrial Management from Science and Research Branch of Islamic Azad University and his BSc in Industrial Engineering from Isfahan University of Technology of Iran. He has been manager of number of simulation projects and has taught simulation software in number of companies and universities.

STABILITY AND CONVERGENCE OF THE MODERN TAYLOR SERIES METHOD

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Abstract

The paper deals with extremely exact, stable and fast numerical solutions of systems of differential equations. In a natural way, it also involves solutions of problems that can be transformed to solving a system of differential equations.
The project is based on an original mathematical method which uses the Taylor series method for solving differential equations.
The Taylor Series Method is based on a recurrent calculation of the Taylor series terms for each time interval. Thus the complicated calculation of higher order derivatives (much criticized in the literature) need not be performed but rather the value of each Taylor series term is numerically calculated. Another typical algorithm is the convolution operation. Stability and convergence of the numerical integration methods when the Dahlquist problem is solved, Taylorian initial problems with automatic transformation, stability and convergence of a system of linear algebraic equations and stability and convergence when algebraic and transcendental equations are solved will be discussed in the paper.

Keywords: Stability, Convergence, Modern Taylor Series Method, Differential equations, Continuous system modelling

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. He has presented the work on the Modern Taylor Series Method and the simulation language TKSL at many occasions at home and abroad.

ONE APPROACH TO VERIFICATION AND VALIDATION OF SIMULATION MODEL

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Abstract

The problems of simulation model validation and verification in CAD system Triad.Net are discussed. CAD system Triad.Net is developed for computer system design. It uses simulation as the main method for computer systems investigation. Authors observe the specifications of the simulation model in Triad.Net, consider the program tools for simulation model analysis (information procedures and conditions of simulation) and propose to use them for simulation model validation and verification, debugging and testing. Besides, authors suggest program tools including the intellectual agents and ontology for localization of mistakes determined during verification and validation processes.

Keywords: Simulation Model, Validation, Verification, Debugging, Ontology

Presenting Author's biography

Elena Zamyatina is an Associated Professor of Computer Science at Perm State University, the lecturer of the Faculty of Mechanics and Mathematics. 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 30 years of professional experience in programming tools design, particularly in simulation domain. She is the author of over 70 papers in the area of simulation, distributed simulation, parallel and distributed systems

FROM TRACEFILE ANALYSIS TO UNDERSTANDING THE MESSAGE OF SIMULATION RESULTS

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Abstract

Recent approaches for automatic trace file analysis mainly focus on formalizing simulation outcome in the context of a certain application area. They have in common the very much reduced role they give to the persons who build or use the simulation model. Instead they assume any result derived from simulation can directly and automatically be extracted from the trace file without any additional intervention by the simulating person. Against this background the paper reviews related work for trace file analysis with regard to its motivation, approaches and state-of-the-art. This is put into relation to simulation user needs in the logistics application area in order to discus to what extent trace file analysis helps in deriving findings, which role the user plays in receiving those results, which kind of support is missing here and how it could be provided. Conclusions emphasize that it is necessary to see behind pure simulation data in order to understand the real message of simulation results. This interpretation step requires both knowledge and understanding of the domain and mathematical/statistics skills. Automatic trace file analysis supports preparation of interpretation steps but cannot fully replace the user who brings in objectives, motivation and focus of the simulation project as well as domain-specific experiences and competences to understand the message of simulation results.

Keywords: simulation output interpretation, trace file analysis, simulation knowledge, discrete event simulation, logistics.

Presenting Author's biography

Gaby Neumann is Professor in Engineering Logistics. Since 1991 she has been part-time consultant in logistics simulation, too. Her current activities and research interests are mainly linked to problem solving and knowledge management in logistics simulation and planning, but also cover technology-based logistics learning. She has widely published in these fields. Her e-mail address is gaby.neumann@tfh-wildau.de.

THIRD PARTY OPTIMIZATION TOOLS - A SURVEY

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Abstract

Most specialized software packages for simulation lack the capability of optimization (and therefore also identification). Third Party software fills this gap by providing optimization tools that treat the simulation as a black box function that has to be minimized. The range of this tools spans from elaborate commercial products with comfortable GUIs to open source products which are delivered as packages for programming languages. The standards in scientific documentation of the employed algorithms and their exact implementation vary between undocumented propitiatory code with unknown functionally to scientifically disseminated algorithms shipped together with well defined interfaces. In this paper, eight software tools or libraries are described and tested on two problems, a classical optimization problem - the Rosenbrock function - and a benchmark problem from the SNE magazine, which resembles a real life model calibration task. It is shown that commercial products do not outperform open source Software. Therefore open source tools or libraries unsurprisingly excel in cases where transparency is important, while the commercial tools are better suited for users who only care for results.

Keywords: Optimization, identification, ARGESIM Comparison

Presenting Author's Biography

Florian Judex specialised in modelling and simulation during his master and PhD studies in applied mathematics at the Vienna University of Technology. Currently he is a researcher in the field of sustainable building technology in the Energy Department of the Austrian institute of technology, dealing with the modelling and optimization of renewable energy systems.

SCENARIO-BASED APPROACH TO AGENT'S EVALUATION

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Abstract

Software agents allow solving problems, which cannot be easily described in the pure analytical way. Control of the traffic light signalization in city is an example of such problem, and many different agent-based solutions were proposed in the last decade. However, it is difficult to compare proposed solutions and determine which agent will provide best results. We have created a system that allows comparing different traffic control agents. We are using microsimulation of the real traffic network and the agents are operating in the same conditions, described in the detailed scenarios. Scenarios allows us to model non-linear character of the traffic flow and embrace different situations, which may occurs in the real traffic – such as accidents or sudden changes of weather conditions. Comparison of agents in the different scenarios may show their strong and weak parts, and help with selection of agent which provides the best results.

Keywords: Traffic control, Software agent, Evaluation, Microsimulation.

Presenting Author's biography

Richard Lipka was born in Plzeň, Czech Republic and went to University of West Bohemia, where he obtained master degree in 2007. Since then, he is a PhD student at Department of Computer Sciences and Engineering of UWB. His main scientific interests are road traffic simulation and agent control of large networks. His e-mail address is: lipka@kiv.zcu.cz .

ANALYSIS OF WAREHOUSE ORDER PICKING SYSTEMS USING SIMULATION TECHNOLOGY

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Abstract

Order picking tends to be one of the most important processes occurring in a warehouse because it is directly linked to the ability of the quick and accurate processing of customer orders. The different order picking systems can vary greatly and depend on the characteristics of the handled articles, number of transactions, number of orders, picks per order, quantity per pick, value-added processing such as labeling, weight and volume of the articles, etc. Often a combination of picking systems is needed to handle distinct article and order characteristics. Furthermore picking processes often vary with the season or with an increasing business. Against the background of these influences the question arises if picking systems are plannable and optimizable? The primary goals of optimizing a picking process include increases in productivity, reduction of cycle time and increases in accuracy. Unfortunately these goals conflict with each other and the interactions between the various warehouse processes are too complex to observe. A simulation of the involved processes helps to evaluate different order picking systems for a given article and order structure before changes to the picking system are made in the real world. This work deals with the implementation of order picking systems based on their process level into a simulation model, realizing alternative experiments and a rudimentary interpretation of their simulation results.

Keywords: Eurosim, Simulation, Warehouse logistics, Order picking

Presenting Author's Biography

Rainer Frick. He is currently studying Business Administration and Computer Science at the University of Innsbruck. His main focus is developing software in the simulation field at V-Research company.

THE POSITION DETECTION SYSTEM OF THE AUTONOMOUS MODEL CAR GT-CAR

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Abstract

Gigatronik has developed GT-Car as a new experiment for laboratories in control theory, mechatronics, vehicle dynamics, or embedded software engineering at universities and technical colleges. GT-Car is an autonomous model car in the 1:10 scale driving on a conveyor belt with speeds up to $4.2\frac{m}{s}$. The control algorithms of GT-Car are developed in a model-based development process in MATLAB/Simulink. By one single mouse click, C-Code is generated from the Simulink model, compiled and flashed to the microcontroller of GT-Car, so that students can rapidly design and test control algorithms. Since GT-Car integrates the powerful microcontroller Infineon TriCore TC1796, computationally expensive advanced control algorithms can be applied in real-time. The focus of this paper is on the position detection algorithm of GT-Car that integrates infrared distance sensors and an inertial measurement unit. By processing the infrared distance signals as well as the acceleration and yaw rate signals of the inertial measurement unit, an onboard Kalman filter estimates the position of the car on the conveyor belt in real-time. In addition, the dynamical simulation model of GT-Car is presented that describes the vehicle dynamics in relative motion on a moving surface.

Keywords: Autonomous model car, Laboratory experiment, Position detection system, Kalman filter, Vehicle dynamics model, Model-based software development.

Presenting Author's Biography

Frank Tränkle received his Master of Science degree in Chemical Engineering at the University of Wisconsin in 1993 and his diploma in Technische Kybernetik at the Universität Stuttgart in 1994. In his doctoral thesis at the Universität Stuttgart he developed the modeling tool PROMOT for the object-oriented modeling and dynamical simulation of chemical processes. After his doctoral degree in 1999 he worked as a software engineer for hardware-in-the-loop test systems at ETAS GmbH in Stuttgart. He took over the lead of the LABCAR software development team at ETAS in 2001. Since 2006 Frank Tränkle is the director of the function development and simulation department at Gigatronik Stuttgart GmbH. His work focuses on model-based embedded software development, real-time vehicle simulation models, and hardware-in-the-loop testing.

THE FLOW MODELIZATION BY PETRI NET AND URBAN TRAFFIC

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Abstract

The observation and the regulation of flows is very usefull in numerous domains of applications : in production systems, considering the flow of objects on a production line, in software ingeneering, considering data flow, in urbanism, considering the flow of vehicles. Among the applications of Petri Nets, there is a great number of examples in these domains in order to represent, to analyse the production systems and the conflicts management in urban traffic. Among others, these points need to solve some problems of resource sharing and complex sequencing. In this viewpoint, we propose now a modelization of regulation flow by Petri Net (PN). Then, we propose some models of flow measurement, in order to compare the occupation rate and some dynamical sequencers for a better dispaching of tasks in a real structure.
After a presentation of the principles on which the regulation takes place, we take up a specifical application : the flow regulation in an urban traffic. The exposed problem is relatively simple and could be extended to more complex situations.

Keywords: Petri Nets, flow control, urban network, modelization, real time, sequencers.

Presenting Author's biography

Marc Bourcerie obtained PhD degree in 1988. His work was about the aging of N-MOS transistor. In 1989, he joined the University of Angers where he obtained "HDR" degree in 1996. In LISA laboratory, he works on the modelling of complex systems by generalized or coloured Petri nets. He is particularely interested by the modelization of flow a regulation in manufacturing, production systems by Petri Nets.

EXTENSIVE TRANSPORTATION SERVICE SYSTEMS AND THEIR FLEXIBLE SIMULATION MODELING

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Abstract

Largely developing area of computer simulation brings many unresolved issues when it comes to building extensive simulation models of complex service systems. For the purpose of creating the simulation models of such systems it is necessary to choose appropriate tools and approaches, which allows designers to respect the real system structure and create models with highest values of model quality indicators. Such models must be flexible and easy to maintain. The fact is that without existence of adequate supportive environment the work with complex simulation models, regarding their size and need of detailed modeling becomes very hard to accomplish and in some cases even unmanageable. One of the contributions of our work is to push forward imaginary frontiers, when the simulation model is still manageable towards more complex models. Presented solutions enable us to create far more extensive models as we could accomplish in the past. For these purposes we are using our own agent architecture ABAsim and our software tool for building generic simulation models called ABAbuilder. This paper also talks about one generic simulation model called Villon, which is suitable for simulating processes in railway transportation terminals.

Keywords: extensive service systems, conceptual modeling, nonprocedural algorithms, generic simulation models, large scale simulation modeling

Presenting Author's Biography

Michal Lekýr graduated at the University of Žilina in 2003, where he in the same year started PhD study and graduated in 2007. For two years he worked at the Boston University, in Brain and Vision Research Lab as a research assistant and scientific programmer. Currently he is working as an assistant professor, teaching and doing research in simulation and computer graphics as well as teaching assembly language programming course.

RULE-BASED INTERVAL VALUED FUZZY LOGIC SYSTEM

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Abstract

Today road transport models (microscopic, mesoscopic and especially macroscopic) are not respecting influence of driver mental processes or are strongly simplifying them. Human brain processes uncertain information from imprecise sources on the base of incomplete model of environment, other driver behaviors, skills and features, traffic situation, etc. The big problem of today development is to model human reasoning under conditions of incomplete, imprecise, insufficient or vague information and to bring human mental models and human information processing into our transportation models. It limits today models predictive capabilities. This paper presents novel rule-based description extending well known Takagi-Sugeno-Kang system and implementing Interval Valued Fuzzy Sets. The main difference to standard Takagi-Sugeno-Kang rule system is that left side of the rule does not describe position of one singleton but whole set of parameters determining positions of fuzzy number landmarks. Non-standard interpretation of resulting fuzzy set called granulation replaces usual defuzzyfication to improve understanding of uncertainty of the result. The system is used for human driver mental model development to improve today road transport systems because it is able to describe change of uncertainty. For example, uncertainty of future trajectory of neighborhood car changes with quality of street surface, speed weather conditions, etc.

Keywords: Transport modeling, Mental models, Fuzzy set, Rule, Fuzzy linguistic variable, Granulation.

Presenting Author's biography

Tomas Brandejsky is head of Department of informatics and telecommunications of Faculty of Transportation Science at Czech Technical University in Prague. He received Ing in mechanical engineering and PhD in Cybernetics at CTU. He publish many papers in Soft computing, especially fuzzy sets, genetic algorithms and genetic programming. He also works in area of Artificial Intelligence and Software reliability and safety.

LABI – MODELLING AND ANALYSIS THROUGH EXAMPLES

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Abstract

In the educational publications it is often pointed out that modelling is just another word for system understanding. Technically it can be regarded also as a system analysis. During teaching process examples usually play an important role to dynamical system understanding. To improve illustration possibilities, to encourage observation of system properties and to stimulate students' activity LABI (LABoratory of mathematIcal models of SISO and MIMO systems) graphical user interface has been developed in Matlab, through which illustrative examples and important analytical and some design functions can be accessed in a user – friendly way. They are organized in such a manner that they support and complement the lectures, exercises and students' activities which are basically organized through the so called seminars.

Mathematical/simulation models and/or experiments can be divided regarding different criteria. The starting examples are usually very simple (low order, linear, stable, ...), while several of them describe also real processes, some of them are connected with the pilot plants from our laboratories (Laboratory of Modelling, Simulation and Control and Laboratory of Autonomous Mobile Systems, Faculty of Electrical Engineering, University of Ljubljana, Slovenia).

To the set of models analytical toolbox has been added where the properties of the LTI models can be observed in a user friendly manner. These functions can be used for SISO or MIMO processes. Presented environment was well accepted by the students.

Keywords: Education, Modelling, Simulation, Analysis, Tool-box, Visualization.

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 associated professor. Her research interests include modelling and simulation of dynamical systems and control systems analysis and design, especially of MIMO-systems.

ANALYSIS AND COMPOSITION OF DISCRETE EVENT ORIENTED SIMULATIONS USING DISTRIBUTED WEB TECHNOLOGIES

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Abstract

The rising facilities of higher level protocols for internet communication have provided successful implementations in current web development. Web applications are not merely meant to display information and content, but work interactively using standardised conventions. These technology is commonly used in many social platforms where different kind of applications interact together regardless of the actual programming language they were written in.
The purpose of this paper is to use these communicaton layers for a platform independent web based e-learning system for discrete event oriented simulation. The software shold be used for academic teaching purposes. The server-sided simulation is basically a multi-tier software architecture. The client communicates only through the W3C defined standards such as XML,HTML, Javascript and JSON. Thus the client's browser does not require any third party software like Flash, Java Plugin, etc. This convenience allows the simulation environment to swap the backend simulation engines so that the same experiment can be executated with different simulators for e-learning portals.

Keywords: Discrete Event Simulation, Web-Based Simulation, AJAX Webinterfaces, E-Learning

Presenting Author's Biography

Aman Atri studied Software and Information Engineering at the Vienna University of Technology. His bachelor thesis analyses automated proofs for model checking in temporal logic. After his bachelors program he pursued with the master course Software Engineering and Internet Computing. His master thesis deals with discrete simulation and visualisation schemes for the web. This work has been dilated in his PhD thesis where he is analysing and developing service oriented simulation frameworks and interoperable connectivity of different simulators. He is working as a research assistant at the Vienna University of Technology (Institute for Analysis and Scientific Computing).

TOWARDS A TUTORING SYSTEM FOR BIOLOGY STUDENTS LEARNING MODELING AND SIMULATION

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Abstract

From the wet-lab to the dry-lab, Biologists have a big step to do – and little help. Conventional lectures can be completed by the use of a tutoring system to help Biology students with the learning of modeling and simulation of biochemical processes. In order to develop such a tutoring system, we first defined a modeling and simulation workflow aiming to minimize the sources of error for novice modelers and to give a structure to a tutoring system. We then identified teaching objectives through an expert survey. These teaching objective describe the most critical issues to be assimilated by the students to improve the modeling skills they need. With a user survey, we identified the mental model of the target group regarding biochemical processes and established the requirements on the structural and visual design of the tutoring system. Thus, we laid the foundation stone for the development of a tutoring system for Biology students learning modeling and simulation.

Keywords: systems biology, workflow, eLearning, mental model

Presenting Author's Biography

Géraldine Ruddeck is a Ph.D Student at the University of Rostock in the domain of eLearning and Cognitive Systems. She is part of the Research Training Group "Integrative Development of Modeling and SImulation Methods for RegeneratIve Systems" (dIEM oSiRiS), an interdisciplinary research group involving Biologists and Computer Scientists.

SIMULATION EDUCATION AND ITS COLLABORATIONS WITHIN UNIVERSITY CURRICULA

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Abstract

Simulation education has been a significant facet of university curricula, both in industrial engineering and in business management, for many years. Indeed, the importance of simulation education to both these curricula approximately coincides with the accessibility of simulation analyses via skillful programming in computer languages on mainframes and significantly precedes the availability of desktop computers and their specialized, largely point-&-click software tools. The simulation educator, whether teaching within a college of engineering (and most likely the sub-discipline of industrial engineering) or within a college of business or management, has various valuable opportunities to emphasize the reliance of simulation upon prerequisite and concurrent course work. Likewise, educators in related disciplines have opportunities to stress the usefulness of material taught in their courses to simulation analyses. When fully exploited, these cross-fertilization opportunities enhance collegiality, student motivation, and retention and integration of important concepts and techniques. In this paper, we explain these opportunities, particularly with respect to statistical concepts, computer analysis and programming skills, industrial engineering and managerial observations, and interpersonal and teamwork skills. Broadly stated, we undertake the examination of both how the simulation educator can support the educator of related disciplines, and the converse how the educator of disciplines related to simulation can support the instructor of simulation.

Keywords: simulation, education.

Presenting Author's Biography

Edward J. Williams holds bachelors and masters 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 (December 2001) as a computer software analyst supporting statistical and simulation software. After retirement from Ford, he joined PMC, 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.

MODELING AND SIMULATION TRAINING FOR UNDERGRADUATE STUDENTS

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Abstract

Education should be beyond simply offering content and asking learners to master it. Primarily, it should aim to create a critical view for the problems that exist and make individuals flexible, creative and open to different approaches towards potential solutions. Modeling and simulation deal with the real world issues through abstractions of its complexities and testing possible outcomes using "what if" analysis. Getting a deeper insight in the nuts and bolts of this area demands long training with a good start. Hence, developing an introductory course that will introduce undergraduate students to the art of modeling and various techniques in performing experiments using simulation is a demanding and daunting task. Many concerns need to be addressed. Inter alia, the conceptual syllabus, the scope of the coverage, the pedagogical approach, and the simulation software environment. The article argues that a course that spans over the three major approaches to simulation and does not require rigorous prerequisites and extensive background from the students, in addition of being a smooth introduction to modeling techniques, serves as a sound and fertile basis for their future education. Moreover, the latest developments of multi-paradigm software tools, which are user friendly and intuitive to use, further facilitate the process of course design, implementation, and acceptance by the students. The experience gained through the first two years in offering this kind of course proved most of the enumerated expectations.

Keywords: Modeling, Simulation, Multi-paradigm approach, Courses in M&S.

Presenting Author's biography

Iskra Popova has Ph.D. in Computer Science and has thought at Saints Cyril and Methodius University, European University, and Mid Sweden University. At present she works at Department of Computer and System Sciences at Stockholm University. Her research and educational interests are focused in the areas of Internet technologies, e-Learning modeling and simulation.

TEACHING GPSS IN E-LEARNING ENVIRONMENT

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Abstract

This paper describes specific implementation of GPSS (General Purpose Simulation System) for teaching discrete event simulation in e-learning environment. Primary goal of the research is to develop interactive and user-friendly web based environment for creating, testing and analyzing discrete event system models and integrate it in existing e-learning system. We introduce a new solution for learning simulation over web - FONWebGPSS. Architecture and key components of FONWebGPSS application are described in the paper, as well as integration with e-learning management system Moodle. In addition, we provide an example of applying FONWebGPSS in solving a typical problem of discrete event simulation.

Keywords: GPSS, FONWebGPSS, discrete event simulation, e-learning, web based learning.

Presenting Author's biography

Marijana Despotović was born in 1977, in Ruma, Serbia. She received her BS degree at the Faculty of Organizational Sciences, University of Belgrade in 2001, and MSc degree in 2003. She received her PhD degree with thesis "Design of methods for postgraduate e-education based on internet technologies" in 2006. Since fall 1995 till present she has been with the University of Belgrade, Faculty of Organizational Sciences, Department of Information Systems, currently as a professor of computer sciences. Since 2001 she has been teaching several courses at the Faculty of Organizational Sciences: E-business, Simulation and simulation languages, Internet technologies, Risk management in information systems. Her current professional and scientific interests include computer simulation, simulation languages, information systems, software project management, internet technologies, distance education. She can be reached at maja@myelab.net.

HIGH-ORDER GAUSSIAN PROCESS MODELS FOR PREDICTION OF OZONE CONCENTRATION IN THE AIR[1]

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Abstract

Ozone is one of the main air pollutants with harmful influence over human health. Therefore, predicting the ozone concentration and informing the population when the air quality standards have been exceeded is an important task. In this paper, first- and high-order Gaussian process models for 1-hour ahead prediction of ozone concentration in the air of Bourgas, Bulgaria are identified and verified. For this purpose, the hourly measurements of the concentrations of ozone, sulfur dioxide, nitrogen dioxide, phenol and benzene in the air and the meteorological parameters, collected at the automatic measurement stations in Bourgas, are used.

Keywords: System identification, Ozone concentration prediction, Gaussian process models.

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, IEEE.

[1] This work was financed by the National Science Fund of the Ministry of Education and Science of Republic of Bulgaria, contract №DO02-94/14.12.2008 and the Slovenian Research Agency, contract №BI-BG/09-10-005 ("Application of Gaussian processes to the modeling and control of complex stochastic systems")

A HYBRID APPROACH TO MODEL AND SIMULATE THE DOUBLE-GIMBALED MEMS-BASED MICROMIRROR

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Abstract

In this paper, the hybrid approach to model and simulate the behavior of the double-gimbaled MEMS-based micrommiror is presented. The model of the micromirror is represented as a system of coupled equations and combines both the distributed and lumped parameter description. The advantage of the hybrid approach is improved accuracy of simulation results in comparison with the results obtained from pure lumped parameter models, and on other hand, the enormous reduction in simulation time in comparison with the models completely based on the distributed parameter description. The model involves electrostatics, solid mechanics and gas dynamics. Thus, the multiphysics interactions have to be considered and therefore they are discussed in the paper. The gas-damping is modeled by the finite element analysis (via squeeze-film damping effect), and thus, there is no need for the derivation of the analytical formula of the gas-damping.

Keywords: Hybrid model, Multiphysics interactions, MEMS-based micromirror, FEM

Presenting Author's biography

Michal Stepanovsky received the MSc and PhD degrees in mechatronics from the Alexander Dubcek University of Trencin. His research interests include the design of optical switches for all-optical networks and multi-physics simulation of dynamical systems by using finite element analysis, especially the simulation of the MEMS-based devices. He is interested in the modeling and simulation of the mechatronic systems and also in the parallel computer architectures.

STUDY ON HIGH EFFECTIVE SIMULATION OF COMPLEX ELECTROMAGNETIC ENVIRONMENT

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Abstract

The simulation of Complex Electromagnetic environment (CEME) is very helpful and can provide much information for communication systems design and the testing of electronic equipment. In order to simulate CEME in a computer, the commutating time and capacity of the computer memory must be considered, especially for large-scale areas. In this paper, a hierarchy and structure of high efficiency simulation for CEME is proposed, as well as the performance index in the simulation. A new performance index is given out to deal with the use of computer memory, communication time, and power consumption. In order to calculate the matrix equation for CEME simulation, we can use computer clusters, and solve the matrix equation which is the derivation using the finite-difference (FD) method by parallel computing. This method requires much higher arithmetic speed, timeliness handling accuracy, and fleetness of the computers. The energy consumption of the entire system is considered in the performance index. The conservation of energy concept in high efficiency simulation for CEME is investigated, and the optimal method used to obtain the optimal performance in the simulation system is studied. In order to get good performance and high efficiency, multiobject optimization method (MOOM) is employed to minimizing the communication time, power consumption, computer memory.

Keywords: CEME simulation, high effective simulation, parallel computation, optimal method

Presenting Author's biography

YingNian Wu, Lecturer. He is currently a Ph.D. student at the School of Automation Science and Electrical Engineering, Beihang University, Beijing, China. He works at the School of Automation, Beijing Information Science & Technology University, Beijing, China. His research interests include system modeling and simulation, high performance computing, networked control systems, and automatic control.

DEVELOPMENT OF A PRESSURE AND THERMALLY CONTROLLED VALVE BY USING FEM - SIMULATION

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Abstract

In solar heat installations the by outgassing from the solar fluid emitted gases has to be discharged from the system in continuous periods to guarantee whose secure and efficient function. In line with this article the development of a novel expansion actuator for valve applications shall be illustrated, which allows a regular and complete stand - alone de - airing of solar heat installations. The special feature of this innovation is that the expansion actuator does not need an external power supply and that there is no need for control electronic and sensor systems.

Keywords: FEM - simulation, smart valve, thermal control, solar heat.

Presenting Author's Biography

Uwe Risto is graduated with a diploma at the university of technology in ilmenau in the year 2006. Since 2006 he is a research assistant at the university of technology in ilmenau/germany at the depatment of mechanism technology. His main research field is the investigation of the snap - through behaviour of axisymmetric spherical shaped caps of a hyper - elastic material by using FEM - simulation. The investigations have the aim to create new and extraordinary compliant systems, especially for valve applications with smart mechanical features.

THE PSEUDO-OUTPUT ERROR IDENTIFICATION ALGORITHM: EFFECT OF THE STATIONARY FILTER

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Abstract

A new off-line optimization approach for system identification, known as the Pseudo-Output Error (POE) algorithm, is based on the introduction of a stationary filter in order to compute the sensitivity functions. The selection of the filter is crucial so that the POE algorithm converges to the desired values of the real system. Generally, it is possible to have a priori knowledge of the desired system such as input-output measurements, harmonic studies or the step input response. The selected stationary filter is a low pass filter. Its order is assumed to be the same as the order of the model and the corresponding pass band is a priori information. In this context, the effect of the bandwidth, defined in terms of the cut-off frequency of the stationary filter, on the convergence of the POE algorithm is studied and is analyzed. The results of the performed Monte-Carlo simulations show that the convergence of the POE algorithm to the desired values of the system to be identified is affected by the selection of the cut-off frequency of the stationary filter. It is more appropriate to select the cut-off frequency of the stationary filter to be greater than the corresponding value of the real system for the convergence of the POE algorithm. The convergence is achieved within a range of cut-off frequencies.

Keywords: Pseudo-Output Error Algorithm, Stationary Filter, Gauss-Newton, System Identification, Parameter Estimation.

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 in 1996. Currently, he is a 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.

MULTI-DOMAIN MODELING AND DISTRIBUTED REAL-TIME SIMULATION OF AN AUTONOMOUS VEHICLE

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Abstract

In this paper the modeling and simulation of an autonomous vehicle is presented. The complete reliability of the vehicle's onboard embedded systems is crucially important, especially when their functions are relevant to safety. Increasingly extensive embedded software and even shorter manufacturing times in the automotive industry make it nearly impossible for developers to test real prototypes down to the last detail. For these reasons the functional safety verification of a complete car system should involve virtual engineering techniques. Our goal is to analyze the safety of these embedded systems by means of co-simulation and hardware-in-the-loop tests. This task requires a real-time capable model of the complete mechatronic system. The simulation of the complete car system is distributed among separate simulators that are communicating in real-time with each other: the sensors, the navigation algorithms and the road environment are also co-simulated with our distributed multi-domain model of the driving and steering subsystems and the chassis. The paper reflects also some modeling thoughts that had to be met in order to guarantee a good simulation performance using the Modelica language and Dymola environment.

Keywords: System Modeling, Autonomous Vehicle, Modelica, Dymola.

Presenting Author's biography

Tamas Juhasz received his PhD title in Informatics from the Technical University of Budapest, Hungary in 2009. His thesis has focused on different areas of computer-aided engineering: multi-domain modeling and simulation of physical systems including advanced visualization methods. His recent research addresses the partially automated translation of CAD information to Modelica models, allowing a rapid way of analyzing and optimizing a mechatronic system before it even physically existed.

SIMULATION-BASED DEVELOPMENT AND OPERATION OF CONTROLS ON THE BASIS OF THE DEVS FORMALISM[1]

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Abstract

The Discrete Event System (DEVS) Formalism is based on systems theory and provides an extensive framework for modeling and simulation of discrete event and hybrid systems. This paper investigates the suitability of Parallel DEVS (PDEVS), a general DEVS extension, and of the specific Real-Time DEVS (RT-DEVS) extension for a throughout simulation-based development of discrete event controls. The research is based on the V-Model that generally describes the control development process, whereas main focus is set to the Rapid Control Prototyping (RCP) concept. As a result the PDEVS and RT-DEVS specifications are integrated to form an extended DEVS specification called PDEVS-RCP. Finally, the usage and functionality of PDEVS-RCP is demonstrated using a robot control application.

Keywords: discrete event simulation, discrete event control, DEVS, RCP, robot controls.

Presenting Author's biography

Tobias Schwatinski has studied mechanical engineering at Wismar University and received his Master degree in January 2010. Currently he is working on new approaches in the field of cooperative robot controls.

[1] This work is supported by the German Federal Ministry of Education and Research (support code 1747X08).

A COMBINED CELLULAR AUTOMATA - DEVS SIMULATION FOR ROOM MANAGEMENT WITH VACATION TIMES

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Abstract

In autumn of 2006, at the Vienna University of Technology the project TU Univercity 2015 was launched, which includes the modernization of the buildings and the concentration from the faculties of maximum two locations. In the context of this project, the Institute for Analysis and Scientific Computing intended to create a model to optimize the classroom assignment and simulate the processes in place at the university. This model, which is called MoreSpace, was realized mostly in the simulation language Enterprise Dynamics (ED), with exception of the part which calculates the times which the students need to change the lecture rooms. This outsourced part of the simulation is now the topic of this paper. The simulator is implemented in object-oriented programming language Java and connected via TCP / IP with Enterprise Dynamics. To model the dynamic behavior of single individuals an Agent-based system was chosen in which the individuals move on a discrete grid. The cell size is 0.125 x 0.125m, so that 1m2 consists of 64 cells. Each student takes 4 x 4 cells, or 0.5m x 0.5m. The move forward of people in a building is depending on several related factors. Some of these items are the density of the people in a group, the maximum speed which varies for each individual. These factors of course are in strong relation to the environment. In this case the difference in moving forward in a roomily area or a staircase will be mentioned. It is also of crucial importance, whether a person is facing multiple other individuals. All this is relevant for the speed and thus for the required time which the students need to switch from location A to another location B, in our case.

Keywords: Eurosim, Cellular Automaton, Pedestrian flow

Presenting Author's biography

Martin Bruckner was born in Austria in 1976. He passed his mathematic study on the Vienna University of Technology from 2002-2009. His field of activity is pedestrian flow and evacuation simulations.

MANUFACTURING SIMULATION WITHIN A RAPID CONTROL PROTOTYPING APPROACH – A COMPARATIVE STUDY

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Abstract

The development and realization of complex and automated flexible manufacturing systems is a multi-step and cost-intensive process. Concepts and solutions which provide a systematic development process from the early design phase until the operational control are referred to as Rapid Control Prototyping (RCP) approaches. Where RCP is common practice in developing feedback control systems this approach in context with complex discrete controls of manufacturing systems is still a matter of research.

This paper introduces a project dealing with RCP technology for manufacturing systems and predictive simulations for optimization in the operation phase. The main focus of this contribution is put on the first phase of the control development process. In a detailed comparative study two DES tools are used to model and analyze a coating plant as an example of a flexible manufacturing system. The results of the study are presented and discussed in-depth by addressing modeling effort, simulation accuracy and runtime. After summarizing the preceding sections an outlook on future steps of the complete research project is given.

Keywords: Manufacturing Simulation, Rapid Control Prototyping, Simulation Model Based Control.

Presenting Author's Biography

Tobias Pingel is a Research Associate at the Faculty of Engineering, Hochschule Wismar. University of Applied Sciences: Technology, Business and Design, Wismar, Germany. He obtained the degree (Honours) in Multimedia Engineering in 2007 and M.Eng. in Process Automation in 2010. He joined the Research Group Computational Engineering and Automation in 2006 and then started with PhD studies at the Wismar University in cooperation with the University of Rostock in 2008. His research interests are predictive simulation and optimization of control strategies as well as distributed and parallel computing techniques. His PhD study focuses on predictive simulation of complex controls in the context of RCP.

AGENT-BASED POPULATION MODELS FOR HOUSEHOLD SIMULATION

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Abstract

Social contacts are a key element when modeling the spread of epidemics. Classic top-down approaches like ODEs do not consider the social system explicitly because they use abstract parameters that are representing a combination of various real values. By contrast, agent based models provide a more detailed structure and directly use real world values instead of abstract ones. In this paper we first introduce a basic concept of a simple contact system in an agent based SIR model. Such a model corresponds with known top-down approaches very well. Then we propose a method to extend the basic approach with households. Therefore we make use of detailed data that is provided by Statistics Austria. In a validation process we see that, under special presumptions, the household extension is still comparable with the basic approach. This is important because knowledge about behavior of SIR epidemics still has to apply on the extended model. In contrast to the basic model it is now possible so simulate a wide range of new scenarios. Another strength is the ability for more detailed evaluation of simulation runs. In a sample scenario we show the impact of different household sizes on the spread of an SIR epidemic. Furthermore we give ideas for more detailed and complex scenarios.

Keywords: Agent based model, Epidemics, Households, Social contacts.

Presenting Author's biography

Florian Miksch. He studied Technical mathematics with a focus on mathematical methods in computer science at Vienna University of Technology where he earned his master's degree in 2009. His work area is modeling and simulation in health technology assessment (HTA) for *dwh simulation services* and data mining and analysis for the *Main Association of Austrian Social Security Institutions*. Currently he is also pursuing a PhD degree under Prof. Felix Breitenecker at *Vienna University of Technology*.

SIMULATION STUDY OF PARALLEL MODEL PREDICTIVE CONTROL

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Abstract

Over the decades the model predictive control (MPC) concept has proved successfully in controlling plants with complex dynamics. Due to its high computational complexity its usage is being limited to plants with slow dynamics like in the process industry. To address this limitation several techniques have been developed to enlarge the field of MPC to embedded systems with small sampling times. With the advent of multi-core controllers it seems reasonable that parallel algorithms for MPC could lower the computational burden. In this paper the speed-up behaviour of a parallelisation approach on a functional level, in particular the incorporated optimisation, is studied due to a discrete-time simulation with Matlab/Simulink. This approach leads to some extent to super-linear speed-up of more than eight on four workers. The paper pictures the necessary computational basics in MPC and constrained optimisation and explains the mentioned approach in detail. Numerical simulation results are given on a multi-input multi-output (MIMO) control problem and the efficiency of the approach is shown.

Keywords: Model Predictive Control, Parallel Algorithm, Discrete-Time Simulation, Computational Complexity

Presenting Author's Biography

Stefan Behrendt is a Research Associate in the research group Computational Engineering and Automation (CEA) at the Faculty of Engineering, University of Wismar, Germany. He obtained the degree (Honours) in Electrical Engineering in 2006 and M.Eng. in Process Automation in 2009 from University of Wismar. He joined the Ingenieurgesellschaft Auto und Verkehr (IAV) GmbH as a Process Engineer in 2006 and then started the PhD studies under supervision of CEA at the University of Wismar and in cooperation with the University of Rostock in 2007. His research interests are in the areas of mathematical programming, optimisation algorithms and its application in process control engineering. In particular the author is concerned with spark ignition engine control.

DEVELOPING SIMULATION MODELS USING STATECHART METHODOLOGY

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Abstract

While object oriented programming became the quasi standard of software development, the object-oriented modelling paradigm has emerged as very useful for modelling of simulation models and object-oriented techniques have been introduced in simulation modelling. Especially statechart diagrams as part of the Unified Modelling Language (UML) have shown to be really useful for discrete event simulation modelling.
David Harel of the Weizmann Institute of Science introduced statechart diagrams in the 1980s. He extended the principles of conventional state-transition-diagram formalism, basically drawing states a system can be in and transitions from one state to another, by the concepts of hierarchy, concurrency and communication.
Thereby statechart modelling became a powerful and at the same time easy to apply method to model arbitrary systems. The first version of statecharts was applicable for just discrete systems, but in the meantime a real time compliant version as part of the UML for real time (UML-RT) - standard, was developed.
While the modelling process is flexible and easy to communicate, the number of simulation software that supports statechart-modelling is increasing. Therefore we introduce statechart methodology as a general method for modelling simulation models and emphasise the usefulness in agent based modelling.

Keywords: Discrete Event Simulation, Hybrid simulation, Statecharts, Object oriented Modelling, UML

Presenting Author's biography

Michael Gyimesi studied technical mathematics at the University of Technology in Vienna and received his PhD in 2005. After that he focused on health service related models and data analysis techniques. His current research interests in modelling and simulation include health services research, object oriented modelling and multi-scale modelling.

SIMULATION STUDY OF TATRA ELECTRIC RAILWAY POSSIBLE RECONSTRUCTION

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Abstract

The future development of tourism in High Tatras area is affected by the development of the transportation infrastructure. The Tatra Electric Railways (TEŽ) are important component of it. This autonomous railway system exists in the current state since 1970. Some modernization measures in this area are needed to satisfy demands of passengers in 21st century. This paper describes several scenarios for traffic and constructional changes of TEŽ and introduces application of Villon simulation tool to validate all aspects of the scenarios.

Keywords: railway transportation simulation, Tatra Electric Railways.

Presenting Author's biography

Peter Márton. Graduated in Operation and Economy of Railway Transport at the University of Žilina, dissertation at University of Žilina in 2004. Since 2002 lecturer at Faculty of Management Science and Informatics, University of Žilina. Specializing in operation of freight railway transport, co-author of simulation tools of transportation terminals operation and several simulation studies on railway transport in Slovakia, Germany, Switzerland and China. Member of International Association of Railway Operations Research and Transport Section of Slovak Scientific and Technological Society.

SIMULATION MODEL FOR ESTIMATING EFFECTS OF FORMING PICK-UP TRAINS BY SIMULTANEOUS METHOD

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Abstract

This paper examines the problem of forming the pick-up trains using the stimulation method in order to establish the basic characteristics of track facilities and values of the shunting operation indicators that are important for evaluation of the effects of the application of these methods. Observed problem hasn't been explored to a sufficient extent in the literature, although practice shows the need for it. Therefore, this paper serves the development of simulation studies, whose results should give the values and the measures for assessing the quality of yard operations, as well as the assessment of solutions of newly designed stations.

Key words: Technical freight yards, pick-up goods trains, simultaneous method, number and length of tracks, simulation.

Presenting Author's biography

Sanjin Milinković received his Dipl. Ing. degree in traffic and transportation engineering in 2001. and his MSc degree in 2007., from University of Belgrade, Faculty of Transport and Traffic Engineering. He is currently working on a PhD thesis and his research interests include analysis of railway systems by modeling, simulation and operations research methods. Hi is currently working as a teaching associate with University of Belgrade, Department for railway exploitation.

A FUZZY PETRI NET MODEL FOR ESTIMATION OF TRAIN DELAYS

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Abstract

Even with the best timetable, trains often operate with delays. Planned duration of running and dwelling can be exceeded and that creates primary delay. Primary delay of a train can cause delays of other trains, knock-on delays. Estimation of train delays is important for timetable creation, trains dispatching, infrastructure planning etc. Many factors influence and cause trains delays and it is very difficult to estimate and describe their relations. This paper presents simulation model for train delays estimation based on Fuzzy Petri Nets (FPN). Fuzzy logic system incorporated in FPN uses experts (train dispatchers, operators etc.) knowledge for defining fuzzy sets and fuzzy rules and thus transforming their expertise into a model for train delay calculation. Petri Nets simulation model describes traffic processes in a railway system. Trains are *tokens*, track sections are *places* and *transitions* are discrete events of train moving and interlocking principles. High Level Petri Nets (HLPN) model has properties of hierarchy, color and time. Train delays are calculated in a simulation model by a Fuzzy Petri Net subsystem. Simulation model can be verified and validated by animation of train movement and graphically by train's time-distance graph. Results of simulation are exported to database for additional data mining and comparative analysis. Model is tested on a part of Belgrade Railway Node.

Keywords: Fuzzy Petri Nets, Train delays, Railway simulation.

Presenting Author's biography

Sanjin Milinković received his Dipl. Ing. degree in traffic and transportation engineering in 2001. and his MSc degree in 2007., from University of Belgrade, Faculty of Transport and Traffic Engineering. He is currently working on a PhD thesis and his research interests include analysis of railway systems by modeling, simulation and operations research methods. Hi is currently working as a teaching associate with University of Belgrade, Department for railway exploitation.

BLOCKAGE PREVENTION MECHANISM FOR TRAFFIC MANAGEMENT

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Abstract

Urban traffic networks play an important role in modern society. From a systemic perspective they are dynamic, nonlinear, large scale, complex systems. That is why modeling and controlling them are difficult aspects and a lot of research efforts are made towards solving these problems. This paper presents a study on urban networks and is proposing a general management architecture and, as part of this structure, a mechanism for junction blockages prevention. This fast dynamics control mechanism is used at the bottom level of the architecture and can have autonomy, if needed. In order to design this mechanism, the junctions and the incoming/outgoing road segments are modelled in a macroscopic manner. The model was created by making an analogy between compartmental networks' components (nodes and flows) and traffic networks fixed elements (crossroads, traffic lights and roads segments) and dynamic elements (cars flows) . The blockages are avoided by use of a stabilising nonlinear controller. The analogy, models and control solution, a case study and the manner in which the controller's command can be transferred to the traffic lights are presented. The open loop simulations can provide information on the cars flows values that lead to congestions or blockages, these observations can be used in order to reconfigure the traffic markings. A series of conclusions and possible improvements of this solution are discussed.

Keywords: urban traffic modeling, blockage prevention, compartmental networks

Presenting Author's Biography

Andreea Udrea. She received the BSc and MSc degrees at Automatic Control and Computers Faculty, University "Politehnica" of Bucharest in 2006, respectively 2008. Since then she is a teaching assistant and PhD student and her research interests include numeric control and dynamical systems.

SIMULATION-BASED FITNESS LANDSCAPE ANALYSIS FOR VEHICLE SCHEDULING PROBLEM

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Abstract

Simulation-based analysis of fitness landscapes with application to the vehicle scheduling problem with time windows is discussed in the paper. Methods of analysis of fitness landscapes and measures known in literature are reviewed. The procedure for simulation based analysis of fitness landscape is introduced. The tool that allows automating this analysis is described. The simulation model is developed within AnyLogic 6 simulation software, while Java applications generate landscape path solutions, analyse their fitness values series and implement a genetic algorithms. Experimental study for a vehicle scheduling problem with the time windows is given and demonstrates the main steps of fitness landscape applied to optimization problem.

Keywords: vehicle scheduling, time windows, simulation, optimisation, fitness landscape.

Presenting Author's biography

Galina Merkuryeva is a full professor at Riga Technical University, Department of Modelling and Simulation, Latvia. She has research interests and experiences in discrete-event simulation, simulation metamodelling and optimisation, decision support systems, supply chain simulation and management, and simulation-based training. She is an editor of the Baltic Journal on Sustainability, Technological and Economic Development of Economy (Vilnius, Lithuania).

SIMULATING AN AUTONOMOUS SHIP FOR SEA DEMINING

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Abstract

The paper deals with a sea demining system using autonomous marine surface vehicles (AMSV). The research involves the development of exemplars of these vehicles, and the procedures for area scanning and coverage. The demining is made by field influence, towing a submerged "fish". This study is made both with simulations and with scale experiments. The paper focuses on modeling, based on first principles and experiments, and then in simulation. For modeling a scaled AMSV has been built, and it is currently used to get modeling data and for simulation verification.The simulation is oriented towards path planning and path following for better area coverage in order to clean an area. The simulation uses a realistic map background, for mission planning in the actual constraints.

Keywords: Modeling and simulation of autonomous ship, sea demining, autonomous surface marine vehicles, unmanned surface vehicles (USV), robot area coverage

Presenting Author's biography

Jose Maria Giron-Sierra was born in Valladolid, Spain. He received the Licentiate (1972) and the Ph.D. (1978) degrees in Physics from the Universidad Complutense de Madrid, Spain. He is Full Professor with the Department of Computer Architecture and Automatic Control of the Universidad Complutense de Madrid, Spain, from 1988. He has been the author of 180 publications in conference proceedings and journals. His research is related to applied automatic control and simulation: ships, airplanes and spacecrafts, robotics, process control. His research interests are autonomous ships, simulation, real-time remote monitoring and control, optimisation based on genetic algorithms. Dr. Giron-Sierra is a Member of the IFAC Technical Committee on Marine Systems.

THE INDIVIDUAL CHANNEL ANALYSIS AND DESIGN METHOD APPLIED TO CONTROL OF A COUPLED-TANKS SYSTEM: SIMULATION AND EXPERIMENTAL RESULTS

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Abstract

The method of individual channel analysis and design (ICAD) is a neo-classical frequency-domain approach to analysis and design of multi-input multi-output control systems. In this paper the technique is applied to a two-input two-output nonlinear system involving two coupled tanks of liquid. The complete nonlinear model of the plant is presented and it is shown how the individual channel approach can provide useful insight for multivariable control system design based on linearised representations of the plant. Simulation investigations involving the nonlinear model have demonstrated that the overall performance of an ICAD-based control system design with proportional plus integral controllers satisfies a given set of performance specifications involving steady-state and transient requirements. Simulation results also show that this design provides good disturbance rejection and satisfactory robustness properties. The resulting control system has been implemented on the two-tank system and the paper includes experimental results.

Keywords: multivariable control, coupled tanks, frequency domain, nonlinear.

Author's biography

David Murray-Smith is currently an Emeritus Professor and Honorary Senior Research Fellow at the University of Glasgow where he was Professor of Engineering Systems and Control in the Department of Electronics and Electrical Engineering until 2005. His current research interests lie mainly in the areas of inverse simulation methods and their practical applications and also in model testing and validation, mostly for control systems applications. He has been involved in research in a number of different application areas including the validation of helicopter flight mechanics models, helicopter flight control, ship and underwater vehicle modeling and control, as well as applications of modelling and simulation techniques to several biomedical problems.

SELF-TUNING DECENTRALIZED CONTROLLER DESIGN OF WEB TENSION CONTROL SYSTEM

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Abstract

The paper deals with a self-tuning control design of a web tension control system. Based on the overlapping decomposition of the controlled system that we have proposed, we employ the generalized minimum variance control (GMVC) method combined with the particle swarm optimization to estimate the system parameters. The GMVC formulation of control input is then reduced to the PID structure to conform to a practical use. The results show that the decentralized control system works well under the uncertainties and variations of the system parameters and noise contained in the tension signals, converging to an optimum control state in terms of GMVC evaluation.

Keywords: web tension, decentralized control, overlapping decomposition, self-tuning, generalized minimum variance, PSO, PID.

Presenting Author's Biography

Tetsuzo Sakamoto. He received Dr. of Engineering degree from Kyushu University in Japan. In 1985, he joined the Faculty at Kyushu Institute of Technology as a Research Associate. Later he became Associate Professor at Kyushu Institute of Technology. Since 2002, he has been Professor in the Department of Control Engineering at Kyushu Institute of Technology. His research interests include electromagnetic analysis and control of linear synchronous motors and electrodynamic levitation, and the control system design of the web tension control system and the electromagnetic levitation system. He also wrote a book titled as 'Electrodynamics and Control of Electric Machines', which was published in 2007 by Morikita Publishing Company of Japan.

APPLICATION OF SUPPORT VECTOR MACHINE FOR EVALUATION OF WEAR STATE AND REMAINING LIFE TIME

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Abstract

Usually, mechanical machines do not break down or fail without any kind of warning, which is indicated by a combination of changing measurable symptoms. The complexity and the high dimensionality of the measured signals require reliable, fast, and less demanding methods to recognize the faults. In this work, a production machine related supervision task is investigated over a long duration to design a fault detection and prediction system to support condition-based maintenance of wear parts and to detect and predict failures usually leading to the full loss of functionality. Wear parts failure should be detected before scuffing or seizing lead to serious failure of the machine. An approach for developing the system as a prewarning module is presented. The system is based on support vector machine (SVM) classification as a signal-based diagnosis technique and as a feature fusion tool. The processed and extracted parameters of the machine operation are investigated and fused by the SVM to find the most reliable features for the detection system. Alternative combinations of fusing sensors are taken into consideration to find a complementary sensor array for better accuracy. A parameter indicating the need for wear part replacement; a Change Index (CI) is presented based on the decision value resulting from the SVM which shows a tendency to change over time coinciding with the deterioration of the part and the remaining life time.

Keywords: Condition monitoring, SVM classification, Signal based modeling, Feature fusion, Fault detection and prediction.

Presenting Author's Biography

Mahmud-Sami Saadawia, was born in Benghazi, Libya, in 1969. He received the B.Sc. degree in Mechanical Engineering from the University of Garyounis, Benghazi in 1993, and the M.Sc. degree in Mechatronics from the University of Duisburg-Essen in 2006, and he is currently a Ph.D. student of the Chair of Dynamics and Control, University of Duisburg-Essen. His current research interests include SVM, wavelets, and applications of machine learning techniques in fault diagnosis and prognosis.

HYSTERESIS MODELLING FOR A *MR* DAMPER

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Abstract

An experimental dataset of a commercial Magneto-Rheological (MR) damper is exploited for identification of a Hysteresis-based Control-Oriented model. The model wellness for hysteresis, saturation and transient responses is shown through validation with experimental data. A study case that includes a *Quarter of Vehicle (QoV)* shows that the hysteresis phenomena could affect the primary ride and vehicle handling. Several analysis based on open and closed loop simulation demonstrated that hysteresis must be considered for controller design.

Keywords: hysteresis, MR damper model, model simulation, vehicle dynamics

Presenting Author's Biography

Ruben Morales-Menendez holds a PhD Degree in Artificial Intelligence from Tecnologico de Monterrey. From 2000 to 2003, he was a visiting scholar with the Laboratory of Computational Intelligence at the University of British Columbia, Canada. For more than 23 years, he has been a consultant specializing in the analysis and design of automatic control systems for continuous processes. He is a member of the National Researchers System of Mexico (Level I) and a member of IFAC TC 9.3.

MOON ORBITER SIMULATOR FOR THE ESA PROJECT ESMO

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Abstract

The European Student Moon Orbiter (ESMO) is planned to be the first European student mission to the Moon. ESMO represents a unique and inspirational opportunity for university students, providing them with valuable and challenging hands-on space project experience in order to fully prepare a well qualified workforce for future ESA missions in the next decades. ESMO student teams, supported by faculty staff, will produce a complete spacecraft from scratch. Its mission will be to fly towards the Moon, enter Moon's orbit and execute scientific experiments while orbiting around the Moon. These experiments will be performed with the narrow angle camera, the microwave radiometer and the radar as main spacecraft's payload. As a part of the ESMO project, a Functional Engineering Simulator (FES) will be produced that will allow the project teams to model the spacecraft functions and performance at various stages in the mission and simulate the operational environment including ground station contacts. The simulator is critical to verify the correct sizing of subsystems in the design and the identification of adequate design margins and criticalities, especially in worst case scenarios and in the presence of failures leading to off-nominal situations. It will also be used to determine the telecommands to be generated, test for potential failure and recovery scenarios and provide overall validation of the system functions including data handling and attitude control. In this paper a concept of FES will be presented along with the work that has already been done on the subject.

Keywords: European Student Moon Orbiter, Functional Engineering Simulator

Presenting Author's Biography

Matevž Bošnak graduated in 2009 on the Faculty of Electrical Engineering, University of Ljubljana. Now he works as a PhD student in the Laboratory of Autonomous Mobile Systems at the same faculty.

HEURISTIC ALGORITHMS TO OBTAIN OPTIMIZED SCHEDULES OF MANUFACTURE TCPN MODELS

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Abstract

The timed coloured Petri Net formalism is a modelling formalism which allows several abstraction levels depending on the objective of the study. In order to coordinate the main activities of manufacturing systems it is desired to have simulation-based computer tools that help the decision maker to cope with the complex process of schedule all the available resources in the system. The exploration and analysis of the state space of timed Coloured Petri Nets has been used by several authors to evaluate systems behaviour as well as a search space for states of particular interest. In this paper, recent developments of heuristics implemented in algorithms that use the state space to transform the simulated-based optimization problem into a search problem are presented. These algorithms can be implemented in software tools for controlling and coordinate the activities of real-time systems.

Keywords: Coloured Petri Nets, State space, Heuristics, Makespan, Optimization.

Presenting Author's biography

Miguel A. Mújica Mota was born in Mexico City. He studied chemical engineering at Autonomous Metropolitan University of Mexico, an MSc in Operations Research in the National Autonomous University of México. He also received a Master's in Industrial Informatics from the Autonomous University of Barcelona. Actually he is a PhD Student at Autonomous University of Barcelona. He also has professional experience in manufacture and production planning in the cosmetic industry. His research interest focuses on optimization techniques using the Coloured Petri Nets formalism aiming to solve industrial problems.

CLIENT RELAY SIMULATION MODEL FOR CENTRALIZED WIRELESS NETWORKS

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Abstract

Client relay is a very promising concept for wireless data transmission networks. It is especially attractive for centralized networks, where the relaying process may be governed by the base station. However, currently there are no research results that estimate, whether client relay technology will actually be effective in a real network. As client relay systems demonstrate extremely complex interactions between network, data link and physical layers, the applicability of analytical modelling is very limited. Therefore, simulations tend to be the natural way of assessing the performance of relay networks. Unfortunately, currently there are no open-source system level simulators capable of addressing client relay performance in the realistic channel conditions. In order to tackle this problem, the model is being developed for detailed simulation of different media access and relay protocols in the real-world conditions. In this paper we discuss the system model used for simulations, implementation principles, simulation results and their relations with analytical results. The key features of our system are computational efficiency, flexibility, support for multiple arrival flows and channel models, as well as reliable measurement approaches, which guarantee non-shifted averages and establish distributions for obtained parameters.

Keywords: client relay, cooperation, wireless networks

Presenting Author's Biography

Alexander Pyattaev was born in St.-Petersburg, Russia, on March 16, 1988. He received the Bachelors degree in St.-Petersburg University of Telecommunications, St.-Petersburg, Russia. He is currently a Master's degree student in Tampere University of Technology, Tampere, Finland. He has publications on computer simulations in SUT and was employed as hardware designer in the area of network measurements. His current interests include wireless networking, peer-to-peer technologies, real-time digital signal processing and artificial intelligence.

MODELING OF POWER AND HEAT LOSSES OF ELECTRICAL ARC FURNACES

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Abstract

Two simplified equations to calculate electrical and cooling water losses of a conventional Electrical Arc Furnace (EAF) are proposed. These equations were obtained by modeling electrical and heat transfer aspects of the EAF in order to determine some of the EAF losses. Fundamental aspects of the electrical power delivery and heat transfer theory were considered to propose an equation for the EAF power system electrical losses to compute the amount of active power in the arc including harmonic distortion effects. In addition, a correlation of thermal losses in function of slag coating thickness on water-cooled panels is presented. The electrical model was used to define the boundary conditions of the fluid dynamics simulation to obtain the heat transfer by convection and radiation of the arc to calculate the thermal losses and complete the EAF energy balance. The proposed heat energy balance also considers another fuels supplies and exothermic chemical reactions inside the EAF. The intention of this research work is to serve as framework for further research oriented to improve both the electrical and thermal energy efficiencies of the EAF and contribute in this way to increase the productivity in steel plants and as well as to reduce energy consumption.

Keywords: Electrical Arc Furnace, Harmonic Distortion, Heat Loss, Energy Efficiency.

Presenting Author's biography

Eder Trejo finished his carrier of Chemical Engineering and cursed a Master Degree in Energetic Engineering at the Tecnológico de Monterrey (ITESM) in Monterrey, México. Eder is student of the Engineering Sciences PhD Program and member of the Roberto Rocca´s Energy Cathedra which is supported by Techint Group (Ternium and Tenaris Mexican Steel Plants).

ONE MODELLING TECHNIQUE APPROACH FOR OPERATIONAL RISK PREDICTION

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Abstract

In this paper we approximated operational risks in banks with artificial neural networks. Typically, operational risk losses in banks are grouped in a number of categories: People risk (Incompetence, Fraud), Process risk (Model risk, Transaction risk, Operational control risk), and IT risks. These categories can be further aggregated to the three levels of nominal, ordinary and exceptional operational risks. The Basel Committee on banking supervision at the Bank for international settlements imposes to financial institutions to meet capital requirement based on VaR estimates. Value at Risk (VaR) is very simple in itself, but it is inadequate when applied to operational risk. Until now, no one single method developed for the assessment of operational risk has managed to provide satisfactory results. In these circumstances, new alternative models are needed that can assess small and medium values, predict the probability of extreme events, reflect asymmetric behavior at the output and analyze nonlinearity of the input-output values. As the comprehensive and accurate solution for this problem we suggest using artificial neural networks. Neural network methods, offer a powerful alternative to linear models for forecasting, classification, and risk assessment in finance and economics. In this paper the neural network model is presented. This model is based on back propagation neural network with sequence generator for input data. We observed four different categories of losses: internal causes of business breakdown, external causes of business breakdown, IT risks and non-adhering to working practice and mistakes in execution and management. The data were analyzed separately and cumulatively. The results show that predicted values are very close to real data and that the model can be used in real financial environment.

Keywords: Modelling, Neural network, Operational risk, Risk prediction.

Presenting Author's biography

Ana Savić. She is currently a Ph.D. student in the Faculty of Economics, University of Belgrade. She obtained as M.Sc. degree from the same faculty. Her research interests include risk management, operational risks in banks, and quantification of financial risks. She is the author and coauthor of several economic papers. Now, she works in ICT College in Belgrade, and before that she used to work in several banks.

HARDWARE-IN-THE-LOOP REAL TIME SIMULATION WITH OPENMODELICA FOR PROCESS AUTOMATION

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Abstract

Control Engineers, Plant Operators and Research Scholars often need to work with equipment and systems for learning, designing and testing control systems. With the developments in Information Technology, there has been a totally new approach to the teaching, developing and experimenting with Advanced Control Algorithms for Process Control. Today, process models developed in Object Oriented Modelling languages are widely used to simulate real processes and rigorously design and test appropriate control systems. In todays modern Plant Automation and Control Systems, the Simulation platform is an integral part of the total system. This is provided to be able to learn the process behavior on-line during the normal operation of the plant and improve the performance of the controllers. An accurate simulation model allows operators to train under "live" conditions without exposing the plant to the consequences of their mistakes. The Hardware-in-the-loop set-up is formed using models in OpenModelica and a controller in a PC/104 module. One, two, and three tank systems were modeled in OpenModelica and the level control problems were simulated. The Real Time Synchronization module was a crucial development for interfacing the OpenModelica models and the PID controller in PC/104 system. The simulation results are useful for tuning the controllers and for operator training.

Keywords: Real-Time Simulation, OpenModelica, PC/104- Embedded Controller, Object Oriented Modelling, Connectivity matrix.

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A RETARGETABLE, HIGH-PERFORMANCE ISA SIMULATOR IN JAVA

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Abstract

This paper presents Jahris — a retargetable, high-performance ISA simulator entirely written in Java. It seamlessly integrates a high simulation speed and instruction-accurate observability, both of which are conflicting design goals, by a transparently adapting simulation execution. Jahris implements advanced just-in-time compilation techniques with a platform-independent hotspot engine targeting Java bytecode. It uses large translation units formed by branch-free instruction sequences to widely eliminate the simulation dispatch overhead. Jahris includes its own ISA description language, which aims at both a high simulation speed and the rapid modelling of target architectures. Its flexibility has been proven by the modelling and successful testing of a diverse set of architectures including DLX, i8086, ARMv4 and 32-bit PowerPC. The simulation performance has been determined to achieve up to 78 percent of that of QEMU with an extremely reduced modelling effort.
This paper makes two major contributions. Firstly, it proves the Java Runtime Environment (JRE) to be a virtual but feasible simulation platform. This enables the platform-independent implementation of high-performance JIT-compiling simulation engines, which take advantage of the widely-available and sophisticated JVM implementations. As these handle the further translation to the native code of the actual simulation host, Jahris further benefits from their internal and possibly platform-specific code optimization. Secondly, a novel ISA description language is introduced, which provides a strict separation between the decoder and the instruction behavior of ISA models. This allows the extraction of the behavior from code sequences to enable sophisticated simulation techniques such as behavior caching and block compilation.

Keywords: Retargetable, Dynamic compilation, ISA simulation, Hot Spot, Java

Presenting Author's Biography

Marco Kaufmann is a researcher at the Institute of Computer Engeneering at the Faculty of Computer Science of the Technische Universität Dresden. He received his Diplom in Computer Science from the Technische Universität Dresden in 2009 and is now working towards his Ph.D. His research interests include the modelling and simulation of computer systems and compiler and language design.

ANALYSIS OF THE SIMULATION FIDELITY FOR EXTENDED TARGET IN MMWSS

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Abstract

The simulation for Millimeter Wave (MMW) target is that making use of the method of HWIL (Hardware in Loop) to simulate the target and environment signal within the intercepted processing of radar guidance missile in EHF frequency. The target and environment signal simulation in EHF includes two aspects: space property and electromagnetism property. Space property indicates the position of target and the variety of position. Electromagnetism property indicates the amplitude, glint, Doppler shift, distance/angular spread and polarization of echo signal. In MMW target simulation, detection with MMW can improve the distance and angular resolution. One-point target simulation, which views a target as one point scattering, has been testified satisfying the simulation precision in MMWSS. Our intention in this paper is to demonstrate whether the precision of extended target simulation, in which the target is simulated as the aggregation of Scattering Centers (SC) by adjusting amplitudes and phases, can achieve the required precision.

Key Words: Extended Target Simulation, HWIL, Simulation Fidelity

Presenting Author's biography

Jing MA. She received the Bachelor degree in Telecommunications and Ph.D. degree in Signal Processing from Xidian University, China, in 2004 and 2009, respectively. She was a Visiting Student at Microsoft Research Asia in 2006. From 2007 to 2008, she was a Visiting Scholar in the Space Science Engineer Center, University of Wisconsin-Madison, U.S.A.. Since 2009, she has been a Research Engineer for CASIC (China Aerospace Science and Industry Corporation), where her research interests include target and environment Radio Frequency simulation, HWIL(Hardware in Loop) Simulation and VV&A (Verification, Validation and Accreditation) in modeling and simulation.

AN EXPLORATION OF MULTIVARIATE TIMEVARYING VOLUME DATASETS USING VOLUMETRIC PARALLEL COORDINATES

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Abstract

In this paper, we propose "Volumetric Parallel Coordinates" (VPC) as a technique to explore a multivariate time-varying volume dataset. Recently, this type of a large-scale dataset has often required a high-performance computing environment. In addition, such a dataset often includes multiple variables defined on high-resolution grids and thousands of time steps. We can make use of volume visualization, information visualization or animation techniques, which can handle high-resolution grids, multiple variables and time-varying datasets, respectively. However, there is currently no technique that visualizes a multivariate timevarying volume dataset in a single picture, which is often a good starting point for data exploration. The VPC stacks parallel coordinates that represent the relation between multiple variables at a given time step in order to construct a volume dataset. A volume visualization technique can be used to visualize how the relation between variables changes over time. We apply the VPC to results generated from a liquid atomization simulation to confirm its effectiveness, and we find that the relation between the liquid curvature and the velocity maintains a negative correlation over time.

Keywords: Parallel Coordinates, Particle-Based Volume Rendering.

Presenting Author's Biography

Koji Koyamada received a B.S., M.S. and Ph.D degrees in electronic engineering from Kyoto University, Kyoto, Japan in 1983, 1985, and 1994, respectively. He is a professor at Kyoto University. From 1985 to 1998 he worked for IBM Japan. From 1998 to 2001 he was an associate professor at Iwate Prefectual University. From 2001 to 2003 he was an associate professor at Kyoto University. His research interest includes modeling, simulation and visualization.

MODEL OF GAME INDUSTRY

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Abstract

The goal of the paper is to present a model of market where information goods are being sold. The model describes a system that contains many uncertainties. We use principles of fuzzy control and random processes. The model deals with social, economical and psychological aspects that influence decision making about purchasing goods. The source areas are microeconomics, marketing, competitive advantage and economics of information goods. We suggest a further extension of defined model and an importance of possible simulation results. The paper also includes directions for improvements that lead to validity of proposed model of market.

Keywords: Network Economics, Pricing, Piracy, Switching Costs, Price Discrimination.

Presenting Author's biography

ŠÁRKA KVĚTOŇOVÁ was born in 1981, Brno, Czech Republic. She has studied Economics and Management at the Brno University of Technology, Faculty of Business and Management, Brno, Czech Republic. In 2009, she finished Ph.D. study at Brno University of Technology, Faculty of Information Technology, Brno, Czech Republic. Her main research interests are software engineering, economics of information products, modeling of network economics, agent based systems, processes and project management with focus on Petri Net techniques and their application for software projects management.

MODELING AND SIMULATION OF LIGHT PROPAGATION FOR MULTISTATIC 3D PMD-CAMERA AND -ILLUMINATOR CONSTELLATIONS

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Abstract

The progress in high-speed technical 3D-Vision development opens up completely new possibilities for many new and special kinds of applications. To make a conclusion whether uncommon or novel PMD sensor designs and -illuminator constellations will work in practice as expected, a simulation of the intended configurations is fundamental and supports the development of further 3D-Vision technologies.

This paper presents a modeling and simulation approach for light propagation for mono- and multistatic 3D camera systems and illuminator constellations. The simulator allows calculating the light intensity and the phased array for arbitrary scenarios with coherent and incoherent modulated light sources which, amongst others, are used in PMD cameras for environment illumination. The results of some simulated scenario including an error analysis and the comparison with real data are discussed.

Keywords: PMD, Simulation, Modeling, Light Propagation, Multistatic

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 and simulations, multi sensor data fusion, computer based 2D and 3D sensor simulations, Synthetic Aperture Radar (SAR) raw signal simulations.

VIRTUAL REALITY PLATFORM DESIGN FOR ELECTRIC WHEELCHAIR SIMULATION IN AN ENABLED ENVIRONMENT

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Abstract

This study presents the development of a virtual reality platform for electric wheelchairs with a multipurpose usage in an enabled environment. The platform with the electrical wheelchair will be stationary with pitch and roll actuated actions for possible different uses as electric wheelchair driving simulations, wheelchair training, assistive technology research, architectural route planning and accessibility evaluation. The investigation into the mobility factor of wheelchair bounded users will be beneficial in the area of ergonomic designs of architectural structures. The use of the virtual reality platform can further be extended to the evaluation and training of inexperienced electric wheelchair users. The platform will be a mechatronic design consisting of both mechanical- and electrical properties. The mechanical components will consist of rollers driven by the electric wheelchair and its user placed on the platform where acquired electrical signals of the rotation of the wheelchairs wheels are of importance. The platform will be placed onto actuators for simulating angular movements of the wheelchair approaching an inclining or declining given path. The simulator must map intended motion by an electric wheelchair user into the virtual world with considering influences such as collisions, gradient changes and different surface properties. The design will finally consist of a combination of different engineering disciplines with the relevant kinematics and dynamics controlled in a simulated virtual reality environment.

Keywords: Electric Wheelchair, Motion Platform, Virtual Reality.

Presenting Author's biography

Nico Steyn a professional registered engineering technologist at the Engineering Council of South Africa (ECSA) and a lecturer at the Tshwane University of Technology in the Department of Electrical Engineering. He is a PhD student with the University of Versailles Saint Quentin in Yvelines in the field of the Enabled Environment at the French South African Institute of Technology in South Africa.

A COMBINED APPROACH OF PATH PLANNING FOR MOVING OBJECTS IN VIRTUAL ENVIRONMENTS

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Abstract

The paper compares selected methods of path planning with regard to the computational complexity with the goal of establishing a framework for path planing of moving objects in virtual environment. The path planning framework is intended for use in various training simulators, e.g. in cases where the trainee is driving a simulated vehicle while there are other autonomously moving vehicles within the virtual environment. The trajectories of autonomously moving objects have to be carefully planned in order to obtain a realistic performance of a simulator. Based on the results of the comparison of the path planning methods, the advantages and drawbacks of selected methods are identified and a new combination is proposed with a suboptimal but efficient corridor calculation and an advanced path optimization within the corridor. The combined approach utilizes heuristic search algorithms as well as methods of numerical solving of a particular form of partial differential equation - an eikonal equation. The use of related fast marching method enables to derive smooth trajectories within the corridor identified by the heuristic search algorithm while keeping the on-line computational burden relatively low.

Keywords: virtual environments, path planning, quadtrees, triangulation, fast marching method.

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 interests are in discrete event and hybrid dynamical systems, supervisory control, production control and industrial informatics.

EXAMINING SOURCES OF INTERINDIVIDUAL PHARMACOKINETIC VARIABILITY BY NONLINEAR MIXED EFFECTS MODELING

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Abstract

The application of the nonlinear mixed effects modeling to pharmacokinetics can maximize the goals of drug administration from the time a drug is first administered in human during the initial phases of development to the routine patient care. Nonlinear mixed effects modeling has a pivotal role in population pharmacokinetics, which is especially valuable since it targets the patient group that will eventually receive the drug of interest. It is applicable in sparse data situations, quantifies pharmacokinetic variability at several levels and aims to explain the sources of variability. When applied to direct patient care, the purpose of nonlinear mixed effects modeling is to provide quantitative and semi-quantitative guidelines for dosage individualization and optimization. Consequently it is of utmost importance in therapeutic drug monitoring. The aim of this paper is to present the background, the underlying conceptual theory, and the utility of the nonlinear mixed effects modeling approach. A special attention is put on the development of covariate sub-models, which aim to identify and quantify the sources of interindividual variability in pharmacokinetics. Finally, examples of how nonlinear mixed effects modeling can be applied to therapeutic drug monitoring in routine care of patients with epilepsy are presented.

Keywords: Nonlinear mixed effects model, Population pharmacokinetics, Therapeutic drug monitoring, Individual drug dosing

Presenting Author's biography

Iztok Grabnar was born in 1971 in Ljubljana, Slovenia. In 2000 he obtained a PhD degree at the Faculty of Pharmacy of the University of Ljubljana. Since 2006 he holds a position of an assistant professor at the Faculty of pharmacy of the University of Ljubljana. His work is focused on modeling and simulation of biomedical systems and biostatistics and their application to studies in the fields of pharmaceutical technology, biopharmaceutics, pharmacokinetics, and clinical pharmacology.

HOW HEALTH CARE SYSTEMS REACT ON EPIDEMICS

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Abstract

Standard approaches to simulating epidemics of infectious diseases include the classic SIR-model and agent based simulations. Another interesting application for modelling and simulation are studies of the dynamics of whole parts of health care systems and their reimbursement schemes. We show how to integrate the transmission of infectious diseases into a model of this type. It is agent based and consists of three main agent types: Patients, Medical Providers and Medical Problems. The latter represents different diseases which patients can contract. Each patient implements a statechart for every medical problem type. These statecharts model the random generation of new diseases and corresponding medical problem objects which control disease progression and the treatment pathways a patient takes. A central "Health Market" object manages provider search of the patients. As an example, we integrate influenza as an infectious disease into the model with a separate object type "InfluenzaEpidemic" that stores the characteristics of every new epidemic during simulation time. Transmission of the disease takes place between agents which are connected by a network based on spatial relations. Each agent stores his past infections so he does not get the same virus strain twice. Experiments show that this resembles the behaviour of SIR-models and that this model can provide insight into the impact of epidemics on the utilization of the health service system and its reimbursement.

Keywords: Epidemics, SIR-Model, Health Services Research, Agent based modelling.

Presenting Author's biography

Patrick Einzinger was born on March 19th 1984 in Tulln, Austria. He studied technical mathematics at the University of Technology in Vienna and graduated with a diploma thesis on a System Dynamics model of the financing of Austrian regional health insurances. Currently he is working on simulation studies at dwh simulation services and continues his academic career towards a PhD.

ANALYSIS OF THE STEADY-STATE RELATIONS IN MATHEMATICAL MODEL OF CHOLESTEROL BIOSYNTHESIS

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Abstract

In European Union 10-15% of population has elevated levels of cholesterol, which is know to be a risk factor for cardiovascular diseases. Several treatment strategies and drugs have been developed to control the elevated cholesterol levels, however, they are not always successful. Statins are now most widely used cholesterol-lowering drugs, however, all the mechanisms of their action are not understood and can sometimes lead to adverse effects. A dynamical mathematical model of the cholesterol biosynthesis network was developed to study the effects of various substances that interfere with cholesterol biosynthesis. In this article we show that in spite of serious lack of data, the model can be used to study the concepts of possible mechanisms of cholesterol biosynthesis and drug interactions. If only steady-state data is used for model identification the model can predict steady-state relations in different situations, while dynamical properties cannot be correctly simulated. However, the model can be improved if dynamical data becomes available. The performed experiments that were analysed with the model simulations show, that the two substances with completely different modes of action most likely trigger the same control mechanism.

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.

COMPARTMENT MODELLING OF OBESITY IN INHOMOGENEOUS POPULATIONS: PROBLEMS AND ALTERNATIVE APPROACHES

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Abstract

Introduction: Obesity is a chronic disease defined as the presence of excess adipose tissue and it is a national and also worldwide problem with a lot of consequences for health, like coronary heart disease, diabetes mellitus type 2 and even death. It is a very complex problem and to work against this epidemic, it is important to understand the mechanisms influencing this disease.
Methods: This paper is about different modeling approaches in the area of differential equations, Markov Models and System Dynamics Models found in the literature, their advantages and disadvantages.
Results: Some of the described models divide the population into sex, age or severity degree of the disease, which is important, since there is, for example a difference in the basal metabolic rate for persons with different age, sex and weight, but no model divides into all dimensions together. One alternative approach is proposed, describing an Agent Based Model that includes all dimensions when studying such a complex system. Advantages and disadvantages of the proposal in contrary to System Dynamics Modeling are shortly discussed.
Conclusion: When it comes to modeling complex systems it is necessary to make decisions about what is required to be displayed from the real world in our models.

Keywords: System Dynamics, obesity, Markov Models, Agent Based Modeling

Presenting Author's biography

Barbara Glock. She was born in Vienna on 5th of March, 1984, started school in 1990 and passed with distinction 2002 from secondary school. After that, she studied Technical Mathematics in Computer Sciences, which she will finish in the end of 2010. Her recent work includes her diploma thesis about a System Dynamics Modeling approach of the prevalence of obesity in Austria.

THE OPTIMIZATION OF HEALTHCARE ADMINISTRATIVE PROCESSES

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Abstract

The paper presents application of discrete event simulation in healthcare processes. The goal of the project was to optimize several processes in the context of business process engineering. The project in one of the largest hospitals in the region revealed several possibilities to improve quality of service. Besides simulation several other techniques and tools were used. Discrete models evolved in four iterations: a) preliminary model, verified in the first phase of the project, b) iteration 0: a simulation model for the reception in two clinical departments, c) iteration 1: a simulation model was improved by inclusion of the third clinical department and d) iteration 2: doctors at the site realized that medical activities (outpatient examination and functional diagnostics) must be included in the simulation model, since administrative process is interrupted by medical activities. Special attention was put on refining simulation input data, distribution of service times, measurement of average service times and deviations. Two simulation programs model behaviour of the present (separate reception sites) and proposed (joint reception site) process. The simulation results confirm that centralization of administrative personnel would contribute to higher quality of service, improved working environment for employees and decreased possibility of errors, mistakes and lost documents.

Keywords: simulation, health care, business process reengineering.

Presenting Author's biography

Robert Leskovar Ph.D. is an Associate professor at University of Maribor, Faculty of Organizational Sciences. His research focus is the integration of multicriteria decision support, information systems, process simulation and quality.

EVALUATION OF DIFFERENT MODELING TECHNIQUES FOR SIMULATION OF EPIDEMICS

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Abstract

The spread of infectious disease and the induced harm and deaths are of main interest in populations since the existence of modern social structures. For example the Spain flu in the early 20th century or the modern swine flu is influencing the overall world social systems.
To find the best suited strategy against an illness taking into account additional boundaries it is necessary to calculate different scenarios in advance. Thereby assumptions regarding bounded resources of vaccines or money for a strategy as well as epidemiological key parameters have to be taken into account.
In mathematical theory the ordinary differential equations of Kermack and McKandrick in 1927 describing the spread of disease are one key step in simulation of the behavior of an epidemic. The so called SIR (Suspected – Infected – Recovered) model.
Nevertheless these equations are not the only way of modeling complex disease behavior. In this work the main solution strategies used in modern pharmacoeconomic output research are discussed. These strategies are Markovian models, ODE models and agent based modeling techniques.
The three strategies are explained briefly and in the second task the differences and benefits as well as problems of each method are figured out. In the outlook a concept for feedback in modeling and more general in problem solving in pharmacoeconomic decision making regarding infectious diseases is presented.

Keywords: modeling techniques, epidemics, evaluation of strategies

Presenting Author's biography

Günther Zauner. He studied Technical Mathematics with a focus on mathematical methods in computer science at Vienna University of Technology. His current field of work is modeling and simulation in health technology assessment (HTA), development of simulation strategies for infectious diseases for dwh Simulation Services. He is also working on a PhD thesis supervised by Prof. Felix Breitenecker in Vienna.

MODELLING OF FLOW AND PRESSURE PATTERNS. ESTIMATION OF BLOOD FLOW AND BLOOD PRESSURE MANNER IN DIFFERENT SIZED PATIENTS. NEW CHALLENGE FOR CARDIOLOGY AND CARDIAC SURGERY

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Abstract

"Modelling of flow and pressure patterns could help us to better understand real blood flow and blood pressure in the human body." We use Modelica for modelling blood flow and blood pressure patterns in different size patients. Every patient has his/her unique systemic vascular bed size and pulmonary vascular bed size. We define the vascular bed parameters for describing the patient's vascular bed. We acquire vascular bed data by means of assessment and processing of flow and pressure biosignals. We are at the beginning of developing models of blood flow and blood pressure pattern in the human body, but we are aware of the importance of our efforts for cardiology and for cardiac surgery and for the development of new pumps - mechanical circulatory support devices. Modelling of blood flow and blood pressure pattern in the human body is going to become a very important tool for solution of cardiology and cardiac surgery problems in the case of patients supported by pumps worldwide. As the main medical aim of our contribution we present pressure and flow pattern change, when employing pump with stroke volume of 100 ml into the normal-sized patient (the patient adapted to the stroke volume of 65ml).

Keywords: Modelling, Blood flow, Blood pressure, Cardiology, Cardiac surgery

Presenting Author's biography:

David Macku, MD, MSc works as the research fellow in the BioDat Research Group at the Gerstner laboratory. He graduated in chemical engineering at the Institute of Chemical Technology Prague in 1997. He is a medical doctor. He finished the 1st Medical Faculty of the Charles University in Prague in 2003.
His main research is focused on mechanical circulatory support devices, another research interests include modeling of blood flow and blood pressure patterns, fluid dispersion in branched systems.

COMPACT VHDL-AMS SYSTEM LEVEL MODEL OF SMART POWER SWITCHES FOR CONTROL CONCEPT VERIFICATION

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Abstract

This paper presents a method for simulation and experimental verification of compact electro-thermal models for smart power switches. We focus on short circuit events in an automotive environment where high power dissipation and thermal stress severely affect device reliability. For accurate temperature calculation, a compact non-linear thermal network was derived from Z_{th}-curves obtained by non-linear 3D FEM simulations. In this network, we introduced temperature dependent coefficients which are related to the thermal material properties of the smart power device. The electric MOSFET model used was derived from well known SPICE transistor model equations. VHDL-AMS was used to model and simulate the proposed compact electro-thermal power MOSFET model, gate driver and loading conditions. Additionally the simulation results were verified experimentally by combination of both a test chip and a hardware-in-the-loop (HIL) system. The test chip was built in a power technology and consists of power transistors and temperature sensors. The HIL system is a test setup for the laboratory incorporating a FPGA, a compact printed circuit board and a high power DC supply. It is capable to verify thermo-electrical power MOSFET models with arbitrary loading condition and to investigate advanced control concepts. Representative measurements have shown very good correlation with the simulation results which verified the accuracy of the presented approach.

Keywords: Automotive, VHDL-AMS, Compact Modeling, FEM, Smart Power Switch

Presenting Author's biography

H-P Kreuter, graduated in 2007 in Informatics at University of Klagenfurt, Austria, Faculty of Technical Sciences. In 2002 he carried out his diploma thesis at KAI GmbH in Villach, Austria on a topic related to advanced control of pulse stress test systems for smart power switches. He started his PhD in 2008 at TU Vienna, Department of Computer Engineering, and currently works on advanced control and protection concepts for smart power switches.

ELECTRO-THERMAL SIMULATION OF A SEMICONDUCTOR DEVICE BASED ON SIMULATIVELY EXTRACTED ELECTRICAL PARAMETERS FROM MEASUREMENTS

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Abstract

In order to investigate degradation phenomena in the metallization of power semiconductor devices, a test chip with integrated N-type poly-silicon heaters has been designed. The goal is to correlate degradation rate with the temperature rise. To obtain the temperature rise electro-thermal FEM simulations were performed. The test chip has not been produced using standard semiconductor processes. Therefore a combination of measurements and FEM simulations has been applied to determine the temperature dependent electrical resistivity of the poly-silicon. Based on the measurements of the total heaters' resistance, the electrical resistivity was determined by iterative way of minimizing error between measurements and simulations for each temperature point. As a result, the proper temperature dependent material model of the poly-silicon was obtained. By means of the physically meaningful equation, the poly-silicon model was extrapolated for higher temperatures. Subsequently, the test chip temperature in the reliability investigations could be determined. The simulations have shown very good correlation with the actual measurements.

Keywords: FEM, electro-thermal simulation, semiconductor, temperature dependence

Presenting Author's biography

Vladimír Košel, graduated in 2003 in electrical engineering at Slovak University of Technology (STU) in Bratislava, with focus on DSP and integrated optoelectronics. He received his PhD in 2009 from STU FEI. During his PhD study was working on reliability of power devices at Infineon Technologies Austria and at KAI GmbH. Nowadays, he is working as R&D engineer at KAI GmbH.

COMMUNICATION EFFICIENCY AND PATTERN OPTIMIZATION IN FPGA ACCELERATED RTL SIMULATION

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Abstract

For verification of complex RTL circuit models, simulation efficiency can be increased through the application of FPGA accelerators and their integration into software-based environments. However, this integration requires both RTL model partitioning and data exchange between these partitions mapped either to fast FPGA hardware or to traditional software based RTL simulators. Beside the hardware execution benefits, the acceleration degree of the entire simulation process heavily depends on the organization of the inter-partition communication scheme, which is strongly related to the particular transfer patterns. In this paper, a novel, highly efficient communication scheme named interaction-based modeling is introduced and evaluated against widely used non-overlapping and transaction level modeling (TLM [1]) methods. Applying the new model to typical communication patterns mainly found in stream processing applications, we could decrease the number of transfered events, thus gaining an overall simulation speedup over the simple communication model. In terms of simulation parallelization and acceleration, the interaction-based modeling can compete with TLM methods, without requiring a high modeling effort. In contrast to TLM, the interaction-based communication provides a versatile and less abstract interface model, which allows more flexible partitioning and requires significantly less FPGA resources. Real-world simulation results have been obtained from a RTL simulation prototype platform, which is also described in this paper.

Keywords: RTL Simulation, FPGA Accelerator, Communication, Partitioning

Presenting Author's Biography

Steffen Köhler is a research and teaching staff member of the Department of Computer Science at the Technische Universität Dresden. He received his Diploma (Dipl.-Inform.) in Computer Science and his Doctoral degree (Dr.-Ing.) in Computer Engineering in 1992 and 2009 respectively. His research interests include the analysis and optimization of data and instruction streams in embedded processors as well as trace data reconstruction and simulation.

2D POSITION IDENTIFICATION OF A SOUND SOURCE USING PHASE DIFFERENCE SPECTRUM IMAGES

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Abstract

The visually handicapped person can localize the position of the sound source only by hearing. The auditory space might be constructed on the auditory system in the brain. Such an auditory mechanism remains unknown. A human-like robot that can construct an auditory space with two microphones might reveal an alternative solution to clarify such a mechanism. The present paper describes a new computational algorithm for constructing a 2D auditory space with two microphones. The cross-power spectrum phase of the sound pressure transmitted from a broadband sound source in a reverberation room is discontinuous with respect to the frequency. The discontinuous phase differences spectra (images) are used to identify both the distance to the sound source and the azimuth of the sound source. A head and torso simulator with a built-in microphone in each ear was fixed at the center of the reverberation room. The 2D positions were identified for the source placed at various positions. The results showed that the source positions could be identified over a range of 3 meters and an approximate range of azimuths of from -50° to +50°.

Keywords: 2D, Position identification, Sound source, Phase difference, Images, Head and torso.

Presenting Author's biography

Ryuichi Shimoyama. He received Doctor of Engineering in System Science at Okayama University. He was an invited researcher at Center for Intelligence Systems of Vanderbilt University, USA and Polo Sant'Anna Valdera of Pisa University, Italy, from 2005 to 2006. He is Professor of Nihon University, Japan. His current research interest includes artificial intelligence on auditory system and robotics. He is a member of IEEE, IEICE, IPSJ, ASJ and JSST.

MODELING AND SIMULATION RESULTS ON A NEW COMPTON SCATTERING TOMOGRAPHY

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Abstract

Conventional tomography (X-ray scanner, Computed Tomography : CT, Single Photon Emission CT : SPECT,...) is widely used in numerous fields such as medical imaging and non-destructive testing. In theses tomographies, a detector rotates in space to collect primary radiation emitted by an object under investigation. In this case Compton scattered radiation behaves 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 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 is feasible [1, 2, 3, 4, 5]. In this work we propose a new form of Compton scattering tomography (CST), akin to the X-ray scanning tomography, in the sense that it works in transmission but uses Compton scattered radiation. The new image formation modeling is based on a new class of Radon transforms on circular arcs. Through simulation results we show the feasibility and the relevance of this new process.

Keywords: Radon transforms (RT), Circular-arc Radon transform (CART), image reconstruction, Biomedical and nuclear imaging modeling, Compton scattering tomography (CST), scattered radiation

Presenting Author's Biography

Gaël Rigaud, M.Sc., is a 2010 graduate of the École Nationale Supérieure de l'Électronique et de ses Applications, France. He is presently working on a research project at ETIS under the supervision of Professor M.K. Nguyen. His research interest is in the field of modeling and simulation of Compton scattering tomography, inverse problems and generalization of Radon transform.

DEVELOPMENT AND IMPLEMENTATION OF A DOMAIN MODEL FOR PERSISTENCE AND CODE GENERATION FOR CONSISTENT MATERIAL FLOW SIMULATIONS WITH MILAN

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Abstract

This paper gives an introduction to the domain model of the material flow simulator MILAN, showing the advantages of domain driven design. MILAN incorporates a component based event discrete infrastructure with material flow analysis functionality. It is built on the open source plugin-based rich client platform EMPINIA. MILAN extends the framework towards the specific field of material flow simulation. The concept of material flow simulation combines the approach of production-oriented, job-related simulation and material flow analysis for the application field production systems. EMPINIA offers a Domain Specific Language (DSL) to define a domain model. This approach simplifies the complexity of designing the domain logic providing best practice and good tested code. The domain, for which the material flow simulator MILAN was developed, consists of model, experiments, simulation entities and material flow definitions. Additional simulation entities and their relations can be developed and added to MILAN respectively existing components can be customized much more easily utilizing this mechanism.

Keywords: Event Discrete Simulation, Production Systems, Plugin-based Components, EMPINIA Framework, Material Flow Simulation

Presenting Author's biography

Paul Jahr is a master student and Lars Schiemann is a master of science of industrial environmental informatics at HTW Berlin. Both are core developers of the EMPINIA framework since 2006 and are professionals in Microsoft .Net. Together they designed and developed most parts of the event discrete simulation tool MILAN.

THE DESIGN OF SELF-DEVELOPMENTAL MODEL OF ATMOSPHERIC POLLUTANT DISPERSION

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Abstract

This paper presents the design of self-developmental model of atmospheric pollutant dispersion. As many of existing physical models of atmospheric phenomena are statically defined for certain conditions, for simulation it is emergent to update these models to reflect the natural dynamic behaviour of self-adaption. In recent research we have already proposed new evolutionary method denoted as Content/Form computing. Here we apply this evolutionary method as main iterative process to develop adaptive model of atmospheric pollutant dispersion. Main inspiration of our design comes from existing equation of atmospheric pollutant dispersion, its inner parts like wind or diffusion models and from and Sheldrake's extended evolutionary theory of "*Nature as Alive*" [1].

Keywords: pollutant dispersion, advection, dispersion, atmosphere, evolution, Content/Form computing, morphic fields.

Presenting Author's Biography

Radim Dvořák is a Ph.D. student in the Department of Intelligent Systems at the Faculty of Information Technology, Brno University of Technology, Czech Republic. He received a master degree in information technology program from the Brno University of Technology on subject of deformable bodies' dynamics. He is interested in modeling, simulation, biometric systems and computer graphics. For more information see please http://www.fit.vutbr.cz/ idvorak.

MODELLING THE FLOW PROCESSES IN UNSATURATED POROUS MEDIA FOR PREDICTING THE WATER CONTENT DISTRIBUTION IN LEVEES AND EARTH DAMS

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Abstract

Levees and earth dams play an important role as flooding protection systems in Germany. The construction and used materials define the stability of a levee or earth dam. To assess the stability and to perform possible measures, knowledge of the geo-hydraulic properties of the levee is necessary. Therefore, it is not sufficient to have information only about the flow processes within the fully saturated part of the levee or earth dam. Moreover, the unsaturated regions are also important because instabilities on the downstream face can occur already at partial saturation. The simulation software SiWaPro DSS, which was developed by the authors, is able to describe the geo-hydraulic processes in both the fully and partly saturated zone in a closed form. Several physical experiments at model-scale dikes with different constructions were performed at the TU Dresden. The program SiWaPro DSS was used to model and simulate these physicals experiments. The basic numerical method and hydraulic model is described, the model setup including boundary conditions as well. Furthermore, a transient boundary condition was implemented to allow for the simulation of fluctuating flooding waves with increasing and decreasing water levels on the water-side. Their effects on the water balance are analysed in that paper and an outlook to further possible improvements is given.

Keywords: Unsaturated flow modelling, transient dike simulation, Richard's equation

René Blankenburg's biography

René Blankenburg studied Geodesy at the Technische Universität Dresden, Germany and obtained his degree in 2004. Since he moved to the Institute of Waste Management and Contaminated Site Treatment, René Blankenburg is attended to the development of numerical simulation software for transient water flow and solute transport in variably-saturated porous media using the Finite Elements Method.

PRELIMINARY STUDY OF USING ELLAM FRAMEWORK FOR SOLUTION OF ATMOSPHERIC ADVECTION-DIFFUSION-REACTION EQUATION

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Abstract

This paper deals with the numerical solution of the specific atmospheric equation called advection-diffusion-reaction equation (ADR). This equation describes the behaviour of the pollutant that was released to the atmosphere, namely a change of its concentration during time. The ADR equation is rather complicated, because of the highly variable coefficients with respect to time and space. The common technique to simplify the solution is to use the approach of operator splitting, where the ADR equation is divided into two or three parts that contain advection, diffusion or reaction part, sometimes two of them together. Then the special methods are used to solve each part of it. This paper contains the results of experiments where the Walcek [1] and ELLAM methods were compared with each other through various tests that refer to the pure advection equation. The slightly adapted ELLAM method has turned out to be the more accurate and the more stable in these tests.

Keywords: contaminant dispersion, atmospheric pollution, advection-diffusion-reaction equation, ELLAM framework

Presenting Author's Biography

Radim Dvořák is a Ph.D. student in the Department of Intelligent Systems at the Faculty of Information Technology, Brno University of Technology, Czech Republic. He received a master degree in information technology program from the Brno University of Technology on subject of deformable bodies' dynamics. He is interested in modeling, simulation, biometric systems and computer graphics. For more information see please http://www.fit.vutbr.cz/ idvorak.

SPEEDUP 512 ? – USING GRAPHIC PROCESSORS FOR SIMULATION

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Abstract

Current hardware development is characterized by an increasing number of multi-core processors. The performance advantages of dual and quad core processors have already been applied in high-speed calculations of video streams and other multimedia tasks. New options arise from the increasing power of new graphic processors. They include up to 1600 shading processors, which can also be used for universal computations at present. The paper discusses possible applications of graphic processors in continuous and discrete simulation. The implementation of parallel threads on more than one core requires substantial changes in the software structure, which are only possible inside the source code. Changes like these cannot be realized with COTS simulation systems. The paper also introduces feasible architectures and compares the CUDA and OpenCL approach.

Keywords: Massively parallel computing, graphic processors, CUDA, OpenCL

Author biography

Thomas Wiedemann is a professor at the Department of Computer Science at the University of Applied Sciences Dresden (HTWD). He was graduated (as a Diploma engineer) at the Technical University Sofia and received the Ph. D. degree from the Humboldt-University Berlin. His research domains are focused on simulation methodology, tools and environments in distributed simulation and manufacturing processes. He also presents lectures in intranet solutions and database applications.

IMPLEMENTING A LARGE-SCALE SPATIAL EPIDEMIC MODEL AS AGENT-BASED SYSTEM USING GPGPU AND DATABASES

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Abstract

Epidemiological Models are basically composed of medical, demographic and spatial features of arbitrary complexity depending on available data and purpose of the simulation. With increasingly subtle structures the formulation and implementation becomes more and more challenging. Additionally the performance limit of simulators, applications and hardware interferes with the models fidelity. The purpose of this investigation is to find and test new approaches for implementing and simulating systems with large data volume and complexity. Some approved approaches/concepts involve matrix based programming languages, parallelisation, cellular automata and agent-based systems. Our goals are to swap costly calculations to equivalent methods with lower time penalty, make use of fundamental concepts such as databases during simulation or to facilitate access to advanced programming techniques like GPGPU (computing on graphics devices). This contribution presents and evaluates different approaches towards implementing large spatial systems using cellular automata and agent-based approaches. The discussion is based on a spatial model for simulating the spread of two competing diseases (serotypic shift).

Keywords: Cellular Automaton, Spatial Agent-Based System, Database, GPGPU, Disease Propagation

Presenting Author's Biography

Günter Schneckenreither studies mathematics at Vienna University of Technology. He joined the Modelling and Simulation Group in 2006 and works on Cellular Automata and Agent-Based Systems.

AN APPROACH FOR COMBINED SIMULATION BASED PARAMETER AND STRUCTURE OPTIMIZATION USING EVOLUTIONARY ALGORITHMS

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Abstract

Modeling and simulation with integrated parameter optimization is used routinely to improve system performance. In this established technique model structure is considered to be fixed as the relationships between model elements are defined during model development. As model performance is optimized it may be necessary to redesign the model structure. The redesign is normally carried out manually.
Evolutionary Algorithms are a subtopic of Artificial Intelligence that are involved in combinatorial optimization problems. These algorithms are based on ideas inspired by biological evolution: reproduction and selection, mutation and recombination. They often perform well for many problem types because they do not make assumption about the problem specific search space.
The research reported in this paper details an approach providing optimization through automatic reconfiguration of both: model structure and model parameters. An evolutionary algorithm based optimization method is assisted by model management using a meta-modeling method. It searches for an optimal solution with repeated, combined model parameter and model structure changes resulting in a combined parameter and structure optimized model. Therefore the model management provides algorithms to join an evolutionary algorithm with model generation and simulation.

Keywords: DEVS, Structure Optimization, Evolutionary Algorithm, Parallel Computing.

Presenting Author's biography

Olaf Hagendorf studied electrical engineering with the specialization computer engineering at Universities Wismar and Rostock. After finishing his study in 1997 he set up a company, among other specialized in automation system and machine control development for the photofinishing industries. His company dealt with orders mainly in Middle and Northern Europe. Parallel to his business he started with a PhD project at Liverpool John Moores University and successfully finished it at 2009. Currently he is a research assistant at University Wismar.

APPLICATION OF ADVANCED SEARCH-METHODS FOR AUTOMOTIVE DATA-BUS SYSTEM SIGNAL INTEGRITY OPTIMIZATION

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Abstract

Automotive bus systems are used to connect control units, intelligent sensors and actors in vehicles. From economical point of view extended cable networks are desirable. Systems are often operated close to their specification limits. To provide safety critical applications under these circumstances, the functionality of a bus system must be ensured with sophisticated methods.
An approach to detect problematic behaviour and its causes is the computational investigation of the transmitted signal quality (signal integrity) of the physical layer of the bus system. Models for any component of a bus system have to be developed. Accuracy of models and methods has to be ensured by measurements with realistic systems.
However, many system parameters are not fixed, e.g. tolerances of devices, variations in the topology, external electromagnetic influences etc., so that there is a nearly unmanageable number of combinations. Validation of safe function becomes difficult. By simulation with parameterized models powerful search methodologies can be applied to find the most critical parameter combinations in the operation of a bus and to validate a system design this way. The application of several modern search methods is investigated and the results are compared to classical Monte Carlo Analysis.

Keywords: Bus System, Signal Integrity, Simulation, Search Methods, Validation.

Presenting Author's biography

Harald Günther studied computer science with electrical engineering at Technische Universität Dortmund. Currently he is research assistant and PhD student at Arbeitsgebiet Bordsysteme. His main interest of research is modeling of bus system physical layer components and simulation based bus system investigations.

HYBRID STATE CHART MODELLING FOR NONLINEAR BOUNCING BALL DYNAMICS

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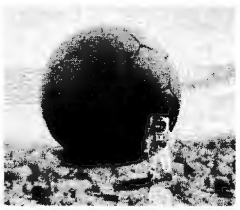
Abstract

This contribution highlights two aspects of the classical bouncing ball modeling and simulation. On modelling level, the ball characterises more a big bubble than a ball, so that drag forces cannot be neglected and impacts must be modelled by distortion, and additionally the implication of the big-sized ball for different atmospheres (comparing Earth and Mars). What looks like fun – may be used for education in modelling and simulation, and may become serious science once. (http://saturn.astrobio.net/pressrelease/63/having-a-ball-on-mars)



On implementation level, the presented MATLAB/Stateflow version is a purely discrete approach: fly and distortion are modelled by state charts, updated by triggered stepsize events which drive an ODE solver. Switching between impact, distortion, and fly is triggered by state events following a predictive event finding strategy: as the event function is the state ball height, also first and second derivative of event function are known. Thus allows approximating the event function by a polynomial of first order or second order near the impact, the known zero of which may be used for adjusting a smaller step size, and in last consequence, to give the impact time. The idea may be generalized for contact problems in mechanical systems.

Keywords: Bouncing Ball, State Flow, State Charts, Hybrid Modelling.

Presenting Author's biography

Pavol Bauer is working on a master degree in Medical Informatics and Modeling and Simulation, currently writing his thesis at TU Vienna, ARGESIM Group. His research focus emphasis is on hybrid models, cellular automata and agent based modeling. He is involved in a project on discrete modeling approaches, supported by state chart descriptions.

EVOLUTIONARY OPTIMISERS IN CALIBRATION OF ACTIVATED SLUDGE MODELS

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Abstract

In most applications of the Activated Sludge Models (ASM), calibration is based on more or less ad-hoc and trial and error approaches. There is a need for more systematic and automated approaches for ASM calibration. In this study, the applicability of real-coded genetic algorithms and differential evolution in calibration of a modified ASM No. 1 was evaluated. The evolutionary optimisers were used in parameter identification of a subset of the model parameters. The results were compared with a previously proposed calibration approach based on Monte Carlo simulations. All methods were capable of calibrating the model when given enough computation time. However, some of the evolutionary optimisation methods had a clear advantage in terms of computation time against the Monte Carlo method. The calibration was tested on an independent data set. The calibrated model provided accurate predictions on the testing data. However, it was found that the best parameter set for the calibration data did not result in the best performance for the testing data. Therefore the calibration and testing data sets have somewhat different optimal parameter values. As the optimal parameter values cannot be expected to remain constant for extended periods of time, the model will need recalibration in practical applications. This result emphasises the importance of methods which can automate the model calibration.

Keywords: pulp and paper wastewater, modified activated sludge model no. 1 (ASM1), parameter identifiability, model calibration, full-scale WWTP.

Presenting Author's biography

Jukka J. Keskitalo was born in Oulu, Finland in 1984. He received the M.Sc. degree in process engineering with honours from the University of Oulu, Finland in 2008. Currently he is a PhD student at the Control Engineering Laboratory, Department of Process and Environmental Engineering, University of Oulu and at the Graduate School in Chemical Engineering (GSCE). His current research interest is modelling and control of biological wastewater treatment. The research covers first principles and data driven approaches to biological wastewater treatment modelling, and combination of the two, the so called hybrid modelling.

MODELLING OF RESIDUAL ALUMINUM IN WATER TREATMENT PROCESS

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Abstract

Aluminium compounds are widely used as coagulation chemicals in water treatment processes. However, the concentration of residual aluminium should be minimized in potable water because it causes acceptability problems for consumers. In this paper, residual aluminium of a water treatment process was modelled using linear and nonlinear methods. The aims were to construct process models and to determine whether the concentration of residual aluminium could be predicted reliably by using these methods. A variable selection procedure with both methods was used to find the most important factors affecting the concentration of residual aluminium. The results showed that the most effective variables were water temperature, Al/$KMnO_4$-ratio and silicate concentration. In conclusion, the results were promising, and the methods used showed potential considering the wider use of the data processing procedure in water treatment processes.

Keywords: Water treatment, residual aluminium, modelling, variable selection.

Presenting Author's biography

Petri Juntunen (M. Sc. in Env. Eng.) is a post graduate student in University of Eastern Finland in Process Informatics Group. His main time job is in Kuopion Vesi (waterworks of Kuopio municipality) as a design engineer. Petri Juntunen's main interest of his studies is intelligent methods of water treatment.

DATA-BASED DEVELOPMENT OF HYBRID MODELS FOR BIOLOGICAL WASTEWATER TREATMENT IN PULP AND PAPER INDUSTRY

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Abstract

Modelling and simulation of biological wastewater treatment in pulp and paper industry requires hybrid models since the operating conditions can fluctuate drastically. A lot of process measurements are available, but measurement sets do not include sufficient information on special features of the influent nor on microbial composition of the sludge. Populations of microorganisms are highly important. A compact dynamic simulation is realized with linguistic equation (LE) models. The models consist of two parts: interactions are handled with linear equations, and nonlinearities are taken into account by membership definitions. Process insight is maintained, while data-driven tuning relates the measurements to the operating areas. Genetic algorithms are well suited for LE models. A new approach based on generalised norms and skewness has been developed for analyzing scaling functions from data sets, which include various operating conditions. Sensitivity to small changes from the optimal conditions is increased considerably. The resulting model has a cascade structure with specialized LE models.

Keywords: dynamic models, nonlinear systems, pulp and paper industry, wastewater, linguistic equations.

Presenting Author's Biography

Esko K. Juuso has M.Sc. (Eng.) in Technical Physics from University of Oulu. He is currently a university teacher 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 secretary of EUROSIM Board, and chairman of FinSim and SIMS. His main research fields are intelligent systems and simulation in industrial applications, including control and fault diagnosis. In 1991 he introduced the linguistic equation (LE) methodology, which is currently used in many applications of modelling, control and fault diagnosis.

SIMULATION ANALYSIS OF TERAPEUTIC OUTCOMES REGARDING CHRONIC HEART FAILURE WHEN USING BETA BLOCKERS

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Abstract

Cardiovascular (CV) diseases have become the most important cause for mortality in developed countries. This indicates that they also significantly influence the quality of life and represent an important social and economic burden. As national registers for such diseases are not available in all countries and/or for all CV diseases and because of the fact that statistical data are for small populations not very reliable in the paper three phase modelling structure is suggested with which different important aspects of hypertension and chronic heart failure (CHF) can be evaluated on the basis of combination of data from different sources. Mentioned structure enables the observation of hypertension and CHF prevalence (simulation results of the first and second phase), while in combination with demographic data also quantitative prediction of observed patients is possible. In the third phase information of treatment expenses and population data in Slovenia was added. In this way social and economic burden was estimated in the form of expected patients' number regarding their age and year treatment expenses. In addition also treatment efficacy of drugs with beta blockers is evaluated. The simulation results show that observed drugs are justified also from economical point of view. Finally the extrapolation of results to the countries with similar social and demographic situation is suggested.

Keywords: Hypertension, Congestive Heart Failure, Beta-blockers, Economic Burden.

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 associated professor. Her research interests include modelling and simulation of dynamical systems and control systems analysis and design, especially of MIMO-systems.

PULSE WAVE SEPARATION: A COMPARISON OF METHODS

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Abstract

In the last years new concepts such as pulse wave analysis (PWA) have emerged to determine cardiovascular risk. In PWA the augmentation of the aortal blood pressure due to reflections in the arterial system is expressed by the augmentation index or the augmentation pressure. One of the drawbacks of these parameters is their dependence on the timing of the reflected pressure waves. This problem can be overcome with the concept of wave separation analysis (WSA), which is carried out in the frequency domain and separates the measured pressure wave into forward and backward going waves. Another method for wave separation is known as wave intensity analysis (WIA), which is based on the methods of characteristics and is operating in the time domain.
The aim of this work is to compare the wave separation analysis method and the wave intensity analysis method by looking at several parameters derived from the separated pulse waves based on a study population of 131 patients.
For the backward pressure wave (P_b) the mean amplitude using WSA is 16.26 ($\pm$ 5.13) mmHg and with WIA 16.16 ($\pm$ 5.12) mmHg. The mean reflection magnitude (RM) using WSA is 0.626 ($\pm$ 0.099) and with WIA 0.616 ($\pm$ 0.096).
The results of this study give a good basis to fully accept wave intensity analysis as an alternative method to perform pulse wave separation.

Keywords: pulse wave analysis, wave separation analysis, wave intensity analysis

Presenting Author's biography

Bernhard Hametner. He was born in 1982 and grew up in Lower Austria. He studied Applied Mathematics in natural sciences at the Vienna University of Technology with specialization in the field of modeling and simulation. Since 2008 he is a PhD student focused on pulse wave analysis at the Vienna University of Technology and in the Health and Environment Department of the Austrian Institute of Technology.

REPRESENTATION OF COMPETITIVE SEROTYPES IN DYNAMIC MODELS

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Abstract

Health economic questions demand accurate models for the spread of diseases. There already exist various approaches. Health economists mostly use Markovian models which are not suitable when analyzing dynamic effects like herd-immunity or serotype shifting. Wanting to understand these effects dynamic models like differential equations or agent-based models have to be used. Correctly modeling the transmittance of pathogens automatically considers herd-immunity. Serotype shifting on the other hand is a far more complex effect.
Usually a disease is not caused by a certain bacteria where vaccination prevents from getting infected with it. A more realistic view considers many different serotypes which all interact with each other. Vaccination only prevents from carrying certain serotypes but does not immunize against all of them. Wanting to establish a model representing different serotypes and especially simulating occurring serotype shifting, we show several ways how to extend an ordinary differential equation model. First we analyze the trivial case where they are not interacting with each other. Afterwards we run a scenario where people can carry strains of both serotype groups and then the most sophisticated way where serotypes affect each other in non-trivial ways.
Most of the time it is unknown how serotypes interact with each other therefore data of studies and expertise must be used to identify the model parameters. Model structure has to be chosen problem-dependent therefore there is not one correct method.

Keywords: Epidemiology, Serotype shifting, Vaccination, Health technology assessment

Presenting Author's biography

Christoph Urach studied *Technical Mathematics* at *Vienna University of Technology*, specializing on modeling and simulation, where he earned his master degree in 2010. He now works at *dwh simulation services* in the section for health technology assessment (HTA) and health economics. Currently he is also pursuing a PhD degree under Prof. Felix Breitenecker at *Vienna University of Technology*.

COMPTON SCATTERING EMISSION IMAGING BASED ON THE V-LINE RADON TRANSFORM AND ITS SIMULATION

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Abstract

The Radon transform (RT) on straight lines deals as mathematical foundation for many imaging systems (e.g. X-ray scanner, Positron Emission Tomography) operating only with non-scattered (primary) radiation. Using Compton scattered radiation has turned out to be an attractive alternative to conventional emission imaging. In this paper, we propose a new two-dimensional emission imaging from Compton scattered gamma-rays. Its modeling leads to a Radon transform defined on a pair of half-lines forming a vertical letter V (TV). Moreover we establish the analytic inverse formula of this new TV, which forms the mathematical basis for image reconstruction. Through simulations, image formation and reconstruction results show the feasibility and the relevance of this new imaging. The main advantage is to use a one-dimensional non-moving detector for two-dimensional image reconstruction.

Keywords: Radon transform, image reconstruction, nuclear imaging, tomography, Compton scattering, Biomedical and nuclear imaging modeling

Presenting Author's Biography

Rémi Régnier, M.Sc., is a 2010 graduate of the "École National Supérieur d'Électronique et ses applications", France. He is presently on a research project at the laboratory Équipes Traitement de l'Information et Systèmes under the supervision of professor M.K.Nguyen. His research interest is in the field of modeling and simulation of Compton scattering tomography, inverse problems and generalization of Radon transform

A KINETIC SORPTION MODEL FOR CITRATE IN SOIL

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Abstract

Citrate is a low-molecular weight organic acid anion that is frequently released by plant roots into the rhizosphere. The negatively charged carboxylate has been found to beneficially influence plant growth by solubilizing nutrients (mainly phosphorus, iron, zinc) or by detoxifying rhizotoxic metals (aluminum).The beneficial effect of citrate in soil is determined by the proportion that is available in the soil solution. Therefore sorption is a fundamental soil process which needs to be accurately described. In this work we develop a new kinetic sorption model for citrate based on non-linear ordinary differential equations. The model incorporates two Freundlich sorption curves as stable steady states which represent ad- and desorption isotherms respectively. We describe the model development and parameter estimation based on experimental data for a specific soil type. Results of the of the kinetic sorption model showed good agreement with the observed kinetic data.

Keywords: Mathematical modelling, kinetic sorption, Freundlich isotherm

Presenting Author's Biography

Daniel Leitner graduated in mathematics at the Vienna University of Technology. He did his doctoral thesis about the simulation of blood flow at the Austrian Research Centers. He currently works as a postdoctoral research fellow at the University of Natural Resources and Applied Life Sciences in Vienna where he develops mathematical models describing rhizosphere processes. His main interests are continuous modelling and simulation, especially multiscale models, as well as the application of homogenisation and averaging techniques.

A METHOD TO IMPROVE TEAM PERFORMANCE IN THE OR THROUGH INTENT INFERENCING

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Abstract

Medical care is provided by individuals who are very well trained and highly motivated for improving patient health. When these individuals work together, their communication and awareness of circumstances is the key to team performance and directly impact patient safety. The operating room (OR) is an especially vulnerable place since a wide variety of people, medical devices, as well as a range of actions and events are mixed together interacting dynamically. Due to this fact, the sharing of information and understanding of co-workers can easily break down and result in various adverse events. Consequently, there is a need to assist the OR team members' awareness of their dynamic environment/situation as well as their understanding of the goals and actions of their co-workers. To that end, in this paper, we present a computational framework that accounts for the OR team members' decision making. This also includes implicit decisions and misunderstandings among the team members such as those relating to miscommunication, miscues, and misinformation. In particular, we simulate the OR team members' understanding of their situations through intent inferencing, where an individual's intent is embodied by combining goals, supporting actions, and plans.

Keywords: Intent Inferencing, Bayesian Knowledge Bases, Probability Reasoning

Presenting Author's biography

He is currently Professor of Engineering in the Thayer School of Engineering at Dartmouth College, Hanover, NH. He is currently Editor-in-Chief for the *IEEE Transactions on Systems, Man, and Cybernetics: Part B*, an associate editor for the *International Journal of Image and Graphics*, and is also on the editorial advisor board for *System and Information Sciences Notes* and on the editorial boards for *Journal of Intelligent Information Systems* and *Journal of Experimental and Theoretical Artificial Intelligence.*

A CASE STUDY: PERFORMANCE EVALUATION FOR A COMPUTER INTEGRATED POWER PLANT NETWORK

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Abstract

The paper presents a solution designed for big and medium power generating plants or combined heat and power generating plants in Poland many years ago. The basic components of the solution, the operator's control systems, have been implemented successfully in numerous power (and heat-and-power) facilities in the country and presently, it seems that the time has come to implement the full, computer integrated manufacturing and management solution enabling adequate operation of the power plant manufacturing (generation) and management. This needs development of local area networks and/or metropolitan networks of the wireless type, in dependence on the power plant size. The paper is devoted to performance evaluation/prediction for such case-study network.

Keywords: Power plant, computer integration, computer network, wireless network, performance evaluation, performance prediction.

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 applied analytical and event-driven simulation methods to investigate performance of the systems he designed. Though the computer 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. Presently, he designs novel computer solutions needed by prospective users and performs the scientific investigations of the solutions.

NEW ANN MODELS FOR SHORT TERM FORECASTING OF ELECTRICITY LOADS

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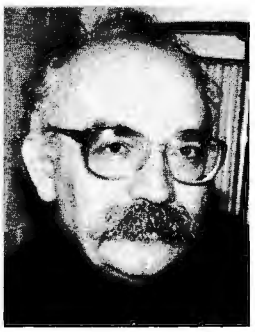
Abstract

Short term prediction of electricity load is discussed. It will be shown here first that for the subject of short term prediction of electricity load, even though a large amount of data may be available, only the most recent of it may be of importance. That gives rise to prediction based on limited amount of data. We here propose implementation of feed-forward artificial neural network models for a potentially systematic solution of that problem as opposed to heuristics that are in use. Examples will be given related to short-term (hourly) one- and two-steps-ahead forecasting of the electricity load at suburban level.

Keywords – modelling, forecast, power consumption, artificial neural networks

Presenting Author's biography



Vančo B. Litovski was born i Rakita, South Macedonia, Greece. He received all his degrees from the Faculty of Electronic Engineering in Niš, Serbia. His research interest spans from electronic filters, over electronic circuits and systems modeling and simulation, to integrated circuits design, testing, and diagnosis. He is author of several hundreds of scientific papers and several tenths of scholar books. He received The Tesla and The Savastano awards. Prof. Litovski is the establisher and President of the Yugoslav Simulation Society. He is chairing the Organising and the Program Committees of the Small Systems Simulation Symposium.

MULTIPHYSICAL SIMULATION IMPROVES ENGINEERING OF ELECTRIC DRIVES

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Abstract

In many electric drive applications – especially road and rail vehicles – dimensions and weight of the electric machine are crucial factors. Taking the time varying load conditions of such drives into account, fast and accurate prediction of the machine's electro-mechanic and thermal behavior over a given load cycle is essential to achieve a design that is neither too small nor too large; these results are desired in an early phase of the drive's engineering process. Additionally the cooling method is limited by the application's specification, influencing the thermal behavior respectively the utilization of the machine's active part. To support the design engineer, both an electro-mechanical model – taking all loss sources into account – and a thermal model – considering the cooling method – have been developed. For this challenging multiphysical modeling task, the object oriented modeling language Modelica is used. The main focus of the presented models is extensibility, easy adaption for different cooling methods, satisfying accuracy and performance of the simulation. To validate the developed models, simulation results are compared with measurements of a 4-pole standard induction motor 400 V / 50 Hz, 18.5 kW, totally enclosed fan cooled (TEFC). The drive is tested under varying load conditions, monitoring electrical, mechanical and thermal quantities.

Keywords: Multiphysical modeling and simulation, electric drives, Modelica.

Presenting Author's biography

Anton Haumer was born in 1957 in Vienna. He received the Dipl.-Ing. (M.Sc) degree in electrical engineering from Vienna University of Technology, Austria, in 1981. He worked for 15 years at ELIN Union AG, later VA Tech ELIN EBG, in various positions in the field of electric drives, especially development and design of electric motors. 1997 he achieved the license "Technical Consulting - Electrical Engineering". After some more years of experience in the field of electric measurement, sensors and automation, as well as power supply systems he began to work as a self-employed technical consultant. Since 2004 he is associated with Austrian Institute of Technology, Vienna, Austria. His main interests are development and simulation of electric drives. As a member of the Modelica Association, he developed several Modelica Libraries for the simulation of electric drives and acted as the Program Chair of the 5th International Modelica Conference 2006.

THEORETICAL CONSIDERATION OF LARGE DYNAMIC GAS DISTRIBUTION SYSTEMS, BY USING SIGNIFICANT COEFFICIENTS TO EVALUATE THE ENERGY EFFICIENY

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Abstract

In times of heavily increasing energy costs, companies more and more try to find further cost reducing provisions. Large gas distribution systems, like those in integrated iron an steel works, have losses caused by different physical behavior. The physical contexts in large systems are complex. This makes it complicated to find causal relationships between cause and effect. To visualize those causal behaviors, the gas distribution system of a 5 mil. tonnes of steel producing integrated iron and steel work was numerically modeled. Therefore APROS, a simulation tool for one dimensional dynamic simulation of different gases, steam or water-steam media, was used. The blast furnace gas distribution was modeled and evaluated. With the model, different analyses in terms of controlling, disturbance and changing net configurations were realized. For easier comparison, it becomes more and more important to have an objective method in order to quantify the efficiency of different network configurations . Therefore two coefficients have been developed which make it possible to compare different configurations of networks in terms of efficiency. Furthermore the developed coefficients were applied to the dynamic model, to show how numerical simulation can be used to develop optimization methods for a later implementation into a real plant.

Keywords: Apros, integrated steel works, gas distribution system, minimizing losses

Presenting Author's Biography

Rene Schimon was born in Salzburg in 1978. He visited a technical school with focus on mechanical engineering. After one year working for a German car manufacturer in Regensburg (Germany) he started to study mechanical engineering at the Vienna University of Technology, with focus on biomechanical engineering. After finishing his study he starts a PhD project at the Institute of Energy Systems and Thermodynamics. At the University he engages in one- and two-phase flow in distribution systems, like in steam boiler or gas distribution systems of iron and steel works.

DEVELOPMENT OF THE LATVIAN ENERGY SECTOR SYSTEM DYNAMIC MODEL

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Abstract

One of the most pressing problems in the Latvian economy is related to the energy sector. The most characteristic feature is coupled with the low efficiency of thermal energy consumption of households as a result of poor insulation of existing buildings in Latvia. Solving energy sector problems requires a comprehensive decision, both in energy production and consumption. Latvian energy sector model consists of resources, production and consumption blocks. Resource blocks consist of primary energy resource blocks: petroleum products, solid fuel, wood and gas blocks. Primary energy resources are used for production of heat or electricity, they are shown in the production blocks. Both the primary and produced energy are passed on to final consumers, who make consumer unit blocks. It consists of: transport, agriculture, households and other (industrial and services sectors) blocks. The model key role is to forecast energy consumption by separate groups, both consumers and energy resources groups; to estimate energy sector impact on environment. The model has been developed to estimate the impact of buildings thermo insulation program on Latvian economy, the article reflects these results.

Keywords: energy efficiency, consumption, system dynamic, modelling and simulation, building warming and renovation, the CO_2 emissions and quotas.

Presenting Author's Biography

Valerijs Skribans, Dr.oec., 2006, Riga Technical university. Leading researcher, assistant professor of Riga Technical University; has experience of managing chair; more than ten years practical work in economist and financial officer positions. Specialist in system dynamic. Member of International System Dynamics Society, Society for the Study of Emerging Markets, Archive of The Munich Personal Research Papers in Economics, Russian System Dynamics Society, Imitation and Modeling Society (Latvia), Latvian Association of Econometrics.

MODELING AND SIMULATION OF THE DYNAMICS OF HYDRO-ENERGETIC SYSTEMS

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Abstract

This paper presents a strategy for modeling and simulation of the hydro-energetic dam dynamics. The useful information for the evaluation of the mathematical models is represented by a data set collected for twenty years from one of the hydro-energetic systems in Romania. The results of our work allow the evaluation of the present state of this system and offer some important information for the computer aided design of similar systems. These results have been obtained using software tools dedicated to data acquisition, modeling, identification and simulation.

Keywords: hydro-energetic dam, multivariable system, data measurement, modeling identification, simulation.

Presenting Author's Biography

Silviu Cirstoiu is a Politehnica University of Bucharest 2008 Automation Graduate who continued his studies through a Systems Engineering Masters Program. His is currently improving his studies and research through a PhD doctoral program at Politehnica University of Bucharest in collaboration with Universite Picardie dAmiens, France. His is undergoing a research stage in Amiens modeling and controlling the behavior of the modern turbo charged diesel engine. The goal is to limit even more the NO2 exhaust gases of the engine through studies made over the relationships between pressures and torques inside the engine.

MOVING BOUNDARY HEAT EXCHANGER MODEL AND VALIDATION PROCEDURE

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Abstract

A moving-boundary model for condenser and evaporator heat exchangers in vapour compression cycles is presented. The model is formulated as system of differential and algebraic equations suitable for an implementation in the modeling language Modelica. The main idea of moving boundary models is to introduce separate control volumes for two-phase and single phase fluid flow. The boundaries of these control volumes or zones change dynamically. The model consists of a maximum of three zones: superheating, subcooling and condensing/evaporating. During simulation the number of zones dynamically changes by switching between different equations. Occurring discontinuities are formulated in a way that allows the simulation tool to handle them numerically stable. The models are well-suited for control design purposes as well as for model based control. Additionally, a validation procedure is presented. The zone lengths, which are differential states of the model, are measured directly by infrared thermography. This method allows a direct comparison of simulated and measured values of all state variables.

Keywords: Moving Boundary, evaporator, condenser, vapour compression, heat pump.

Presenting Author's Biography

Manuel Gräber studied mechanical engineering at RWTH Aachen with focus on energy technology and numerical simulation. Currently he is research assistant at the Institute for Thermodynamics at TU Braunschweig. His research topics are object-oriented modeling and Nonlinear Model Predictive Control of thermodynamic system. He is member of the Modelica Association, which is a non-profit organization developing the open modeling language Modelica and the Modelica Standard Library.

DESIGN OF A HYBRID CONTROL MODEL FOR AUTOMATIC SAMPLE CHANGERS AT SGAS/IAEA

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ABSTRACT

The International Atomic Energy Agency's (IAEA) Safeguards Analytical Services (SGAS) and their laboratories analyze nuclear material and environmental samples taken by Safeguards Inspectors in the field. The radiometry team at the SGAS's Environmental Laboratory (ESL) is responsible for detailed non-destructive sample screening prior any other analytical procedure, using a variety of radiometric techniques, such as gamma-spectrometry, X-ray fluorescence spectrometry and Secondary Electron Microscope (SEM). However, sample screening is very time consuming due the required measurement periods. Since working hours at SGAS are not 24/7, automatic sample changer systems can be used to save time and ensures the proper placement of samples on the detector. The ESL has a couple of sample changers (both, turntables and robotic arms) for gamma-screening, but since some of them have come to a certain age, the radiometry teams thinks of an open solution to replace old relay-based control units with new ones. Thus, a modern and flexible control unit was developed in LabView (Laboratory Virtual Instrumentation Engineering Workbench), to fulfill all the requirements needed as well for robotic arms systems as for turntable systems: starting/stopping a measurement, moving the turntable/robotic arm, monitoring intrinsic systems parameters, but also managing the data storage, barcode screening and reporting. To ensure best variability all these tasks can be mounted as subroutines to the controller. Thus, it consists of two main control units, one for sample changing and the other one for data handling. LabView has been proven to be a good choice was for the new sample changer's control unit, and it is able to control both, turntable sampling changers and robotic arms.

Keywords: Automatic Sample Changer, Control Unit, LabView, Machine Monitoring.

Presenting Author's biography

Katharina Breitenecker studied Technical Physics at the Vienna University of Technology, where she did her Master's in neutron activation analysis and her PhD in Nuclear Physics. She worked at the Nuclear Engineering Seibersdorf. After finishing her PhD, she started working at the International Atomic Energy Agency as a radiometry specialist. She really enjoys her rather contradictory working area, where she can combine both, mathematical modelling and practical work in the lab.

CREATING A SIMSCAPE HYDRAULIC LIBRARY FOR PHYSICAL MODELLING

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Abstract

Modelling and simulation of physical systems is more than ever an important topic in scientific computing. There is not only a wide range of application possibilities in various branches of physics, but computer simulation can also be used for different kinds of tasks, like optimization and acceleration of development processes or finding design errors. New approaches based on physical networks are making it easier for modelers to implement physical models as it allows them to focus on the physical structure rather than the underlying mathematical equations.
This paper describes a way how one can create reusable components representing hydraulic elements for modelling and simulation of hydraulic systems with MATLAB/Simscape™ using the physical network approach. Therefore, it is also defined a hydraulic domain in Simscape, describing how energy is transmitted throughout the physical system.
Since the balance equations used for the hydraulic components are non-linear, whereas the balance equations of mechanical or electrical systems are typically linear, it is presented a fundamental distinction between these classical physical domains and the hydraulic domain. To verify the created Simscape library, the rear part of this paper shows an example of a typical hydraulic system test environment, which has been modeled and simulated in Simscape.

Keywords: Simscape, physical networks modelling, hydraulic library, Simscape language

Presenting Author's Biography

Bernhard Heinzl received the BSc degree in technical mathematics and in electrical engineering from the Vienna University of Technology in February 2010 and in August 2010, respectively. He is currently continuing his studies in technical mathematics and automation towards a MSc degree.

BCP - A BENCHMARK FOR HYBRID MODELLING AND STATE EVENT MODELLING

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Abstract

Modelling and simulation of hybrid systems is getting more and more important in advanced modelling theory and application. Therefore, the requirements regarding flexibility on modern simulators are getting higher and higher. The necessity of fast and stable algorithms is increasing considering higher complexity in simulation questions. ARGESIM started in 1990 the series Comparison of Simulation Software in the journal Simulation News Europe (SNE). These software comparisons developed towards benchmarks not only for simulation tools but also for modelling tools and for modelling techniques and modelling approaches. To see how modelling and simulation environments deal with state events of different order, three classical examples are discussed in this benchmark. These parts offer a spectrum of questions for testing basic features and they represent minimum requirements to hybrid simulators regarding state events. Sample solutions are carried out in MATLAB® and partly in SIMULINK® and can be used for comparison with solutions calculated with other simulation environments.

Keywords: hybrid modelling, state event modelling, bouncing ball, electrical circuit, pendulum

Presenting Author's Biography

Andreas Körner. He passed his bachelorstudy in electrical engineering and his masterstudy in telecommunications. Now he is on the way to finish his diplomastudy in technical mathematics. Before he started his academic studies he passed a higher technical engineering college for electronics and technical informatics.
His field of activity include physical modelling and simulation. Because of his education in electrical engineering, his work is focused on technical applications. Another scope of work is the usage, design and development of e-learning systems for mathematical education and education in modelling and simulation.

EXPLOITING STRUCTURAL DYNAMISM IN FUNCTIONAL HYBRID MODELLING FOR SIMULATION OF IDEAL DIODES

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Abstract

Current main-stream non-casual modelling and simulation languages, like Modelica, are designed and implemented on the assumption that model causality remains fixed during simulation. This simplifies the language design and facilitates the generation of efficient simulation code. In particular, simulation code can be generated once and for all, at compile time. However, for hybrid models, the assumption of fixed causality is very limiting: there are many examples, including simple ones, that cannot be simulated. A half-wave rectifier with an ideal diode and an in-line inductor is one such example. Functional Hybrid Modelling is a new approach to non-causal modelling where models are first-class entities and structural dynamism is supported by switching among model configurations. Fixed causality is thus *not* assumed. Continuous simulation remains efficient thanks to just-in-time generation of simulation code at structural changes and the use of a standard, industrial-strength solver. Re-generation of code at each structural change of course incurs an overhead, but this is typically modest. In this paper we demonstrate how Functional Hybrid Modelling makes it possible to simulate electrical circuits with ideal diodes in a straightforward manner. We consider both a half-wave rectifier and a significantly more challenging full-wave rectifier.

Keywords: Non-causal Modelling and Simulation, Structurally Dynamic Systems, Just-In-Time Compilation

Presenting Author's Biography

Dr. Henrik Nilsson is a Lecturer at the School of Computer Science, University of Nottingham. He holds a PhD in Computer Science from Linköping University, Sweden. Prior to taking up his current post, he held a position as Associate Research Scientist at the Department of Computer Science, Yale University. His research interests include functional programming and programming language design and implementation, specifically domain-specific ones. At present, his research is focused on non-causal modelling languages supporting structurally dynamic systems.

SIMULATORS FOR PHYSICAL MODELLING CLASSIFICATION AND COMPARISON OF FEATURES / REVISION 2010

Felix Breitenecker[1], Nikolas Popper[2], Günther Zauner[2], Michael Landsiedl[2], Matthias Rößler[1], Bernhard Heinzl[1], Andreas Körner[1]

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Abstract

These series of contributions elaborate, classify and compare features of modern simulation systems, with special emphasis on physical modelling. First each contribution shortly reviews classical features of simulators: model sorting, event description, time event handling, state event handling, and DAE support with or without index reduction, and introduces a feature table with yes available, (yes) available but difficult to use, no not available, and (no) not available, but implementation possible or way around shown with classic simulators. Next, structural features are introduced, which reflect the developments in the last decade: object-oriented approach, a-causal modelling, physical modelling, structural dynamic systems, modelling standardisations as Modelica and VHDL-AMS, impacts from computer engineering (e.g. state charts), co-simulation, and environments. The feature list of 2009 included textual and/or graphical physical modelling, simulation-driven visualisation, Modelica modelling standard, textual and/or graphical state chart modelling, modelling of structural-dynamic systems, frequency analysis, real-time capabilities, solver splitting, and access to derived state equations. Mainly based on solutions to the ARGESIM Benchmarks - Benchmarks for Modelling and Simulation Techniques, published in ASIMs scientific journal SNE Simulation News Europe, the a comparison list could be set up, which in 2009 included 21 simulators (combination of different modules of simulators). This Revision 2010 extends the list of structural features by three new items: functional hybrid modelling, co-simulation, and multibody notations. Functional hybrid modelling is an essential extension of hybrid decoupling for structural-dynamic systems, co-simulation is an alternative approach in multidomain modelling, and the entry of multibody notations remember that Modelica is not the only standard. And consequently, the list of simulators is extended by two systems supporting functional hybrid modelling.

Keywords: Simulators, Classification, Comparison, Features, Structures

Presenting Author's Biography

Matthias Rößler. He is on his way to finish his diplomastudy in technical mathematics. He currently writes on his diploma thesis in the course of the INFO-project, a collaboration between Vienna University of Technology and industrial partners. His field of activity is physical modeling and simulation.

MODELLING HP STEAM GENERATOR WITH FUZZY FEEDFORWARD CONTROL SYSTEM

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Abstract

Currently, a lot of attention is given to the environment. The energy industry has a great influence on this situation. In this area, there is an effort to increase efficiency and achieve smaller energy losses and fewer environmental effects. One of the ways to achieve higher efficiency is to design a new control structure. Steam generator is one part of the thermal power plant. This paper is engaged in design of alternative high pressure steam generator output temperature control. Current feedback control system is designed with conventional PI controllers with variable parameters in the cascade connection. We have six valves as actuating values. This system is relatively complex and supplemented by a number of feedbacks accelerate. This paper describes a possible method of substituting an optimally set feedback PI-controller for fuzzy feedforward control. The principle is based on the direct relation between the value of power level and valve setting, which is applied through fuzzy logic. Testing and experiments proceed on a developed non-linear simulation model. The paper presents different variants of generating influencing values for the various defuzzyfication methods or a different selected power sequences. The resulting output temperatures are compared with obtained feedback control curves.

Keywords: steam generator, fuzzy logic, feedforward control, nonlinear model, cascade control structure.

Presenting Author's Biography

Tomáš Náhlovský. Tomáš Náhlovský graduated from on Technical university of Liberec with a degree in Automatic Control and Computer Engineering. Currently, he is pursuing his PhD degree in Technical Cybernetics at Technical University of Liberec. His research interest lies in advanced technologies, control systems and modeling in the special focus on the power engineering. Tomáš Náhlovský passed out 3 month Erasmus internship at the Chemnitz University of Technology, Germany. He was concentrated on the Institute of System Theory by Prof. Dr. sc. techn. Steffen F. Bocklisch on the fuzzy control.

MEASURING AND MODELING THE DYNAMICS OF REACTIONS OF CAR DRIVERS

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Abstract

Future requirements of vehicle control dynamics especially the car, requires explore abilities of driver's in more detail. This research is motivated of possibility to apply potential of new automation's and information technologies on change control of vehicles towards a higher quality, called "making decision's with the aid of intelligent system driver&car". This paper describes possibilities for realisation of new conceptual models behaviour of driver's and the levels of control in the intelligent control systems "driver/vehicle/traffic situation" and also conceptual simulator on verification (by measuring) for using of these conceptual models. Simulation experiments in the past made and published by author shows, that key parameter which described dynamics in driver behaviour's is its "dead time," or "transport delay", which were assumed constant in simulation experiments but in real driver behaviour varies in large scale and substantially determine dynamics in behaviours of driver's. Some experiments with variable dead time in models of driver were made. In the paper it is illustrated the hypothesis, that immediate transport delay is probably created from constant time delay caused by the muscle of hand and its nerve connection, and variable time delay created in the brain. This variable time delay is probably generate by "models of the known traffic situations", which are continually adapted in the driver's brain.

Keywords: Measurement, Identification, Simulation, Driver, Car, Eyes/Limbs dynamics

Presenting Author's biography

Mikuláš Alexík is a professor in the field of Information and Control Technics at the Technical Cybernetics Department, University of Zilina, Slovak Republic. He received his Ph.D. degree in Technical Cybernetics in Slovak Technical University, Bratislava, in 1980. His research interests include self tuning control algorithm, continuous identification of dynamics processes parameters, modeling and simulation of transportation means and processes, especially searching of optimal trajectory of underground vehicles and modeling and identification of driver in the car dynamics behaviors. He is worked a long time in national and international boards and societies (SSAKI, CSSS, ECCAI, IFAC, EUROSIM) and is member of the editorial boards of several journals. In the period 2007-2010 he was the EUROSIM President.

MODELING AND SIMULATION OF THE ELECTRIC ARC FURNACE FOR THE CONTROL DESIGN PURPOSES

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Abstract

Steel is one of the most universal and widely used materials, for which there is yet no suitable substitution. It is produced in two main routes: the ore base route and the scrap based route. The second route is becoming increasingly important, due to large quantities of available scrap metal and today represents more than 1/3 of the world's annual steel production. Therefore, the operation of the electric arc furnace (EAF), which is used to melt the scrap and the melting process also represent an interesting technical, economic and ecologic research field. The main idea of the EAF is to use the heat, which is dissipated from the electric arcs to melt the steel loaded in the baskets. Therefore, in this paper we present an approach to mathematical modeling of the electric processes in an AC EAF, which represent the most critic, complex and very important part of the whole EAF model, which further consist of several energy balance and chemical processes. The presented model is obtained according to different mathematical, physical and electrical laws. The parameters, which are needed to correctly identify the melting process have been fitted experimentally using the measured data of an 80MVA AC furnace operation. Similar data has also been used for the model validation in different operating situations. The aim of the EAF modeling is to obtain a reliable mathematical model of the scrap melting process, which shall further be used for control design purposes and optimization of the energy consumption.

Keywords: Dynamic Model, Electric arc furnace, EAF, Modeling

Presenting Author's Biography

Vito Logar received his B.Sc. and Ph.D. degrees in electrical engineering from the Faculty of electrical engineering, University of Ljubljana, Slovenia in 2004 and 2009, respectively. His research interests include modeling and identification in neurophysiological systems, advanced brain-wave analysis and modeling of the industrial processes.

DISCRETE-TIME FUZZY MODELLING AND PARALLEL DISTRIBUTED COMPENSATION CONTROL OF WHEELED MOBILE ROBOTS

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Abstract

This paper deals with Takagi-Sugeno modelling and parallel distributed compensation (PDC) control of nonholonomic mobile robots. The emphasis is given especially to the modelling part where the problem of discretization is solved. The nonlinear tracking error-model is solved analytically under the premise of ZOH present at the system input. The nonlinear discrete model is then developed. Several discretization approaches are discussed and the modelling errors are analysed and compared. The goal is to find the model that would allow for a simple solution of the underlying control problem. This is why the trade-off between the complexity and the accuracy of the model is discussed. The sector nonlinearity approach is used for constructing the Takagi-Sugeno discrete model. The PDC control is then designed in the LMI (linear matrix inequalities) framework to ensure the stability of the controlled system and to optimise the decay rate. Some performance issues are discussed on the simulation cases.

Keywords: Takagi-Sugeno, PDC control, Mobile robot, Kinematic model, Discretization.

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 Associate Professor at the same faculty. The research interests of Sašo Blažič include adaptive, fuzzy and predictive control of dynamical systems and modelling of nonlinear systems. Lately, the focus of his research is in the area of autonomous mobile systems.

A SIMULATION-BASED APPROACH FOR CONTROL-OPTIMIZATION OF LECTURE-ROOM MANAGEMENT

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Abstract

The present paper describes an approach to improve control of the room-allocation process at large building complexes. Derived from a project currently being implemented at Vienna University of Technology it primarily focuses on the assignment of adequate lecture rooms to all (scheduled) courses. In order to include all relevant entities and influencing factors a hybrid model is designed (coupling Discrete Event Simulation, Cellular Automata and Agent-Based methods). To tackle the common problem of uncoordinated production of software that subsequently cannot be integrated within the target-system Business Process Modeling is being utilized. These techniques, their modification and their coupling are briefly presented. Due to the preliminary project-stage well-founded results are not available yet. Thus the interesting and promising insights gained so far are presented and analyzed.

Keywords: Lecture room management, Space management strategies, Room allocation, Building utilization, Ecological footprint.

Presenting Author's Biography

After finishing his studies of technical mathematics at Vienna University of Technology in June 2007, Štefan Emrich went on to work on a simulation project at ETH Zürich. Since October 2008 he is employed at TU Vienna as project assistant for the project "MoreSpace". Parallel he is working on his PhD-thesis.

MODELING OF THICK-WALLED COMPOSITE STRUCTURE CURE PROCESS

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Abstract

A mathematical model of epoxy-based resin curing at forming of a thick-walled composite structure is presented. A differential equations system link a kinetic equation of the resin cure, that has derived from the differential scanning calorimetry investigation, with heat conduction equation taking into account a phase transfer from liquid to gel and next to solid phase. Implemented in Comsol Multiphysics software the developed model gives the spatio-temporal patterns of a curing front propagation in a moulded composite body. A possibility of using the developed model for improving the control of the molding thermal regime is discussed.

Keywords: Composite material, Thermoset resin, Curing process, Kinetic equations, Differential scanning calorimetry, Exothermal heat, Finite-element model.

Presenting Author's biography

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WORKFLOW MANAGEMENT OF THE GROUND HANDLING AT THE AIRPORT THROUGH MODULAR SYSTEM OPTIMIZING

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Abstract

Because of the high density of population in most European countries, the possibilities to extend airports are slim. The biggest potential for improvement is to be found in the apron traffic management. An approach on how to realize a reusable solution concerning the ground vehicle management on middle sized airports is presented here. Each one of the stakeholders, like the luggage transport services, has resources in form of vehicles available to achieve his goals. To increase effectiveness of their service, an optimal planning of the resources tasks is essential. Modern localization technologies in combination with flight schedules can provide the information to achieve just that. The optimizer introduced in this article is able to link tasks from the flight plan with resources, by choosing the most suitable option according to the vehicles relative position to the tasks dispatch location. One big feature the architecture of this optimizer presents, is its data management. Saving the relevant task informations in a database, the parallel use of several of these optimizers by the service providers involved in the turnaround process, would actually map the whole dispatch related traffic on the aprons. This modularly obtained data is ready to use, to synchronize the many processes at the airport apron.

Keywords: Optimization, Modular, Workflow, Airport, Turnaround.

Presenting Author's biography

Marc Widemann. He achieved his diploma in 2009 in computer science at the University of Hamburg, where he is now working in the department for technical informatics systems as a scientific employee and Ph. D. student. On the basis of the experience collected during his master thesis in the field of optimization and workflow management at the airport, he has done more research in this context, as seen in this article and other publications (see e.g. [1], [2] and [3]).

GLOBAL OPTIMIZATION OF LOCAL WORKFLOW MANAGERS USING THE EXAMPLE OF AIRPORT HAMBURG

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Abstract

We present an approach on global optimization of interdependent workflows. The goal was first to create a concept and than a prototype that optimizes these interdependent workflows in any area with its requirements. The requirements for the prototype will be presented in this contribution by using the airport context. The main goal of the optimization is to improve the economic efficiency in these areas like optimizing the time to decrease the costs. Workflow is a term that can be found in different branches of commerce for example in logistic areas like airports. Therefore this contribution will use the context of the airport Hamburg to present the concept and the prototype of this contribution. The prototype will present in an exemplary way the global optimization of the ground handling workflows in the airport. These are for example the transit of the passengers on the apron, the dispatching of the luggage, the catering of an aeroplane and the refuelling. These ground handling workflows contain local optimizers.
The prototype contains a simple GUI (graphic user interface) for the representation. Because of the quick access the interface of the prototype is based on a local database. Furthermore the access to the real existing workflows was not possible. Unfortunately this is a great hurdle and will be justified in this contribution.

Keywords: Workflow, Optimization, Module, Scenario.

Presenting Author's biography

Yousef Farschtschi. He studied computer science at the University of Hamburg and achieved his diploma in 2009 [1] in the field of airport optimization and workflow optimization. On the basis of his experience in the airport area, he has made more research activities in this context see e.g. [2, 3]). Now he is working in the University of Hamburg in the Faculty of Informatics as an employee and Ph.D. student.

MACROSCOPIC MODELING OF A LUGGAGE STREAM IN AN AIRPORT TERMINAL

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Abstract

In the course of today's globalization, mobility becomes an increasingly important factor. To ensure this mobility, a fast and efficient traffic management is of the essence. Because of the increasing travel distances and the tight time frames, the airports are rapidly gaining customers. This contribution aims to model the dispatching of luggage at the airport, to assess possible improvements of the workflow, so as to increase efficiency of available resources and improve customer satisfaction, allowing the airport to run more profitably. The observations are intended to represent an abstract, general airport, at some points however, references to the airport Hamburg will be made. The workflows will be modeled as UML activity diagrams. Designing such traffic models is of use, when analysis in the actual environment is not possible, because of the complexity and / or disruptions in the flow of work are not permissible, like in the case of an airport. The ultimate goal of these activity diagrams is to lay the foundation for future development of executable models, in order to allow forecasts of future traffic situations affected by structural alteration, expansion measures or social changes, with different scenarios, and identify their bottlenecks to plan ahead and find possible solutions accounting for them.

Keywords: Model, Airport, Workflow, Luggage, Traffic.

Presenting Author's biography

Marc Widemann. He achieved his diploma in 2009 in computer science at the University of Hamburg, where he is now working in the department for technical informatics systems as a scientific employee and Ph. D. student. On the basis of the experience collected during his master thesis in the field of optimization and workflow management at the airport, he has done more research in this context, as seen in this article and other publications (see e.g. [1], [2] and [3]).

MODELLING AND SIMULATION OF VEHICLE MOVEMENTS USING A SPPTW-ALGORITHM AND THE APPLICATION TO AIRPORT SURFACE MOVEMENTS ANALYSIS

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Abstract

For the optimization of aircraft ground movements a method is described herein based on means of modelling and simulation. The paths of the vehicles are described as a network. Based on graph theory, an algorithm is developed that attempts to find the least time consuming, conflict-free path. The algorithm presented is based on one designed for Automated Guided Vehicles, which was adapted for an Advanced Surface Movement Guidance and Control System at airports. It is derived from a Dijkstra algorithm which calculates the shortest possible path between two nodes in a given network.
Due to the fact that the time dependency of the planned paths are taken into account, approaches like this are called Shortest Path Planning with Time Windows (SPPTW), meaning that the path is segmented into parts of fixed duration. In case of a conflict, the vehicle is delayed in a preceding path segment or rerouted. The calculation of the paths for the different vehicles is initiated by a request, including the nodes at the start and at the end as well as the time at entry.
The results of the simulations are used to estimate the performance of an airport airside system, with particular focus on the taxiway system.

Keywords: graph theory, Shortest Path Planning with Time Windows, airport movements planning, aircraft taxiing

Presenting Authors' biography

Niclas Dzikus received his Diploma Degree in Aerospace Engineering from the Technical University of Berlin in 2008. After working at the Technical University of Braunschweig, Institute of Flight Guidance, he started working at the German Aerospace Center in 2009, faculty of Air Transportation Concepts and Technology Assessment.

MACROSCOPIC MODELLING OF PASSENGER STREAMS ON THE AIRPORT AND ITS ADAPTATION IN MATLAB SIMULINK

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Abstract

We present an approach on macroscopic modelling of passenger streams on airports. In today's logistic areas like harbours or airports the efficiency has to be increased constantly by for example reducing the costs. The efficiency of all stations from the arrival to the boarding of passengers in an airport is very important. The airports and accordingly the airlines have to hold their labour costs low and handle the stream of passengers. Therefore the operator of an airport like the one in Hamburg has to search for useful methods. This paper will show the concept of a macroscopic passenger model and the resulting possibilities will support the efficiency of an airport. The concept will be introduced in UML in order to offer a clear model and will be adopted in a simulation programme to show the bottlenecks in the workflow. The adaptation will be made in the widespread simulation programme MATLAB Simulink. The goals of this contribution are the macroscopic model and its adaptation in UML and MATLAB Simulink. The main goals will be to increase the efficiency by offering the airport operator or airlines the possibility to receive a forecast of their workflow by using different input data for the simulation. The result will be to identify the bottlenecks in the workflows.

Keywords: Model, Airport, Bottleneck, Passenger, Simulation.

Presenting Author's biography

Yousef Farschtschi. He studied computer science at the University of Hamburg and achieved his diploma in 2009 [1] in the field of airport optimization and workflow optimization. On the basis of his experience in the airport area, he has made more research activities in this context (see e.g. [2, 3]). Now he is working in the University of Hamburg in the Faculty of Informatics as an employee and Ph.D. student.

BOTTLENECK-ANALYSIS ON INTERMODAL MARITIME TRANSPORTATION CHAINS

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Abstract

Scenario analysis often is used to determine bottlenecks in multimodal transportation and logistics chains. Bottleneck-analysis itself is a process related approach to identify shortages in multimodal transportation and logistic supply chains, and concerned with analysis of resource planes, optimization of multimodal transportation chains, consideration of timeliness and concurrency using resources, transaction analysis, multi-criteria approach, etc. Henceforth, the scenario analysis has to include the evaluation of the impact on intermodal transportation chains, the results of which can be obtained from simulation.

Keywords: Bottleneck-analysis, intermodal maritime transportation; multi-criteria analysis, scenario analysis.

Presenting Author's biography

Dietmar P. F. Möller is a Professor of Computer Science and Engineering and Chair of Computer Engineering at the MIN Faculty of the University of Hamburg, Hamburg, Germany. His current research work is focused on aviation systems, computational modeling and simulation, e-learning, embedded computing systems, maritime systems, mobile autonomous systems, multimodal transportation and logistics, nanotechnology, virtual and augmented reality.

SIMULATING THE IMPACT OF VARIOUS QUAY OPERATIONAL PROTOCOLS ON CONTAINER UNLOADING AND LOADING EFFICIENCY

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Abstract

This paper presents a simulation model for evaluating the impact of various quay operational protocols on the unloading and loading of containers at a container terminal. Two quay operational protocols were evaluated: 1) unload one container, load one container and then repeat the cycle and 2) unload all containers and then load all containers. In summary, Protocol1 was the more efficient quay operation. Also twelve chasses are necessary to maximize ship throughput, to minimize any delays in container unloading and loading and to minimize ship time at the terminal. Ship arrivals less than 1.5 days, even with twelve chasses, caused the simulation to become unstable. Ship throughput was similar for ship time between arrivals of 3 and 2.25 days for both protocols. Ship throughput varied considerably when the ship time between arrivals dropped to 1.5 days. As the time between arrivals of ships decreased ship delays increased and in most cases significantly when only six chasses were available. With six chasses for Protocol1 (Run2) the ship delay was 155 minutes and increased to 553 minutes (+256%) for Protocol2 (Run8). An increase in the number of chasses to twelve greatly reduced the ship delays for both protocols. There were no ship delays for Protocol1 (Run4) and Protocol2 (Run10) with 3 days between arrivals and twelve chasses. The ship delay was only 18 minutes for Protocol1 (Run5) and zero minutes for Protocol2 (Run11) with 2.25 days between arrivals and twelve chasses. With six chasses the time to unload and load a ship was greater for Portocol2 as compared with Protocol1. For Protocol1 (Run1) the total ship time was 1,248 minutes as compared to 1,923 minutes (+ 54%) for Protocol2 (Run7). Also with twelve chasses the time to unload and load a ship was greater for Protocol2 as compared with Protocol1. For Protocol1 (Run4) the total ship time was 1,227 minutes as compared to 1,653 minutes (+34%) for Protocol2 (Run10). Included in this paper are a description of the two quay protocols, the two quay ProcessModel simulation models and the simulation results.

Keywords: Container terminal, quay crane, quay protocol, discrete event simulation

SIMULATION AND GENETIC EVOLUTION OF SPIKING NEURAL NETWORKS

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Abstract

In this paper, an implementation of a simulator for spiking neural networks and learning algorithm using genetic evolution is described. We have implemented two neural models (simplified Spike Response Model and Integrate and Fire model) and two learning algorithms – SpikeProp (its original version modifying only weights and an enhancement for changing all network variables – weights, delays, time constants and thresholds) and a simple genetic learning algorithm (presented in this paper). This learning algorithm is easy to understand and does not require any special network topology like feed-forward networks and back-propagation algorithms or thorough investigation of network architecture. It is based on an assumption that small changes in network variables have a small impact on the output and big changes have a big impact, thus calculating a difference between a desired output and a real output and mutating individuals according to a size of this difference we can expect a population to converge. We verified this approach on frequently used benchmarks.

Keywords: Eurosim, congress, spiking neural networks, genetics, evolution.

Presenting Author's biography

Petr Podhorský is a Ph.D. student at Czech Technical University in Prague, Faculty of Information Technology, Department of Computer Systems. After getting his master degree in 2009, he has joined the Computational Intelligence Group. His research focuses on spiking neural networks.

CLASSIFICATION OF SPATIO-TEMPORAL DATA

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Abstract

This paper presents a new approach in spatio-temporal data classification. This classification can be used in many branches including robotics, computer vision or medical data analysis. Due to easy transformation of time dimension of spatio-temporal data into the phase of complex number, the presented approach uses complex numbers. The classification is based on a complex-valued neural network with multilayer topology. The paper proposes an extension of complex-valued backpropagation algorithm, which uses activation function applying non-linearity on the amplitude only (preserving the phase) instead of commonly used activation function applying non-linearities on the real and the imaginary part separately. In order to transform the input data into complex numbers, a new coding technique is presented. It encodes the time-dimension into phase of complex number and space-dimensions into amplitude of complex numbers. Another task is to develop output coding, that would allow the classification from complex numbers. It is solved with introduction of one-of-N coding extension into complex numbers, which is used as network's output coding. This approach is verified in application of hand-written character recognition, using the data collected during the writing process. The simulation results of this application are presented in the paper.

Keywords: complex-valued, neural network, spatio-temporal, backpropagation.

Presenting Author's biography

Jakub Zahradník is a Ph.D. student at Czech Technical University in Prague, Faculty of Information Technology, Department of Computer Systems. After getting his master degree in 2009, he has joined the Computational Intelligence Group. His research focuses on neural networks, especially the complex-valued ones.

HYBRID NEIGHBORHOOD CONTROL METHOD OF ADAPTIVE PLAN SYSTEM WITH GENETIC ALGORITHM

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Abstract

With the aim to reduce a large amount of calculation cost and to improve the convergence to the optimal solution for multi-peak optimization problems with multi-dimensions, we propose a new method of Adaptive Plan System with Genetic Algorithm (APGA). This is an approach that combines the global search ability of Genetic Algorithm (GA) and Adaptive Plan (AP) for the local search ability. The APGA differs from GAs in handling design variable vectors (DVs). GAs generally encode DVs into genes and handle them through GA operators. However, the APGA encodes the control variable vectors (CVs) of AP, which searches for local optimum, into its genes. CVs determine the global behavior of AP, and DVs are handled by AP in the optimization process of APGA. The proposed strategy using Hybrid neighborhood control method is introduced into the APGA (H-APGA) to improve the convergence towards the optimal solution. The H-APGA is applied to some benchmark functions to evaluate its performance.

Keywords: Memetic Algorithms, Evolutionary Computation, Genetic Algorithms, Adaptive system, Global - Local search, Multi-peak problems.

Presenting Author's Biography

Pham Ngoc Hieu. He received the BE (2007) in Mechatronics from Hanoi University of Technology, Vietnam. Currently, he is a second year master student at Graduate School of Engineering, Shibaura Institute of Technology, Japan. He is PhD candidate of Shibaura Institute of Technology. His research interests include optimization design, intelligent and expert systems and bio-engineering.

STUDY OF ACCURACY OF THE PHYSICAL PARAMETER EVALUATION BY USING THE NEURAL NETWORKS APPROACH

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Abstract:

Nuclear Safeguards includes tools and concepts for quantification, detection and monitoring of nuclear materials. Gamma multiplicity theory has been developed recently in addition to neutron multiplicity theory for assay of nuclear materials or nuclear waste. The total number of measurable multiplicities exceeds the number of unknowns parameters, such as the sample fission rate, the leakage multiplication and the α ratio and γ ratio. Artificial neural networks (ANN) has been used to evaluate the unknown parameters of nuclear material, since an analytical inversion of the highly non-linear system of over-determined equations is not possible. The parameters have been unfolded with high accuracy, especially the most important parameter such as sample fission rate which is proportional to mass of fissile sample. Simulations are executed on few different hardware platforms. Parameters used in physics problem and number of epochs in learning of the network are variated and used in the comparative perfomans study of different hardware platforms.

Keywords: **neutron and gamma multiplicities, neural networks, core2 duo, core2 quadd.**

Presenting Author's biography

Zenan Šehić is an associate professor at the Faculty of Electrical Engineering of the University of Tuzla, Tuzla, Bosnia and Herzegovina. He holds a Ph.D. in Electrical Engineering from the University of Ljubljana, Slovenia since 1998. He holds a Diploma engineer in Electrical Engineering and M.Sc. in Electrical Engineering from the University of Ljubljana since 1987 and 1990, respectively. His research interests include modelling and simulation of continuous, discrete event and hybrid systems, control system analysis and design, real-time computer control systems, computer based instrumentation. He has worked in several research and development projects funded by the government and industry in Slovenia and Bosnia and Herzegovina. He has published a number of research papers.

A CONCEPT OF A ROBOT FOR THE ROBOTOUR COMPETITION

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Abstract

This paper deals with design of an autonomous robot for the robotic competition Robotour. It describes short history of this competition and its rules with changes for this year. The second section describes hardware of the robot, its sensors and proposes changes and modifications suitable or necessary for participation in the competition. In the section Objectives and strategy the strategy for participation in the competition based on robot's sensors and appropriate algorithms is presented.

Keywords: Robotour Competition, Autonomous Robot, Navigation, Path Finding

Presenting Author's biography

Jaroslav Rozman was born on November 3, 1979 in Brno. He entered the Faculty of Electrical Engineering and Computer Science of the Brno University of Technology in 1998 where he studied cybernetics and automation. He received M.Sc. in 2003. He is currently a Ph.D. student at the Faculty of Information Technology of University of Technology, Brno. His main research interests are robotics, artificial intelligence and computer vision.

CELLULAR AUTOMATA IN THERMODYNAMIC AND CLOUD DYNAMICS SIMULATIONS

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Abstract

In real system simulations, the application of cellular automata has been shown as an interesting option, because it can represent an emergent behavior and its implementation is simple. This paper presents a method for simulating thermodynamic systems, such as cloud dynamics, with cellular automata. In accordance with thermodynamic principles, this paper presents an isolated system model that describes temperature dynamics. The model uses the Von Neumann neighborhood of five cells, each with two possible states: the presence or absence of a cloud or a part of it. Our model uses three weather properties, as follows, condensed cloud water particles, temperature and outer winds. Two types of experiments were performed to validate the model proposed: one with a warm body in the center of the environment and another with a cloud.

Keywords: Cellular automata, Thermodynamic systems, Cloud dynamics, Simulation.

Presenting Author's Biography

Maury Meirelles Gouvêa Jr. teaches and undertakes research in the Institute of Exact Sciences and Informatics, Pontifical Catholic University of Minas Gerais. He obtained a Ph.D. degree in Artificial Intelligence from the Centre of Informatics, Federal University of Pernambuco, in 2009. His research interests include evolutionary algorithms, neural networks, and dynamic and adaptive systems.

COMPARING ABILITY OF GENERALISATION FOR METHODS SOLVING DECISION MAKING PROCESSES WITHIN SIMULATION MODELS OF PASSENGER RAILWAY STATIONS

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Abstract

The paper compares methods that support decision making processes within passenger railway stations. We focus mainly on problem of platform track assignment problem that occurs in cases of arrival trains delay. We compare ability of (i) mathematical methods related to multiple-criteria evaluation and (ii) artificial neural network (perceptron network) generalization for various periods of simulation time (morning and afternoon peak time) in this paper.

Keywords: Simulation, Neural network, Mathematical methods, Transportation.

Presenting Author's Biography

Micheal Bazant (Ing., Ph.D.) is assistant professor at the University of Pardubice (Faculty of Electrical Engineering and Informatics). He received his Ph.D. in 2009 in area of designing support systems for simulation models of transportation systems at the University of Pardubice (Jan Perner Transport Faculty). His main research interest is related to simulations of transportation processes with a view to decision-making processes in simulation models of passenger railway stations. As university teacher, he participates in tuition of courses: Modelling & Simulation and Discrete Simulation.

AN E-LEARNING STUDY: USING MAPLE T.A. TO IMPROVE THE MATHEMATIC SKILLS OF STUDENTS

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Abstract

New students at universities have a widely varying knowledge of mathematics. In this paper we present a blended-learning approach using Maple T.A. to refresh the mathematical knowledge of the new students on the one side, and to teach them enough elementary mathematical skills to be able to follow the elementary applied lectures of different curricula on the other side. The Maple T.A. e-learning platform was used, since it allows for free learning as well as for randomized, supervised tests. In this way the students can specifically train these fields, in which they lack skills, and their progress can be monitored. Although the examples in Maple T.A. can be highly randomized, they can be constructed with this software to guarantee for simple solutions. School students were used to test the software platform beforehand and their feedback was incorporated in the course. After the refreshment course the effectiveness of this approach was evaluated statistically and it was shown, that the knowledge of the students increased significantly.

Keywords: E-learning, Blended Learning, Mathematic Education.

Presenting Author's biography

Vilma Urbonaite. She finished Vepriai secondary school and Ukmerge music school in Lituania. Afterwards, she began bachelorstudy in financial and actuarial mathematics at the University of Vilnius. After two years, she came to Vienna as exchange student and started the bachelor study in statistics and mathematics in economics at Vienna University of Technology. Her field of interest on the one hand is mathematical modeling with differential equations and on the other hand she works on the development of the e-Learning system Maple T.A..

ADVANCED RANDOMIZATION AND GRADING IN THE E-LEARNING SYSTEM MAPLE T.A.

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Abstract

In this paper we introduce an enhanced use of the web-based e-learning system Maple T.A, that is distributed by the company MapleSoft. At the Vienna University of Technology the software is additionally attached to common mathematical lectures and provides some useful practice and assignment capabilities for students. Main advantages of the system are the abilities to create mathematical exercises with randomized specifications and to automatically verify the correctness of students' responses. For both tasks, the randomization and the grading, Maple T.A. provides certain functions. With increasing complexity of the exercises these common methods are not sufficient. Especially more complex mathematical objects like vectors, matrices, etc. showed to be difficult to handle, since there are no standard functions implemented.
For this purpose Maple T.A. allows to integrate Maple code, that assumes the randomization and grading of mathematical objects of these types. The generation of these Maple algorithms is not always an easy task, on the other hand it didn't turn out to be necessary to develop each algorithm over and over again because some of the problems equal each other to a certain degree. Within this paper we describe methods and algorithms that build the basis of additional moduls, that were created for simplification of above mentioned tasks and give some concrete practical examples, as they are used in mathematical lectures.

Keywords: Maple T.A., Maple, e-learning, blended learning

Presenting Author's Biography

Andreas Zimmermann is a student of Technical Mathematics at the Vienna University of Technology and will soon start his diploma thesis in the field of Soft Computing. During the last few years he also was a member of a group that developed and evaluated e-Learning systems for education in mathematics and modeling and simulation at the Vienna University of Technology.

MMT - A WEB-BASED E-LEARNING SYSTEM FOR MATHEMATICS, MODELING AND SIMULATION USING MATLAB

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Abstract

This contribution deals with an e-learning system called MMT- Mathematics, Modeling and Tools. It is constituted to help students of Vienna University of Technology to increase their abilities on both, basic mathematics on the one hand and modeling and simulation on the other hand. This e-learning system is based on the MATLAB® Web Server Technology. Initially the MATLAB Server of version 2006 was used. As this product has been discontinued MMT has been using a self-made server containing the actual version of MATLAB. This fact supports us to update our examples for the students or create examples containing the latest tools of MATLAB, for instance SIMULINK®.

Currently there are generated examples which integrate the tools of MATLAB/SIMULINK. The system is also modified to use a Content Management System (CMS). This system supports and organizes the shareable creation and adaptation of text- and multimedia-files. The CMS will provide the means to develop and maintain the MMT examples without the need of HTML knowledge.

Keywords: e-learning system , MATLAB , SIMULINK , SIMSCAPE , CMS

Presenting Author's Biography

Stefanie Winkler. She finished the Vienna high school of music and then started studying mathematics in technology and science. She is on her way to finish the bachelor. The bachelor thesis is focused on physical modeling and simulation. A related field of work is the development of e-learning systems based on simulation environments. Additionally to the MMT she is working with Maple TA, another e-learning system.

RADIOACTIVE DECAY MODELS IN A MATLAB E-LEARNING ENVIRONMENT

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Abstract

The Institute of Analysis and Scientific Computing at the Vienna University of Technology runs a web e-learning platform in an MATLAB environment for dynamical models. Teachers can use these online models for teaching and demonstrating in classes, whereas students can more understanding and increase their programming skills. Each module consists of a general introduction to the thematic, and a list of possible experiments with the model, with selected parameters. All examples are programmed and implemented in MATLAB whereby the underlying MATLAB *m-files* are also available for users.

Recently, the course *Modeling and Simulation* was enriched by modules concerning radioactive decay and diffusion, from basic radioactive decay via electron adsorption until contamination spread in the plane. This contribution describes details on the models used for these new modules (simple decay equation, decay with mother-daughter dynamics, nonlinear balance equation for agglomeration of atoms, and cellular automata model with global diffusion for radioactive spread) and shows adjoint web experiment modules in the e-learning platform.

Keywords: Radioactive Decay, Migration Models, e-Learning, MATLAB

Presenting Author's biography

Peter Kristöfel. He finished two master studies with distinction. He got one degrees in applied physics, where he studied a chaotic atomic system, and in applied mathematics, where he wrote his thesis on a model of the diabetes 2 prevalence in Austria. After that, he started his PhD work on semiconductor modeling. Besides that, he uses his interdisciplinary skills also in teaching and e-learning, where he works with the ARGE-SIM Group at TU Vienna.

A.RIES - A WEB LECTURE AND ONLINE EXERCISE MANAGEMENT SYSTEM FOR APPLIED MATHEMATICS AND MATHEMATICAL MODELLING

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Abstract

A Learning Management System (commonly abbreviated as LMS) is a specialized type of CMS focused on lecture organization and educational management. It is an application designed for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs, and training content. At the Vienna University of Technology the learning management system TUWIS++ is used for administering users and courses. The TUWEL subsystem is used complementary, mainly to manage learning content and course contents. Additionally it has certain management functionality for grading and testing students. TUWEL is a generalized web-based e-learning application, which works well for various kinds of simple and standardized e-learning objects. Specialized applications and certain e-learning content like videos and podcasts or mathematical simulation examples cannot be integrated via TUWEL, they have to be embedded via external interfaces and specialized applications. The A.RIES LCMS application is a learning content management system designed for mathematical content and simulation examples. The LCMS is an advancement of the existing MMT e-learning infrastructure, which was necessary because of the growing number of learning objects and simulation examples. The A.RIES LCMS consists of a web application, a relational database backend and different application servers in the background. The application servers compute the model data and deliver the results to the A.RIES web frontend application. This paper shows the structure and implementation of our mathematical e-learning system as well as the integration of the application into existing web and e-learning resources (like TUWIS++ and TUWEL) at the Vienna University of technology.

Keywords: E-Learning, Blended Learning Modelling and Education, Learning Management, Content Management Systems, Web-based Simulation

Presenting Author's biography

Nicole Nagele. She finished a technical college for computer science (HTL) and started studying computer science at the Vienna University of Technology in the year 2006. She is on her way to finish the bachelor. The bachelor thesis is focused on e-learning implementations in the field of mathematics, modelling and simulation.

A MULTIMEDIA INTERACTIVE 3D VIRTUAL ENVIRONMENT FOR EMERGENCY SIMULATION, TEACHING AND PRACTICE OF SAFETY PROCEDURES.

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Abstract

The paper presents a virtual environment that can be a powerful support in a course focused on safety procedures to be adopted in public environments (e.g. industrial sites but also supermarkets, schools and universities). It is formed by three modules for the teaching of the procedures, their practice and the assessment of user's comprehension. The created virtual environment can make the user experience realistic simulations and provide a complete set of information on the building structure and the exploitation of the main tools which are useful in case of emergency by means of multimedia contents. The considered virtual environment is fully customizable: maps are created by the users, new events, objects and procedures can be defined in order to make the tool usable in a wide set of frameworks. Currently some very common harmful si-tuations are implemented together with standard safety procedures. The pursued tests show the efficiency of the proposed tool in improving the users' knowledge of the explained safety procedures.

Keywords: safety; virtual reality; simulation; multimedia

Presenting Author's Biography

Marco Vannucci got the master degree in computer science in 2001 from Pisa University and the Ph.D. in engineering from Scuola Superiore S.Anna in 2006. His research activity includes simulation, mathematical modeling, artificial intelligence and robotics. He collaborated in several research project focusing his interest in the exploitation of simulation techniques in the industrial framework.

PROJECTILE MOTION – BOUNDARY VALUE PROBLEM AND OPTIMIZATION IN EDUCATION

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Abstract

The numeric treatment of boundary- and optimization problems is carried out by iterations. With an air resistance proportional to the square of the velocity, the projectile motion does not have any elementary analytic solution. In case of no air resistance however those solutions exist and they may be taken as tests for the numeric methods. The projectile motion with air resistance is characterized by a more steeply falling trajectory. Depending on the starting angle at constant initial velocity, the projectile motion as a boundary value problem and the maximization of the trajectory range are treated. The target deviation forms the functional of the boundary value problem. The algorithms consist of a modified Newton's Method, which is used to search the zero of the deviation, as well as of an angle correction proportional to the deviation. Optimization methods are the Three-Points Plan and the Method of the Golden Ratio. This method needs only a single new run for the comparison. During the maximization the uncertainty interval of the starting angle decreases iteratively by comparisons of the trajectory ranges. When the object hits the ground, i.e. the trajectory crosses the threshold zero, the simulation run is finished by a state event. The calculated range is then used as input parameter of the iteration. The algorithms are implemented in the TERMINAL section of the simulation system ACSL.

Keywords: Projectile motion, Education, Quadratic friction, Modified Newton's Method, Golden Ratio Method, Three-Points Plan.

Presenting author's biography

Rüdiger Hohmann completed his physics study at the Technical University of Dresden, afterwards he was employed in the Research and Development Department of 'veb rechenelektronik glashütte', a producer of electronic analog computers. Later Rüdiger Hohmann became assistant professor in the Institute of Mathematics at the Technical University of Magdeburg and after achieving his PhD he became group leader for hybrid simulation in the Computer Technique and Data Processing Department. He received his Habilitation from the Faculty of Computer Science, and is now among others lecturer for continuous simulation.

MODELLING OF MOBILE ROBOT DYNAMICS

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Abstract

This paper presents two approaches to modelling of mobile robot dynamics. First approach is based on physical modelling and second approach is based on experimental identification of mobile robot dynamics features. Model of mobile robot dynamics can then be used to improve the navigational system, especially path planing and localization modules. Localization module estimates mobile robot pose using its kinematic odometry model for pose prediction and additional sensor measurements for pose correction. Kinematic odometry models are simple, valid if mobile robot is travelling with low velocity, low acceleration and light load. Disadvantage is that they don't take any dynamic constraints into account. This leads to errors in pose prediction, especially when significant control signal (translational and rotational velocity reference) changes occur. Problem lies in the fact that mobile robot can't immediately change its current velocity to the desired value and mostly there exists a communication delay between the navigation computer and mobile robot micro-controller. Errors in predicted pose cause additional computations in path planning and localization modules. In order to reduce such pose prediction errors and considering that mobile robots are designed to travel at higher velocities and perform heavy duty work, mobile robot drive dynamics can be modelled and included as part of the navigational system. Proposed two modelling approaches are described and first results using a Pioneer 3DX mobile robot are presented. They are also compared regarding to complexity, accuracy and suitability of implementation as part of the mobile robot navigational system.

Keywords: Modelling, mobile robot, estimation, dynamic model.

Presenting Author's Biography

Edouard Ivanjko received his PhD in 2009. from Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia where he is currently working. His main research interests are: mobile robotics, localization of mobile robots and environment modelling for mobile robots. He published 3 papers in international journals and 19 papers in proceedings of international conferences. He is a member of IEEE, KoREMA and Croatian Society for Robotics. He speaks fluent German and English.

IDENTIFICATION OF A HYBRID FUZZY MODEL OF A BATCH REACTOR FOR SIMULATION AND CONTROL

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Abstract

The complex hybrid and nonlinear nature of many processes that are met in practice causes problems with both structure modelling and parameter identification; therefore, obtaining a model that is suitable for MPC is often a difficult task. In this paper we focus on using the hybrid fuzzy model formulation. The framework is suitable for modelling nonlinear hybrid systems and can be implemented in model predictive control design. The basic idea of this paper is to present an identification method for a hybrid fuzzy model based on a fuzzy clustering algorithm. In the paper, we first introduce the hybrid fuzzy model. We present the hierarchical structure and the generalization of the Takagi-Sugeno formulation for the nonlinear hybrid system and give the output of the hybrid fuzzy model in a compact form. Next, we tackle the identification method. We treat the fuzzy clustering algorithm, deal with the projections of the fuzzy clusters into the input space of the hybrid fuzzy model and explain the estimation of the parameters of the hybrid fuzzy model by means of a modified least-squares method. Furthermore, we verify the usability of the proposed identification approach on a hybrid nonlinear batch reactor example. The result suggest that the batch reactor can be efficiently identified and thus formulated as a hybrid fuzzy model, which can eventually be used for model predictive control purposes.

Keywords: Identification, Hybrid fuzzy model, Batch reactor, Hybrid systems, Nonlinear systems.

Presenting Author's Biography

Gorazd Karer received his B.Sc. and Ph.D. degrees in 2004 and 2009, respectively, from the Faculty of Electrical Engineering, University of Ljubljana. He is currently a researcher and assistant at the same institution. His research interests are in hybrid and nonlinear systems and model predictive control.

MODELLING AND SIMULATION OF THE ACTIVE VIBRATION CONTROL BY MEANS OF PI REGULATED ELECTRO-DYNAMIC ACTUATOR AND BOND GRAPH APPROACH

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Abstract

The implementation of active vibration control to the two dof system by means of PI controller is modelled and simulated using bond graphs and conventional multi-physics matrix approach. The active vibration control of the transient and harmonic excitation is considered. The analysis has been performed in time and frequency domain. The results are correlated to the experiments on the real model.

Keywords: active vibration control, electrodynamic exciter, PI control, discrete system

Presenting Author's biography

Željan Lozina is professor at the University of Split. He leads research group for Dynamics and vibration and Laboratory for vibration and noise. He delivers lectures in Dynamics and Finite element method. Research topics were Numerical integration in dynamics, Component mode synthesis, Numerical methods in engineering and simulation, Vibration control.

MODELLING DEADLOCK AVOIDANCE IN AGV SYSTEMS VIA COLOURED PETRI NETS

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Abstract

Deadlocks are undesirable states in resource allocation systems (RAS). Their avoiding presents a major issue in control of RAS. Out of extensive theory on this topic, we focus on comparison of two deadlock avoidance methods for sequential RAS: Banker's algorithm and C/D-RUN deadlock avoidance policy (DAP). We present their impact on a system of automated-guided vehicles (AGV system), modelled and analyzed by coloured Petri nets.

Keywords: Deadlock avoidance, Banker's algorithm, C/D-RUN DAP, coloured Petri net, AGV system.

Presenting Author's Biography

Michal Žarnay received the engineering degree in Information and Management Systems and the PhD. degree in Transportation and Communications Technology from the University of Žilina, Žilina, Slovak Republic, in 1999 and 2007, respectively. He works currently as an Assistant Professor in the Transportation Networks Department, Faculty of Management Science and Informatics, University of Žilina, where he is in charge of courses on Petri nets and management.
In 2008, he worked as researcher with the Institute for Traffic Safety and Automation Engineering at the Technical university of Braunschweig, Germany, in his main research area: modelling and analysis of systems control using Petri nets with applications to transportation and communication systems. In 2009, he joined the Group of Discrete Event Systems Engineering at the University of Zaragoza, Spain, to participate on theoretical research on decolourisation of coloured Petri net models and their further fluidification to obtain continuous Petri net systems.

HIGHER-ORDER DIFFERENTIAL DELAY SYSTEMS WITH CONTROL APPLICATIONS

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Abstract

We are interested in solving and presenting some applications of higher order linear descriptor differential systems given by the expression:

$$FX^{(r)}(t) = GX(t-\tau),\ \tau > 0$$

with constant square coefficients and consistent initial conditions. Higher order linear descriptor systems can result from several types of linearization of general non-linear high order descriptor delay differential systems of the general form: $F\left(\underline{x}, \dot{\underline{x}}, ..., \underline{x}^{(n)}\right) = 0$. Typical applications where second order descriptor systems naturally arise involve multi-body systems and networked control systems (NCS). In our case, in order to solve such kind of systems, we apply the complex Weierstrass canonical form (WCF) and the Drazin inverse theory. Indeed, these two effective tools for the solution of descriptor systems have been systematically used in different areas of control and systems theory. Applying the WCF, two lower dimension sub-systems are obtained with a particular structure. A numerical example from the emerging area of NCS with constant and unknown network induced delays is presented as our basic motivation.

Keywords: Descriptor Systems, Time Delay Systems, Networked Systems

Presenting Author's biography

Athanasios Pantelous, PhD, is with the Department of Mathematical Sciences, University of Liverpool. He is interested in different areas of control and system theory.

MODELLING AND SIMULATION OF SEMI-BATCH POLYMERIZATION REACTOR FOR IMPROVED REACTANTS DOSING CONTROL

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Abstract

This paper presents a temperature model of an industrial, semi-batch, emulsion-polymerization reactor, which together with the already designed chemical reactions model is able to predict the temperature in the reactor as a result of varying operating conditions. The model was derived from the energy balance and validated on real-plant data. The model was used to analyse the influence of reactants dosing during the batch on the reactor temperature. The analysis shows that during the batch dosing of the two reactants, initiator and monomer, needs to be mutually balanced and adjusted to the current process situation, otherwise, the temperature in the reactor may become oscillatory and unstable towards the end of the batch because of the limited heat removal capacity of the condenser. To keep the reactor temperature in a narrow region also the control strategy was proposed that adjusts the monomer flow and initiator addition, using reactor temperature as a controlled variable. Simulation results show that the proposed reactants dosing control significantly reduces the variations in the reactor temperature and at the same time results in more uniform final batch results.

Keywords: emulsion polymerization, semi-batch industrial reactor, calorimetry model, gPROMS, control.

Presenting Author's biography

Nadja Hvala is employed as a researcher at Jožef Stefan Institute, Department of Systems and Control. Her research interests are modelling, simulation, control and optimization of chemical and biochemical processes. Some of the problems she was involved in are the following: pulp cooking, hydrolysis in TiO_2 production, polymerization. In the last ten years she is mainly involved in modelling and control of biological wastewater treatment processes.

MODELING OF ROBOT LEARNING IN MATLAB/SIMULINK ENVIRONMENT

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Abstract

The paper describes our environment for off-line programming and control design of robot systems developed in Matlab/Simulink environment. A special emphasis has been given on robot learning. Nowadays, it is commonly accepted that preprogrammed robots are applicable only in highly structured environments. In order to bring robotic technology in every-days life as well to be used for small batches of unstructured production, it is required that robots poses certain level of self-adaptation. One of the important aspect of the self adaptation is unsupervised learning, which imitates a learning processes of animals and human beings. Learning is a long process, based on many successful or unsuccessful repetitions of a given task. For that a judgment on how successful was the previous attempt is crucial. Usually, learning assures a convergence to the globally optimal solution. Since successful learning depends on many parameters, like given rewards, learning speed, noise rejection, etc. the simulation becomes an essential tool for designing and tuning the learning algorithms. In the paper, we describe our simulation models for learning the ball-in-a-cup game, which is often used as a test bed for various learning algorithms.

Keywords: robot simulation, robot learning, robot programming.

Presenting Author's Biography

Nemec Bojan is senior research associate at Dept. of Automatics, Biocybernetics and Robotics, Jozef Stefan Institute. He received BS, MSc and PhD degree from the Univerity of Ljubljana in 1979, 1982 and 1988 respectively. In 1993 he spent his sabbatical leave at the Institute for Real-Time Computer Systems and Robotics, University of Karlsruhe. His research interests include robot control, robot simulation, sensor guided control, service robots and biomechanical measurements in sport. Between 2002 and 2005 he was a task leader in the largest NAS European project EUROShoE. He has published over 100 conference and journal papers and is author of 1 patent, and co-author of a book.

SIENA: A SUPPORT FOR AUTONOMOUS LEARNING FOR FUTURE CLASSROOM

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Abstract

SIENA (http://siena.ull.es/) is a web application that was designed to detect a student's existing knowledge and to aid in self-evaluation and self-learning, providing for student-oriented learning. The tool was conceived to work with a subset of conceptual maps, created by the professor, whose nodes are situated in the map in the order that the students requires for its comprehension progressing from objective concepts to existing knowledge. These nodes contain a set of questions for an adaptive test and several materials for self-learning such as web pages, tutorials, applets, etc. The SIENA computer tool starts to evaluate from the previous concepts until the target concepts defined on the map along in the map as long as the student achieves a satisfactory grade on the nodes. When a concept is failed, the system stops progressing along that branch of the map, since it is assumed that if that concept has not been assimilated, then neither will those that follow and for which a knowledge of the former is a prerequisite. The tool has been successfully used in courses relating Computer Architecture (Higher Education), using simulators, among others, such as MNEME and SIMDE (simulators developed by the authors for memory hierarchy and superscalar/VLIW architectures respectively) and elementary Mathematics (primary education), showing that it is applicable regardless of the field of knowledge involved.

Keywords: Educational resources, Educational practices.

Presenting Author's biography

Lorenzo Moreno received his Ms and PhD degrees from the Universidad Complutense de Madrid, Spain, in 1973 and 1977 respectively. From 1989 he is Full Professor in the University of La Laguna, Spain. His research include computer architecture and computer education.

MODELLING AND SIMULATING OF AN ULTRASONIC FLOW MEASURING SYSTEM*

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Abstract

Ultrasonic measuring systems using a single beam to determine the discharge in pipes are state of the art. Current systems measure the velocity along one ultrasonic beam evaluating echoes from particles, which are moved with the flow. These data are extrapolated afterwards to calculate the mean velocity of the cross section by using standard calibration parameters. The total discharge is determined by multiplying the mean velocity with beforehand determined cross section of the pipe.

This principle can hardly be used in open channels due to complex and changing cross sections of the flume. The weaknesses of this measuring system applied in pipes and channels is the accurate determination of the mean velocity and the correct cross section. Both are effected by the channel shape up- and downstream as well as by the channel roughness. Sedimentations may cause variations of the cross section, too. Accurate calculation of the velocity flow requires permanent adaption of the standard calibration parameters. Well calibrated systems reveal measurement errors of roughly $\pm 5\%$.

To overcome these weaknesses the new method includes continuous measurements of the contour of the channel and of the flow velocities along the main cross section. This requires a new ultrasonic front end technology.

Modelling and simulation of the system enables the design of signal processing algorithms related with the new ultrasonic front end, the transmitted signals and the evaluation of the echoes. The final product may generally be used for flood prediction and water management in all types of flumes.

Keywords: Ultrasonic measuring system, modelling, simulation, signal processing methods, open channels, pipes, computational fluid dynamics.

Presenting Author's Biography

Manuel Haide studied at the University of Applied Sciences in Ulm. He graduated with a German degree in Industrial Electronics and a Master of System Engineering. Presently he is a member of the research staff at the Institute for Applied Research in Ulm. The focus of his work is to specify and analyze different signal processing methods for a new ultrasonic phased array system.

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MODULAR PMD SIMULATOR FOR MULTISTATIC CAMERA SYSTEMS

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Abstract

In recent years the progress in high-speed technical 3D-Vision development aroused increasing interest in many industrial, automotive and safety-related applications.This paper presents a simulation approach for a 3D PMD camera with arbitrary resolution and consists of some major parts.
In the first part the software-based PMD sensor simulator developed by ZESS is described. This module of the simulator allows calculating the theoretical response of a PMD sensor for a given 3D absolute referenced scene, which is comparable to real PMD sensor data.
For accurate PMD simulations we need the information about the wave propagation of the transmitted signal. For this purpose the modular illumination presimulator has been developed and will be described in the second part of this paper.
The third part of the paper is concerned with the modeling and simulation of bistatic reference 3D data, which are indispensable for adaptive correction of bistatic deformation caused by different illuminator and sensor positions.
The results of the simulated scenario including an error analysis and the comparison with real PMD camera data are discussed.

Keywords: PMD, 3D, Simulation, Modeling, Multistatic

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 and simulations, multi sensor data fusion, computer based 2D and 3D sensor simulations, Synthetic Aperture Radar (SAR) raw signal simulations.

MULTIPHASE MODELLING IN POROUS MEDIA

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Abstract

Two chemicals, formaldehyde and allyl isothiocyanate (AITC), have been analysed both experimentally by soil column experiments and theoretically by inverse simulation in order to determine their risk potential and leaching behaviour in porous media. The software products HYDRUS-1D and COMSOL Multiphysics 3.5a coupled to MATLAB (v. 7.0.1) are applied for inverse modelling of the soil column experiments. Due to the viscous properties of AITC, a tool able to simulate multiple phase flow (i.e. COMSOL Multiphysics or STOMP 3.0) has to be used for this substance, while for formaldehyde HYDRUS-1D can be applied. Regarding formaldehyde breakthrough curves, linear adsorption and first-order decay reactions are assumed. AITC reduction in the soil might also be explained by reactions with the soil matrix, biodegradation and partly volatilization. Parameter fitting of the water-oil two-phase flow equations, coupled to equations for solute transport, will be implemented by applying the multidimensional nonlinear minimisation module fminsearchbnd with bound constraints, which uses the Nelder-Mead simplex (direct search) method. Advantages and disadvantages, ease and limits of use, besides flexibility of the respective simulation tools will be pointed out. Results show that formaldehyde is faster degraded than AITC. Thus, the latter will have stronger impact on soil organisms as it is retained longer and migrates slower than formaldehyde.

Keywords: Multiphase flow, Porous media, Inverse modeling.

Presenting Author's Biography

Sabine Klepsch. After finishing the study of Technical Physics, S. Klepsch focused on numerical simulation and modelling of solute transport processes and theories of non-equilibrium phenomena in porous media. Since May 2001 she is research scientist at the Institute of Soil Research, BOKU - University of Natural Resources and Applied Life Sciences, Vienna, funded by the AIT Austrian Institute of Technology, Seibersdorf. Other research topics include linking sorption studies on molecular scale to macroscopic sorption parameters, and rhizosphere modelling.

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