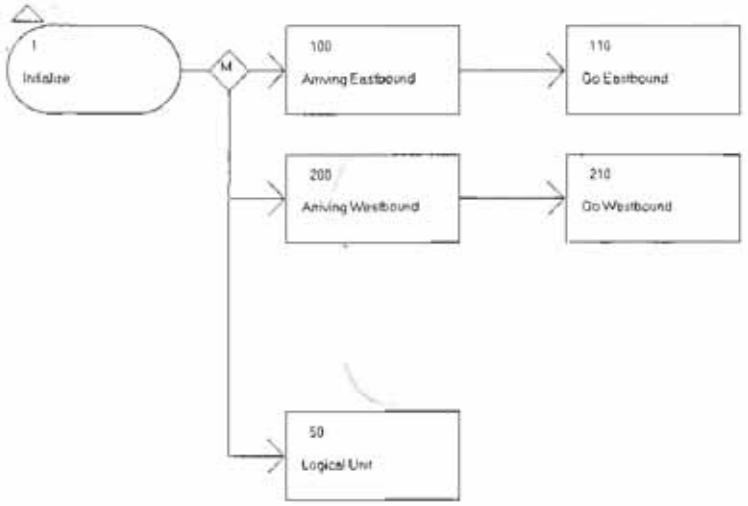
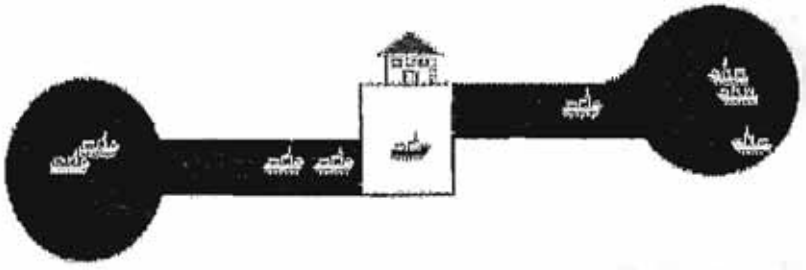
# SIMULATION NEWS EUROPE

# EUROSIM

ISSN 0929 - 2268



Number 17

July 1996

A EUROPEAN FORUM ON SIMULATION ACTIVITIES

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## Readership Information


EUROSIM - Simulation News Europe is published on behalf of EUROSIM (the Federation of European Simulation Societies) three times a year by the "ARGE Simulation News", a non-profit working group. Circulation is 2100. EUROSIM - Simulation News Europe (SNE) is distributed by all member societies to their individual members (as part of the membership services). It is also included in the scientific journal "Simulation Practice and Theory" (SIMPRA).

Editor-in-Chief: Felix Breitenecker
Associate Editor: Mrs. Irmgard Husinsky

Address: SNE-Editors / ARGESIM,
c/o Computing Services, Technical University of Vienna
Wiedner Hauptstr. 8-10, A-1040 Vienna, Austria.
Tel: +43-1-58801-5484, 5374, Fax: +43-1-5874211
Email: sne@argesim.tuwien.ac.at or
husinsky@edvz.tuwien.ac.at
WWW: http://eurosim.tuwien.ac.at/sne/
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If you have any contributions, remarks, suggestions, etc. please contact the editors per mail, fax, or email. For file transfer please use the incoming directory of the ftp-server. Deadline for the next issue will be October 2, 1996.

**Editors of the EUROSIM societies**, responsible for news and conference announcements of their societies (please contact them if you have contributions concerning a particular society): AES: J. Giron-Sierra, ASIM: I. Bausch-Gall, CROSSIM: V. Ceric, CSSS: M. Alexik, DBSS: J. Zuidervaart, FRANCOSIM: M. Lebrun, HSS: A. Jávor, ISCS: M. Colajanni, SIMS: E. K. Puska, SLOSIM: B. Zupancic, UKSS: R. Cheng (full addresses see societies).

The production of the newsletter is financed by advertisements and grants covering current expenses for editing, running of the editorial office, promotion, maintenance of the EUROSIM WWW server and other editorial expenses.


## Editorial

The object-oriented approach becomes more and more suitable also for modelling and simulation. The essay in this issue deals with the context of this approach with model reusability. Aspects of object-oriented modelling will also be discussed in future issues.

The EUROSIM comparisons of simulation software are continued with six solutions and the definition of a new comparison: fuzzy control of a two tank system. Software tools that allow to model fuzzy logic are invited to take the challenge of this comparison. The title page shows parts of the model description and an animation shot of a solution of comparison 8.

During the last months a lot of work has been put into the structure of the EUROSIM WWW server and a database containing relevant information about the comparisons has been developed. All the comparison definitions, sample solutions and additional information are available (http://eurosim.tuwien.ac.at/) as well as information on the EUROSIM societies and a calendar of events.

As usual we would like to thank all who have contributed to this issue.

*F. Breitenecker, I. Husinsky*

## Aims and Scope

The journal EUROSIM - Simulation News Europe (abbreviated SNE) publishes information related to modelling and simulation. It is distributed to all members of European member societies and to other simulation societies or to individuals.

SNE's aims are: to inform about new developments in simulation methodologies, software and hardware (esp. in Europe) and to report news from European simulation societies and European simulation events.

SNE contains news on EUROSIM, on the EUROSIM societies, on other international simulation societies and groups (and societies from related areas), on European simulation centers, and contains a calendar of events.

Each SNE publishes essays dealing with new developments in a particular area and reports on software and hardware developments. Furthermore, there are book reviews and industry news.

A special series on simulation comparisons (EUROSIM comparisons) gives a comprehensive overview on features and developments of simulation software and hardware, including parallelisation techniques.

General information, parts of the news section and information about the EUROSIM comparisons may be found on EUROSIM/ARGESIM's WWW server (http://eurosim.tuwien.ac.at/).

All contributions are selected and may be edited by the editors of the journal.

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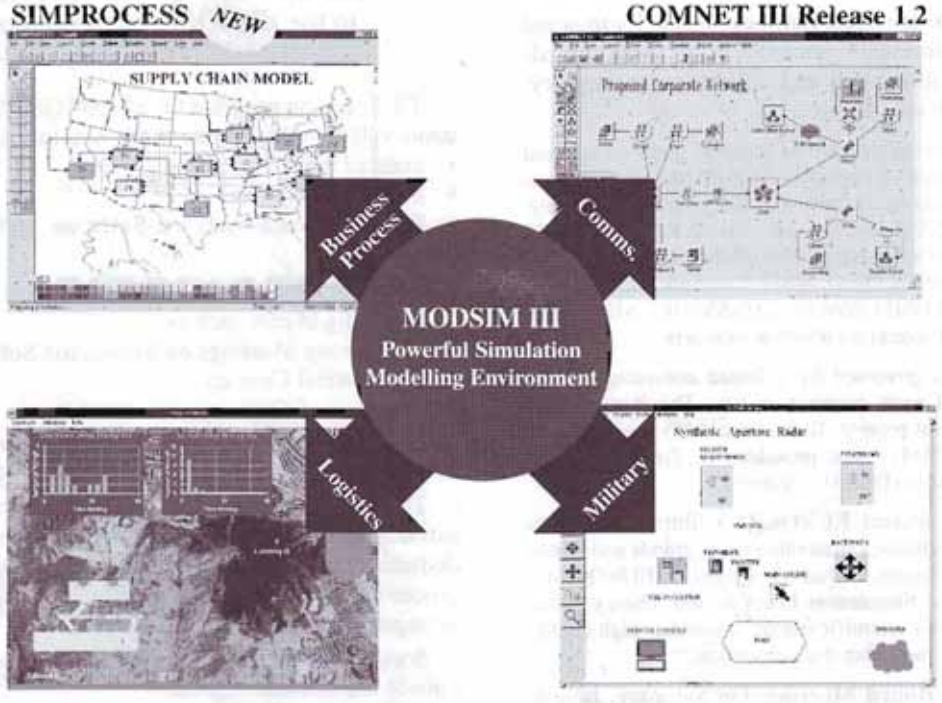


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**EUROSIM**, the **Federation of European Simulation Societies**, was set up in 1989. The purpose of EUROSIM is to provide a European forum for regional and national simulation societies to promote the advancement of modelling and simulation in industry, research, and development.

EUROSIM members may be regional and / or national simulation societies. At present EUROSIM has nine full members and two observer members: ASIM (Austria, Germany, Switzerland), CSSS (Czech Republic, Slovak Republic), DBSS (Belgium, The Netherlands), FRANCOSIM (Belgium, France), HSS (Hungary), ISCS (Italy), SIMS (Denmark, Finland, Norway, Sweden), SLOSIM (Slovenia), UKSS (UK). AES (Spain) and CROSSIM (Croatia) are observer members.

EUROSIM is governed by a Board consisting of one representative of each member society. The Board elects officers, who are at present: K. Juslin (SIMS) - president, F. Breitenecker (ASIM) - past president, R. Zobel (UKSS) - secretary, L. Dekker (DBSS) - treasurer.

EUROSIM's journal **EUROSIM - Simulation News Europe** (SNE) publishes simulation news, trends and developments in simulation, including reports of EUROSIM's member societies. **Simulation Practice and Theory** (SIMPRA), EUROSIM's scientific journal, publishes high quality contributions on modelling and simulation.

**EUROSIM Board Meeting**: On Saturday, June 8, 1996 the EUROSIM Board met in Delft, on the occasion of the HPCN EUROSIM conference.

In order to improve the efficiency of the administration, due to the bylaws an Executive Board was installed. This board, consisting of president, treasurer, secretary, officers for SIMPRA and SNE affairs and past president (president elect), will run the daily affairs, prepare the Board Meetings etc. and has to report to the Board. There will be one meeting of the EUROSIM Board each year, the Executive Board will meet at least twice.

EUROSIM is a Federation of simulation societies, each society having individual members. Each individual member may also feel himself as "EUROSIM member", showing the European flag in the simulation area. In order to underline this European identity a membership card will be designed, showing the logo of EUROSIM and of the member society. The member societies will be asked to issue such membership cards to their individual members. One benefit is, e.g., the identification as "EUROSIM member" at conferences etc. in order to get the the reduced conference fees and other benefits.

The EUROSIM conference "HPCN", starting after this meeting, promises to become a success. The ongoing preparations for the congress EUROSIM'98 promise a very interesting congress. The congress will be organized as multi-conference, covering a very broad area. The offer of DBSS to organize the EUROSIM congress in 2001 was accepted.

EUROSIM expanded again, accepting CROSSIM as an observer member. SLOSIM, up to now observer member, became a full member.

## Call for Arrangers of Subevents to the EUROSIM'98 Congress April 14-18, 1998 in Helsinki

The common program for all EUROSIM'98 participants will be concentrated to the first two days:

- State of the Art Lectures
- Selected full papers
- Exhibition on Simulation Software, Hardware and Literature

The subsequent days will be devoted to independent 1-3 day long events such as

- User Group Meetings on Simulation Software
- Commercial Courses
- Meetings of Organisations operating in specialized fields like Chemical Engineering, Manufacturing Systems, Thermo Hydraulics or Training Simulators

The arrangers of the EUROSIM '98 subevents are assisted with marketing of their event, collection of dedicated participation fees, printing of separate proceedings, reservation of meeting rooms, travelling arrangements and hotel reservation.

Some subevents may with preference be arranged outside the Helsinki region:

- in a cosy countryside congress hotel,
- as a cruising ship roundtrip to Tallinn or Stockholm, or
- in a winter sports resort in Lappland in the far north

For further information and early reservation of your time slot, kindly contact us at:

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*Dear simulationists,*

*On behalf of the President it is a pleasure for me to welcome CROSSIM, the Croatian Simulation Society, as new observer member in our Federation. I am sure, this new member society will enrich the work of EUROSIM essentially. Furthermore, I am glad to announce that SLOSIM, the Slovenian Simulation Society, up to now observer member, has achieved the status of a full member, with all voting rights, because of the society's intensive national and international work in the last year.*

*I would like to draw your attention to the coming EUROSIM congresses, conferences and events. You will find detailed information in the reports of the member societies, and about the ongoing preparations for the congress EUROSIM'98 on this page. I hope to see you at one or the other EUROSIM event.*

*Yours sincerely*

*F. Breitenecker, Past President*

# Object Oriented, Modular Hierarchical Simulation Modeling: Towards Reuse of Simulation Code*

Herbert Praehofer
Systems Theory and Information Engineering, Johannes Kepler University, A-4040 Linz / Austria
email: hp@cast.uni-linz.ac.at

## Introduction and Motivation

Modeling and computer simulation of large scale systems, like transportation systems, traffic systems, manufacturing systems, large scale networks and others, usually requires taking into account a huge number of different alternatives and parameters in system realization. However, often the variations in design of one system to another are relatively small. But the models and knowledge acquired in one simulation project are only used in the next project to a minor extent. Simulation models often are built from scratch.

An important issue in simulation modeling and programming, therefore, is to enhance model reusability. Model libraries provide basic building blocks for different types of application and have successfully been applied in several domains, like manufacturing systems, transport systems and others. However, model libraries only store and make reusable knowledge about basic components. They are not capable of codifying information about how systems are composed, what favorite system architectures are, what kind of limitations in system realizations exist, etc.

In this paper we address the question of reusability in simulation modeling. We discuss different approaches to reusability known from software engineering, we review the systems theory based approach to modular, hierarchical simulation modeling and show how they can work together to enhance simulation model reusability. Finally we discuss a modeling and simulation system prototype currently developed at our institute which targets towards simulation model reusability.

## Approaches to Software Reusability

During the last decade several approaches have emerged to support software reusability:

### Object oriented programming

Object oriented programming gains its expressive power through the concepts of inheritance hierarchies and polymorphic operations. An object class defines an abstract function call interface which can be realized in several different ways in specialized classes through polymorphic operations.

Polymorphism together with specialization hierarchies allows for specifying so-called "template" methods which define general behavioral patterns, with the possibility for delegating specific tasks to "hook" methods which are polymorphic [9]. Depending on the hook class, the general template behavior can be varied. Design patterns and frameworks [4] based on these concepts aim at providing general architectural principles in software design and reusable object libraries.

### Generic programming

Another approach to achieve reusability is generic programming. It allows for defining objects and algorithms for generic types from where concrete classes and algorithms are derived by determining a concrete type for the generic type parameter. Generic programming works intensively with functional parameterization, i.e., using functional parameters for parameterization of behavior.

Generic programming in C++ [12] is realized by *template classes* and *template functions* together with *functional objects*. Functional objects in C++ are classes with a function call operator defined and are used more conveniently than function pointers for behavior parameterization.

### Object oriented analysis, modeling, and design

Object oriented modeling and design techniques realize that complex engineering designs need object oriented concepts, most notably taxonomic knowledge representation schemes in the form of inheritance hierarchies. Rumbaugh [11], Booch [2], Jacobson [3] and others use graph-like representations of complex object oriented software which in particular show how objects are composed from smaller objects (*has-a* relation), what kind of interrelations between objects exist (*association*) and what kind of taxonomic relations between object classes exist (*is-a* relation). This static object view forms a framework for a behavioral model in the form of various state transition diagrams and a func-

* Work supported by Siemens AG Munich, Corporate Research and Development

tional model showing the data and event flow between objects of the system. Based on those representations an object oriented software engineering methodology is defined which distinguishes several steps like system analysis, system design, object design and implementation [11].

### Domain modeling

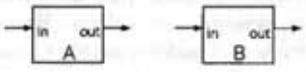
Object oriented analysis and design techniques are intended to address only single problems and their theme is not reusability in the first place. In contrast to that, domain analysis and modeling [1, 5, 6] are intended to encode domain requirement and design models for reusability over a family of systems in one domain. Based mostly on object oriented modeling techniques, they recognize the necessity to enhance those techniques, in particular, they recognize the need to do requirement engineering, specification, and design *for* reusability. A domain model identifies the essential features, interfaces, components, variations and alternatives, abstractions, capabilities, limitations etc. of a family of systems in a domain. Domain modeling, which is a recent research effort, today is believed to be the key factor in developing an economic and scaleable means for constructing families of related software systems.

In domain modeling, two major approaches are identified, viz. *integrative modeling* and *generative modeling* [1]. Integrative modeling is a direct extension of object oriented modeling techniques and typically define an integrated set of submodels in the form of object decomposition/coupling and generalization/specialization hierarchies. They extend conventional object oriented schemes by the ability to represent optional objects, relationships, and states when specifying a target. Generative or reference architecture models are the second kind of domain models. They primarily deal with such issues like: identifying the fundamental programming abstractions in a domain, creating libraries of interoperable software components, defining knowledge representation schemes for stating constraints on combinations of building blocks, and finding different types of coupling schemes [1].

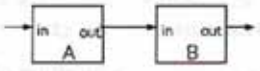
Based on system theory simulation modeling concepts, Zeigler [15] defined a methodology for *modeling in the large* (termed *multifacetted modeling*) which recognizes the multiplicities of objectives and models in the modeling and simulation enterprise. This methodology regards a model as a means to embody knowledge of a real system, it concentrates on the organization of model bases for a domain, and, in that, shows strong resemblance to domain modeling efforts. The heart of the methodology is the *System Entity Structure (SES)* knowledge representation scheme which recognizes the need to represent decomposition and coupling as well as taxonomic knowledge. Based on multifacetted modeling, Rozenblit [10] defined a knowledge-based system design and simulation methodology which introduces knowledge representation schemes to define coupling and synthesis constraints, selection rules, and non-functional parameters. A heuristic, rule based pruning process has been realized to extract possible system configurations satisfying stated requirements.

## Modular, Hierarchical System Modeling Reviewed

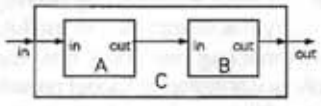
Modular, hierarchical system modeling [15, 16, 7] is an approach to complex dynamic system modeling where modular building blocks, i.e., system components with a well defined interface in the form of *input and output ports*, are coupled in a hierarchical manner to form complex systems. In system modeling, one distinguishes between atomic or coupled models. While an atomic model specifies its internal structure in terms of its set of states and state transition functions, a coupled model's internal structure is specified by its components and coupling scheme, i.e., how ports are connected.




(a) model components *A* and *B*




(b) coupling *A* and *B*




(c) model component *C*

Figure 1: Modular hierarchical system modeling

System modeling means modeling complex systems by interface based object composition. Figure 1 shows this methodology. Modular building blocks are defined by specifying their input and output interface in the form of input and output ports through which all the interactions with the environment occur (Fig.1-a). These modular building blocks can be composed by connecting their output and input ports (Fig.1-b). A system composed in such a way again forms a modular building block which is usable as components in bigger coupled models (hierarchical model composition, Fig. 1-c).

Modularity allows for setting up bases of reusable building blocks. The model interface thereby determines its applicability as a component in a system, i.e.,

models which obey to the same interface are interchangeable.

Modular hierarchical system modeling concepts have been applied in several domains, most notably hardware design and communication engineering. Zeigler [15, 16] introduced modular hierarchical modeling for discrete event simulation. The *DEVS-formalism* is an application and computer implementation independent formalism for discrete event modeling and parallels the differential equation specified and finite state automaton formalism. An atomic DEVS knows two types of events: (1) *external events* occur upon input events on the input interface and are handled by an *external state transition function*, (2) *internal events* are time scheduled events, i.e., they occur when a certain time span determined by a *time advance function* elapses, and are handled by the *internal state transition function*.

The DEVS-formalism and methodology have been extended in several ways. The extension to multiformalism modeling and simulation [7] allows combined discrete/continuous modeling and simulation and the integration of components specified in several different formalisms. Another extension is to allow coupled models with state behavior [13, 8], i.e., a coupled model owns its own state transition function and, in that way, is able to dynamically change its component and coupling structure. This extension facilitates the realization of variable structure models [14].

## Towards a simulation environment with model reusability

Based on a C++-realization of DEVS-based modeling and simulation and on object oriented domain modeling concepts, an environment is currently realized which facilitates the representation of simulation application domains, the configuration of simulation models, and the automatic generation of C++ simulation code from those configurations. Furthermore, the environment also serves as a framework for specification of experimental conditions, to support execution of simulation runs, and the administration of simulation results.

Figure 2 shows the structure of the environment. The basis of the environment is the C++-implementation of the DEVS-based modeling and simulation concepts. Exploiting C++, DEVS-based modeling has been extended with object oriented and generic programming features. DEVS-based models, atomic as well as coupled, are defined by C++-class definitions which implement the model interface, set of states, and component systems by data definitions and behavior and couplings by polymorphic methods. In that way it is feasible to use the object oriented features of C++, viz. inheritance, polymorphism, and genericity for model realization. In particular, generic library components can be built which can be parameterized in the following ways:

- The types of input and output values can be changed by definition of template parameters.
- Variables with scalar values are used to determine model parameters, like capacity of queues, number of components etc.
- Model components can be determined at configuration time and even exchanged at runtime. Any model with equal interface is usable.
- Functional object parameters are employed to parameterize the behavior of model components. For example, a functional object can be used for random number generation, or to implement various control strategies.

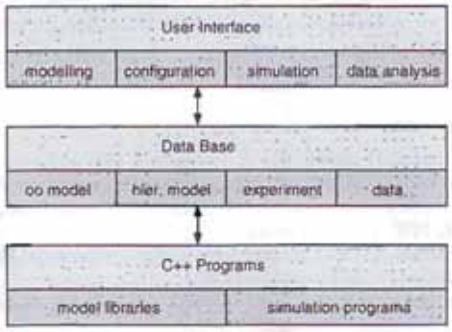



Figure 2: Architecture of the domain modeling and configuration system

Above the C++-simulation layer, an object oriented database system stores and manages the object oriented model of the domain, the different configurations already derived from it in the form of hierarchical model structures, and the experimental conditions and the simulation results for the models. The object oriented model of a simulation domain is intended to represent the domain in all its variations and alternatives, abstractions levels, and with all the restrictions which apply. It is the central tool for model reusability. It supports the simulationist in the selection of a simulation model which represents a particular system design to be tested by simulation.

Reviewed in the sense of the object oriented C++-realization of the simulation models, the object oriented model of a simulation application is a *meta-model* of the C++ model definitions. It represents the hierarchical structure of the simulation model and it represents the different variants for model components. Furthermore, the object oriented model has to show the possible parameterization of the model components by parameters, template parameters and functional objects.

Object oriented modeling as well as simulation program generation and simulation experimentation are supported by an interactive user interface. The environ-

ment supports users with different expertise: (1) the *simulationist* can run simulation experiments for existing model configurations and analyze the results, (2) the *modeler* configures new systems designs based on the available domain knowledge, (3) the *expert programmer* is able to realize new model components and integrate them into the domain knowledge base.

### Summary

In this paper we have shown how different approaches can be employed to achieve reusability in simulation programming. Object oriented and generic programming and modular hierarchical system modeling can cooperate successfully to implement reusable generic model libraries. Object oriented modeling techniques facilitate the representation of application domains. Based on these concepts, a software environment is realized which supports the configuration of simulation models and automatic generation of simulation programs.

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# EUROSIM'95 Special Interest Sessions

The EUROSIM'95 Congress, which took place in Vienna in September 1995, featured several "Special Interest Sessions" with emphasis on specific up-to-date simulation topics. *EUROSIM - Simulation News Europe* publishes reports on these sessions.

## Comparison of Simulation Software

The aim of this session was to investigate

- how to compare and evaluate simulation software,
- how to choose an appropriate simulation software for a specific task,
- how to define criteria for evaluation of simulation software.

The session started with an overview paper [1] which considered the trends for simulation to be used directly by non-specialists. Reflecting on the non-trivial nature of simulation as a technique, it reported some results from surveys of actual user practice in simulation experimentation and discussed implications. The outcome "that simulation methodology in practice is, as best, suspect and variable" was discussed intensively after the presentation. The contribution pointed out the big gap between the demands of expert users and non-expert users, and between the demands of the users and the offers of the software suppliers, and the fact that now powerful tools are available for non-expert users who have problems with using the tool correctly.

Then the work of the continuous systems simulation group of FRANCOSIM, the French speaking simulation society, was presented [2]. It is concerned with the production of a document that allows end users of simulation software to analyse their needs and choose an appropriate software tool. Software developers may also use this work to analyse the view of their users. An evaluation table is given, where the intent of the outlined criteria is to choose a simulation software for a specific task and not to compare features of software for a specific problem.

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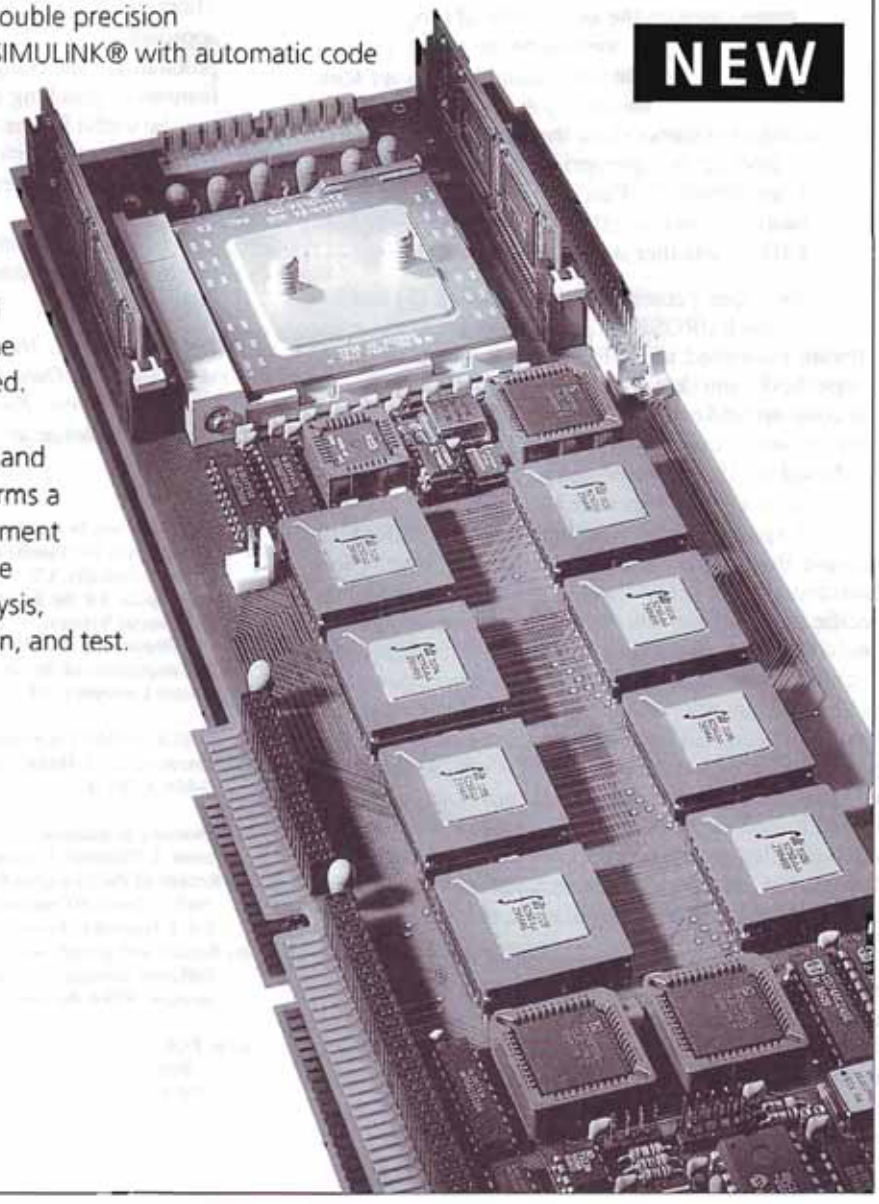

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The next paper [3] presented an evaluation and comparison of fourteen widely used discrete simulation packages carried out at Brunel University. The evaluation presented was primarily performed in order to identify the most important features of these packages and therefore to provide some help to the users when selecting simulation software for discrete processes. The approach used is based on an a priori choice of fourteen languages, and on an a posteriori selection of features to be compared which caused some discussions after the presentation.

The realisation of a JIT in flexible manufacturing is usually connected with the ability to effectively translate the working of decision making processes into the job shop. The success in carrying out such a task depends in many cases on the availability of proper simulation tools. From this viewpoint in paper [4] the features of mainly discrete simulation systems are seen through the scope of "on-line" job shop experiments. The concluding remarks show the aim of the investigations, i.e. finding an appropriate simulation system: ***UFO*** - "**U**ser-friendly", "**F**ast" and "**O**pen". Main point of the discussion was whether the approach is taylor-made for JIT or whether it is a general one.

The last paper presented in this session [5] briefly introduced the EUROSIM Comparisons on Simulation Software published in EUROSIM - Simulation News Europe (SNE) and sketches the way how these comparisons compare and evaluate software. Then results of the first continuous comparison "Lithium Cluster Dynamics", based on 25 sent in solutions (different simulation languages or different modelling techniques) are discussed. A specific result was, that it is very difficult to compare the quality and effectiveness of integration algorithms, while other features being checked in this specific comparison can be compared easily. In the concluding remarks some trends and developments which have shown up in the solutions were presented. The discussion after the presentation dealt with the question whether all solutions sent in are of same quality - done by expert or non-expert users, whether the trends and developments are general ones or not, and with the old question, whether there exists a really combined simulation language (only one language, SIMUL_R has indeed combined features, and offered also solutions for the discrete comparisons, see [6]).

The last paper of the session [6] could not be presented, because the authors had to cancel their participation. The paper summarises the results of the EUROSIM Comparison "Flexible Assembly System", the first discrete comparison published in SNE. The interesting outcome was, that - although all 19 solutions sent in showed nearly the same results - people had different understandings about some formulations in the definitions. Although after clarification some misunderstandings remained between engineers who tried a solution and people from computer science or mathematics - which is a strange phenomenon. The paper discusses this phenomenon and states that problems in discrete simulation may also arise due to the fact that tasks cannot be formulated as exactly as in continuous simulation.

This Special Interest Session gave interesting insight into comparison of simulation software. Results of the contributions and discussions may be summarised as

- There is a big need in comparisons and evaluation of simulation software.
- There are two approaches of the users for choosing an appropriate software: analysing the needs for a specific problem and searching for a software with appropriate features or checking comparisons for features which may be useful for the specific problem.
- In defining and performing comparisons, there is a big difference between the continuous and the discrete world.
- The EUROSIM Comparisons are becoming a certain standard for comparing and evaluating simulation software.

*F. Breitenecker, I. Husinsky, ARGESIM, c/o Computing Services, Technical University Vienna, Wiedner Hauptstraße 8-10, A-1040 Vienna; Email: {Felix.Breitenecker, Irmgard. Husinsky} @tuwien.ac.at*

## References

[1] Simulation may be Dangerous - Experimentation Practice and the Implications for Simulation Software. B.W. Hollocks, Bournemouth University, UK

[2] A Template for the Evaluation of Tools for the Simulation of Continuous Systems. Y. Hamam, F. Rocaries, A. Carriere,Control Department ESIEE, Noisy-le-Grand, France

[3] A Comparison of Simulation Software Packages. V. Hlupic, Brunel University, UK

all in: EUROSIM'95 Simulation Congress - Proceedings. Eds. F. Breitenecker, I. Husinsky; Elsevier, Amsterdam (1995), ISBN 0-444-82241-0

[4] Choosing Simulation Software for Flexible Job Shop Environment. J. Niwinski, Danube Hydro Austria

[5] Results of the EUROSIM Comparison "Lithium Cluster Dynamics" - Trends in Continuous Simulation Software. F. Breitenecker, I. Husinsky, Technical University Vienna.

[6] Results and Experiences Derived form a Comparison between Different Simulation Systems. J. Klußmann, J. Krauth, R. Splanemann, BIBA Bremen

all in: EUROSIM'95 Simulation Congress - Late Paper Volume. Eds. F. Breitenecker, I. Husinsky; ARGESIM Report No. 1, ARGESIM Vienna (1995), ISBN 3-901608-01-X

# ASIM

ASIM (*Arbeitsgemeinschaft Simulation*) is the association for simulation in the German speaking area. ASIM was founded in 1981 and has now about 680 individual members.

## Report from ASIM

This year's major event, the annual ASIM conference, ***10. Symposium Simulationstechnik***, will be organized by Prof. W. Krug, DUAL-Zentrum GmbH, Dresden and his team.

**ASIM 96**
***10. Symposium Simulationstechnik***
**Dresden, September 16-19th, 1996**

The programme includes:

| | |
|---|---|
| Sept. 16: | User Group Meetings, Tutorials |
| Sept. 17-19: | Parallel Sessions, Invited Papers, Overview Papers, Posters, Exhibition, Social Programme |

**Contact Address:**
Prof. Dr.-Ing. W. Krug, DUAL-Zentrum Dresden
Gillesstraße 2, D-01219 Dresden
Tel: +49-351 47791-0, Fax: +49-351 47791-99
Email: dual@dual-zentrum.de
WWW: http://www.htw-dresden.de/asim96/

6 invited papers, 10 overview papers and more than 100 contributed papers will cover a wide spectrum of simulation activities in the German speaking area. More than 20 exhibitors will present their new products. The interesting social program will allow to meet old friends and make new friends. For ASIM members the preliminary programme is included in this mailing. We look forward to seeing many ASIM members at this meeting.

***Mitgliederversammlung:*** ASIM's general assembly and elections of the Board will take place on September 17, 1996 in Dresden. This year the complete ASIM Board has to be elected. The ASIM Board consists of eight elected members, all the speakers of the working groups, and co-opted members. Please contact one of the members of the current Board if you are interested to be a candidate for one of the eight seats. The members of the Board will be elected for three years. The election will take place during the general assembly on **Tuesday, September 17, 1996** at HTW Dresden, F.-List-Platz 1, D-01069 Dresden, from 18.00 - 20.00, on the occasion of the ASIM 96 conference. All ASIM members are invited to come to this meeting, independent of conference participation. All ASIM members will receive an invitation to the general assembly with this mailing.

The ***11. Symposium Simulationstechnik***, the next annual ASIM conference will be organized in September 1997 at Universität Dortmund. A first call for papers will be available at the conference in Dresden. For more information contact Prof. Kuhn (address see below) after September 1996.

## Contact Addresses

**Austria, payment issues and membership administration:**
Prof. Dr. Felix Breitenecker
Technische Universität Wien, Abt. Simulationstechnik
Wiedner Hauptstraße 8-10, A-1040 Wien
Tel: +43-1 58801 5374, Fax: +43-1 5874211
Email: asim@argesim.tuwien.ac.at

**Germany:**
Prof. Dr. D. Möller
TU Clausthal, Institut für Informatik
Erzstraße 1, D-38678 Clausthal-Zellerfeld
Tel: +49-5323 72 2504 or 2402 (Secretary)
Fax: +49-5323 72 3572
Email: moeller@vax.in.tu-clausthal.de
or
Dr. Ingrid Bausch-Gall
Wohlfartstraße 21b, D-80939 München
Tel: +49-89 3232625, Fax: +49-89 3231063
Email: 100564.302@compuserve.com
(member of the Editorial Board of SNE)

**Switzerland:**
PD Dr. Jürgen Halin
ETH Zürich, Institut für Energietechnik
Clausiusstrasse 33, CH-8092 Zürich
Tel: +41-1 632-4608, Fax: +41-1 632 1166
or
Dr. Veronika Hrdliczka
ETH Zürich, Betriebswissenschaftliches Institut
Zürichbergstr. 18, CH-8028 Zürich
Tel: +41-1 632 0546, Fax: +41-1 632 1045
Email: hrdliczka@bwi.bepr.ethz.ch

## ASIM Meetings to come

**September 16-19, 1996**: ASIM 96, *10. Symposium Simulationstechnik* in Dresden. Contact: Prof. Dr. W. Krug.

**March 3-4, 1997**: Joint Meeting of the working groups "*Simulation Technischer Systeme*" und "*Simulationsmethoden und -sprachen für verteilte Systeme*

*und parallele Prozesse*" in Rostock. Contact: Dr. Ingrid Bausch-Gall.

**March 1997**: 6. Symposium "*Simulation als betriebliche Entscheidungshilfe*" Braunlage. Contact: Prof. W. Hummeltenberg (address see below).

**April 17-19, 1997**: *7. Ebernburger Gespräch "Soft Computing: Möglichkeiten eines Paradigmenwechsels für dynamische Systeme in Medizin, Biologie und Ökologie*" Contact: Prof. Dr. Möller (address see above) or Prof. Dr. Richter (address see below).

**September 1997**: ASIM 97, *11. Symposium Simulationstechnik* in Dortmund. Contact: Prof. Dr. Kuhn (address see below).

## Working Groups

### "Simulationsmethoden und -sprachen für verteilte Systeme und parallele Prozesse"

The next meeting of the working group will be held together with the working group "*Simulation Technischer Systeme*" on March 3-4, 1997 at Universität Rostock at the institute of Prof. Tavangarian. Topics of the meeting will include: modelling and simulation of parallel systems, parallel and distributed simulation (e.g. in workstation clusters and distributed computer nets), coupling of simulators.

**Speaker:** Dr.-Ing. Peter Schwarz, Fraunhofer-Institut IIS/EAS, Zeunerstr. 38, D-01069 Dresden, Tel: +49-351 4640 730, Fax: +49-351 4640 703, Email:schwarz@eas.iis.fhg.de
**Vice-speaker:** Dr. Hans Fuss, GMD, D-53731 St. Augustin, Tel: +49-2241 14 3125, Fax: +49-2241 14 3006, Email: fuss@cartan.gmd.de

### "Simulationssoftware und -hardware"

The working group started this year joint meetings with other working groups. The first joint meeting was held in February (Feb. 26 - 28, 1996) together with the working group "*Simulation Technischer Systeme*".

The meeting was organized as follows: the first day dealt with simulation of technical systems, on the second day so-called "*Arbeitsgespräche*" were organized as joint meetings to gain insight into special subjects (for details see the report of the working group "*Simulation Technischer Systeme*"), and on the third day subjects related to software were discussed in nine contributions. Monday and Tuesday were hosted by the *Institut für Meß-, Regel- und Mikrotechnik* of University Ulm, the meeting on Wednesday by the research Center of Daimler Benz at Ulm. Main topics of the software-related meeting on Wednesday were object-oriented ("O-O") approaches, soft computing and parallelization-subjects which are of very recent interest. The contributions on O-O started with an overview by Prof. Schmidt (Univ. Passau) on "*Objektorientierte Modellspezifikation-Grundlagen und Anwendungen*". Afterwards applications and discussions were presented in Mr. Mügge's contribution on "*Objektorientierte Spezifikation von Modellen und Experimenten mit MSL*" and in "*Effizienzsteigerung bei der Modellbildung unter Ausnutzung der Objektorientiertheit und der automatischen Modellierung - Fallstudien mit SIMPLE++*" by Mr. Kraus and Mr. Salzmann (Vienna), and finally by Mr. Kilmer, who entitled his presentation "*Objektorientierte Modellspezifikation - Objektorientiert kontra Praxistauglich*". At the end of these contributions a very intensive discussion on benefits of O-O took place. Another important new area is softcomputing, summarizing fuzzy systems, neural nets, genetic algorithms etc. Prof. Möller gave an overview on "*Einsatz von Fuzzy Logic in der Simulation Dynamischer Systeme*", then applications were presented: "*Künstliche Beatmung - Vorteile von Softcomputing bei der Regelung*" (Mr. B. Bracio, Univ. Clausthal) and "*Meßwerterfassung und Bestimmung von Modellparametern als Grundlage der Simulation biologischer Abwasserreinigungsprozesse*" (J. Jungbluth). Dr. R. Ruzicka's contribution dealt with softcomputing and parallelization: "*Fuzzy Logic und Prinzipien einer plattformunabhängigen parallelen Simulationsumgebung in CSSL-Strukturen - Anwendungen in SIMUL_R*". The session closed with Prof. Breitenecker's contribution on "*Stand und Auswertung der EUROSIM Comparisons - Dokumentation und Evaluierung über WWW*", which summarized some of the aspects discussed before.

The joint meeting turned out to be very successful, and it was decided in the assembly of the working group (on Tuesday evening) to continue with this strategy.

**Speaker:** Prof. Dr.-Ing. Dietmar P.F. Möller, TU Clausthal, Institut für Informatik, Erzstraße 1, D-38678 Clausthal-Zellerfeld, Tel: +49-5323 72 2402 or 72 2504, Fax: +49-5323 72 3572
**Vice-speaker:** Prof. Dr. Felix Breitenecker, TU Wien, Abt. Simulationstechnik, Wiedner Hauptstr. 8-10, A-1040 Wien, Tel: +43-1 58801 5374, Fax: +43-1 587 4211, Email: fbreiten@email.tuwien.ac.at

### "Simulation und künstliche Intelligenz"

MAASIM'96, the 1996 Workshop of the GI 4.5.1.3 working group "Simulation and Artificial Intelligence" was held together with the GI 1.1.6. interest group "Distributed Artificial Intelligence" on March 5-6 in Ulm.

It was the first workshop held in Germany with the objective to bring together scientists working in the area of simulation and multiagent systems. About 30 participants of the workshop came from United Kingdom, Italy, France, Switzerland and Germany giving 14 talks. The term "agent" subsumes varying concepts. However in the workshop we interpreted agents as entities with deliberative capabilities, as dynamic autonomous evolving entities. A comparison between conventional simulation and simulation of individual and multiagents was a central issue of discussions. A lot of presentations focused on component oriented, object oriented and discrete event oriented approaches in application to simulation of multiagent systems. Object oriented discrete event systems DEVS might provide one of possible conceptual frameworks to build agent oriented simulation systems. Test beds for multiagent systems and their application in traffic scenarios clarified an agent oriented view in the modelling and simulation of complex systems. An interesting issue was a consideration how far artificial societies research has seri-

ous potential as a source of scientific insight into human and other societies and how far multiagent modelling are important as methodological concepts.

One interesting feature of the MAASIM'96 programme was a demonstration session, where three agent based simulation systems have been presented. A fruitful discussion about mutual benefits between simulation and multiagent techniques was an important result of the workshop. Multiagent concepts were considered an enhancing modelling method in order to make simulation systems more flexible, faster and more efficient. However current simulation methodologies and tools do not support these concepts sufficiently. Concepts of multiagent systems are a challenge for development of new modelling languages and simulation techniques. We believe that the co-operation of agent systems and simulation research has just started and will be a very important research and technology area of the future.

Speaker: Prof. Dr.-Ing. Helena Szczerbicka, Universität Bremen, Fachbereich 3 - Informatik, Postfach 33 04 40, D-28334 Bremen Tel: +49-421 218 7389 or 7390, Fax +49-421 2187385, Email: helena@informatik.uni-bremen.de.

### "Simulation in Medizin, Biologie und Ökologie"

In the working group intensive discussions have taken place at the Technical University of Clausthal and the Technical University of Braunschweig concerning the future policy of the group.

It was noticed that most of the subjects covered in the past by the working group have become now common practice in many fields of medicine, biology and ecology. Advanced simulation tools with various possibilities of performing parameter sensitivity analysis or even parameter identification are now widely spread and are available even on the PC. This has had a profound effect on the acceptance of the use of models in biomedical research. Although many technical problems still remain to be addressed, it is the feeling of the working group that the main task of the working group is the development and assessment of new concepts. Soft computing has become now one of the major issues in technical applications. However, in medicine, biology, ecology and environmental research in particular, the problem of uncomplete knowledge plays a much greater role than in technical systems. It is therefore important to promote new vision and creative imagination in applying the methods of soft computing to these fields. The group decided to direct future activities towards this aim.

In spring 1997 the 7th *"Ebernburger Gespräch"* will be dedicated to explore the impact of the new soft computing concept on biomedical and environmental research. The meeting will take place from April 17 to 19 with the main topic: Soft computing: possibilities of a change of paradigm in dynamical systems theory in biomedical and environmental research. Special topics will be fuzzy-systems, neuronal nets, genetic algorithms, evolutionary strategies and cellular automata.

For ASIM members an invitation to the "7th *Ebernburger Gespräch*" is included in the mailing with this issue or can be obtained from the speaker.

**Speaker:** Prof. Dr. Otto Richter, TU Braunschweig, Institut für Geographie und Geoökologie, Langer Kamp 19c, D-38106 Braunschweig, Tel: +49-531 391 5627, Fax: +49-531 391 8170
**Vice-speaker:** Prof. Dr. Björn Gottwald, Universität Freiburg, Fakultät für Biologie, Schänzlestraße 1, D-79104 Freiburg, Tel: +49-761 203 2891, Fax: +49-761 203 2894

### "Simulation technischer Systeme"

The annual workshop of this ASIM working group was a joint meeting with the working group "*Simulationssoftware und -hardware*". It was held on February 27-28, 1996 and hosted by Universität Ulm, Institut für Meß-, Regel- und Mikrotechnik of Prof. Hofer and by the Research Center of Daimler Benz.

About 70 persons visited this meeting. As new concept we had general overview talks on Monday afternoon (organized by our working group) and parallel socalled "*Arbeitsgespräche*" on Tuesday morning, together with the working group "*Simulationssoftware und -hardware*" (which organized the software sessions on Wednesday, see report of this working group). On Monday, in the first of three sections, Dr. Bantle and Herr Wenzel of Daimler-Benz Aerospace in Ulm reported on their methods for System- and HIL-simulation. The second section was organized by Dr. Schäfer of Daimler-Benz AG on "*Simulation in der Prozeßkette*". Dr. Hempel of Daimler-Benz central research reported on "*Simulation im Kfz-Entwicklungsprozeß*" and Dr. Kuhnke of GSC Chemnitz on "*Prozeßkette Automatisierungstechnik*". The third section included three talks of the hosting institution organized by Prof. Hofer: Herr Sawdony "*Modellbasierte Qualitätsregelung für die Drehbearbeitung*", Dr. Tibken "*Neue Simulationstechniken für unsichere Systeme*", Herr Patzer "*Finite-Volumen Ver-fahren zur Charakterisierung von Mikrobauteilen*". Tuesday sessions were organized together with the working group "*Simulationssoft- und Hardware*".

Six "*Arbeitsgespräche*" on Tuesday gave more deep insight on the following special subjects: *Elektronik* (Hans Gall), *Echtzeitsimulation* (Harald Schmitz), *Simulation und Virtuelle Realität* (Prof. D. Wloka), *Meß-, Regel- und Mikrotechnik* (Prof. Hofer, Dr. Schäfer), *Simulatorkopplung* (Dr. Bausch-Gall), *Was ist objektorientiert und was bringt Fuzzy Logic in der Simulationstechnik* (Prof. Breitenecker, Prof. Möller, Prof. Schmidt).

After lunch a tour through the very interesting and diverse experimental and research department of Prof. Hofer's institute showed experiments from optimization, realtime simulation, robotic, microtechnic, brewery and control of a motor. This was an interesting and rewarding highlight of this meeting, which gave all participants an additional chance to discuss simulation techniques and application. The report about this meeting will appear as *ASIM-Mitteilungen Nr. 52*. This report will be shipped to working group members with this mailing, other persons can order it from the speaker for DM 30,00 plus shipping costs.

On Monday afternoon the working group members met for a short meeting to discuss the future work in the group. Traditionally almost all participants met later on Monday evening for a longer meeting with food, wine and beer in a comfortable restaurant in Ulm.

The next working group meeting will be held on March 3-4, 1997 at University Rostock at the institute of Prof. Tavangarian. It will be organized together with the working group "*Simulationsmethoden und -sprachen für verteilte Systeme und parallele Prozesse*". Amongst others, a major subject will be VHDL and VHDL-A. Please contact the speaker, if you want to organize a socalled "*Arbeitsgespräch*" at the meeting.

**Speaker:** Dr. Ingrid Bausch-Gall, BAUSCH-GALL GmbH, Wohlfartstraße 21b,D-80939 München, Tel: +49-89 3232625, Fax: +49-89 3231063, Email:100564.302@compuserve.com
**Vice-speaker:** Ewald Hessel, Hella KG Hueck&Co., Abt. EL-R, Werk II, Beckumer Straße, D-59552 Lippstadt, Tel: +49-2941 38 8572, Fax: +49-2941 38 8427, Email: hessel@hella.de

### "Simulation in Produktion und Logistik"

The ASIM-Working Group "*Simulation in Produktion und Logistik*" organized a working group meeting on February 22, 1996, at the University of Nürnberg/ Erlangen, Germany. A special topic of this meeting was the preparation of the next working group conference, which takes place every two years. This time the working group conference titled "*Simulation - Anwendernutzen und Zukunftsaspekte*" is planned for June 11 - 13, 1996, in Dortmund, Germany.

The conference program contains different sections concerning simulation technology in organizations, in logistics and material flow, and aspects of simulation methods in planning and operation, a workshop "*Was interessiert den Fabrikplaner das Produkt?*" and different logistics business games. In the scope of this event the Working Group organizes, together with the GI-*Fachgruppe 4.1.4* "*Graphische Simulation und Animation*" a workshop titled "*Visualisierungsverfahren beim Einsatz der Simulationstechnik in Produktion und Logistik*" on June 11, 1996. The workshop is a forum to discuss different methods and application possibilities of visualization in discrete event simulation.

For detailed information please contact: Dipl.-Inform. Sigrid Wenzel, Fraunhofer-Institut für Materialfluß und Logistik, Joseph-von-Fraunhofer-Straße 2-4, D-44227 Dortmund, Email: wenzel@iml.fhg.de

**Speaker:** Prof. Dr.-Ing. A. Kuhn, Fraunhofer-Institut für Materialfluß und Logistik, Joseph-von-Fraunhofer-Straße 2-4, D-44227 Dortmund, Tel: +49-2319743 132, Fax: +49-231 9743 234

### "Simulation in der Betriebswirtschaft"

The sixth symposium "Simulation for managerial decision support - new tools and approaches in practice" is announced for spring of 1997 at the traditional place in Braunlage. For further information, please contact the speaker.

**Speaker:** Prof. Dr. W. Hummeltenberg, Universität Hamburg, Institut für Wirtschaftsinformatik, Max-Brauer-Allee 60, D-22765 Hamburg, Tel.: +49-40-41 23-40 23, Fax: +49-40- 41 23-64 41

### "Simulation von Verkehrssystemen"

The meeting of the working group took place on June 14th in Zürich. A report will be published in the next issue of this journal.

**Speaker:** Karl-Heinz Münch, SIEMENS AG, Bereich VT2 SYS, Ackerstraße 22, D-38126 Braunschweig, Tel: +49-531 226 2225, Fax: +49-531 226 4305

### GI-Fachgruppe "Informatik in den Biowissenschaften" Modeling and Simulation in the Environmental Domain A Report of the Working Group 4.6.1.5

The Working Group 4.6.1.5 "Tools for Simulation and Modeling for Environmental Applications" is joined with the German Society of Informatics GI, the group "Environmental Informatics" and cooperates with ASIM.

The 6th meeting of the working group was realized in March 13 - 15, 1996. The meeting took place at the computer science department of the Otto-von-Guericke University of Magdeburg, Germany. During two and a half days of the meeting 23 lectures have been given to about 50 participants. The main emphasis of the workshop was put on methods of modeling and simulation and their applications in the environmental protection, the coupling of environmental information systems and geographical information systems with simulation tools, the effect of traffic and logistical decisions on environmental systems, and the effect of production and operational processes on the environment. The methodical oriented lectures reported of applications of neuronal networks in the environmental domain, fuzzy methods, fuzzy Petri Nets and stochastical modeling methods. The fields of application of such methods in the environmental system analysis are concentrated on landscapes and ecosystems, e.g. the assessment of changes in landscapes to special animal populations, the ecological regeneration of brown coal stocks in the east part of Germany, the determination of quality of surface water, biological cleaning of waste water, extension of odour, and operational planning and control processes. The reports on traffic and logistic modeling with environmental effects represented the first research results of the project MOBILE manipulated at the University of Hamburg and of other institutes. A close connection between modeling and simulation methods and environmental information systems or geographical information systems is very important in all of the application main points of the workshop. The aim of such a connection is to get an easy access from simulation experiments to the data of the information systems and to integrate and visualize simulation results in geographical maps. An important task is also the management of models, and of experiment descriptions. Such problems formed another main point of the meeting. All lectures of the workshop will be published in the "Research Reports of the Research Center Karlsruhe" (*Forschungsberichte des Forschungszentrums Karlsruhe*).

The next workshop of the working group will be executed in March 1997 at the University of Oldenburg, Germany. The scientific main points are: a) connection of environmental systems with simulation systems and b) individual oriented modeling and simulation - systems of autonomous agents - in ecological applications.

Information about the activities of the Working Group 4.6.1.5 is available at http://www.informatik.uni-rostock.de/FB/Praktik/Mosi/ak5/

**Speaker:** Prof.Dr.habil. Rolf Grützner, University of Rostock, Dept. of Computer Science, WG Modeling and Simulation, Albert-Einstein-Str.21, D-18056 Rostock, Tel: +49-381 4983369, Fax: +49 381 4983426 Email: gruet@informatik.uni-rostock.de

*Ingrid Bausch-Gall*

# CSSS

## General Information

On April 23, 1996 the regular assembly of our society was held at Krnov, Czech republic, during the International Conference "MOSYS'96" with the following agenda: 1) report of the activities in the past period, 2) report of the supervisory board, 3) report of the EUROSIM co-operation, 4) plan of activities for the years 1996 and 1997. Currently CSSS has around 60 members in the 2 national societies, Czech and Slovak Simulation Societies. CSSS is a member of EUROSIM.

Steering Committee: J. Stefan, Technical University Ostrava (Chairman); M. Alexik, University of Transport and Communications Zilina (Vice Chairman); J. Snorek, Czech Technical University Prague; J. Lauber, Economy University Prague; E. Kindler, Czech Technical University Prague; Z. Rabova, Technical University Brno; M. Sujansky, Technical University Kosice; J. Luhan, Research Institute TESTCOM Prague (secretary).

CSSS organized two conferences in the first half of the year 1996 and has prepared three for the second half.

## Past Events

The 30th spring International Conference "Modelling and Simulation of Systems" (**MOSYS'96**) was held on April 23rd-26th, 1996 in the nice Moravian city of Krnov, Czech republic. There were 78 visitors from the Czech and Slovak republics and 14 members from the UK, Poland, Bulgaria, and Russia. The conference had the following topics: Yesterday Simulation * Theory of Modelling and Simulation * Simulation Software * Information System Modelling and Simulation in Economy * Control System Modelling * Modelling in Biology, Biotechnology and Medicine * Liquid Modelling - Theory and Practice * other Applications of Modelling and Simulation. The publications consist of 2 volumes of 384 and 275 pages, there are 107 articles and 154 authors. All articles have English abstract and 72 articles are written in English.

The 3rd International Symposium **ZEL'96** "Computer Control and Simulation of Transport Systems" was on May 30-31, 1996 in Zilina. There were 120 participants from the Czech and Slovak republics and 31 from Switzerland, Holland, Austria, Sweden and Hungary. The conference had the following topics: Information technology * Control processes in the Railway Transport Systems * Simulation of Railway Transport Systems.

## Coming Events

The 12th International Conference on "Process Control and Simulation" (**ASRTP'96**) will be held on September 10-13, 1996 in Kosice, Slovak republic. The conference has the following topics: Measurements and Monitoring Systems * Modelling and Simulation * Process Management and Control * Production Management and Control * Information Technology * Control and Management Systems * Knowledge-based Process Control Management * Real-time Process Control and Management. Papers can be focused on theory, design, education and applications. The conference languages will be English, Slovak and Czech. The chairman of the international program committee is Prof. Ivan Plander, Academy of Science Bratislava, Slovak republic.

The 18th international workshop "**Advanced Simulation of Systems**" will be held on September 17-19, 1996, Zabreh na Morave, Czech republic. The workshop is connected with the annual assembly of the CSSS society. Until now 55 papers have been prepared. Chairman of the workshop is Dr. J. Stefan, TU Ostrava.

The third International conference "**Computer and Informatics**" will be held on September 26-27, 1996 in Herlany, Slovak republic. The chairman of the conference is Prof. M. Jelsina, Technical University Kosice, Slovak republic. The conference has the following topics: Algorithms and theoretical informatics * Information systems * Modelling and Simulation of Systems. Herlany is a small town 30 km from Kosice with a special attraction, a big geyser.

## Contact Addresses

Jan Stefan
FEI - VSB TU, tr. 17 listopadu
CZ - 70 33 Ostrava Poruba, Czech republic
Email: JanStefan@vsb.cz

Mikulas Alexik
University of Transport and Communications
Dept. Technical Cybernetics, Velky Diel
SK - 010 26 Zilina, Slovak republic
Tel: +42 89 54042, Fax: +42 89 54806
Email: alexik@frtk.utc.sk
(member of the Editorial Board of SNE)

*M. Alexik*

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**25-27 September 1996**

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Graphical programming tool that generates ACSL code by allowing the user to build models in block diagram form or a combination of text and block diagram.

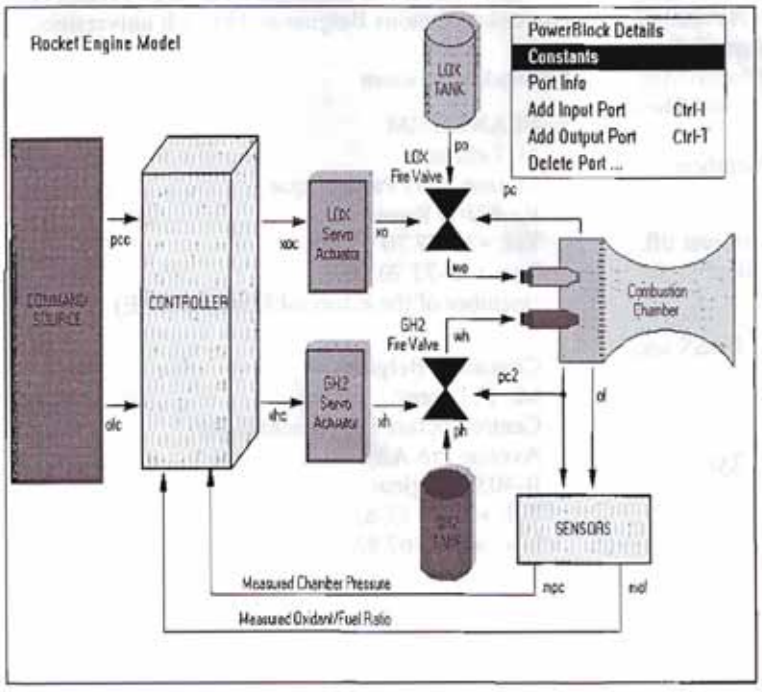
***ACSL Vision***
Graphical tool which allows animation of ACSL models as well as the creation of *widgets* such as pushbuttons and sliders in order to run a simulation from a control panel.

***ACSL Math***
Mathematical environment for matrix computation and state-of-the-art 2D and 3D plotting which incorporates a high-level programming language. With a DDE link to the ACSL environment, ACSL models can be run and variables processed in one single script.

***ACSLrt***
Real time applications (hardware-in-the-loop or man-in-the-loop) can be developed using the special functions available in ACSL to interface with I/O cards with ACSLrt.

***ACSL Code***
C and Ada code generator tightly integrated with the Graphic Modeller for controller design and prototyping.

Graphic Modeller Example





For further information, or for a full evaluation, contact us at

**RAPID DATA LTD**
**Crescent House,**
**Crescent Road, Worthing,**
**West Sussex, BN11 5RW, UK**
**Tel +44 1903 82 12 66**
**Fax +44 1903 82 07 62**
**Email info@radata.demon.co.uk**

Continental Office

**Scientific Data Benelux**
**Olivier van Noortlaan 110**
**3133 AT Vlaardingen**
**The Netherlands**
**Tel +31 10 460 39 85**
**Fax +31 10 460 47 77**

## DBSS

### General Information

The Dutch Benelux Simulation Society (DBSS) was founded in July 1986 for the purpose of creating an organisation of simulation professionals within the Dutch language area. DBSS has actively promoted creation of similar organisations in other language areas. DBSS is member of EUROSIM and works in close co-operation with the other members and is affiliated with SCS International and IMACS.

Steering Committee: L Dekker, Delft University of Technology (Chairman), A.W. Heemink, Delft University of Technology (Vice Chairman), W. Smit, AKZO NOBEL (Member), J.C. Zuidervaart, Delft University of Technology (Secretary/Treasurer)

### DBSS Membership

Both corporate entities (companies, institutes, etc.) and individuals are welcome to join DBSS as full corporate or individual member. Becoming member of DBSS includes automatically being member of EUROSIM, the overall organisation of European Simulation Societies. DBSS members enjoy reduction of the fees attending the "EUROSIM events" which means congresses, conferences, symposia, workshops etc.

So far members of DBSS received three times a year the EUROSIM newsletter "Simulation News Europe". As an exception for 1996, all members of DBSS will receive volume 4 (6 issues) of the EUROSIM journal "Simulation Practice and Theory". The journal also includes the above mentioned newsletter. In November this year the Steering Committee will contact all their members in order to discuss an optional subscription to the EUROSIM journal "Simulation Practice and Theory" at a reduced price offered by the publisher or a compulsary subscription, included in the membership fee of DBSS.

The membership fee for 1996 amounts to just dfl. 75,- or bfr. 1400,- for individual and the double for corporate members.

Those interested to become a member of DBSS are invited to write to the secretary:

Dutch Benelux Simulation Society
Secretariat: Computing Centre, P.O. Box 354
NL - 2600 AJ Delft, The Netherlands
Tel: +31 15 2785698
Fax: +31 15 2783787
Email: Zuidervaart@rc.tudelft.nl
(member of the Editorial Board of SNE)

(Please mention your name, affiliation and address, and indicate whether you are interested in the personal or institutional membership).

The membership fee should be paid to:
Giro account 3582241, J.C. Zuidervaart
Leeuwerikplantsoen 27
2636 ET Schipluiden, The Netherlands
with the mention: DBSS membership 1996

### Past and Coming Events

The international EUROSIM conference "HPCN challenges in telecomp and telecom, parallel simulation of complex systems and large-scale applications" has taken place, when this issue of SNE will be published. We will inform you in detail about the conference in the next issue.

Furthermore two members of DBSS (ir. S.W. Brok and ir. F.J. Pasveer) were involved in a one day seminar on June 6, at the Hogeschool Holland in Diemen. Topic of this seminar was "*Simulatie binnen het HBO-onderwijs*".

*J.C. Zuidervaart*

## FRANCOSIM

FRANCOSIM was created in 1991 and aims to the promotion of simulation in research, industry and university fields. It has members from large French companies and famous Belgian and French universities.

### Contact Addresses

FRANCOSIM
M. Lebrun
Maison de la Productique
F - 42300 Roanne
Tel: +33-77 70 80 80
Fax: +33-77 70 80 81
(member of the Editorial Board of SNE)

Contact in Belgium:
Mr. F. Lorenz
Centre Socran, Parc Scientifique
Avenue Prè-Aily
B-4031 Angleur
Tel: +32-41 67 83 75
Fax: +32-4167 83 00

# HSS

### General Information

The Hungarian Member Society of EUROSIM was established in 1981 as an association promoting the exchange of information within the community of people involved in research, development, application and education of simulation in Hungary and also contributing to the enhancement of exchanging information between the Hungarian simulation community and the simulation communities abroad. HSS deals with the organization of lectures, exhibitions, demonstrations, round table discussions and conferences.

### Activities

The Hungarian Simulation Society as a co-sponsor participates in the organization of the **10th European Simulation Multiconference** of SCS to be held in Budapest, Hungary June 2-6, 1996. Prof. A. Jávor, Chairman of HSS, is the General Conference Chairman. The Conferences within ESM'96 are the following: * Simulation Methodology and AI * Simulation in Economics * Simulation in Electronics and Telecommunications * Qualitative Information, Fuzzy Techniques, and Neural Networks in Simulation * Analytical and Numerical Modelling Techniques * Simulation of Multibody Systems * Modelling the Dynamics of Organizations and Information Systems * Mission Earth * Session for Students

Further information about the 1996 European Simulation Multiconference can be found on WWW under: http://hobbes.rug.ac.be/~scs. Participants from 44 countries from all continents of the globe have registered. The conference deals with the various topics in 65 sessions and a possibility for exhibiting and demonstrating simulation software is provided. A report will be published in the next issue of SNE.

### Contact Address

Prof. András Jávor, Ph.D., D.Sc.
Chairman of the Hungarian Simulation Society
KFKI Research Institute for Measurement and Computing Techniques
H-1525 Budapest, P.O.Box 49., Hungary
Tel: +36 1 1699499
Fax: +36 1 1601290
Email: javor@sunserv.kfki.hu
(member of the Editorial Board of SNE)

*A. Jávor*

# ISCS

### General Information

The Italian Society for Computer Simulation (ISCS) is a scientific nonprofit association of members from industry, university, education and several public and research institutions with common interest in all fields of computer simulation. Its primary purpose is to facilitate communication among those engaged in all aspects of simulation for scientific, technical or educational purposes.

The affairs of the ISCS are directed by a Steering Committee presently consisting of the following persons: Franco Maceri (chairman), Felice Cennamo (vice-chairman), Vincenzo Grassi (treasurer), Mario Savastano (secretary).

### Membership

At present ISCS counts 132 members: 6 institutional, 4 honorary, 120 regular and 2 affiliate.

Charges per annum are Lit. 30,000 for regular and affiliated members and Lit. 400,000 for institutional members.

### Contact Addresses

For further information or application for membership, please contact:

ISCS
c/o Dipartimento di Informatica, Sistemi e Produzione
Università di Roma "Tor Vergata"
Via della Ricerca Scientifica
I-00133, Roma, Italy
Tel: +39 6 7259.4477
Fax: +39 6 2020519
Email: grassi@info.utovrm.it

### Activities

The steering committee of ISCS is presently involved in the organization of **ISCS '96**, the annual conference of the ISCS that will take place in Rome, Italy, November 14-15, 1996.

Topics of interest for the conference are methodological and application aspects of simulation. Interested people should submit 4 copies of an extended abstract (max 2 A4 pages) of their paper by August 20, 1996, to the following address:

Segreteria ISCS '96
Dipartimento Di Ingegneria Civile
Università di Roma "Tor Vergata"
Via della Ricerca Scientifica
I-00133, Roma, Italy

Papers may be written in Italian, English or French. Notification of acceptance will be sent by September 20, 1996, and camera-ready copies (max 6 A4 pages) will be due on October 20, 1996. Accepted papers will be published in the conference proceedings, and a limited number of papers will be selected for publication in the journal "Simulation Practice and Theory".

For further information please contact prof. Vincenzo Grassi at the address above, or connect to: http://russell.ce.utovrm.it/~ISCS/

**Notice to ISCS members:**

The annual meeting of ISCS members is scheduled to be held in November 1996 in Rome, during the ISCS '96 Conference. On that occasion, we are planning to organize a meeting between members coming from academia and industry.

*Vincenzo Grassi*

# SIMS

**Information on SIMS**

The Scandinavian Simulation Society, SIMS, has at present nearly 300 members from Denmark, Finland, Norway and Sweden. For 35 years SIMS has served as the regional society in Scandinavia, gathering individuals and organisations involved in simulation. The activities have been concentrated on arranging annual meetings and courses, delivery of information letters, and co-operation at European and international level in the field of simulation.

SIMS will organize the congress EUROSIM'98.

**How to join SIMS**

Just send an informal application or recommendation for membership to the SIMS secretariat:

Eija Karita Puska
VTT Energy, Nuclear Energy, P.O.Box 1604
FIN-02044 VTT, Finland
Tel: +358-0-4565036, Fax: +358-0-4565000
Email: eija-karita.puska@vtt.fi
(member of the Editorial Board of SNE)

*E.K. Puska*

## AES

**Contact Address**

J.M. Giron-Sierra,
AES, Asociación Espanola de Simulación,
Avda. San Luis 146, E-28033 Madrid, Spain,
Tel: +34-1 394 43 87
Fax: +34-1-394 46 87
Email: gironsi@dia.ucm.es
(member of the Editorial Board of SNE)

## SLOSIM

The Slovenian Society for Simulation and Modelling has currently 84 members, both from Slovenian Universities and from industrial companies.

**Presentation of Simulation Groups**

On May 14 the society organized a regular simulation groups presentation meeting on the Faculty of Electrical Engineering and Computer Science in Maribor. The following groups prepared presentations: Group for Kinematics and robotics (Prof. P. Cafuta, Fac. of. El. Eng. and Comp. Sc.), Group for Process technology and optimization (Prof. Z. Kravanja, Fac. for Chemical Technology), Group for Transient responses in liquid and solid materials (Prof. L. Skrget - Fac. for Mech. Eng.), Group for Modelling of Electrical Machines and Drives (Prof. D. Dolinar, Fac. of. El. Eng. and Comp. Sc.), Group for Transient responses and control of electroenergetic systems (Prof. B. Grcar, Fac. of. El. Eng. and Comp. Sc.).

After the presentations some laboratories have been visited. Before the presentation the SLOSIM Board had a regular meeting. Some conclusions:

- From now on SLOSIM will order 74 copies of *Simulation News Europe* (SNE) and 10 copies of *Simulation Practice and Theory* (SIMPRA). SIMPRA will be distributed to more active and numerically superior groups.
- The modelling and simulation sessions of the Electrotechnical and Computer Science Conference (ERK 96) are being prepared. The best paper in these sessions will be selected and possibly awarded (there were several proposals, the possibility to recommend the paper for SIMPRA publication was also discussed).
- The next presentation (Group for Biokibernetics, Group for Robotics, Fac. of El. Eng., Ljubljana ) together with the annual assembly will take place in autumn (probably at the beginning of November).

**ERK 96** - Electrotechnical and Computer Science Conference, Sept. 19-21, Portoroz, Adriatic Coast, Slovenia: The Conference is traditional and will be held for the fifth time. Invited lectures, presentations and tutorials will be held in conjunction with the basic scientific program. The following areas will be represented at the conference: Electronics, Telecommunications, Automatic control, Simulation and modelling, Robotics, Computer and information science, Artificial intelligence, Pattern recognition, Biomedical Engineering, Power engineering, Measurements. Authors who wish to present a paper should sent three copies of the final camera ready paper to the chairman of the Program Committee Prof. Sasa Divjak till July 22, 1996.

Program Committee Chairman: Sasa Divjak, University of Ljubljana, Faculty of Comput. and. Inform. Science, Trzaska 25, SLO - 1000 Ljubljana, Slovenia, Tel: +386 61 1768 260, Fax: +386 61 1264 630, Email: sasa.divjak@fri.uni-lj.si

9th International Conference on **Mechanics in Medicine and Biology**, June 30- July 4, 1996, Ljubljana: There are app. 160 contributions (oral and poster) from many European countries, and overseas with the following sessions: Clinical biomechanics, Sports biomechanics, Rehabilitation, Functional electrical stimulation, Muscle mechanics, Bone structure, Electrochemotherapy & Pharmacokinetics, Blood flow, Simulation and modelling, Gait & Posture, Biorobotics, Cardiac mechanics, Bone implants & Biomaterials & Dental mechanics.

**Contact Address**

Zupancic Borut
Chairman
Faculty of Electrical Engineering
Trzaska 25
SLO - 1000 Ljubljana, Slovenia
Tel: +386 61 1768 306
Fax: +386 61 1264 631
Email: borut.zupancic@fe.uni-lj.si
slosim@fe.uni-lj.si
(member of the Editorial Board of SNE)

*B. Zupancic*

# UKSS

The Society is now preparing for its next national meeting scheduled for Easter of next year. If you are interested in finding more about the Society, the Membership Secretary is:

Mr Chris Bowyer
CAM UK, Beckett House,
4 Billing Road, Northampton, NN1 5AW
Tel +44-1604 259036/7/8,
Fax +44-1604 230086.

Alternatively contact the General Secretary:

Prof Russell Cheng
Email: R.C.H.Cheng@ukc.ac.uk
Fax: +44-1227 764000 ext3665
(member of the Editorial Board of SNE)

The updated details for the conference are set out below.

*R. Cheng*

**United Kingdom Simulation Society Conference UKSS 97**
**Keswick Country House Hotel, Lake District, England, 22-25th April 1997**
**Second Call for Papers**

Papers are invited on any aspect of simulation to be presented at a three day event to be held in the Lake District. The conference hotel has recently been fully refurbished and is in an area of outstanding natural beauty, set in its own very pleasant grounds. Access is easy via Manchester International Airport or London, and coach or rail to Keswick.

Abstracts(two pages of A4 without figures) are invited on any aspect of simulation and its applications. The following are suggested topics, but other topics are also welcome: Simulation methodology and practice, languages, tools and techniques. Models and modelling tools. Data/Object bases. Analysis and statistical tools. Simulators and simulation hardware, training simulators. Integration of simulation with concurrent engineering, integrated design and simulation systems. AI in simulation. Parallel and distributed simulation. Neural networks.

Simulation applications include: aerospace; electronic circuits and systems; computer networks; business; management; finance; economics; leisure; biology; medicine; public health; manufacturing; planning; control; robotics; measurement; monitoring; energy; safety critical systems; transportation; oil and gas; education and training; military.There will be an Exhibitions area.

Accepted papers will be published in the Proceedings of the Conference.

Although a national event, presenters and participants from any country are also welcome especially EUROSIM member countries.

The registration cost is 150 pounds sterling for members of EUROSIM Societies. This includes proceedings. Hotel Accommodation including all meals (including Conference Dinner) and refreshments tea/coffee is 70 pounds sterling per day for double occupancy or 85 pounds per day for single occupancy.

Abstracts/submissions/proposals to the Programme Chair or Conference Chair from whom further information is available.

Deadlines:
Abstract (four copies, 2 pages of A4): 1st Oct 1996.
Notice of Provisional acceptance; 16th Dec 1996.
Camera ready copy and registration fee; 3rd Feb 1997.

Programme Chair:
Paul Luker, School of Computing Sciences
De Montfort University
Leicester, LE1 9BH, UK.
Tel: +44 116 257 7488
Fax: +44 116 254 1891
Email: luker@dc-montfort.ac.uk

General Chair:
Graham Birtwhistle,
Div. of OR and Information Systems,
School of Computer Studies
The University
Leeds, LS2 9JT, UK.
Tel: +44 113 243 1751,
Email: graham@scs.leeds.ac.uk

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integrated systems

## CROSSIM

CROSSIM (The Croatian Society for Simulation Modelling) was founded in March 1992 in Zagreb. CROSSIM is a non-profit society with the following main goals: promotion of knowledge, methods and techniques of simulation; establishment of professional standards in simulation; development of education and training in simulation; organization of professional meetings and publishing in the field; cooperation with similar domestic and international institutions.

In June 1992 CROSSIM sent a letter of intention to EUROSIM with a request to become the full member of the EUROSIM federation, and in November 1993 another letter of intention to get the "Observer status" in the EUROSIM federation. The Society is also in the process to become the affiliation institution with The Society for Computer Simulation, USA.

### Membership

The annual membership fee is equivalent to 8 German marks for regular members, and 2 German marks for students.

CROSSIM currently has 49 individual members (including one member from each of the following countries: USA, United Kingdom and Hungary).

### Activities

- Co-organizing the 18th International Conference "**Information Technology Interfaces**" ITI '96, to be held in Pula, Croatia, from 18-21 June 1996. The conference has the strong modelling and simulation session and an international invited lecturer in the field of simulation (Prof. Robert Sargent, Syracuse University, USA).
- Co-organizing the **5th Operations Research Conference** in Croatia, to be held from 1-3 October 1996 in Rovinj, Croatia.
- Organizing a simulation seminar which is held at the Faculty of Economics, University of Zagreb.
- Work on several scientific projects in discrete and continuous simulation, and applications of simulation in such diverse fields as engineering, economy, medicine, ecology etc.
- Publication of papers in international and domestic journals and conference proceedings.

### Contact Address

Professor Vlatko Ceric
Faculty of Economics, University of Zagreb
Kennedyjev trg 6
HR - 41000 Zagreb, Croatia
Tel: +385 1 2331 111
Fax: +385 1 2335 633
Email: vceric@efzg.hr

*V. Ceric*

# European and International Societies

## SCS

This year marks the first year in the history of SCS in Europe that SCS organises four major events. Next to its successful ESM (which is this year in its 10th year) and the 7th ESS (which has been completely overhauled to reflect changes in the world of computer simulation, and now focuses more on the industrial simulation applications then on pure research), SCS now also organises a yearly event called Concurrent Engineering Europe or CEE and a new event called EUROMEDIA.

This year's ESM, held at the Budapest University of Economic Sciences from June 2-6, is one of the biggest yet with some 200 presentations and 5 tutorials covering Methodology, Economics, Training, Education, Analytical Methods, Qualitative Simulation, Multibody Systems, Simulation Dynamics in Organisations, Mission Earth and a session for students.

The ESS, set for take off in its new guise, the 26th of October at the Sheraton Congress Centre in Genoa promises to feature the most industrial simulation based event ever in Europe. The line-up from companies is very impressive and the exhibition will thus also be the key feature of this event. Papers are still coming in and we expect to equalize the numbers we had in presentations for the ESM.

EUROMEDIA will be held the first week of December at the Scandic Crown Hotel in London. This event will cover the new and exciting field of new media applications and research. The keynote speaker for this

event is Patti Maes of MIT, who will give a presentation on Intelligent Agents.

CEE (centered around Concurrent Engineering and Simulation) will be repeated next year at its location in Cambridge. It will be upgraded from a double topic event to a four topic event. All, however, linked to the field of concurrent engineering and electronics.

Further details and more in-depth information can be found on the SCS websites: for Europe: http://hobbes.rug.ac.be/~scs/ and on http://www.scs.org/ (for the events and news of our American cousins).

1996 also marked the beginning of the activities of the SCS European publishing house. This initiative taken by Rainer Rimane of the University of Erlangen, gives researchers and PhD students the opportunities to publish their work or for companies to publish a high-quality software manual under the wing of SCS. So far some 6 books have been published and a further 3 are in the pipeline.

**Contact Address**

Philippe Geril,
SCS Europe European Simulation Office
University of Ghent
Coupure Links 653
B-9000 Ghent, Belgium
Tel: +32.9.233.77.90
Fax: +32.9.223.49.41
Email: Philippe.Geril@rug.ac.be
URL: http://hobbes.rug.ac.be/~scs

private Tel/fax: +32.59.800.804
private URL: http://hobbes.rug.ac.be/~phil

*Philippe Geril*

## LSS

The Latvian Simulation Society

**Contact Address**

Dr. Yuri Merkuryev
Department of Modelling and Simulation
Riga Technical University
1, Kalku Street
LV-1658 Riga, Latvia
Tel. +371-7-324480
Fax +371-7820094
Email: merkur@itl.rtu.lv

## IMACS

2nd MATHMOD VIENNA

IMACS

### February 5–7, 1997
### Technical University Vienna, Austria

**Scope:** All aspects of mathematical modelling of all types of systems are discussed, i.e. of systems which are * dynamic or static * deterministic or stochastic * continuous or discrete * lumped parameter or distributed parameter * linear or nonlinear * or of any other nature. Consequently, a wide variety of formal models will be discussed and the term "mathematical model" will include classical models such as differential or difference equations, Markov processes, ARMA models as well as more recent approaches such as Bond graphs or Petri nets, etc.

**Organizer:** Division for Mathematics of Control and Simulation at Technical University Vienna

**Sponsors:** IMACS (Int. Ass. for Maths. & Comp. in Simulation), Division for Mathematics of Control and Simulation at Technical University Vienna and Technical University Vienna.

**NOC:** F. Breitenecker, I. Troch, F. Urbanek

All accepted papers will be published in a Proceedings Volume. The Proceedings (published in the series ARGESIM-Reports, ISBN 3-901608-11-7) will be available at the registration desk. Furthermore, any paper submitted is automatically considered for publication in a special issue of the IMACS journal MCS (Mathematics and Computers in Simulation).

New results can be displayed during a Poster Session. Deadline for poster abstracts is Oct. 1, 1996. Book exhibition and Software Presentation will be provided.

Social Program / Program for Accompanying persons: Get-Together Party, Concert, Heurigen evening, sightseeing tour (only acc. persons).

Conference fees in ATS (payment before and after November 15, 1996): members of IMACS or any cosponsoring society 3500 ATS (3900 ATS), non-members 3900 ATS (4300 ATS), students (without lecture) 500 ATS (700 ATS), accompanying persons 1000 ATS (1200 ATS).

All correspondence should be addressed to:

Univ. Prof. Dr. Inge Troch
Technische Universitaet Wien (E114/5)
Wiedner Hauptstrasse 8-10
A-1040 Wien
Email: itroch@email.tuwien.ac.at

## Advanced Aircraft/Missile Simulation

**1. Introduction:** Rapid Data Ltd and Kingston University are developing in a joint effort a computer aided advanced aircraft/missile analysis and design facility based on industry standard ACSL. The developed computer model encompasses modern control and analysis tools and new design concepts for aircraft in-flight control and ground handling systems rapid prototyping.

The software package will include the following modules: a state space aircraft/missile in flight module, a non linear aircraft/missile in flight module, a non linear aircraft ground handling module. The package will offer the user the ability to generate the aircraft/missile configuration, build the environment it is flying in and develop his own databases. The package will also include sample aerodynamic databases of different aircraft/missiles.

**2. Background:** The aerospace industry has a number of business pressures, such as longer service life-time, increased performance requirements, retrofitting current systems and safety. Aircraft need to be designed to be strong enough to withstand the predicted load, however, oversizing of structures, and overexpenditure on the design phase and testing will impact adversely on costs and competitiveness. Normally, predicted loads are based on static calculations and laboratory tests. A holistic analysis facility would be a better approach to determining how the aircraft systems and sub-systems interact collectively to give the desired performance. A thorough understanding of the systems and sub-systems dynamic interaction will allow the designer to make informed decisions on improvements without generating undesirable effects of the system performance as a whole.

The National Strategic Plan for Aeronautics (NSTAP) reports that past improvements in this area have generally been dealt with on a piecemeal basis with individual companies sponsoring research into their practical product line [1]. Communication between companies in the field is poor especially when competitiveness is high and standardisation of design procedures is lacking. The document identifies total system integration, modelling, design and manufacture of hybrid systems as a category one priority, category one being those technologies without which the future of the aerospace industry in UK could be in doubt.

The Defence and Aerospace Foresight Document [2] recommends a holistic engineering systems approach to understanding the design requirements and the means to satisfy them. The aim is to understand the performance of the interactive parts of the structure in an unambiguous way and foresee design future improvements to satisfy customer needs.

**3. Innovation Through Simulation:** The Foresight document claims that the reduction in defence budgets has increased the sensitivity of major decisions in the aerospace industry. Both the Foresight and NSTAP documents recommend that improved modelling and simulation of physical and manufacturing systems will reduce development time, costs and risk.

**4. Current State of the Art**: The Aircraft Simulation Research Centre of Kingston University has developed a systems integration design facility for simulating aircraft in-flight and ground contact performance using a total and systems interactive holistic modelling approach. Short cuts were avoided and the software model represents the dynamic behaviour of the aircraft throughout the envelope of operation from brakes-off to take-off, landing and parking. The dynamic linking of all system component parts of the aircraft allows the manufacturer to investigate the effects of design changes on the sub-systems and the system as a whole in terms of customer requirements, performance, cost, ease of manufacture and safety. Such a design and evaluation facility is particularly useful in the aerospace industry where it is often not possible for reasons of safety and cost to evaluate the full effect of system changes and malfunctions during dangerous manoeuvres. The aim of the joint effort between the University and Rapid Data Ltd is commercialisation of the above product.

**5. Market Need:** The aerospace market predicts faster aircraft, faster landing speeds and take-offs, heavier payloads and shorter stopping distances under all types of runway and landing conditions. From a safety point of view a scrubbing tyre in an undeflected skin can, in seconds, burn through its plies and blow out. In an even shorter time, the tyre can "flat spot" and have to be removed and scrapped. More effective braking systems create more strut fore-and-aft loading and the possibility of gear collapse.

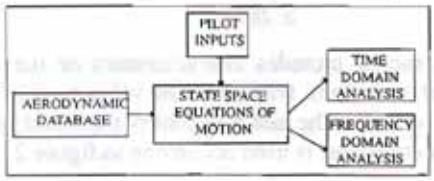
The tendency in industry has been to simulate too much of what is understood and brush over the model elements that are ill-defined such as the behaviour of the aircraft and landing gears during the transition of "soft" aerodynamics to the "hard" on the wheels dynamics.

**6. About the Software Product**: The Advanced Aircraft Simulation software package provides a "whole system" modelling facility that will allow air-

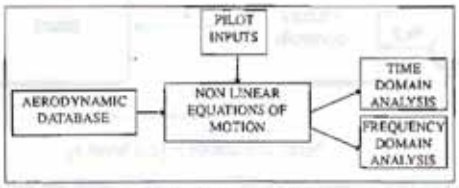
craft systems and sub-systems to be collectively linked, analysed and improved throughout the product life cycle, from the preliminary design stage, through certification and further enhancements. The aim of the computer package is to provide a generic and holistic real-time model to accurately replicate the aircraft response from brakes-off to taxi, take-off, landing and parking. The work will in particular provide solutions to problems associated with accurate landing approach and ground handling simulation.

**7. Timelines and Novelty:** The approach is to avoid short cuts and simulate the dynamics of the aircraft body and landing gears in terms of first principles of physics. A method of defining the aerodynamic forces of the aircraft in-flight in terms of aircraft characteristics and environmental conditions, using aerodynamics data curves is derived. Currently tyre and strut are over simplified and static relationships or look up tables are used to describe the dynamics of the landing gears. The tyres will be modelled in terms of their physical characteristics and coupling, centrifugal effects, tyre radius growth etc. will be accurately simulated. The struts will also be modelled in the same manner. Chamber pressures and areas, orifice areas, metering pins, flapper valves, etc. will feature the dynamic response of the struts. The model will be detailed and provide considerable enhancements, increase design efficiency and meet customer needs at low cost. The modelling methods used will allow the manufacturers to predict minimum model complexity that meets the customer requirements [3].

**8. The Aircraft/Missile State Space Module**:The State Space Module will be used for the linear analysis of the aerodynamic response of aircraft and missile for the development of auto pilots, auto stabilisation systems, etc.

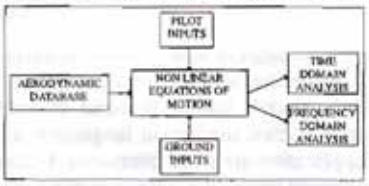



The State Space module



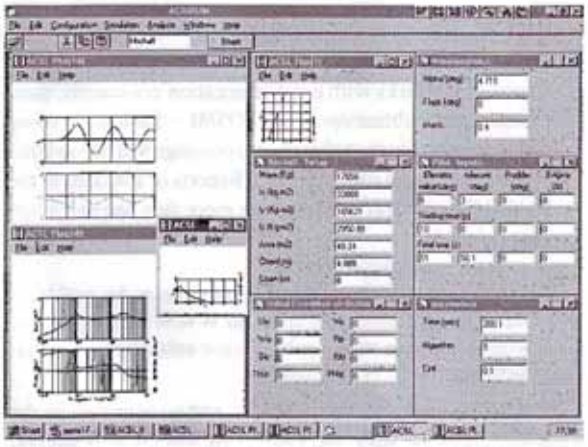

Non linear module

**9. The Aircraft/Missile Non-Linear Module:** The non linear in flight module will provide an accurate representation of the aircraft/missile dynamics to control and environment inputs. The module can be used for the development of high fidelity flight simulator trainers.




Ground handling module

**10. The Ground Handling Module:** The third module will simulate the aircraft response to take off, landing, steering, braking and taxiing. Aircraft tyre deformities and characteristics, and strut dynamics will be taken into account during landing and taxiing. Therefore, the user will be able to analyse for example the tyre compression during landing, aircraft velocities, etc.



The Windows interface

An easy-to-use Windows interface is generated to run these modules. From this interface the user will enter all the characteristics of his aircraft/missile (configuration, environment, initial attitude, etc.) and the control inputs. A choice of integration algorithms will be available to run his simulation with full control of the integration parameters.

**References**

[1] National Strategic Technology Plan for Aeronautics. DTI Aviation Committee 1992, UK.

[2] DTI Technology Foresight Document, UK.

[3] G. Kapadoukas, Taxonomy of Aircraft Modal Behaviour During Landing: A Brief Report. Article in Simulation for Understanding, October 1995 ,v65 No4, pp242-251, ISBN 0037-5497/93, USA.

*Georgios G. Kapadoukas, Aircraft Simulation Research Centre, Kingston University, Roehampton Vale Centre, London SW15 3DW, UK, Email: G.Kapadoukas@kingston.ac.uk; Frederique Marteau, Ali Goucem, Rapid Data Ltd, Crescent House, Crescent Rd, Worthing BN11 5RW, UK, Email: marteau @radata.demon.co.uk*

# Comparison of Simulation Software

*EUROSIM - Simulation News Europe* features a series on comparisons of simulation software. Based on simple, easily comprehensible models special features of modelling and experimentation within simulation languages, also with respect to an application area, are compared. Features are, for instance: modelling technique, event handling, numerical integration, steady-state calculation, distribution fitting, parameter sweep, output analysis, animation, complex logic strategies, submodels, macros, statistical features etc.

This issue introduces a new comparison C9, see definition and sample solution below. We invite all readers to participate in these comparisons. Please, simulate the model(s) with a tool of your choice and send a report to the editors in the following form (on diskette, any word processing format, or per email or transfer to our ftp-server):

- short description of the language,
- model description (part of source code, diagram, ...),
- results of the tasks with experimentation comments, max. 1 page. (For publication in *EUROSIM - Simulation News Europe* all contributions that exceed one page will be modified by the editors to fit into one page.) Reports of solutions of the Parallel Comparison should not be more than one and a half page in length.

We offer to place the full model (source code, graphics, etc.) and additional information on our WWW server. We also invite you to prepare animations. Please send files and additional information in HTML-format.

The definitions of all comparisons, and an overview on the solutions sent in may be found on our WWW-server: **http://argesim.tuwien.ac.at/comparisons/**

| SNE | Comparison | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | CP 1 | C8 | C9 |
| 0 | Def | | | | | | | | | |
| 1 | 5 | Def | | | | | | | | |
| 2 | 4 | 4 | Def | | | | | | | |
| 3 | 4 | 3 | 3 | Def | | | | | | |
| 4 | 1 | 5 | 5 | 2 | Def | | | | | |
| 5 | 4 | - | 1 | 1 | 2 | | | | | |
| 6 | - | 2 | - | 2 | 1 | Def | | | | |
| 7 | 1 | 2 | 1 | 2 | - | 1 | Def | | | |
| 8 | - | 1 | - | - | - | 1 | 3 | | | |
| 9 | - | - | - | - | - | 2 | 3 | | | |
| 10 | 1 | 2 | - | - | - | 1 | 2 | Def/1 | | |
| 11 | 2 | 2 | 1 | - | 1 | - | - | 2 | | |
| 12 | 1 | - | 1 | - | - | - | 2 | 3 | | |
| 13 | - | - | - | - | - | | 3 | 1 | | |
| 14 | 3 | - | 1 | - | - | - | 2 | - | | |
| 15 | - | - | 1 | - | 1 | - | - | - | | |
| 16 | 1 | - | - | - | - | - | 1 | - | Def/1 | |
| 17 | - | - | 1 | - | 1 | - | 1 | 1 | 1 | Def/1 |
| Σ | 27 | 21 | 15 | 7 | 6 | 5 | 17 | 8 | 2 | 1 |

## Comparison 9: Fuzzy Control of a Two Tank System

The number of applications containing fuzzy components is still increasing. Modern simulation systems provide enhancements to implement fuzzy components in a convenient way.

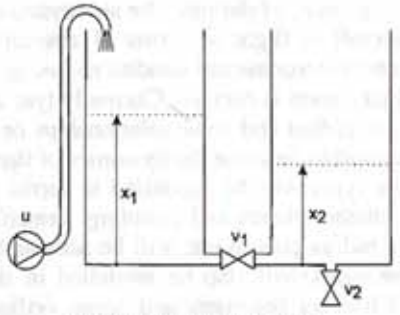



Figure 1: The two tank system

A two tank system (see figure 1) in a specific configuration is characterized by the following nonlinear ODE set

$$f = 0.06624\, v_1 \sqrt{|x_1 - x_2|}\, \mathrm{sign}(x_1 - x_2)$$

$$\dot{x}_1 = 0.067\, u - f$$

$$\dot{x}_2 = f - 0.0605\, r\, v_2 |x_2|^{0.43}$$

where

$$r = \begin{cases} 1.2 : x_2 < 16\ \mathrm{cm} \\ 1 \ : x_2 \geq 16\ \mathrm{cm} \end{cases}$$

This model includes characteristics of the liquid (laminar, turbulent, friction). The valve positions are $v_1 = 0.4$, $v_2 = 0.3$. The task is to control the liquid level $x_2$. A fuzzy controller is used according to figure 2.

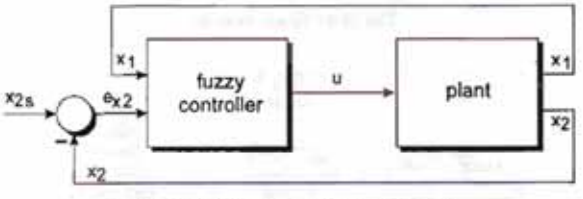



Figure 2: Fuzzy control of liquid level $x_2$

Two fuzzy controllers FC1 and FC2 will be defined. They should be implemented as discrete systems operating using 1 second sampling time. The membership functions for $e_{x2}$ and $x_1$ are defined in figure 3. They are the same in the case of FC1 and FC2.

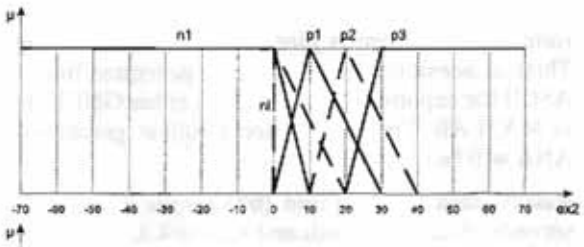



Figure 3: Membership functions of $e_{x2}$ and $x_1$ for FC1 and FC2

The membership functions for the linguistic output variable $u$ in the case of FC1 are defined in figure 4 and in the case of FC2 singletons are used as shown in figure 5.

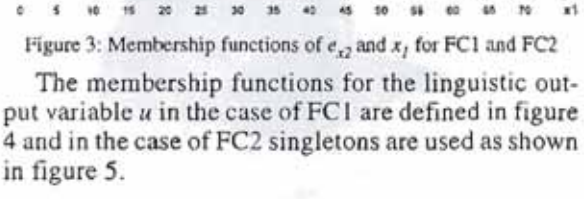



Figure 4: Membership functions of $u$ for FC1

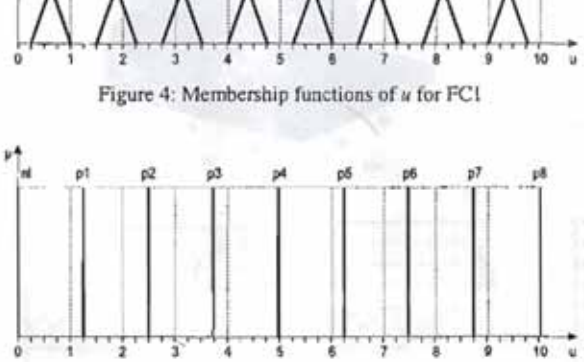



Figure 5: Membership functions of $u$ for FC2

The rulebase (figure 6) should be implemented using the operators *MIN* for AND and *MAX* for OR. For the interference algorithm use *max-prod* and for defuzzyfication *center of gravity*.

| | | $x_1$ | | | | |
|---|---|---|---|---|---|---|
| | | nl | p1 | p2 | p3 | p4 |
| | p3 | p8 | p7 | p5 | p3 | nl |
| | p2 | p7 | p6 | p4 | p3 | nl |
| $ex_2$ | p1 | p7 | p5 | p3 | p2 | nl |
| | nl | p4 | p3 | p2 | p1 | nl |
| | n1 | nl | nl | nl | nl | nl |

Figure 6: Table of rules

The tasks to be performed are:

**Task a**

- (a1) Describe the features supporting fuz in your simulator or the interface to an fuzzy tool. Model the controller by means of the simulator or an appropriate addi linked to the simulator. Give a rough model of the controller and of the overall model.
- (a2) Compute and visualize the 3 dimens acteristic (surface) of the fuzzy controller $e_{x2}$ [-70 .. 70] on the x-axis, $x_1$ [0 .. 70] on and $u$ on the z-axis. Subdivide the x and times (41 times 41 points). State the calcu $ta_{fc1}$. Specify the machine used. Since the tion of fuzzy systems is a complex task, t tion time for 1681 lookups documents mance of the implementation.
- (a3) Repeat (a2) using FC2. If your syste support singletons directly, you may use *emulation*. State the calculation time $ta_{fc}$ cify the ratio $ta_{fc1}$ over $ta_{fc2}$.

**Task b**

- (b1) Simulate the whole system using $x_{2s} = 25$ cm for 1000 seconds. Plot $x_2, x_1$ a time. State the computation time over $tb_{fc}$
- (b2) Repeat (b1) using FC2. State the time $tb_{fc2}$ and specify the ratio $tb_{fc1}$ over

**Task c**

- (c1) FC3 is defined using FAM interfere obtained by weighting the rules of FC2 ac the following table

| | | $x_1$ | | | | |
|---|---|---|---|---|---|---|
| | | nl | p1 | p2 | p3 | p4 |
| | p3 | 1 | 1 | 0.1 | 1 | 1 |
| | p2 | 1 | 1 | 0.1 | 1 | 1 |
| $ex_2$ | p1 | 1 | 1 | 0.1 | 1 | 1 |
| | nl | 1 | 1 | 0.1 | 1 | 1 |
| | n1 | 1 | 1 | 0.1 | 1 | 1 |

Figure 7: Table of weightings

Repeat (a2) using FC3. State the calcul $tc_{fc3}$ only (no surface plot). Describe how can be implemented into your fuzzy desc

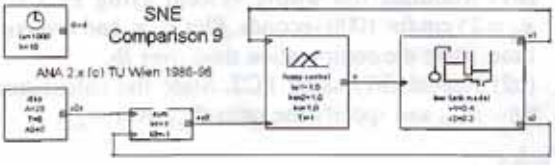
- (c2) Describe the outstanding features of lation system regarding to fuzzy modelli

*Johannes W. Goldynia, Johann M. Marin*
*goldynia@iert.tuwien.ac.at, marinits@iert.tu*
*Vienna University of Technology, Institute for Control Engineering, Gusshausstr. 27-29/37 Vienna/Austria*

## Comparison 9 - ANA 2.x

**Short description:** *ANA 2.x* is a comprehensive software tool for all control engineering tasks. A short description of *ANA 2.x* has been already given in [Goldynia96]. All tasks of this comparison were done using the interpreting *ANAmdl* compiler without the need of any additional computer language. The time for compiling the model is less than 4 seconds. Therefore a turn around is extraordinarily fast.

**Model description:** *ANA 2.x* offers seamless integration of a development environment for fuzzy control named *ANAfuzzy 2.5*. The user interface is intuitive and simple but yet very powerful. *ANAfuzzy 2.5* comprises graphical editing of membership functions, specification of rules using a flexible syntax, several selectable methods for operator and defuzzyfication semantics, generation of surface plots and automatic creation of interface blocks to the fuzzy subsystem to become part of a block circuit diagram generated by *ANA 2.x*. The plant is specified using *ANAmdl*.




ANA 2.x circuit within the environment

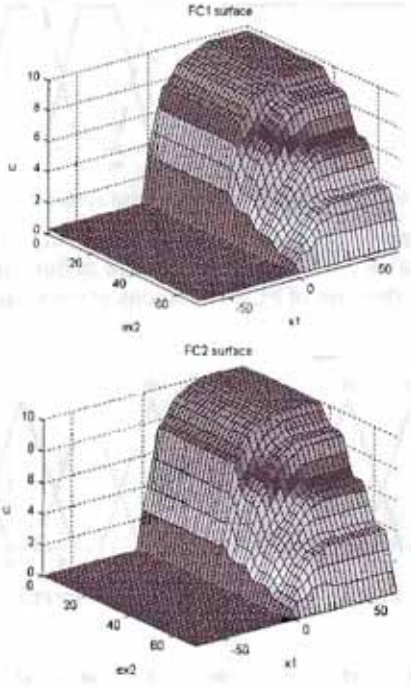
**Results task a):** **(a1)** Representation: Beside the graphical definition of the membership functions, the rules are written within a fuzzy rule editor, which is part of *ANAfuzzy 2.5*. Syntax checks and checks for valid identifiers are done automatically. The common rule base for FC1 and FC2 reads:

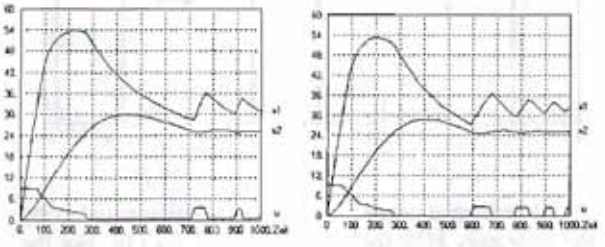
```
# rules 1-5
IF (ex2==p3) AND (x1==n1) THEN u=p8;
IF (ex2==p3) AND (x1==p1) THEN u=p7;
IF (ex2==p3) AND (x1==p2) THEN u=p5;
IF (ex2==p3) AND (x1==p3) THEN u=p3;
IF (ex2==p3) AND (x1==p4) THEN u=n1;
# rules 6-10
IF (ex2==p2) AND (x1==n1) THEN u=p7;
IF (ex2==p2) AND (x1==p1) THEN u=p6;
IF (ex2==p2) AND (x1==p2) THEN u=p4;
IF (ex2==p2) AND (x1==p3) THEN u=p3;
IF (ex2==p2) AND (x1==p4) THEN u=n1;
...
# rules 21-25
IF (ex2==n1) AND (x1==n1) THEN u=n1;
IF (ex2==n1) AND (x1==p1) THEN u=n1;
IF (ex2==n1) AND (x1==p2) THEN u=n1;
IF (ex2==n1) AND (x1==p3) THEN u=n1;
IF (ex2==n1) AND (x1==p4) THEN u=n1;
```

The setup of the fuzzy operators and methods has been set globally via a dialog window.

**(a2 and a3)** Visualization of FC1 and FC2: All computations were done using *ANA 2.5* on a PC with 80486 100 MHz CPU. $ta_{fc1}$ = 39 seconds, $ta_{fc2}$ = 4.5 seconds, *ratio* = 8.67. There is direct support for singletons. Three dimensional surfaces can be generated from an ASCII file exported from ANA with either GNUPLOT or MATLAB. Three dimensional built in graphics for ANA will be available soon.

**Results task b):** **(b1) and (b2)** results in $tb_{fc1}$ = 24 seconds, $tb_{fc2}$ = 5 seconds and *ratio* = 4.8.



Simulation of whole system using FC1 — Simulation of whole system using FC2

**Results task c):** **(c1)** FAM interference: Weighted rules can be defined using the `WITH` clause e.g. `IF (ex2==p3) AND (x1==p2) THEN u=p5 WITH 0.1;` The computation time $tc_{fc3}$ = 4.5 seconds.
**(c2)** Outstanding features: No more than shown above.

References: [Goldynia96], SNE 16, 1996, p. 35
The ANA 2.x system is free of charge (ftp://ftp.iert.tuwien.ac.at/ana2). Information: http://www.iert.tuwien.ac.at/ana2.

*Johannes W. Goldynia, Institute for Electrical Control Engineering, Vienna University of Technology, Gusshausstr. 27-29/375, A-1040 Vienna, Tel. +43-1-58801 5220, Fax +43-1-5058907, Email: goldynia@iert.tuwien.ac.at*

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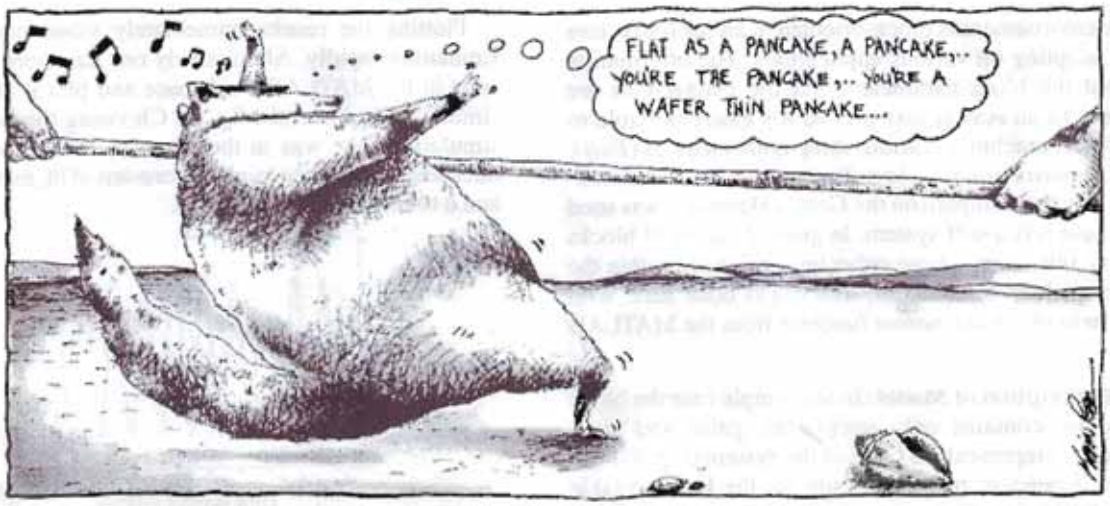


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## Comparison 3 - SIMULINK

SIMULINK is a dynamic system simulation tool built on top of the MATLAB software which runs on PCs as well as on Workstations and Supercomputers. The environment is block-oriented in an open structure for adapting on various applications. The information about the block-parameters and the connections are stored in an ASCII text file, so it's easily portable to different machines. Various integration methods *(Euler, RK34, Gear, Adams,...)* can be chosen for solving models. For this comparison the *Gear's* algorithm was used because it is a stiff system. In general values of blocks (gain, init. state, ...) can either be set directly within the graphical environment or, like it was done here, with the help of the *set_param* function from the MATLAB command window.

**Description of Model**: In this simple case the block diagram contains only integrators, gains and sum-blocks to represent the ODE of the system (Fig. 1). The time dependent resistor is built by the look up table block R(t).

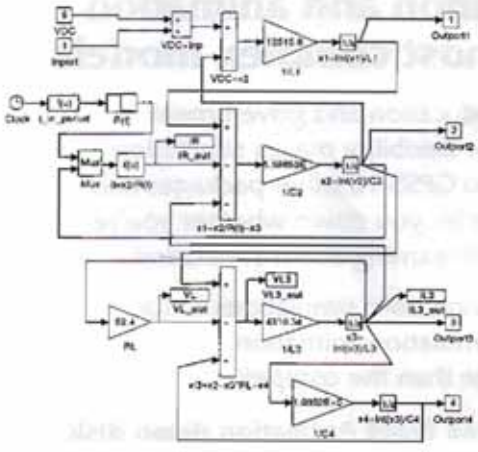

Fig. 1: Block diagram of the system

**Results**: All calculations were carried out on an Intel based PC, 66 MHz, 16 Mb RAM under MS-Windows 3.11.

(a) Because there is no special function in SIMULINK for eigenvalue calculations the system was linearized at two specific operating points for which R(t) is $R_{ON}$ and $R_{OFF}$ respectively by setting the time to certain values. Using MATLAB's built-in function *eig(A)* the eigenvalues of the system matrix *A* could then be calculated.

| Eigenvalues for $R_{ON}$ | Eigenvalues for $R_{OFF}$ |
|---|---|
| -1.1173e+009 | -5.4708e+004+1.0408e+006i |
| -6.2578e+002 | -5.4708e+004-1.0408e+006i |
| -1.1304e+005-6.5835e+005i | -5.8228e+004+5.3275e+005i |
| -1.1304e+005+6.5835e+005i | -5.8228e+004-5.3275e+005i |

(b) Instead of starting the simulation from *Simulation-menu* one can also call the SIMULINK system within the MATLAB command window (or by running a command file). Choosing the *Accelerator option* (uses a C-Compiler to build so called *mex-files*) simulation time can be decreased.

Plotting the results immediately slows down the simulation rapidly. Alternatively one can store the results in the MATLAB workspace and plot it after the simulation is done (see fig. 2). Choosing this way the simulation time was in the range of 8s (14s without *Accelerator*) with the minimal timestep of dt_min=1e-16 and a relative error of tol=1e-9.

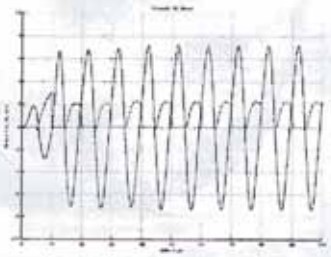

Fig. 2: Time domain solution

(c) As there is no feature within SIMULINK to perform parameter variation studies the parameters TRF and the final states from task (b) were set from the MATLAB command window. The four simulations were executed separately. The results for all different values of TRF can be distinguished lightly in fig. 3 and fig. 4 respectively.

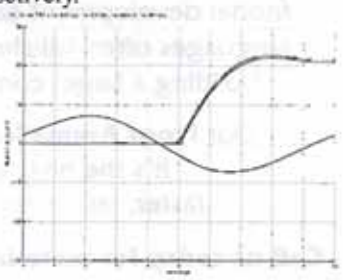

Fig. 3: Parametric analysis: time curves

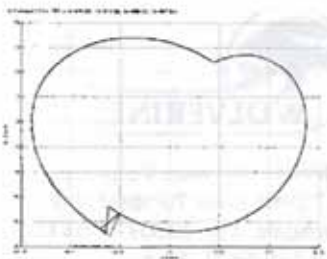

Fig. 4: Parametric analysis: phase plain curves

*Michael Steurer, Institute for Switchgear and High Voltage Technology, TU Vienna, A-1040 Vienna, Gußhausstr. 25/374, Tel.: +43-1-505 03 35 /-13, Fax.: +43-1-504 11 03, Email: st@sht.tuwien.ac.at*

# Comparison 5 - ANA 2.x

**Short description:** *ANA 2.x* is a comprehensive software tool for all control engineering tasks. A short description of *ANA 2.x* has been already given in [Goldynia96]. All tasks of this comparison were done using the interpreting *ANAmdl* compiler without the need of any additional computer language. The time for compiling the model is less than 0.1 seconds. Therefore a turn around is extraordinarily fast.

**Model description:**

```
FROM 'Eurosim' BLOCK COMP5;
PARAMETER   te = 5+0.01; "[s] Simulationsdauer";
STATE  Y1 "[1] state 1"; Y2 "[1] state 2";
VAR    c1 DISCRETE; c2 DISCRETE;
       c3 DISCRETE; c4 DISCRETE; state DISCRETE;
SIM
   SWITCH state
   CASE 1:  ONRISE Y1 >= 5.8 DO SetState2;
   CASE 2:  ONRISE Y1 <= 2.5 DO SetState1;
   ENDSWITCH
   Y1 .= c1*(Y2 + c2 - Y1);  Y2 .= c3*(c4 - Y2);
ENDSIM
PROCEDURE SetState2;
   c2 = -0.3; c4 = 2.73; state = 2; STORE;
ENDPROCEDURE
PROCEDURE SetState1;
   c2 = 0.4; c4 = 5.5; state = 1; STORE;
ENDPROCEDURE
PROCEDURE RecordFinal; STORE; ENDPROCEDURE
PROCEDURE terminate; QUIT; ENDPROCEDURE
INIT
   c1 = 2.7e6; c3 = 3.5651205; c2 = 0.4;
   c4 = 5.5; state = 1; Y1 = 4.2; Y2 = 0.3;
   SCHEDULE RecordFinal AT 5;
   SCHEDULE terminate AT te;
ENDINIT
ENDBLOCK COMP5;
CIRCUIT GedGen; # comp5.ana
   FROM "Eurosim" USE comp5 AS B_1 ENDUSE;
   SAVE  B_1.Y1 B_1.Y2 B_1.state;
ENDCIRCUIT GedGen; # comp5.ana
```

This listing shows a stripped version of the model input data. The example consists of a custom defined block `comp5`. The two states of the model are distinguished by the `DISCRETE` variable state. The `SIM - ENDSIM` section holds the nonlinear state space equations and is subdivided using a `SWITCH` statement. The state switching is driven by `ONRISE` conditions, which are used to change to another state by calling a `PROCEDURE` in the case the watched condition turns from false to true. Exact recording of events is possible due to the `STORE ALL` statement. The bisection method is used to calculate the state events at the selected precision. *ANA 2.x* uses double precision numbers (64 bit). *ANA 2.11* and higher offers the *DASSL* integration algorithm. This provides the possibility to master implicit ODE systems and can be used successfully to solve stiff ODE systems.

**Results task a):** The setup parameter for the DASSL integration method have been relative error 1e-14, absolute precision 1e-40 and event precision 5e-15. With the Windows NT version of *ANA 2.11* the calculation time was about 8.9 seconds on a 66 MHz 80486 and the equations of the `SIM - ENDSIM` section where evaluated 130012 times. This is enormously fast. The setup is identical to that used for task c.

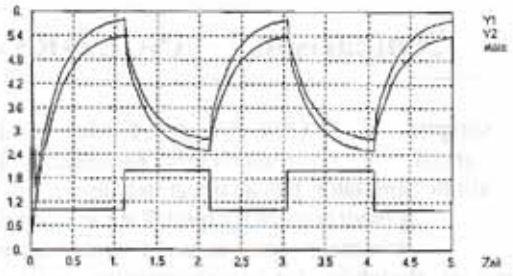


Figure 1: Simulation showing `Y1`, `Y2` and `state` for task a

**Results task b and c):** The column named `Correct Answer` is cited from [Waardenburg92]. Parts of the numerical solutions not identical to the correct answer are crossed out. Note that the switching points are found with the maximum precision possible using double precision arithmetic and `Y1(5)` matches the exact result within a precision of 6 digits. Beside of the varying relative local error the absolute precision was set to 1e-40, the event precision to 5e-15 seconds.

| | Correct Answer | Error 1e-6 | Error 1e-10 | Error 1e-14 |
|---|---|---|---|---|
| #1 | 1.10830616777 | 1.10833662925 | 1.10830617486 | 1.10830616777 |
| #2 | 2.12968535515 | 2.12973205984 | 2.12968536774 | 2.12968535515 |
| #3 | 3.05415290700 | 3.05421372230 | 3.05415293336 | 3.05415290700 |
| #4 | 4.07553209438 | 4.07559985062 | 4.07553211029 | 4.07553209438 |
| #5 | 4.99999964622 | 5.00007491064 | 4.99999965866 | 4.99999964622 |
| Y1(5.000000000000) | | | | |
| | 5.369312123 | 5.799974110783 | 5.369136280083 | 5.369316361230 |
| Time (seconds) | | 1.4 | 2.4 | 8.9 |
| SIM ENDSIM calls | | 22855 | 37305 | 130012 |

**Results task d):** This task was done using the corrected value of `c2` [Houbak92]. The calculation time was 31.2 seconds. The equations have been evaluated 489849 times.

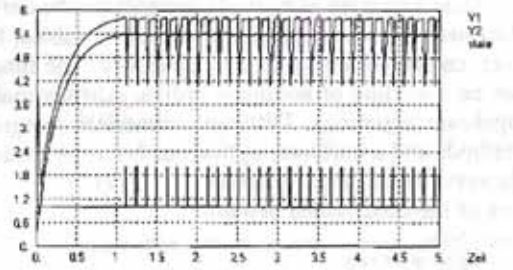


Figure 2: Simulation showing `Y1`, `Y2` and `state` for task d

```
#1  1.10830616777 #2  1.12172996789 #3  1.23546396575
#4  1.24888776587 #5  1.36262176372  ...
#58 4.68214831127 #59 4.79588230912 #60 4.80930610924
#61 4.92304010710 #62 4.93646390722
Y1(5.00000000000000)     5.78040251353
```


References:
[Goldynia96] Comparison 7 - ANA 2.x, SNE 16, 1996, p. 35
[Waardenburg92] Comparison 5 - STEM, SNE 5, July 1992, p. 39
[Houbak92] Comparison 5 - SIL, SNE 5, 1992, p. 38p

The ANA 2.x system is free of charge (ftp://ftp.iert.tuwien.ac.at/ana2). Information: http://www.iert.tuwien.ac.at/ana2.


*Johannes W. Goldynia, Institute for Electrical Control Engineering, Vienna University of Technology, Gusshausstr. 27-29/375, A-1040 Vienna, Tel. +43-1-58801 5220, Fax +43-1-5058907, email: goldynia@iert.tuwien.ac.at*

## Comparison 7 - ASCET-RS

**Description of ASCET-RS:** ASCET-RS stands for Advanced Simulation and Control Engineering Tool - Realtime Simulator. It is an integrated design and rapid prototyping environment for modelling and simulating of linear, nonlinear, continuous, discrete and mixed systems. Portability for on-site operation, and realtime capability for time-critical events help to optimize the entire development process. Along with block- and equation-oriented modelling and simulation capabilities, ASCET-RS offers easy-to-use measurement data acquisition and evaluation, as well as documentation routines and various design procedures.

ASCET-RS is an open system as it allows data input and output from and to other systems, user inputs during simulation (system modifications and parameter variations) and hardware-in-the-loop applications. Special features are user-defined functions, parameter optimization and system identification under realtime conditions as well as state machine description. Work in the graphical user interface is carried out on a PC, the simulation itself is run on a scaleable multi-transputer system.

**Model description:** The ASCET-RS block editor is used to define inputs and outputs of individual blocks, as well as their functions. The functional description of an ASCET-RS block is based on a high level language with special syntax elements for simulation. Variables and state variables as well as constants can be defined. Parameters and characteristic curves or tables, however, can be edited as list or graphically. The function can be a mixture of nonlinear ordinary differential and algebraic equations. Different numerical integration methods and a mulitrate option can be set individually for every block. Figure 1 shows the functional description of the constrained pendulum.

```
CONDITION: (phi < phi_p) - Short Pendulum
  OutputEquations:
    if (last_state = 2) then
      phi_dot:= phi_dot*l/ls;
      call start(Integrator);
    endif;
    out1     := phi;
    out2     := phi_dot;
  StateEquations:
    phi'     := phi_dot;
    phi_dot' := -phi_dot*d/m-sin(phi)*g/ls;
    last_state := 1;
OTHERWISE:                  - Long Pendulum
  OutputEquations:
    if (last_state = 1) then
      phi_dot:= phi_dot*ls/l;
      call start(Integrator);
    endif;
    out1     := phi ;
    out2     := phi_dot;
  StateEquations:
    phi'     := phi_dot ;
    phi_dot' := -phi_dot*d/m-sin(phi)*g/l;
    last_state := 2;
```

Figure 1: ASCET-RS block description language

**Results:** Results can be displayed during simulation using different data displays or a convenient multi-channel oscilloscope:

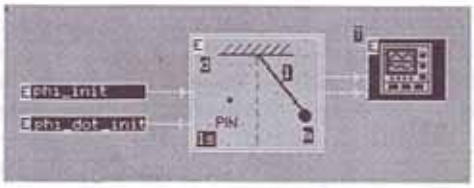


Figure 2: ASCET-RS modelling window

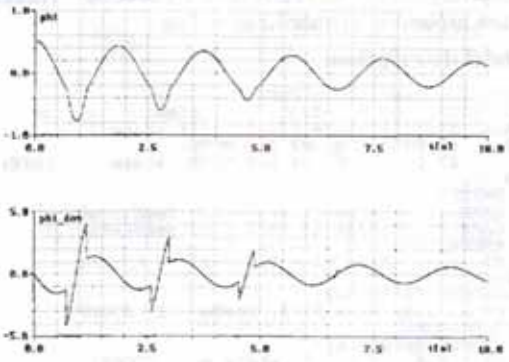

Figure 3: Results of task a, i)

Task c is solved with the ASCET-RS parameter optimizer, a tool for minimization by varying constants automatically using standard or user-defined methods under realtime conditions. Using the hierarchical-grid-method for task c the initial angular velocity phi_dot_init is found with 2.2813 for initial condition 2.0 and -2.1875 for initial condition -2.0 after 30 iterations. Task d (see SNE 9, Nov 1993, p29) could also be carried out with ASCET-RS in realtime. Figure 4 shows plots of phi, phi_meas (measurement data) and phi_dot using the gradient method after 27 iterations with D=0.4, phi_init=0.8 and phi_dot_init=-0.3 as starting guesses. The estimated parameters are D=0.3382, phi_init=0.8275, phi_dot_init= -0.3582.

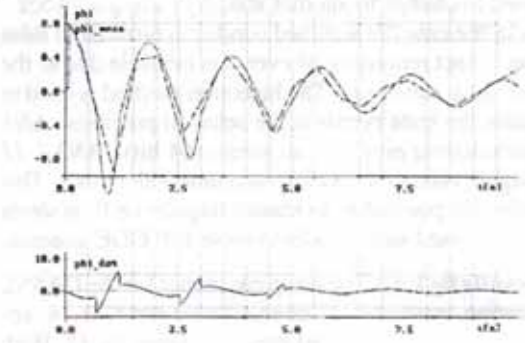

Figure 4: Task d

For further information about ASCET-RS and comments please contact: *Jörg Schäuffele, ETAS GmbH &Co.KG, Markgröninger Str. 45, D-71701 Schwieberdingen, Tel: +49-711 811-3653, Email: etepa_sf@ siiks.a1.bosch.de*

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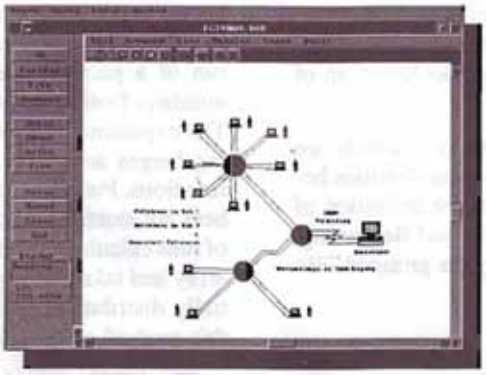

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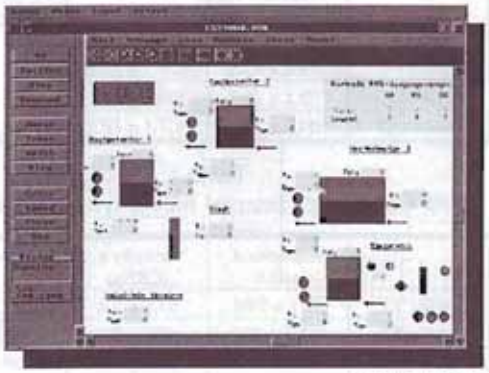

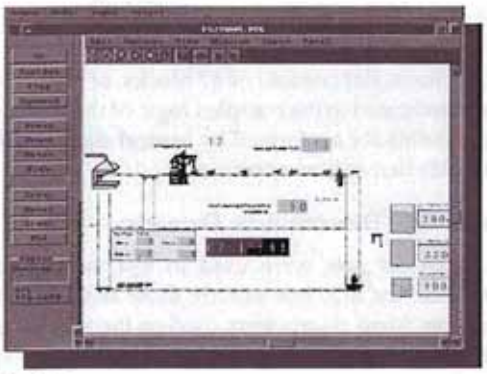

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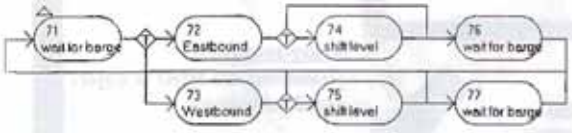
## Comparison 8 - MicroSaint

MicroSaint is a process-oriented general purpose discrete simulator with a graphical user interface. It is available for UNIX as well as for DOS and MS Windows. MicroSaint Release 1.1b with ActionView (animation see title page of this issue) under MS Windows 3.11 was used to model the canal-and-lock-system of comparison 8.

The basis for modelling are "tasks", which are passed by "entities". Decision blocks route entities between different tasks. The tasks offer free definition of Release Condition, Time Distribution, and Beginning, Launch, and Ending Effect and may be grouped into subnets.

**Model Description:**

The two canals and the lock are represented by one task each. This was done twice, once for each direction. Six tasks and six decisions are used to generate the arriving barges. The tasks described above are grouped into four subnets. One task initializes the system. The flow of the barges is controlled by fourteen tasks, seven decisions, and three subnets.




Subnet: Lock Control

Totally, the model consists of 47 blocks, of which 24 blocks are dedicated to the complex logic of the system. The experiments are performed by several slightly different models that are run separately.

**Validation with Deterministic Datasets:**

The given datasets were used to test the model, giving results that matched exactly those described in the definition. Most efforts were used on the validation of the lock control system (about 80% of modelling procedure).

**Results and Discussion of Probabilistic Datasets:**

For experiments, MicroSaint offers only batches of a certain number of simulation runs. It supports neither of the variance reduction methods ARV or CRN directly. But direct access to random number generation and to the number of the simulation run is granted, so that complex experiments can be formulated in the model and controlled by model variables.

The **ARV** method tries to reduce the variance of a batch of simulation runs by using pairs of antithetic random numbers. This method is difficult to implement. We have chosen the following strategy: A batch of fifty pairs of simulation runs is performed. The first run of a pair chooses uniformly distributed random numbers from the system's random number generator. The exponentially distributed numbers for the incoming barges are calculated "manually" by user defined functions. Furthermore, the uniformly distributed numbers are stored in an array. The second run of the pair of runs calculates the antithetic numbers from the stored array and takes these as the basis for the new exponentially distributed numbers. For the implementation of this method additional blocks had to be defined.

The **CRN** method is useful in comparing two alternatives of a model. If the experiments for the two alternatives are performed in different batches of simulation runs, MicroSaint resets the random number seed as default, so that the CRN method is applied "automatically". In order to produce results with independent non-CRNs, the seed for the second batch of runs is chosen differently.

The different strategies were carried out by a model change between the several batches of runs.

The following tables were produced by importing the result files to Excel 5, because the built-in statistical functions of MicroSaint cannot calculate a confidence interval.

| | Activities 1 and 2 | Activity 3 (ARVs) | Decrease in CI |
|---|---|---|---|
| 90% CI 1 | 534.7 ± 48.6 | 492.6 ± 36.6 | 24.7% |
| 90% CI 2 | 514.8 ± 45.5 | 528.5 ± 33.0 | 27.5% |
| 90% CI 3 | 479.1 ± 48.3 | 500.8 ± 31.1 | 35.6% |
| Overall CI | 509.5 ± 27.4 | 507.3 ± 19.3 | 29.6% |

Table 1:
90% Confidence Interval for Activities 1, 2 and 3

| | Activities 4 and 5 | Activity 6 (CRNs) | Decrease in CI |
|---|---|---|---|
| 90% CI 1 | 89.1 ± 73.6 | 67.9 ± 9.4 | 87.2% |
| 90% CI 2 | 102.1 ± 93.3 | 66.7 ± 9.2 | 90.1% |
| 90% CI 3 | 59.9 ± 88.8 | 65.1 ± 9.8 | 89.0% |
| Overall CI | 83.7 ± 49.2 | 66.6 ± 5.4 | 89.0% |

Table 2:
90% Confidence Interval for Activities 4, 5 and 6

*M. Lingl, F. Breitenecker, ARGESIM, Dept. of Simulation Techniques, TU Vienna, Wiedner Hauptstr. 8-10, A-1040 Wien, Email: argesim@argesim.tuwien.ac.at*

## Comparison of Parallel Simulation Techniques
## ACSL
## Shared Memory Multiprocessors/UNIX

Shared memory multiprocessors hold great potential for improvement of simulation execution times, owing to zero-latency communication and the absence of a need to encapsulate or otherwise prepare data for transmission. Owing to its FORTRAN heritage, ACSL relies heavily on static data, i.e. data not kept on a stack. It is not possible to create *instances* of ACSL models dynamically at run-time. Thus, a thread-based implementation (where all processes share one address space) is less appropriate than a true fork process based implementation with an explicitly allocated shared memory area.

We distribute the work among the processors (using **fork**) by partitioning the equation set among the processors. Since the equations are not independent, the values of the state variables must be exchanged from time to time. Ideally, state variables would reside in the shared memory segment and thus would be visible to all processors immediately. ACSL does not allow state variables to be placed at arbitrary memory locations; thus, the programs must copy the state variables that are to be shared into the shared memory segment. A further difficulty arises because the processors of multiprocessor machines are not guaranteed to remain synchronised. Consequently a synchronisation phase must be executed during every update.

Two different types of synchronisation were tested: one using operating system semaphores and one that works exclusively in user mode. For this strategy to work, all processes must be integrating at the same speed - which is guaranteed by using fixed step algorithms.

A library (with two versions) was developed for forking the processes and exchange data. The first version of the library, the one using operating system semaphores (S_LIB), consists of three user-visible procedures:

**shminitialize** takes two parameters: the number of processes to create - typically the number of processors in the machine - and the number of bytes a process needs in shared memory. It returns a small integer indicating the processor number this process is running on; user code must later use this number to select the appropriate right-hand sides of the differential equations. **shmwriteread** takes a vector of values to be exchanged with the other processors and a vector where the values calculated by other processors are returned. **shmwriteread** is typically called in the DYNAMIC or DISCRETE SECTION, i.e. once per communication interval or for each evaluation of the right-hand side of the differential equations. **shmterminate** releases the resources allocated by **shminitialize**. After **shmterminate**, only the original process remains.

Besides needing the operating system to synchronise, the above version suffers because it copies data unnecessarily. The second version of the library (F_LIB) avoids this copying completely by making the shared memory area visible to the user's code. In case of the HP Precision Architecture RISC machine (used for these investigations, with four processors) the only way to do this in FORTRAN is by passing the address of the shared memory area as an actual parameter to user-supplied subroutines.

The interface changes as follows: **shminitialize** additionally takes two subroutine arguments. The first is called when data is to be copied into the shared memory segment, the second is called to read from the shared memory segment. Instead of **shmwriteread**, this second version of the library calls **shmbarrier** (using subroutines made available in the **shminitialize** function).

### Monte Carlo-Study

The first version of the library was used to solve this "Monte- Carlo Study" task. In the INITIAL SECTION M parallel processes (**procs**) are forked with **shminitialize** performing 1000 / M simulation runs. No data transfer is necessary during the simulation. In the TERMINAL SECTION the results are read out by **shmwriteread**. The following table shows the efficieny factor $f$ of the parallelisation.

```
INITIAL; .......
proc= shminitialize(procs, resultnum*4); ...
LOOP.. i = i + 1; ..........
END
DYNAMIC
   DERIVATIVE; ............
TERMINAL; ............
call shmwriteread (procresults = results)
if .... goto LOOP
call shmterminate; .........
END
```

| | M = 1 | M = 2 | M = 3 | M = 4 |
|---|---|---|---|---|
| S_LIB - | 1 | 0.535 | 0.345 | 0.257 |

### Partial Differential Equation

Discretising the PDE with the method of lines (with N lines) results in a system of weakly coupled ordinary differential equations (2N equations). Each process has to integrate 2N / M equations, and data transfer is only necessary between the boundary lines. The parallel processes are forked in the INITIAL SECTION, the data transfer takes place in the DYNAMIC section each communication interval ($c_{int} = h$, with S_LIB, F_LIB in brackets):

```
INITIAL; ...........
pr = shminitialize (procs, boundaries * 4)
 [ pr = shminitialize (procs, boundaries,
                       srupdate, sr read) ]
END
DYNAMIC
DERIVATIVE; ..............; END
call shmwriteread (boundary  =  bound)
 [ call shmbarrier ]
END
TERMINAL; call shmterminate: END
```

Fourth order Runge-Kutta was used to integrate the equations, which evaluates each equation four times per integration step - whereas data is exchanged only once. To eliminate the resulting discretisation error, **shmbarrier** was called in the DERIVATIVE SECTION; surprisingly, execution speed increased in some cases.

Results in term of the efficiency factor *f* for different numbers of processors M and different numbers of lines N are summarised in the following tables:

| *N=800* | M = 1 | M = 2 | M = 3 | M = 4 |
|---|---|---|---|---|
| S_LIB, DYN.S. | 1 | 0.629 | 0.472 | 0.400 |
| F_LIB, DYN.S. | 1 | 0.578 | 0.450 | 0.342 |
| F_LIB, DER.S. | 1 | 0.729 | 0.458 | 0.345 |

| *M = 4* | N = 600 | N = 800 | N = 1000 |
|---|---|---|---|
| S_LIB, DYN.S. | 0.439 | 0.400 | 0.375 |
| F_LIB, DYN.S. | 0.361 | 0.342 | 0.322 |
| F_LIB, DYN.S. | 0.357 | 0.342 | 0.319 |

**Coupled Predator-Prey System**

This task consists of only five pairs of equations that are strongly coupled. As only four processors were available, and the forked processes have to be of the same structure, only three processors were used; each processor calculating two pairs. Forking and data transfer was done as in the PDE task.

Parallelisation is not successful. It turned out, that the communication overhead is as big as the benefit of parallelisation. If a communication interval $c_{int}$ bigger than the stepsize $h$ is chosen ($c_{int} = \alpha h$, $\alpha > 1$), a speedup can be achieved. The systems remains stable until $c_{int} = 20h$. The following table summarises the results for the efficiency factor *f*, where also a version with two processors (each three pairs of models) was tested:

| M=3<br>F_LIB<br>$c_{int}$=h | M=3<br>F_LIB<br>$c_{int}$=2h | M=3<br>S_LIB<br>$c_{int}$=20h | M=3<br>F_LIB<br>$c_{int}$=20h | M=2<br>F_LIB<br>$c_{int}$=5h |
|---|---|---|---|---|
| 1 | 0.943 | 0.917 | 0.806 | 0.813 |

*K. Schwarz, F. Breitenecker, ARGESIM, Dept. of Simulation Techniques, TU Vienna, Wiedner Hauptstr. 8-10, A-1040 Wien, Email: argesim@argesim.tuwien.ac.at*

# Book Reviews

**The Handbook of Brain Theory and Neural Networks,**
**M. A. Arbib (Ed.)**
**MIT Press 1995, ISBN 0-262-01148-4**

This book is of high value for everybody interested in the field of brain research, neural modeling and neural networks. It is inspired from the idea to combine the topics "How does the brain work" and "How can we build intelligent machines". Students as well as experts will find many answers to their questions on our knowledge especially about computational neuroscience. In contrast to most books on neural networks both the biological situation and the aspects of modeling are extensively discussed.

A short introduction (23 pages) is given on (1) the basics of the neuron, (2) the levels and styles of analysis and (3) the dynamics and adaptation in neural networks. In part II (30 pages) the reader who wants to survey a major theme will find a set of 23 "road maps" which place every article of part III in a thematic perspective.

The main part of the book (1000 pages) consists of 226 articles, which are arranged in alphabetical order. Most of these articles have the following structure: The introduction provides a nontechnical overview of the material covered in the whole article, and the final section provides a discussion of key points, open questions and linkages to other areas of brain theory and neural networks. There are about 15 references per article primarily for readers who look for an introduction to the literature on the given topic including background material, relevant review articles and original research citations. Most of these articles are written by prominent experts and show the state of the art.

*F. Rattay, Technical University Vienna*

**Signal and Image Processing with Neural Networks: A C++ Sourcebook,**
**T. Masters**
**John Wiley & Sons, Inc. 1994, ISBN 0-471-04963-8**

This text is concerned with solving signal and image processing problems with multiple-layer feedforward networks (MLFN). Many of such problems can be solved in the complex domain with significantly lower errors than by real-domain networks. Therefore a large section is dedicated to the design and training of complex MLFNs. All necessary equations are presented and justified. Highly commented code fragments for different aspects of computation are supplied in the book and the complete source coude for a working program is provided on disc. The techniques presented include: Gabor transform in one and two dimensions, wavelets focusing on the Morlet wavelet, in one and two dimensions, object identification based on shape via Fourier analysis, image classification via tone and texture variables, fast algorithms in the frequency domain and the integration of these techniques with feedforward networks.

The final sections of many chapters are devoted to a variety of applications. Many of them are at home in the complex domain and processing is in accordance with this fact. Nevertheless, a significant amount of space is devoted to closely related problems that are better served by real-domain processing.

*F. Rattay, Technical University Vienna*

**Modern Physics Simulations**
**Consortium for Upper-Level Physics Software (CUPS)**
**D. Brandt, J.R. Hiller, M.J. Moloney,**
**ISBN 0-471-54882-0, John Wiley & Sons, Inc.**

The package available under the name "Modern Physics Simulations" consists of a PC software and an accompanying book and is a part of a series including such fields as astrophysics, quantum mechanics and solid state physics. The package discussed here includes several examples from modern physics, for example laser dynamics, quantum mechanics or atomic physics. Each chapter basically consist of a program, which helps to illustrate and explore some aspects of the field under discussion.

The book gives a short introduction to the theoretical background of the problems handled in the program. This part of the book, to my opinion, is very well done. Some criticism, however, arises as far as the description of the programs themselves are concerned. This part of the book seems to be not detailed enough. In particular, it is nearly impossible to obtain from it information about the algorithms and how the simulation is done in general. Even considering the fact, also stated in the book, that the programs should be self explanatory, which to a high degree they indeed are, the reader is sometimes left with many open questions.

As far as I have tried out the programs myself and also together with a few students, they represent a helpful tool to visualize and explore the selected areas of modern physics. For instance the "Laser Cavities and Dynamics" program lets you play around with rays

in a laser cavity and can give students an idea of stable and unstable resonators. The other parts of this program can be quite helpful in better understanding the development of level populations and the lasing conditions under various conditions (pump power, temperature, oscillator strengths etc.).

The "Quantum Mechanics" program, just to pick randomly another one of the choices, can be used in lectures or laboratory work to increase the understanding of such basic concepts as free and bound particles, quantized energy states and wavepackets.

It should be also mentioned here, that there exist still several bugs in the program. For instance, sometimes the program quits, if certain parameters are entered, even if they are physically plausible.

In conclusion, the CUPS software package and book "Modern Physics Simulations" represents a nice tool for upper level physics education. Further improvements and additions could make it even more attractive for the use intended by the authors.

*Wolfgang Husinsky*
*Institut für Allgemeine Physik, TU Wien*

# Industry News

## ACSL Code, a C code generator from block diagrams

Honeywell, Inc. and Mitchell and Gauthier, Associates (MGA) agreed last year to develop a state-of-the-art C code generator from MGA's block diagram tool, the Graphic Modeller.

ACSL Code addresses many of the shortcomings of existing products by generating efficient code that maintains the block diagram hierarchy and naming conventions. The resulting code is easy to read, verify, and maintain which will result in a more reliable embedded system.

ACSL Code compliments MGA's powerful continuous modelling tool ACSL (Advanced Continuous Simulation Language), giving users an easy to use, highly integrated solution for a wide range of problems. Typically, a user will model a hybrid system of continuous and discrete elements in a Graphic Modeller block diagram. Then, the user generates C code for the discrete elements using ACSL Code and creates a realtime application from the continuous elements using ACSL Real Time. Finally, the ACSL Real Time model is wired to the controller running the embedded C and exercises the embedded system as a hardware-in-the-loop simulator.

For more information please contact Dr. Goucem at Rapid Data Ltd by phone at +44 1903 821 266 or by fax at +44 1903 820 762 or by Email at info@ radata.demon.co.uk.

## ACSL Math, an advanced visualization and matrix computation environment

In creating ACSL Math, Mitchell and Gauthier Associates, Inc. (MGA) gives simulationists a fast, flexible and easy-to-use matrix computation tool. ACSL Math is an excellent stand-alone software product for any requirement, where fast, accurate data manipulation is required. When coupled with ACSL (Advanced Continuous Simulation Language), ACSL Math provides the simulationist with an unparalleled, tightly integrated model development and experimentation environment.

ACSL Math was developed by Dr. Edward E. L. Mitchell, the principle author of ACSL and a world renowned simulationist. His main design objective was to create a single tool where a user could run experiments on simulation models, manipulate the data, and revise model parameters in fast development and prototyping process. ACSL Math does this by providing a command line input mode with over 300 mathematical commands plus an easy-to-use graphical interface. In addition to supporting a graphics programming language, ACSL Math lets you specify most graphics properties via toolbuttons and dialog boxes. Further, ACSL Math can programatically control an ACSL simulation giving the user the ability to perform parametric searches on a model via user written script and function files.

For more information please contact Dr. Goucem at Rapid Data Ltd by phone at +44 1903 821 266 or by fax at +44 1903 820 762 or by Email at info@ radata.demon.co.uk.

## 300 MHz Alpha for Real Time

dSPACE GmbH announces the first implementation of a RISC processor in its real-time systems. This high performance chip, the DEC Alpha AXP™ 21164/ 300MHz, with its 11.6 Specfp95 is considered to be the fastest 64-bit floating-point processor available. A PowerPC 604/100MHz benchmarks at a considerably lower value of 2.5 Specfp95. The increased computing power of the dSPACE Alpha board is intended to support large hardware-in-the-loop (HIL) simulations. A second key advantage of the AXP 21164 is its ability to handle double floating point precision (64 bit) numbers nearly as rapidly as single precision (32 bit). The Alpha board is seamlessly integrated into the existing dSPACE software environment, including a SIMULINK® block-diagram connection.

Contact: dSPACE GmbH, Technologiepark 25, D-33100 Paderborn, Tel: +49-5251 1638-0, fax: +49 5251 66529, email: info@dspace.de

## DESIRE/N96T for WINDOWS 95 and NT

DESIRE/N96T and DESIRE/NEUNET/N96T are new versions of DESIRE for 486, Pentium, and Pentium Pro based personal computers running under Windows 95 and Windows NT. A DOS version, which replaces DESIRE/W, is also included in the distribution. DESIRE generates Pentium-optimized machine code and has a new, user-friendly Windows 95-type user interface.

Under Windows 95, DESIRE full-screen simulation runs automatically preempt the computer's central processing unit, so that the convenient Windows 95 interface does NOT slow the simulation. Windows tasks are suspended only during the simulation run proper. This is a unique feature quite different from the usual slow-running Windows programs; DESIRE is dramatically faster than interpreted simulators like MATLAB/SIMULINK. DESIRE's Pentium-optimized machine language code at least matches the speed of FORTRAN-based differential-equation solvers like ACSL.

Contact: G.A. and T.M. Korn Industrial Consultants, RR1, Box 96C, Chelan, WA 98816, USA, Tel: +1-509 687 3390.

## Classes on Simulation

**September 1996**

4-6 **COMNET III Training Course**. Camberley, U.K.
Contact: CACI Products Division, Suite 11, Coliseum Business Centre, Riverside Way, Camberley, Surrey GU15 3YL, UK, Tel:+ 44 1276 671 671, Fax:+ 44 1276 670 677

10-11 *Simulink-Kurs*. Munich, Germany.
Contact: BAUSCH-GALL GmbH, Wohlfartstr. 21b, D-80939 München, Tel: +49-89 3232625, Fax: +49-89 3231063, Email: 100564.302@compuserve.com

11-13 **COMNET III Training Course**, Frankfurt, Germany.
Contact: CACI Products Division

16-18 **MODSIM Training Course**, Camberley, U.K.
Contact: CACI Products Division

17-19 **COMNET III Training Course**, Paris, France.
Contact: CACI Products Division

18-20 **ACSL Course**. TU Delft, The Netherlands
Contact: Rapid Data Ltd., Crescent House, Crescent Road, Worthing, West Sussex, BN11 5RW, UK, Tel: +44-1903 821266, Fax: +44-1903 820762, Email: info@radata.demon.co.uk

25-27 **ACSL Course**. Kingston Unversity, U.K.
Contact: Rapid Data Ltd., Crescent House, Crescent Road, Worthing, West Sussex, BN11 5RW, UK, Tel: +44-1903 821266, Fax: +44-1903 820762, Email: info@radata.demon.co.uk

30 *Effektive Simulation von Schaltnetzteilen.*
Munich, Germany.
Contact: BAUSCH-GALL GmbH

**October 1996**

1 *Effektive Regelung von Schaltnetzteilen.*
Munich, Germany.
Contact: BAUSCH-GALL GmbH

1-3 **SIMPROCESS Training Course**, Paris, France.
Contact: CACI Products Division

8-9 *MATLAB-Kurs*. Munich, Germany.
Contact: BAUSCH-GALL GmbH

9-11 **SIMSCRIPT Training Course**, Camberley, U.K.
Contact: CACI Products Division

16-18 **MODSIM Training Course**, Frankfurt, Germany.
Contact: CACI Products Division

22-23 *ACSL-Kurs mit Graphics Modeller.* Munich, Germany.
Contact: BAUSCH-GALL GmbH

22-24 **MODSIM Training Course**, Paris, France.
Contact: CACI Products Division

23-25 **COMNET III Training Course**, Camberley, U.K.
Contact: CACI Products Division

*ACSL und Graphic Modeller.* Seminar at TU Vienna, Austria
Contact: Prof. Dr. Felix Breitenecker, ARGESIM, TU Wien, Abt. Simulationstechnik, Wiedner Hauptstraße 8-10, A-1040 Wien, Tel: +43-1 58801 5374, Fax: +43-1 5874211, Email: argesim@argesim.tuwien.ac.at

**November 1996**

4-6 **COMNET III Training Course**, Paris, France.
Contact: CACI Products Division

6-8 **COMNET III Training Course**, Frankfurt, Germany.
Contact: CACI Products Division

13-15 **MODSIM Training Course**, Camberley, U.K.
Contact: CACI Products Division

28 *Effektive Simulation von Schaltnetzteilen.*
Munich, Germany.
Contact: BAUSCH-GALL GmbH

29 *Effektive Regelung von Schaltnetzteilen.*
Munich, Germany.
Contact: BAUSCH-GALL GmbH

**December 1996**

*DYMOLA-Kurs*. Munich, Germany.
Contact: BAUSCH-GALL GmbH

*Objektorientierte Diskrete Simulation - SIMPLE++.*
Seminar at TU Vienna, Austria
Contact: Prof. Dr. Felix Breitenecker

## Calendar of Events

**July 1996**

21-25 **SCSC'96** Summer Computer Simulation Conference. Portland, Oregon
Contact: SCS International, P.O. Box 17900, San Diego, CA 92177, USA, Tel: +1-619 277 3888, Fax: +1-619 277 3930, Email: scs@sdsc.edu.

**September 1996**

10-13 **ASRTP'96,** 12th International Conference on Process Control and Simulation. Kosice, Slovak Republic
Contact: Dr. Mikulas Alexik, University of Transport and Communications, Dept. Technical Cybernetics, Velky Diel, SK-010 26 Zilina, Slovak Republic, Tel.: +42 - 89 - 54042, Fax: +42 - 89 - 54806, Email: alexik@frtk.utc.sk

16-19 **ASIM 96**, *10. Symposium Simulationstechnik*. Dresden, Germany
Contact: Prof. Dr. W. Krug, DUAL Zentrum Dresden, Gillesstraße 2, D-01219 Dresden, Tel.: +49-351 47791 0, Fax: +49-351 4779! 99, Email: dual@dual-zentrum.de, WWW: http://www.htw-dresden.de/asim96/

17-19 **Workshop "Advanced System Simulation"**. Zabreh na Morave, Czech Republic
Contact: Jan Stefan, FEI -VSB TU, tr. 17. listopadu, CZ-708 33 Ostrava Poruba, Email: Jan.Stefan@vsb.cz

19-21 **Simulation, Gaming, Training and Business Process Reengineering in Operations**. Riga, Latvia
Contact: Dr. Galina Merkuryeva, Riga Technical University, 1, Kalku Street, LV-1658 Riga, Latvia, Tel: +371-7324480, Fax: +371-7820094, Email: conf96@itlpro.itl.rtu.lv, WWW: http://www.itl.rtu.lv/Riga_Conf96.

19-21 **ERK'96**, Electrotechnical and Computer Science Conference. Portoroz, Slovenia
Contact: Prof. Sasa Divjak, University of Ljubljana, Faculty of Comp. and Inform. Science, Trzaska 25, SLO-1000 Ljubljana, Slovenia, Tel.: +386-61 1768 260, Fax: +386-61 1264 630, Email: sasa.divjak@fri.uni-lj.si

26-27 **3rd International Conference Computer and Informatics**. Herlany, Slovak Republic
Contact: Dr. Mikulas Alexik, University of Transport and Communications, Dept. Technical Cybernetics, Velky Diel, SK-010 26, Zilina, Slovak Republic, Tel.: +42 - 89 - 54042, Fax: +42 - 89 - 54806, Email: alexik@frtk.utc.sk

30-October 2
**GCB'96**, German Conference on Bioinformatics. Leipzig, Germany
Contact: R. Hofestädt, Universität Leipzig, Institut für Medizinische Informatik und Statistik, Liebigstr. 27, D-04103 Leipzig, Tel.: +49-341 9716100, Fax: +49-341 9716109, Email: GCB96@imise.uni-leipzig.de

**October 1996**

06-08 **ISIR 1996**, 27th International Symposium on Industrial Robots. Milan, Italy
Contact: Centro Esposizioni Ucimu Spa, ISIR '96 Secretariat, Viale Fulvio Test 128, I-20092 Cinisello Balsamo, Tel.: +39-2 26255 1, Fax: +39-2 26255 214, Email: molfino@dimec.unige.it

*EUROSIM - Simulation News Europe*

*Scope: Information on simulation activities, membership information for European simulation societies, comparisons on simulation techniques*

*Editors:* *F. Breitenecker, I. Husinsky*
*ARGE Simulation News*

*Layout: I. Husinsky*

*Address: c/o Computing Services, Technical University of Vienna, Wiedner Hauptstraße 8-10, A-1040 Vienna.*

*ARGE Simulation News: Gröhrmühlg. 8, A-2700 Wiener Neustadt*

*Printed by: Elsevier Science B.V., Amsterdam, The Netherlands*

*ISSN 0929 - 2268*

24-26 **ESS'96** European Simulation Symposium. Genova, Italy
Contact: Philippe Geril, SCS European Simulation Office, University of Ghent, Coupure Links 653, B-9000 Ghent, Tel: +32-9-2337790, Fax: +32-9-2234941, email: philippe.geril@rug.ac.be, WWW: http://hobbes.rug.ac.be/~scs/

**November 1996**

14-15 **ISCS'96**. Rome,Italy
Contact: Segreteria ISCS'96, Università di Roma "Tor Vergata", Dipto. di Ingegneria Civile, Via della Ricerca Scientifica, I-00133 Roma

**December 1996**

08-11 **WSC 96**, 1996 Winter Simulation Conference. Coronado, CA, USA
Contact: J.J. Swain, University of Alabama, Dept. Industrial and Systems Engineering, Huntsville, AL 35899, USA, Tel.: +1-205 895 6749, Fax: +1-205 895 6733, Email: jswain@ebs.330.eb.uah.edu, WWW: http: http://kuhttp.cc.ukans.edu/wsc96/

**February 1997**

05-07 **2nd MATHMOD**, IMACS Symposium on Mathematical Modelling. Vienna, Austria
Contact: Prof. Dr. Inge Troch, Dept. Simulation Technique, Technical University Vienna, Wiedner Hauptstr. 8-10, A-1040 Wien, Tel.: +43-1-58801-5367, Email: itroch@email.tuwien.ac.at

**March 1997**

*6. Symposium Simulation als betriebliche Entscheidungshilfe*. Braunlage, Germany
Contact: Prof. Dr. W. Hummeltenberg, Universität Hamburg, Institut für Wirtschaftsinformatik, Max-Brauer-Allee 60, D-22765 Hamburg, Tel.: +49-40 41234023, Fax: +49-40 41236441

03-04 **ASIM Workshop**, *Simulation Technischer Systeme und Simulationsmethoden und -sprachen für verteilte Systeme und parallele Prozesse*. Rostock, Germany
Contact: Ingrid Bausch-Gall, Wohlfartstraße 21b, D-8000 München, Tel.: +49-89 3232625, Fax: +49-89 3231063

**April 1997**

17-19 *7. Ebernburger Gespräch*, ASIM Workshop. Ebernburg, Germany
Contact: Prof.Dr. D.P.F. Möller, TU Clausthal, Institut für Informatik, Erzstraße 1, D-38678 Clausthal-Zellerfeld, Tel.: +49-5323 72 2504, Fax: +49-5323 72 3572

23-25 **UKSS'97** United Kingdom Simulation Society Conference. Keswick, U.K.
Contact: Prof. G. Birtwhistle, The University Leeds, School of Computer Studies, Leeds LS2 9JT, UK, Tel: +44-113 243 1751, Email: graham@scs.leeds.ac.uk.

**August 1997**

24-29 **15th IMACS World Congress**, Berlin, Germany
Contact: Prof.Dr. A. Sydow, GMD FIRST, Rudower Chaussee 5, D-12489 Berlin, Tel.: +49-30 67045610, Email: sydow@prosun.first.gmd.de

**April 1998**

14-18 **EUROSIM '98**. European Simulation Congress. Helsinki, Finland
Contact: EUROSIM'98, P.O. Box 1301, FIN-02044 VTT, Fax: +358-0 4566 422, Email: eurosim98@vtt.fi

An extended version of the calendar of events can be found on WWW: http://eurosim.tuwien.ac.at/conferences/

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