EUROSIM

Simulation News Europe

COMPARISON 11: SCARA ROBOT

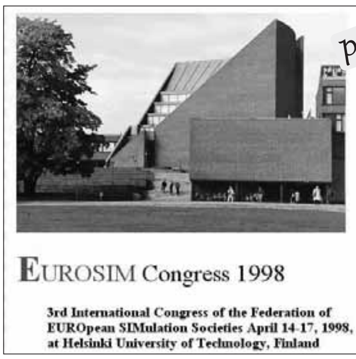
EUROSIM'98 CONGRESS

Number 22 March 1998

A European Forum on Simulation Activities

In this issue ...

... you find the latest information on the EUROSIM'98 Congress



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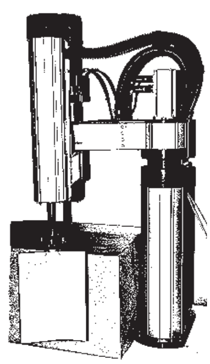

... you may win a one-year subscription to "Simulation Practice and Theory"

if you take the challenge and solve one of the EUROSIM comparisons with any tool of your choice, document the solution and send it to the editors. Please read details in the Editorial.

New EUROSIM WWW Server:

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Editorial

This issue of ***EUROSIM - Simulation News Europe*** *(SNE) presents itself in a slightly changed layout and improved printing quality. It is no longer printed as addendum in "Simulation Practice and Theory" (SIMPRA), EUROSIM's scientific journal, published by Elsevier B.V.*

The EUROSIM comparisons on simulation software consist now of 11 different easily comprehensible models from various application areas, for continuous and discrete modelling, and for parallel computation.

An evaluation has shown that the comparisons not only reflect a special simulator's features for certain tasks, they also show different modelling approaches and quite different methodologies. Therefore, we are not only interested in solutions with different simulators, but also in different "types" of solutions with the same simulator.

The comparisons are well documented on our WWW server, which has a new address now (http://www.argesim.org/comparisons/). There you may find all definitions and some of the solutions. Up to now 145 solutions to the comparisons have been published in SNE. The results will be entered into a database in order to make a comprehensive evaluation and comparison of simulation software. Details will be published in the next issue.

If you choose to solve one of the comparisons, document the solution and send it to us for publication, you will be eligible for a free one-year subscription to SIMPRA, which will be given to the author of the first correct solution sent in until June 3, 1998. You may use any tool or method of your choice for solving a comparison. Please note that the documentation of the solution should not exceed one page in SNE. Good luck !

We would like to thank all who contributed to this issue, especially the authors of the very interesting essays.

F. Breitenecker, I. Husinsky

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Deadline for the next issue will be June 3, 1998.

Contents

Aims and Scope

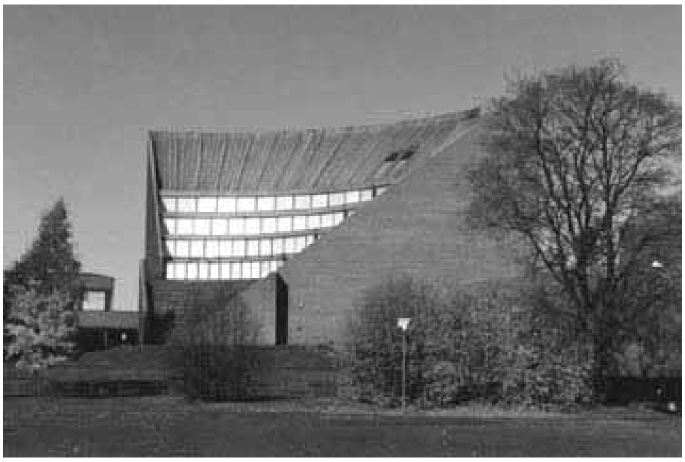
The journal EUROSIM - Simulation News Europe (abbreviated SNE) publishes information related to modelling and simulation. SNE's aims are: to inform about new developments in simulation methodologies, applications and software and hardware for modeling and simulation, to report news from European simulation societies and European simulation events and from international simulation societies and working groups all over the world. SNE contains news on EUROSIM, on the EUROSIM societies, on other international simulation societies and groups, on software user groups, on simulation centers, and contains a comprehensive calendar of events and of classes on modeling and simulation. SNE publishes essays dealing with new developments in a particular area and reports on software and hardware developments, new applications and new methodologies and their applications. The section on industry news contains the latest news available through press releases and announcements.There are book reviews and book news. A special series on simulation comparisons (EUROSIM comparisons) gives a comprehensive overview on features and developments of simulation software and hardware, including parallelization techniques. These comparisons are also becoming standard benchmarks for simulation programs. SNE is a printed journal as well as an electronic journal. ARGESIM's WWW server can be found at http://www.argesim.org/sne/. All contributions are selected and may be edited by the editors of the journal.

Members of the Editorial Board of SNE

Please contact them if you have contributions concerning a particular society.

YOU MAY STILL SUBMIT SHORT PAPERS AND POSTERS TO THE

EUROSIM'98 CONGRESS



at Helsinki University of Technology

Main Scientific Congress and Exhibition:
April 14-15, 1998
Post Congress meetings, tours, and visits:
April 16-18, 1998

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HTTP://WWW.EUROSIM.ORG/

MARCH 10, 1998 DEADLINE:

- Ordinary Paper Submission (4-6 pages) upon accepted abstract.
- Short Paper Deadline (1-4 pages) without abstract procedure.
- Poster Picture Deadline.
- Author registration ends.
- Early Registration ends.

Additional papers may by preference be addressed to the very popular special sessions, although all disciplines of simulation are considered:

Special Session 1. Hybrid Systems

Scientific Committee: Pieter J. Mosterman, DLR Munich(D); Jan F. Broenink, University of Twente (NL).
Increased complexity and safety and performance demands on computer controlled systems require comprehensive modelling and analysis approaches. Such systems typically operate in a number of distinct operational modes. Discrete event models govern changes in operational mode and continuous formalisms model behavior in each operational mode. Hybrid systems combine continuous and discrete event behavior. We aim to bring together researchers to discuss how to combine concepts, theories, models, methodologies, and tools from the domains of continuous control systems and discrete-event systems to apply to hybrid systems.

Sp. Session 2. Impact of HPCN on Parallel Simulation

Scientific Committee: J. Bruin, FEL TNO (NL); L. Dekker, TU Delft (NL); J. Halin, ETH Zürich (CH); A.W. Heemink, TU Delft (NL); J. Keane, University of Manchester(UK); H.X. Lin, TU Delft (NL); E. Shapiro (USA); W. Smit, AKZO NOBEL (NL); J.C. Zuidervaart, TU Delft (NL).
For this session we invite those people to submit abstracts, who have relevant experience in the application of High Performance Computing (HPC) to simulation of complex systems. The author has to specify the necessary properties (functional characteristics) of (future) parallel computer systems in order to facilitate maximally modelling and simulation. On the other hand also contributions that describe new modelling techniques for optimal use of existing (and future) HPC and related communication systems are welcome. We encourage a broad variety of types of applications.

Special Session 3. Modelica Language

Scientific Committee: H. Elmqvist, Dynasim, Lund (S);
Novel applications of the MODELICA language in various fields of engineering, such as mechatronics, robotics, and energy systems will be presented. Modelica is an object oriented, equation-based, declarative data-oriented modelling language for non-causal modelling of physical systems. The general principles and design goals that have been applied during the design of the Modelica language will be dealt with: Efficiency as engineering tool, reliability and correctness, coping with system evolution, generality and uniformity, declarativity and referential transparency, adherence to common de facto language standards, high level of abstraction, code reuse, and a firm mathematical foundation.

Sp. Session 4. Computational Intelligence in Simulation

Scientific Committee: Jacques LeFevre, Ecole Centrale de Lille (F) & UMDS, London (UK); Henri Pierreval, IFMA, Aubiere,(F); Esko Juuso, Kauko Leiviskd, Infotech, University of Oulu (FIN); Agostino Bruzzone, University of Genoa (I).
Computational intelligence can be considered as an extension of artificial intelligence (AI) on building reasoning and problem solving mechanisms. Simulation is an attempt to study and understand the operation of real physical systems by running computer models of these systems. Computational intelligence is working on symbolic level, and simulation on numerical level. These two worlds are merging, and nowadays the research, on how they could help each other, is all the time increasing. Computational intelligence can be considered as a collection of methods for qualitative simulation (in broad sense). Intelligent methods are needed because of uncertainty since all the necessary details cannot be included to simulation systems. Computational intelligence has the key role in connecting applications and making them easier to access for non-specialist users. All these methodologies can be adapted to appropriate levels in simulation applications. In the special session these technologies and tools will be discussed.

Special Session 5. Use of Modelling and Simulation of Unit Operations in Process Industry

Scientific Committee: Hannu Sippola, GEM Systems Oy (FIN); Rainer Backman, Ebo Academi (FIN); Markku Hurme, Ari Jokilaakso, Helsinki University of Technology

(FIN); Reijo Karvinen, Tampere University of Technology (FIN); Erkki Laitinen, University of Oulu (FIN); Timo Tiihonen, University of Jyvdskyld (FIN).

The computer aided modelling and simulation has become a common tool in designing and understanding unit operations such as reactors, boilers, pumps, heat exchangers, etc. in process industry. As a result temperature, pressure, concentration and other profiles inside the modelled/simulated unit operation are obtained. During the last decades also several commercial software packages have become available in the field. However, at the same time the increasing demands and expectations from process industry have been laid on computer aided modelling and simulation. This session attempts to give real-life examples of the use of modelling and simulation of the unit operations in process industry today. The session will also act as a meeting place for experts in process modelling and simulation to discuss the current status of the art.

Special Session 5. Simulation and Hypermedia

Scientific Committee: Peter Williams, MEDC, University of Paisley, Scotland (UK); Jaakko Oksanen, Valmet Automation Inc./Control Systems (FIN); Leena Yliniemi, Juha Lindfors, Infotech, University of Oulu (FIN).

With the rapid development of hypermedia tools, the use of new tools has become a viable option in many simulation situations. Using hypermedia technology, important information can be added to support the simulation situation. The support can be in a form of an intelligent manual or only a web document the user can browse. Though hypermedia and simulation has already an important role in education and training, the use of simulation combined with hypermedia has won place in industry together with the development of internet and intranet technology. In industry there is need for just-in-time information that can be easily distributed through networks using hypermedia documents. In the special session these technologies and tools will be discussed.

Special Session 6. Dynamic Simulation Platforms for Process Design and Optimization

Scientific Committee: Jaakko Junttila, ABB Power Ltd. (FIN); Kari Porkholm, IVO Power Engineering Ltd (FIN); Olli Tiihonen, VTT Energy (FIN).

Dynamic process simulation is currently gaining acceptance in the design of industrial processes. The availability of affordable computing power with easy-to-use simulation tools has increased the number of potential users drastically. The capabilities of the simulation tools have also increased. Planning and optimization of plant operation is enhanced due to possibility to of studying new operational situations, including accidents and malfunctions. Finally, the models developed during the design process can be used as a basis for operational staff training, even before the plant start-up. This session attempts to give a glimpse at the available tools, their properties and the results achieved in different applications.

Special Session 7. Modeling and Simulation of Enterprise Systems

Scientific Committee: Riitta Smeds, HUT, Espoo (FIN);

With the advancement of IT, the variety and applicability of enterprise simulation models is rapidly increasing. The models can be classified e.g. according to the nature of the system to be simulated, and the tools used the simulation. But enterprises do not only consist of technical systems, rather they are complex socio-technical systems, and the models of enterprise processes should also incorporate the interaction of human beings. This can be achieved "manually" in brainstorming and simulation games, but also in a computer supported way, applying visual models and even virtual reality to support the human interaction in simulation. In this hybrid simulation, the people are engaged as actors in the virtual reality model, and can as a group experience, experiment, discuss and understand the virtual organization and its dynamic functioning. Presentations of a wide variety of enterprise simulation models and methods and from different application areas are welcome: simulations for training purposes in Universities / in industry, simulations for planning and decision making in enterprises, etc.

Sp. Session 8. Web-based Modeling and Simulation

Scientific Committee: Paul A. Fishwick, University of Florida (USA); Roger Smith, Mystech Associates, FL (USA); Peter Lorenz, Otto-von-Guericke-Universität Magdeburg (D); Dick Zobel, University of Manchester (UK); Giuseppe Iazeolla, Andrea D'Ambrogio, University of Roma Tor Vergata (I); Chun-Hung Chen, Department of Systems Engineering, University of Pennsylvania (USA).

The aim of the session is to explore the use of web-based languages and technologies in the field of modeling & simulation. Suggested topics for paper presentation include, but are not limited to: - web-enabled simulation applications - web-based simulation environments - web-based distributed simulation - web-based simulation for education, training and learning - web use for publication of simulation experiments - sharing and reuse of simulation models and tools on the web - web standards for model integration/communication/interoperability - web-based visualization/animation of simulation models.

Special Session 9. Use of Models in Control Engineering,

Scientific Committee: Jari Hamalainen, VTT Automation, Leif Hammarstrom, Neste Engineering;

Simulation models have traditionally been of large importance when testing control system concepts and optimizing control parameters. Transfer function models have been part of the basic control engineering tools. Mechanistic models have been taken into use for testing larger ranges of operation as starting sequences. Models have been applied for estimation of parameters not possible to measure on line. Faster than real time simulation is needed for optimal control of grade changes or batch processes.

Any contributions, questions or comments with regard to the scientific programme may be addressed to the Local Organizing Committee:

email: EUROSIM98@VTT.FI or
fax +358-9-456-5752.

Questions concerning registrations, hotel reservations and payments should be made to the Congress Team of AREA Travel Agency Ltd:

email: CTEAM@AREA.FI
or fax +358-9-477 5811 or Tel. +358-9-818 383.

There will be good possibilities for authors who want to demonstrate their simulation software during the coffee beaks and the vendors evening session. Kindly contact me for reservations.

Kaj Juslin, general chair
email: kaj.juslin@vtt.fi

EUROSIM - General Information

EUROSIM, the **Federation of European Simulation Societies**, was set up in 1989. The purpose of EUROSIM is to provide a European forum for regional and national simulation societies to promote the advancement of modelling and simulation in industry, research, and development. EUROSIM members may be regional and/or national simulation societies. Full membership and observer membership are available.

At present EUROSIM has ten full members and one observer member: ASIM – *Arbeitsgemeinschaft Simulation* (Austria, Germany, Switzerland), CROSSIM – Croatian Society for Simulation Modelling (Croatia), CSSS – Czech & Slovak Simulation Society (Czech Republic, Slovak Republic), DBSS – Dutch Benelux Simulation Society (Belgium, The Netherlands), FRANCOSIM – Société Francophone de Simulation (Belgium, France), HSS – Hungarian Simulation Society (Hungary), ISCS – Italian Society for Computer Simulation (Italy), SIMS – Simulation Society of Scandinavia (Denmark, Finland, Norway, Sweden), SLOSIM – Slovenian Simulation Society (Slovenia), UKSIM – United Kingdom Simulation Society (U.K.). AES – Asociación Española de Simulación (Spain) is observer member.

EUROSIM is governed by a **Board** consisting of one representative of each member society, plus the organizer of the last EUROSIM Congress (past president) and the organizer of the coming EUROSIM Congress (president). The Board elects officers, who are at present: K. Juslin (SIMS) – president, F. Breitenecker (ASIM) – past president, R. Zobel (UKSIM) – secretary, L. Dekker (DBSS) – treasurer.

EUROSIM - Simulation News Europe (SNE), the journal for EUROSIM members, publishes information on simulation news in Europe and trends and developments in simulation, including reports of EUROSIM's member societies. **Simulation Practice and Theory** (SIMPRA), EUROSIM's scientific journal, publishes high quality contributions on modelling and simulation.
Further information can be found on the EUROSIM WWW Server, please note the new address:

`http://www.eurosim.org/`

Exploiting *Weak* Interactions in Object-oriented Modeling

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Abstract. Large-scale dynamic models of physical systems often present intrinsic, though not exact, decoupling among different parts. This can be exploited by the modelist in the phase of model building by defining certain variable-equation relations or certain models' connections as "weak". The paper shows how this simple heuristic criterion allows drastic simplifications of the numerical procedure needed to simulate the system, especially important when the modeling approach (like object-oriented modeling) naturally leads to DAE systems of considerable dimension.

Introduction

In the last few years, thanks to the remarkable progress of programming environments, the approach to modeling of complex systems has been radically changed. Particularly, modeling languages have been proposed which aim at making the analyst rid of the problem of giving the model a procedural form easy to treat by a numerical solution process. On the contrary, such languages, called Object-Oriented Modeling (OOM) languages, ask the modelist to describe its model in a structured modular way, with the maximal adherence of the modeling modules to the physical components they have to represent. Though the basic concepts of OOM and of acausal modeling are not very recent (refer to work of Wellstead [1] and of Elmquist [2]), the concrete development of modeling software based on these ideas has only recently reached a significant level [3, 4, 5, 6].

OOM approach is very convenient in the phase of model building but, just because models are given in acausal implicit form, the resulting overall model generally consists of large Differential Algebraic Equation (DAE) systems, and these DAE systems do not generally have a block-triangular structure. Since the integration of DAE systems must be implicit, it requires repeated solutions of linear systems, which may result in excessive computational burden if the system is large-scale and without any particular structure.

The objective of this paper is to introduce a modeling expedient that, without losing numerical stability and robustness, allows the reduction of the DAE system in block-triangular form. The basic idea is the following: though implicit integration formulas are required to ensure numerical stability, considering a given equation there are often variables that, either because they are associated to a *rather-slow dynamics* or because their structural influence in that equation is quantitatively small, can be given the value of the past integration step while integrating the equation along the new time step. Thus, looking at the system Jacobian, the entry corresponding to the said variable-equation relation will disappear. If the expedient is properly used for several times, the Jacobian may be transformed into a block-triangular form, which is efficiently dealt with by DAE system solvers. Variable-equation relationships of the kind just described, which are ignored within a time step, are called *weak*. Note that, in this way, it is expected that the numerical integration will maintain stability properties similar to fully implicit formulas (the integration step is only limited by the required accuracy of the desired solution), whereas stability limits depends on fast dynamics when explicit integration formulas are used.

The choice of weak relations is based on the dynamic properties of the physical system under consideration, thus requiring a deep knowledge of the real system behavior: in the framework of OOM, weak relations may belong to a primitive (simple) model (i.e. they may be specified in the model library) or to the connection between two models (i.e. they are specified in the phase of model building). OOM languages should be equipped with constructs to deal with weakness, as is shown in the following.

A simple example

To clarify the basic concept behind the idea of *weakening*, consider the simple electric circuit of Fig.1, where electric poles identify the ports by which model objects are interconnected.

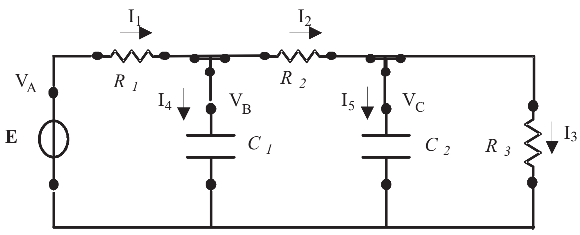

Fig. 1 A simple example: linear electrical circuit.

If equations of model objects are collected and port connections are taken into account, one obtains the system equations in classical DAE form, as follows:

$$E - V_A = 0 \qquad V_B - V_C - R_2 I_2 = 0$$
$$V_A - V_B - R_1 I_1 = 0 \qquad I_5 - C_2 \dot{V}_C = 0$$
$$I_1 - I_2 - I_4 = 0 \qquad V_C - R_3 I_3 = 0$$
$$I_4 - C_1 \dot{V}_B = 0 \qquad I_2 - I_5 - I_3 = 0$$

In this particular case (linear system), the algebraic equations can be solved for algebraic variables and the system can be written in the following normal form:

$$\dot{x} = Ax + Bu \qquad (1)$$

with $x = [V_B \ V_C]'$ and $u = E$, while A and B are suitable matrices. Suppose that system (1) is numerically solved by *implicit Euler* integration formula; then, at any time step one has to solve the following linear system:

$$Hx_{k+1} = x_k + f_{k+1} \qquad (2)$$

where the matrix $H=I-Adt$ (dt is the integration step) is a generic matrix to be inverted (note that the corresponding matrix inversion is required at each time-step for nonlinear systems) and $f=dtBu$. However, the solution is numerically stable for any dt.

On the other side, if *explicit Euler* formula is used, the solution is given by:

$$x_{k+1} = Fx_k + f_k \qquad (3)$$

where $F=I+Adt$. In this case there is no need of matrix inversion but the solution is numerically stable only for $dt<2T_{min}$, where T_{min} is the minimum time constant of matrix A. Thus, explicit integration formulas are not convenient when fast dynamics exists mixed with fundamental slow dynamics.

Now, assume that, in the circuit of Fig. 1, the resistance R_2 is "**rather large**" and the capacitance C_2 is "**rather large or not too small**"; then the variation of voltage V_C within an integration interval is likely[1] to be small, therefore to have a *weak* influence on current I_2. To denote the said situation in a formal way, we shall say that *the electrical connection is* <u>*voltage-weak*</u> *at the right terminal of resistor* R_2. This quite obvious remark can be turned into a modeling criterion, expressed in Fig. 2: the left part of the circuit is cut at the right pole of R_2 and artificial boundary conditions are imposed by introducing a fictitious voltage generator $\{V_C\}$, where $\{V_C\}$ denotes the value of V_C computed in the preceding integration interval; in the right part of the circuit, a fictitious current source I_2 is linked to the free left pole, where I_2 is the current actually flowing through R_2. Each sub-circuit is individually solved with an *implicit integration* formula. With this reformulation the left circuit can be solved first, using at each time step the old value of V_C; once this solution has been obtained, the right part is solved with the just-computed value of I_2. It is quite obvious that the solution of the "weakened" model of Fig. 2 will tend to the true solution if the time step is chosen sufficiently small. It can be interesting to note that the numerical stability of the solution will generally be ensured for much larger time steps than for explicit integration methods and, at the same time, no system inversion is needed.

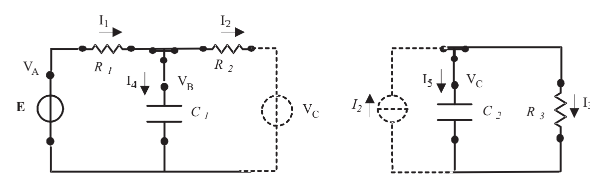

Fig. 2 Approximate model of the circuit by weakening

To prove the second point, the solution formula corresponding to the said criterion is written, that is:

$$G_L x_{k+1} = G_R x_k + f_{k+1} \qquad (4)$$

where G_L and G_R are the following **triangular** matrices:

$$G_L = \begin{pmatrix} 1+\dfrac{dt}{C_1 R} & 0 \\ -\dfrac{dt}{C_2 R_2} & 1+\dfrac{dt}{C_2 R_3} \end{pmatrix} \qquad G_R = \begin{pmatrix} 1 & \dfrac{dt}{C_1 R_2} \\ 0 & 1-\dfrac{dt}{C_2 R_2} \end{pmatrix}$$

To prove the first point, the following set of numerical values are considered:

R_1=0.1; C_1=1; R_3=1; C_2={1,3,10}; R_2=[0.1-10].

The stability regions of systems (3) and (4) are shown in Fig. 3, where the integration steps yielding stability are relative to points below the corresponding curve.

1 The voltage of a large capacitor is generally associated to a slow dynamics if the circuit design is "reasonable": in our case if C_2 is not "shunted" by a very small resistor R_3.

It is apparent that, while the explicit Euler formula severely restricts the integration step, the weakening approach combined with the implicit Euler formula practically yields an unconditionally stable system provided that C_2 and/or R_2 are not too small, which was the essential hypothesis to apply weakening.

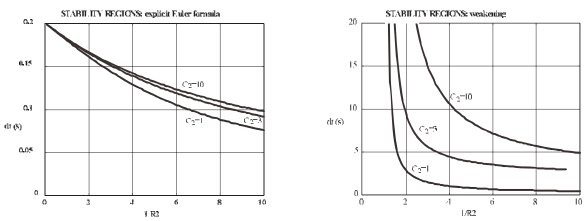

Fig. 3 Stability regions for systems (3) and (4)

Generalization

Weakening is a problem-dependent heuristic criterion based on dynamic decoupling, which may lead to impressive simplification and computation saving. It can be applied in object-oriented modeling environments both while building the model library and while assembling a plant model. To this end, a useful classification of *weakness* types is the following:

1. A *variable* may be *weak in* an *equation* belonging to a certain library model, which means that the influence of that variable in that equation is dynamically weak (small and/or slow).
2. A *connection* may be *effort-weak at* a model *terminal*, which means that the effort variable [1] composing that physical terminal will be assigned the past value of the variable to which it corresponds through the terminal connection (this is the case of the preceding example, where the connection between the resistor R_2 and the node to its left is *voltage-weak* at the electrical right terminal of R_2).
3. A *connection* may be *flow-weak* at a model terminal, which means that the flow variable [1] composing that physical terminal will be assigned the past value of the corresponding variable to which it corresponds through the terminal connection.

Note that weakness of type 1 regards model library (it is within an elementary model), while weakness of type 2 and 3 regard model assembling. With the above three syntactic constructs the method can be applied to any interdisciplinary system model: examples of successful real-size applications of the weakening techniques are available in the following areas: thermo-hydraulic networks (like those involved in power plants, chemical processes and energy systems), electromechanical systems (where the electric dynamics is much faster than the mechanical one) and electrothermal systems (where the electric dynamics is much faster than temperature dynamics).

Conclusions

Object-oriented modeling is a very powerful approach from the point of view of the analyst/modelist, since it allows reasoning by components and components' connection. However it generally gives rise to large implicit systems with non-triangular incidence matrices, which are heavy to treat numerically. There exist exact symbolic manipulation techniques that are useful to reduce the size of the resulting DAE system, but their effect is not sufficient in many practical cases, because the possibility of problem simplification is based on the recognition of zero/non-zero elements in the incidence matrix.

Weakening is presented here as a heuristic technique based on qualitative reasoning that allows a skilled modelist to decompose the overall problem of system solution into a set of (much) simpler problems, typically transforming the overall system structure into block-triangular form, thus avoiding the solution of large implicit DAE system. The key idea, which has been illustrated by a simple example, is to exploit dynamically-weak couplings (weak influence of a variable in a certain equation in the short term) to identify variables or connections, whose value can be taken as "essentially fixed" along an integration interval. Application to real-size problems results in dramatic benefit in simulation computing charge, without significant loss of accuracy and without affecting the object-oriented reasoning approach.

References

[1] P. E. Wellstead. *Physical System Modelling.* Academic Press, 1979.

[2] H. Elmqvist. *A Structured Model Language for Large Continuous Systems*. Ph.D Thesis Dept. of Automatic Control, Lund Institute of Technology, 1978.

[3] H. Elmqvist. *Dymola - Dynamic Modeling Language. User's Manual*. Dynasim AB, 1994.

[4] S.E. Mattsson, M. Andersson. *OMOLA: an Object-Oriented Modeling Language.* In M. Jamshidi and C. J. Herget, editors, "Recent Advances in Computer Aided Control Systems. Studies in Automation and Control", Elsevier Science Publisher, vol. 9, 291-310, 1993.

[5] P.I. Barton, C.C. Pantelides*. Modeling of Combined Discrete/Continuous Processes.* AIChE Journal 40, pp. 966-979, 1994.

[6] C. Maffezzoni, R. Girelli. *Moses: Modular Modeling in an Object-Oriented Database*, to appear in Mathematical Modelling of Systems, 1998.

Object-oriented Modeling and Simulation of Hydraulic Drives

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http://www.uni-paderborn.de/extern/fb/12

History

Hydraulic drives are used when high power in a restricted space is required. Typical examples are hydraulic systems in aircraft, cars or mobile construction machinery. However these systems tend to be highly oscillatory because the hydraulic oil is compressible and combined with the moving masses this leads to spring-mass-systems. The damping of these systems is often very low because all parts are very well lubricated. These effects require usually a very thorough theoretical study of the system to achieve a sufficient damping.

This situation led to the use of computers. The first studies were made in the early fifties, using analog computers [1]. In the sixties the use of digital computers began [2]. The software was written individually for each specific task. In the eighties specialised programs for the simulation of hydraulic systems were developed at several universities [3,4]. They used the fact that the modeling of hydraulic systems always leads to a simple structure of the differential equations. These programs used ASCII text files as input. Defining and verifying a simulation model was therefore a tedious task.

In the nineties graphical user interfaces made the building of system models much easier [5, 6, 7]. The user has only to choose a library model, e. g. a pump or a valve, position it on the screen and connect it with the other components. For a number of general purpose simulation languages libraries of hydraulic components became available, e. g. Dymola, EASY5, SABER [8, 9].

Mathematical models of hydraulic circuits

To model hydraulic circuits lumped volumes are usually added at each node, i. e. at the connection of two or more components. In these lumped volumes the net flow is integrated with respect to time to calculate the pressure, eq. (1).

$$\frac{d\,p_i}{dt} = \frac{\beta(p_i)}{Vol_i} \sum q_k \qquad (1)$$

The flow between two lumped volumes is given by an algebraic equation, eq (2).

$$q_j = f_j\,(p_1, p_2, \ldots, p_n) \qquad (2)$$

Traditional simulation programs for hydraulic systems exploit the simplicity of the structure of the resulting equations. They work well for pure hydraulic systems but reach their limit if mixed systems, e. g. hydraulic drives in multi body systems or electrical systems, need to be modelled.

Object oriented, general purpose simulation packages, like Dymola, are much more flexible if mixed systems are to be studied [10, 11]. Their strength is the ability to connect submodels to the overall system model. To do that a physical meaningful interface between the submodels is used. For hydraulic systems this means that both pressure and flow are transmitted by a single (graphical) connection when two or more components are connected.

This approach makes it possible to build a library of components that can be reused. Dymola's handling of events makes it easy to model even complex hydraulic components with only a few lines of code. With this library the modeling of a hydraulic circuit consists of simply selecting the needed library models, entering the needed parameters and connecting them. Dymola analyses this system, builds the simulation model and solves the equations.

Example: Laminar Flow

Fig. 1: Long and narrow tube

The flow as a function of differential pressure can be calculated by [12]:

$$q\,(\Delta p) = \frac{\pi R^4}{8 \mu L}\,\Delta p \quad (3)$$

To model this tube the following Dymola statements are used

```
model class laminar

  cut HydA (pa / q)
  cut HydB (pb / -q)

  local dp

  parameter R = 1.e-3{m; radius}
  parameter L = 1    {m; length)
  constant mu=46.e-6{m**2/s,viscosity}
  constant pi= 3.14159

  dp = pa - pb
  q  = dp*pi*R**4/(8*mu*L)

end {of class laminar}
```

The statements `Cut HydA` and `HydB` define the interaction of this component with other components. The pressure differential `dp` is defined as a local variable, the radius `R` and the length `L` as parameters that can be changed after each simulation run. `Mu` and `pi` are constants that need no modification during the simulation study. As Dymola can manipulate equations, the model could also be written in the form

```
  q * 8 * mu * L = dp * pi * R**4
```

Example: Pressure relief valve

The relief valve limits the system pressure. It is a closed loop control system but usually modelled by its (static) input-output characteristic [13]. This model shows how easy switching functions can be created in Dymola.

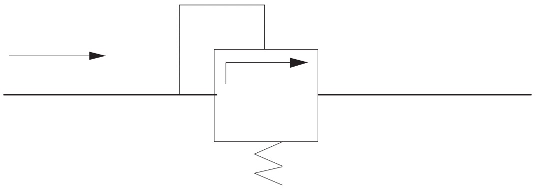


Fig. 2: Symbol of a relief valve

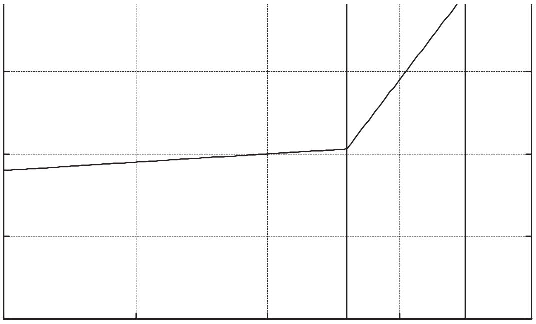


Fig. 3: Characteristics of a relief valve

```
model class ReliefValve

  cut HydA (pa / q)
  cut HydB (pb / -q)

  local dp

  parameter dpmin   = 4e5
  {Pa; valve closed if dp smaller}
  parameter dpmax   = 5e5
  {Pa; valve wide open if dp higher}

  parameter bleakage  = 1.111e-12
  {m**3/(s*Pa); conductance of
       leakage of closed valve}
  parameter bopen = 1.666e-9
  {m**3/(s*Pa); conductance of
       wide open valve}

 dp = pa - pb
 q = if dp < dpmin then dp*bleakage->
    else if dp > dpmax then        ->
   (dp-dpmin)*bopen+dp*bleakage    ->
    else (dp-dpmin)**2*bopen/      ->
    (dpmax-dpmin)+dp * bleakage

end {of class ReliefValve}
```

The hydraulics library consists of a number of models. To build a simulation model the needed components are selected from the library, connected and the required parameters entered. To avoid the numerical solution of a system of non-linear equations it usually makes sense (in terms of computing time) to place a lumped volume at each node. But Dymola could also solve the system of non-linear equations.

The library uses the best mathematical models that are available. Whenever applicable leakage is included in the models, e. g. the leakage when the pressure relief valve is closed. The library models also describe the "global" behaviour of the components, e. g. they take into account that the delivered flow of a pump is reduced when the intake pressure drops below atmospheric pressure or that the square root law of a sharp edged orifice is valid only for turbulent flow.

If necessary new component models, e. g. a specialised valve or a complete valve-actuator-system, can easily be built from the library submodels and added to a library.

Example: Propel circuit of an excavator

Parts of the library and a typical example of a hydraulic drive are shown in fig. 4. The circuit was built using the library models and parameters from [14], and run with Dymosim. This simple model helps to understand the typical problems of this kind of drives and to find unconventional but very effective ways to improve the overall system performance [15].

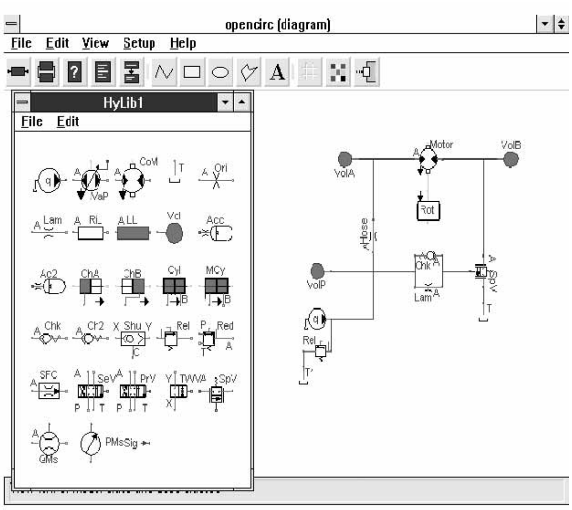


Fig. 4: Open circuit modelled with Dymola

Summary

Computers have proven to be a very effective tool when studying hydraulic systems. Today's powerful digital computers can solve even detailed system models in reasonable time. The most time consuming part of these studies can be sped up considerably by using modern object-oriented simulation languages and component libraries.

References

[1] Reethof, G. *The Analog Computer as a Design Tool in the Study of a Velocity-Control Hydraulic System*. Proceedings of the 11th National Conference on Industrial Hydraulics, Chicago, 1955.

[2] McCloy, D; Martin, H. R. Some Effects of Cavitation and Flow Forces in the Electro-Hydraulic Servomechanism. *Proc. Inst. Mech. Engineers*. Vol 178, pt 1, no 21, 1963 - 64.

[3] Schulz, R. Berechnung des dynamischen Verhaltens hydraulischer Antriebe durch Simulation. *ölhydraulik und pneumatik*. Vol. 23. No. 12. 1979. pp 883 - 888.

[4] Bowns, D. E., Tomlinson, S. P.; Dugdale, S. K. Progress Towards a General Purpose Hydraulic System Simulation Language. *J. of Fluid Control*. Vol 14, No. 4, Dec. 1982, pp 38 - 53.

[5] Richard, C. W., Tilley, D. G., Tomlinson, S. P., Burrows, G. R. *A Second Generation Package for Fluid Power Systems*. Fluid Power Proceedings of the 9th International Symposium. 1990.

[6] Kett, R. Ein Plus für DSH. *ölhydraulik und pneumatik*, Vol. 37. No. 6. 1993. pp 517 - 523.

[7] Piechnick, M; Feuser, A. Simulation mit Komfort - HYVOS 4.0 und MOSIHS 1.0. *ölhydraulik und pneumatik* Vol. 38. No. 5, 1994. pp 270 - 275.

[8] Ginsburg, C. *EASY 5 Hydraulic Library*. User's guide. Boeing Compan. 1993.

[9] nn. *Hydraulic Templates Library*. Analogy. Beaverton, OR. 1994.

[10] Elmqvist, H. A. *Structured Model Language for Large Continous Systems*. PhD-Thesis. Lund Institute of Technology, Report CODEN; LUTFD2/(TFRT-1015). 1978.

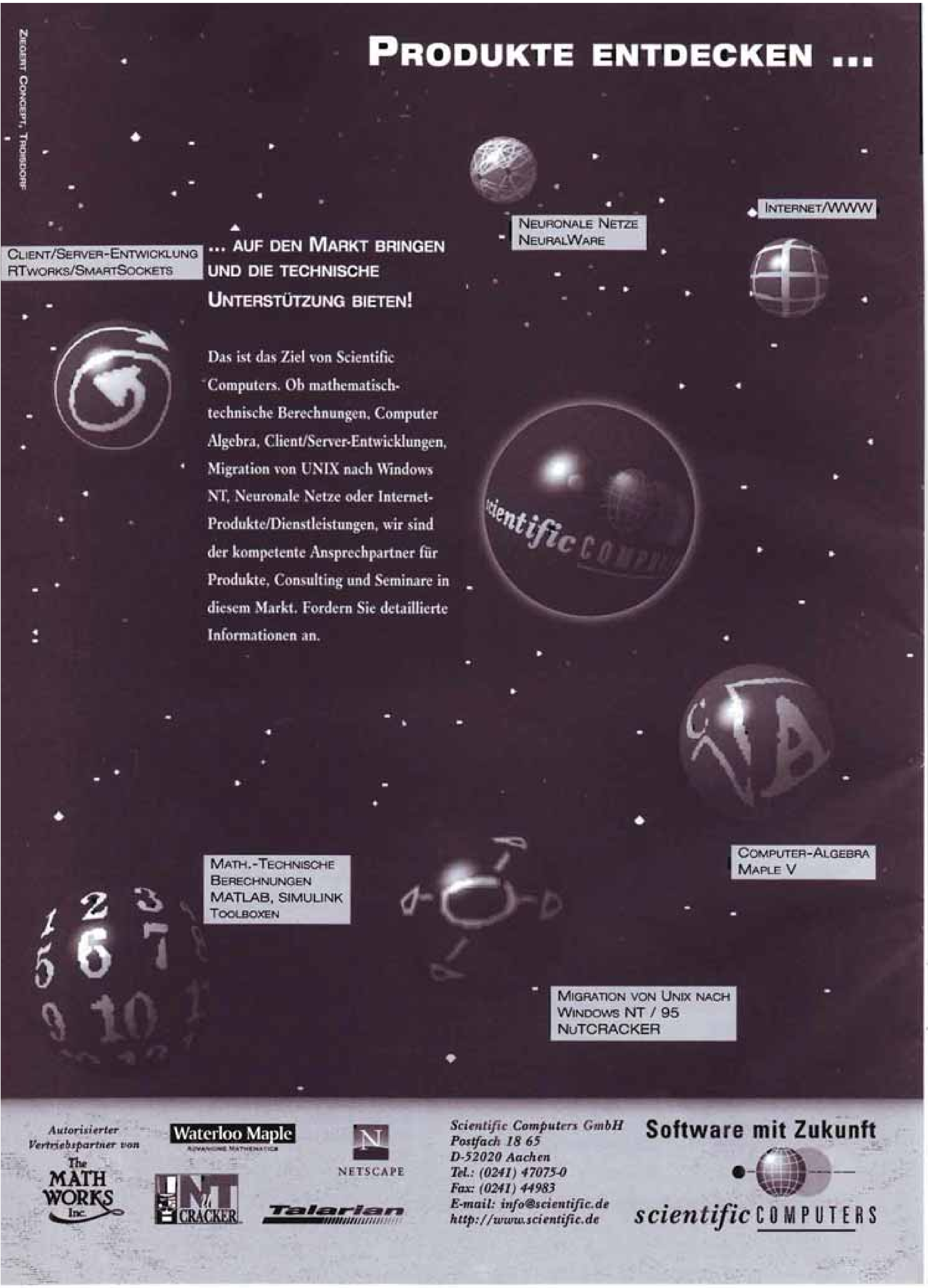
[11] Elmqvist, H., Cellier, F. E., Otter, M. *Object-oriented Modeling of Hybrid System*s. ESS'93, European Simulation Symposium, Delft. The Netherlands. 1993.

[12] Merrit, H. E. *Hydraulic Control Systems*. New York: John Wiley & Sons. 1967.

[13] Dransfield, P. *Hydraulic Control Systems - Design and Analysis of Their Dynamics*. Springer-Verlag. Berlin 1981.

[14] Kraft, W. *Analytische und experimentelle Untersuchung hydrostatischer Fahrantriebe*. PhD-Thesis RWTH Aachen. 1996.

[15] Beater, P. *Hydrostatisches Antriebssystem im offenen Kreislauf mit Bremsventil*. German patent application DE 43 42 309 A1. Deutsches Patentamt. München. 1995.



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ASIM

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

ASIM'97, Dortmund

ASIM'97, the annual ASIM Conference was held in Dortmund, Germany, November 11 - 14, 1997, organised by A. Kuhn and S. Wenzel from *Fraunhofer Institut für Materialfluß und Logistik*.

The highlights of the successful conference were: more than 350 participants with a high percentage of people from industry, outstanding contributions summarised in a 750-pages proceedings volume, a large exhibition on simulation and visualisation, a professional environment in the *Westfalenhalle*, presentation of research centres, and last but not least a charming social programme with a beer party and a cabaret.

At the end of the conference D. P. F. Möller, ASIM speaker, congratulated the organisers for a milestone in ASIM's conference series (see picture below).

A. Kuhn, S. Wenzel, D.P.F. Möller

A longer report on this conference may be found in the March issue of *ASIM-Nachrichten*, the German supplement to SNE.

ASIM'98, Zürich

The next ASIM annual conference will be held in September, as usual in most previous years. It will take place in Zürich and is organized by Dr. Veronika Hrdliczka.

ASIM'98 Zürich September 15 - 18, 1998

ASIM'98 will be hosted by ETH Zürich and University Zürich, from September 15 to 18, 1998. Local organiser is the *Institut für Werkzeugmaschinen und Fertigung* of ETH Zürich. All kinds of modelling and simulation aspects will be addressed.

Preliminary Program:

Tuesday, Sept. 15, 1998: tutorials, user group meetings, welcome cocktail
Wednesday, Sept. 16, 1998: invited lectures, parallel sessions, poster session, ASIM *Mitgliederversammlung*, reception
Thursday, Sept. 17, 1998: invited lectures, parallel sessions, exhibition, poster session, social event
Friday, Sept. 18, 1998: parallel sessions, exhibition, meetings of ASIM working groups
All days: exhibition of developers and vendors, ASIM booth with publications, representations of societies (SCS, ...)

Contributions are welcome in classical simulation application and methodology as well as in new trends and approaches. Deadlines are:

- March 31, 1998 - paper abstracts
- May 1, 1998 - acceptance/rejection of papers
- June 1, 1998 - poster abstracts
- July 1, 1998 - CRC papers

Information, conference secretariat:
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WWW: http://www.iwf.bepr.ethz.ch/asim98/
or: http://www.asim-gi.org/asim98/

Report on ASIM *Mitgliederversammlung,* ASIM Board

On November 12th, 1997 many ASIM members met at *Westfalenhalle* in Dortmund. Prof. Dietmar Möller, the ASIM speaker and all other members of the Board informed the members on current activities of the *Fachgruppen*, conferences and publications. Prof. Möller thanked Prof. Kuhn and Mrs. Wenzel for organizing the conference.
Due to significantly increased mailing costs the membership fee for 1998 was decided to be DM 60.-.

The ASIM Board decided at its meeting to support the next EUROSIM conference to be held in 2001 in Prague. Until now most interested West European EUROSIM member organizations organized the EUROSIM conference. Due to ASIM's opinion it would be important to organize the next conference in one of the new member states, especially in one of the East European countries to build the bridge to those countries. Prague has one of the oldest technical universities in Europe, is in the heart of Europe and can be easily reached by plane or train. It would be an excellent location to meet people from all parts of Europe and to encourage persons from East Europe to visit a EUROSIM conference.

ASIM Publications

The ASIM booth at ASIM'97 was a service desk for membership administration affairs and presented an overview on ASIM and ASIM-related publications. The publications presented were:

- *ASIM Mitteilungen* (reports from the working groups)
- *ASIM Nachrichten* (supplement to SNE)
- *SNE* - EUROSIM Simulation News Europe
- ASIM book series *Fortschritte in der Simulationstechnik* (Vieweg Verlag) and ASIM *Fortschrittsberichte Simulation* (ARGESIM Verlag)
- *ARGESIM reports*,
- and *SCS book series*

F. Breitenecker, J. Plank

Highlights were the presentations of five new books (two in the series *Fortschitte in der Simulationstechnik*, and three in the series *Fortschrittsberichte Simulation*). Of interest for non-German speaking people may be vol. 3 of the second series entitled "State Events in Continuous Modelling and Simulation - Concepts, Implementation and New Methodology" by J. Plank, written in English. Actual information about the status of ASIM's publications can be found in the *ASIM Nachrichten*, a complete list of all available publications in the *ASIM- Jahresbericht 1997*. Both publications are mailed to the ASIM members with this issue or can be obtained from Ingrid Bausch-Gall or Felix Breitenecker. Further information on publications may also be found on ASIM's WWW server.

Reorganisation of ASIM's WWW server

In February 1998 ASIM's WWW server was newly defined and organised, based on the experiences of the last two years. There is a new address and a new homepage:

`http://www.asim-gi.org/`

The reason for choosing **asim-gi** instead of simply **asim** is i) to show ASIM's relation to GI, and ii) there already exists a server with this name (ASIM – American Society for Internal Medicine).

The structure behind the homepage ("Further Information" will also be reorganised within the next months, and the well accepted interactive services (membership administration, online address change, online application, interactive membership lists, online order of publications) will be improved. Links to GI – *Gesellschaft für Informatik* (ASIM is structured as so-called *Fachausschuß 4.5 Simulation in GI*), to EUROSIM (new address and hompage !), to ARGESIM (new address, new homepage), and to the journal SNE and the Software Comparisons are provided on each page.

Also new email contacts are available:
info@asim-gi.org (for information)
admin@asim-gi.org (for adminstration)

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ASIM Meetings to come

March, 29-31, 1998: Meeting "Tools for Environmental Modelling and Simulation", 8th Workshop of the Working Group FG9, Witzenhausen.
Contact: Rolf Grützner or see http://www.informatik.uni-rostock.de/FB/Praktik/Mosi/ak5/ak_info.html

April 21-22, 1998: Workshop SIWIS-98 – *Simulation in Wissensbasierten Systemen*, Paderborn. Contact: Prof. Szczerbicka.

June 25, 1998: Workshop "*Event Simulation – Verkehrssimulation im Umfeld von Massenveranstaltungen*". Dortmund. Contact: A. Graber.

September 15-18, 1998: *ASIM'98, 12. Symposium Simulationstechnik*, the annual ASIM conference, Zurich, Switzerland. Contact: Dr. Veronika Hrdliczka. Information will be mailed to ASIM members with this SNE.

March 8-10, 1999: Seventh symposium "Simulation for managerial decision support – new tools and approaches in practice" in Braunlage. Contact: Prof. Hummeltenberg.

September 21-24, 1999: *ASIM 99. 13. Symposium Simulationstechnik*, Weimar. Contact: Prof. G. Hohmann, Bauhaus-Universität Weimar, D-99421 Weimar, Tel: +49-3643 584 250, email: hohmann@ informatik.uni-weimar.de

ASIM'2000 is planned to be held at the Ebernburg castle in September 2000.

Meetings with ASIM Participation

April 14-17, 1998: EUROSIM'98. ASIM is co-organiser of the triennial family meeting of the European simula- tionists. It is hoped that many ASIM members will take part in this event. Unfortunately no printed information is available from the organisers. Recent information may be found at http://www.vtt.fi/eurosim/congress/congress2.htm

June 16-19, 1998: ESM98, 12th European Multiconference, Manchester, U.K. This classical European Simulation Multiconference is combined with the 50th anniversary celebrations of the University of Manchester's first computer, the "Manchester Baby". This conference is this year's second international event, which is co-organised by ASIM. ASIM members may contact D. Möller or the track organisers from ASIM with respect to late papers.
WWW: http://hobbes.rug.ac.be/~scs/conf/esm98/

Working Groups (*Fachgruppen* FG)

"Verteilte Systeme und parallele Prozesse" (FG 1)

Speaker: Dr.-Ing. Peter Schwarz, Fraunhofer-Institut IIS/EAS, Zeunerstr. 38, D-01069 Dresden Tel: +49-351 4640 730, Fax: +49-351 4640 703, email: schwarz@eas.iis.fhg.de

"Simulationssoftware und -hardware" (FG 2)

Begin of March the working group is organising an intensive workshop in Magdeburg. At this occasion speaker and vice speaker are elected, and the further activities of the group are thought over.
Main ideas are:

i. the incorporation of the soft computing methods, also in the EUROSIM comparisons, which are run by this working group and ARGESIM,
ii. extension and documentation of the EUROSIM comparison on simulation software and simulation methodology, and
iii. general study on benchmarks, comparisons etc., with intensive literature and WWW-search.

Speaker (prel.): Prof. Dr. Felix Breitenecker, TU Wien, Abt. Simulationstechnik, Wiedner Hauptstraße 8-10, A-1040 Wien, Tel: +43-1 58801 5374, Fax: +43-1 5056849, email: Felix.Breitenecker@ tuwien.ac.at

Vice-speaker (prel.): Prof. Dr.-Ing. Dietmar P.F. Möller, TU Clausthal, Institut für Informatik, Erzstraße 1, D-38678 Clausthal-Zellerfeld, Tel: +49-5323 72 2402, 2504, Fax: +49-5323 72 3572, email: moeller@ informatik.tu-clausthal.de

"Simulation und künstliche Intelligenz" (FG 3)

Speaker: Prof. Dr.-Ing. Helena Szczerbicka, Universität Bremen, Rechnerarchitektur und Modellierung, Fachbereich 3 - Informatik, Postfach 33 04 40, D-28334 Bremen, Tel: +49-421 218 7389 or 7390, Fax +49-421 2187385, email: helena@informatik.uni-bremen.de
Vice-speaker: Dr. Thomas Uthmann, Johannes-Gutenberg-Universität Mainz, Institut für Informatik, Staudingerweg 9, D-55099 Mainz, Tel: +49-6131 39-3610, Fax +49-6131 39-3534, email: uthmann@informatik.uni-mainz.de

"Simulation in Medizin, Biologie und Ökologie" (FG 4)

Speaker: Prof. Dr.-Ing. Dietmar P.F. Möller, TU Clausthal, Institut für Informatik, Erzstraße 1, D-38678 Clausthal-Zellerfeld, Tel: +49-5323 72 2402, 2504, Fax: +49-5323 72 3572, email: moeller@ informatik.tu-clausthal.de
Vice-speaker: Prof. Dr. Otto Richter, TU Braunschweig, Institut für Geographie und Geoökologie, Langer Kamp 19c, D-38106 Braunschweig, Tel: +49-531 391 5627, Fax: +49-531 391 8170

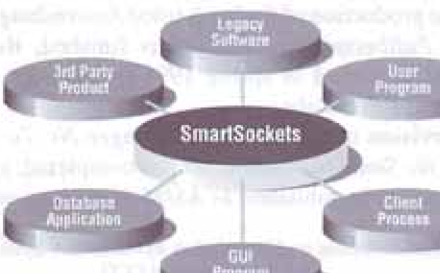
"Simulation technischer Systeme" (FG 5)

The spring meeting takes place on March 2nd/3rd at FH Heidelberg. Host is Prof. Schmidt. The program includes on Monday about 10 talks on specific simulation subjects, on Tuesday so-called "*Arbeitsgespräche*" and a visit of ABB in Heidelberg. At this meeting new speaker and vice-speaker are elected. Ingrid Bausch-Gall resigns from the speaker's position, as she acts as vice-speaker of ASIM. A detailed report will be written for the next issue of SNE.

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

"Simulation in Produktion und Logistik" (FG 6)

The production of the book titled *Anwendungsorientierte Fallbeispielsammlungen* is finished; the book will be published in spring 1998 by Springer Verlag (Editors: Kuhn/Rabe).
The revision of the *ASIM-Mitteilungen Nr. 7a: "Leitfaden für Simulationsbenutzer"* is completed, too. The new edition is published as *ASIM-Mitteilungen Nr. 58*



and is available directly from ASIM. The biannual Working Group Conference of the ASIM Working Group "Simulation in Production and Logistics" took place on February 16 - 17th, 1998 in Berlin, Germany. The working group meeting was arranged during the conference, on February 17th, 4.00 p.m. For detailed information about the conference and the conference proceedings please contact: Markus Rabe, Fraunhofer Institut für Produktionsanlagen und Konstruktionstechnik (IPK), Pascalstr. 8-9, D-10587 Berlin, Fax: +49-30-39 32 503, email: Markus. Rabe@ipk.fhg.de, WWW: http://www-plt.ipk.fhg.de/ASIM-Fachtagung.

Speaker: Prof. Dr.-Ing. A. Kuhn, Fraunhofer-Institut für Materialfluß und Logistik, Joseph-von-Fraunhofer-Straße 2-4, D-44227 Dortmund, Tel: +49-231 9743 132, Fax: +49-231 9743 234
Vice-speaker: Prof.Dipl.Ing. Adolf Reinhardt, Universität Gesamthochschule Kassel, Fachbereich 15, IPL, Kurt-Wolters-Str. 3, D-34125 Kassel, Tel.: +49-561 804 2693, Fax: +49-561 804 2697, email: fps@hrz.uni-kassel.de
For detailed information about working group activities please refer to http://www.asim-pl.uni-kassel.de or contact: Mrs. Dipl.-Inform. Sigrid Wenzel, Fraunhofer-Institut für Materialfluß und Logistik, Joseph-von-Fraunhofer-Straße 2-4, D-44227 Dortmund, email: wenzel@iml.fhg.de.

"Simulation in der Betriebswirtschaft" (FG 7)

Speaker: Prof. Dr. W. Hummeltenberg, University of Hamburg, Institute for Computer Science in Business Administration, Max-Brauer-Allee 60, D-22765 Hamburg. Tel.: +49-40-4123-40 23, Fax: +49-40-4123-64 41, email: wi@mba.uni-hamburg.de.
Vice-speaker: Prof. Dr. Biethahn, Georg-August-University of Göttingen, Platz der Göttinger Sieben 5, D-37073 Göttingen.

"Simulation von Verkehrssystemen" (FG 8)

Speaker: André Graber, CSC Ploenzke AG, Binzmühlestr. 14, CH 8050 Zürich, Tel: +41 1 308 23 23, Fax: +41 1 303 11 80, email: agraber@cscploenzke.ch
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"Simulation in Umweltanwendungen" (FG 9)

For detailed information please have a look at the WWW pages of the working group (http://www.informatik.uni-rostock.de/FB/Praktik/Mosi/ak5/ak_info.html) or contact the speakers.

Speaker: Prof.Dr.habil. Rolf Grützner, University of Rostock, Dept. of Computer Science, WG Modeling and Simulation, Albert-Einstein-Str.21, D-18059 Rostock, Tel: +49-381 4983369, Fax: +49 381 4983426, email: gruet@informatik. uni-rostock.de
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Ingrid Bausch-Gall, Felix Breitenecker

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CROSSIM

CROSSIM (The Croatian Society for Simulation Modelling) was founded in 1992 in Zagreb. CROSSIM is a non-profit society with the following main goals: promotion of knowledge, methods and techniques of simulation; establishment of professional standards in simulation; development of education and training in simulation; organization of professional meetings and publishing in the field; cooperation with similar domestic and international institutions. Since April 1997 CROSSIM is a full member of EUROSIM.

Membership

CROSSIM currently has 64 individual members. The annual membership fee is equivalent of 8 German marks for regular members, and 2 German marks for students.

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Activities

- Co-organizing the *First European Ecological Modelling Conference* held in Pula, Croatia, from 16-19 September 1997.
- Co-organizing the 20th International Conference *"Information Technology Interfaces" ITI '98*, to be held in Pula, Croatia, from June 16-19, 1998.
  The conference has traditionally a strong modelling and simulation session. Information about the conference can be found on the Web address: http://www.srce.hr/iti/.
- Regularly organizing a simulation seminar held at the Faculty of Economics, University of Zagreb.
- Work on scientific projects in discrete and continuous simulation, and applications of simulation in such diverse fields as engineering, economy, medicine, ecology etc.
- Publication of papers in international and domestic journals and conference proceedings.
- Preparing publication of a booklet about the CROSSIM society.

It is a special pleasure to announce that four CROSSIM members successfully defended their Ph. D. thesis in 1997. They are dr. Jadranka Bozikov, dr. Vesna Bosilj Vuksic, dr. Dalibor Benic and dr. Ivan Strugar.

The first WWW site in Croatian devoted to simulation was developed at the Faculty of Electrical Engineering and Computing.
Its address is: http://www.rasip.fer.hr/nastava/mis/.

V. Ceric

CSSS

General Information

CSSS (The Czech and Slovak Simulation Society) has about 75 members in 2 groups connected to the Czech and Slovak national scientific and technical societies. The main objectives of the society are: development of education and training in the field of modelling and simulation, organising professional workshops and conferences, disseminating information to its members about modelling and simulation activities in Europe, informing the members about publishing in the field of modelling and simulation.

Steering Committee

J. Stefan, Technical University Ostrava (Chairman)
M. Alexik, University of Zilina (Vice Chairman)
J. Snorek, Czech Technical University Prague
J. Lauber, Economy University Prague
E. Kindler, Czech Technical University Prague
Z. Rabova, Technical University Brno
M. Sujansky, Technical University Kosice
J. Luhan, Research Inst. TESTCOM Prague (secretary)
P. Menhart, Slovak Techn. University, Bratislava.

Coming Events

The 32nd International Conference on **"Modelling and Simulation of Systems"** (**MOSIS' 98**) will take place on May 5-7, 1998 in the Moravian city Bystrice pod Hostinem, Czech republic. The chairman of the international organising committee is Dr. Ing. Jan Stefan.
Main topics: Graphics, Visualisation and Animation in the Simulation; Neuronal Nets and Simulation; New Simulation

Tools; Petri Nets – Modelling and Simulation; New Concepts of Simulation; Information Systems Modelling (Database theory and design, Object-Oriented databases, Formal definition of Information System Models, Web-Based Information Technologies, Geographic Information Systems etc.); Simulation Case Studies – Manufacturing Systems, Management an Logistic Systems, Electronics and Control Systems, Telecommunication and Transport Systems.

Conference WWW page: http://www. fee.vutbr.cz/UIVT/ism

The 13th International Conference on "**Process Control and Simulation", (ASRTP'98)** will take place on September 8-11, 1998 in the Kosice, Slovak republic.

Main topics: Measurement and Monitoring Systems, Modelling and Simulation, Information Technologies, Real Time Process Control and Management, Artificial Intelligence. The ASRTP conferences have more than 20 years old tradition with high reputation in control systems theory, modelling and simulation and its industrial applications.

The chairperson of the International program committee is Prof. Dr. Ing. D. Malindzak, Technical University of Kosice dept. of Management and Control Engineering, 042 00 Kosice, Slovak republic, email:asrtp98@ccsun. tuke.sk

The 20th International workshop "**Advanced Simulation of Systems**" will be held on September 15-17, 1998, in the capital of Moravia, Brno, Czech republic. Chairperson of the workshop is Dr Ing. Zdenka. Rabova, TU FEI Brno, Bozetechova 2, Czech republic.

The scientific conference with international participation "**Electronic Computers and Informatics"** with a section on Modelling and Simulation, will be held October 8-9, 1998 in Herlany, Slovak republic. The chairperson of the conference is Dr. Ing. Milan Sujansky, Technical University Kosice, Slovak Republic. Herlany is a small spa 30 km from Kosice with a special attraction, a big geyser.

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M. Alexik

DBSS

General Information

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

DBSS Membership

Both corporate entities (companies, institutes, etc.) and individuals are welcome to join DBSS as full corporate or individual member.

The contribution is divided in two options:

I. Dfl. 75,- individual member or Dfl. 150,- institutional member, which means that you will receive the newsletter Simulation News Europe three times a year.

II. Dfl. 150,- individual member or Dfl. 250,- institutional member, which means that you will receive the Journal Simulation Practice and Theory eight times a year, and the newsletter Simulation News Europe three times a year.

Becoming member of DBSS includes automatically being member of EUROSIM, the overall organisation of European Simulation Societies. DBSS members enjoy reduction of the fees attending the "EUROSIM events" which include congresses, conferences, symposia, workshops etc.

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

Dutch Benelux Simulation Society
Mrs. Marja Dekker-Genemans
Noordeindseweg 61
2651 LE Berkel en Rodenrijs, The Netherlands
Tel: +31-10 51 12714
Fax: +31-10 51 13883
email: dekker@cp.tn.tudelft.nl

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

Past Events

In co-operation with Delft Hydraulics in Delft the DBSS organized at January 29, a one day symposium on the application of neural networks (NNs). The objective of this day was to show that NNs have now already found their applications in a variety of technical disciplines. The emphasis was more the practical application of NNs rather than the theoretical and the mathematical background or recent developments of NNs.

After the chairman Arnold Heemink welcomed the participants Henk van den Boogaard of Delft Hydraulics started with an introductory presentation of NNs. Of special interest was the so-called hybrid modelling where NNs are embedded in the traditional (conceptual) way of modelling.

Iva Smit showed in her presentation that NNs can also be successfully applied in the field of social and cultural sciences where until now conceptual modelling is hardly possible.

At the Chemical Department of the University of Nijmegen Willem Melssen investigates among others the early diagnosis of tumors in the brains and in which ways the transition from one state to another can be realized. In his lecture he explained how NNs can be used to map the brain tissue and to create realistic images of the brain.

Eugene Kerckhoffs of the Delft University of Technology showed the audience that NNs may now or in the near future play a role in the prediction of prices of shares on the stock-exchange market.

From the foundation "Neurale Netwerken" of the University of Nijmegen Tom Heskes was invited to talk about his experience with the behaviour of consumers in relation to NNs. In particular he described the Saturday circulation and distribution of a national Dutch newspaper.

Also Rijkswaterstaat has recognized the importance of the practical use of NNs as Hans Wüst demonstrated in his lecture. In this case NNs were employed for the navigation of incoming and outcoming ships at the harbours of Rotterdam and IJmuiden.

The last speaker of this day Ton de Weijer from Akzo Nobel developed together with his research team a software package in which NNs were included to support the production of synthetic fibres.

This one day symposium ended with an informal meeting where everyone could further discuss the interesting topics presented today. Altogether one could conclude that NNs can be successfully applied in those situations where conceptual modelling of deterministic or stochastic systems is hardly possible or even fails.

Coming Events

- As announced already several times, DBSS is organizing as parallel session during the EUROSIM'98 Congress in Helsinki, April 1998, a parallel session with the title "The impact of HPCN on parallel simulation".
- It is the intention to have a follow-up of the neural network symposium mentioned above still this year.
- We will inform you about further planned activities for this year in the next issue of SNE.

On January 29, 1998, after the above mentioned symposium, a general DBSS meeting took place in Delft. Minutes of this meeting will be mailed in the beginning of March to all the members of DBSS. The new members for the Steering Committee, nominated by the Steering Committee, were elected, which means that this Committee exists of the following members:

A.W. Heemink (TU Delft)	Chairman
L. Dekker	Vice-Chairman
J.C. Zuidervaart (TU Delft)	Treasurer
M.J. Dekker-Genemans	Secretary
W. Smit (AKZO NOBEL)	Member
Th.J. van Stijn (Rijkswaterstaat/RIKZ)	Member

In the minutes of the General Meeting the members are informed about the professional activities of the members of the Steering Committee.

The Committee would appreciate very much to have some information about the professional activities of their DBSS members. Please send a short email to the secretary. We will distribute this information among the members.

Those interested to organize a DBSS event, are kindly requested to write to the secretary of DBSS.

Marja Dekker-Genemans

FRANCOSIM

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

BioMedSim'99
1st Conference on Modelling and Simulation In Biology, Medicine and Biomedical Engineering
20-22 April 1999, ESIEE Noisy-le-Grand, France

FRANCOSIM will organise this EUROSIM event in April 1999. This is the first of a series of conferences to be held once every two years. These conferences are intended to be an opportunity for researchers and industrials to present fundamental work and applications in fields related to the modelling and simulation in living systems.

The conference will consist of several tracks related to the following themes:

- Mathematical modelling in biology, medicine, biophysics and biochemistry;

- Mathematical modelling in immunology, neurophysiology, population dynamics and enzyme kinetics;
- Mathematical models for drug adminstration;
- Modelling and design of control and assistance devices;
- Signal and image processing chains for biological and medical applications with emphasis on diagnosis;
- Biomechanics and artificial organs, study of muscular motion;
- Models, techniques and simulation tools to case integrated understanding of living organisms functions;
- Knowledge based systems and knowledge driven data processing for biological and medical applications with emphasis on aids to explicit diagnostic process and diagnosis rule formation;
- Systems for educational purposes in subfields of biology and medicine with explicit emphasis on mathematical models, simulation and display tools.

Place: ESIEE, Noisy-le-Grand. The conference site is on the Parisian public transport, near Euro Disney.

Important Dates:

Deadline for extended abstracts	June 30, 1998
Notification of acceptance	October 30, 1998
Deadline for final papers	January 15, 1999
Conference	April 20 - 22, 1999

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HSS

General Information

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

Activities

Last year demonstrations of applications of artificial intelligence controlled simulation have been performed in various fields for their specific subject matter expert audiences. This year an interdisciplinary workshop and demonstration is planned.

We would like to call the attention of our friends and colleagues that the postal address, phone, fax and email numbers has been changed as given below. In case of postal correspondence please use the complete address to ensure the proper arrival of your letter.

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A. Jávor

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 presently consisting of the following persons:

Franco Maceri	(chairman)
Felice Cennamo	(vice-chairman)
Vincenzo Grassi	(treasurer)
Mario Savastano	(secretary)

Membership

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

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

Contact Addresses

For further information or application for membership, please contact:

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Activities

On December 16, 1997 the **annual conference of ISCS** was held in Napoli. The conference involved a plenary session with 18 contributed talks selected by the Scientific Committee composed of F. Maceri, University of Rome "Tor Vergata" (Chairman); S. Balsamo, University of Udine, F. Cennamo, University of Naples; B. Ciciani, University of Rome "La Sapienza"; M. Colajanni, University of Rome "Tor Vergata", G. de Pietro, University of Naples, L. Donatiello, University of Bologna; V. Grassi, University of Rome "Tor Vergata", G. Iazeolla, University of Rome "Tor Vergata"; M. Savastano, CNR; R. Vaccaro, University of Naples. Moreover, an invited talk on "Parallelism: A new dimension in science" was given by Professor Len Dekker of the University of Delft. The contributions covered several topics, including theory, tools and applications.
Persons interested to contact an author or receive a copy of the proceedings can ask the ISCS secretariat. The following publications are in English:

"Simulation of passenger flows in airports", A. Tamburro, M. Savastano; "Advanced planning and scheduling: A powerful application of the simulation technique", A. Mascolo; "On the performance issue of system naming in Internet", C. Comella; "An error correction technique for scan conversion-based transient digitizers", P. Arpaia, F. Cennamo, P. Daponte; "Using simulation for training in industry", A. Gatta; "The use of a parallel numerical library in industrial simulations: The case study of the design of a two-stroke engine", P. D'Ambra, S. Filippone, P. Nobile; "An algorithm for monitoring real-time flow variations in vehicle traffic", M. Giorgi, L. Pasini; "Comparing different methods to estimate parameters for a Markov chain with binomial-like transition probabilities", M. Abundo; "An efficient algorithm for the zero crossing detection in digitised measurement signal", A. Molinaro, C. Pizzuti, Y.D. Sergeyev; "Parallel simulation of particle dynamics problems in distributed platforms", M. Cermele, M. Colajanni, S. Tucci; "Using genetic algorithms for the optimal design of pipeline architectures", V. Bevilacqua, G. Mastronardi, W.D. Wall; "The completion time evaluation of housing activities by means of neural network", M. Marra, V. Bevilacqua; "Estimating upcrossing FPT densities via simulation of Gaussian processes", E. Di Nardo, A. Nobile, E. Pirozzi, L.M. Ricciardi; "Simulating defects of impervious facing in embankment dams", R. Jappelli, F. Federico.

September 6-13, 1998: **European Summer School on Reliability and Safety of Human-Machine Systems**, Crete, Greece.
Organized by the OLOS research network of the European Human Capital and Mobility Programme
Contact: Virginia Bocci, Multimedia Lab, University of Siena, Via del Giglio 14, I-53100 Siena, Italy, email: school@media.unisiena.it, Fax:+39 577 298461, WWW: http://www.media.unisi.it/school

M. Colajanni

SIMS

General information

SIMS is the Scandinavian Simulation Society with members from the four Nordic countries Denmark, Finland, Norway and Sweden. The SIMS history goes back to 1959. SIMS' matters are taken care of by a board, the ombudsman and the treasurer. SIMS' board has eight members – two from each country. The annual meeting takes place in connection with the conferences. Usually the board meets a second time per year. The bylaws are written in Swedish and have recently been proposed updated.

How to join SIMS?

From 1996 the basic membership is free. You may register as a member by sending a mail with personalia to the address

sims@ecy.sintef.no

As a member you will receive invitation to the conferences and other information related to simulation. You will also get a discounted conference fee on the SIMS conferences. Individual subscriptions for a discounted price to *EUROSIM - Simulation News Europe* and *Simulation Practice and Theory* are available.

For more information visit the Internet address **http://www.itk.ntnu.no/SINTEF/sims/sims.html**

SIMS Annual Conference

The 1998 annual meeting of SIMS will be arranged in connection with the EUROSIM'98 Congress at Helsinki University of Technology, April 14 - 17, 1998, in Finland.

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Torleif Iversen

SLOSIM

On November 3, 1997 the regular annual assembly of our society was held at the Faculty of Electrical Engineering, Ljubljana with the following agenda:

1. report of the activities in the past period
2. financial report
3. report of the supervisory board
4. plan of activities for the year 1998
5. acceptation of the society rules modifications.

Some important data in conjunction with the activities in the year 1997:

- contributions in SNE, presentation of Slovene simulation groups
- SLOSIM orders 74 copies of SNE, 10 subscriptions to Simulation Practice and Theory
- one new presentation of groups
- co-organization of ERK 97 conference
- one invited lecture (lecture of prof. R. Hanus from the Free University, Brussels with the title: *Selected applications of models)*.

Some items in conjunction with the future plans:

- continuation of representative group meetings (two new groups),
- co-operation with EUROSIM, SNE, ...
- lectures of visiting professors,
- dissemination of information,
- co-organization of ERK 98 conference,
- collecting of new members (also from industry),
- collecting of sponsors.

The Ministry of Science and Technology of Slovenia sponsors SLOSIM in 1997 with ca. DM 1600.

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Borut Zupancic

UKSIM

General Information

The UK Simulation Society has about 80 members throughout the UK from both universities and industry. It is active in all areas of simulation and holds a biennial conference as well as regular smaller meetings and seminars.

Fourth United Kingdom Simulation Society Conference, April 1999

Papers are invited on any aspect of simulation to be presented at the next UK Simulation Society conference to be held in Cambridge, England on April 7-9, 1999. The conference venue is St Catherine’s College Cambridge. For further information, please see the announcement in this journal or contact the Conference Chair from whom further information is available.

European Simulation Multiconference, June 1998

Preparations for the European Simulation Multiconference (ESM’98) are well in hand. On 21st June, 1998, the University of Manchester celebrates the fiftieth anniversary of the first stored-program electronic digital computer. The ability to store and run any program put in by a user set this machine apart from all the special purpose computing machines that had gone before and made it a Universal Machine, the first computer as we know it today.

The European Simulation Multi-conference (ESM'98) will be hosted by the University of Manchester in June 1998. The conference will be held over a 4-day period from June 16th - 19th to coincide with the fiftieth anniversary celebrations. This year, in addition to covering the normal topics ranging from simulation algorithm design through to applications across a range of diverse domains, there will be a special History of Simulation track reflecting the role that simulation has played in design over the years.

More information on this conference is available at http://hobbes.rug.ac.be/~scs/conf/esm98/.

Membership

Membership of the UK Simulation Society is very good value at only £20 per year including a subscription to Simulation News Europe. For more information, contact the Membership Secretary,

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Gary J. Gray

Fourth United Kingdom Simulation Society Conference
UK Sim 99

St Catherine's College, Cambridge, England

7th-9th April 1999

Initial Announcement and First Call for Papers

Papers are invited on any aspect of simulation to be presented at a three day event to be held in Cambridge, England. The conference venue is St Catherine's College Cambridge. Founded in 1473, St Catherine's College is beautifully located in the heart of Cambridge, surrounded by many other well-known colleges. The accommodation, renowned catering and conference facilities are an ideal blend of modern and historic. The venue offers an especially attractive opportunity for both professional discussion and socialising.

Abstracts (two pages of A4 without figures) are invited on any aspect of simulation and its applications. The following are suggested topics, but other topics are also welcome; Simulation methodology and practice, languages, tools and techniques. Models and modelling tools. Data/object bases. Analysis and statistica1 tools. Simulators and simulation hardware, training simulators. Integration of simulation with concurrent engineering, integrated design and simulation systems. AI in simulation. Parallel and distributed simulation. Neural networks.

Simulation applications include: aerospace; electronic circuits and systems; computer networks; business; management; finance; economics; leisure; biology; medicine; public health; manufacturing; planning; control; robotics; measurement; monitoring; energy; safety critica1 systems; transportation; oil and gas; education and training; military. There will be an Exhibitions area.

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

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

The registration cost is 160 pounds sterling for members of EUROSIM Societies. This includes proceedings. Accommodation including all meals, (including Conference dinner) and refreshments, tea/coffee is 65 pounds sterling per day for double occupancy or 75 pounds per day for single occupancy.

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

Deadlines:

Abstract (four copies. 2 pages of A4): 1st November 1998.
Notice of provisional acceptance: 17th December 1998.
Camera ready copy and registration fee: 1st February 1999.

Conference Chair:

Russell Cheng
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European and International Societies

IMACS

3rd MATHMOD Vienna

3rd IMACS Symposium on Mathematical Modelling
February 2-4, 2000 in Vienna (Austria)

The international symposium on **Mathematical Modelling** will take place during February 2-4, 2000 at Technical University Vienna. Scientists and engineers using or developing models or interested in the development or application of various modelling tools will find an opportunity to present ideas, methods and results and discuss their experiences or problems with experts of various areas of specialization.

The scope of the conference covers theoretic and applied aspects of the various types of mathematical i.e. formal modelling (equations of various types, Petri nets, bond graphs, qualitative and fuzzy models etc.) for systems of dynamic nature (deterministic, stochastic, continuous, discrete or hybrid with respect to time etc.). Comparison of modelling approaches, model simplification, modelling uncertainties and the impact of items such as these on the problem solution, validation, automation of modelling and software support for modelling etc. will be discussed in special sessions as well as applications for control, design or analysis of systems in engineering and other fields of application.

Presentations of software and a book exhibition will be organized.

Deadline for submission of extended abstracts (1 - 2 pages in triplicate) is May 15, 1999.

Organizer: Division for Mathematics of Control and Simulation (E114/5) at Technical University Vienna.
Chair of IPC: Univ.Prof. Dr. Inge Troch.

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http://simtech.tuwien.ac.at/3rdMathmod.html

LSS

The Latvian Simulation Society is organising, in co-operation with the Society for Computer Simulation International (SCSI), the international workshop "**Modelling and Simulation within a Maritime Environment**" (September 6 - 8, 1998, Riga, Latvia).

The workshop will deal with various aspects of modelling and simulation for maritime applications. It is aimed to discuss the role of simulation in increasing efficiency of maritime operations, and to share already existing experiences in that area. The list of conference topics includes (but is not limited to) modelling and simulation activities along the following main lines: Container Terminals, Harbour Management, In-Harbour Traffic Control, Maritime Traffic Control, Multimodal Transportation, Naval Architecture, Naval Training Equipment, Navigation Line Management, Safety in Maritime Environment, Ship Building.

The workshop will be hosted by the Riga Technical University, the largest technical university in Latvia, that was founded in 1862, and was at that time the first technical higher school in the whole Russian Empire. Currently it incorporates 8 faculties with the total number of about 7.000 students, and is a basic institution for LSS.

Riga, the capital of Latvia, is a nice, old town situated near the Baltic Sea. The first information of Riga relates to 1198. Now there are about 900.000 inhabitants in the city. Its architecture reflects many styles and epochs, from medieval Gothic and Roman to the tall modern buildings. There are many beautiful buildings in Riga, made in the Art Nouveau style. Riga is also a major port city, with the passenger and commercial harbours. The last one comprises one of the biggest container terminals on the Baltic Sea.

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or visit the Website: http://hobbes.rug.ac.be/~scs/conf/ew98riga/index.html

Yuri Merkuryev

SCS (The Society for Computer Simulation International)

The SCS European Office (in close co-operation with the SCS European Council) continues to organize high-quality international scientific conferences on computer simulation and related fields. For many of our conferences both written Proceedings and CD-ROMs are available, which also can be ordered afterwards.

In the recent past two successful events have been held. ESS97 (9th European Simulation Symposium & Exhibition) in Passau, Germany, October 19-23, 1997 was a well-organized and scientifically interesting conference. Over 150 participants also enjoyed the magnificent exhibition. There was a well-attended tutorial on Java. During the conference dinner, Prof. dr. Eugene Kerckhoffs (Delft, the Netherlands) received the SCS Distinguished Service Award. EuroMedia98 (2nd EuroMedia conference) has been held in Leicester, UK, January 5-7, 1998. Although only approximately 60 participants attended this event, the mini-conference was regarded to be very successful. It is decided to continue the EuroMedia series. Next year the event will be organized in Passau, Germany, most likely in April 1999. In the following we summarize the forthcoming SCS events in 1998.

1. ECEC98 (5th European Concurrent Engineering Conference) Erlangen-Nuremberg, Germany, April 26-29, 1998.

General chair: Uwe Baake (Daimler-Benz); General Program Chair: Richard Zobel (University of Manchester). Sponsored by Daimler-Benz AG, Research and Technology, Stuttgart, Germany.

The aim of ECEC98 is to provide European researchers with a forum where they can discuss the latest developments linked to Concurrent Engineering (CE). ECEC98 aims to identify the progress that has been made in CE over the last year. It helps the dissemination of information and exploitation of results from research and technical developments, and provides a forum for the exchange of experiences in developing and implementing CE-based solutions across a wide spectrum of manufacturing and engineering industries. The conference is targeted at industrial enterprises, industrial associations, universities and research institutes.

With a view to the unexpected relatively high number of submitted papers the event promises to be most interesting for those interested in Concurrent Engineering techniques and applications.

2. ESM98 (12th European Simulation Multiconference), embedded in the programme of events to celebrate the 50th anniversary of the world's first stored program computer ("Manchester Baby") Manchester, UK, June 16-19, 1998

DON'T MISS THIS; THIS IS SOMETHING TO REMEMBER!

General chairmen: Richard Zobel (Manchester University, UK), Paul Luker (De Montfort University, UK); General Program Chairmen: Dietmar Möller (Clausthal University, Germany), Roy Crosbie (Calstate University Chico, USA).

The 12th European Simulation Multiconference ESM98 (organized by SCS in cooperation with ASIM) is part of the programme of events in the week of celebrations at the 50th anniversary of the world's first stored program computer.

The major topics of the conference are: Simulation Tools and Methodology; Simulators, Real-Time Simulation, Distributed Simulation, HLA, Military Simulation; Simulation in Medical Informatics and Health Care; Simulation in AI and Robotics; Simulation in Education, McCleod Centres; Simulation in Multibody Systems; Simulation in Operations Research; Analytical and Numerical Modelling Techniques; Student Papers; Partner for Projects sessions.

Because of the above-mentioned celebrations of the 50th anniversary of the world's first stored program computer, a special (invited) session on "History of Simulation" is organized (invited talks are presented, among others, by Prof. Eugene Kerckhoffs, the Netherlands, with Prof. Ghislain Vansteenkiste, Belgium ("Looking back to a period of 25 years simulation in Europe") and Prof. Roy Crosbie, USA ("The history of SCS International").

3. ESS98 (10th European Simulation Symposium & Exhibition) Nottingham, UK, October 26-28, 1998.

General Chair & Program Chair: Andrzej Bargiela (Nottingham, UK); General Program Co-Chair: Eugene Kerckhoffs (Delft, the Netherlands).

This conference focuses on simulation in industry. The major topics are: Simulation Methodologies; Simulation in Sciences; Engineering Systems Simulation; Simulation in Industry and Services; Simulation in Business and Finance; Simulation and Artificial Intelligence; Human Centered Simulation. Special care will be spent to exhibitions showing the latest developments in simulation and related software.

In addition to the above yearly events in the ESS, ESM, ECEC and EuroMedia series, the SCS European Office decided to support the organization of smaller dedicated Workshops. At the moment of writing this, two events are planned:

4. International Workshop on "Advanced Simulation (including visualization and animation) and AI, Supporting Production Process Development in the Factory of the Future". Bucharest, Romania, August 23-25, 1998 (local organization: The Bucharest Research Institute for Informatics).

General Chairs: Florin-Gheorghe Filip (Research Institute for Informatics, Bucharest, Romania) and

Ghislain Vansteenkiste (University of Ghent, Belgium). General Program Chairs: Carmen-Veronica Bobeanu (Research Institute for Informatics, Bucharest, Romania) and Eugene Kerckhoffs (Delft University of Technology, the Netherlands).

The Workshop intends to contribute to the dissemination of scientific and technological results of using advanced modelling and simulation as well as AI-techniques in industrial design and manufacturing. Three different tracks are planned to cover recent progress in modelling enterprises in general, production process planning and control, and simulation and AI in the factory of the future, encompassing methodological approaches, methods, tools and applications. Being a Workshop, rather than a Conference or Symposium, more than normal attention is paid to discussion on the basis of the presented lectures and it is tried to formulate in writing the major conclusions on the spot!

5. International Workshop on "Modelling and Simulation within a Maritime Environment". Riga, Latvia, September 6 - 8, 1998 (local organization: LSS: The Latvian Simulation Society)

The workshop will deal with various aspects of modelling and simulation for maritime applications. It is aimed to discuss the role of simulation in increasing efficiency of maritime operations, and to share already existing experiences in that area. The list of conference topics includes (but is not limited to) modelling and simulation activities along the following main lines: Container Terminals, Harbour Management, In-Harbour Traffic Control, Maritime Traffic Control, Multimodal Transportation, Naval Architecture, Naval Training Equipment, Navigation Line Management, Safety in Maritime Environment, Ship Building.

For more details on all above conferences, please contact:

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http://hobbes.rug.ac.be/~scs

Publications

SCS European Publishing House Being a part of the SCS European Office, the SCS European Publishing House publishes high-quality scientific books on computer simulation and related fields in the series "Advances in Simulation" and "Frontiers in Simulation" (editors-in-chief: Eugene Kerckhoffs, Axel Lehmann, Henri Pierreval, Richard Zobel).

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Executive Directors
SCS European Office

SCS Distinguished Service Award

for Prof. Eugene J.H. KERCKHOFFS

On October 21, 1997, during the ESS97 in Passau (Germany) the SCS (Society for Computer Simulation International) "Distinguished Service Award" has been presented to Prof.dr.ir. Eugene J.H. KERCKHOFFS (FSCS), professor at Delft University of Technology , the Netherlands, and a chairholder of the SCS Chair in Simulation Sciences at the University of Ghent (Belgium). The award was handed over by SCS President Wayne Ingalls (USA) and SCS Senior Vice-President Prof. Axel Lehmann (Munich, Germany). It was the 5th time that the award has been given to an SCS member for extensive long-time service to the Society that has rarely been demonstrated. After Prof. Ghi Vansteenkiste (Ghent, Belgium) Prof. Kerckhoffs is the second European recipient of this prestigious award.

Prof. Kerckhoffs obtained the award for 23-years dedicated service to the Society. He was a member of the SCS Board of Directors (14 years), SCS Associate Vice-President for Europe (7 years, with Ghi Vansteenkiste as the Vice-President for Europe), SCS Vice-President for Europe (2 years), founder and 1st chairman of the SCS European Council, with Ghi Vansteenkiste co-founder of the SCS European Office (which organizes already for 12 years the two annual SCS conference series ESS and ESM), and initiator of the ESS (European Simulation Symposium) series. He had a key position in numerous European SCS Conferences and was co-editor of 8 SCS Conference Proceedings. Since 1994 he is one of the three executive directors of SCS Europe BVBA. Prof. Kerckhoffs (co-)authored over 220 scientific publications and presented some 150 scientific lectures world-wide. In 1992 he was appointed a FELLOW of SCS.

Comparison 11: SCARA Robot

C11 - SCARA Robot, is the 11th comparison on simulation software and modelling techniques. It is the 6th comparison of continuous type and deals with the handling of implicit systems.

Background: Mechanical and mechatronic systems often result in an implicit second order model description of the type

$$M(\vec{q})\ddot{\vec{q}} = \vec{g}(\dot{\vec{q}}, \vec{q}, \vec{u}, t)$$

with a state-dependent mass matrix *M*, an acceleration vector $\ddot{\vec{q}}$ and a generalised force function $\vec{g}$.

Simulators often impose restrictions for this type of model descriptions. Only a few simulators accept the description as given above, some allow a description as an implicit first order system

$$A(\vec{z})\dot{\vec{z}} = \vec{h}(\vec{z}, \vec{u}, t)$$

and some require the explicit description given by

$$\dot{\vec{z}} = \vec{f}(\vec{z}, \vec{u}) = A(\vec{z})^{-1}\vec{h}(\vec{z}, \vec{u}, t) .$$

The symbolic derivation of the explicit form is only possible with reasonable effort for very small systems or systems with a simple-structured mass matrix. Therefore it is common practice to carry out the inversion of the mass matrix numerically.

Another interesting question is, whether a simulator that permits implicit descriptions breaks the implicit loop before integrating the states or uses an implicit integration scheme to solve the system directly. Few simulators offer so-called DAE solvers for the second method, sometimes with restrictions with respect to other features like linearisation, event handling etc. In general, advanced features like implicit description, DAE solvers, algebraic loop solvers etc. result in higher computation times and in some computational overhead. Therefore it has to be checked whether it is worth to use such a tool or to work "conventionally" by setting up an explicit system description. In order to investigate this class of problems, a model for a SCARA robot (*Selective Compliance Assembly Robot Arm*) as shown on the title page of this SNE issue was chosen.

Mechanical System (Task a)

A three-axis SCARA robot as indicated in Fig.1 is investigated. This robot type has two vertical revolute joints and one vertical prismatic joint. The axes of all three joints are vertical (parallel to the z-axis in Fig. 1). The joint vector $\vec{q}$ consists of the joint angles q_1 and q_2 and the joint distance q_3.

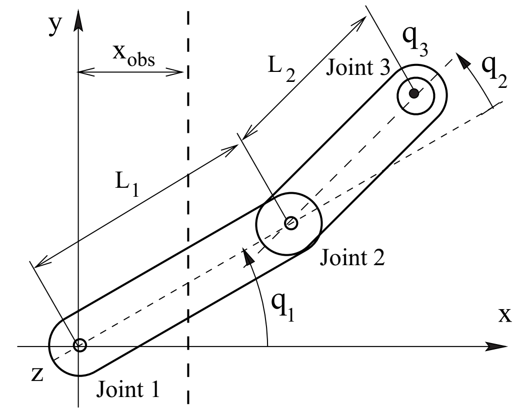


Figure 1

$$\vec{q} = (q_1, q_2, q_3)^T, \quad \dot{\vec{q}} = \frac{d\vec{q}}{dt}, \quad \ddot{\vec{q}} = \frac{d\dot{\vec{q}}}{dt}$$

The equations of motion of can be written in the following compact form

$$M\ddot{\vec{q}} = \vec{b} .$$

The mass matrix *M* is block-diagonal and can be easily inverted symbolically.

$$M = \begin{bmatrix} ma_{11} & ma_{12} & 0 \\ ma_{21} & ma_{22} & 0 \\ 0 & 0 & ma_{33} \end{bmatrix}$$

Several elements of *M* depend on the joint variable q_2

$$ma_{11} = \Theta_1 + 2\Theta_2\cos(q_2) + \Theta_3,$$
$$ma_{12} = \Theta_2\cos(q_2) + \Theta_3,$$
$$ma_{21} = ma_{12}, \quad ma_{22} = \Theta_3,$$
$$ma_{33} = m_{3L} + \Theta_{3mot}u_3^2 .$$

The calculation of the moments of inertia Θ_i is based on the assumption that the two physical links are rods of mass m_1, m_2 with homogeneous mass distribution along the length L_1, L_2. The stator mass of the vertical drive motor is m_{3A},the moment of inertia of the rotating parts is Θ_{3mot} and the mass of the load is m_{3L}.

$$\Theta_1 = (\frac{m_1}{3} + m_2 + m_3)L_1^2, \quad \Theta_2 = (\frac{m_2}{2} + m_3)L_1L_2,$$

$$\Theta_3 = (\frac{m_2}{3} + m_3)L_2^2, \quad m_3 = m_{3A} + m_{3L}$$

The right-hand side of the dynamic equations is

$$\vec{b} = (b_1, b_2, b_3)^T,$$

$$b_1 = T_1 + \Theta_2(2\dot{q}_1\dot{q}_2 + \dot{q}_2^2)\sin(q_2),$$

$$b_2 = T_2 - \Theta_2\,\dot{q}_1^2 \sin(q_2),\; b_3 = T_3 - m_{3L}\, g$$

with the joint torques $T_1(t)$, $T_2(t)$ and the joint force $T_3(t)$. Numerical data for the geometric and mass parameters of the SCARA robot are given below:

$$m_1 = 8\text{kg},\quad L_1 = 0.4\text{m},\quad g = 9.81\,\text{m/s}^2,$$

$$m_2 = 6\text{kg},\quad L_2 = 0.3\text{m},\quad u_3 = 1047\text{m}^{-1},$$

$$m_{3A} = 2.5\text{kg},\, m_{3L} = 0.5\text{kg},\, \Theta_{3\text{mot}} = 9.1\cdot 10^{-6}\,\text{kgm}^2$$

Servo Motor and PD-Control (Task b)

The electrical relationship of the armature of a robot servo motor is given by a first order differential equation

$$\dot{I}_i = \frac{(U_{ai} - k_{Ti}u_i\dot{q}_i - R_{ai}I_{ai})}{L_{ai}},\quad i = 1,2,3$$

$$I_{ai} = [-I_i^{\max} \le I_i \le I_i^{\max}],\quad i = 1,2,3$$

where $U_{ai}(t)$ is the applied armature voltage. The resulting armature current I_i is limited to maximum value $I_i^{\max}$ that can be calculated from the maximum permitted torque $T_i^{\max}$

$$I_i^{\max} = T_i^{\max}\left(\frac{\sqrt{3}}{2}k_{Ti}\right)^{-1},\quad i = 1,2,3\,.$$

The joint torque (force) T_i of a motor is proportional to the armature current I_{ai} and given by

$$T_i = u_i\frac{\sqrt{3}}{2}k_{Ti}I_{ai},\quad i = 1,2,3\,.$$

Numerical values for the motor constant k_{Ti}, the gear ratio u_i, the resistance R_i and the inductance L_i for each motor are given below. Note that u_3 includes the transformation from the rotational to the linear motion and is not dimensionless.

$$k_{T1} = 0.4\text{ Vs},\quad k_{T2} = 0.25\text{ Vs},\quad k_{T3} = 0.4\text{ Vs},$$

$$R_{a1} = 3.9\text{ Ohm},\quad R_{a2} = 50\text{ Ohm},\quad R_{a3} = 40\text{ Ohm},$$

$$L_{a1} = 7.3\text{ mH},\quad L_{a2} = 25\text{ mH},\quad L_{a3} = 25\text{ mH},$$

$$u_1 = 130,\quad u_2 = 100,\quad u_3 = 1047\,\text{m}^{-1},$$

$$T_1^{\max} = 2.3\text{ Nm},\quad T_2^{\max} = 0.6\text{ Nm},\quad T_3^{\max} = 0.6\text{ Nm}$$

In order to control the point-to-point motion of the robot a rather primitive single-axis PD-control is employed. For a given target joint position vector $\hat{\vec{q}}$ position errors $(\hat{q}_i - q_i)$ can be calculated. From the position errors and the joint velocities $\dot{q}_i$ the control voltage U_{ai} is determined by

$$U_i = P_i(\hat{q}_i - q_i) - D_i\,\dot{q}_i,\quad i = 1,2,3$$

$$U_{ai} = [-U_i^{\max} \le U_i \le U_i^{\max}],\quad i = 1,2,3\,.$$

Proportional gains P_i and derivative gains D_i are given for each controller. In regular operation mode the armature voltage shall be limited by $U_{i\,\text{reg}}^{\max}$. However, in an emergency situation $U_{i\max}^{\max}$ may be used (see task c).

$$P_1 = 1000\text{ V},\quad P_2 = 1000\text{ V},\quad P_3 = 5000\text{ V},$$

$$D_1 = 10\text{ Vs},\quad D_2 = 25\text{ Vs},\quad D_3 = 10\text{ Vs},$$

$$U_{1\text{reg}}^{\max} = 100\text{ V},\quad U_{2\text{reg}}^{\max} = 75\text{ V},\quad U_{3\text{reg}}^{\max} = 90\text{ V},$$

$$U_{1\max}^{\max} = 230\text{ V},\quad U_{2\max}^{\max} = 230\text{ V},\quad U_{3\max}^{\max} = 230\text{ V}$$

Obstacle definition and collision avoidance manoeuvre (Task c)

An elevation profile for the *x-y* plane is given by

$$h = h_{obs}\;\forall\; x \le x_{obs},\quad h = 0\;\forall\; x > x_{obs}$$

$$h_{obs} = 0.2\text{ m},\quad x_{obs} = 0.25\text{ m}$$

with a straight borderline at x_{obs}, separating the elevated area h_{obs} from the area with zero elevation. The border represents an obstacle for the tool-tip of the robot arm. Contact has to be avoided when the robot tool-tip moves from the starting point to a target position in the elevated area. Possible contact must be detected during robot motion and control of the rotational drives must be changed until the tool-tip has cleared the obstacle height. Maximum voltage $U_{i\max}^{\max}$ may be used in this situation for motors 1 and 2 to obtain maximum deceleration. An obstacle sensor shall measure the distance from the robot tool-tip to the borderline and shall trigger an emergency manoeuvre if the distance d falls below the critical distance $d_{\text{crit}} = 0.1$ m.

If $(x_{tip} - x_{obs}) \le d_{crit}$ and $q_3 < h_{obs}$ then decelerate $\dot{q}_1, \dot{q}_2$ until $q_3 > h_{obs}$.

The *x*-position of the tool-tip can be calculated from

$$x_{tip} = x_3 = L_1\cos(q_1) + L_2\cos(q_1 + q_2)\,.$$

The following tasks should be performed:

Task a) Modelling method. There are several ways to formulate and implement the model, depending on the simulator's features, e.g.

i) "manual" symbolic manipulations for setting up explicit model equations, implementation of the explicit model description,

ii) derivation of explicit equations using software for symbolic calculations, implementation of the explicit model description,

iii) using special features of the simulator for deriving and simulating the equations (mechatronic modules, etc.),

iv) implementation of the implicit equations, using algebraic loop breaking features of the simulator,

iv) implementation of the implicit equations, using an implicit solver of the simulator, etc.

The simulator's features for this type of models should be sketched briefly by giving (parts of) the model description of at least one (but preferably of some) of the above given methods. In case of alternative modelling approaches the effectiveness should be compared, taking into account preparation time, necessary knowledge for certain alternatives, etc.

Task b) Simulation of a point-to-point motion, controlled by a single axis PD-control shall be performed. No obstacle is present for this task.
Initial values at $t = 0$:

$$q_1 = q_2 = q_3 = 0, \quad \dot{q}_1 = \dot{q}_2 = \dot{q}_3 = 0$$

Target (terminal) values at $\hat{t}$:

$$\hat{q}_1 = \hat{q}_2 = 2, \quad \hat{q}_3 = 0.3\,\text{m}, \quad \dot{\hat{q}}_1 = \dot{\hat{q}}_2 = \dot{\hat{q}}_3 = 0$$

As results graphs of the joint positions should be plotted. In case of alternative model descriptions simulation times are to be compared.

Task c) Collision avoidance may cause difficulties in the models descriptions. Based on the point-to-point control of task b), now an obstacle has to be avoided (see problem definition). Extend the model description by a collision avoidance feature of the proposed type, using for instance state-dependent control, state event mechanism, etc.

For documentation the program extensions are to be outlined and a plot of $x_{tip}(t)$, $(q_3(t) - h_{obs})$ and x_{obs} over t is to be given.

References: R.J.Schilling, Fundamentals of Robotics, Prentice-Hall, 1990

Acknowledgement: The authors thank Dr. G. Kronreif (TU Vienna) for providing realistic robot data.

Horst Ecker, Institute for Machine Dynamics and Measurement, email: hecker@email.tuwien.ac.at, Tel: +43-1-58801 5567, and Felix Breitenecker, SIMTECH, Vienna University of Technology, Wiedner Hauptstr. 8-10, A-1040 Vienna/Austria.

Comparison 11 - ACSL
Implicit/DAE Modelling Approach

ACSL is a well known and widely used, compiler-based simulation language for continuous models. It provides explicit and implicit integration algorithms, event handling features and a powerful experimentation environment via ACSL Math. ACSL offers both textual and graphical model description.

Model description (Task a): ACSL allows the description of implicit models (and DAE models) by means of an `IMPLC` operator, which either breaks an algebraic loop before a numerical integration step or calls directly an implicit integration scheme (DASSL Code).

The following abbreviated `DERIVATIVE` Section shows the essentials of the implicit model description.

```
DERIVATIVE ! Implicit Dynamic Model
ma11 = th1+2*th2*c2+th3; ma12 = ...
b1 =t1+th2*(2*dq1*dq2+dq2**2)*s; b2 = ...
residdq1 = ma11*ddq1 + ma12*ddq2 - b1
residdq2 = ma21*ddq1 + ma22*ddq2 - b2
residdq3 = ma33*ddq3              - b3
dq1, ddq1 = IMPLC(residdq1, dq10)
dq2, ddq2 = IMPLC(residdq2, dq20)
dq3, ddq3 = IMPLC(residdq3, dq30)
q1 = INTEG( dq1, q10); q2 = ...
END ! of Derivative
```

If a standard integration algorithm is chosen (via `IALG`-parameter), the algebraic loop for the second derivatives `ddqx` within the `IMPLC` statement and the equations for the variables `residxx` is broken by a Newton-Raphson iteration within each evaluation of the derivatives. Since version 10.2 ACSL offers also the DASSL-Code for direct integration of implicit equations. If this algorithm is chosen the `residxx` variables represent the residuum for the algorithm. In order to compare these two implicit methods also a "classical" approach was programmed.

```
DERIVATIVE ! Explicit Dynamic model
ma11 = th1+2*th2*c2+th3; ma12 = ...
b1 = t1+th2*(2*dq1*dq2+dq2**2)*s2; b2 = ...
det  = ma11*ma22 - ma12*ma21
ddq1 = (ma22*b1 - ma12*b2)/det
ddq2 = (ma11*b2 - ma21*b1)/det
ddq3 = b3/ma33
dq1  = INTEG(ddq1,dq10); dq2 = ...
q1   = INTEG( dq1, q10);  q2 = ...
END ! of Derivative
```

From the viewpoint of implementation, the implicit method is to be preferred. It is very simple to formulate whereas the symbolic inversion of the mass matrix would be practically impossible in case of a large system. A numerical inversion of the mass matrix could be implemented by means of external FORTRAN subroutines.

Point to Point Control (Task b): Servo motors and control can be easily implemented by standard modelling features of ACSL like the limiting integrator `LIMINT`. Figure 1 shows the results for the joint angles using the DASSL Code. The following table compares the normalised simulation times for a simulation over 2 sec (execution is very fast because ACSL is a compiling simulator). As expected the DASSL Code is faster than the iterative loop breaking method using a standard Runge-Kutta algorithm. However, in this case the explicit model is still significantly faster.

Model Description	Implicit		Explicit
Integr. Algorithm (Stepsize 0.005 s)	RK-4 `IALG=5`	DASSL `IALG=10`	RK-4 `IALG=5`
Norm. CPU-time	1.0	0.86	0.12

Computation times on a HP715/100, ACSL Vers.11

Obstacle avoidance (Task c): State events may be described in ACSL by `DISCRETE` Sections that are managed by `SCHEDULE` operators which start an iterative state event locating routine.

For collision avoidance two such sections are used: `Obs_Stop` is activated if the distance `d` to the obstacle borderline falls below the critical distance `dcr` and if the alarm switch `alon` is set. Within this first `DISCRETE` Section the target position for the joint angles is changed temporarily and set to the momentary position. To guarantee maximum deceleration the voltage limits `LmU` are changed to the maximum values `MxU`. The second `DISCRETE` Section `Obs_Clear` resets all modified parameters when the tool-tip position `q3` has reached a level above the obstacle height (q_3-h_{obs} = $h > 0$).

```
SCHEDULE Obs_Stop .XN.(alon*(d-dcr)+ aloff)
SCHEDULE Obs_Clear .XP. h
:
DISCRETE Obs_Stop
q1tp=q1; q2tp=q2;LmU1=MxU1; LmU2=MxU2
alon = 0; aloff = 1.d0
END    ! obs_stop
DISCRETE Obs_Clear
q1tp=q1fin; q2tpc=q2fin;
LmU1=OpU1;LmU2=OpU2; alon=0;aloff=1
END    ! obs_clear
```

Figure 2 shows that the *x*-position of the tool-tip does not cross the obstacle borderline (dashed line) until the tool-tip height has reached a positive height above the obstacle. Identical results were obtained with the implicit model description using standard integrators and the DASSL-code. However, a considerable increase in computational time was observed for the last-named, caused by the usage of state events.

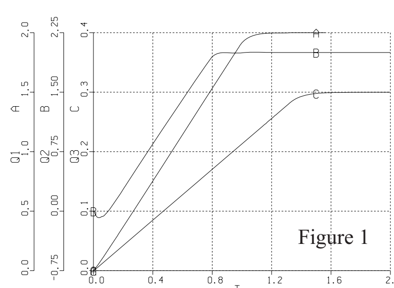


Figure 1

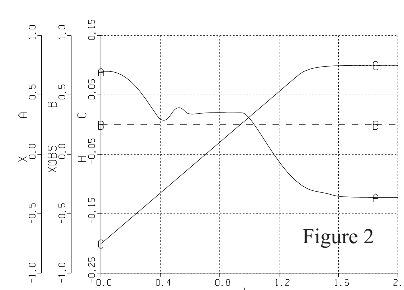


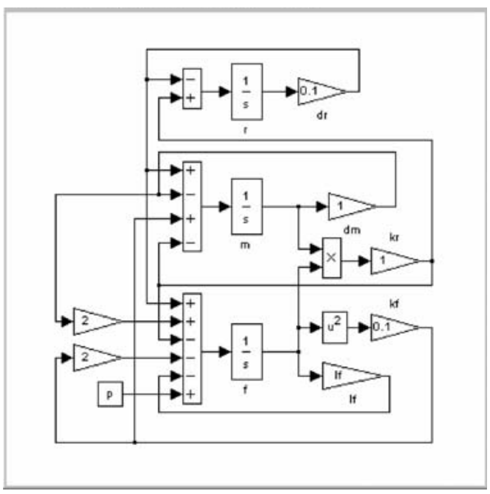
Figure 2

Horst Ecker, Institute for Machine Dynamics and Measurement, TU-Vienna, Wiedner Hauptstr. 8-10, A-1040 Vienna/Austria, email: hecker@email.tuwien.ac.at

Comparison 1 - MATLAB/SIMULINK
External Parameter Study

MATLAB is a widely used software tool based on numerical vector and matrix manipulation – being the best known representative of Computer Numeric Systems (CNSe), SIMULINK is MATLAB's extension for graphical modelling and numerical simulation of dynamic systems.

Model Description: The model implementation in SIMULINK is straightforward, using basic standard blocks from the library, see fig.:

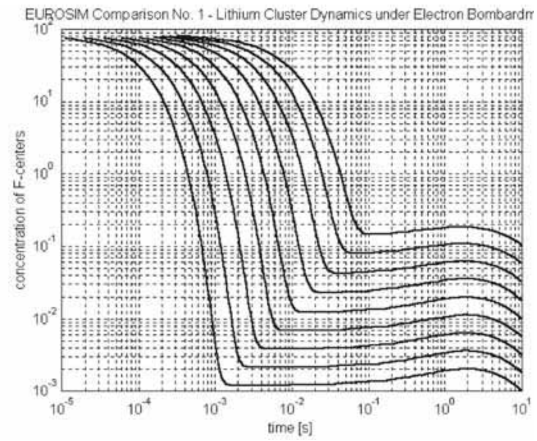


Task a. SIMULINK 2.x offers a wide range of integration algorithms, amongst them two stiff solvers, well suited for the problem. The fastest solver is the a new implicit NDF-Solver (variable stepsize, variable order from 1 to 5, implicit), followed by a modified Rosenbrock solver (variable stepsize, order 1/2, implicit), both with standard values for relative and absolute tolerances (1.e-3, 1.e-6) and no limits on minimal and maximal stepsizes.
It is astonishing that also SIMULINK's standard solver, the Dormand-Prince solver (variable stepsize, order 4/5, explicit) gives suitable results with the default parameters, despite the fact that small stepsizes have to be taken. Details are given in the table, with normalised simulation time for one run, without data storing (measured with MATLAB's `tic - toc` command).

METHOD	Dormand-Prince	Modified Rosenbrock (stiff)	stiff NDF
Single Run	**45**	**2.2**	**1**

Task b. MATLAB is a very convenient experimentation environment for SIMULINK (from the simulationist's viewpoint. The parameter study for l_f in logarithmic steps and the parameter study plot may be done by the following commands:

```
>for n=9:-1:1
>   lf=10^(1.75+n/4); sim('c1',[0 10]);
>   fc{n}=f; ti{n}=t;
>end
>hold off
>loglog(ti{1},fc{1},'b','LineWidth',2);
> .... title(.......
>grid; hold on
>for n=2:9
>  loglog(ti{n},fc{n},'b','LineWidth',2);
>end
```



The above loglog-plot, resulting from the commands before, starts at t=1.e-5, because of the initial stepsize (automatically chosen). It is relatively tricky to force the integration algorithm to take a smaller initial stepsize.

Task c. SIMULINK not only adds graphical description of dynamic models and ODE solvers to MATLAB, it enriches the MATLAB commands by analysis commands for searching a steady state, for linearising the model etc. The trim command finds steady state parameters for a system $\dot{\vec{x}} = \vec{f}(\vec{x},\vec{u},t)$, $\vec{y} = \vec{g}(\vec{x},\vec{u},t)$, given a set of conditions. `trim` calls (amongst other routines) the routine `constr`, which performs a constrained optimisation and which is called also by several other MATLAB routines, by routines of the optimisation toolbox, NCD toolbox etc. In this case only a solution $\vec{x}$ for $\vec{f}(\vec{x}) = \vec{0}$ is to be determined. A simple `m`-file varies the parameter p, calls the `trim` function and displays the results:

```
>p =0;[xp1]= trim('c1c'); xp1=[p xp1'];
>p = 1.0e4; [xp2]=trim('c1c'); xp2=[p xp2'];
> disp('       p        r        m       f');
> disp(xp0);disp(xp10000);

  p          r           m            f
    0  5.4938e-19  1.653e-20   -2.3566e-14
10000       10          10          1000
```

The results given above are sufficiently accurate. The solution for p=0 could be improved by allowing e.g. more iteration steps. The solution for p=1000 is more accurate, because the algorithm starts as default with the initial state.

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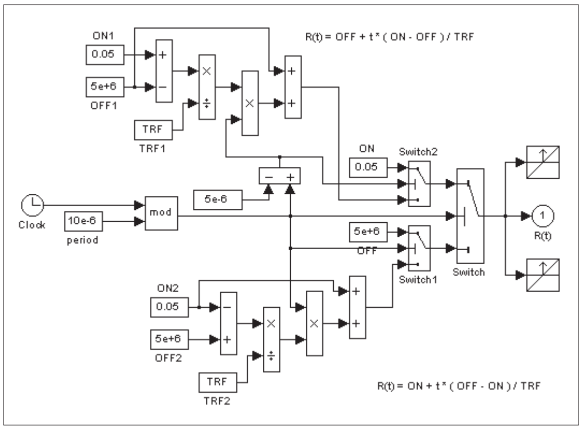
Comparison 3 - MATLAB/SIMULINK
Dynamic Function Approach

MATLAB is a widely used software tool based on numerical vector and matrix manipulation, SIMULINK is MATLAB's extension for graphical modelling and numerical simulation of dynamic systems.



Model Description: The model for the amplifier (four states) is built up from the **`Linear library`** of SIMULINK. For the time-dependent resistor *R(t)* first a table function (**`From Workspace`**) was used. But this method is not accurate enough, because the evaluation is done by linear interpolation , not synchronised with the time instants for rising and falling. Therefore a "dynamic" implementation as SIMULINK sub- model was chosen (see fig. above), which switches between the constant values for the ON- and OFF-period, and between the rising or falling slope. Two **`Hit Crossing`** blocks synchronise the switching times with the integration algorithm (state event finder).

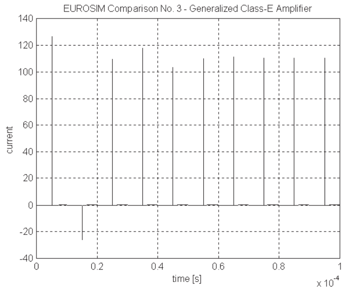
Task a. The **`linmod`** command allows to linearise the system $\dot{\vec{x}} = \vec{f}(\vec{x}, \vec{u}, t)$ by calculating the matrices *A* and *B* for $\dot{\vec{x}} = A(\vec{x} - \vec{x}_s) + B(\vec{u} - \vec{u}_s)$ around a linearisation point $(\vec{x}_s, \vec{u}_s)$, using numerical perturbation.
As the model is linear in the ON- and in the OFF- period, it is not necessary to simulate until the linearisation point, and an arbitrary linearisation point (zero point) can be chosen. Only the time *t* (which is "hidden" in the 2nd algorithm parameter `para`) has to be set properly.

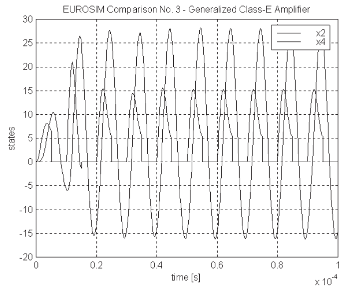
In order to validate the results of linearisation also the "generic" linear model is set up in MATLAB. In the following the **`m`**-file and the results are given (only in the OFF-period the results differ slightly):

```
» disp('linmod-linearisation: ON');
» xs=zeros(1,4);us=[];para=[1.e-5,0.7e-5];
» eigenvalues=eig(linmod('c3b',xs,us,para))
» disp('linmod-linearisation: OFF');
» para=[1.e-5,0.3e-5];
» eigenvalues=eig(linmod('c3b',xs,us,para))
» disp('Generic linear model: ON');
» A(1,:)=[0 -1 0 0]/L1;
» A(2,:)=[1 -1/0.05 -1 0]/C2;
» A(3,:)=[0 1 -RL -1]/L3;A(4,:)=[0 0 1 0]/C4;
» eigenvalues=eig(A)
» disp('Generic linear model: OFF');
» A(2,2)=(-1/5e+6)/C2;eigenvalues=eig(A)
```

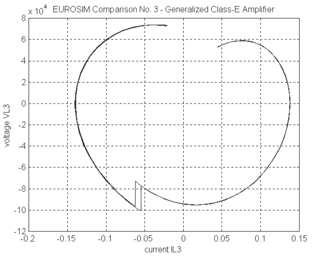
```
linmod-linearisation: ON
eigenvalues = 1.0e+009 *
 -1.11731759441059
 -0.00000062578277
 -0.00011303881490 + 0.00065835222047i
 -0.00011303881490 - 0.00065835222047i
linmod-linearisation: OFF
eigenvalues = 1.0e+006 *
 -0.05470820246681 + 1.04079719784500i
 -0.05470820246681 - 1.04079719784500i
 -0.05822841860813 + 0.53275019240145i
 -0.05822841860813 - 0.53275019240145i
Generic linear model: ON
eigenvalues ..same as before
Generic linear model: OFF
eigenvalues = 1.0e+006 *
 -0.05470820246506 + 1.04079719785483i
 -0.05470820246506 - 1.04079719785483i
 -0.05822841860988 + 0.53275019240597i
 -0.05822841860988 - 0.53275019240597i
```

Task b. As the time instants for switching are synchronised with the integration, the results are sufficiently accurate, also for the impulse-like current $IR(t) = x_2/R(t)$ and the nearly discontinuous states - see next two figures, using the **`stiff Mod. Rosenbrock`** method with initial stepsize **`TRF`**.





Task c. The following commands perform a simulation run over [0, 9E-6] with storing the terminal values of the states, reinitialize the states with these values, and do the parameter study for varying rise/fall time.



Zooming into the phase plot shows, that only the simulation for **`TRF`** value 1.e-7 is different from the smaller values.

```
» clear all;TRF = 1e-15; sim('c3c');
» x1=x(2); x2=x(3); x3=x(4); x4=x(5);
» trf=[1e-15 1e-11 1e-9 1e-7];
» for n=1:4
»    TRF=trf(n); sim('c3c');
»    e1{n}=erg1; e2{n}=erg2;
»    v1{n}=VL3;  i1{n}=IL3; end
```

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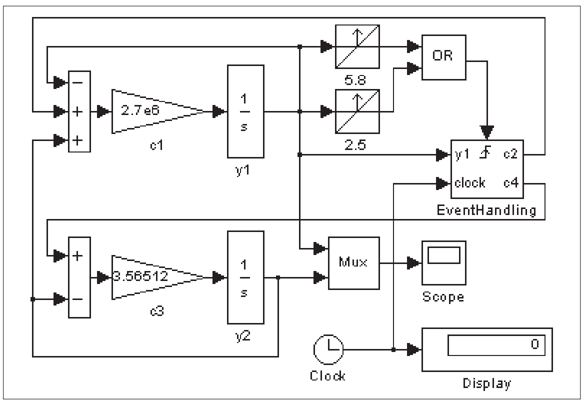
Comparison 5 - MATLAB/SIMULINK
Simulation Based Approach

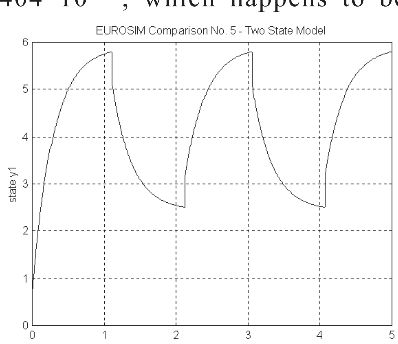
MATLAB is a widely used software tool based on numerical vector and matrix manipulation, SIMULINK is MATLAB's extension for graphical modelling and numerical simulation of dynamic systems.



Model Description: SIMULINK 2.x now offers state event handling: i) events may be described in conditionally executed subsystems, ii) events are detected and localised by the **`Hit Crossing`** block (using interpolation techniques depending on the integration algorithm).

The model description above makes use of standard blocks for the states and of two **`Hit Crossing`** blocks, which generate a trigger signal (synchronised with the integration algorithm) if a threshold value for y_1 is reached. This signal executes once the subsystem **`EventHandling`**, where the values of the parameters c_2 and c_4 are changed.

Tasks *a*. As the system is stiff, for simulation the stiff modified Rosenbrock method (**`ode23s`**) was used. SIMULINK does not allow a relative tolerance of 10^{-14}. It is too small, so it is automatically set to $2.8421709430404 \cdot 10^{-14}$, which happens to be 128***`eps`**, where **`eps`** is a hardware-dependent system-variable containing the smallest positive real number that can be represented.



The results for the graph y_1 and for the switching times are given below. The final value for y_1 is 5.09799994294882, and discontinuities are detected at the following times:

0.00000024628483, 1.10826695015899, 2.12959779857330, 3.05402823509310, 4.07535908448041, 4.99978942209375

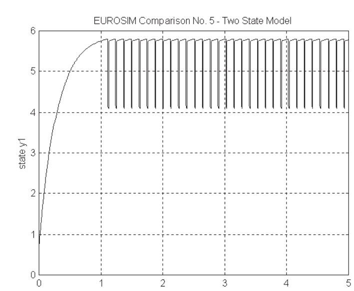
SIMULINK's second stiff algorithm, a stiff NDF - algorithm (**`ode15s`**) gives slightly less accurate results for the terminal value (y_1 = 5.79999136263942), although a higher order integration scheme is used.

Task *b*: The variation of the relative accuracy is done with the following m-file, which gives results as shown in the table below – as in task a), the relative tolerance of 10^{-14} is too small and automatically set to 128***`eps`**:

```
» for tol=[1.e-6 1.e-10 1.e-14]
»   sim ('c5ab');
»   disp('located discontinuities:'); times
»   disp('final value of y1:'); y1(length(y1),2)
» end
```

relative accuracy	10^{-6}	10^{-10}	10^{-14}
discontinuities	0.00000024628121	0.00000024628483	0.00000024628483
	1.10819668289891	1.10826705772098	1.10826695015899
	2.12948094634134	2.12959790634861	2.12959779857330
	3.05384115254203	3.05402834304646	3.05402823509310
	4.07512592059667	4.07535919164680	4.07535908448041
	4.99948491090611	4.99978952921041	4.99978942209375
final value of y_1	5.09510508285971	5.09800096181504	5.09799994294882

Task *c*. The change of the parameters results in a high frequent oscillating behaviour of the state with 63 switching instants, as shown in the figure:



The first switching instant is isolated, the following are periodical:

```
0.00000001073602,
1.10826685836098, 1.12169051593078,
1.23541602636997, 1.24883968395372, ..............
4.80901638474374, 4.92274189502738,
 4.93616555261176
```

The terminal value of $y_1(5)$ = 5.78053130853560 was reached with the stiff Modified Rosenbrock method, where the initial stepsize had to be tuned to 10^{-6} in order to meet the first event properly.

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Comparison 7 - MATLAB/SIMULINK
Hybrid Modelling Approach

MATLAB is a widely used software tool based on numerical vector and matrix manipulation, SIMULINK is MATLAB's extension for graphical modelling and numerical simulation of dynamic systems. MATLAB itself can be seen as (powerful) runtime interpreter for handling SIMULINK models, building complex experiments.

Model Description: This solution follows an approach which interprets the overall system as a sequence of in principle independent processes. In this case, the overall system consists of a long and a short pendulum, processed in a loop. Furthermore, based on the ideas of hybrid systems, a common state space (CSS) is introduced. This CSS has a dimension that is the maximum of the dimensions of the individual state spaces and which is normalised. In the CSS conditions select the valid individual state and (re-)normalisations are interfacing between the single states. The individual state spaces are given by $(\varphi_s, \dot{\varphi}_s)$ and $(\varphi_l, \dot{\varphi}_l)$, resp., while for the CSS (φ, v) with $\varphi = \varphi_s = \varphi_l$ and $v = \dot{\varphi}_s \cdot l_s = \dot{\varphi}_l \cdot l$ is chosen.

The individual state spaces are implemented in SIMULINK models, while the CSS is formulated in MATLAB: Two SIMULINK models with standard blocks represent the two pendulums (`pendulum_short; pendulum_long`, fig. 1). In each model a HIT-crossing-block and a `STOP`-block cause the model to stop when it is no longer valid (i.e. when reaching the angle of the pin). The models are called by MATLAB, the logic which model to call is handled by MATLAB, too. Normalising and re-normalising (in MATLAB) calculate the new velocities. All calculations were done with the integration algorithm `ODE45` (`Dormand-Prince`) and a maximum step size of 0.01. Consequently, implementation is done at three levels:

- **Experiment level:** calls sequence of models, logs data, plots (`task_a2.m`)
- **Interface level:** decides which model to call, provides interfaces for CSS (`pendulum_start.m`)
- **Model level:** SIMULINK models run one at a time, stopping when reaching the angle of the pin (fig. 1)

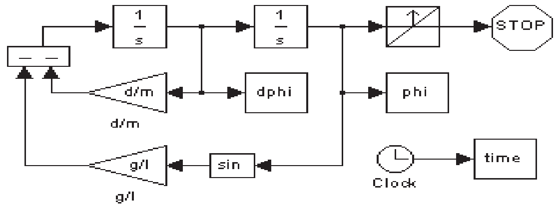
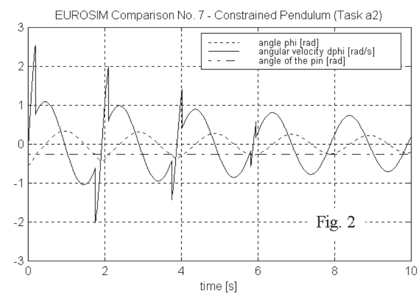


Fig. 1: model `pendulum_long` (length `l`)

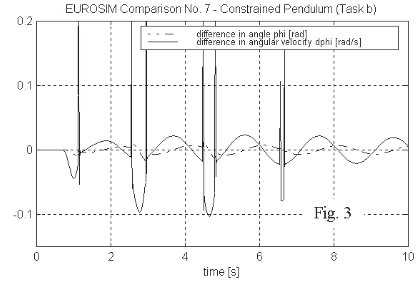
The m-file `pendulum_start` provides the decision which model to call and the interfaces for the CSS:

```
if ((phi_p-phi0)*phi_p<0 | (phi0==phi_p & phi_p*v>0))
   dphi0=v/ls;
   sim('pendulum_short',[t(length(t)),10]);
   v=dphi(length(dphi))*ls;
else
   dphi0=v/l;
   sim('pendulum_long',[t(length(t)),10]);
   v=dphi(length(dphi))*l;
end
phi0=phi(length(phi));
```



Task a. Tasks a1) and a2) and any other experiment are performed by setting initial values and starting a loop with calls to the m-file deciding the next model, simulating the model and normalising the state space, with logging the data sequentially (`task_a2.m`; results in fig. 2). The time instants of the hits are given by the termination time of each simulation run.

```
M-file task_a2:
g = 9.81; m = 1.02; l = 1.0; lp = 0.7; ls = l-lp;
d = 0.1; phi_p = -pi/12; phi0 = -pi/6; v = 0;
t=0; pendulum_start; t=time;
t_h=t(length(t)); phis=phi; dphis=dphi;
while t(length(t))<10
   t_h=[t_h; t(length(t))]; pendulum_start;
   phis=[phis; phi]; dphis=[dphis; dphi]; t=[t;
time];
end
```



Task b. The comparison of the non-linear and the linear model was done by running the two models sequentially and calculating the difference in MATLAB. Because of the different variable step sizes the models create output at different times, so interpolation is necessary, here done by the following commands (results in fig. 3):

```
data(:,2)-
   interp1(data_lin(:,1),data_lin(:,2),data(:,1),'linear')
```

Task c. For solving the boundary value problem a simple binary search is performed in MATLAB. The models are only extended by a `STOP`-block finishing the simulation when the pendulum reaches the velocity `dphi=0`. After 48 iterations the search results in `dphi0=-2.18469928866723`.

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Comparison 7 - MATLAB/SIMULINK
Hybrid Modelling – Finite State Machine

MATLAB is a widely used software tool based on numerical vector and matrix manipulation, SIMULINK is MATLAB's extension for graphical modelling and numerical simulation of dynamic systems. Furthermore, STATEFLOW extends MATLAB's and SIMULINK's capabilities for handling discrete events (discribed as finite state machine) in simulation.

Model Description: This solution follows an approach which interprets the overall system as a sequence of in principle independent processes. In this case, the overall system consists of a long and a short pendulum, processed in a loop. Furthermore, based on the ideas of hybrid systems, a common state space (CSS) is introduced. This CSS has a dimension that is the maximum of the dimensions of the individual state spaces and which is normalised. In the CSS conditions select the valid individual state and (re-)normalisations are interfacing between the single states. The individual state spaces are given by $(\varphi_s, \dot{\varphi}_s)$ and $(\varphi_l, \dot{\varphi}_l)$, resp., while for the CSS (φ, v) with $\varphi = \varphi_s = \varphi_l$ and $v = \dot{\varphi}_s \cdot l_s = \dot{\varphi}_l \cdot l$ is chosen.

The basic idea for implementation is: In SIMULINK all dynamic models with normalisation for the CSS are described (with submodels), in STATEFLOW the control for the subsequent execution of these submodels is done (complex conditions possible). For this simple sequence of long and short pendulum an overall SIMULINK model is created, consisting of three subsystems (fig. 1), one (`Models`) for the pendulum models (fig. 2), one (`Control`) for the control (fig. 3), and one (`Output`) for creating user-friendly output. The pendulum models are placed in one enabled submodel each, containing also the necessary interfaces for the CSS. The subsystem `Control` controls the sequential execution of the submodels by means of a STATEFLOW description, which also takes care of the conditions at time `t=0`. The `Models` segment sends the values of the CSS to the `Controls` segment, which sends back a control signal for execution of the actual dynamic submodel.

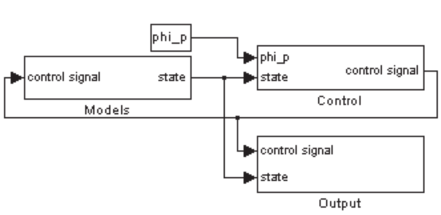

Fig. 1: SIMULINK diagram for task a

Task a. The overall model is executed from the MATLAB level, where also the initial values are set, producing exact results for both task a1 and task a2.

Task b. The comparison of the nonlinear and the linear model is done by running the two models sequentially and calculating the difference in MATLAB. Interpolation is necessary, because of the different variable step sizes, so that the models create output at different times. Here this interpolation is done by the following commands:

```
data(:,2)-
    interp1(data_lin(:,1),data_lin(:,2),data(:,1),'linear')
```

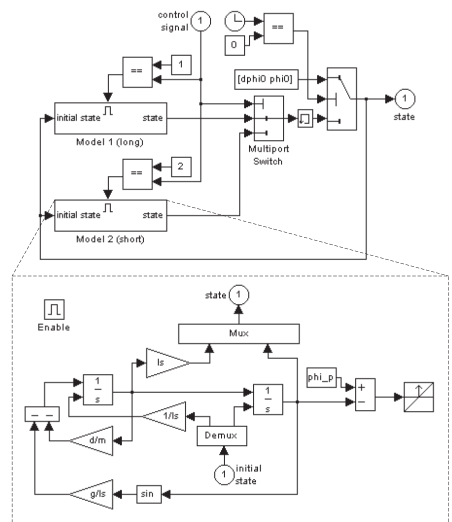

Fig. 2: Subsystem `Models` with model `short`

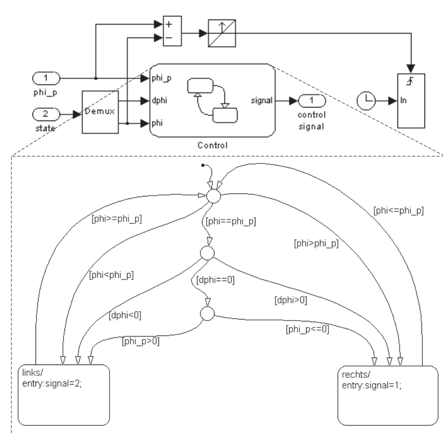

Fig. 3: Subsystem `Control` with stateflow `chart`

Task c. For solving the boundary value problem the Optimization Toolbox is used. The model is extended by a `STOP`-Block that finishes the simulation when the value of `dphi` changes the sign. The model execution has to be formulated as a function with `dphi` as input parameter, so that it can be called by the `fzero` function of the toolbox, which tries to find the desired goal `phi-pi/2=0`. This gives `dphi0=-2.18474028342616`.

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Comparison 7 - MATLAB/SIMULINK
Classical Modelling with State Transformation

MATLAB is a widely used software tool based on numerical vector and matrix manipulation, SIMULINK is MATLAB's extension for graphical modelling and numerical simulation of dynamic systems.

Model Description: Normally, the given equation

$$m\cdot l\cdot\ddot{\varphi} = -m\cdot g\cdot\sin\varphi - d\cdot l\cdot\dot{\varphi}$$

would be transferred to a system of two first order equations with the state space $h_1 = \varphi$ and $h_2 = \dot{\varphi}$:

$$\dot{h}_1 = h_2\,,\, \dot{h}_2 = -\frac{g}{l}\cdot\sin(h_1) - \frac{d}{m}\cdot h_2$$

The discontinuous change of the angular velocity is derived from the principle of energy consumption, i.e.

$$v = l_1\cdot\dot{\varphi}_l = l_s\cdot\dot{\varphi}_s,$$

which is the tangential velocity and cannot change discontinuously. So another state space with $h_1 = \varphi$ and $h_2 = v$ may be used – which is continuous all the time! The equations to be implemented are now:

$$\dot{h}_1 = \frac{h_2}{l},\; \dot{h}_2 = g\cdot\sin(h_1) - \frac{d}{m}\cdot h_2,$$

In the SIMULINK implementation (fig. 1) the change of the length is done by a switch block that takes φ as input. A HIT-crossing block is used to meet the time instants of hitting or leaving the pin more accurately and to trigger a submodel that logs these hit times. All calculations were done with the integration algorithm `ODE45` (`Dormand-Prince`) and a maximum step size of `0.01`.

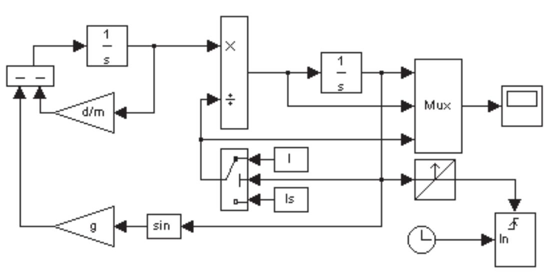

Fig. 1: SIMULINK model for task a

Task a. The model is called from the MATLAB level (m-file), where the variables, that control the initial values in the models, are set and the results are plotted (fig. 2).

```
Hit times for task a1:
0.70345948576220, 1.15177970759669,
2.59041798757767, 2.99052905658756,
4.54274139054858, 4.86748779384877,
6.64870714050877, 6.72038416645902
```

Task b. The comparison of the nonlinear and the linear model is done by running the two models in parallel,

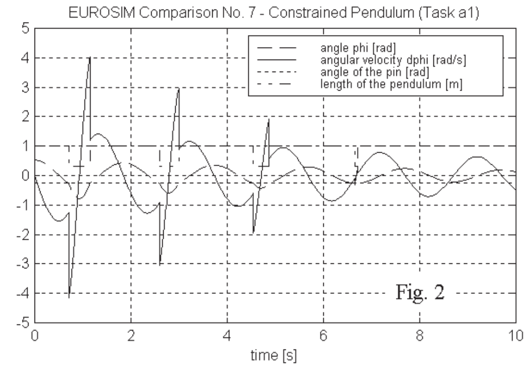

Fig. 2

calculating the difference in SIMULINK. The setting of the initial values and the plots (fig. 3) are done in MATLAB like in task a. It should be noticed, however, that parallel simulation of linear and nonlinear model may produce results slightly different from those of the models run separately, because now there are two HIT-crossing blocks and the integration algorithm may choose finer steps.

```
Hit times for task b:
   non-linear           linear
0.69485080978310 | 0.69202334008965
1.12809805302788 | 1.12054472929480
2.55297893506536 | 2.54086045784231
2.94619417375543 | 2.93179914906389
4.48469674244018 | 4.46575548307712
4.80972431154533 | 4.79078611131192
6.55976278154389 | 6.53205756078711
6.67094522624046 | 6.65299544877758
```

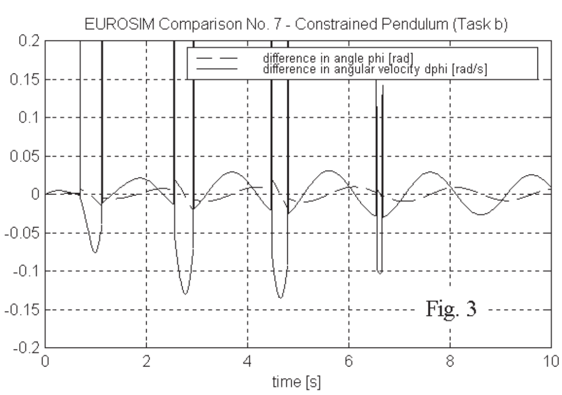

Fig. 3

Task c. The boundary value problem can be avoided by a time transformation with reverse time so that only an initial value problem has to be solved. The time transformation can be "simulated" in this model by changing the sign of the damp factor and using the desired results (`phi=-pi/2, dphi=0`) as initial values. The model is extended by a `STOP`-block that stops at the proposed initial angle of `phi=pi/6` (met more accurately by using another HIT-crossing-block). Thus an angular velocity of `dphi0=-2.18469928771788` can be determined.

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Comparison 7 - ACSL
Classical Modelling with State Transformation

ACSL (Advanced Continuous Simulation Language) in the newest version (ACSL 11.4) is a simulation system consisting of ACSL Model (textual modelling), ACSL GM (graphical modelling), ACSL Vision (animation) and AMATH. AMATH – a MATLAB-like interpreter allows to control the environment and is more powerful than ACSL's standard runtime interpreter. AMATH variables (case-sensitive) are organised in a workspace; if an ACSL model is loaded all ACSL variables are imported into this workspace (variables and parameters in capitals, prepare-variables as vectors with prefix '_').

Model Description: The modelling approach used in this solution changes the state space. Instead of angle velocity $\dot{\varphi}$ the tangential velocity $v = l\dot{\varphi}$ is used:

$$\dot{\varphi} = \frac{v}{l}, \ \dot{v} = -g\sin\varphi - \frac{d}{m}v$$

The big advantage of this representation is the fact that in case of hitting or leaving the pin the tangential velocity v is continuous and only the length l changes form l_l to l_s because of $v = l_l \cdot \dot{\varphi}_l = l_s \cdot \dot{\varphi}_s$.

The following ACSL model changes the length with a `RSW` switch (equivalent to an `IF-THEN-ELSE`), the `SCHEDULE` operator and the `DISCRETE` section `hit` determine the hit more precisely:

```
PROGRAM Constrained Pendulum
! ---------------------------------------------------
! EUROSIM Comparison - Nonlinear pendulum, hitting a pin
! ---------------------------------------------------
ARRAY hits(10); INTEGER index; LOGICAL swilin
INITIAL !- Model parameters
CONSTANT ll=1., ls=0.3, m=1.02, d=0.2, g=9.81
CONSTANT phi0=0.3, phip=0.2, dphi0=0
CONSTANT index=0, hits=10*0., tend = 10, swilin=.FALSE.
!--- Determine initial position, calculation of v0
l = RSW((phip-phi0)*phip .LE. 0, ls, ll); v0 = l*dphi0
END ! of INITIAL
DYNAMIC
  DERIVATIVE
    l = RSW(phi-phip .GE. 0, ll,ls )
    sphi = RSW(swilin, phi, SIN(phi))
    v     = integ ( -g*SIN(phi) - (d/m)*v, v0)
    dphi  = v/l
    phi   = integ ( dphi, phi0)
    SCHEDULE hit .XZ. (phi-phip)
  END ! of DERIVATIVE
  DISCRETE hit ! Determining Hit, logging time instants
   call logd(.TRUE.); index=index+1; hits(index)=t
  END ! of DISCRETE hit
 TERMT ( T .GE. tend )
END ! of DYNAMIC; END ! of PROGRAM
```

Task a. Experiments may be done from the ACSL runtime interpreter (RTI) or from the much more powerful AMATH environment. In AMATH one may toggle to the RTI by the prefix `!!`, used in the following m-file for task a1). There e.g. parameters are set in AMATH (capitals, because ACSL variables) as well as in the RTI:

```
load(@file='c7_acslt.prx',@format='model')
PHIP  = -pi/12; TEND = 10; PHI0 = pi/6; DPHI0 = 0;
!! set d=0.2, ll=1, ls=0.3, swilin=.FALSE.
!! prepar t,phi,dphi,l; start
plot(_t,_phi,'b',_t,_dphi,'r',_t,_l,'--');
format long; disp('Hits occurred at times')
HITS=HITS(find(HITS))
```

Task b. The comparison of the nonlinear and the linear model is done by running first the nonlinear and then the linear model (setting `swilin = .TRUE.`). As hit times differ, the stored time courses for `phi` and `dphi` are not equally spaced. So interpolation in AMATH is necessary before calculating the difference.

Hit times for task a1):

```
0.7034594758326
1.1520148375975
2.5905016239353
2.9907644847297
4.5425777317882
4.8686273350132
6.6436619880250
6.7263766018376
```

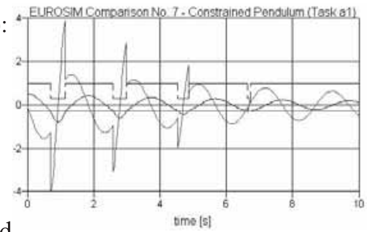
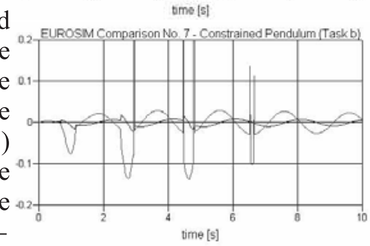


Fig. 1: `phi, dphi` and l over t, task a1)

A faster method is to calculate the difference in the ACSL model (in the `DYNAMIC` section) where data from the previous run are provided by a `TABLE` statement.



At AMATH level, between the two runs these tables must be updated with the correct values:

```
load(@file='c7_acslt.prx',@format='model')
PHIP  = -pi/24; TEND = 10; PHI0 = pi/12; DPHI0 = 0;
!! prepar t,phi,dphi,l
!! set swilin=.FALSE.; start
hitsnonlin=HITS(find(HITS));
COMPPHI(1:length(_phi))=_phi(1:length(_phi));
COMPPHI(521:(length(_phi)+520))=_t(1:length(_t));
COMPDPHI(1:length(_dphi))=_dphi(1:length(_dphi));
COMPDPHI(521:(length(_dphi)+520))=_t(1:length(_t));
!! prepare /clear; prepare t, diffphi, diffdphi
!! set swilin=.TRUE.; start
hitslin = HITS(find(HITS));
plot(_t, _diffphi,'b', _t, _diffdphi,'r');
disp('      non-linear      |     linear')
allhits=[hitsnonlin hitslin]
```

Task c. In an Optimisation Toolbox AMATH offers special features for optimising parameters of ACSL models with respect to the final value of an ACSL variable and for identifying ACSL parameters with respect to measured data. For solving the boundary value problem the model is extended by a `SCHEDULE` operator which terminates the simulation if `dphi` gets 0 and by the calculation of the boundary value to be minimised (`reached=(phi-phie)*(phi-phie)`). A simple command performs the optimisation successfully:

```
load(@file='c7acslto.prx',@format='model')
LL = 1; LS = 0.3; D = 0.2; TEND = 10;
PHIP  = -pi/12; PHI0   = pi/6; DPHI0 = -1; PHIE=-pi/2;
[opt_reached, opt_dphi0, init_dphi0, num_iter, time_iter]=
   acslmin("REACHED", 1, "DPHI0", -1, "DPHI0", [0.5 1])
```

```
DESCRIPTION    INITIAL      FINAL
 ----------------------     -------      -----
               REACHED    0.36026    4.67524e-015
                 DPHI0         -1      -2.1847
Time elapsed:                   4.67 seconds
Number of function evaluations: 21
Optimization Method:  Generalized Reduced Gradient
GRG2 concluded successfully.
```

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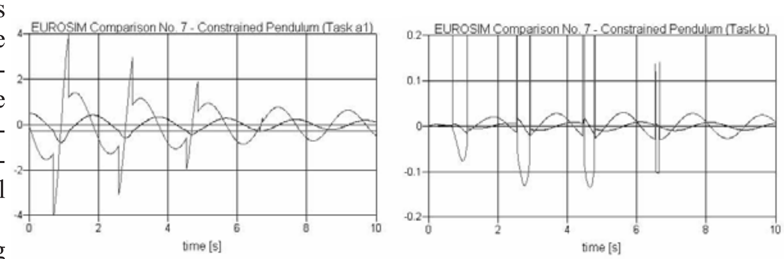
Comparison 7 - ACSL
Hybrid Modelling Approach

ACSL (Advanced Continuous Simulation Language) is now embedded into a simulation environment with graphical modelling, animation, realtime code generator controlled by AMATH, a MATLAB-like interpreter, which is much more powerful than ACSL's standard runtime interpreter. AMATH variables (case-sensitive) are organised in a workspace; if an ACSL model is loaded all ACSL variables are imported into this workspace (variables and parameters in capitals, prepare-variables as vectors with prefix '_').

Model Description: This solution interprets the overall system as a sequence of in principle independent processes, in this case of a long and a short pendulum, processed in a loop. Based on the ideas of hybrid systems, a common state space (CSS) is introduced. In general, this CSS has a dimension that is the maximum of the dimensions of the individual state spaces and which is normalised. In the CSS conditions select the valid individual state and (re-)normalisations are interfacing between the individual states. In this case, the individual state spaces are given by $(\varphi_s, \dot{\varphi}_s)$ and $(\varphi_l, \dot{\varphi}_l)$, resp., the CSS is (φ, v) using the tangential velocity v instead of the angle velocity $\dot{\varphi}$ with $\varphi = \varphi_s = \varphi_l$ and $v = \dot{\varphi}_s\, l_s = \dot{\varphi}_l\, l_l$.



The following simple ACSL model represents the long and the short pendulum, valid until hitting (if long pendulum) or leaving (if short pendulum) the pin. The `SCHEDULE` operator is used to stop exactly when hitting or leaving the pin:

```
PROGRAM Constrained pendulum
! --- Model for pendulum until hitting
CONSTANT phip = 0.0, phi0 = 0.0, dphi0 = 0.0
CONSTANT l = 1.0, g = 9.81, m = 1.02, d = 0.2
VARIABLE t, tic = 0.0
  DERIVATIVE !-- Model dynamics
   dphi =integ(-(g/l)*SIN(phi)-(d/m)*dphi, dphi0)
   phi  = integ (dphi, phi0)
   SCHEDULE hitstop .XZ. (phi-phip)
  END ! of DERIVATIVE
  DISCRETE hitstop  ! --- Determine Hit exactly
   TERMT (.TRUE.)
  END ! of DISCRETE; END ! of DYNAMIC; END
```

The model is called from an AMATH script (m-file `pendulum_start`) which, depending on `phi0`, `dphi0` and `phip` (position of the pin), starts the model with long or short pendulum length. Before and after the run (executed by toggling to the ACSL RTI with `!! start`) the space transformations are calculated:

```
if ((PHIP-PHI0)*PHIP<0 | (PHI0==PHIP & PHIP*v>0))
   L=ls; else L=ll; endDPHI0=v/L;
!!start
v=DPHI*L; PHI0=PHI;
```

The overall model and further investigations may now be formulated as loop around this m-file.

Task a. The m-file `task_a2.m` shows how to perform task a2): first, the ACSL model is loaded, and parameters are set – either in AMATH or in ACSL (toggling by `!!`). ACSL variables **ab** appear in AMATH (which is case-sensitive) in capitals **AB**, prepare-variables, e.g. phi, as **_phi** (vectors). After the first simulation run a `while`-loop alternatively executes long and short pendulum simulation until the next hit. The time courses are sequentially put together by concatenating the prepare vector `_phi` to the overall vector `phis: phis=[phis; _phi]`. Plots may be done in ACSL or AMATH (fig.1).

M-file `task_a2:`

```
load(@file='c7_amath.prx',@format='model')
ll = 1; ls = 0.3; v = 0; %(=dphi*l)
PHIP = -pi/12; PHI0 = -pi/6;
!! set d = 0.1, tic = 0.0, swilin = .FALSE.
!! prepar t,phi,dphi
pendulum_start;
t=_t; t_h=t(length(t)); phis=_phi; dphis=_dphi;
while t(length(t))<10
   t_h=[t_h; t(length(t))]; TIC=t(length(t));
   pendulum_start;
   phis=[phis; _phi];    dphis=[dphis; _dphi]; t=[t; _t];
end
plot(t,phis,'b',t,dphis,'r',[0; 10],[PHIP; PHIP],'m');
format long
xlabel('time [s]');
disp('Hits occurred at times')
t_h=t_h(2:length(t_h))
```

Task b. The comparison of the nonlinear and the linear model (replacing in the model description `SIN(phi)` by `phi`) was done by running the two overall models sequentially and calculating the difference in AMATH. Because of the different stopping time instants the models create output at different times, so interpolation is necessary, done by standard interpolation commands:

```
philinint = interp1(tlin, philin,tnonlin);
diffphi = phinonlin-philinint;
................
plot(tnonlin,diffphi,'b', tnonlin,diffdphi,'r');
Hits occurred at times
     non-linear    |    linear
allhits =
     0.6948507953576      0.6920233252220
     1.1280980292485      1.1205447058297
     2.5529788811510      2.5408604030056
     2.9461941113819      2.9317990863259
     4.4846966472331      4.4657553873837
     4.8097242094708      4.7907860077940
     6.5597626401332      6.5320574222774
     6.6709450858390      6.6529953051872
```

Task c. For solving the boundary value problem a simple binary search is programmed in AMATH. The models are extended by a SCHEDULE operator with a DISCRETE SECTION terminating the simulation when the pendulum reaches the `dphi=0`. After 36 iterations the search results in `dphi0= -2.18469928866723`.

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Comparison 8 - SLX
Internal Variance Reduction

SLX is a C-like programming language with special add-ons for discrete event simulation. Developed by Wolverine Software Corporation, it has maintained a compilation and text based simulation environment. Additionally, a run time environment for creating, debugging and simulating has been built. Running under Windows 95 / NT it is one of the fastest simulation packages available.

The Model: The model contains three different object classes: the *lock_control* models the lock in the comparison.

While the ships are waiting for the gates to open to enter the opposite canal, all simulation time concerning the lock (gate passing, fill/unfill) is included. Eastbound and westbound ships are modelled separately. Using Boolean and integer variables, the whole logical system is built up according to the definitions. For each direction, four integer variables are used: one for controlling the barge movement cycle, one for counting the barges waiting to pass, one for counting the number of barges arriving at the lock, and the fourth for counting the number of barges passing the system. The variable for controlling the movement cycle is set to zero every time a barge passes into the other direction, or when the last barge leaving the system indicates that there are no other barges waiting. The statistical library of SLX is used to compute the statistical outputs by tabulating all travelling times. Creating the model took about two days, including the statistical features.

Variance reduction experiments and the statistical evaluation: SLX includes features for manipulating the built-in random number generator.

```
rn_stream      eastbound_arrival,
               westbound_arrival;
```

defines two different random number streams, one for the random arrival of the westbound and the other for the random arrival of the eastbound barges. SLX automatically starts the next random number stream 200.000 positions later than the one before, unless there is no user defined starting position.

```
rn_seed  eastbound_arrival = 1000000 antithetic,
         westbound_arrival = 1500000 antithetic;
```

sets the *eastbound_arrival* random number stream to the starting position 1000000 and starts using antithetic variates (same for *westbound_arrival* stream).

```
report (rn_stream_set);
```

shows all the information of these random number generators including sample count, initial position, current position, using of antithetic variates and χ^2-uniformity.

```
random_variable   westbound_travelling_time,
                  eastbound_travelling_time,
                  total_travelling_time;
```

declares three random variables, and during the simulation run every barge stores its travelling time in two of them.

For statistical evaluation comfortable functions of the SLX statistical library are used:

- computation of the mean of the sample of one run:
  `total_mean[counter]=sample_mean(total_travelling_time);`
- computation of the 90% confidence interval:
  `report_mean_ci("\nAverage Total Time:", 0.9, total_mean_exp1, replications);`
- calculation of a 90% confidence interval for the antithetic experiments:
  `report_antithetic_mean_ci("\nAverage Total Time:", 0.9, total_mean_exp1, total_mean_exp4, replications);`
- computation of a 90% confidence the Common Random Number variance:
  `report_common_mean_ci("\nAverage Total Time:", 0.9, total_mean_exp1, total_mean_exp7, replications);.`

The Experiments and Results: The following table shows the results of the experiments (every experiment was replicated 100 or 50 times) by calculating 90% confidence intervals:

	EXPERIMENT 1&2	EXPERIMENT 3 (ARV)
Run 1	536.4345 ± 46.1803	504.3867 ± 33.8091
Run 2	484.3503 ± 38.3604	481.3414 ± 34.2247
Run 3	438.3666 ± 30.8107	484.8900 ± 35.0508
	EXPERIMENT 4&5	**EXPERIMENT 6 (CRN)**
Run 1	67.4351 ± 87.0000	73.2690 ± 8.0157
Run 2	42.4669 ± 70.4508	60.7041 ± 8.2600
Run 3	-7.1866 ± 70.9001	57.0343 ± 7.4935

Table 1 - Results of the Experiments

Using antithetic random variates the confidence interval increases by 13.7% in Run3 (!) to one side while it is reduced by 26.8% in Run1. Using common random numbers the results reduced about 88.3% to 90.8%. As the confidence interval for all three runs in experiment 4 and 5 includes negative numbers (a negative mean was computed in Run 3) the hypothesis can be rejected with the probability of a Type I error set to 0.05.

A whole simulation run took about 40 seconds on a 486DX-133 including the computation of all the results (which is very fast).

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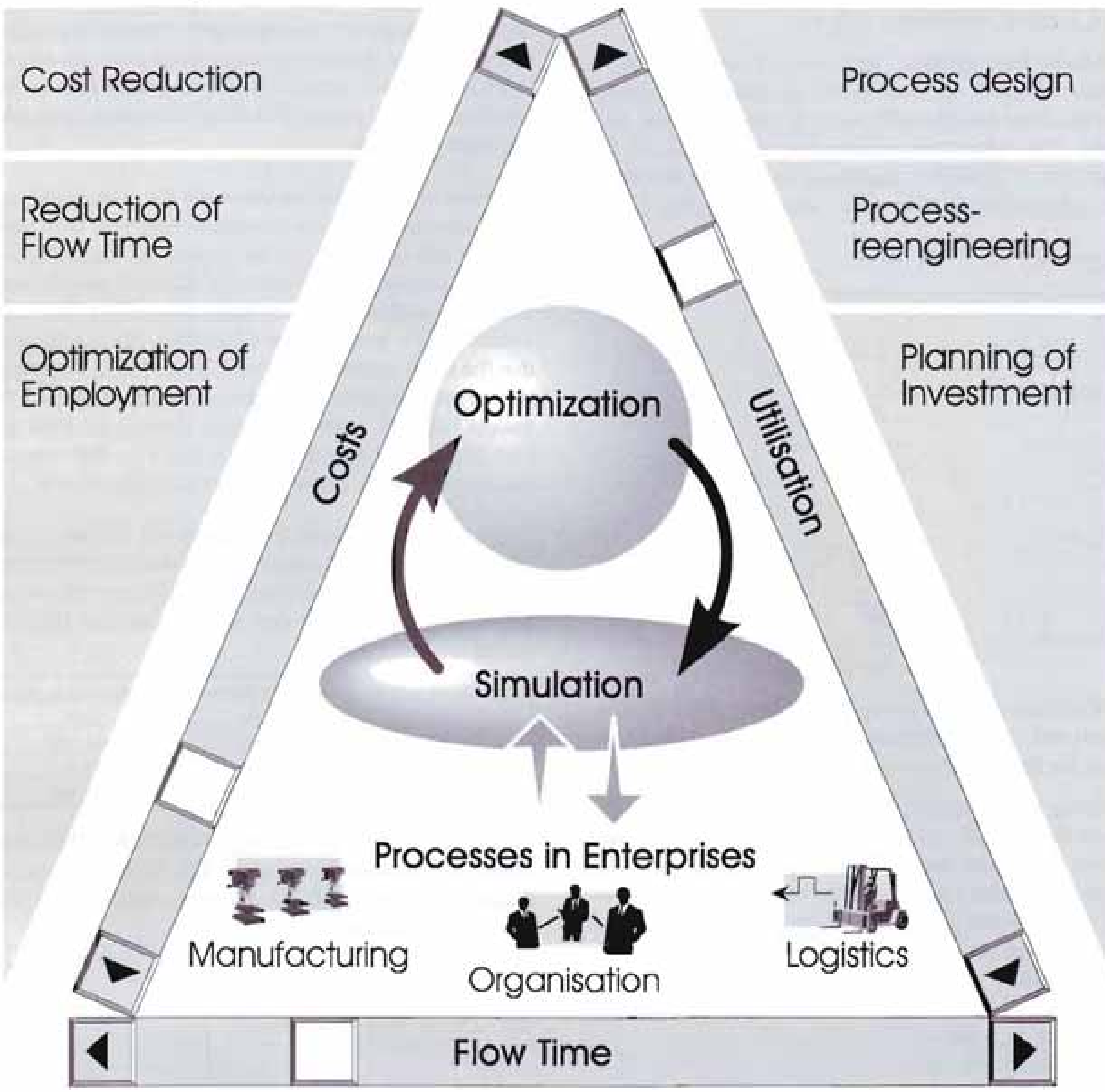

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Book Reviews

Parallel Computational Fluid Dynamics – Algorithms and Results Using Advanced Computers Proceedings of the Parallel-CFD-'96 Conference,
P.Schiano, A.Ecer, J.Periaux and N.Satofuka (Eds.)
Elsevier Science B.V., 1997, 516 pages
ISBN 0-444-82327-X

Computational Fluid Dynamics ranges among the most CPU intensive problems. When calculating models of a reasonable size very long computation times are encountered. To reduce these computation times more and more of these calculations are moved to parallel computers. The programming of parallel computers raises some special problems like load distribution and communication.

The book contains papers from the Parallel-CFD-'96 conference which took place in Capri on May 20-23, 1996. Its contents can be roughly divided into three parts: applications of fluid dynamics, numerical algorithms for the solution of the equations and implementation of these algorithms on parallel computers.

The applications range from "Climate Modelling" and aircraft design to "Turbulence" and "Reactive Flows". Among the chapters that deal with the algorithms are "Navier-Stokes Solvers" dealing with the implementation of the Navier-Stokes differential equations and "Implicit Schemes" that describe the solution of the Navier-Stokes and the Euler differential equations with implicit schemes. Among the chapters that deal mostly with parallelization specific issues are "Mesh Partitioning and Adaptive Schemes" that deals with the distribution of the computational domain to processors, "Software Tools and Environments" describing various languages and communication schemes for parallel computations and "Distributed Computing".

Most of the papers do not fall exactly into one of the three described categories and so do the chapters. Among the chapters that can't be assigned to one category are "Parallel Visualization and Postprocessing" about the visualization of the large data sets generated by CFD computations and "Parallel Applications" about the parallelization of some specific CFD problems.

This book gives an interesting overview to the current developments in the challenging field of Parallel Computational Fluid dynamics. It is in no way an introductory text to the fields it touches (Fluid Dynamics, Numerics, Parallelization). But to those with a basic knowledge and interest in these fields it can be a stimulating read.

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Models of Phase Transitions
Visintin A.
Birkhäuser Boston, 1996
ISBN 0-8176-3768-0, 322 + ix pages

The aim of the book is to give an overview on some current research problems concerning the subject of phase transitions in two-phase models and is especially dealing with the analysis of solid-liquid systems. It consists of two main parts which are subdivided into three and six chapters respectively.

The first part summarizes some well-known results in respect of nonlinear PDEs: After some general discussion about modeling of space-distributed systems the reader's attention is directed to initial and boundary value problems for some special classes of PDEs such as quasilinear and doubly nonlinear parabolic system descriptions. Consequently, variational techniques of L^p-type, integral transformations and convexity are debated in a strict mathematical manner.

The second part concentrates on phase transitions. An introduction to the Stefan problem in several space dimensions is followed by some generalizations like phase relaxation and phase transitions in multi-component systems. Here use is made of the results derived in the first chapters. The part concludes by pointing the reader's interest to more advanced problems which are under the author's current research: stable and metastable equilibria, phase nucleation and the Gibbs-Thomson law yield to the introduction of Sobolev spaces and the definition of a so-called two-scale Stefan problem.

The 9 chapters are completed by a spacious appendix (47pp.) which supplies some analytical tools to the interested reader by listing necessary definitions, theorems and proofs.

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Modellierung und Simulation im Umweltbereich
(in German)
Rolf Grützner (Editor)
Verlag Vieweg, ISBN 3-528-06940-6

"*Modellierung und Simulation im Umweltbereich*" is a collection of 16 contributions (all in German) about the methods from the field of modelling and simulation and about models used in environmental engineering. Because of the complexity of the systems and the lack of knowledge about relations between parameters new concepts are necessary. Some of them are fuzzy systems, neural networks, rule-based system descriptions and expert systems, qualitative simulation – in short, methods of modern computer science.

The starting contribution by R. Grützner gives an overview of terms and definitions, of application areas of modelling and simulation in environmental engineering, methods and tools as well as of problems and tendencies of development.

Chapter 2 by H.B. Keller treats rule based expert systems, fuzzy systems, evolutionary algorithms for optimization, and mechanical learning algorithms and their application based on selected examples. Chapter 3 by J. Gebhard and R. Kruse outlines the semantics of possibilistic networks in comparison to probabilistic networks. The basics of neural networks, their application and related simulation tools are discussed in chapter 4 by H.B. Keller. In chapter 5 A. Thuma et al. show how fuzzy Petri nets can be used for logging material and energy flow. R. Hohmann and E. Möbus introduce in chapter 6 the concept of qualitative simulation and their application to ecosystems.

Chapters 7 to 10 deal with applications in some selected fields of environmental engineering. L.M. Hilty describes in chapter 7 the project MOBILE, an application concerned with traffic systems. B. Page et al. examine in chapter 8 advantages and disadvantages of three software packages (E4CHEM, STELLA, EXTEND) for calculating the expansion of chemicals in the ground.

In chapter 9 N. Grebe shows the use of the simulation system SIMPLEX for regional planning. N.X. Thinh introduces the concept of integrative system analysis in chapter 10. In chapter 11 A. Sydow et al. report new approaches for expansion models. The documentation system ECOBAS for the documentation of ecological models is described in chapter 12 by J. Benz and R. Hoch.

The chapters 13 to 16 are concerned with fuzzy systems in modelling. G. Lutze and R. Wieland (13), P.W. Gräber (14), W. Paul (15), and D.P.F. Möller (16) use neuro-fuzzy-technologies and Monte-Carlo-simulation for environmental modelling.

This book on the one hand outlines the state of the art in many of the above mentioned fields and on the other hand introduces important concepts and approaches. It shall enable the reader to overlook the connections and the underlying concepts in order to choose an approach fit for a certain problem. Certain models, algorithms, and software tools are not described in detail, but there is a voluminous list of literature for this purpose.

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Simulation und Animation '97 (English / German)
O. Deussen, P. Lorenz (ed.), SCS-EUROPE 1996
ISBN 1-56555-111-7, 294+vi pages

Simulation and Animation'97 was the title of a congress held in Magdeburg in 1997. This book is a collection of the papers presented there. It reflects the main topics of that conference which involved discrete-event simulation, mainly with textual based - compiler oriented simulation packages and post simulation animation. Beside the traditional topics mentioned, the new area of World Wide Web based simulation including Java modelling and simulation is covered as a special topic.

The book is divided into 6 parts: WWW & VR-Tools, Modelling Techniques, Rendering and Animation, Tools and Applications, 3D-Modell Results and Simulation in Planning and Logistics. The invited lecture was given by Jim O. Henriksen.

In particular the papers covering Internet based simulation and those covering the discrete-event simulation software / packages themselves are worth mentioning, because of their innovative character in the German speaking area.

The congress proceedings can be seen as a reflection of discrete-event simulation techniques and an indicator for new trends in this area. It provides the reader with an overview of the wide range of possibilities included in this kind of simulation, and also a brief insight into problems and future developments in this area.

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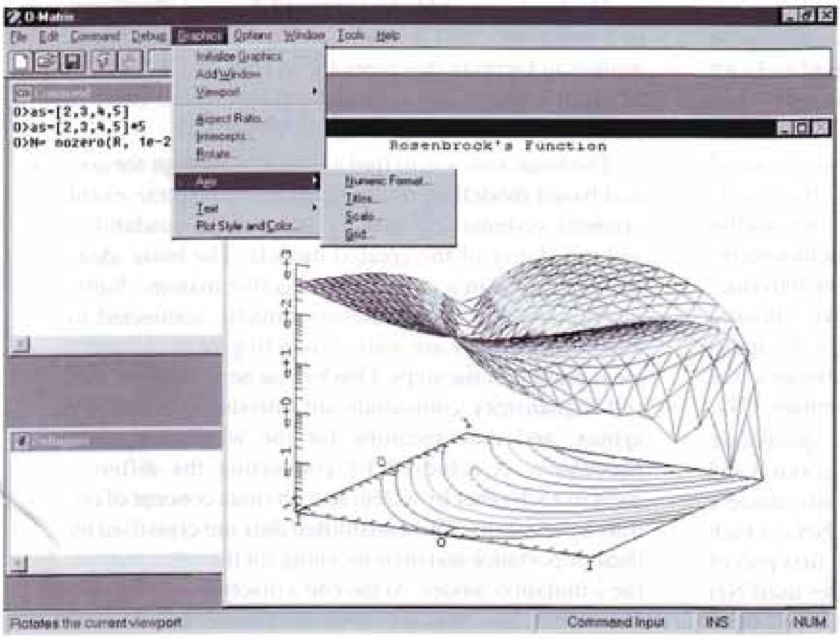

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Petri Nets – A Tool for Design and Management of Manufacturing Systems
Jean-Marie Proth, Xiaolan Xie
John Wiley & Sons, Inc., 1996
ISBN 0-471-96770-X, 288+x pages

Originally written in French (1994), this book is dedicated to the use of Petri Nets (PNs) for specifying, modelling and evaluating the performances of manufacturing systems. It is divided into two parts, the first presenting the theory of PNs, the second discussing the applications. Each chapter is clearly structured and a lot of examples, exercises and problems are added.

The book starts with a detailed introduction to PNs containing the basic definitions and some general analysis methods like incidence matrices, the coverability and reachability trees, and the coverability graphs. The first chapter also describes reduction methods for PNs (which cannot be found in every introduction to PNs) and some useful extensions like coloured PNs. The reduction methods are necessary for the applications of the book, not so the extensions because the authors have restricted themselves to elementary PNs.

The second chapter is devoted to the qualitative properties, well distinguished between behavioural and structural properties. There is fortunately also made a clear difference between the many types of Nets, which is important for the qualitative studies. The first part of the book ends with a description of the later used Net types, namely Event Graphs, Decomposable and Controllable PNs. All examples, comments and exercises refer to manufacturing systems and so the long first part (nearly two thirds of the book) is not only a general introduction but also a description of problems, etc. for the special subject.

In the second part the modelling, analysis and management of manufacturing systems with PNs is shown. These chapters are dedicated to the use of PNs for suitable models and no more problems of the PNs (models with conflicts, etc.) are discussed. First the authors describe models for the usual components of a manufacturing system like machines, transportation systems and automated buffers. These modules and the reduction methods are later used to develop complex systems, in particular cyclic and acyclic manufacturing systems. A very detailed chapter of solutions to the Exercises and Problems (75 pages) completes the book.

In summary it is both, a good introduction for beginners of PNs, whose interest is focused on problems like manufacturing systems, and a book with applicable methods for engineers, managers and designers, who already work with PNs.

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Konzeption einer deklarativen und zustandsorientierten Sprache zur formalen Beschreibung und Simulation von Warteschlangen- und Transportmodellen (Concept of a declarative and state-oriented language for the formal description of queuing and transport systems**) (in German)**
Peter Eschenbacher, SCS-EUROPE 1995
ISBN 1-56555-047-1, 261+xi pages

The book was published in the SCS series "Frontiers in Simulation". It is a reprint of the habilitation thesis written in German describes the syntax of SIMPLEX-MDL, the model description language which itself is part of the simulation package SIMPLEX II.

The main aim was to find a modular concept for textual based modelling and simulation of discrete-event oriented systems and thus to improve the readability and the clarity of the created models. The basic ideas are introduced in a simple but effective manner. Some mathematical examples are not directly connected to this field, but they are well chosen to give the reader a clear picture of the steps. One by one new concepts and self explanatory commands are introduced with their syntax, and their meaning for the whole language. Modularity is achieved by connecting the different parts to each other by a clear and obvious concept of entrances and exits. The transmitted data are classified by their importance and their meaning for the other parts of the simulation model. At the end a discrete event model description language has been developed, with a lot of possibilities for user defined extensions. The common interfaces between the modules make it very easy to define new toolboxes.

The last chapter gives the reader a practical view with common examples from the discrete-event world such as Petri Nets and the five philosophers problem. These examples are explained and the program listing is printed. Unfortunately, the five philosophers problem shows only a program listing, and no results are given. The basic goals of this example for the whole simulator package are described. Other examples including one out of the field of System Dynamics demonstrate the power of this programming language, including open interfaces to the rest of the simulation world.

This book itself gives the reader an impression of a programming / reference manual first – which it is not. The introduced concepts are very important. Regarding the field of graphical based discrete-event simulation tools, the developed language offers a wide range of possibilities for creating one's own tools after dealing with the whole package.

Markus Klug, Dept. E&E, University of Glasgow
email: m.klug@elec.gla.ac.uk

Postgraduate Research Programme: Modelling and Model-Based Design of Complex Technological Systems, University of Dortmund

Organisation and Structure: In general, postgraduate research programmes are temporary institutions which focus on interdisciplinary team work paying particular attention to the interactions fields of research which are not traditionally combined. At the University of Dortmund, the programme ”Modelling and Model-Based Design of Complex Technological Systems” was initiated in 1996. Its researchers come from nine different chairs of the university out of the Departments of Chemical Engineering, Electrical Engineering, Computer Sciences, Mechanical Engineering and Statistics. The postgraduate research programme is financially supported by the "Deutsche Forschungsgemeinschaft". There are currently eleven postgraduate researchers who are PhD students, one postdoctoral researcher and six associated researchers taking part in the programme. They are supervised by ten professors. Their work can be structured into four projects.

Objectives: Technical systems consist of numerous interacting components which are controlled locally, centralised or hierarchically by distributed computing systems and/or operator inputs. Examples of such systems are energy supply networks, process and manufacturing plants as well as distributed control and communication systems. Today, the design, the safe and reliable operation and the control of „widely“ distributed systems is still based on heuristics. Frequently, modifications and improvements result from extensive tests during the start-up and operating phase. This is associated with high costs and technical risks. Hence, a method for systematically developing, verifying and optimising widely distributed systems is urgently required. Adequate modelling is an indispensable basis.

Mathematical **modelling** and **simulation** of technical systems has already been in the limelight of intensive research. However, the analysis and design of large scale and widely distributed systems can only be tackled effectively by the innovative combination of available techniques and the improvement of existing tools. A compromise between the accuracy of the model’s components and a manageable complexity of the overall description has to be found. Thus, the application of exact and quantitative as well as qualitative modelling methods is required.

The postgraduate research programme aims to develop modelling paradigms and techniques for modelling complex systems, and intends to create appropriate tools to support the design, optimisation and verification of them.

Research Project 1: Functional Analysis of Distributed Systems. Correctness, dependability, maintainability and robustness are of fundamental importance for the productivity and the safety of plants or other safetycritical systems. The research project aims at the model-based and tool-supported design of complex distributed technical systems. The focus is mainly on the proof that the system fulfils the specified functional requirements.

Research Project 2: Modelling Complex Processes Using Fuzzy Logic. Often the underlying structure of a process to be modelled is unknown. In this case, methods that generate models from measured or simulated process data are needed. The potential of using a two-way fuzzy structure with positive and negative rules instead of a one-way structure in a series of different application areas are examined systematically. Furthermore, methods are investigated that teach Bayesian networks for fault diagnosis of complex systems.

Research Project 3: Modelling and Analysis of Hybrid Systems. This research project deals with the class of dynamic systems called hybrid systems which exhibit both discrete and continuous characteristics. It will be determined if purely continuous models can constitute an approximation of hybrid systems. In the first stage, continuous black-box models that approximately describe the causalities between the system’s inputs and outputs are derived from measured data. Wavelets are used as basis functions owing to their property to capture phenomena at different resolutions.

Research Project 4: Modelling of Distributed Production Systems. Enterprises are open and dynamic systems. The processes inside enterprises comply with the laws of the theory of evolution and probabilities. A range of concepts like segmentation of production, holons, fractional, extended and virtual enterprises have been developed in order to increase productivity, flexibility and quality. The elements in these decentralised and distributed structures are largely autonomous in their planning and control. As a result of this a concept for the organisation of structure and process both in and between these elements is needed. This concept should not be limited to technical aspects but should also include human factors, information, quality and management. Within this research field a concept for distributed production systems will be developed in three projects which concentrate on the points logistics, industrial engineering and quality management.

Further information at:
http://astwww.chemietechnik.uni-dortmund.de/~gkstips/ titel_e.html

Jörg Praczyk, Lehrstuhl für Elektrische Steuerung und Regelung, Fakultät für Elektrotechnik, Universität Dortmund, D-44221 Dortmund, Tel.: +49-231-755-4621, Fax: +49-231-755-2752, email: praczyk@esr.e-technik.uni-dortmund.de, http://astwww.chemietechnik.uni-dortmund.de/~praczyk/

Classes on Simulation

March 1998

10-11 **SIMPROCESS**. Camberley, U.K.
Contact: CACI Products Division, Suite 11, Coliseum Business Centre, Riverside Way, Camberley, Surrey GU15 3YL, UK, Tel:+ 44 1276 671 671, Fax:+ 44 1276 670 677

12 Seminar: ***"MATLAB und SIMULINK. Entwicklung und Anwendungen"***. TU Vienna, Austria
Contact: ARGESIM, TU Wien, Abt. Simulationstechnik, Wiedner Hauptstraße 8-10, A-1040 Wien, Tel: +43-1 58801 5374, Fax: +43-1 5056849, email: argesim@argesim.tuwien.ac.at

13 ***SIMULINK Kurs***. Gümlingen, Switzerland.
Contact: Scientific Computers, Franzstr. 107-109, D-52064 Aachen, Tel.: +49-241- 47075-0, Fax: +49-241-44983, email: info@scientific.de

16-18 ***Simulation mit SIMULINK***. Munich, Germany.
Contact: BAUSCH-GALL GmbH, Wohlfartstr. 21b, D-80939 München, Tel: +49-89 3232625, Fax: +49-89 3231063, email: 100564.302@compuserve.com

17 **COMNET Predictor**. Camberley, U.K.
Contact: CACI Products Division

17-18 ***Einsatz von SIMULINK in der Regelungstechnik***. Aachen, Germany.
Contact: Scientific Computers

18-20 **WinCrew workshop**. Worthing, UK
Contact: Rapid Data Ltd., Amelia House, Crescent Road, Worthing, West Sussex, BN11 1RL, UK, Tel: +44-1903 821266, Fax: +44-1903 820762, email: info@radata.demon.co.uk

18-20 **COMNET III.** Camberley, U.K.
Contact: CACI Products Division

20 ***MATLAB-Interaktives Arbeiten***. Gümlingen, Switzerland.
Contact: Scientific Computers

24 **COMNET Predictor**. Paris, France.
Contact: CACI Products Division

24-25 ***Simulation von Zustandsautomaten mit Stateflow.*** Aachen, Germany.
Contact: Scientific Computers

25-27 **COMNET III.** Paris, France.
Contact: CACI Products Division

26 "**Understanding simulation**" Lyon, France.
Contact: Jacqueline Gélinier, 1Point2, Tel.: +33 478231651

27 ***Control System Theory/Signal Processing***. Gümlingen, Switzerland.
Contact: Scientific Computers

April 1998

1-3 **Learning Simulation with Extend.** Lyon, France.
Contact: Jacqueline Gélinier, 1Point2

1-3 **MODSIM II.** Camberley, U.K.
Contact: CACI Products Division

3 ***MATLAB Programmierung***. Gümlingen, Switzerland.
Contact: Scientific Computers

17 ***SIMULINK-Kurs***. Gümlingen, Switzerland.
Contact: Scientific Computers

20-21 ***MATLAB-Kurs***. Munich, Germany.
Contact: BAUSCH-GALL GmbH

21 Seminar: "***Symbolic Computation (Mathematica, Maple, Derive, Dymola, Matlab) - Neuerungen, Anwendungen***". TU Vienna, Austria
Contact: ARGESIM

21 **COMNET Predictor**. Camberley, U.K.
Contact: CACI Products Division

22 Seminar: "***Graphische Modellbildung und Simulation diskreter Prozesse (Micro Saint***".
TU Vienna, Austria
Contact: ARGESIM

22-24 **Micro Saint course**. Worthing, UK
Contact: Rapid Data Ltd.

22-24 **COMNET III.** Camberley, U.K.
Contact: CACI Products Division

24 ***Objektorientierte Modellierung mit DYMOLA***. Munich, Germany.
Contact: BAUSCH-GALL GmbH

24 ***MATLAB-Interaktives Arbeiten***. Gümlingen, Switzerland.
Contact: Scientific Computers

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

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

28-29 ***Einsatz von MATLAB in der Regelungstechnik***. Aachen, Germany.
Contact: Scientific Computers

May 1998

5 **COMNET Predictor**. Herford, Germany.
Contact: CACI Products Division

6-8 **COMNET III.** Herford, Germany**.**
Contact: CACI Products Division

8 ***MATLAB-Programmierung***. Gümlingen, Switzerland.
Contact: Scientific Computers

11-12 ***Filterentwurf mit QuickFil.*** Munich, Germany.
Contact: BAUSCH-GALL GmbH

12-13 **SIMPROCESS.** Camberley, U.K.
Contact: CACI Products Division

14-15 ***ACSL, ACSL/MATH, Graphic Modeler***. Munich, Germany
Contact: BAUSCH-GALL GmbH

19 **COMNET Predictor**. Camberley, U.K.
Contact: CACI Products Division

20-22 **COMNET III.** Camberley, U.K**.**
Contact: CACI Products Division

25-27 ***Simulation mit SIMULINK***. Munich, Germany.
Contact: BAUSCH-GALL GmbH

25-29 **Mathematical Modeling and Digital Continuous Computer Simulation of Engineering and Scientific Systems** (Lecturers: Walter J. Karplus, Univ. of California, Los Angeles, and H. Jürgen Halin, ETH Zurich, Switzerland)
Contact: H.J. Halin, Tel: +41-1-632 4608 or +41-1-632 4603, Fax: +41-1-632 1166, email: halin@iet.mavt.ethz.ch, WWW: http://www.lkt.iet.ethz.ch/lkt/courses/

27 Seminar: "***Textuelle Modellbildung und Simulation diskreter Prozesse (GPSS/H, Proof Animation)***". TU Vienna, Austria
Contact: ARGESIM

June 1998

10-12 **Learning Simulation with Extend.** Lyon, France.
Contact: Jacqueline Gélinier, 1Point2

15-16 ***MATLAB-Kurs***. Munich, Germany.
Contact: BAUSCH-GALL GmbH

25 Seminar: "***Diskrete und kombinierte Modellbildung und Simulation mit Zustandsgraphen und System Dynamics***". TU Vienna, Austria
Contact: ARGESIM

October 1998

26-28 CCG-Kurs. ***Modellbildung und Simulation dynamischer Systeme*** (I. Bausch-Gall and F. Breitenecker). Oberpfaffenhofen, Germany.
Contact: Carl-Cranz-Gesellschaft e.V., Postfach 11 12, D-82230 Weßling, Fax: +49-8153 281345, email: ccg@dlr.de

Industry News

New Simulation Products from Rapid Data Ltd

Rapid Data Ltd is pleased to announce the release of two new Human Factors simulation products developed by Micro Analysis & Design.

WinCrew is based on the Micro Saint simulation engine. It is the ideal tool for constructing system performance models when a central issue is whether the humans and machine will be able to handle the workload. WinCrew can be used to predict operator workload for a crew for a given design concept. However, what makes WinCrew truly unique is its ability to model and predict the effects of that workload on crew and system performance. With WinCrew, you can predict how the human will dynamically alter behaviour when he or she encounters high workload situations. WinCrew can simulate the following as a function of high workload: dynamic allocation of tasks between humans, machines; dropping tasks based on task priority; task time and accuracy degradation.

The **Integrated Performance Modelling Environment (IPME)** is an integrated environment of models intended to help the Human Factors practitioner analyse human system performance. IPME provides: a more realistic representation of humans in complex environments; interoperability with other model components and external simulations; enhanced usability through a user friendly graphical user interface.

The key IPME features are: Environment Model, Operator Characteristics, Performance Shaping Functions, Prediction of Operator Performance (POP) Workload Measurement, Measurement Suite, Micro Saint Human Operator Simulator (MS HOS) Engine.

Rapid Data Ltd, 266 Amelia House, Crescent Road, Worthing, West Sussex BN11 1RL, Tel: +44 1903 821, Fax: +44 1903 820 762, email: ali@radata.demon. co.uk, Web Site: http://www.radata.demon.co.uk

ADI wins major contract award

Applied Dynamics International (ADI, Ann Arbor, MI) and United Defense Limited Partnership (UDLP, Minneapolis, MN) announced that ADI has been selected to provide a total of twenty-two SIMsystems to UDLP, in support of the Crusader System. UDLP is the prime contractor for the US Army for the Crusader, a two-vehicle armament system comprised of a self-propelled battlefield vehicle and a resupply vehicle. The value of the ADI contract is in excess of $3 million.

Applied Dynamics International provides hardware, software, and engineering services for embedded software developers and control system engineers. Since 1957, ADI real-time computer systems have been used extensively in advanced control system applications in the aerospace, defense, training, and automotive industries.

For further information, contact Steve Trombino, Applied Dynamics International, Inc., 3800 Stone School Road, Ann Arbor, Michigan 48108-2499, Tel: +1-313-973-1300, Fax: +1-313-668-0012, email: adinfo@adi.com, WWW: http://www.adi.com.

Calendar of Events

March 1998

29-31 ***Workshop der ASIM-Fachgruppe "Simulation in Umweltanwendungen"***. Witzenhausen, Germany
Contact: Prof.Dr.habil. Rolf Grützner, Universität Rostock, FB Informatik, Albert-Einstein-Str. 21, D-18051 Rostock, Tel.: +49-381-4983369, Fax: +49-381-4983426, email: gruet@informatik.uni-rostock.de, WWW: http://www.informatik.uni-rostock.de/FB/Praktik/Mosi/ak5/ak_info.html

April 1998

14-17 **EUROSIM '98.** 3rd EUROSIM European Simulation Congress. Helsinki, Finland
Contact: EUROSIM'98, Congress Secretariat, P.O.Box 1301, FIN-02044 VTT, Finland, Tel.: +358-9-456 4637, Fax: +358-9-456 6752, email: eurosim98@vtt.fi, WWW: http://www.eurosim.org/

21-22 **SIWIS'98.** *ASIM Workshop "Simulation in Wissens-basierten Systemen" der ASIM-Fachgruppe "Simulation und Künstliche Intelligenz"*. Paderborn, Germany
Contact: Prof. Dr. Helena Szczerbicka, Rechnerarchitektur und Modellierung, Univ. Bremen, D-28334 Bremen, , email: helena@informatik.uni-bremen.de, WWW: http://www.uni-paderborn.de/fachbereich/AG/agklbue/workshops

26-29 **ECEC98.** 5th European Concurrent Engineering Conference. Erlangen-Nuremberg, Germany
Contact: Philippe Geril, SCS European Simulation Office, University of Ghent, B-Ghent, Tel.: +32-9 233 77 90, Fax: +32-9 223 49 41, WWW: http://hobbes.rug.ac.be/~scs

May 1998

5-7 **MOSIS'98.** Modelling and Simulation of Systems. Swaty Hostyn
Contact: Jan Stefan, Department of Computer Science, FEEI VSB - Technical University, tr. 17. listopadu 15, CK-70833 Ostrava, Fax: +420-69-6919597, email: jan.stefan@vsb.cz, WWW: http://www.fee.vutbr.cz/UIVT/ism

13-16 **MS'98.** IASTED Int. Conf. on Modelling and Simulation. Pittsburgh, USA
Contact: IASTED Secretariat, Suite 101, 1811 West Katella Avenue, USA-Anaheim, CA 92804, Tel.: +1-714-778-3230, Fax: +1-714-778-5463, email: iasted@cadvision.com, WWW: http://www.iasted.com/

26-29 **PADS'98.** 12th Workshop on Parallel and Distributed Simulation. Banff, Canada.
Contact: Camille Sinanan, Tel: +1-403-220-6316, Fax: +1-403-284-4707, email: camille@cpsc.ucalgary.ca

June 1998

16-19 **ESM 98.** 12th European Simulation Multiconference. Manchester
Contact: Philippe Geril, Society for Computer Simulation, European Simulation Office, University of Ghent, Coupure Links 653, B-9000 Ghent, Tel.: +32-9-233-7790, Fax: +32-9-223-4941, email: philippe.geril@rug.ac.be, WWW: http://hobbes.rug.ac.be/~scs

16-19 **ITI'98.** 20th International Conference Information Technology Interfaces. Pula, Croatia
Contact: J. Marohnica, University Computing Centre, HR-10000 Zagreb, Croatia, Tel.: +385-1-616-5591, email: iti@srce.hr, WWW: http://www.srce.hr/iti

21-25 **Third St. Petersburg Workshop on Simulation**. St. Petersburg, Russia.
Contact: Viatcheslav B. Melas, Math.& Mech. Faculty, St.Petersburg State University, Bibliotechnaya sq. 2, 198904 Petrodvoretz, St.Petersburg, Russia, Fax: +7-812 186 63 15, email: slava@melas.niimm.spb.su

25 ASIM Workshop **"*Event Simulation – Verkehrs-simulation im Umfeld von Massenveranstaltungen*"**. Dortmund, Germany.
Contact: A. Graber, CSC Ploenzke AG, Binzmühlestr. 14, CH 8050 Zürich, Tel: +41 1 308 23 23, Fax: +41 1 303 11 80, email: agraber@cscploenzke.ch

July 1998

7-11 **1st IMACS Conference in Mathematical Modelling and Computational Methods in Mechanics and Geodynamics**. Prague, Czech Republic
Contact: Prof. Jiri Nedoma, Institute of Computer Science, Academy of Sciences, Pod vodarenskou vezi 2, CZ-18207 Prague 8, Tel.: +422-6605-3280, Fax: +422-8585789, email: nedoma@uivt.cas.cz

19-22 **SCSC'98. Summer Computer Simulation Conference**. Reno, USA.
Contact: SCSC'98 Secretariat, 4838 Ronson Court, Suite L., San Diego, CA 92111-1800, Tel: +1-619-277-3888, Fax: +1-619-277-3930, email: branch@sdsc.edu

19-24 **MASCOTS'98.** Int. Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems. Montreal, Cananda
Contact: Azzedine Boukerche, McGill University, School of Computer Science, School of Computer Science, Montreal, H3A-2A7, Canada, , email: azedine@cs.mcgill.ca, WWW: http://www.cs.mcgill.ca/~azedine

August 1998

23-25 **Intl. Workshop on "Advanced Simulation and AI"**. Bucharest, Romania
Contact: Philippe Geril, SCS European Simulation Office, University of Ghent, Coupure Links 653, B-9000 Ghent, Tel.: +32-9 233 77 90, Fax: +32-9 223 49 41, email: Philippe.Geril@rug.ac.be, WWW: http://hobbes.rug.ac.be/~scs/

September 1998

6-8 **SCSI workshop "Modelling and Simulation within a Maritime Environment"**. Riga, Latvia
Contact: Prof. Dr. Yuri Merkuryev, Dept. Modelling and Simulation, Technical University, 1 Kalku Street, LV-Riga, Latvia, Tel.: +371-7324480, Fax: +371-7820094, email: merkur@itl.rtu.lv, WWW: http://hobbes.rug.ac.be/~scs/conf/ew98riga/index.html

6-13 **European Summer School on Reliability and Safety of Human-Machine Systems**. Crete, Greece.
Contact: Virginia Bocci, Multimedia Lab, University of Siena, Via del Giglio 14, I-53100 Siena, Italy, email: school@media.unisiena.it, Fax:+39 577 298461, WWW: http://www.media.unisi.it/school

8-11 **ASRTP'98.** Process Control and Simulation. Kosice, Slovak Republic
Contact: Prof. Dr. D. Malindzak, Technical University of Kosice, dept. of Management and Control Engineering, SK-042 00 Kosice, email: asrtp98@ccsun.tuke.sk

15-18 **ASIM'98.** *12. Symposium Simulationstechnik.* Zürich
Contact: Ilona Deutsch, Institut für Werkzeugmaschinen und Fertigung, ETH Zürich, ASIM'98 Tagungssekretariat, Tannenstrasse 3, CH-8092 Zürich, Tel.: +41-1-632-2421, Fax: +41-1-632-1125, email: asim98@iwf.bepr.ethz.ch, WWW: http://www.iwf.bepr.ethz.ch/asim98/

15-17 **ASIS.** Advanced Simulation of Systems. Brno, Czech republic
Contact: Dr.Ing. Zdenka Rabova, TU FEI Brno, Bozetechova 2, CZ-Brno

October 1998

8-9 **Electronic Computers and Informatics**. Herlany, Slovak Republic
Contact: Dr.Ing. Milan Sujansky, Technical University Kosice, SK-042 00 Kosice

26-28 **ESS'98.** 10th European Simulation Symposium. Nottingham, UK
Contact: Philippe Geril, SCS European Simulation Office, University of Ghent, Coupure Links 653, B-9000 Ghent, Tel.: +32-9 233 77 90, Fax: +32-9 223 49 41, email: Philippe.Geril@rug.ac.be, WWW: http://hobbes.rug.ac.be/~scs/

December 1998

13-16 **WSC'98.** 1998 Winter Simulation Conference. Washington, D.C.
Contact: John Carson, AutoSimulations, 1355 Terrell Mill Rd.., Bldg. 1470, Suite 200, Marietta, GA 30067-9482, Tel.: +1-770-955-1501, Fax: +1-770-955-1592, WWW: http://www.wintersim.org/

March 1999

8-10 **7th Symposium "Simulation for managerial decision support"**. Braunlage, Germany
Contact: Prof.Dr. Wilhelm Hummeltenberg, Universität Hamburg, Institut für Wirtschaftsinformatik, Max-Brauer-Allee 60, D-22765 Hamburg, Tel.: +49-40-4123 4023

April 1999

7-9 **UK Sim 99.** Fourth United Kingdom Simulation Society Conference. Cambridge, U.K.
Contact: Prof. Russell Cheng, Canterbury Business School, The University, GB-Canterbury, Kent CT2 7PE, Tel.: +44-1227-823665, Fax: +44-1227-761187, email: R.C.H.cheng@ukc.ac.uk

20-22 **BioMedSim'99.** 1st Conference on Modelling and Simulation in Biology, Medicine and Biomedical Engineering. Noisy-le-Grand, France
Contact: Prof. Dr. Yskandar Hamam, Groupe ESIEE, Cite Descartes, BP 99, 2 Bld Blaise Pascal, F-93162 Noisy le Grand Cedex, Fax: +33-1 45 92 66 99, WWW: http://www.esiee.fr/~hamamy/bioconf.html

September 1999

21-24 **ASIM 99**. *13. Symposium Simulationstechnik*, Weimar.
Contact: Prof. G. Hohmann, Bauhaus-Universität Weimar, D-99421 Weimar, Tel: +49-3643 584 250, email: hohmann@ informatik.uni-weimar.de

February 2000

2-4 **3rd MATHMOD.** International Symposium on Mathematical Modelling. Vienna, Austria
Contact: Prof.Dr. Inge Troch, TU Wien, Wiedner Hauptstrasse 8-10, A-1040 Wien, Tel.: +43-1-58801-5367, Fax: +43-1-586 29 59, email: inge.troch@tuwien.ac.at

ARGESIM

ARGE Simulation News (ARGESIM), located at TU Vienna, is a non-profit working group disseminating information on simulation, organising activities in the area of modelling and simulation, publishing journals and books, and providing support for EUROSIM and ASIM administration.

ARGESIM maintains WWW-servers for EUROSIM, ARGESIM and ASIM. The structure and addresses of these servers have been changed in February 1998. Entry for ARGESIM information is now

`http://www.argesim.org/`

The old address will be maintained until the end of 1998.

Individual subscriptions to SNE may be ordered via WWW at

`http://www.argesim.org/sne/subscribe.html`

The price is ATS 120.- per year.

EUROSIM - Simulation News Europe

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

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