EUROSIM
Simulation News Europe

Number 2 | A European Forum on Simulation Activities | July 1991

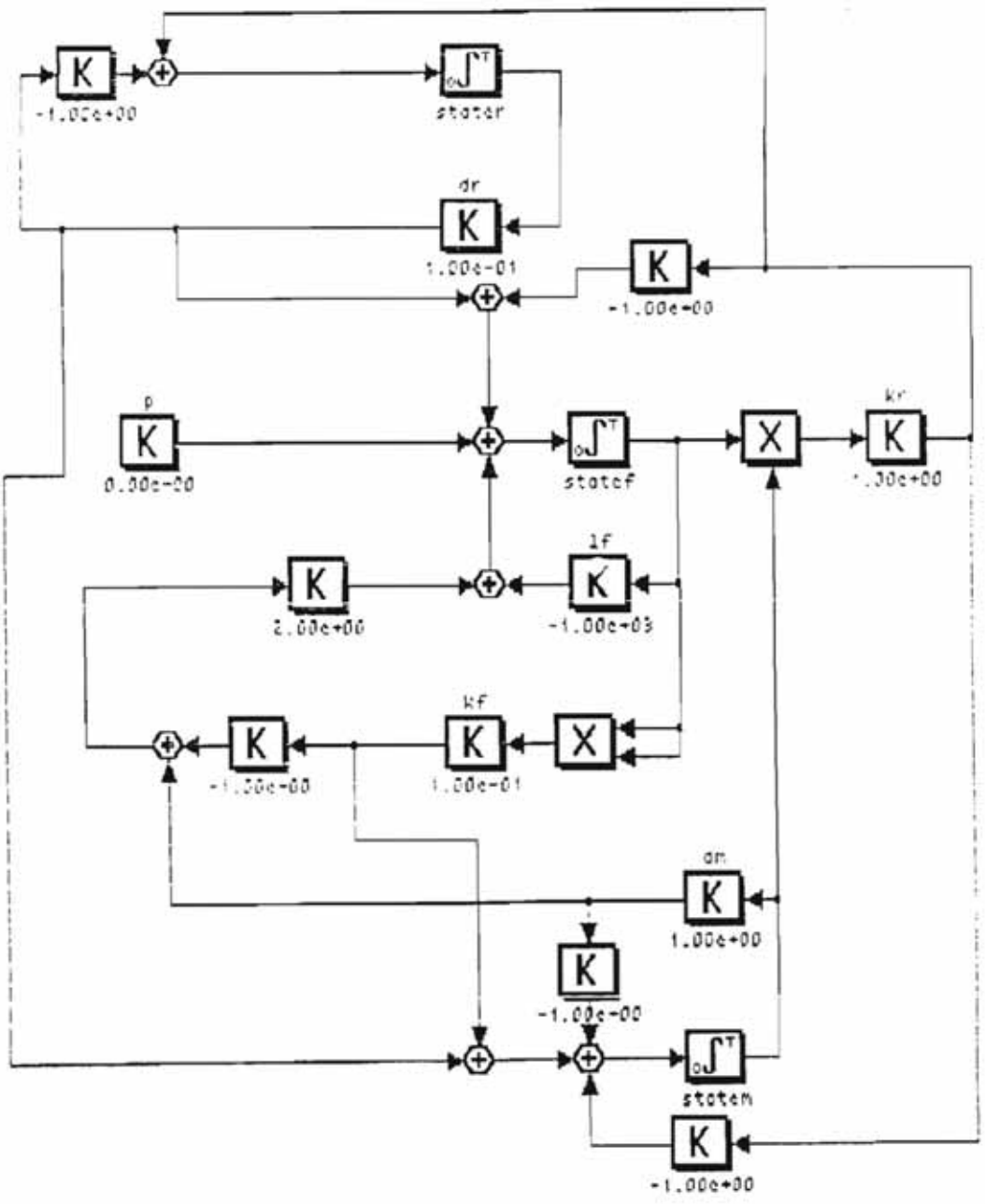


Table of Contents

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", supported by the Scientific Academy of Lower Austria. Circulation is 2500. Printed by HTU-Druck, Wien, Austria.

EUROSIM - Simulation News Europe is distributed by all member societies to their individual members. The price of EUROSIM - Simulation News Europe is covered by the membership fees of the societies. For receiving extra copies, for advertisements, for subscriptions, and for other organizational affairs please contact the editors.

Editors: Prof. Dr. Felix Breitenecker,
Mrs. Irmgard Husinsky

Address: c/o Computer Center, Technical University of Vienna, Wiedner Hauptstraße 8-10, A - 1040 Wien. Tel: +43-(0)222 58801 5484. Fax: +43-(0)222 587 42 11.

Editorial Board of the European Simulation Societies:

ASIM: Dr. Ingrid Bausch-Gall, Wohlfartstraße 21b, D - 8000 München 45. Tel: +49-(0)89 3232625, Fax: +49-(0)89 3231063.

DBSS: J. C. Zuidervaart, Rekencentrum, Delft University of Technology, P.O. Box 354, 2600 AJ Delft, The Netherlands, Tel: +31-(0)15 785698, Fax: +31-(0)15 783787.

FRANCOSIM: F. Lorenz, Lorenz Consulting sprl, Clémodeau 196A, B - 4550 Villers-le-Temple, Belgium, Tel.: +32-(0)85 51 23 90.

ISCS: Dr. Michele Colajanni, Dip.to Ing. Elettronica, Università di Roma II, Via O. Raimondo 8, I - 00173 - Roma, Tel: +39-(0)6 79794484, Fax: +39-(0)6 2020519.

SIMS: M. Hänninen, Technical Research Center of Finland, Lab. of Electrical and Autom. Eng., P.O. Box 34, SF - 02151 Espoo, Finland. Tel: +358-0 4566564, Fax: +358-0 4550115.

UKSC: Prof. D.J. Murray-Smith, Department of Electronics and Electrical Engineering, University of Glasgow, Glasgow G12 8QQ, Scotland, U.K., Tel: +44-(0)41 339 8855 5222, Fax: +44-(0)41 330 4907.

Editorial

EUROSIM Simulation News Europe disseminates information on simulation to the members of the European simulation societies, to interested R&D institutions, to companies, to libraries, etc. The Newsletter, the official Newsletter of EUROSIM, startet in November 1990, it will be published three times a year (March, July, November). Reactions from readers from all areas showed a great acceptance and the need for this newsletter.

This issue, number 2, announces as important event in the area of simulation the **EUROSIM '92 - EUROSIM Simulation Congress**, to be held in Capri, Italy, September 29 - October 2, 1992. This is the first EUROSIM congress, continuing the tradition of the European Simulation Congresses (ESC '83 - Aachen, ESC '86 - Antwerp, ESC '89 - Edinburgh).

After a report on the EUROSIM activities an essay "Qualitative Simulation - Deriving Behaviour from Knowledge about Structure and Function" gives an overview on this new area of simulation.

European simulation societies report on their activities and provide special information for their members.

The series on simulation centers presents again three institutions dealing with simulation. We invite all simulationists in companies, research institutes, universities to send us short descriptions of their institutions and indicating which simulation tools are used and which projects are performed, etc.

This issue starts with two new sections: "industry news" and "book news". We offer companies dealing with simulation to announce news in this section. If you are interested, please send approx. 10 - 20 lines. Furthermore, we ask publishers and editors send information on new books, jounals, etc. (approx. 10-20 lines).

A big success are the software comparisons. This issue repeats the two previous comparisons and starts a third one. With great pleasure we received solutions using different languages from all over Europe. We thank all simulationists who took the challenge and will do it in the future.

The editors would like to thank to all who contributed to this issue, the advertising companies and the Scientific Academy of Lower Austria for the financial support (especially sponsorings the copies for Eastern Europe).

All readers are kindly invited to send letters, comments, suggestions or contributions to one of the editors.

F. Breitenecker, I. Husinsky

EUROSIM, the Federation of European Simulation Societies was initiated 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. Activities of EUROSIM will concern: information distribution to member societies about activities, advancements and the state-of-the-art in system simulation; co-ordination of meetings of member simulation societies; co-operation in joint research projects, in standardization committees and with international societies in the field of simulation.

The following national and regional simulation societies founded EUROSIM: ASIM - Arbeitsgemeinschaft Simulation (Austria, Germany, Switzerland), DBSS - Dutch Benelux Simulation Society (Belgium, The Netherlands), FRANCOSIM - Société Francophone de Simulation (Belgium, France), ISCS - Italian Society for Computer Simulation (Italy), SIMS - Simulation Society of Scandinavia (Denmark, Finland, Norway, Sweden), UKSC - United Kingdom Simulation Council (UK)

EUROSIM Board Meeting, Zürich, March 1-2,1991

This board meeting was hosted by ETH Zürich (Mr. Halin). Participants were: Mr. Breitenecker and Mr. Halin (ASIM), Mr. Dekker (DBSS), Mr. Maceri and Mr. Savastano (ISCS), Mr. Juslin (SIMS), Mr. Zobel (UKSC). Notices were sent by Mr. Iazeolla (ISCS) and Mr. Lorenz (FRANCOSIM). Mr. Maceri, the EUROSIM president, chaired the meeting.

The following items were discussed and initiated: EUROSIM is now being founded as society formally, therefore Mr. Zobel (secretary) will change and prepare the "minimum" bylaws given by FAIB (a society specialized in preparing bylaws for societies). Mr. Maceri (president) will answer letters from Mr. Kotva (CSFR) and Mr. Ceric (YU) concerning the membership of their societies in EUROSIM and invite them for discussions.

EUROSIM - Simulation News Europe could be printed by a professional publisher, increasing the distribution of the newsletter. There exists a quotation of Springer-Verlag for the newsletter. North Holland offered to add the newsletter to the planned journal "Journal of Simulation - Practice and Theory". It was agreed that the societies also need a separate newsletter, because on the one side only a part of the members of the societies will subscribe to the journal and on the other side the journal is too expensive to be financed by the societies for each member. North Holland will be asked to send an offer for a separate newsletter, too. Mr. Breitenecker is willing to continue editing the newsletter also in case a publisher will print the journal.

Furthermore it was agreed, that apart from the newsletter a journal is necessary, too. About the contract proposed by North Holland for the journal "Journal of Simulation - Practice and Theory" professional advice is needed. Mr. Zobel and Mr. Dekker will take care of it. The societies will nominate candidates for the preliminary editorial board of the journal. Mr. Maceri chaired an ESPRIT meeting in November 1990. Three very interesting papers were presented there (simulation applications); it is planned to publish these contributions in the new journal.

Most interest was given to the preparations for the EUROSIM Conference in Capri (1992). Mr. Maceri gave an overview about the state of preparations. The first call for papers was reviewed, it will be mailed soon. The Savastano Award will be assigned at this conference. The proceedings of the conference will be printed by North Holland. The scientific committee was nominated. For more information see the conference announcement on the back cover of this issue.

Giorgio Savastano Award

EUROSIM, the Federation of European Simulation Societies institutes the Giorgio Savastano Award to honour the memory of its first President, Prof. Giorgio Savastano.

The award will be made to the author (or the authors) of the best paper published by June 30, 1991 in the field of Simulation in Electrical Engineering. Young researchers, no more than 33 years old on June 30, 1991, can participate in this competition.

Only papers published in journals with referees will be taken into consideration.

Authors interested have to submit one copy of the paper by March 31, 1992 to the EUROSIM President:

Prof. Franco Maceri, Dipartimento di Ingegneria Civile, Università di Roma "Tor Vergata", Via della Ricerca Scientifica, I - 00173 Roma, Italy

After June 30, 1992 the appointed commission will review the papers and will assign the award. The winning author will be invited guest to the ESC'92 Congress.

Letter from the president

Dear Reader,

within this issue of EUROSIM - Simulation News Europe you will find the first announcement of the forthcoming EUROSIM '92 Congress.

I hope that you will attend this first meeting organized by our Federation, and I wish you a fruitful co-operation with all participants.

I look forward to welcome you in Capri.

Franco Maceri
EUROSIM President

Qualitative Simulation - Deriving Behaviour from Knowledge about Structure and Function

Georg Gottlob and Franz Lackinger (member of ASIM)
Vienna University of Technology, Christian Doppler Laboratory for Expert Systems
Paniglgasse 16, A-1040 Vienna/Austria
EMAIL:{gottlob or lackinger}@vexpert.dbai.tuwien.ac.at

1. Introduction

Predicting the behaviour of physical systems is an important engineering task. In order to allow precise behavioural predictions, physical systems are mostly modelled by means of ordinary differential equations which require the availability of numerical data for the simulation process.

Unfortunately, behavioural prediction based on numerical simulation reaches its limits if the underlying models are complex or the required numerical data are not available.

These severe problems can be at least partially solved if we use a simulation methodology which is able to deal with symbolic, qualitative data and abstract problem solving concepts. We will refer to such a simulation methodology as *qualitative simulation*.

As a consequence, we detect well-founded arguments why qualitative simulation should be applied to such domains where quantitative, numerical simulation fails:

1. Quantitative knowledge is sometimes incomplete or not available.
2. Extensive numerical simulation can be time-consuming and inefficient if the quantitative models are complex.
3. Numerical simulation usually does not provide sufficient causal explanations for its behavioural predictions.
4. Quantitative knowledge is sometimes not necessary for simple predictions (e.g. for commonsense reasoning).

2. What is Qualitative Simulation ?

One of the early key-ideas of qualitative reasoning was to provide a new type of physics which was called *qualitative causal physics*. Reasoning about physical systems expressed in terms of qualitative physics should be done purely symbolically without any needs for numerical computation. Besides qualitative physics, naive physics, qualitative temporal reasoning and other styles of qualitative reasoning (e.g. exaggeration, orders-of-magnitude reasoning, comparative analysis), qualitative simulation has attracted more and more attention within the research community.

In fact, qualitative simulation has become a widely discussed field of advanced AI research. Starting about a decade ago, the first steps towards a qualitative description of the physical world were done by [Hay85] who tried to develop a *naive physics* for qualitative commonsense reasoning.

Qualitative simulation is usually interpreted as the derivation of a qualitative description of the behaviour of a physical system from the qualitative model that describes its structure [Kui86]. Quantitative simulation can be analogously done by means of numerically evaluating or analytically solving ordinary differential equations as it is depicted in Fig. 1.

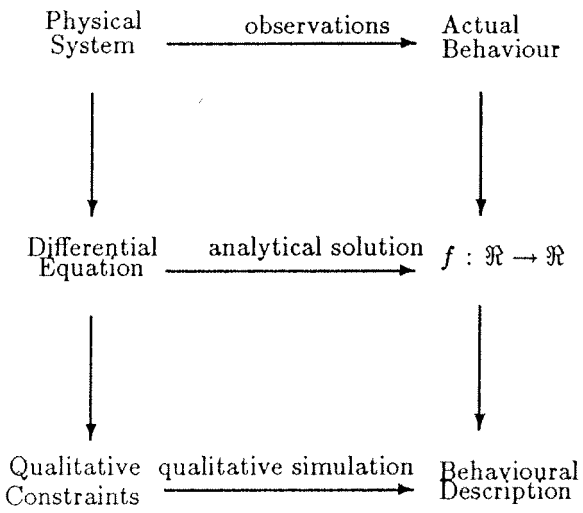


Figure 1: Quantitative and Qualitative Simulation

Thus both types of simulation (qualitative and quantitative simulation) can be viewed as the derivation of abstractions of the actual system behaviour where a direct connection between the two simulation models is clearly detectable.

Consequently one of the main challenges in qualitative simulation is to find the best abstraction from the quantitative model to a qualitative representation.

2.1 Three Important Frameworks

Most approaches to qualitative simulation follow at least one of the three most popular basic frameworks in this field. For a more detailed discussion of the three frameworks, see [Lac90].

2.1.1 The Device-Centered Approach

The main idea behind the device-centered approach of Johan deKleer and John Seely Brown [dKB84] is to describe the physical world in terms of so-called confluences which are qualitative differential equations. These equations work on a symbolic domain {-,0,+} which can be viewed as a symbolic abstraction of the real numbers. Note that the confluences are deduced from the component-connection structure and not from ordinary differential equations in general.

The confluences are fed into a simulation engine called *ENVISION* which uses a structural description and known input-values together with the confluences to predict possible states of system behaviour. A typical feature of this approach is that all qualitative states are computed first and the possible transitions between them are determined in a next step.

This approach can be used especially well for diagnostic tasks for technical systems where behaviour can usually be derived from the component-connection model. If causality is carefully regarded the simulation provides useful causal predictions and explanations for system behaviour.

Unfortunately, ENVISION fails if system behaviour cannot be causally related to device structure or if the physical system cannot be represented by a component-connection model.

2.1.2 Qualitative Process Theory

A fundamentally different approach has been presented by Ken Forbus in [For84]. Forbus uses the term *qualitative process (QP)* to denote the changes in physical systems and the effects they cause.

The main difference to the above approach is that Forbus views the physical world as a collection of physical situations and not as physical devices like deKleer does. As a consequence, qualitative processes can describe physical phenomena even in domains where a component-connection oriented approach fails (e.g. the behaviour of a geyser).

A physical situation in Forbus' approach is described in terms of a collection of objects, their properties and the relationships between them. The transition between different physical situations can be viewed as a process - something that acts through time to change the parameters of objects in a given situation.

Forbus uses a closed-world-assumption when he states that *all changes in physical systems are caused directly or indirectly by processes.*

Although the ideas of qualitative process theory have been implemented [For86] and recently been extended [For89] they seem to be less applicable to a wide range of engineering problem domains. Diagnosis which is necessarily based on structural information cannot be handled by QP efficiently as causal structural information is not sufficiently available from the process definition alone.

2.1.3 Qualitative Differential Equations

The early beginnings of causal simulation based on qualitative differential equations can be found in [Kui84]. In [Kui86], Ben Kuipers defines the basic concepts of qualitative simulation as a means of deriving behaviour from structure and introduces the QSIM-program, a sophisticated simulation framework based on constraint satisfaction.

This approach is the only to derive the qualitative constraints directly from the underlying quantitative differential equations.

QSIM starts with a description of the structure of the system (parameters and constraints) and an initial state. The system is described by symbols which represent physical parameters which are continuously differentiable real-valued functions (e.g. acceleration, velocity, pressure).

These symbols are linked via constraint equations which describe the relationships between the parameters.

Analogously to the definition of a *quantity space* for a parameter which consists of a finite set of landmark values, the notion of time is defined as a set of distinguished time-points and open time-intervals.

The simulation engine then produces an incremental behaviour tree which consists of the possible future states of the physical system.

Consequently the possible system behaviours can be detected by tracing a path from the initial state through the tree to one of its final states.

Note that [Kui84] distinguishes between the two terms of *system function* and *system behaviour.* He interprets functionality in a teleological way (i.e. what the system is intended to do). An emergency power plant can serve as an example - its function is to maintain the operation of safety-critical electrical systems; its behaviour, however, is a temporary production of electric currency. Obviously the (teleologic) function of a physical system (in contrast to its behaviour) cannot be deduced solely from the system structure - this deduction requires additional meta-knowledge.

3. Applications and Current Research Topics

Industrial applications of qualitative simulation can be found in many areas like

- design
- model-based monitoring, diagnosis and repair

Current research activities mainly concentrate on the following areas:

- integration of multiple ontologies for representation and reasoning
- qualitative reasoning with uncertainty

- qualitative reasoning with microscopic theories
- application of qualitative simulation to engineering domains

3.1 The Laboratory

The Christian Doppler Laboratory for Expert Systems (founded in 1989) mainly deals with the application of *Artificial Intelligence* to engineering domains. In this context, qualitative simulation plays an important role for many problem areas like model-based monitoring and diagnosis.

In the field of qualitative simulation, we are currently investigating the following topics:

- qualitative simulation with multiple dimensions
- the integration of qualitative simulation and reasoning with uncertainty
- the application of qualitative simulation to model-based monitoring and diagnosis
- the integration of multiple ontologies for qualitative simulation and its implementation in an object-oriented language
- qualitative simulation of non-linear dynamic systems

References

[dKB84] Johan de Kleer and John Seely Brown. A Qualitative Physics Based on Confluences. *Artificial Intelligence*, 24:169-203, 1984

[For84] Kenneth D. Forbus. Qualitative Process Theory. *Artificial Intelligence*, 24:85-168, 1984

[For86] Kenneth D. Forbus. The Qualitative Process Engine. Technical report, University of Illinois, Department of Computer Science, 1986

[For89] Kenneth D. Forbus. Introducing Actions into Qualitative Simulation. In *Proceedings of the International Joint Conference on Artificial Intelligence*, pages 1273-1278, Detroit, August 1989. Morgan Kaufmann Publishers, Inc.

[Hay85] Patrick J. Hayes. The Second Naive Physics Manifesto. In J. Jobbs and B. Moore, editors, *Formal Theories of the Commonsense World*, pages 1-36. Ablex Publishing Corporation, 1985

[Kui84] Benjamin Kuipers. Commonsense Reasoning about Causality: Deriving Behaviour from Structure. *Artificial Intelligence*, 24:169-203, 1984

[Kui86] Benjamin Kuipers. Qualitative Simulation. *Artificial Intelligence*, 29:289-388, 1986

[Lac90] Franz Lackinger. Qualitative Methoden zur Simulation dynamischer Prozesse. In *6.Symposium Simulationstechnik*, pages 145-149. ASIM, Verlag Friedr. Vieweg und Sohn G.m.b.H., Braunschweig, September 1990

ASIM

ASIM (Arbeitsgemeinschaft Simulation) is an association for simulation in the German speaking area. ASIM was founded in 1981 and has now about 650 individual members.

Report on the last meeting of the ASIM board

The ASIM board met on April, 29 to discuss current affairs and future activities. 13 of currently 14 board members were present. Main points of discussion were the organisation of the *7. Symposium Simulationstechnik* in Hagen. The state of preparation was very good. The announced papers cover a broad field of simulation activities. More information on this conference see page 9.

ASIM plans to found new working groups in order to cover additional important fields of simulation activities. New working groups could be *"Simulation in den Wirtschaftswissenschaften"*, *"Simulation von Verkehrsabläufen"*, *"Simulation von Rechnern"* and *"Graphische Darstellung von Simulationsergebnissen"*. More information will be mailed to ASIM members as soon as it will be available. The co-operation of working groups has to be improved if further working groups will be founded. Further subjects of discussion were organisational improvements, layout and distribution of *ASIM-Mitteilungen*. The board will meet again on Monday, September 23rd, the day before the *7. Symposium Simulationstechnik*. Please contact a board member if you feel that the board should discuss a special subject.

ASIM general meeting

The next general meeting for all members will take place on Tuesday, September 24th at the *7. Symposium Simulationstechnik* in Hagen, after the end of the sessions. Detailed information will be sent to all ASIM members.

Contact Addresses

Austria and membership administration:

Prof. Dr. Felix Breitenecker,
Technische Universität Wien,
Abt. Simulationstechnik,
Wiedner Hauptstraße 8-10, A-1040 Wien
Tel: +43-(0)222 58801 5374,
Fax: +43-(0)222 5874211

Germany:

Dr. Ingrid Bausch-Gall,
Wohlfartstraße 21b,
W-8000 München 45
Tel: +49-(0)89/3232625,
Fax: +49-(0)89/3231063

Switzerland:

PD Dr. Jürgen Halin,
ETH Zürich,
Institut für Energietechnik,
Clausiusstrasse 33, CH-8092 Zürich.
Tel: +41-(0)1/256-4608,
Fax: +41-(0)1/262 2158 or 2520192

ASIM Meetings to come

September 24-26, 1991: **7. Symposium Simulationstechnik** in Hagen. This is ASIMs 1991 annual German speaking conference. For more information see page 9.

October 17-18, 1991: Working Group *"Simulationssoftware und -hardware"* meets at ETH Zürich. For more information see Reports from the Working Groups or contact Dr. J. Halin.

March 9-10, 1992: Working Group *"Simulation technischer Systeme"* meets at Universität in Paderborn. For more information contact Prof. G. Kampe.

May 7-8, 1992: Working Group *"Simulation und künstliche Intelligenz"* meets at Fraunhofer-Institut für Materialfluß und Logistik in Dortmund. For more information contact Dr. J. Krauth.

October 1992: Conference of the Working Group *"Simulation in der Fertigungstechnik"*. For more information contact Prof. Dr. A. Kuhn.

September, 1993: *8. Symposium Simulationstechnik* in Berlin. For more information contact Peter Schäfer, DAIMLER-BENZ AG, Forschungsinstitut, Alt-Moabit 91 b, W-1000 Berlin 21.

Other meetings with ASIM participation

November 21-22, 1991: *Arbeitsgespräch Physik und Informatik; Informatik und Physik* in München. This is a first common meeting organized by Gesellschaft für Informatik (GI), Deutsche Physikalische Gesellschaft (DPG) and Informationstechnische Gesellschaft (ITG). For more information contact Dr. Ingrid Bausch-Gall.

Reports from the Working Groups

Report from the Working Group "Simulationsmethoden und Sprachen für parallele Prozesse"

The 7th ASIM/GI workshop on simulation methodology for distributed systems and processes took place in Berlin on April 22nd and 23nd, 1991. Sponsor of the event, and local organizer was C.I.T., Communication and Information Technology GmbH (Dr. Scheschonk).

Participants came to equal parts from industry, private and/or public funded research groups, and universities. As the conference language for ASIM working groups is German, participants came from the German

speaking countries (in the case of Switzerland: from the German speaking part of it), and one Russian guest researcher based in Austria at present. Of course quite a proportion of participants came from the former GDR, though many communication obstacles were to overcome.

All participants presented either a paper or a short problem statement of their current work. The main objective of this annual working shop is not to present theoretical results, programs or tools, but to discuss problems and concepts among peers. The open, sometimes controversial but always friendly and intensive discussion is of great help for all participants, especially for those who are in the midst of their projects.

Topics of this workshop were (among others): parallel programming, partitioning of parallel simulation models, avoiding special cases in Petrinets, combining and connection of different simulation programs, the new class of 'objectnets' (an extension of Petrinets), problems in auctioneering and banking, problems with the re-use of software of different origin and the presentation of several simulation tools.

Abstracts of the papers etc. will be published in the ASIM series '*ASIM Mitteilungen No. 26*' .

Speaker of the working group: Dr. Hans Fuss, GMD-F1, Postfach 1240, W- 5205 St. Augustin 1. Tel: +49-(0)2241/14-2778, Fax: +49-(0)2241/14-2889

Report from the Working Group "Simulationssoftware und -hardware"

The working group "*Simulationssoftware und -hardware*" will meet on October 17 and 18, 1991 at the ETH Zürich.

Topics are: numerical optimization - algorithms, software and applications.

Introductory lectures will give an overview of available methods and especially on available software for the solution of optimization problems (parameter optimization and function optimization). Advantages and disadvantages of the methods and software products shall be discussed and compared.

Participants will report on their experiences with methods and software in typical applications.

All papers will be published as *ASIM-Mitteilungen*. Everyone interested in this meeting (also non-ASIM members are welcome) are asked to contact the speaker of the working group.

Speaker of the working group: PD Dr. J. Halin, ETH Zürich, Institut für Energietechnik, Clausiusstrasse 33, CH-8092 Zürich. Tel: +41-(0)1/256-4608, Fax: +41-(0)1/262-2158

Report from the Working Group "Simulation und künstliche Intelligenz"

The ASIM working group "Simulation and Artificial Intelligence" held its fourth workshop in April 1991 in Berlin at the Central Institute for Cybernetics and Information Processing of the Academy of Sciences of the former GDR. To organize this event was somewhat difficult because the communication between East and West Germany does not yet conform to West European standards.

In spite of these problems the meeting has been a great success. More than thirty participants had very intensive discussions about the twelve contributions which addressed theoretical problems as well as problems related to different applications of simulation techniques. A major application field has been the simulation of manufacturing and production systems, but also environmental systems and even tennis simulation were discussed. The second day was mainly devoted to a very vivid round-table-discussion on object oriented modelling approaches and their advantages over conventional techniques. This discussion was seen as very interesting and helpful by all participants, and it was decided to have such events in future workshops too, maybe with an introductory tutorial by an invited expert.

The presented papers and a short summary of the round-table-discussion will be published as *ASIM-Mitteilungen No.25* and can be ordered from the ASIM-speaker.

The next workshop on simulation and AI will be held on the 7th and 8th of May at the Fraunhofer-Institut für Materialfluß und Logistik in Dortmund. More detailed information will be published on time in later issues of this journal.

Speaker of the working group: Dr. Johannes Krauth, BIBA, Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaft, Postfach 33 04 40, W-2800 Bremen 33. Tel: +49-(0)421/22009-43, Fax: +49-(0)421/22009-79

Report from the Working Group "Simulation in Medizin, Biologie und Ökologie"

no report received

Speaker of the working group: Dr. D. Möller, Drägerwerk AG, GB Medizintechnik, Moislinger Allee 53-55, W-2400 Lübeck. Tel: +49-(0)451/8822940, Fax: +49-(0)451/8823779

Report from the Working Group "Simulation technischer Systeme"

The ASIM Working Group "Simulation of Technical Systems" had its annual spring workshop on March 4-5, 1991. About 80 participants from industry, universities and research centers met at the Institute for Flight Systems Dynamics within the German Aerospace Research Establishment at Oberpfaffenhofen near Munich.

The program was divided into four sessions:

1. Reports from the Institute for Flight Systems Dynamics at DLR:
The modular simulation design and analysis tool ANDECS was presented, which is based on RSYST and allows a selection of methods and data as well as the management of simulation projects. Other papers focussed on the dynamic simulation of ground vehicles and on the multisensory telerobotic concepts for space and underwater applications. The realization of these concepts was shown to the participants during a visit to the nearby labs.

2. Reports from ASIM members:
These papers showed a broad spectrum of simulation applications: hydraulically driven handling systems, analysis of manual working operations according to the MTM method, railway wheelset modelling, Elbe river pollution control, and online simulation with the SIMUL_R software package.

3. Simulation of electrical circuits:
The simulation of power electronics with NETASIM as well the features of ICAPS for analogue circuits were presented. Computer aided filter design with FILSYN, and switch-level timing models in digital MOS circuits were the topics in further papers.

4. Simulation of vehicles:
This session has been organized by members of the BMW Motor Company's research center. In an introduction, an overview on the BMW vehicle simulation toolbox was given. A modular model library for cars and motorcycles allows a high flexibility in vehicle design. In a simulation project the application of radar sensors in ABS control was studied. The advantages of a single track model for the design of vehicle control systems was explained by various examples.

The workshop dinner was sponsored by the BMW Motor Company and allowed fruitful discussions in the pleasant atmosphere of a bavarian inn.

At the end of the workshop the participants visited the German Space Operation Center and got interesting information about the challenges and risks of mission control.

All contributions of this Workshop (*ASIM-Mitteilungen No.24*) are available from ASIM or from Prof. G. Kampe.

Speaker of the working group: Prof. Dr.-Ing. Gerald Kampe, FHT Esslingen, Flandernstraße 101, W-7300 Esslingen. Tel: +49-(0)711/394-258 or 266

Report from the Working Group "Simulation in der Fertigungstechnik"

The working group met for a conference on "*Simulation und Verstehen*" in March 1991 in Hannover. More than 80 participants presented papers or participated at the discussion. Subjects of the conference were:

Fabriksimulatoren für Strategie- und Struktur-entscheidungen, Am Simulator üben und erproben, Simulatoren für Schulung und Qualifizierung, Experimente bis zur Gesetzmäßigkeit, Interpretationsverfahren: Simulationsergebnisse wollen verstanden werden, Der Mensch im Produktionssystem: Belastung und Beanspruchung bewerten lernen.

Conference proceedings in German language are available from: gfmt - Gesellschaft für Management und Technologie - Verlags KG, Lothstraße 1a, W-8000 München 2.

At a second meeting, as well in March 1991, several members of the working group discussed future projects. The next conference of the working group will probably be held in October 1992.

Speaker of the working group: Prof. Dr.-Ing. A. Kuhn, Fraunhofer-Institut für Transporttechnik und Warendistribution, Emil-Figge-Straße 75, W-4600 Dortmund 50. Tel: +49-(0)231/7549-130, Fax: +49-(0)231/7549-211

Software Comparison

All ASIM members being specialists for certain simulation languages or developers of simulation software are invited to solve one of the software comparisons introduced in EUROSIM - Simulation News Europe. Please send your contribution to the editors.

ASIM Co-operation with GMA

The GMA committee 1.3 on "Modelling and Simulation in Automation" organizes a conference on

Modelling for Control and Simulation
Methods, Tools, Case Studies

which will take place on March 25-26, 1992 in Langen/Hessen, Germany. Topics include Modelling, Model reduction, Software tools for support of modelling and simulation. Speakers are: I. Troch, W. Bub, P. Lugner, H.G. Natke, B. Thomson, K.O. Proskawetz, M. Köhne, P.C. Müller, S. Engell, K.H. Fasol, W. Kortüm, G. Leister, A. Schumann, W. Marquardt.

Contact: Prof. I. Troch, Technische Universität Wien, Wiedner Hauptstraße 8-10, A-1040 Wien, Austria, Tel.: +43-(0)222 58801 5374, Fax: +43-(0)222 5875863.

ASIM 91

7. Symposium Simulationstechnik

Annual ASIM Conference

September 23 to 26, 1991

organized by Prof.Dr.-Ing. Dj. Tavangarian
University of Hagen

Invited papers by: Prof.Dr. R. Piloty (TH Darmstadt), Prof.Dr. H. Rake (RWTH Aachen), Prof.Dr. R. Schehrer (University of Dortmund), Prof.Dr. W. Giloi (TU Berlin), Prof.Dr. F. Breitenecker (TU Vienna).

119 papers in 4 parallel sessions. Topics are modelling and methodology, simulation tools (hardware and software), and applications.

Exhibition of simulation hardware and software during the conference.

Proceedings in the book series "*Fortschritte in der Simulationstechnik*" at Vieweg-Verlag will be available at the conference.

User Group Meetings on MATRIX$_X$, AGO, SPICE, Matlab, ACSL.

Tutorials on VHDL, RISC architecture, fuzzy-sets.

Contact Address: FernUniversität Hagen; Technische Informatik II / ASIM 91, Postfach 940, D - 5800 Hagen 1, Fax: +49-(0)2331 804 313

DBSS

DBSS-Membership

Individuals (in particular Dutch speaking ones) and institutes etc. from the Benelux countries, interested or active in the field of simulation, can become DBSS-member. Membership fee (per annum) is in 1991:

- personal member:
  50 guilders or 900 Belgium francs
- institutional member:
  100 guilders or 1800 Belgium francs

DBSS-members receive "EUROSIM-Simulation News Europe" and can benefit in many cases from special discounts on conferences, meetings, organized by DBSS or other member societies of EUROSIM, IMACS and SCS.

Notice to DBSS members:

Unfortunately, there still are members who did not pay their membership fee for 1990 and/or 1991 up to now. We kindly but urgently request them to pay the due fee as soon as possible on the giro account of the treasurer (see below).

Contact addresses

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

ir. J. C. Zuidervaart
Rekencentrum
Delft University of Technology
P.O. Box 354
2600 AJ Delft, The Netherlands

(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 (1990 and/or) 1991.

If you changed address or your address is incomplete, please inform the acting secretary.

If you are interested to contribute in future activities of DBSS or if you have ideas in this respect, please contact the acting secretary.

Do you have information for 'EUROSIM-Simulation News Europe', please send it to the acting secretary.

Events in the foregoing period

1. DBSS members have been invited to attend a lecture entitled "**Lindenmayer Systems**" by **Narendra S. Goel** (Department of Systems Science, State University of New York). This event was held May 30, 1991 at the University of Ghent.

Short contents: L-systems have been widely used to model structures of plants and trees. L-systems have many attractive features: (a) Simplicity - simple rules can generate complex structures and behaviours; (b) Variety - small changes in the rules produce a variety of structures and behaviours; (c) Modularity - rules can be modulary combined to generate more complex structures; (d) Universality - applicable to different disciplines of science and engineering; and (e) Fun to play with while doing serious science.

In the talk, all of the above features have been illustrated. In particular, a variety of applications of L-systems have been presented including the simulation of a corn plant growth, to designing castles and cottages, for modelling optical scattering from objects of arbitrary shapes for use in remote sensing, to create musical composition, and for doing symbolic computations. A video tape presenting some of these simulations has been shown.

2. In the period June 10-15, 1991 two major seminars have been organized jointly by SCS, CESC (Continental Europe Simulation Council of SCS) and DBSS:

a) **STRUCTURED PROGRAMMING IN ADA** (June 10-11, 1991)

presented by:

Ralph C. Huntsinger PhD (Computer Science Department, California State University Chico, Chico, CA 95929, USA).

Course Contents:

Monday, June 10, 1991:

* Language Syntax Introduction with Examples
Types and Values, Expressions and Statements, Subprograms and Blocks

* Special Features of Ada
Exceptions, Packages, Input/Output

Tuesday, June 11, 1991:

* Parallelism etc.
Program Structure, Parallel Programming, Generics, Separate Compilation Tasking and Rendez-vous

* Application to Simulation
Access Types, Special Packages, Discrete Systems Simulation, Continuous Systems Simulation

Course Material:

Paul A.Luker (1987) "Good Programming Practice in Ada", Blackwell-Scientific, Oxford. A copy of the book was included in the registration fee.

b) **COMPUTER-AIDED MODELLING OF CONTINUOUS PROCESSES** (June 12-15, 1991)

presented by:

Francois E.Cellier, PhD (Dept. of Electr. & Comp. Science, University of Arizona, Tucson, AZ 85721, U.S.A.

Course Contents:

Wednesday, June 12, 1991:

Introduction to Continuous System Modelling CSSL Languages, Electrical Circuit Modelling, Mechanical System Modelling, Hierarchical Modelling, ACSL, CTRL-C, and MATLAB

Thursday, June 13, 1991:

Modular Modelling, DYMOLA, Bond Graphs, Thermodynamic and Chemical Reaction Bond Graphs

Friday, June 14, 1991:

Qualitative Modelling, Knowledge-Based Modelling, Naive Physics, Pattern-Based Modelling, Inductive Reasoning, Neural Network Modelling, Genetic Algorithms, QualSim, SAPS-II, NEUNET-DESIRE

Saturday, June 15, 1991:

Object-Oriented Modelling, Automated Model Synthesis, System Entity Structures, Time Windows, Event-Based Intelligent Control, Fault Diagnosers and Watchdog Monitors, Task Planners, an Architecture for High Autonomy Systems, DEVS-Scheme

Course Material:

F.E. Cellier (1991) "Continuous System Modeling", Springer-Verlag, New York. A copy of the book was included in the registration fee.

Coming events

1. It is planned to have a one-day meeting for DBSS members in the beginning of October 1991 on the subject "**Computer Graphics / Computer Animation in Simulation**". The meeting will take place at Delft University of Technology. The organisers of the meeting are intending to invite speakers from research institutes as well as from industrial companies.

As soon as the final program of the meeting is known all DBSS members will receive a personal invitation to attend.

2. The "DIANA-meeting" is to be held at the end of October 1991. The meeting will focus on the following topic in the domain of systems simulation: **Structural analysis through parallel finite element simulation with the software package DIANA.**

DIANA is a finite element analysis software package developed by TNO Institute for Building and Construction Research (Rijswijk, The Netherlands). DIANA can be used to model and simulate the mechanical and physical behaviour of a large variety of structures. The finite element analysis of many engineering problems is very computation intensive; the use of vector/parallel computers is therefore inevitable. First, DIANA and its application fields will be discussed. Then the modelling and parallelization of the I/O-system for the DIANA-database will be considered, followed by a presentation of a methodology for parallel direct solution of large sparse matrix systems and its implementation onto DIANA. Finally, some results of the parallel iterative solver will be discussed.

Related events

On October 23, 24, 30 and 31, 1991 PATO organizes a course on "Simulation of Dynamic Systems" at the Delft University of Technology.

Further information: PATO, P.O. Box 30424, 2500 GK Den Haag, Tel: +31-(0)70 3644957, attn. drs. M.M.P. Kimmel.

FRANCOSIM

The idea of a French speaking simulation society has been first discussed in Lyon in March 1989 during the workshop "A.I. in Numerical and Symbolic Simulation". However, it took one full year to mature the idea and the society has finally been informally founded in Liège (Belgium) on the 3rd of April, 1990. At the moment FRANCOSIM is being founded formally. More information will be available in the next issues.

Any information about the society may be obtained from

FRANCOSIM
c/o Maison de la Productique
Esplanade Diderot
F - 42300 Roanne, France
Tel.: +33-77.71.20.00
Fax: +33-77.72.52.99

or

F. Lorenz
Lorenz Consulting sprl
Clémodeau 196A
B - 4550 Villers-le-Temple, Belgium
Tel.: +32-(0)85 51 23 90

ISCS

General Information

The Italian Society for Computer Simulation (ISCS) is a scientific non-profit 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 actually consisting of the following persons:

G. Iazeolla	(chairman)
F. Cennamo	(vice-chairman)
V. Grassi	(treasurer)
M. Colajanni	(secretary)

Membership

At present the membership situation is as follows: 108 members, 7 of which are institutional and 4 are honorary, 95 are regular members and 2 are affiliate ones.

Charges per annum are Lit. 20,000 for regular and affiliated members and Lit. 350,000 for institutional members.

Contact addresses

For further information of application for membership, please contact:

ISCS
c/o Dip.to Ing. Elettronica
Università di Roma II
Via O. Raimondo, 8
I - 00173, Roma, Italy
Tel: +39-(0)6-79794.473/.477/.486
Fax: +39-(0)6-2020519
E-mail: IAZEOLLA@IRMENEA.BITNET

Activities

The ISCS activities in the period February through June 1991 can be synthesized as follows:

1. A co-operation has been promoted between the University of Rome II and IBM ECSEC scientific center of Rome in the area of parallel and vector processing for linear algebra problems. As a first step, a cycle of five seminars (in co-operation with Intel Scientific Computers too) has been held at the University of Rome II on some relevant topics in this area.

2. After the decision taken at the 1990 ISCS annual meeting of organizing Simulation Working Groups, the ISCS steering committee is now collecting adhesions to the proposed Working Groups from the ISCS members. First goal of these groups is to organize regular meetings between ISCS members interested in the same simulation field, in order to provide a forum for presentation of results, exchange of ideas and scientific discussions. In a second step the Working Groups may establish contacts with other yet existing regional groups having analogous interests.

For all who are interested, the proposed Working Groups are here reported:

- Simulation in Industry
- Simulation in Agriculture and Environmental Sciences
- Simulation in Training and in Education
- Simulation of Biological and Medical Systems
- Simulation of Stochastic and Fluctuation Systems
- Simulation Methodologies
- Parallel and Distributed Simulation
- Software and Hardware for Simulation
- Graphical Simulation
- Expert Systems and Simulation

Adhesions (even from non ISCS members) and new proposals are welcome.

3. The ISCS is currently involved in the organization of the 4th European Simulation Congress which will take place in Capri, Italy, from September 29, 1992 to October 2, 1992, see also page 36.

SIMS

The Scandinavian Simulation Society SIMS has about 260 members from Denmark, Finland, Norway and Sweden. For 32 years SIMS has served as the regional simulation society in Scandinavia, gathering individuals and organizations involved in simulation. The activities have been concentrated on arranging annual meetings and courses, delivery of information, and co-operation at European and international level in the field of simulation. The 33rd annual meeting of SIMS was held in close connection to the European Simulation Multiconference ESM 91 in Copenhagen. Torleif Iversen, PhD, Research Scientist at SINTEF in Trondheim, Norway, was elected as chairman for SIMS, Markku Hänninen is continuing as secretary, Lars Lidner as treasurer and Odd Falmyr, Mats Johansson, Erik Mosekilde, Paul Rathje and Sakari Kaijaluoto as board members. Kaj Juslin is acting as international liaison.

SIMS-92

The 34th annual SIMS meeting will take place June 10-12, 1992 at Lappeenranta Technical University of Technology, Lappeenranta, Finland. Topics of interest include, but are not limited to

- modeling of physical phenomena and process components,
- verification and validation of models,
- engineering simulators,
- training simulators,
- man-machine interaction, and
- calculation of thermophysical properties.

The conference is aimed to users of simulation software, software developers and vendors, research organizations and universities. The authors of papers should submit an abstract describing their work to SIMS secretariat by December 1, 1991. Acceptance will be notified by December 31, 1991. The official language of the conference is English.

How to join SIMS

As a member of SIMS, you will get SIMS Information Letters, EUROSIM Simulation News Europe, and additional information on courses, projects and meetings in the field of simulation. SIMS members have reduced participation fees on many simulation congresses. If you or somebody of your Nordic colleagues are interested in simulation but not yet a member of SIMS, then just send an informal application or recommendation for membership to the SIMS secretariat:

c/o M. Hänninen,
VTT/YDI, P.O. Box 208
SF-02151 Espoo, Finland
Tel: +358-0-4565024,
Fax: +358-0-4565000

UKSC

Reports on UKSC Meetings

Following the success of the UKSC 90 Conference held at the University of Sussex in September, UKSC has returned to its regular pattern of one-day meetings.

A meeting was held at the Lucas Advanced Engineering Centre, Solihull, West Midlands, in March, on the topic of "Automotive Simulation". The following papers were presented:

'Automotive Electrical Systems', M.J. Holt, Engineering Computing Dept., Lucas Advanced Engineering Centre.

'Finite Element Analysis in Car Body Design', M.D. Austin, Rover Group, Body Engineering Dept., Cowley, Oxford.

'Databus Simulation', N.J. Devaney, Electronic Systems Dept., Lucas Advanced Engineering Centre.

'Modelling of Automotive Vehicles for Motion Control Studies', A.L. Costa and R.P. Jones, Engineering Dept., University of Warwick.

'Drive-train Dynamic Simulation', P.C. Mason, Engineering Computing Dept., Lucas Advanced Engineering Centre.

'Using Computational Fluid Dynamics in the Automotive Industry', C. Shaw, Engineering Dept., University of Warwick.

A number of interesting demonstrations were also provided in the Lucas Advanced Engineering Centre.

A further meeting was held on May 8th at Middlesex Polytechnic, Bounds Green, London. The topic was "Simulation in Robotics" and the following presentations were made:

'Robot Kinematics', S. Adams, South Bank Polytechnic, London.

'Interactive PC-based Robot Simulator for the Disabled', T. Parsons, Middlesex Polytechnic.

'ROSIE Simulation Tool', Cambridge Control Ltd.

'Neural Network Object Recognition', B. Parsons, Kodak and M. Stoker, Middlesex Polytechnic.

'Offline Programming and Robot Calibration', D. Stanton, University of Surrey, Guildford.

'Learning to use Grasp Effectively', D. Saunders, Portsmouth Polytechnic.

'Simulation of Rehabilitation Robots using CATIA', S.Prior, Middlesex Polytechnic.

Some commercial software demonstrations were also given at this meeting.

The UKSC Steering Committee is very grateful to all those concerned with the organisation of these two meetings.

Future Meetings

One-day meetings are planned on the following topics:

'Aerospace Simulation' at Rediffusion, Crawley (Autumn 1991, organised by D. Vint).

'VLSI CAD Simulation' at University of Manchester (Autumn 1991, organised by N. Filer)

'Military Simulation' at RMCS Cranfield (February 1992, organised by I. Whitworth).

Future Conferences

Members of the UKSC Steering Committee are involved in arrangements for the European Simulation Multi-Conference 92, which will take place in York during the period 1-4 June 1992.

Steering Committee

Keith Nock has retired from the Committee after many years of service. His role as Honorary Treasurer has been taken over by Adrian Magill. The present and past Chairmen of UKSC wish to record their thanks to Keith for all the work which he undertook so efficiently during his period on the Steering Committee.

Further details about UKSC membership and events may be obtained from:

Mrs. Elizabeth Rimmington
Computing Centre
Watts Building
Brighton Polytechnic
Moulsecomb
Brighton BN2 4GJ
United Kingdom
Tel: +44-(0)273 600 900

or from:

Dr. R.N. Zobel
Department of Computer Science
University of Manchester
Oxford Road
Manchester M13 9PL
United Kingdom
Tel: +44-(0)61 275 6210
Fax: +44-(0)61 275 6280

Hungarian Simulation Group - IMACS Hungary

Considering the fact that simulation is an applied science that can have an important impact on the fields of applications we intend to organize demonstrations and lectures in the last quarter of this year where simulation tools and methods can be introduced to the experts of the application fields.

Our aim is to close or at least to diminish the gap between R&D activities and the communities of the fields of application. We also intend to include scientists from abroad - with whom we have scientific co-operation - in our activities.

A selection of extended versions of papers presented at the *IMACS European Simulation Meeting on Problem Solving by Simulation* held in Hungary, Esztergom last year will be published in a special issue of the journal *Mathematics and Computers* in Simulation.

We find it important and are involved in the education of simulation on both graduate and post-graduate levels of Hungarian as well as foreign students.

Further information can be obtained from the chairman:

Prof. Dr. A. Javor, Institute for Measurement and Computing Techniques, Central Research Institute for Physics, Hungarian Academy of Sciences, P.O. Box 49, H - 1525 Budapest, Tel.: + 36 1 1699499, Fax: + 36 1 1553894

YUSIM

General Information

The Yugoslav Simulation Society (YUSIM) is an informal association formed in the autumn of 1990, with the idea to reach the formal status in about one year. YUSIM recently has about 40 members. Co-ordinator of the society is Professor Vlatko Ceric (see address below).

YUSIM is proposed to be a member society of EUROSIM.

Key YUSIM goals will be to promote the following:

- research in simulation modelling and analysis;
- teaching simulation methodology on the University level;
- development of simulation studies of real systems;
- development of simulation software;
- teaching simulation methodology and practice for users in industry and federal organizations;
- co-operation with international experts in the field;
- dissemination of information for members of YUSIM about the simulation activities on the international scene.

Activities in the beginning of 1991

Concerning the further steps in the formal organization of YUSIM, the idea of forming a YUSIM board is being circulated among YUSIM members. It is expected that till autumn 1991 the YUSIM board will be formed and will decide about the procedure of YUSIM formal organization.

In a regular monthly seminar on "Simulation Modelling", organized by Prof. Vlatko Ceric on the Faculty of Economics, University of Zagreb, the following lectures were given in 1991:

Dr. Nikola Masic, "Neural Networks"; Prof. Dr. Gabro Smiljanic, "Teaching of Modelling and Simulation on the Faculty of Electric Engineering in Zagreb"; Prof. Dr. Mladen Alic, "Population Dynamics Modelling"; Dr. Tarzan Legovic, "Modelling and Simulation of Ecosystems"; Dr. Vesna Luzar, "Monte Carlo Method and Statistics".

Further activities in 1991

The following activities are proposed:

YUSIM members have society meetings (besides professional lectures and contacts) on two conferences in Yugoslavia in 1991.

The 13th International conference "Information Technology Interfaces ITI-1991" was held in Cavtat near Dubrovnik, from 10-14 June 1991.

The 18th Yugoslav operational researchers symposium SYM-OP-IS'91 will be held in Herceg Novi, from 8-11 October 1991. It will have a simulation section, and one of the international invited lecturers will be from the simulation modelling area. The YUSIM society meeting will be held during the symposium.

A new international journal: "Yugoslav Journal of Operations Research" (YUJOR) is just being founded. It will deal with theoretical and computational aspects of operations research, systems science and management science. It is published semi-annually, two numbers in one volume, and will publish contributed papers, survey papers, tutorial expositions and technical notes. The International Editorial board is including several researchers in the field of simulation. Simulation researchers and practitioners are invited to send their contribution to the following address:

YUJOR Editorial Office, University of Belgrade, Faculty of Organizational Sciences, Lab. of Operations Research - LABOR, Jove Ilica 154, YU - 11000 Belgrade, Yugoslavia, Tel: + 38 11 465 855, Fax: + 38 11 461 221

Books for review should be sent to the same address. For subscription refer to : JUGOSLOVENSKA KNJIGA, Trg Republike 5/VIII, YU - 11000 Belgrade, Yugoslavia.

Information

Any information about the society may be obtained from: *Professor Vlatko Ceric, Faculty of Economics, University of Zagreb, Trg J. F. Kennedy 6, YU - 41000 Zagreb, Yugoslavia, Tel: + 38 41 231 111, Fax: + 38 41 235 633*

International Societies

IMACS

IMACS has decided to create a new Technical Committee i.e.

TC-2: Mathematical Modelling

This TC will decide itself upon its activities and the intensity with which these are performed. One of the main tasks will be co-operation (esp. in the IPC) at conferences devoted to this topic and which are sponsored by IMACS or other societies co-operating with IMACS (e.g. IFIP, IFAC). Especially, there is a plan to have in 1993 an international symposium on this topic in Vienna (organizers: I. Troch, F. Breitenecker).

The first meeting of all those interested in this TC will take place during the IMACS Congress in Dublin.

Contact:

Prof. Dr. I. Troch,
Technische Universität Wien,
Wiedner Hauptstraße 8-10,
A - 1040 Wien, Austria,
Tel.: +43-(0)222 58801 5367,
Fax: +43-(0)222 5875863.

Book News

This section will present new books and journals on simulation. Editors and publishers are invited to send short announcements to be published here to the editors of EUROSIM - Simulation News Europe.

The journal *Mathematics and Computers in Simulation*, published bimonthly by Elsevier Science Publishers, will appear in a new cover as of volume 33, issue 1, July 1991. The journal covers a wide scope of topics in the field of computer simulation of systems and publishes material that ranges from short concise research papers to more general tutorial articles.

Write for further information to the Publisher, P.O. Box 103, 1000 AC Amsterdam, The Netherlands.

Industry News

This section is intended to inform readers about new simulation products and activities from companies related to simulation. Companies are invited to send contributions (10 to 20 lines) to be published here to the editors of EUROSIM - Simulation News Europe.

Origin Software will be presenting their MATCH parametric cost estimating model during the International Summer School in Logistics Engineering which is being held at Exeter University, England, from 15th to 26th July. The Summer School concentrates on the concepts underlying MIL-Std-1388-1A/2A, and Match is being presented as a tool for generating inputs to Life Cycle Cost models at the concept design stage of the new product development.

Details of the Summer School are available from Exeter University (Tel: +44 392 411906) and information about Match from Origin Software Ltd. (Tel: +44 892 667880) or from Origin Italia (Tel: +39 6 5263000, Fax: +39 6 5515662).

Scientific Computers GmbH is member of a European group of companies - the Scientific Computers Group - with three bases: London, Paris and Aachen.Tel: +41-(0)444 235101, +33-1-45770813, +49-(0)241 26041.

The company is specialised in the needs of scientists and engineers in the fields of Simulation, Knowledge Technology and Image Processing.

The product portfolio in detail:

1. Hard- and software products for discrete and continuous simulation, hybrid simulation and "Hardware-in-the-Loop" simulation (Ctrl-C, Model-C, XANALOG)

2. COBOL-Reverse-Engineering (Hypersoft)

3. Hybrid and inductive Expert System Shells for PC, Sun, VAX and Macintosh (GoldWorks III under MS-Windows 3.0, Leonardo, Ist Class)

4. Full Common Lisp Compiler with graphic and window environment for 80386/80486 under DOS, UNIX and AIX, IBM RS 6000 and DEC/VAX Computer

5. Neural Network Development Tools and Machine Learning Tools (NeuralWorks Professional, AIM)

6. Knowledge-based Image Processing (KBVision)

Simulation Training Activities in the Carl-Cranz-Gesellschaft (CCG) at Oberpfaffenhofen - Germany

The Carl-Cranz-Gesellschaft has been active in the expanding field of post-graduate scientific education for almost 30 years. Its training activities concentrate on the continuing training of scientists, engineers, technical managers, and other staff members involved in various fields of engineering and science in industry, research organizations, universities, administration with special emphasis to

- computer science and information processing including various fields of application such as image processing, CAD, artificial intelligence;
- communications engineering and networks;
- remote sensing, radar and microwave engineering including their application to earth sciences, command and control, ecology;
- system dynamics and control with applications in flight systems, robotics, vehicle and traffic systems;
- aerospace engineering and sciences and their applications such as satellite communications, remote sensing.

Starting with three tutorials in 1964, the lecture program of the society has expanded to more than 100 short courses annually. These tutorials of 2 to 5 days duration are intended to introduce attendants into new fields of research and application as well as to give experts an opportunity to keep up-to-date with new results of research and development. Lecturers are scientists and experts from all over the world. Attendance is in general restricted to 25 to ensure successful training of every participant.

Simulation and its various theoretical and practical aspects are playing a major role in the CCG Lecture Series. With respect to its main topics the CCG-program comprises seminars and tutorials on

- modelling and simulation of continuous and discrete systems
- simulation with bond graphs
- robotics and simulation
- simulation of multibody systems and vehicles
- simulation languages
- simulation as a decision tool
- simulation of parallel processes with transputers
- prototyping
- requirements engineering

The Carl-Cranz-Gesellschaft offers among others the following tutorials on simulation:

"Numerical Integration Methods for the Simulation of Constrained and Unconstrained Mechanical Systems" 30.9.1991-2.10.1991

"Simulation als Entscheidungshilfe in Führungssystemen" 14.10.1991 - 18.10.1991

"Simulation diskreter Systeme" 13.11.1991 - 15. 11. 1991

"Programmierung und Simulation paraller Prozesse in OCCAM auf Transputern" 28.10.1991 - 30.10.1991

"Realistische Simulation Dynamischer Systeme mit Bondgraphen" 17.3.1992 - 19.3.1992

"Flug - und Systemsimulation - Einführung in die Simulationstechnik" 23.3.1992 - 27.3.1992

"Simulation kontinuierlicher Systeme" 18.5.1992 - 21.5.1992

"Simulation als Ausbildungshilfe" 19.10.1992 - 23.10.1992

For further detailed information please contact:

Carl-Cranz-Gesellschaft (CCG)
D - 8031 Oberpfaffenhofen, Germany
Tel.: +49-(0)8153 28 444
Fax: +49-(0)8153 28 1345

Simulation and Control at TZN Forschungs- und Entwicklungszentrum Unterlüß GmbH

TZN is a technical research and development facility located in Unterlüß north of Hannover, Germany. TZN does applied research and development; constructs prototypes, pilot installations, and special instruments; develops application and system software; and performs simulations and related studies.

Established in April 1986 with only 15 people, TZN was created as a development center and initially worked to develop military applications. After a four and one-half year existence, however, TZN is now focusing their efforts on technology transfer from the military to the civilian market, with a staff of 75 people.

The expertise of TZN is especially valued by the small- and medium-sized companies which cannot afford high-quality instruments and expensive testing equipment. TZN also has mobile equipment to permit on-site measurements and tests.

Besides serving as a development center for military applications, TZN is also using its considerable technical skills to assist the auto industry (e.g. Porsche and VW) in sensor and control system technology and to support research and development in former East Germany.

TZN has seven labs, all of them supported by a central computer facility.

Sensor technology, image and signal processing, micro-electronics, computer-aided simulation, laser technology, real-time graphics, and test and integration are all part of TZN's applied research and development.

TZN uses high-performance software packages and modern hardware for the simulation of components, systems and sequences.

TZN uses the MELISSA simulation language for applications. MELISSA is an interactive simulation tool and a preprocessor to ADSIM. ADSIM is a trade mark of Applied Dynamics International.

With the aid of the MELISSA simulation system, tasks are solved on the basis of module-oriented programming. This system is characterised by its simple and fast applicability. In addition to software tools, ultramodern hardware is also used for the design and optimisation of controllers. These facilities make it possible to design sturdy and adaptable controllers to satisfy the quality requirements in question.

The 'hardware-in-the-loop' plant is a central item of equipment at TZN. Its most important components are two motion simulators and a fast simulation computer. This configuration permits the incorporation of real parts (sensors, digital controllers, on-board computers) in the simulation process.

In this way the effect of rotary and relative motions can be investigated realistically. A high-capacity image simulation computer calculates situation-dependent scenes in real time and represents them visually. The plant permits image-linked operations with the operator or with an image processing system in the simulation circuit (e.g. flight simulator).

With the named equipment TZN is engaged in simulation activities listed below

- sensor simulation (IR and MMW)
- missile simulation
- image simulation
- satellite docking simulator
- simulation of hydraulic valves
- simulation of multibody systems
- closed loop simulation with controller and sensor systems.

For further information please contact

Bernd Schmidt
TZN Forschungs- und Entwicklungszentrum
Unterlüß GmbH, Dept. TZ, P.O. Box 27
D-3104 Unterlüß
Tel: +49-(0)5827 87-666, Fax: +49-(0)5827 5356

Simulation Activities within the Electronic Engineering Department University of Rome II

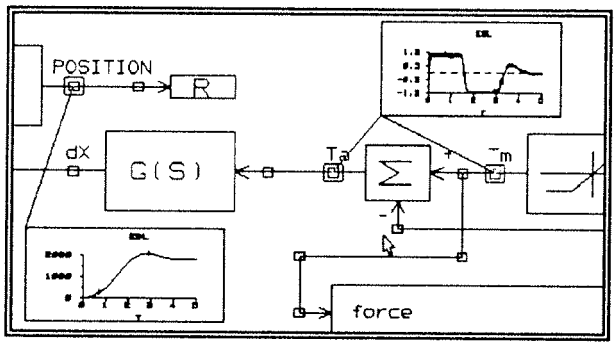
The Parallel Activity Group (PAG) within the Electronic Engineering Department, University of Rome II, has been involved in the development of parallel simulation tools since 1987. In these last years, most of the efforts of this group have been concentrated on the development of a discrete simulation parallel tool, based on the "time-warp" paradigm.

Time warp is an asynchronous optimistic paradigm for the implementation of distributed discrete simulation. At PAG, a Time Warp Operating System (TWOS) has been designed and it is currently being implented on an iPSC/2 INTEL hypercube.

Each instance of TWOS which resides at a hypercube node behaves as a high level scheduler which guarantees the appropriate advancement and synchronization of the processes involved in the simulation. One of the main efforts in the implementation of TWOS has been to make the process synchronization mechanism as much transparent as possible to the user. Presently, the TWOS allows each user to write his simulation processes according to the conventional (and probably more familiar) methodologies of sequential discrete simulation; the only difference is that the variables which constitute the state of each process must be explicitely declared.

Further details may be obtained from:

Dr. Bruno Ciciani
Dipartimento Ingegneria Elettronica
Università di Roma II
Via O. Raimondo
I - 00173 Roma, Italy
Tel: +39-(0)6 79794477
Fax: +39-(0)6 2020519



ESL: THE LANGUAGE OF SIMULATION

With over seven years development maturity, ESL is **THE** simulation language for advanced applications.

Developed with the support of the European Space Agency and used on several advanced projects, ESL offers a full range of simulation facilities.

Whatever your process, if it can be modelled, it can be simulated by ESL.

* Advanced language features for handling continuous mathematical models with discontinuities.

* Advanced graphical interface for generating simulation models and displaying results.

* Interpretive running for checking or compiled Fortran 77 code for optium performance.

* Hardware support includes PC-AT, SUN and DEC workstations, IBM RS6000, VAX, Prime and Gould Minicomputers.

* Low cost evaluation copies available.

* Regular seminar and training course programme.

* Alternative textual or pictorial block model definition.

For more information contact:-

Dr J L Hay

iSiM SIMULATION
A Divison of Salford University Business Services Ltd
Salford Tramways Building
PO Box 50
Frederick Road
SALFORD, M6 6BY
England

Tel: 44 (0)61 736 8921 Fax: 44 (0)61 737 0880

Comparison of Simulation Software

EUROSIM - Simulation News Europe started 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, shall be compared.

The idea has become quite successful. Here we would like to thank all the authors who took the challenge and the time, solved the problems, documented them and sent in their contributions.

Up to now each issue of EUROSIM - Simulation News Europe introduced a new comparison. We now repeat the description of the first two comparisons so that you can still participate, especially with simulation languages that have not yet been introduced. Also a new comparison is published, page 31.

We invite all institutes and companies developing or distributing simulation software to participate in this comparison:

Please, simulate the model described and send a report to the editors in the following form:

- short description of the language
- model description (source code, diagram, ...)
- results of the tasks with experimentation comments
- approx. 1 page A4

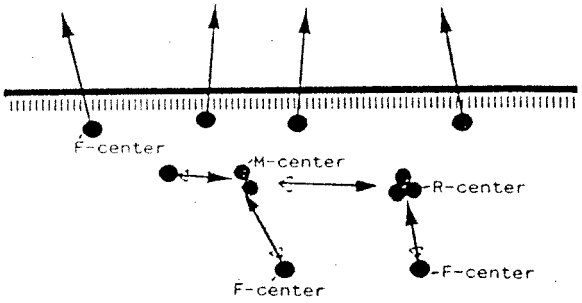
Reports will be published in the next issues of EUROSIM - Simulation News Europe.

New comparisons will be prepared for the next issues. As it is difficult to find suitable "simple" models and relevant tasks we would like to ask you to contact the editors if you have an idea for a model to be compared in different simulation languages.

Comparison 1: Lithium-Cluster Dynamics under Electron Bombardment

The first model to be compared is taken from solid state physics. The special features to be compared are rate equations (application area), stiff systems (numerical integration), parameter sweep and steady-state calculation (experimentation).

The model describes formation and decay of defect ("F-centers") aggregates in alcali halides. The defects are produced by electron bombardment near the surface of the crystal and can either form aggregates or will evaporate if they reach the surface.



The variable f(t) denotes the concentration of F-centers, m(t) and r(t) respectively denote the concentration of aggregates consisting of two (M-center) or three F-centers (R-center). In principle the system can be easily extended taking into account formation of larger aggregates (n F-centers). The variable p(t) is the production term of F-centers due to electron bombardement (irridiation):

$$dr/dt = -d_r r + k_r mf$$
$$dm/dt = d_r r - d_m m + k_f f^2 - k_r mf$$
$$df/dt = d_r r + 2d_m m - k_r mf - 2k_f f^2 - l_f f + p$$

The parameter l_f measures the loss of F-centers at the surface. k_r and k_f are rate constants describing the formation of an M-center out of two F-centers, or the formation of an R-center out of an M-center and an F-center. The decay of an R-center into an M-center and an F-center is described by the rate constant d_r and the decay of an M-center into two F-centers by the rate constant d_m. Investigations are started after constant electron bombardment $p(t) = p_c = 10^4$ of approximately 10 s; the production term has to be set to zero ($p(t) = 0$), the initial values are:

$$f(0) = 9.975$$
$$m(0) = 1.674$$
$$r(0) = 84{,}99$$

The parameter values are:

$$k_r = 1$$
$$k_f = 0.1$$
$$l_f = 1000$$
$$d_r = 0.1$$
$$d_m = 1$$

The following tasks should be performed

a) simulation of the stiff system over [0,10] with indication of computing time depending on different integration algorithms.

b) parameter variation of l_f from 1.0E2 to 1.0E4 and a plot of all $f(t;l_f)$, logarithmic steps preferred.

c) calculation of steady states during constant bombardment $p(t) = p_c = 1.0E4$) and without bombardment ($p(t) = 0$).

Wolfgang Husinsky, Institut für Allgemeine Physik, Technische Universität Wien, Wiedner Hauptstraße 8-10, A - 1040 Wien, Austria.

Comparison 1 - XANALOG

XANALOG is a block-oriented simulation system. A version is available for IBM PC/AT (or 100% Compatible), Compaq 386 (or 100% Compatible) and IBM PS/2 Models 50, 60, 70, 80 and 30-286.

Model Description

The model is described in terms of the XANALOG block diagram of Figure 1.

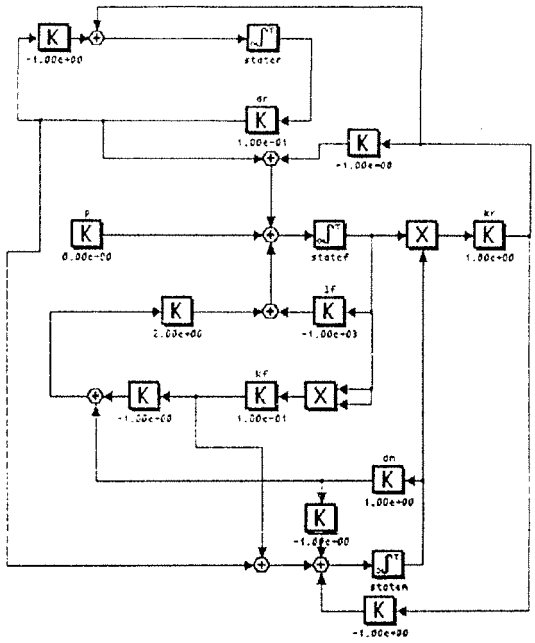


Figure 1

Results

All calculations were done using an NCR PC (80286 processor with 80287 numeric co-processor).

Comparison of Computer Time (task a):

Integration Method	Step Size (sec)	Computing Time (sec)
RK4	0.001	225
	0.002	112
	0.0025	88
	0.003	Numerically unstable
Euler	0.001	82
	0.002	Numerically unstable
Modified Euler	0.001	118
	0.002	Numerically unstable

Variation of Parameter l_f (task b).

Simulations were carried out for values of l_f of 100, 200, 500 and 1000. The results are shown in Figures 2 and 3. Figure 2 is a graph of 2*ln(f) versus time on a linear scale. Figure 3 is a graph of 2*ln(f) versus time on a logarithmic scale. In both cases the top curve represents the response for parameter $l_f = 100$, with the lower curves showing corresponding results for $l_f = 200$, 500 and 1000 respectively. These two figures show very clearly the stiff nature of this simulation problem. They also provide an illustration of two of the many different forms of graphical presentation possible with the facilities of the XANALOG Time Domain Post-Processor.

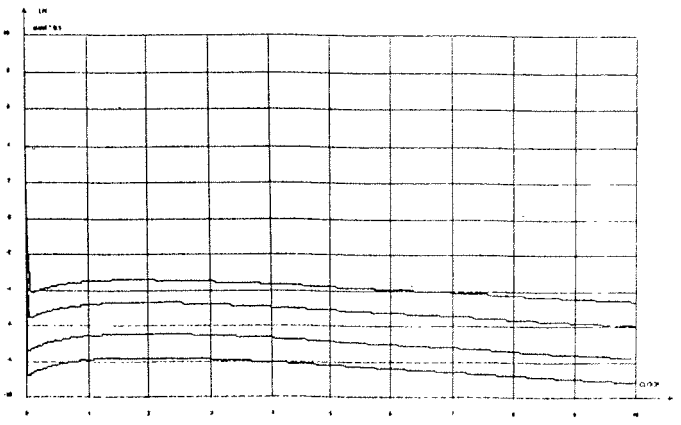


Figure 2

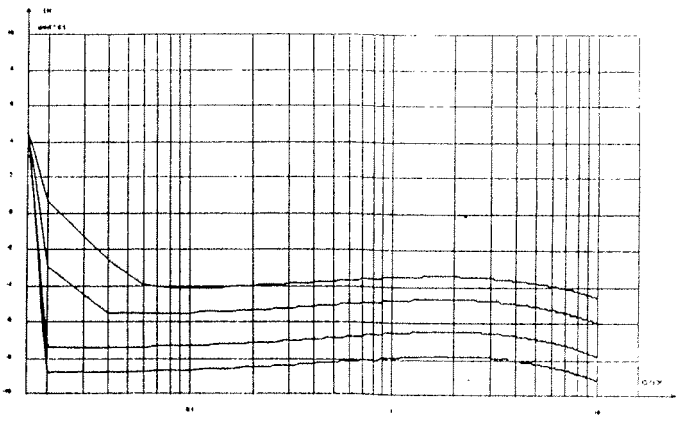


Figure 3

Calculation of Steady State (task c).

Calculations in the time domain for $l_f = 1000$ resulted in the following:

During constant bombardment (p = 10000)

f(t = 100 sec.) = 9.98991

Without bombardment (p = 0)

f(t = 100 sec.) = 1.27722E-6

D. Murray-Smith, Department of Electronics and Electrical Engineering, University of Glasgow, Glasgow G12 8QQ, Scotland, U.K.

Comparison 1 - HYBSYS

The development of the Hybrid Simulation System HYBSYS has been started 12 years ago at the Technical University of Vienna, Austria, on a hybrid machine. Now the latest version 7.0 runs on AT-compatible PCs under DOS 3.2 or higher and on UNIX-based workstations with the X-Window-System. HYBSYS is a simulation environment that supports modelling, identification, and optimization, working interpretative. So there is no need of any FORTRAN or C-Compiler, although tested models can be compiled in memory for faster run.

Model description:

```
par
    kr = 1, kf = .1, lf = 1000, dr = .1, dm = 1;
    f0 = 9.975, m0 = 1.674, r0 = 84.99;
    p  = 0.0;
end
var
    f,m,r;
    krmf,kff2,dmm,drr;
end
equ
    krmf = mult(kr*m,f);
    kff2 = mult(kf*f,f);
    dmm = mult(dm,m);
    drr = mult(dr,r);
    r = integ(r0,-drr,krmf);
    m = integ(m0,drr,-dmm,kff2,-krmf);
    f = integ(f0,drr,2*dmm,-krmf,-2*kff2,-lf*f,p);
end
run.mtd = 7
run.step = 1.e-5;
plot.xaxtyp = 4; plot.zaxtyp = 4; plot.zlog = 1;
plot.xtext = "T"; plot.ztext = "LOG10( F )";
plot.htext = "LITHIUM-CLUSTER DYNAMICS";
plot.axmode = 0; plot.xsctyp = *; plot.zsctyp = *;
plot.xmin = 0; plot.xmax = 10.;
plot.zmin = 1.e-3; plot.zmax = 10.;
run.ssize = 5000;
mtd smmo:etime = 9;
```

To accelerate the calculation (larger stepsize after tend = 1) and to measure the time the macro LCD1.HYB has been used:

```
tend = 1;
etime;f;t0 = 1;tend = 10;run.ic = 0;plot.s = 1;
ndt = 1000;run.step = 1.e-4;f;etime:
t0 = 0;run.ic = 1;run.step = 1.e-5;ndt = 100;
```

The model was tested on a DECStation 3100 (MIPS R2000 processor, R2010 coprocessor, 16.67 MHz) under Ultrix 3.2 and X-Windows X11R4.

Results of the tasks:

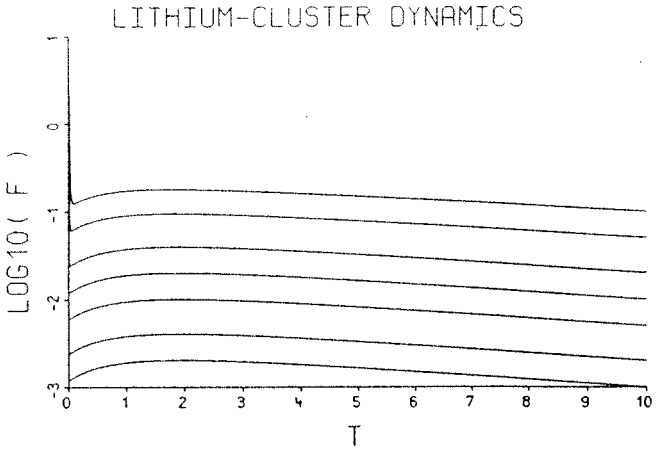
a)

method	step	time in sec.
1 (Euler)	1.E-04	8.47
4 (Runge Kutta 4th order)	2.E-04*	9.31
7 (Runge Kutta Fehlberg)	1.E-05*	9.98
7 (same, with LCD1.HYB)	1.E-05*	9.38
8 (Adams Moulton)	1.E-05*	16.80
8 (same, with LCD1.HYB)	1.E-05*	18.00

* initial stepsize

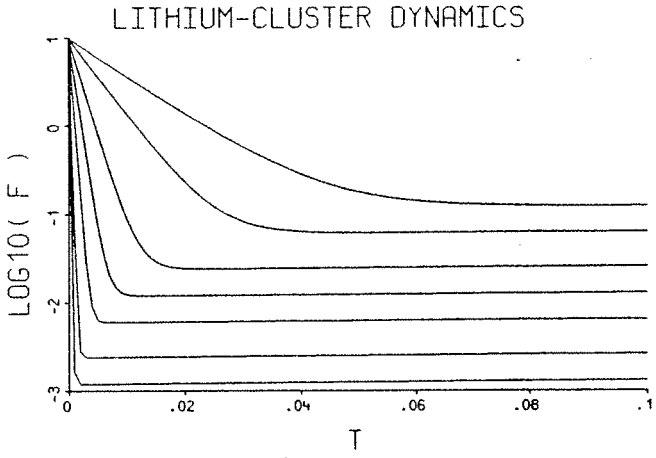
b) The command for the parameter loop is:

lf = {100,200,500,1000,2000,5000,10000}! lcd1; lf, f:



here the 'etime' command in LCD1.HYB is not necessary; the command for the next figure is:

lf = {100,200,500,1000,2000,5000,10000}! f



c) The following parameters and commands for the steady state analysis

```
p = 0.0              (p = 1000.0)
lf = 1000
trim.ceps = 1.e-5
trim.dmax = 100
trim, l
```

deliver these results:

```
Solution after 15 Evaluations
r = .4684E-03
m = -.7858E-08
f = -.2328E-09
```

respectively:

```
Solution after 34 Evaluations
r = .1000E+04
m = .1000E+02
f = .1000E+02
```

For further information, please contact:

Dietmar Solar, Schönbrunnerstraße 65, A - 1050 Vienna, Austria, Tel: +43-(0)222 5562864

Comparison 1 - ESL

The ESL Simulation Software

ESL is a continuous systems simulation software environment, designed originally to meet the requirements of the European Space Agency for simulating spacecraft subsystems.

ESL provides two completely different user interfaces: a conventional programming language to specify a simulation; or a mouse driven graphical input facility (IMP) which allows a block diagram to be constructed to define a simulation. Either interface may be used, without the need to understand the other, to undertake complete simulation projects. For some applications a mixture of the two approaches is an ideal answer. Both routes provide excellent integrity of a simulation, and ESL IMP provides fully checked automatically generated code.

ESL is a "natural model definition language", having the following characteristics: separate experiment and model specification sections; a submodel concept; unambiguous model definition code; clear definition of non-linearities, or discontinuities; full matrix, vector, and array slice support; optional transfer function notation; linearization features, steady-state finders; and, of great importance, strict variable usage rules rigorously imposed by the ESL compiler subsystem.

An Interpreter provides fast turn-round during program development, and a Translator efficient production simulation runs. Following a simulation post-mortem graphic analysis is performed by the DISP (display) subsystem.

Model Description

A commented listing of the ESL Benchmark Program is presented below. Note in particular - separate model and experiment regions; presentation of differential equations in dynamic region and analysis region in which the steady-state requirements are specified.

```
STUDY
 MODEL REACTION(: = REAL:p,lf);
-- The model defines the dynamics of the system
    REAL:f,m,r;
    CONSTANT REAL:kr/1.0/,kf/0.1/,dr/0.1/,dm/1.0/;
    INITIAL
    f: = 9.975;              -- Initialization of states
    m: = 1.674;
    r: = 84.99;
    DYNAMIC
-- Differential equations of system
    r': = -dr*r + kr*m*f;
    m': = dr*r-dm*m + kf*f*f-kr*m*f;
    f': = dr*r + 2.0*dm*m-kr*m*f-2.0*kf*f*f-lf*f + p;
    STEP
        PLOT t,f,0,TFIN,0,100; -- plot while computing
        PREPARE "lithium",t,r,f,m; -- save data for postmortem plot
    ANALYSIS
        TRIM [r,m,f]: = [r',m',f']; -- define parameters for steady-state
        PRINT "Steady state for p = ",p:8.1," r,m,f = ",r:8.1,m:8.1,f:8.1;
    END REACTION;
-- EXPERIMENT - the following code defines the experiment to
be carried out
    REAL:p/0.0/,lf,loglf;
    CINT: = 0.1; -- defines maximum integration step length
    ALGO: = GEAR1; -- defines Gear's integration algorithm
-- Parameter variation of lf from 1.0E2 to 1.0E4 in logarithmic steps
    FOR loglf: = 2.0..4.0 STEP 0.5
    LOOP
        lf: = 10.0**loglf;
        REACTION(: = p,lf); -- call model with specified values of p and l
        PRINT "lf = ",lf;
    END_LOOP;
-- Compute steady states for p = 1.0E4
    ALGO: = LIN1; -- defines "analysis" call of model to find steady-
state
    lf: = 1.0E3;
    p: = 1.0E4;
    REACTION(: = p,lf);
-- Compute steady states for p = 0.0
    p: = 0.0;
    REACTION(: = p,lf);
END_STUDY
```

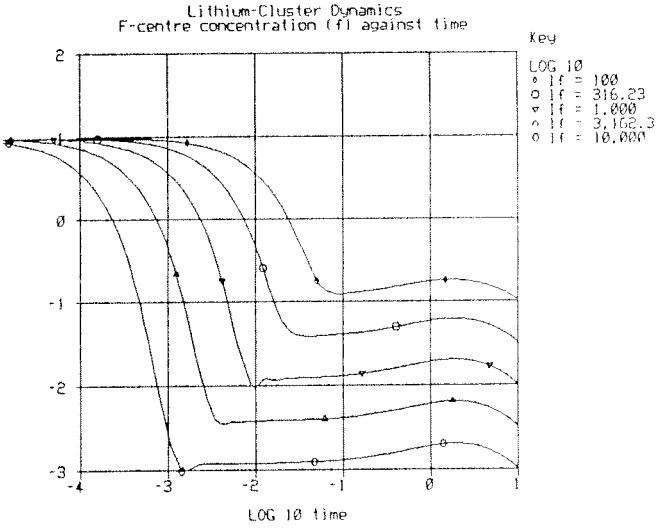
Results

(a) Comparison of integration algorithms. The stiff system was simulated over a 10s period using each of the seven integration algorithms available in ESL. Computation times for a 16MHz 386SX PC with 387 coprocessor are presented in the table below.

algorithm	max step length	computation time (s)
5th order v/step (Sarafyan)	0.1	10.00
4th order f/step Runge-Kutta	0.001	12.00
2nd order f/step Runge-Kutta	0.001	8.00
2nd order stiff (Gourlay)	0.1	0.32
Gear's stiff algorithm	0.1	0.20
Gear with diagonal Jacobian	0.1	0.25
Adams Bashforth	0.1	21.00

These results demonstrate dramatically the efficiency of the algorithms designed specifically for solving systems of stiff equations.

(b) Parameter sweep. The following figure, produced by the ESL display package, presents a plot of F-centre concentration (f) against time for a variation of l_f from 1.0E2 to 1.0E4.



(c) Steady state calculation. The ESL steady state finder returns the following steady states, which, by inspection of the equations, are clearly correct:

p	r	m	f
1.0E4	1000	10	10
0	0	0	0

D. Irving, ISIM Simulation, Frederick Road, Salford M6 6BY, U.K.

Comparison 1 - SIL

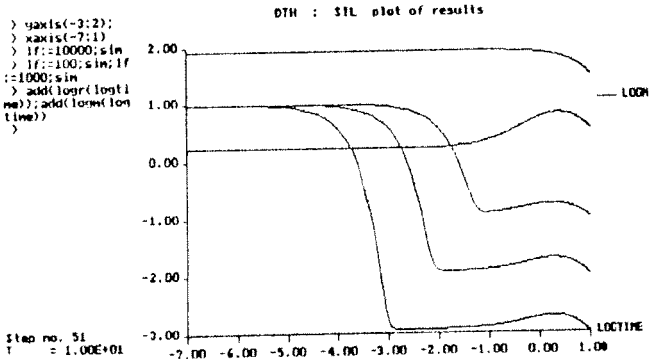
SIL is a general purpose simulation system with a mathematically oriented user-interface. It is designed to solve (in general) differential-algebraic equations eventually with discontinuities. It can handle discrete systems as well. The results are displayed graphically during the solution phase.

The SIL language is free-format and statement oriented. It is specially designed for the description of simualtion models. Below the "comparison 1" model is given in the SIL language. This model also includes auxiliary statements needed for logarithmic scaling of the axes.

```
BEGIN
VARIABLE r(84.99), f(9.975), m(1.674),
         LOG10, LOGr, LOGf, LOGm, LOGtime;
PARAMETER Kr(1), Kf(0.1), Lf(1000), Dr(0.1), Dm(1), p(0);
DERIVATIVE rdot(r), mdot(m), df(f);
TIME T(0:10);
METHOD := 139;   (* Stiff option for integrator   *)
ABSERROR := 0; RELERROR := 1.0E-5;

(* The equations   *)

rdot := -Dr*r + Kr*m*f;
mdot :=  Dr*r - Kr*m*f - Dm*m + Kf*f*f;
df   :=  Dr*r - Kr*m*f + 2*Dm*m - 2*Kf*f*f -Lf*f + p;

(* Output statements  *)

LOG10 := 1/LOG(10);
LOGr  := LOG(r)*LOG10;
LOGf  := LOG(f)*LOG10;
LOGm  := LOG(m)*LOG10;
LOGtime := LOG(T+1.0E-20)*LOG10;
WRITE(1000,LOGr, LOGf, LOGm, LOGtime);

PLOT(1000,LOGf(LOGtime))
END.
```

SIL model.

The screen dump below shows the results from running this model.



Screen dump.

It takes less than 5 minutes (including the screen dump) on an 8 MHz IBM PC/XT-286 with a 6 MHz co-processor to produce the above results. Specially for $l_f = 10000$ it is essential to use relative error tolerance in order to avoid f being negative. In the table the CPU time (in seconds) is given for solving the problem ($l_f = 1000$) with different relative accuracies. IBM is the above XT-286 and NCR is a 16 MHz 80386 with a 16 MHz 80387.

RELERROR	CPU-seconds		#STEPS	
	IBM	NCR	ACCEPT	REJECT
1.0E-2	6.92	2.64	33	3
1.0E-4	13.68	4.01	50	3
1.0E-6	21.59	5.60	57	2
1.0E-8	31.74	7.58	61	2
1.0E-10	50.80	11.43	86	2

CPU-time for different accuracy requirements.

In order to compute the steady state solution the model is changed to a pure algebraic problem (the derivatives are set to zero) and the model is run "in batch mode"; that is, the results are written to a .LST file. Below this file is shown for this problem; notice that the solution time is only 0.72 seconds on the XT-286.

```
SIL VERSION 2.0 (880808)
DTH         90-07-06                                    91-05-08  15:03:05  PAGE 01

  1 1-  BEGIN
  2 --  VARIABLE r(84.99), f(9.975), m(1.674),
  3 --  PARAMETER Kr(1), Kf(0.1), Lf(1000), Dr(0.1), Dm(1), P(10000);
  4 --
  5 --  (* The equations   *)
  6 --
  7 --  1.0E-8 := -Dr*r + Kr*m*f;
  8 --  1.0E-8 :=  Dr*r - Kr*m*f - Dm*m + Kf*f*f;
  9 --  1.0E-8 :=  Dr*r - Kr*m*f + 2*Dm*m - 2*Kf*f*f -Lf*f + p;
 10 --
 11 --  (* Output statements  *)
 12 --  WRITE(m,r,f)
 13 -1  END.

  1.92  SECONDS IN COMPILATION

MODEL CONSISTS OF :
   6 PARAMETERS
   3 IMPLICIT STATIC VARIABLES


SIMULATION STATISTICS:

   NUMBER OF ACCEPTED STEPS      :   0
   TOTAL NUMBER OF FUNCTION CALLS :   1
   NUMBER OF ALGEBRAIC ITERATIONS :   8


SIMULATION OPTIONS USED:

   DEBUG            :   1
   METHOD           :  119
   MAXORDER         :   10
   MAXCPU           :  0.0
   INITIAL TIME     : 0.000E+0000
   FINAL TIME       : 0.000E+0000
   MAXIMUM STEPSIZE : 0.000E+0000
   INITIAL STEPSIZE : 0.000E+0000
   ABSERROR         : 1.000E-0005
   RELERROR         : 1.000E-0005


 PARAMETER VALUES :
KR       =  1.00000E+0000 KF       =  1.00000E-0001 LF       =  1.00000E+0003
DR       =  1.00000E-0001 DM       =  1.00000E+0000 P        =  1.00000E+0004



      S I L   S I M U L A T I O N   R E S U L T S

    Time          M             R             F

 0.00000E+0000  1.00000E+0001  1.00000E+0003  1.00000E+0001

   0.72  SECONDS in execution

  214.5  KBytes left in Long Heap memory
```

Steady state solution

Reference:

SIL - a Simulation Language, Users Guide. Niels Houbak, Lecture Notes in Computer Science. Vol. 426. 1990 Springer Verlag.

Niels Houbak, The Technical University of Denmark, Lab. for Energetics, Building 403, DK-2800 Lyngby, Denmark.

Comparison 2: Flexible Assembly System

The following example of a flexible assembly system has been chosen because it checks two important features of discrete event simulation tools:

- the possibility to define and combine submodels,
- the method to describe complex control strategies.

The model consists of a number of almost identical submodels of the following structure (figure 1):

Figure 1

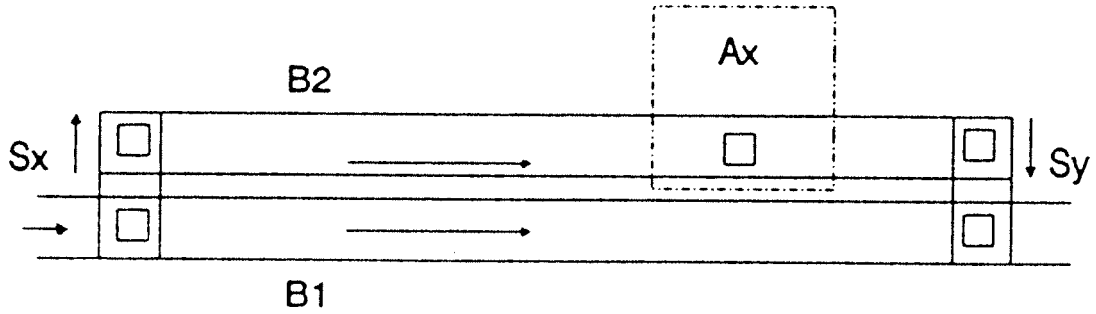


Table 1 shows the operation time of each station, the total length of B1 and the length of the buffer in front of the station.

Table 1

Station	Operation time (sec.)	Length of B 1 (m)	Length of buffer in front station (m)
A 1	15	2.0	1.2
A 2	60	1.6	0.8
A 3	20	1.6	0.8
A 4	20	1.6	0.8
A 5	20	1.6	0.8
A 6	30	2.0	1.2

There are three identical stations A2 in the system, because the operation in A2 takes much longer than the other operations.

Two parallel conveyor belts, B1 and B2, are linked together at both ends. An assembly station Ax is placed at B2. Pallets are coming in on belt B1. If they are to be processed in Ax they are shifted in Sx to B2 and possibly enter a queue in front of Ax. If there is no more empty buffer space on B2 or the pallet is not to be processed in Ax it continues its way along B1. Parts that have been processed in Ax are shifted back to B1 in Sy, having priority over those coming from the left on B1.

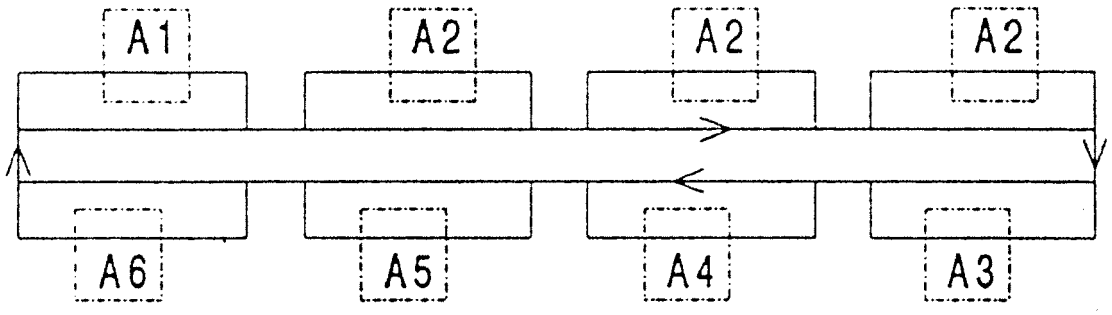
The total system now consists of 8 of these subsystems, varying in length, operation and operation time (see figure 2). Between two subsequent subsystems there is a space of 0.4 m, whereas pallets from the third subsystem A2 can be shifted directly to A3, and from A6 directly to A1. The shifting parts, however, cannot function as buffers, i.e. a pallet can only enter an Sx if it can leave it immediately.

Unprocessed parts are put on pallets in A1. They can either be processed in A2 first, and then in A3, A4, A5, or in A3, A4, A5 first, and then in A2. The sequence of operations among A3, A4, and A5 is arbitrary. Station A6 is a substitute for any of the stations A3, A4, A5, i.e. whenever one of these stations is down, or the buffer in front of it is free, the corresponding operation can be executed in A6. Finished parts are unloaded in A1, unfinished parts enter another circle.

All conveyors are running with a speed of 18 m/min., any shifting takes 2 sec., and pallet length is 0.36 m. Assuming that no station ever has a breakdown, the optimum number of pallets in the system is to be found. Therefore the total throughput and the average throughput time of the parts have to be evaluated, when 20, 40, and 60 pallets are circulating in the system.

To simplify comparison of results we suggest starting simulation experiments with empty pallets and collecting data from the 120th to the 600th minute (8 hours).

Figure 2



Remarks

In number 1 of EUROSIM - Simulation News Europe (March 1991) we had proposed to test discrete event simulators using an example flexible assembly system. Some letters from readers however made it clear that the description of the system has been somewhat incomplete. We therefore try to answer the open questions and ask you not to hesitate to contact us if any other questions arise.

What follows is not a full definition of the model but only some details in addition to the description in EUROSIM - Simulation News Europe 1.

1. The subsystems contain two parallel conveyors B1 and B2. The total length of B2 between Sy and Sy is given in table 1. Sx and Sy themselves are 0.4 m wide. A pallet can either pass Sx or Sy without any delay with its normal speed along B1 or can be shifted to B2 in 2.0 sec. The lengths of B1 and B2 are the same. B2, however, is divided into three parts: the buffer in front of the station (its length being given in table 1), the station's positioning unit of length 0.4 cm, and the buffer behind the station (the remaining part of B2).

2. The conveyors themselves can function as buffers. Pallets can queue up in front of the stations or in front of Sx and Sy but the conveyor will move on with its normal speed. Also during the shifting of one pallet or while it is being processed on one of the positioning units in an Ax the other pallets are being transported without any delay. The capacity of each buffer can be easily calculated by dividing its length by the pallet length (0.36 cm). Of course, only integers are feasible results.

3. If the buffer in front of Ax is full, all pallets move on along B1 even if they require processing in Ax. They may either be processed when the pass Ax the next time, or they may be processed in A6 (if x = 3, 4, or 5).

4. The transportation time from Sx to Ax (i.e. its positioning unit) is not part of the operation time as given in table 1. The same holds for the transportation time from Ax to Sy.

5. In the beginning empty pallets are circulating in the system. Their positions on the conveyors B1 (not B2!) can be chosen randomly. Unprocessed pieces are put on them in A1 (operation time 7.5 sec), and finished parts are unloaded in A1, too (operation time 7.5 sec, hence total time for load/unload is 15.0 sec). A1 is only used for these load/unload operations.

6. Pallets are being brought to A6 if they have not undergone one or more of the operations of A3, A4, or A5. They can then undergo all the missing operations at a time.

We hope we have clarified the open questions now. Again: if any other questions come up during modelling, don't hesitate to contact us.

Finally we ask everybody who has tried or will try to model the system to send us a report on the experiences he/she has made even if no results have been achieved. We believe it is as important to learn why certain approaches or tools are not appropriate, as it is to learn how other colleagues have solved the problem. Unfortunately scientists do not communicate their unsolved problems and unsuccessful approaches as freely as they communicate their solutions. Please help us to change this and tell us if you have not been able to model this system with a simulation tool, and what the difficulties were. Thank you very much!

Contact:

J. Krauth, BIBA Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaft, Postfach 33 05 60, D - 2800 Bremen 33, Tel: +49 421 22009-51, Fax: +49 421 22009-79

Comparison 2 - PS SIMDIS

Description of PS SIMDIS OS/ES

PS SIMDIS is a block-oriented simulation language for discrete systems. It is a system of the GPSS family. Model elements are divided in static (storages, facilities, chains, queues...) and dynamic elements (transactions). Transactions can be generated and annihilated during the simulation process. A PC version (SIM-PC) of this simulation language was developed at the department of informatics at the Technical University Magdeburg. This PC-version consists of all features of the PS SIMDIS OS/ES and additional components for animation.

Model description

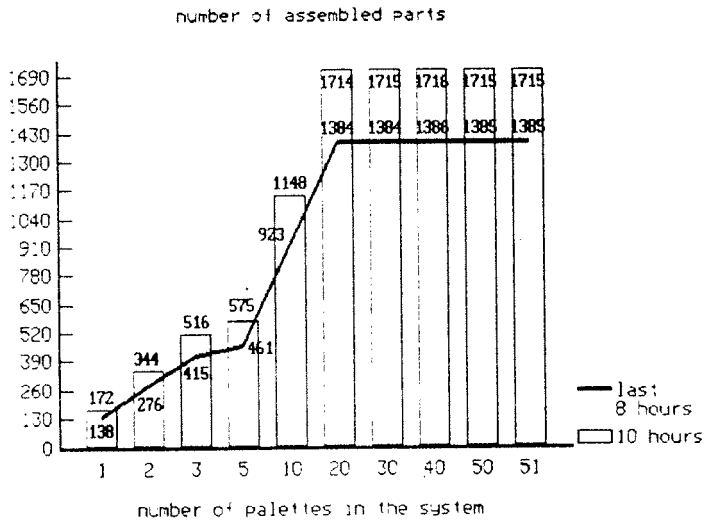
The model was programmed on a 80386 SX AT-type system. The parallel conveyor belts are modeled as static elements (storages). The capacities of these storages are equivalent with the length of the belts. The static element 'facility' represents an assembly station. The palettes are the dynamic elements in the system. The combination of the properties of the transactions, facilities and storages controls the whole system.

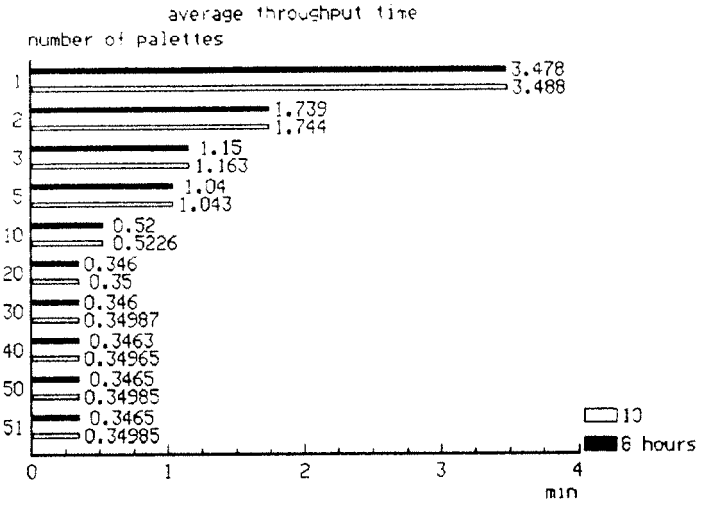
Results

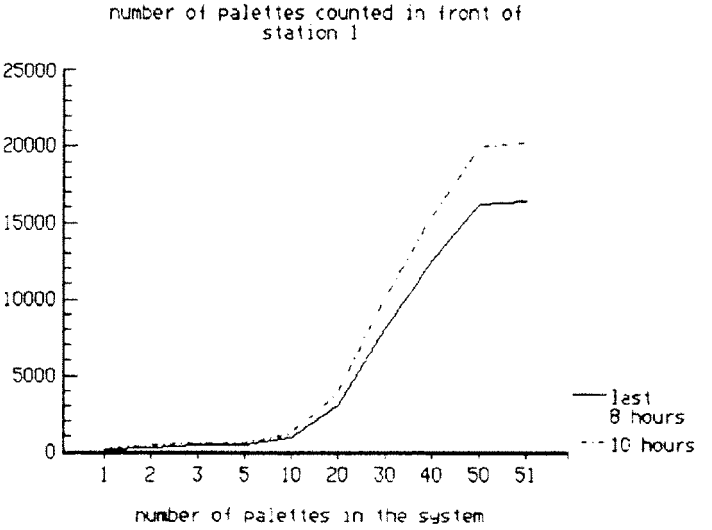
The system was not able to work with more than 51 palettes. The optimum number of palettes is 40. The figures show the results of some simulation passes.

```
SYB   ADVANCE   AV#SHI_T          shifting the palette
*-------------------------------------------------------------*
      SEIZE     WAYB
      LOGIC R   TORB              open second way
      TRANSFER  ,BBBB
* Here begins the belt B1.
*-------------------------------------------------------------*
BBA1  ENTER     SBB1,AV#PAL_L     OK, entering this belt B1
      RELEASE   WAYA
      ADVANCE   SK#SBB1
      GATE LR   TORB
      SEIZE     WAYB
BBE1  LEAVE     SBB1,AV#PAL_L     leaving the belt
* This is the end of this belt.
*-------------------------------------------------------------*
BBBB  ADVANCE   AV#WAY_L          between two subsystems
*-------------------------------------------------------------*
* This is subsystem C
*-------------------------------------------------------------*
MMM3  TEST E    PB1,1,BCA1        we have to skip - no part loaded
      TEST E    PB2,0,BCA1        we can skip - nothing to do
* OK. We have something to do.
      TEST E    AV#SEQU,0,BCA1    sorry, not allowed to do anything
* OK. Let's do it.
      TEST GE   SP#SCB2,AV#PAL_L,BCA1
      RELEASE   WAYB
* The buffer in front of station C is not full.
SXC   ADVANCE   AV#SHI_T          shifting palette to belt B2
* Here begins the buffer in front of station C.
*-------------------------------------------------------------*
BCA2  ENTER     SCB2,AV#PAL_L     OK, palette enters the buffer
      ADVANCE   SK#SCB2           move palette to the station
* Station C is empty.
      SEIZE     STC               entering the station C
      ADVANCE   AV#PAL_L
BCE2  LEAVE     SCB2,AV#PAL_L     leaving the buffer
* Here is the end of the buffer in front of station C.
*-------------------------------------------------------------*
```

Part of the model description







Diethard Wettrau, Im Winkel 1, O-3701 Abbenrode, Bundesrepublik Deutschland (student of informatics at the Technical University Magdeburg).

Comparison 2 - DOSIMIS3

1. Description of language

The simulator DOSIMIS3 used for solving the given task is an element oriented simulator. DOSIMIS3 is based upon chronological event lists and is particularly designed for analysing discrete Material Flow Systems (MFS). Being element oriented, DOSIMIS3 does not provide a simulator language as other simulation packages. Instead, it is possible to build a complete MFS by combining so called elements on the screen. The 20 standard elements are similar to those of real MFS and they can be placed via a menu oriented, graphic user interface. The characteristics of the elements are to be specified by parameters (length, speed, etc.) within a parameter mask, which can be popped up for each single element. Elements with more than one input or output can be equipped with a local intelligence by which strategies such as FIFO, priorities of input, etc. can be realized. Postrun animation and presentation of simulation results in tables and graphs allow for the evaluation of the simulation results. If control of the model via standard DOSIMIS3 strategies is insufficient, decision tables can be employed to model functional and informational interrelationships. These decision tables can be entered via the graphic user interface, such that no programming skills are required. In case of highly complex problems, the system's control can be improved by additionally using the DOSIMIS3 programming interface (PASCAL).

The given task was solved entirely by using decision tables. No extra programming was necessary.

2. Model Description

To solve this problem the following DOSIMIS3 elements were used

elements	function
1 source *	create new parts
1 sink *	terminate completely processed parts
1 assembly element*	put unprocessed parts on pallets
1 disassembly element *	unload parts from pallets
7 workstations	assembly stations A2(3x), A3 - A6
8 junctions 8 discharging devices	shiftplaces between conveyor belts B1-B2
30 buffer sections	sections of conveyor belts B1 and B2

* the station A1 consists of these elements

3. Parametrization of the elements

length of a segment	0.4 m
length of an object	0.36 m
conveying speed	0.3 m/s

Number of segments for each belt according to belt length in given task. The empty pallets were put in the buffer sections of all conveyor belts B1 and B2 before start.

4. Results and experimentation comments

numbers of pallets	total through-put	average through-put time	min through-put time	max through-put time
10	939	314.3	293.0	335.6
15	1350	327.5	225.3	413.0
20	**1408**	**436.9**	**263.6**	**1222.3**
30	1410	620.9	340.0	2436.3
35	1408	722.6	350.3	3160.7
40	**1408**	**825.0**	**345.6**	**3145.3**

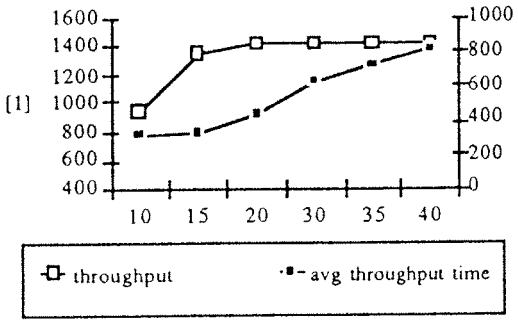
collecting data from 120 th to 600 th minute

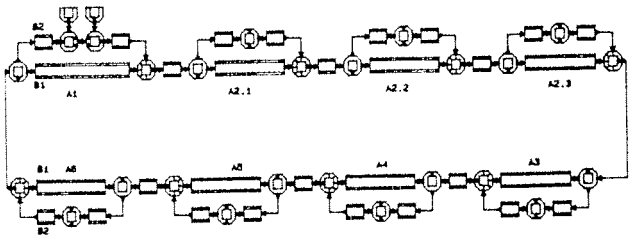
a) 20 is the optimum number of pallets in the system (see diagram below)

b) with increasing number of pallets, the total throughput approaches the optimum value of 1440 parts. This figure is based on the following idea: The longest operation time of an assembly station is 20 s, (A2's is 60 s divided by the number of stations A2 equals 20 s again). Thus the best case will be: 8 hours divided by 20 s equals 1440 parts.

c) With 60 pallets the system couldn't work because of a deadlock.

It seems to be possible to increase the number of pallets by changing the priority of the shift places Sy, thus, that pallets in B1 have priority over pallets on B2. The tradeoff would be longer throughput times.





For information and comments, please phone or fax or write to:

Ariane Beese or Michael Kluger, Fraunhofer Institute for Material Flow and Logistics, Emil Figgestr. 75, W - 4600 Dortmund, Germany, Tel: +49-(0)231 7549 171, Fax: +49-(0)231 7549 211

Comparison 2 - SIMAN

This report discusses the method used to simulate and optimize the Flexible Assembly/Manufacturing System using the Simulation Language SIMAN/CINEMA:

SIMAN is a general purpose SIMulation ANalysis program for modelling combined discrete continuous systems.

SIMAN is designed around a logical modelling framework that separates the model structure and experimental frame into two distinct elements. This allows different experimentation runs to be performed yet, keeping the control and flow logic unaltered in the model frame.

SIMAN runs on various types of computers and offers animation with the CINEMA system. This powerful tool allows not only a visual presentation of the system but is interactive with the debugger and allows rapid validation with the real world system.

A menu generator is available to allow the model builder to develop a series of menus so that the simulation can be run by an unskilled user. Output analysis is performed via the Output Processor.

Model description

For the purpose of this exercise the model was described as a Flexible Manufacturing (rather than Assembly) System. There is a 60 second drilling process at the A2 stations. Stations A3, A4 and A5 are mill, lathe and broach respectively. A6 is a multi-purpose (except drilling). The FMS model has some noteworthy features:

(a) The workstations are submodelled using the 'macro station' feature, allowing all 8 workstations to be modelled as one, as are all entrances to and exits from the conveyor belts.

The workstation belts are modelled as a single 'accumulating conveyor' SIMAN element. The loop conveyor is another.

(b) Two 'FINDJ' blocks determine the appropriate station with the lowest buffer level.

(c) Control for the system is via a 'BRANCH' block. In addition to the information from the FINDJ blocks, the branch statement determines whether the pallet has started on the mill/lathe/broach sequence. From this a decision is made to which process the pallet will visit next. Failing to find a station to visit, results in the pallet being conveyed to the next station and repeating the 'FINDJ, BRANCH' routine.

(d) All buffer levels before workstations, process times, number of pallets in system and conveyor dimensions/velocities can be adjusted in the experimental frame.

Experimentation results

The various pallet configurations were run in 'Batch Mode' and results of flowtime, cycle time and total throughput (number of pallets through system in 8 hours), recorded for 20, 40 and 60 pallets in the system. The SIMAN Output Processor was used to produce the graphs and associated confidence calculations and correlograms.

(a) Results from the first output show the system becomes congested at the 60 pallet level (the loop conveyor reaches its full capacity). The 20 pallet and 40 pallet runs yielded a 919 and 920 pallet throughput in 8 hours. The 20 pallet option is clearly more desirable as the work in progress and flowtimes are halved. More detailed experimentation was necessary around the 20 pallet figure to see if we could reduce these further.

(b) Figures 1 and 2 are plots of number of pallets in system against flowrate and throughput. It was decided 13 pallets are the optimum as it maintains the throughput of 919 pallets, yet has the lowest WIP figure and very low flowtime.

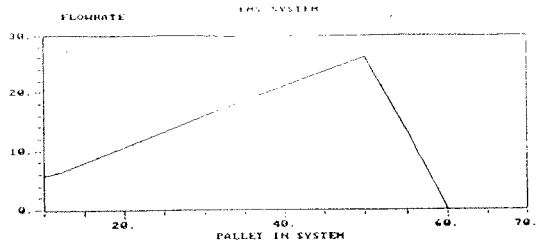


Fig1.

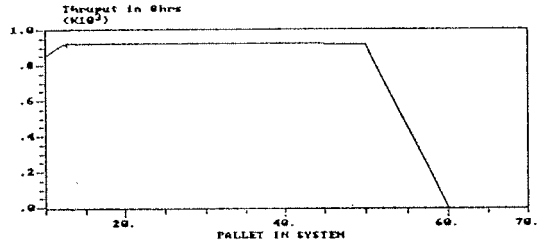


Fig2.

No.of Pallets in System.	Average Flow Time.	No.of Pallets Through System in 8hrs.
10	5.6289	853
12	6.2983	914
13	6.7884	919
14	7.3118	919
15	7.8307	919
20	10.462	919
25	13.054	919
30	15.748	919
40	20.927	920
50	26.047	917
60	0.0	0.0

Fig3.

IDENTIFIER	AVERAGE	STANDARD DEVIATION	.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS.
CycTime	.522	2.132E-03	1.380E-04	.522	.587	919
FlowTime	6.79	1.29	8.373E-02	4.24	14.1	919

Fig4.

Remarks

Interpretation of whether the length of buffer in front of the work stations included the space for the pallet (while being processed) or not could produce different results. This would effect the congestion on the loop conveyor, throughput and flow times.

J.F.S. Heffernan, The CIMulation Centre, Avon House, P.O. Box 46, Chippenham, Wiltshire SN15 1JH, England

Comparison 2 - SLAM II

Short description of the simulation environment used

SLAM II is one of the most popular simulation languages available: it has been developed by Pritsker Corp. during the 70's, and then constantly improved. SLAM II is a discrete-event oriented language, but it includes a network-oriented approach and continuous features as well. For discrete systems modeling with SLAM II, indeed, the network approach is the most direct one. A SLAM II graphic network is a graph with nodes and arrows: the nodes represent typical functions such as queuing points, and the arrows connecting them stand for delays and/or routings. In early versions of SLAM II the graphic network was described in a normal textual form, but in the last years, MS-Windows and OS/2 Presentation Manager versions became available, including a graphic network editor, and a powerful animation building system.

Work description

The model was described with the SLAM II language on an Olivetti PC (with 80386/387 20 MHz) with OS/2. An average simulation run of the model (8 hours) lasts approximately 9 minutes.

The model includes a network (the source is included), with all the conveyor lines modeled as resources. The dynamic entities (pallets) go through them during the simulation, by means of a main loop in the network in which the current resource is incremented: so, we need to define only once the basic submodel, as we can parametrize it. The next resource than an entity needs to go through is allocated by a user function ALLOC that let wait if it is not possible: so the control strategy is implemented in a very simple, readable, and straightforward manner.

Results

We have conducted many experiments with the model, all of them for a time of eight hours, and collecting statistics for the last six, as suggested.

A table is included that summarizes the average throughput time (cycle time) and the total throughput, as well as as the average time in system and the average number of laps for the pallets, for the most interesting experiments (the parameter that changes through experiments is the total number of pallets).

One can see that we found a threshold number of pallets, beyond which the system gets blocked because there are some pallets that cannot go their way in the B1 line even if there could be the theoretical alternative of making it go through B2 without being worked by the machine, but the proposed model didn't provide such a deadlock solving rule.

Number of pallets	Average throughput time (cycle time)	Total throughput (in 6 hours)	Average time in system	Average number of laps
[pure number]	[s]	[pallets]	[s]	[pure number]
10	24.00	900.00	240.00	1.00
14	21.00	1028.00	294.00	1.38
15	20.30	1062.00	305.00	1.49
16	20.00	1080.00	320.00	1.72
17	20.00	1078.00	340.00	2.09
18	20.00	1080.00	360.00	2.45
19	20.00	1081.00	380.00	2.82
20	20.00	1082.00 *	400.00	3.37
30	20.00	1080.00	540.00	6.00
40	20.00	1080.00	800.00	10.70
50	Blocked within the first two hours			
60	Blocked within the first two hours			

(*) Different from the following in spite of the same cycle time, because the cycle times were rounded at two decimal digits

```
;-------------------------------------------------------------------------------
;     MAIN NETWORK FLOW
;-------------------------------------------------------------------------------
; CREATION OF A PREDEFINED NUMBER OF PALLETS
ZAAB  CREATE,,,1,1;
      ACTIVITY;
      ASSIGN,PALLETS=PALLETS-1,2;
      ACTIVITY;
      ACTIVITY,20,PALLETS.GT.0,ZAAB;
;
; ATTRIBUTES INITIALIZATION
ASS1  ASSIGN,OP2=0,OP3=0,OP4=0,OP5=0;
      ACTIVITY;
ASS2  ASSIGN,STATION=1,PREC=16,UP=0;
      ACTIVITY;
;
; OBTAIN THE FIRST RESOURCE FOR THE FIRST TIME
AW0   AWAIT(9),PREC/36;
      ACTIVITY/9;
;
; MAIN LOOP
; OBTAIN THE NEXT RESOURCE, WAITING IN A QUEUE NUMBERED AS THE CURRENT STATIO
; NUMBER, WITH PRIORITY (PREVIOUSLY DECLARED) FOR PALLETS COMING FROM 'UP',
; I. E. THOSE WITH ATRIB(7)=1
; (ALLOC IS THE FORTRAN-WRITTEN NEXT RESOURCE SELECTION RULE)
LOOP  AWAIT(STATION=1,8),ALLOC(1);
      ACTIVITY/10;
PREC  FREE,PREC/36,1;
; SELECT WHERE TO GO, DEPENDING ON ATTRIBUTE UP
      ACTIVITY/STATION=1,8,SPACE/SPEED+SHIFTIME+TRASFA/SPEED,UP.EQ.1;
      ACTIVITY/11,SPACE/SPEED+TRASFB/SPEED,UP.EQ.0,INCR;
; 'UP' SIDE: PASS THROUGH THE MACHINE, OBTAINING THE RELATED RESOURCES
AWMAC AWAIT(MACHINE=25,32),MACHINE,,1;
      ACTIVITY,WTIME,STATION.EQ.1;
      ACTIVITY,WTIME,,AWBU;
; STATISTICS COLLECTION AT THE STATION 1 PASSAGE (OPERATION END FOR THE PALLE
      COLCT(1),BET,CYCLE TIME;
      ACTIVITY;
      COLCT(2),INT(1),TIME IN SYSTEM;
      ACTIVITY;
      COLCT(3),LAPS,NUMBER OF LAPS,10/0.0/1.0;
      ACTIVITY;
; ATTRIBUTE RESET: THE ENTITY BECOMES A 'NEW' PALLET
RST0  ASSIGN,MARK=TNOW,LAPS=0;
      ACTIVITY;
RST1  ASSIGN,OP2=0,OP3=0,OP4=0,OP5=0;
      ACTIVITY,,,AWBUF;
AWBUF AWAIT(BUFFER=17,24),BUFFER/36;
      ACTIVITY;
CURR  FREE,CURR/36;
      ACTIVITY;
MACH  FREE,MACHINE;
      ACTIVITY;
      ASSIGN,CURR=BUFFER;
      ACTIVITY.TRASFC/SPEED+SHIFTIME,,INCR;
```

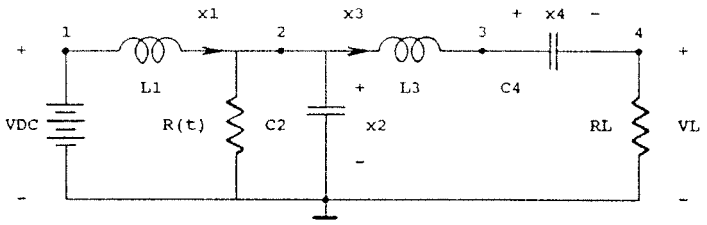
Part of the model description

N. Amicucci, S. Gatteschi, C. Scibilia, AIC S.p.A. Divisione Sistemi, Via Oddino Morgari 31, I - 101125 Torino, Italy, Tel.: +39-(0)11 6690933, Fax: +39-(0)11 657207

Comparison 3: Analysis of a generalized class-E amplifier

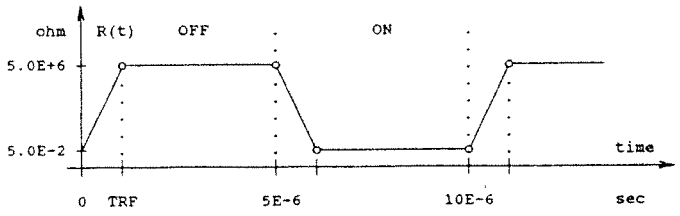
This example is taken from the electrical engineering world.

The basic class-E power amplifier was introduced by N.O. Sokal and A.D. Sokal in their classic paper from 1975 [1]. It is a switching-mode amplifier that operates with zero voltage and zero slope across the switch at switch turn-off. The actual numerical example is taken from J.C. Mandojana, K.J. Herman and R.E. Zulinski [2]. They use the following equivalent circuit of a generalized class-E amplifier as a test example for a procedure to evaluate steady state boundary conditions by means of MATLAB:



The component values are:
VDC = 5 volt, L1 = 79.9E-6 henry, C2 = 17.9E-9 farad, L3 = 232.0E-6 henry, C4 = 9.66E-9 farad and RL = 52.4 ohm.

The time dependent resistor R(t) models the active device acting as a switch with an ON-resistance of 0.05 ohm and an OFF-resistance of 5.0E + 6 ohm. An extreme ON-resistance of value zero ohm will of course result in a pathological system i.e. the old story of what happens when an ideal capacitor with a certain charge is suddenly short circuited. Furthermore the DC voltage source will be short circuited through the ideal coil L1. As a function of time R(t) is given in the following graph:



The duty ratio is 50%. The period is 10E-6 seconds (frequency 100 kHz). The rise/fall time is TRF = 1E-15 seconds.

The equations describing the circuit may be the state-equations where inductor currents and capacitor voltages are chosen as system variables. By using the Kirchhoff voltage and current laws we get the following differential equations:

$$L1*dx1/dt = -x2 + VDC$$

$$C2*dx2/dt = +x1 - x2/R(t) - x3$$

$$L3*dx3/dt = +x2 - RL*x3 - x4$$

$$C4*dx4/dt = +x3$$

where the variables are as follows: x1 = IL1 (the current of L1), x2 = VC2 (the voltage of C2), x3 = IL3 (the current of L3) and x4 = VC4 (the voltage of C4). Note that normally the setup of state equations demands a topological analysis of the circuit excluding some inductor currents and capacitor voltages as candidates for system variables (e.g if there is a loop of N capacitors then only N-1 of these may be given an arbitrary initial charge).

The following tasks should be performed:

(a) Calculation of the eigenvalues of the system in the ON-period: R(t) = 0.05 ohm and in the OFF-period: R(t) = 5E + 6 ohm.

(b) Simulation of the system over the time interval [0, 100E-6] sec with the zero-solution as initial state. Time curves of the state variables, the current in the switch resistor IR(t) = x2/R(t) and the output voltage VL = x3*RL are wanted.

(c) A parameter variation study over the time interval [0, 9E-6] sec with initial solution equal to the final solution at 100E-6 sec from task (b). The rise/fall time TRF should be varied through the values: 1E-15, 1E-11, 1E-9, 1E-7 sec. The phase plane curves of dx3/dt = VL3 as a function of x3 = IL3 i.e the voltage difference V2-V3 as a function of the current IL3 are wanted. Time curves of the current in the switch resistor IR(t) = x2/R(t) and the output voltage VL = x3*RL are wanted.

References

[1] Nathan O. Sokal and Alan D. Sokal, Class E - A New Class of High-Efficiency Tuned Single-Ended Switching Power Amplifiers, IEEE Journal of Solid-State Circuits, Vol. SC-10, No. 3, June 1975, pp. 168-176.

[2] Julio C. Mandojana, Kelly J. Herman and Robert E. Zulinski, A Discrete/Continuous Time-Domain Analysis of a Generalized Class E Amplifier, IEEE Transactions on Circuits and Systems, Vol. 37, No. 8, August 1990, pp. 1057-1060

Erik Lindberg, Institut of Circuit Theory and Telecommunication, 343 Technical University of Denmark, DK - 2800, Lyngby.

Combining the very best of established techniques with new and complex technologies Scientific Computers has an enviable range of tools for the engineer and scientist who needs to analyze, model and simulate dynamic systems

- **XANALOG**
  represents the state-of-the art in interactive modelling and simulation from desktop to hardware-in-the-loop

- **KBVISION**
  is an open, interactive development system for computer vision and image understanding applications

- **CTRL-C/MODEL-C**
  is a powerful, integrated software development environment combining all aspects of control system design, analysis, modelling and simulation for all types of dynamic systems

- **AIM**
  A machine learning tool for developing 'black-box'/system level models automatically from a database of numerical examples

SIMULATION *applications*

These are just some of the products from Scientific Computer's ever increasing portfolio of quality software tools.

With over 30 years in the design, modelling and simulation marketplace, if you have a need for a software package to help you in your work you should call us to discuss your application.

Scientific Computers Ltd
Victoria Road
Burgess Hill
West Sussex RH15 9LW
England

Tel : (0444) 235101
Fax: (0444) 242921

Scientific Computers GmbH
Franzstrasse 107
D-5100 Aachen
Germany

Tel : (0241) 26041
Fax: (0241) 44983

Scientific Computers Sarl
25/27 Rue Ginoux
F-75737 Paris Cedex 15
France

Tel : (1) 45 77 08 13
Fax: (1) 45 77 34 24

TECHNOLOGIES ARE EMERGING WHICH PROVIDE DYNAMIC AND EXCITING SOLUTIONS

Calendar of Events

July 1991

22-24 **1991 Summer Computer Simulation Conference**. Baltimore, Maryland.
Contact: Brian O'Neill, P.O. Box 17900, San Diego CA 92111. Tel: +1-619 277-3888

22-26 **13th IMACS WORLD CONGRESS** on Computation & Applied Mathematics. Dublin, Ireland
Contact: IMACS '91 Secretariat, 26 Temple Lane, Dublin, Ireland. Tel: +353 1 452081, Fax: +353 1 451739

August 1991

5-9 **14th International Symposium on Mathematical Programming**. Amsterdam, The Netherlands.
Contact: 14th International Symposium on Mathematical Programming, Paulus Potterstraat 40, 1071 DB Amsterdam, The Netherlands.

13-15 **IFAC Symposium on Distributed Intelligent Systems DIS '91.** Washington DC, USA.
Contact: Prof.A.H. Lewis, LIDS 35-410, M.I.T. Cambridge, MA 02139, USA

19-22 **EFMI/IIASA/IFAC International Conference. Medical Information Systems and Expert Systems**. Vienna, Austria.
Contact: K.P. Adlassnig, MIE '91 Secr. General, c/o Inst. f. Med. Computerwissenschaften, Garnisong. 13, 8. Hof, A - 1090 Vienna, Austria

20-22 **IBPSA BS'91 Building Simulation**. Nice, France.
Contact: Philippe Geril, European Simulation Office, University of Ghent, Coupure Links 653, B - 9000 Ghent, Belgium. Tel/Fax: +32-91 23 49 41

20-22 **Simulation Conference 16**. La Jolla, California
Contact: Art Hamilton, CACI, 3344 North Torrey Pine Court, La Jolla, CA 92037, USA, Tel: +1-619-457 9681, Fax: +1-619-457 1184

28-30 **Transputer Applications 91**. Glasgow, Scotland,
Contact: Scottish Transputer Centre, Exchange House, 229 George Street, Glasgow G1 1XW, Scotland, UK, Tel: +44-(0)41 582 4400 Ext. 2499

September 1991

2-6 **15th IFIP Conference on System Modelling and Optimization**. Zurich, Switzerland.
Contact: Karl Frauendorfer, Institut für Operations Research, Universität Zürich, Moussonstr. 15, CH - 8044 Zurich, Switzerland

2-6 **ECCTD-91. 10th European Conference on Circuit Theory and Design**. Copenhagen, Denmark. Contact: ECCTD-91, Institute for Circuit Theory and Telecommunication, 343 Technical University of Denmark, DK - 2800 Lyngby. Tel: +45 42 88 15 66, Fax: +45 45 93 03 55

4-6 **IFAC Symposium on Design Methods of Control Systems**. Zurich, Switzerland.
Contact: Prof.F. Kraus, ETH Zentrum ETL, CH - 8092 Zurich, Switzerland

7-9 **International Workshop on Software for Automatic Control Systems**. Irkutsk, USSR.
Contact: V.M. Matrosov, Director of the Irkutsk Computing Center, Siberian Branch, USSR Academy of Science, Lermotov Str. 134, SU - 664033 Irkutsk, USSR

10-13 **IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes SAFEPROCESS '91**. Baden-Baden, Germany.
Contact: Herbert Wiefels, VDI/VDE - GMA, Postfach 1139, D - 4000 Dusseldorf 1, Germany

16-18 **IFAC/IFIP/IMACS Symposium on Robot Control - SYROCO '91**. Vienna, Austria.
Contact: J. Hähnel, OEPWZ, Rockhgasse 6, A - 1014 Vienna, Austria. Tel: +43-(0)222 533 8636/0

18-20 **MMB'91: 6th Conference on Measurement, Modelling and Evaluation of Computer Systems**. Munich, Germany.
Contact: Axel Lehmann, Fritz Lehmann, Fakultät für Informatik, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, D - 8014 Neubiberg, Germany. Tel: +49-(0)89 6004 2648, +49-(0)89 6004 2280, Fax: +49-(0) 6004 3560.

23-25 **3rd IFAC Workshop on Artificial Intelligence in Real Time Control**. Napa, California, USA.
Contact: Prof. G.J. Suski, Lawrence Livermore Nat. Lab., 7000 East Ave, Livermore, CA 94550, USA

23-26 **7. Symposium Simulationstechnik, ASIM 91.** Hagen, Germany.
Contact: Dj. Tavangarian, FernUniversität Hagen, Technische Informatik II, Postfach 940, D - 5800 Hagen 1, Germany. Tel: +49-(0)2331 804 8372, Fax: +49-(0)2331 804 313

25-27 **5th International Conference on Fault-Tolerant Computing Systems**. Nürnberg, Germany.
Contact: W. Hohl, IMMD III, Universität Erlangen-Nürnberg, Martensstr. 3, D - 8520 Erlangen, Germany. Tel: +49-(0)9131 857003. Fax: +49-(0)9131 39388

30 - October 2

First International Conference of the Austrian Center for Parallel Computation. Salzburg, Austria
Contact: P. Zinterhof, University of Salzburg, Hellbrunner Straße 34, A - 5020 Salzburg, Austria, Tel: +43-(0)662 8044 6701, Fax: +43-(0)662 8044 5010

October 1991

1-4 **International Symposium on Computer Arithmetic and Scientific Computation - SCAN '91.** Oldenburg, Germany.
Contact: Prof.Dr. J. Herzberger, Fachbereich Mathematik, Universität Oldenburg, W - 2900 Oldenburg, Germany.

8-11 **SYM-OP-IS'91.** Herceg Novi, Yugoslavia.
Contact: Vlatko Ceric, Faculty of Economics, University of Zagreb, Trg J. F. Kennedy 6, YU - 41000 Zagreb, Yugoslavia. Tel: +38 41 231 111, Fax: +38 41 235 633

13-16 **7th International Conference on Mechanics in Medicine and Biology ICMMB'91.** Ljubljana, Yugoslavia.
Contact: Cankarjev dom, Cultural and Congress Centre, Mrs. Maja Stojkovic, Kidricev park 1, YU - 61000 Ljubljana, Yugoslavia. Tel: +38 61 210 956, Fax: +38 61 217 431

16-18 **IFAC/IMACS/IFIP Workshop on Cultural Aspects of Automation.** Krems, Austria.
Contact: P. Kopacek, ÖPWZ, Rockhgasse 6, A - 1014 Wien, Austria

17-18 **Conference Seminar on Functional Electrical Stimulation.** Ljubljana, Yugoslavia.
Contact: see ICMMB'91

17-18 **ASIM Workshop. Group "Simulationssoftware und -hardware".** Zurich, Switzerland.
Contact: Dr. Jürgen Halin, ETH Zürich, Institut für Energietechnik, Clausiusstrasse 33, CH-8092 Zürich. Tel: +41-(0)1/256-4608, Fax: +41-(0)1/262 2158 or 2520192.

16-19 **Workshop on Cardiovascular Dynamics** (Satellite Symposium of the 7th ICMMB'91). Tinje, Austria.
Contact: Prof. G. Juznic, Institute of Physiology, Faculty of Medicine, Zaloska 4, YU - 61105 Ljubljana, Yugoslavia

21-23 **SIMTEC 91: Simulation Technology Conference International 1991.** Orlando, Florida
Contact: M.L. Padgett; Auburn University, Electrical Engineering Dept., 200 Broun Hall, Auburn, AL 36849-5201, Tel.: +1-502-821 2472

23, 24, 30, 31

Simulation of Dynamic Systems. Delft University of Technolgy
Contact: PATO, P.O. Box 30424, 2500 GK Den Haag, Tel: +31-(0)70 3644957, attn. drs. M.M.P. Kimmel.

DBSS meeting: Computer Graphics/Computer Animation in Simulation. Delft University of Technology.
Contact: J. C. Zuidervaart, Rekencentrum, Delft University of Technology, P.O. Box 354, 2600 AJ Delft, The Netherlands

DBSS DIANA meeting.
Contact: J. C. Zuidervaart, Rekencentrum, Delft University of Technology, P.O. Box 354, 2600 AJ Delft, The Netherlands

November 1991

6-8 **ESS 91. European Simulation Symposium.** Ghent, Belgium
Contact: Philippe Geril, European Simulation Office, University of Ghent, Coupure Links 653, B - 9000 Ghent, Belgium. Tel/Fax: +32-91 23 49 41

December 1991

8-11 **1991 Winter Simulation Conference.** Phoenix, Arizona.
Contact: G.M. Clark, WSC '91 Program Chair, Dept. of Industrial and Systems Engineering, The Ohio State University, 1971 Neil Ave. Columbus, Ohio 43210, Tel.: +1-614-292 7863, Fax: +1-614-292 7852

10-12 **9th Biennial Conference on Modelling and Simulation.** Gold Coast, Queensland, Australia.
Contact: D.G. Mayer, Biometry Branch, Qld Dept. of Primary Industries, GPO Box 46, Brisbane, Queensland 4001

January 1992

20-22 **6th Workshop on Parallel and Distributed Simulation.** Newport Beach, California.
Contact: B. O'Neill, P.O. Box 17900, San Diego, CA 92177. Tel.: +1-619-277 3888.

20-22 **Simulation Business and Management.** Newport Beach, California.
Contact: B. O'Neill, P.O. Box 17900, San Diego, CA 92177. Tel.: +1-619-277 3888.

20-22 **Simulation in Engineering Education.** Newport Beach, California.
Contact: B. O'Neill, P.O. Box 17900, San Diego, CA 92177. Tel.: +1-619-277 3888.

20-22 **Modeling and Simulation on Microcomputers**. Newport Beach, California.
Contact: B. O'Neill, P.O. Box 17900, San Diego, CA 92177. Tel.: +1-619-277 3888.

February 1992

Military Simulation. RMCS Cranfield, U.K. organized by I. Whitworth.

March 1992

9-10 **ASIM Workshop. Group "Simulation technischer Systeme"**. Paderborn, Germany.
Contact: Prof. Dr.-Ing. Gerald Kampe, FHT Esslingen, Flandernstraße 101, W-7300 Esslingen. Tel: +49-(0)711/394-258 or 266

18-19 **"Visualisierung und Präsentation von Modellen und Resultaten der Simulation"**. Magdeburg, Germany.
Contact: Dr. V. Hinz, Technische Universität "Otto von Guericke" Magdeburg, Universitätsplatz 2, PSF 4120, O - 3010 Magdeburg, Germany, Tel.: +49-(0)91 592 766, Email: HINZ@DMDTU11.bitnet.

25-26 **Modelling for Control and Simulation** (GMA-committee 1.3) Langen/Hessen, Germany.
Contact: Prof. I. Troch, Technische Universität Wien, Wiedner Hauptstr. 8-10, A - 1040 Wien, Austria

May 1992

7-8 **ASIM Workshop. Group "Simulation und künstliche Intelligenz"**. Dortmund, Germany.
Contact: Dr. Johannes Krauth, BIBA, Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaft, Postfach 33 04 40, W-2800 Bremen 33. Tel: +49-(0)421/22009-43, Fax: +49-(0)421/22009-79.

June 1992

1-4 **ESM 92. European Simulation Multiconference**. York, U.K.
Contact: Philippe Geril, European Simulation Office, University of Ghent, Coupure Links 653, B - 9000 Ghent, Belgium. Tel/Fax: +32-91 23 49 41

10-12 **34th annual SIMS meeting**. Lappeenranta, Finland.
Contact: M. Hänninen, Technical Research Center of Finland, Lab. of Electrical&Autom. Eng., P.O. Box 34, SF - 02151 Espoo, Finland. Tel: +358-0 4566564, Fax: +358-0 4550115.

July 1992

19-24 **10th International Conference on Multiple Criteria Decision Making**. Taipei, Taiwan.
Contact: Prof. Gwo-Hshiung Tzeng, College of Management, National Chiao Tung University 4F, 114, Sec. 1, Chung-Hsiao W. Rd., Taipei 100, Taiwan, R.O.C. Tel.: 011-886-2-3146515, Fax: 011-886-2-3120082

August 1992

26-28 **IMACS RM2S '92 Kobe**. Kobi, Japan.
Contact: Prof. S. Tsafestas, Intelligent Robotics and Control Unit, Computer Science Division, National Technical University of Athens, Zografou I5773, Athens, Greece, Fax: +30-1-7757504

27 - September 2

4th International Symposium on Systems Analysis and Simulation. Berlin, Germany.
Contact: Conference Secretariat SAS 1992, Clara-Zetkin-Str. 115-117, O - 1086 Berlin.

September 1992

29 - October 2
EUROSIM '92. EUROSIM Simulation Congress. Capri, Italy.
Contact: Mrs. Antonella Di Chiara, Dept. of Civil Engineering, University of Rome "Tor Vergata", Via della Ricerca Scientifica, I - 00173 Roma, Italy, Tel: +39-6-79794575, Fax: +39-6-79794586, Telex: 622302 ROMCIV I

October 1992

2nd Beijing International Conference on System Simulation and Scientific Computing. Beijing, China.
Contact: Prof. Chen, Zong Ji, Dept. of Control Engineering, Beijing University of Aeronautics and Astronautics, Beijing 100083, China, Fax: 86-1-2015347, Telex: 222700 BUAA CN.

December 1992

7-11 **IMACS Symposium on Scientific Computing and Mathematical Modelling**. Bangalore, India.
Contact: Prof. S.K. Dey, Department of Mathematics, Eastern Illinois University, Charleston, IL 61920, Fax: +1-217-581 5188.

January 1993

3-7 **International Conference on Scientific Computation and Differential Equations**. Auckland, New Zealand.
Contact: Dr. John Butcher, Dept. of Mathematics and Statistics, University of Auckland, Auckland, New Zealand.

EUROSIM '92

EUROSIM Simulation Congress

Capri, Italy, Septembe, 29 - October 2 1992

First Call for Papers

This international congress is organized on behalf of EUROSIM by the Italian Society for Computer Simulation (ISCS) in co-operation with

ASIM Arbeitsgemeinschaft Simulation, DBSS Dutch Benelux Simulation Society, FRANCOSIM Sociéte Francophone de Simulation, SIMS Simulation Society of Scandinavia, UKSC United Kingdom Simulation Council

and with the moral sponsorship of the Esprit Operations of the European Economic Community (EEC), the Society for Computer Simulation International (SCSI), the Chinese Association for System Simulation (CASS), the Czechoslovak System Simulation Club (CSSC), the National Research Council of Italy (CNR).

Conference Chairman: F. Maceri (Italy)

Preliminary Scientific Committee: W. Ameling (Germany), I. Bausch-Gall (Germany), F. Breitenecker (Austria), L. Dekker (The Netherlands), A. Frisiani (Italy), J.M. Giron Sierra (Spain), J. Halin (Switzerland), R. Huntsinger (USA), G. Iazeolla (Italy), A. Javor (Hungary), K. Juslin (Finland), E. Kerckhoffs (The Netherlands), M. Kotva (Czechoslovakia), F. Lorenz (Belgium), E. Mosekilde (Denmark), D. Murray-Smith (U.K.), S. Nicosia (Italy), S. Rinaldi (Italy), P.L. Scandizzo (Italy), A. Sydow (Germany), S. Tucci (Italy), G.C. Vansteenkiste (Belgium), K.C. Varghese (EEC), R.N. Zobel (U.K.), Wen Chuan-Yuan (China)

Organizing Committee: F. Maceri, F. Cennamo, M. Colajanni, V. Grassi, M. Lembo, M. Savastano

Scientific Program:

The Eurosim Simulation Congress is concerned with all aspects of computer simulation methodology and application. Papers are invited in the following areas:

- Simulation languages / Simulation architectures
- Simulation methodologies
- Simulation of computer systems and networks
- Simulation in electronic design
- Simulation in environmental problems
- Simulation in control engineering
- Simulation in electrical engineering (power plants)
- Simulation in education
- Simulation in training
- Simulation in economics / business and management
- Simulation in transportation and traffic control
- Simulation in astrophysics
- Simulation in astronautics
- Simulation in earthquake engineering
- Supercomputing in simulation
- Parallel and distributed simulation
- Simulation in energy systems
- Simulation in biology and medicine
- Simulation in factory and automation
- Computational physics and chemistry
- Simulation in automotive industry, etc.

Papers will be considered in any relevant field. Proposals for special sessions, state-of-the-art reviews and panel discussions are also welcome and will be carefully considered by the Scientific Committee.

Venue

The Congress will take place on the Island of Capri, Italy. The Congress sessions will be held at the Grand Hotel Quisisana, from September 29 to October 2, 1992.

Exhibition

There will be an exhibition throughout the period of the Congress at the Conference site.

Enquiries about the exhibition facilities are welcome. It is proposed that the exhibition should have two sections, one for the commercial demonstrations and one for posters.

Registration Fees

Conference registration includes a copy of the Conference Proceedings, coffeee breaks, and official banquet.

Early registration fee (before August 31, 1992) is **300 ECU** for authors and members of ASIM, DBSS, FRANCOSIM, ISCS, SIMS, UKSC, SCSI, **350 ECU** for other participants. After August 31,1992 registration fee will be increased by 50 ECU.

Authors who will present a paper are requested to register and pay registration fee before August 31, 1992 for paper to be included in the Proceedings.

The official language of the Congress will be English.

Congress Secretariat:

Mrs. Antonella Di Chiara
Dept. of Civil Engineering
University of Rome "Tor Vergata",
Via della Ricerca Scientifica
I - 00173 Roma, Italy
Tel: +39-6-79794575, Fax: +39-6-79794586
telex: 622302 ROMCIV I

Deadlines and Requirements

Extended abstracts (two pages typewritten without drawings and tables) are due to arrive in TRIPLICATE at the Congress Secretariat by **October 31, 1991**.

Abstracts will be reviewed by members of the Scientific Committee and notification of acceptance or rejection will be sent by **December 31, 1991**.

Camera-ready copies of accepted papers must be sent to the Congress Secretariat by **May 30, 1992**. A final review of each paper will take place at that time.

Only original papers which have not previously been published elsewhere will be accepted.