# Eurosim'95 *Simulation Congress*

Proceedings of the 1995 EUROSIM Conference, EUROSIM '95,
Vienna, Austria, 11-15 September 1995

*Edited by*

**Felix Breitenecker**
**Irmgard Husinsky**
Technical University Vienna
Vienna , Austria

1995
ELSEVIER
Amsterdam • Lausanne • New York • Oxford • Shannon • Tokyo

ELSEVIER SCIENCE PUBLISHERS B.V.
Sara Burgerhartstraat 25
P.O. Box 211, 1000 AE Amsterdam, The Netherlands

ISBN: 0 444 82241 0



This book is printed on acid-free paper.

Printed in The Netherlands.

# Foreword

Developments over the last years show that beside the classical tools theory and experiment simulation becomes more and more the third major tool for problem solving in application and research. Nowadays simulation is found in nearly every application area, research activities result in new methodologies and tools for simulation, and more and more simulation software, simulators, and simulation systems are offered on the market.

The *EUROSIM Congress*, the European Simulation Congress, an international event normally held every three years, aims to be a common forum for presenting European and international recent results and applications in simulation, and to stimulate the exchange of ideas and experiences among scientists and engineers active in simulation.

*EUROSIM* is the Federation of the European Simulation Societies, acting as a European forum for Simulation Societies and promoting the advancement of system simulation in industry, research, and education.

All these intentions are reflected in the 5th European Simulation Congress *EUROSIM 95*, the 2nd Congress after the formal foundation of EUROSIM. These Proceedings contain eight invited papers and 212 contributed papers which were selected by the International Programme Committee from 459 abstracts received.

The eight invited lectures give an overall picture of developments and trends in simulation methodology and application. The contributed papers show a balanced mixture of new simulation methodologies, languages, tools, architecture, and applications.

It is interesting to compare the titles of papers presented at previous European Simulation Congresses with those in the present volume. Even a brief glance through the four volumes of Proceedings shows that in this twelve year period considerable, remarkable, and sometimes astonishing advances have been made in a number of different areas. For example, developments in parallelism and distributed processing are now not only being seen in simulation applications but are also frequently used. Object-oriented methods are being implemented now, and artificial intelligence and knowledge-based tools appear to be an established part of system modelling and

simulation methodology. The availability of improved graphic algorithms and tools is also leading to some very interesting and innovative research and application in terms of man-machine interface and of animation and visualisation, both for discrete-event and continuous-system simulation.

New developments in terms of mathematical modelling and simulation techniques as well as in terms of general methodology are of little significance unless they are stimulated by the requirements of the real world in terms of industry, business, agriculture and the sciences. We are very pleased, therefore, that application papers are so well represented. This also applies to papers on parallel and distributed simulation, where beside graphics the fastest development can be observed.

We are also pleased that the idea of "Special Interest Sessions" could be realized. These sessions deal with recent developments in areas where methodology and application are considered together. The results of the closing discussion at the end of these sessions are summarized in manuscripts which will be edited and published in abbreviated form in *EUROSIM - Simulation News Europe* (SNE), the newsletter of the EUROSIM member societies. Some of these papers will be prepared for publication in EUROSIM's scientific journal *SIMULATION PRACTICE AND THEORY*. A separate role is played by the Industry Session on "Model Exchange and Software Independent Modeling" where people mainly from industry report on this topic without necessarily having to publish a paper in the Proceedings.

Due to the big respond to the Call for Papers the Scientific Programme is also extended by a Poster Session and by a session on "Software Tools and Products". Abstracts and papers from these Sessions may be found in a special Congress Issue of *EUROSIM Simulation News Europe*.

The lay-out of these Proceedings do not correspond exactly with the Congress sessions as given in the Final Programme, although the papers are broadly divided according to sessions. The Congress Programme also contains presentations of late papers (printed in the Late Paper Volume), additional contributions to the Industry Session on "Model Exchange", and to the Session on "Software Tools and Products" (printed in a special Congress Issue).

The European Simulation Congress *EUROSIM 95*, held in Vienna (Austria) at the Technical University of Vienna from September 11 through September 15, 1995, is organized by *ASIM* (Arbeitsgemeinschaft Simulation ), the German speaking Simulation Society, in co-operation with the other member societies of EUROSIM: *AES* (Asociación Española de Simulación), *CSSS*

(Czech & Slovak Simulation Society), *DBSS* (Dutch Benelux Simulation Society), *FRANCOSIM* (Société Francophone de Simulation), *HSTAG* (Hungarian Simulation Tools and Application Group), *ISCS* (Italian Society for Computer Simulation), *SIMS* (Simulation Society of Scandinavia), *SLOSIM* (Slovene Society for Simulation and Modelling), *UKSS* (United Kingdom Simulation Society).

The moral co-sponsorship of *CASS* (Chinese Association for System Simulation), CROSSIM (Croatian Society for Simulation Modelling), *IFAC* Advisory Board Austria, *IMACS* (International Association for Mathematics and Computers in Simulation), *JSST* (Japanese Society for Simulation Technology), *LSS* (Latvian Simulation Society), *OCG* (Austrian Computer Society), *PSCS* (Polish Society for Computer Simulation), *ROMSIM* (Romanian Society for Modelling and Simulation), *SCS* (Society for Computer Simulation), *SiE* Esprit Working Group "Simulation in Europe" supports this congress.

A successful conference is always due to the efforts of the many people involved. To this purpose, particular acknowledgement goes to the members of the Scientific Committee for their contributions in the paper selection process, to the members of the Local Organizing Committee, and more especially to the head of this committee, to Mr. Manfred Salzmann.

Felix Breitenecker Irmgard Husinsky

**Technical University of Vienna**

## Scientific Committee

F. Breitenecker (Austria), Chairman

H. Adelsberger (D)
M. Alexik (SQ)
W. Ameling (D)
S. Balsamo (I)
I. Bausch-Gall (D)
S.W. Brok (NL)
F.E. Cellier (USA)
V. Ceric (HR)
L. Dekker (NL)
J. Dongarra (USA)
V. De Nitto (I)
H. Ecker (A)
G. Feichtinger (A)
P. Fishwick (USA)
J.M. Giron-Sierra (E)
H.J. Halin (CH)
N. Houbak (DK)
R. Huntsinger (USA)
I. Husinsky (A)
T. Iversen (N)
A. Jávor (H)
K. Juslin (FIN)
G. Kampe (D)
E. Kerckhoffs (NL)
W. Kleinert (A)
P. Kopacek (A)
M. Kotva (CZ)
W. Kreutzer (NZ)
M. Lebrun (F)
F. Lorenz (B)
F. Maceri (I)
D. Maclay (GB)
H. Mang (A)
Y. Merkuryev (LV)
Z. Minglian (VRC)
I. Molnar (H)
D.P.F. Möller (D)
D. Murray-Smith (GB)
F.J. Pasveer (NL)
R. Pooley (U.K.)
W. Purgathofer (A)
P. Schäfer (D)
T. Schriber (USA)
A. Seila (USA)
W. Smit (NL)
F. Stanciulescu (RO)
A. Sydow (D)
H. Szczerbicka (D)
S. Takaba (J)
I. Troch (A)
G.C. Vansteenkiste (B)
W. Weisz (A)
J. Wilkinson (GB)
R. Zobel (GB)
B. Zupancic (SLO)

## Organization Committee

Felix Breitenecker, Dept. Simulation Techniques,
Institute for Technical Mathematics, Technical University of Vienna

Irmgard Husinsky, Dept. for High Performance Computing, Computing Services,
Technical University of Vienna

**Local Organizers** are the Dept. Simulation Techniques of the Technical University of Vienna and the Dept. for High Performance Computing of the Computing Services of the Technical University of Vienna, and the "ARGE Simulation News".

### Local Organizing Committee

M. Salzmann;

K. Breitenecker, B. Gabler, M. Holzinger, C. Kiss, M. Klug, N. Kraus, M. Lingl,
I. Mannsberger, S. Wassertheurer, J. Schuch, G. Schuster, H. Strauß, W. Zeller

# Table of Contents

**Simulation in Mechatronics and Computational Mechanics**



**Simulation in Robotics**



**Simulation in Electrotechnique and Electronics**

**Simulation in Biology and Medicine**



**Simulation of Logistic and Manufacturing Systems**