SIMULATION NEWS EUROPE

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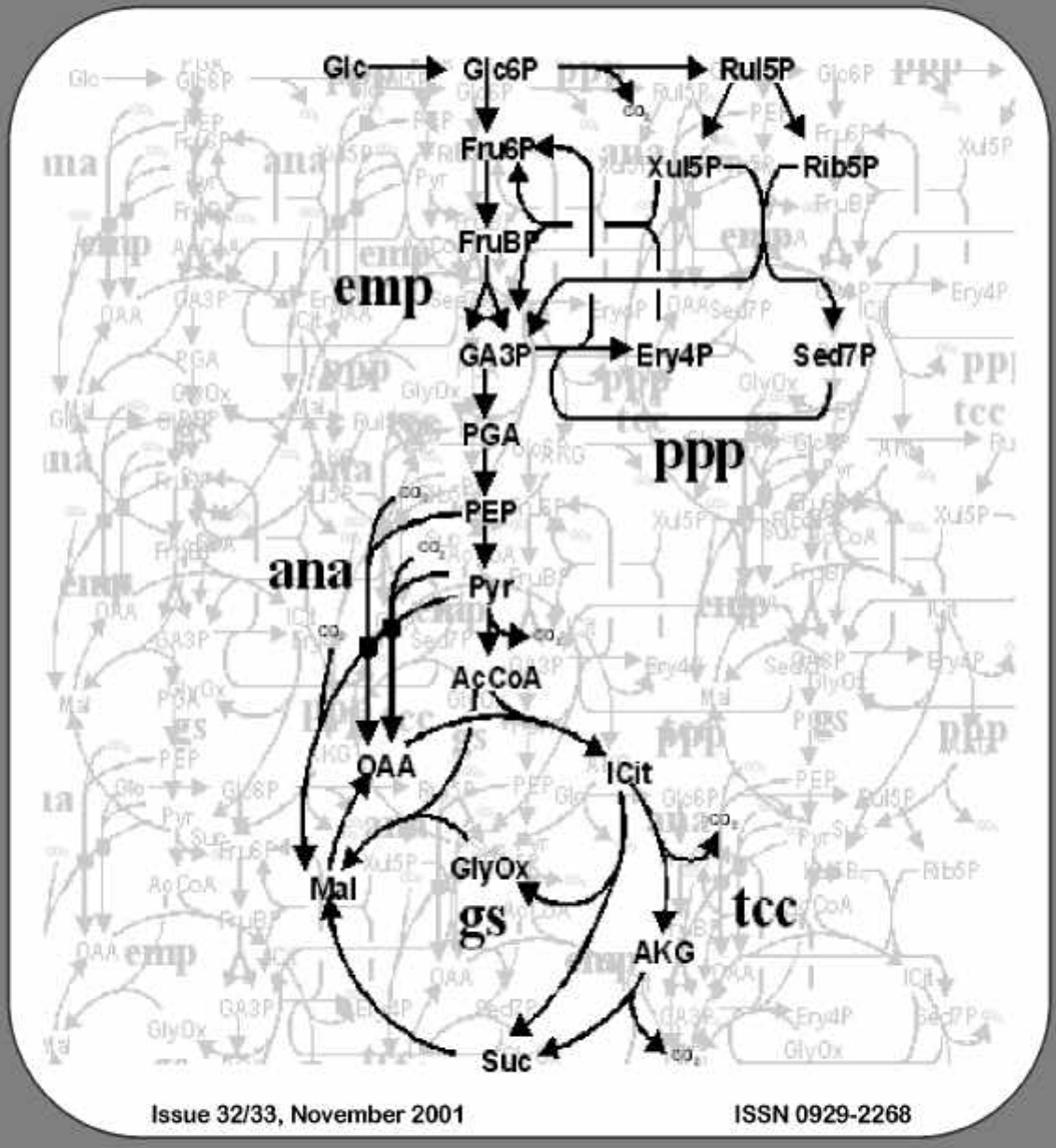
A European Forum on
Development in Modeling and Simulation



Issue 32/33, November 2001 ISSN 0929-2268

A EUROSIM Publication

Published by ARGESIM

in Cooperation with SCS EUROPE

INTRO

News Flash

- **Three Technical Notes:**
  Metabolic Modelling – Melecular Modelling – Discrete Event Graphs
- **Four Short Notes:**
  Zadeh's Concept of Definability – Idenitification in Pharmacokinetic Models –
  Neural Model for Alzheimer Disease –
  Grids for Meteorological Models
- **New** Comparison C14 Supply Chain Management
- 10 Comparison Solutions
- 16 Book Reviews
- New Societies
- And Much More …

Aims & Scope

The journal SNE - **S**imulation **N**ews **E**urope – is intended i) to inform about new developments in modelling and simulation and ii) to report about news from European simulation societies and events from International Simulation Societies and Simulation Groups all over the world. SNE is the also the official membership journal of EUROSIM and SCS Europe.

SNE reports in the *News Section* about EUROSIM, EUROSIM societies, SCS Europe and about other International Simulation Societies and Simulation Groups. A calendar of simulation conferences, industry news, etc. concludes the *News Section*.

SNE's *Archive Section* publishes technical notes and short notes on general overviews or new developments, new software and hardware, new applications and methods. Furthermore SNE presents *Simulation Centres,* introduces *Simulationists* and reviews t recent books on modelling and simulation and related topics. SNE's special series *Comparison of Simulation Technique and Simulation Software* (ARGESIM Comparisons) gives a comprehensive overview on developments in application and implementation.

Parts of SNE can be also found on the web. News from societies are published at EUROSIM's web server (www.eurosim.info). Contents, archive and an evaluation of the Comparisons are available at www.argesim.org/SNE/.

All contributions are selected and may be edited. For news publication, please contact a member of SNE's News Editorial Board (p. XLIV), for publication of technical notes short notes, etc. please contact a member of SNE's General Editorial Board (p.68) or the Editor-in-Chief.

Editorial

Dear readers,

*This is the second double issue with new layout, more than 110 pages information on modelling and simulation. From now on, **SNE** will appear two times a year, a single issue in March, and a double issue in November, with more pages than before.*

In this issue we could emphasise on new developments in methods and applications. Three technical notes and four short notes cover a broad area, from metabolic and molecular modelling to discrete event systems, from meteorological simulation via pharmacokinetic identification to simulation of neural structures (Alzheimer's disease) and Zadeh's new concept of Definability. We have to thank all authors for their efforts.

A new comparison, C14 Supply Chain Management, is defined in this issue, and ten new solutions show, that the comparisons have become a standard for benchmarks. We invite our readers to take this challenge and to send in solutions.

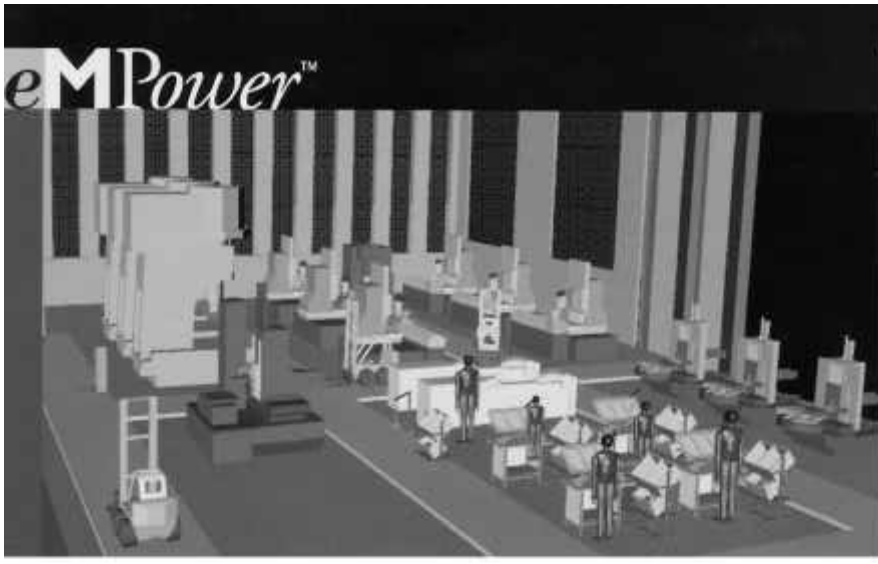
*Modelling and simulation is dealt with not only in simulation societies. More and more developments take place in simulation groups of "application societies". Consequently **SNE** continues to introduce simulation activities from "application societies". This issue reports on societies in biomedical engineering, OR, fluid dynamics, etc.*

*In order to improve comfortable reading and searching in **SNE**, we introduced in this issue a "summary at a glance" for each technical note and short note (in grey boxes). Furthermore, improved headings for societies, groups, and industry news with short name, long name and web address and full addresses at the end support searches of any kind.*

Felix Breitenecker, editor-in-chief
Felix.Breitenecker@tuwien.ac.at

Impressum

SNE Simulation News Europe ISSN 1015-8685 (0929-2268).
Scope: Information on development in modelling and simulation, membership information for European simulation societies and for SCS Europe, comparisons on simulation techniques
Editor-in-Chief: Felix Breitenecker, (ARGESIM),
c/o Dept. Simulation Techniques, Vienna University of Technology, Wiedner Hauptstrasse 8-10, A-1040 Vienna, Austria
Layout: C. Kiss, EDV Dienstleistungen, www.kiss-edv.at, A-7000 St.Georgen,
Printed by: Offsetdruck Sexl, www.sexl.at, Hauptstraße 18, A-7000 Eisenstadt, Austria
Publisher: ARGE Simulation News (ARGESIM), Gröhrmühlg. 8, A-2700 Wiener Neustadt, and ASIM (Arbeitsgemeinschaft Simulation, c/o Wohlfartstr. 21b, D-80939 München



e-Manufacturing Solutions

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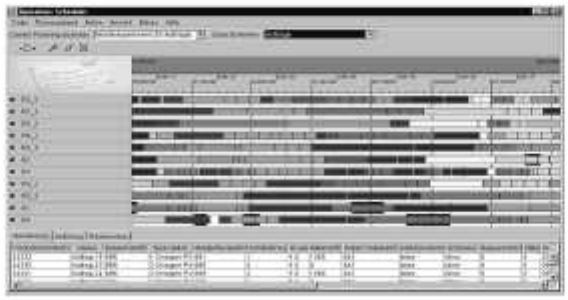
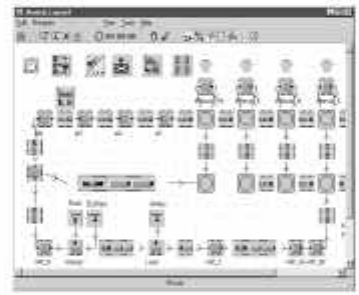
eM-Plant is the simulation tool for visualization, planning and optimization of production and logistics

eM-Plant allows simulating and optimizing production lines in order to accommodate different order sizes and product mixes. Object-oriented technology and customizable object libraries are used to create well-structured hierarchical simulation models that include supply chain, production resources and control strategies as well as production and business processes. Extensive analyse tools, statistics and charts enable you to evaluate different manufacturing scenarios and to make fast and reliable decisions in the early stages of production planning.





Benefits:

- Maximize productivty of existing production facilities by 15-20%
- Reduce investment of planning new production facilities by 20%
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- Optimize system dimensions, including buffer sizes
- Reduce investment risks by early proof of concept
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TECHNICAL NOTES
Modelling and Simulation of Metabolic Networks

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…. shows basic principles of modelling of cellular metabolism resulting in the general metabolic structure (GMS)
…. sketches briefly modelling and simulation tools
…. discusses problems in metabolic modelling, i.e. in model validation,
…. outlines new developments (database-driven validation, automatic model variation, etc.

Regulation of Metabolic Networks

The metabolism of a microbial, plant or animal cell consists of more than thousand chemical reaction steps that take place in a narrow reaction chamber, the cell. Not all these reactions proceed with the same reaction rate. On the contrary, there is a small number of reaction steps composing the central metabolism (figure 1), which takes over the majority of the metabolic fluxes.

The main pathways in the central metabolism are the well-known glycolysis (**emp**), citric acid cycle (**tcc**), pentose phosphate pathway (**ppp**) and some more pathways. Any single glucose molecule taken up by the cell must first pass the reactions of the central metabolism before it enters the branched network of biosynthetic reactions.

Every single reaction step is catalyzed by a specific biocatalyst, an enzyme. Enzymes are proteins whose amino acid sequence is encoded in the DNA. Up to 50% of the cell mass consists of enzymes. The rate of an enzyme catalysed reaction depends on the total amount of the catalyst in the cell (i.e. the number of the corresponding protein macromolecules), its activity and also on the concentration of the metabolised substance, the reaction substrate.

A sophisticated regulatory architecture guarantees that the metabolic fluxes in the network are directed according to the requirements of cellular growth. The regulatory mechanisms are partly implemented on the enzymatic level: Each enzyme is not only influenced by its substrate but usually also by many other substances in the metabolic network. For example allosteric enzymes can be switched on or off by specific chemical substances in a reversible way. These substances are called activators or inhibitors respectively.

By these mechanisms the material flux in the network is controlled depending on the current requirements. Due to the tight coupling of the network it represents a very complex dynamical system.

As an example, a simple network is depicted in fig 2 in which a substance **C** inhibits its own supply from **A** and **B** (end product inhibition). The reaction **u** then proceeds with a rate that is necessary for the synthesis of its successive components. Furthermore, enzymatic reactions can be coupled to energy production or consumption, which is managed in the living cell by the co-factor substances ATP and NADH.

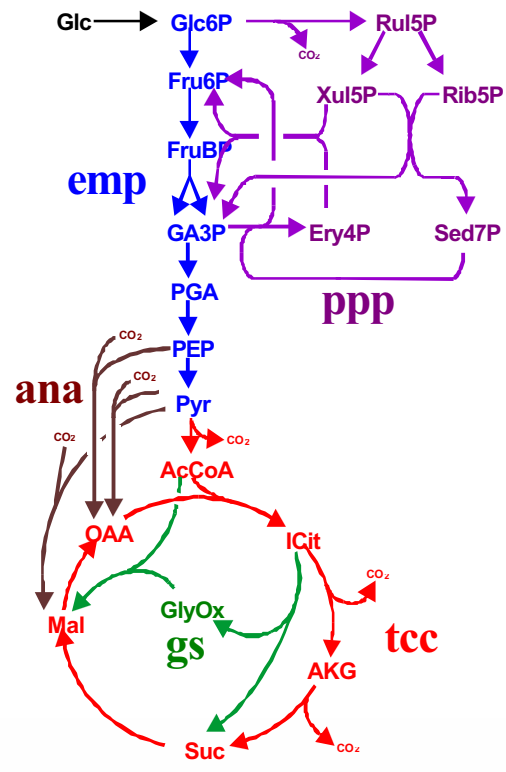

Fig. 1: Central metabolic pathways of a typical cell

Goals of Metabolic Modelling

Mathematical modelling and simulation of metabolic networks has been done for several decades. But nevertheless – driven by the availability of more and more detailed biological knowledge – it is of increasing importance.

The following main application domains of modeling can be distinguished:

1. Within the field of biotechnological production of chemicals, the aim is the targeted improvement of the metabolic capabilities of the microorganisms used in the process. This gave rise to the scientific discipline of metabolic engineering in which first of all modeling and understanding of the central metabolism is of interest.
2. In medicine, the main aim of modeling is the understanding of metabolic diseases, signal cascades which amplify a weak chemical signal in several steps, and the study of the influence of pharmaceuticals on the metabolism
3. Finally, modelling is an important tool for the functional understanding of cellular systems within basic biological research as the complex regulation of the architectures can no more be understood in an intuitive way. In particular, the models are important for the design of experiments and their evaluation.

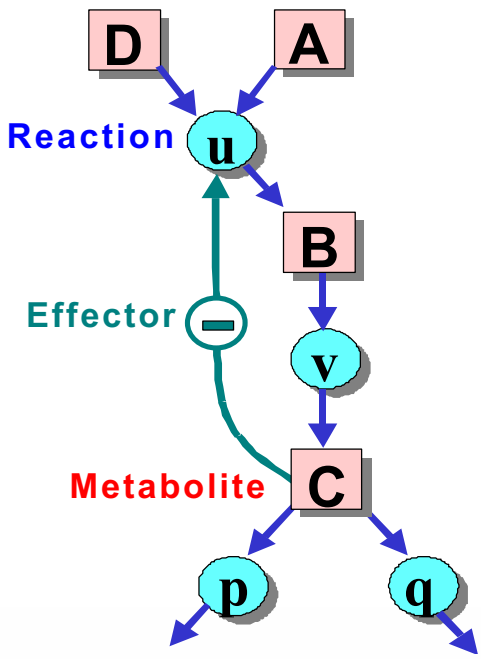

Fig. 2: Structure of a metabolic network, represented by a bipartite graph extended by interaction arcs.

Idealizing Assumptions

Abstractions and simplifications play a very important role when modeling biological systems in order to achieve a manageable complexity of the models and a proper balance between unknown parameters and available measurement data. Usually, the following effects are neglected in cellular models although exceptions for each case exist in the literature [14]:

1. Cell cycle: Each single cell has a cell cycle which means that a cell division takes place from time to time. This cell cycle certainly has an effect on metabolic fluxes inside the cell, which leads to a population inhomogeneity. Nevertheless, this effect is neglected because no meaningful measurement data is available as a basis for model validation. Likewise biological rhythms in higher cells are neglected.
2. Cell morphology: Higher cells frequently do not grow as single cells but within a cellular tissue or a mycele as in the case of fungi. It is well known that cellular metabolism varies depending on the role of the single cell within this cellular arrangment. However, like in the case of the cell cycle, few measurement data is available to build a model on it.
3. Concentration gradients: Higher cells can reach a diameter of up to one tenth of a millimeter so that intracellular concentration gradients can no more be neglected. However, this would lead to very complex reaction - diffusion models with distributed parameters on the one hand and almost no significant data on the other hand. But also the complex spatial structures within a cell can lead to local concentration inhomogeneities. This is particularly the case for so-called channeling and macromolecular crowding phenomena.
4. Genetic regulation: The metabolic regulation is not the only regulatory structure in a cell because not only the metabolic fluxes are regulated but also the enzyme concentrations. This is done by the overlaid genetic regulation network which is only partly known today. However, genetic regulation takes place at a much larger time scale than metabolic regulation so that the assumption of time scale separation is justified on the short time scale and enzyme concentrations can then be assumed to be constant.
5. Stochastic effects: If the number of molecules of a specific substance in a single cell becomes very low chemical reactions take place in a more and more stochastic way. This can be the case for signaling pathways and genetic regulation mechanisms. For metabolic processes the assumption of large numbers is usually justified.

Leaving out any of these assumptions, the arising model complexity would become too large to validate the arising models. Moreover the computational complexity of distributed or stochastic models would become prohibiting for simulation.

At the current state of research, this still excludes very ambitious holistic modeling approaches, which do rely on only a few basic principles but have a lot of unknown parameters.

If the assumptions listed above are justified the modelling of cellular metabolism can be based on an average cell which might have spatial compartments (Fig. 3). Within each of these compartments, all chemical substances are homogeniously distributed, i.e. there are no concentration gradients.

All molecules of the same kind in one compartment are then united to a metabolite pool. Between the pools exist metabolic fluxes, which are driven by the chemical reactions and also by transport steps between the various cellular compartments.

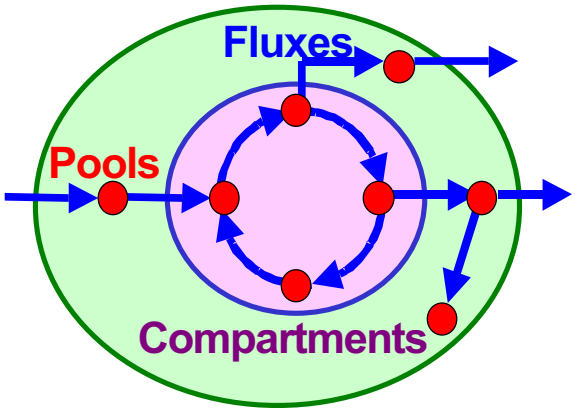

Fig. 3: Idealized model of cellular metabolism by spatial compartments and homogeneously distributed metabolite pools connected by the fluxes.

General Model Structure

Based on this very simple representation of the cell, a metabolic model can be inferred directly from the structure of the underlying metabolic network and its inner regulatory structure.

Figure 2 shows an example. The metabolic network is represented by a generalized directed bipartite graph with round nodes for the chemical reactions and rectangular knots for the metabolites.

A regulatory relation like the influence of the metabolite C on the reaction step u can be additionally indicated by an interaction arc. The model is now set up as follows:

1. Mass balance:
   To each metabolite node in the network a balance equation is assigned which means that the change of the pool size equals the difference between all in-fluxes and out-fluxes.
2. Reaction kinetics:
   To each reaction node a reaction kinetic term is assigned. This is an algebraic expression for the reaction velocity as a function of all concentrations of the participating substances. These can be the concentrations of the reaction substrates but also the concentrations of activators, inhibitors, co-factors and the reaction products.

In summary, the following fictive model structure may result for the metabolic example-network given in figure 2 No notational difference is made here between substances and their concentrations:

Reaction kinetics:

$$u = u_{\max} \cdot \frac{A}{A + K_A} \cdot \frac{D}{D + K_D} \cdot \frac{K_I}{C + K_I},$$

$$v = v_{\max} \cdot \frac{B}{B + K_B},$$

$$p = p_{\max} \cdot \frac{C}{C + K_C}, \qquad q = q_{\max} \cdot \frac{C}{C + L_C}$$

Stoichiometry:

$$\begin{pmatrix} \dot{B} \\ \dot{C} \end{pmatrix} = \begin{pmatrix} 1 & -1 & . & . \\ . & 1 & -1 & -1 \end{pmatrix} \cdot \begin{pmatrix} u \\ v \\ p \\ q \end{pmatrix}$$

In the formula the balance equations, which are always linear with respect to the fluxes, are written in matrix notation. The matrix herein is called stoichiometric matrix of the system. It represents the network structure without the regulatory interactions, which in turn are expressed by the reaction kinetic terms.

Any metabolic network model can thus be represented in the following general metabolic structure [5]:

$$\dot{\mathbf{X}} = \mathbf{N} \cdot \mathbf{v}, \qquad \mathbf{v} = \mathbf{v}(\mathbf{á}, \mathbf{S}, \mathbf{X}) \qquad \text{(GMS)}$$

Here, X is the vector of the balanced substance concentrations, N is a stoichiometric matrix, v is the vector of all metabolic fluxes, α is the vector of all reaction kinetic parameters and S is the vector of the external influencing substrates.

The theory of enzyme kinetics [1] implies a formalism by which the reaction kinetic term of an enzyme can be derived from its functional principle.

This formalism always produces rational expressions with respect to the various concentrations. The parameters of the expressions must be determined from an enzyme kinetic experiment. They are collected in several existing databases [12].

Modelling and Simulation Tools

A few prominent examples of metabolic models illustrate their typical complexity:

- Already in 1984, Domach et al. published a model for a single cell of Escherichia coli with 23 differential equations and 89 reaction parameters [2].
- In 1996, Rizzi et al. built a model for the yeast Saccharomyces cerevisiae which contains 97 differential equations [11].
- Currently, the E-CELL project of Tomita et al. is becoming popular: It represents the organism Mycoplasma genitalium by using 85 differential equations for the metabolic network. Additionally, a model for the genetic regulation of the cell was produced [13].

These examples already show that powerful tools are required to support the modeling process. Several tools with different emphasis on graphical or textual model input, data base support, simulation, systems analysis or evaluation of experiments have been developed in the last decade. Only a few can be mentioned here: GEPASI [10], E-CELL (also being a modeling tool) [13], DBSolve [4], ProMod [9], MMT [8].

The simulation model generated by such tools always has basically the general structure (GMS). This nonlinear system of differential equations is typically stiff because reactions with strongly varying time constants take place in the network. Nevertheless, standard integrators for stiff systems can easily manage even large biochemical reaction networks with reasonably short computation times (e.g. 1 sec for a system of fifty equations for 1 min of simulated time).

Other frequently applied numerical techniques are concerned with the analysis of stationary states. In particular algorithms for stability or oscillation analysis, sensitivity analysis, continuation or bifurcation analysis is implemented in several existing tools.

As opposed to the simple ODE structure of the general model (GMS) tools for metabolic modeling may also support more sophisticated structural concepts. They can be guided for example by a unit decomposition based on the biological function [9] or hierarchical modular structures like e.g. pathway decomposition.

Clearly, model input can be done with different types of graphical notations, formal languages, or a menu driven data base interface. An XML-based standard for model exchange is currently been proposed with BSML [7]. Another important issue for metabolic modelling is data base connection for the available enzyme kinetic and pathway data bases [12].

Problems of Metabolic Modeling

Based on the overview given above the impression may arise that models for metabolic networks can be generated almost automatically from the available data for chemical reaction kinetics.

Model generation from metabolic data bases is indeed one of the goals of current bioinformatics research. Nevertheless, the major problem remains the validation of metabolic networks based on experimental in-vivo data. This problem is explained in the following with a prominent example.

One of the most important reaction steps in central metabolism is the phosphofructokinase (PFK) step with the substrate fructose-6-phosphate and the product fructose-1,6-phosphate. The energy co-factors are ATP and ADP.

Additionally, a vast amount of inhibitors and activators are published for the single reaction step. A total of more than 30 substances can be taken from the literature, which – potentially – influence the reaction rate of PFK in the living cell !

This illustrates the first big problem of metabolic modeling: In order to achieve a manageable model complexity, the modeler must decide which effectors of an enzyme he considers to be relevant. All other regulatory relations must be neglected to keep the model simple.

Even if the number of effectors is restricted the problem does not become much simpler. For example, if the only PFK effectors considered are ADP and AMP and the product is assumed to have no influence then the following reaction kinetics can be found in [6]:

$$v_{PFK}(F6P, ATP, ADP, AMP) = v_{\max} \cdot \ldots$$

$$\cdot \frac{ATP}{ATP + K_{ATPS}\left[1 + \frac{ADP}{K_{ADPC}}\right]} \cdot \frac{1}{1 + \frac{L_O}{\left[1 + \frac{F6P}{K_{F6P}}\right]^8}} \cdot \ldots$$

$$\cdot \frac{F6P}{F6P + K_{F6PS} \cdot \frac{1 + \frac{ATP}{K_{ATP1}} + \frac{ADP}{K_{ADP2}} + \frac{AMP}{K_{AMP2}}}{1 + \frac{ADP}{K_{ADP1}} + \frac{AMP}{K_{AMP1}}}}$$

Without the need to understand this term in detail, it becomes evident that even for the small number of effectors, eleven different kinetic parameters appear. Values for these parameters can be taken from the literature or from databases.

However, great care must be taken because the published values may vary. For instance, the K_{F6P} parameter, which is the most important one of the named eleven parameters, is assigned 10 different values in [3].

These values differ within one order of magnitude because their experimental determination depends on the presence or non-presence of further effectors, which cannot even be detected in the living cell with current measurement instruments.

Finally, the proportionality factor $\square_{max}$, which preludes the reaction kinetic formula plays an exceptional role. This factor corresponds to the enzyme activity that is proportional to the current amount of active biocatalysts in the living cell. This amount depends on the physiological state (e.g. growth, product formation, starvation) of the cell and is determined by the genetic regulation network.

For this reason, this parameter can never be taken from databases and it might have different state-dependent values. Experimental data from in-vivo experiments with whole cells are required to determine these parameters. Alternatively an additional model for the genetic regulation of the cell has to be formulated which will lead to even more unknown or uncertain parameters.

Data based model validation

It becomes immediately clear that the validation of such complex non-linear models with a large number of difficult to determine parameters is still an open problem. On the other hand, there is a continuously growing amount of data corresponding to the unknown model parameters.

This growing database can be used directly or indirectly to support the model discrimination and validation process [14]:

1. The genome of many organisms is now known, in which the protein structure of any enzyme is coded.
2. The transcriptome allows observing part of the genetic regulation network.
3. The proteome contains data about the concentration of enzymes in the living cell.
4. Huge databases for reaction kinetics are available which are based on in-vitro experiments with isolated enzymes.
5. Metabolic flux analysis allows quantifying all intracellular metabolic fluxes in a stationary growing cell without making assumptions about reaction kinetics.
6. The metabolome consists of concentration measurements of intracellular substances within a living cell. These concentrations can also be measured in rapid sampling experiments, which produce 5 measurement values per second, which enables to follow dynamic transients in the cell.

Based on these measurement data and database information, several research teams are currently working on methods to generate valid metabolic models in a systematic way and to determine the parameters.

The development of methods and tools for this goal is also a great challenge for the development of modelling and simulation methods. Nevertheless it must be emphasized that the expertise of the modeler is still the most important source for the development of good models.

Emerging Tools

Some basic methodological approaches should be briefly sketched to give an impression of the emerging computational challenges [14].

1. Automatic model variation:
   From the above explanations it becomes clear that not one single model should be developed for a metabolic system but rather a large family of structurally similar models has to be investigated.

The number of models within the family combinatorially grows with every design alternative considered. The process of simulation and sensitivity analysis for large families of models should be automated by making extensive use of network computing technologies.

2. Model exclusion:
   Clearly, it is very important to exclude as many models as possible from the model family, which do not sufficiently well describe the data. Methods based on linearised models, interval calculations, qualitative simulation or order of magnitude considerations might help to facilitate this operation.
3. Parameter fitting:
   Although the fitting of models to data is a long-known problem and many different parameter fitting algorithms exist, there is still no guaranteed solution. If the model fits the data well most of the commonly used algorithms will be able to find a solution with more or less computing time.
   On the other hand, if the model does not fit, it cannot be decided whether this might be a fault of the algorithm. In particular, due to the simplifying assumptions made for all metabolic models mentioned above, it can never be expected that any model at all will perfectly fit the measured data. Consequently, appropriate measures of fitness must be formulated and treated computationally to better suit the problem of metabolic modelling.
4. Model simplification:
   If a simple model is able to describe the measured data as well as a more complex model it certainly should be preferred.
   Different model simplification approaches exist which are based on time scale separations, linearisations or canonical model structures. However, no automated simplification algorithm is currently available.
5. Experimental design:
   If the available experimental data is not sufficient to determine all the parameters of a model or to discriminate between equally well performing model alternatives a new experiment should be designed.
   Because such experiments can take an extraordinary effort of up to one-man year, experiments must be designed very carefully. Several methodologies for optimal experimental design (even in the non-linear case) and model discrimination exist. However, they are currently limited to rather small models and the computational effort for large models generally explodes with the number of the variables under consideration.

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Simulation of Thin Film Formation

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.... gives an overview about basic computational methods, Molecular Dynamics calculation (MD) and Kinetic Monte Carlo calculations (KMC)
…. discusses advantages / disadvantages of these methods, including stepsize problems, etc.
…. introduces a new method, combining MD and KMC, and shows their advantages

Introduction

Thin film formation and especially the growth of single crystal films on a single crystal substrate is a wide field with many practical applications. Deposition on a single crystal can lead either to island growth or layer-by-layer growth. In the first case no epitaxial growth can be achieved, as the individual islands will generally have different crystal orientation with respect to each other. On the other hand the possibility to grow a film in a layer-by-layer fashion (epitaxial growth) is of great technological interest [1].

For layer-by-layer deposition on a single crystal we can distinguish between homo-epitaxy, if the substrate and the deposit are identical, and hetero-epitaxy, if the deposit is different from the substrate. In the following we will mostly speak about homo-epitaxy or crystal growth by molecular beams (MBE), where the surface is directly bombarded by thermal or low energy atoms.

Numerical methods to study the microscopic theory of crystal growth involve mainly the following basic methods:

- Molecular Dynamics (MD)
- Kinetic Monte Carlo calculations (KMC)

Both techniques take the actual crystal structure and also the atomistic processes such as surface diffusion, deposition and desorption into account.

Other more simple crystal growth models, like those based on the so-called solid-on-solid (SOS) approximation will not be discussed. For a short discussion of such models and a detailed discussion of the MD technique and the KMC method in thin film growth seethe paper by M. Kotrla [2].

Molecular Dynamics (MD)

In Molecular Dynamics the evolution of a system of N mutually interacting particles (atoms) is calculated by numerical integration of the classical equations of motion.

Thus MD allows in principle to describe the true dynamics of a system assuming the validity of classical mechanics. The technique can be described as follows:

1. Set-up of a crystal lattice (usually an fcc lattice for metals) with N atoms.
   N is ranging typically from 1000 – 10000.
   Add one more particle above the crystal moving with a given speed towards the crystal surface.
   This atom will be deposited, if its energy is only a few eV or thermal. It will cause surface erosion (sputtering) at higher energies.
2. Set-up of the classical equations of motion for all particles using a suitable interaction potential.
   This gives 3(N+1) second order differential equations.
3. Integrate these equations with a fast integration method, like the Verlet scheme, Leap-frog scheme or a predictor-corrector scheme [3].
   This gives the evolution of the system with time and at given time intervals a new particle can be released from above the surface, leading to film formation or surface erosion.

Essentially the only physics input is the proper choice of the interaction potential. For metals simple Morse potentials have been used in the past, while nowadays many-body potentials, like the so-called embedded-atom potentials (EAM potentials) are used [3,4]. The latter potentials can give a much more accurate description of a metal crystal and are typically fitted to cohesive energy, lattice constant and elastic constants of the metal to be modelled.

In calculations involving deposition or erosion one has to apply periodic boundary conditions in the lateral directions (normal to the direction of the incoming particle). In this way a particle can be deposited at the surface and after a certain time another particle is started above the surface at a randomly chosen lateral position.

This leads to the growth of a thin film or erosion, at low or high particle energy, respectively. In the case of deposition the nature of the film (island formation or layer by layer growth) can be studied. In the case of erosion the developing surface roughness (topography) is investigated.

Thin film growth is strongly dependent on crystal temperature. Thus the crystal has to be heated initially to the given target temperature. This can be done by positioning the atoms at their ideal lattice positions and giving them randomly chosen initial velocities according to the Maxwell Boltzmann velocity distribution.

There is another important point, which has to be taken into account. Even in the case of a purely thermal deposition beam, an atom will arrive at the surface with a kinetic energy of a few eV. This energy gain is due to the decrease in potential energy if an atom is added to a crystal. The same amount of energy is necessary to remove an atom from the crystal surface and bring it infinitely far away (cohesive energy). Now let us assume we have a lattice consisting of 5 layers with 400 atoms per layer at room temperature (RT) and we deposit 5 layers, i.e. 2000 atoms.

Thus we will have added an amount of energy in the order of a few keV or a few eV / atom to the crystal, which means we have heated the crystal to a temperature most likely well above the melting point or even causing evaporation. Of course in a real experiment the crystal is much larger (in the order of 10^{23} atoms) and the added energy (heat) will diffuse into the crystal bulk and can be ignored. Thus in our MD simulation we have to couple the bottom of the crystal to an infinitely large heat reservoir (heat bath) using for example the Langevin formalism [5].

An important point is the time step in such calculations. Calculations are usually not done at 0° K but at a given temperature. In a metal typical oscillation frequencies of atoms around their equilibrium lattice position are in the order of $10^{13}s^{-1}$. Therefore to properly describe these oscillations a time step in the order of 1 fs (10^{-15} s) has to be chosen. If the surface is hit by an energetic particle the time step has to be further reduced.

As a rule of thumb, the time step should be small enough, such that the fastest moving particle does not move further than about 2% of the lattice constant. Without applying a heat bath the system conserves energy and energy conservation is a good criterion to check, if the chosen time step is sufficiently small.

Usually a number of more technical tricks [3,6] are applied, like truncating the interatomic potential to a maximum distance of 1 – 2 lattice constants (typically 0.5 – 1.0 nm) and using neighbourhood lists, to speed up the calculations. In this way times up to 1 ns (corresponding to 10^6 integration steps) can be performed on a workstation in a few hours of cpu time (for a typical crystal size of a few thousand atoms).

Sputtering, i.e. bombardment of a crystal with energetic (keV) particles can be simulated in this way.

The calculations show that the energy of the incoming particle spreads out to the target atoms so fast, that after a few ps no atom will have a kinetic energy of more than 1eV.

Such energy is sufficiently low to prevent an atom from leaving the surface, as it has to overcome a surface binding energy (essentially the covalent energy which holds the crystal together). Thus one can stop the calculations after a few ps and start a new one for a different impact point to obtain statistically significant information on the emission process in the limit of zero fluence.

For deposition we can do a quick estimate of the deposition rate in the following way: If we want to deposit 5 monolayers (ML) within a few hours of cpu time, using a time step of 1 fs, the total calculation time should not exceed 1 ns. Assuming we use a crystal with a surface of 400 atoms, then we have to deposit 2000 atoms for 5 ML. Thus if we deposit them in 1 ns we have to deposit a new atom every 0.5 ps. With a typical layer distance of 0.3 nm we then obtain deposition rates of 5x109 ML/s or 1.5 m/s. This is a deposition rate, which is by a factor of at least 107 higher than what can be achieved in any experiment.

The main problem is the fact that during such a fast deposition all diffusion processes at the surface, with typical activation energies in the order of a few tenth of an eV will be suppressed at RT, as they occur rather on a time scale of μs and not ps. Special problems, such as the influence of energetic deposition as compared to thermal deposition, have been studied [7], but it is obvious that the results obtained in such a way have to be interpreted very carefully.

Kinetic Monte Carlo (KMC)

KMC is a special variant of ordinary Monte Carlo (MC). In ordinary MC one calculates the average value of some quantity of interest in a given equilibrium thermodynamical ensemble [6]. States in a space of configurations are generated, but the sequence of states does not correspond to a possible evolution of the system with time.

In a typical Metropolis MC algorithm, virtual displacement of atoms are used, which do not correspond to a possible real dynamical development of the system.

Kinetic MC is a procedure for solving kinetic equations. Its aim is to reproduce faithfully nonequilibrium or a relaxation process. The emphasis in this method is on a correct possible time evolution of the system.

Let us look how we can describe diffusion of adatoms. In figure 1 possible diffusion steps for an adatom on a (100) surface of an fcc lattice are shown.

An isolated ad-atom (1), which sits in a local minimum of potential energy, has 4 possibilities to jump to a neighbouring minimum as indicated by the arrows. In each case it has to overcome the same potential barrier height E_b, which for a metal is typically a few tenth of an eV. For any other direction, like jumping directly over a neighbour atom the energy barrier is much higher and we can ignore these cases.

The actual barrier for such a jump can be calculated using MD, if the interaction potential is know. It can be shown that under thermal equilibrium such an event occurs with a rate (jumps/s), which is given by

$$k(E_b, T) = k_o \exp(-E_b / k_b T)$$

where kb is the Boltzmann constant and T the temperature of the target. k_o can be interpreted as an attempt frequency, i.e. the frequency an atom is oscillating around its equilibrium position at a given temperature and is as discussed before in the order of $10^{12} - 10^{13}$ s-1. From this we see that for a typical value of E_b = 0.3 eV at 100K there will be only one jump every 25000 s, i.e. we have frozen out surface diffusion; on the other hand at 300 K we have about 107 jumps / s.

Other possibilities are shown in figure 1, like the case of 2 or 3 neighbouring ad-atoms, where of course due to the additional bonds we will have a higher energy barrier for a jump. For 4 neighbours we have no possibility for diffusion. In addition, processes like jumping up or down a step have to be taken into account with their respective energy barriers. Taking into account that a singe ad-atom can jump into 4 directions, but an ad-atom with 3 neighbours only into one direction, one can calculate for each possible event its rate (or probability per unit time). Thus in a crystal with a free surface we can look at all possible diffusion events, which can take place, like the hopping of an ad – atom.

We can now study the evolution of this system with KMC. The way of solving it is similar as in a thermodynamical MC (Metropolis) calculation. Making random choices a Markov chain is created. However, this chain presents now a possible evolution of the system.

Let N be the number of all possible events (hopping of an ad-atom, jumping down a terrace…), in a given configuration C. The rates of these events are R_i, i = 1,…, N. Of course both N and the set $\{R_i\}$ will depend on the current configuration C. The total rate Q will be

$$Q = Q(C) = \sum_{i=1,N} R_i$$

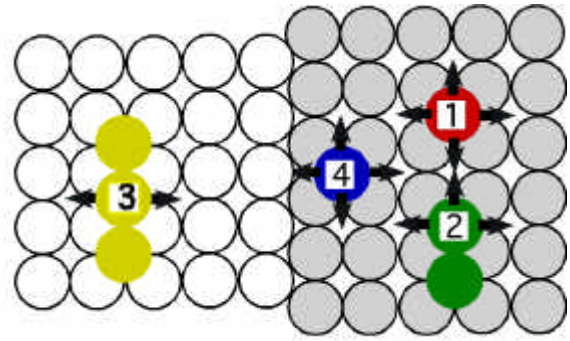

Figure 1. A (100) surface with a step (grey atoms) and ad-atoms (in color).
An isolated ad-atom (1) can jump with equal probability into 4 directions, as the potential barriers are equal. An ad-atom (2) with one nearest neighbour ad-atom can jump only in 3 directions and the potential barrier will be higher. The situation is similar for an ad-atom with two (3) or three next neighbour ad-atoms. An ad-atom with 4 next neighbour ad-atoms cannot move. In addition the ad-atom near the step (4) will experience a larger barrier height for jumping down as compared to remaining on the terrace. This is the so-called Ehrlich- Schwoebel barrier.

A simple algorithm for KMC is now the following:

1. Select the largest rate R_{max} of all possible events in C and create a list of relative probabilities $P_i = R_i / R_{max}$.

Now in each time step do the following:

2. Select a possible event i with P_i, which is compatible with the configuration C.
3. Choose a random number r with uniform distribution in [0,1].
4. Compare r with the probability P_i of event i. If $r < P_i$ then the event takes place and a new configuration C' is created and go to step 1, else remain in state C and go to step 2.

This algorithm can be very slow, if there is a large difference of many orders of magnitude between different events. In this case a low probability event will be selected and then rejected in most cases in step 4.

Faster algorithms exist and can be implemented. One possible choice (even not the fastest) is the Bortz – Kalos - Lebowitz (BKL) algorithm [8], in which the following 4 steps are repeated for each time step:

1. Choose a random number r with uniform distribution in [0,Q(C)].
2. Find the corresponding event, by selecting the first event s for which $\sum_{i=1,s} R_i > r$.
3. Event s takes place resulting in a new configuration C'.
4. Calculate the number of possible events N' and the rates R_i' for the new system and return to 1.

Let us now consider that so far we really were just following a possible chain of events. No real time was defined, but rather a number of time steps. Under the condition, that the events are Poisson distributed and all physical processes can be separated, so that in any time instance only one event takes place, it was shown that a time can be introduced [9].

The time interval τ between two successive events (waiting time) is a random variable with the following distribution $P(\tau) = Q \exp[-Q\tau]$, with Q being the total rate as defined above. Thus after choosing a random number r with uniform distribution in [0,1] the time interval Δt_i to the next event will be $\Delta t_i = -\ln[r]/Q$.

Thus we can follow the evolution of a system for a given time and then deposit a new particle at the surface and again continue with KMC for a given time. Actually this process of deposition can be also included as a process occurring with a given rate, like ad-atom diffusion.

In this way using KMC a large amount of simulations have been carried out and homo-epitaxial growth has been studied for different surfaces [10,11]. There is however one major problem still associated with such a calculation. Deposition is not always occurring at thermal energies (vapour deposition) but quite often sputter deposition or in addition to thermal deposition also more energetic atoms with energies of a few ten eV are deposited simultaneously (beam assisted deposition). The reason is, that the addition of energetic atoms to the deposited flux can have a considerable influence on the properties of the growing film as for example island versus layer-by-layer growth [12.13].

But even in the case of a purely thermal deposition an atom being deposited will arrive at the surface with energy of a few eV. This is the same amount of energy, which is needed to remove an atom from the surface (surface binding energy, cohesive energy). Thus during the time in the order of a ps the region around the impact point will become quite hot and cannot be treated properly by KMC. This problem has been well recognized in KMC studies of deposition. It sometimes has been dealt with in the following way (funnelling): The incoming atom will select within a predefined radius around its impact point the lattice position for which the total energy is a minimum.

Combined Code

We have recently started to implement a combined MD-KMC code, described in the following:

1. MD calculation for a crystal at a given temperature during deposition of a single atom for a time t_{MD}. t_{MD} will depend on the energy of the deposited atom. In the case of thermal deposition a calculation time of 1 ps or even below is sufficient.
2. At the end of the MD calculation all atoms receive their next nearest ideal lattice positions. If t_{MD} is too small and the lattice has not fully relaxed, a lattice position might be occupied by either 2 or 0 atoms. An algorithm was developed to take care of this problem by extending or shrinking the lattice at this position.
3. Now a KMC calculation is started for a time t_{diff}, which can be up to seconds. Compared to an MD calculation for a few ps the used cpu time in an KMC calculation for seconds will still be small, at typical barrier heights of a few tenth of an eV and temperatures not too much above RT. The reason is that a diffusion step will occur on the ns – ms time scale and not on the fs time scale as in MD.
4. The lattice at the end of the KMC step is heated up in an MD calculation to the target temperature and the next atom is deposited (back to step 1).

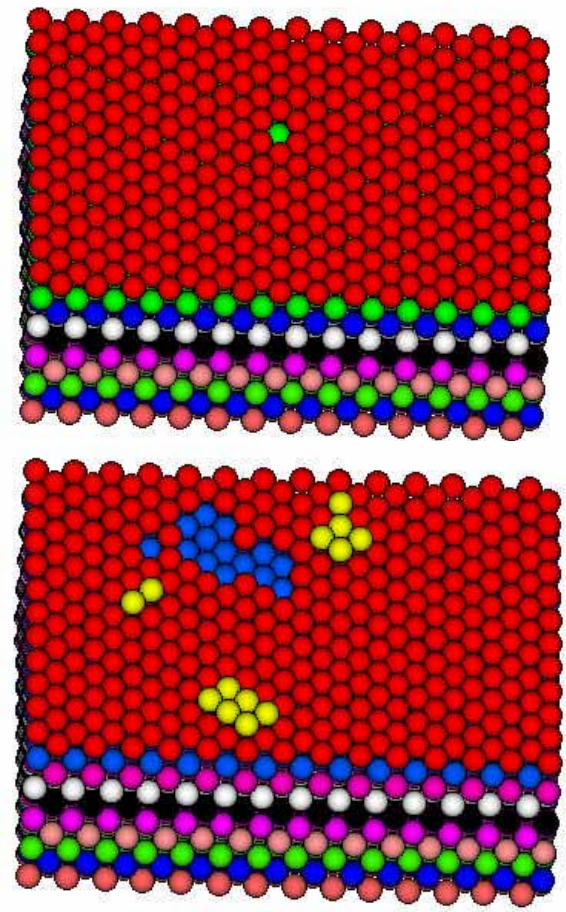

Figure 2. A 600 eV Cu atom impinges on a Cu(100) surface (red atoms) and a total of two Cu atoms are emitted. If the KMC part of the calculation is performed for a long time (t_{diff} = 1s) the surface will anneal and only one vacancy remains as shown in the upper figure. However for a short diffusion time of $t_{diff} = 10^{-3}$ s vacancy islands (blue) and ad-atom islands (yellow) remain (lower figure).

The influence of the KMC timescale is illustrated in figure 2 for the case of an energetic bombardment event. A 600 eV Cu atom hits a Cu(100) surface and in the course of the slowing down of the particle two Cu atoms are emitted from the surface. This leaves in principle only one surface vacancy as seen in figure 2 (upper figure), where we had set the diffusion time t_{diff} in the KMC part to 1 s.

The lower part of figure 2 shows the result after a KMC calculation of only 1 ms. As one can see, we now have a large vacancy island consisting of 12 vacancies and a single vacancy. As there is of course again only 1 atom emitted we have now 3 surface adatom islands of size 2, 5 and 6.

Thus for continued erosion the developing surface topography can be studied depending on the deposition rate.

As an example for deposition we will demonstrate the effect of the energy of the deposited particles on the smoothness of the growing film.

Figure 3 shows the influence of the kinetic energy of the deposited atoms for the deposition of close to 5 monolayers (ML) Cu on Cu (100) at 100K.

The thick black curve is added as a reference for an ideal layer by layer growth which can be achieved for thermal deposition at 300K and t_{diff} = 1 s. Inspection of figure 3 shows for this curve, that only after the first monolayer is completed (720 atoms) the next ML starts to grow and this continues ML for ML.

Performing the same calculation at 100K (red) and also with a diffusion time t_{diff} = 1 s we see that atoms are becoming deposited in the 2nd layer already after the first ML is only completed for about 50% and this effect continues with growth.

After completion of the 4th ML, the 5th ML is already completed to 50% and about 1/7 of a ML is in the 6th ML.

Indeed what happens is, that at 100 K thermal diffusion is frozen out and it does not matter if t_{diff} is varied from 10^{-11} s to 10 s; we obtain always the same result.

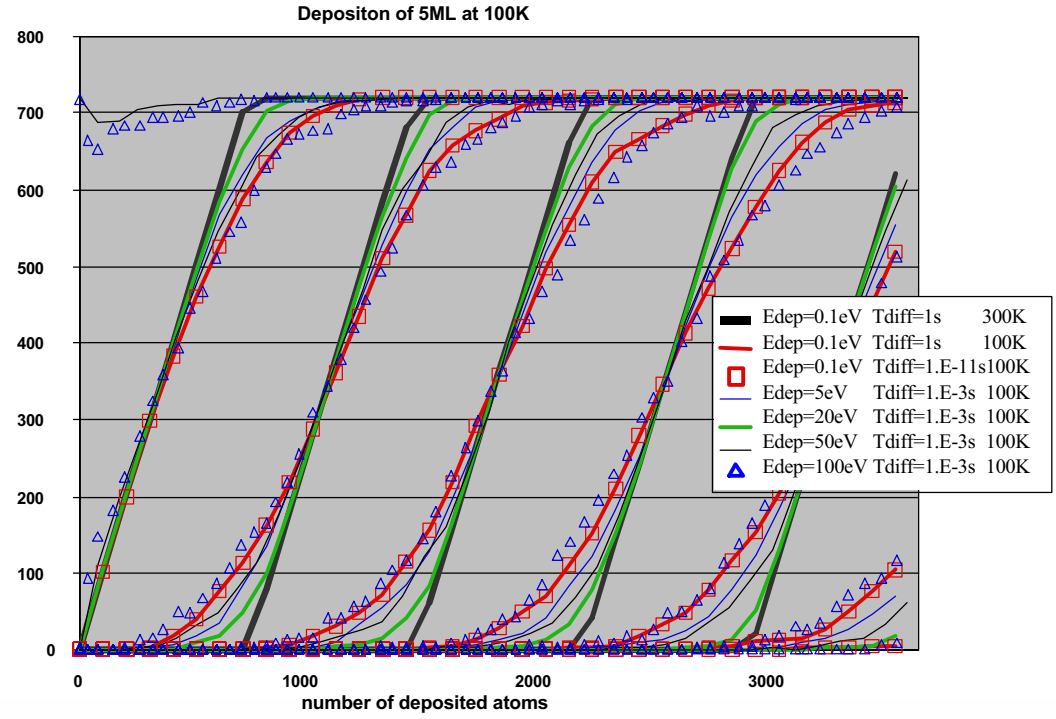

Figure 3. Influence of the kinetic energy of the deposited atoms for deposition of 5 ML of Cu on Cu(100) at 100K. The thick black curve is a reference curve for ideal layer by layer growth at 300K and t_{diff}=1s

This can be changed by increasing the energy of the deposited atoms (beam assisted or sputter deposition). Results are shown for $t_{diff} = 10^{-3}$ s and an energy of the deposited atoms of 5, 20, 50 and 100 eV.

Inspection of the figure shows that at 5eV the deposition is much closer to a layer-by-layer deposition as for thermal energies.

The best results are obtained for 20 eV, while at higher energies the deposition becomes less good (more rough), due to the increased damage done by the impinging atoms.

The ideal energy of 20 eV indicates that at this energy atoms in the neighbourhood of the impact point receive enough energy do allow diffusion processes fast enough during the time of a ms to anneal the lattice.

On the other no severe damage is done to the lattice at these low energies.

Finally two snapshots of the lattice after deposition of about 5 ML for $t_{diff} = 1$s and thermal deposition as compared to $t_{diff} = 10^{-3}$ s and an energy per atom of 20 eV are given in figure 4.

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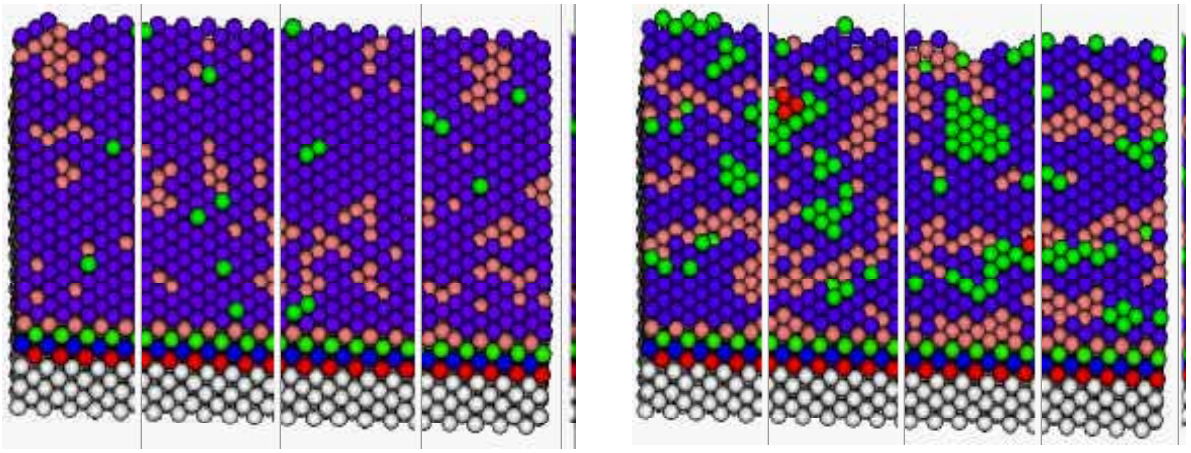

Figure 4. Deposition of 5 ML of Cu on Cu(100). The figure to the right is for thermal deposition and the left figure for energy of 20 eV per atom. In both cases $t_{diff} = 10^{-3}$ s and the target temperature is 100K. The original target atoms are white, deposited atoms are in colour. The fifth ad-layer is blue. For energetic (20 eV) deposition only a few atoms (green) are starting to form the sixth layer, while for thermal deposition already 4 atoms (red) are in the 7th layer and much more atoms (green) are already in layer 6

Discrete Event Programming with Simkit

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.... introduces modelling and simulation with SIMKIT, a JAVA-based OO-simulator (free at web)
…. makes use of event graphs for modelling of discrete processes (DES models)
…. addresses education in discrete simulation and OO – techniques or JAVA

Introduction

This paper is a brief introduction to the use of **Simkit**, a software package for implementing Discrete Event Simulation (DES) models. Simkit is written in Java (for any operating system with Java 2™).

Simkit adopts DES as its fundamental worldview and does not directly implement other worldviews such as process / resource. Although this makes certain simple models slightly more complex, a pure DES worldview provides more flexibility and modelling power than a pure process-oriented worldview.

Event Graph methodology is sufficiently powerful by itself to represent any model that can be captured by the DES framework. In particular, every model that can be represented in the process worldview can also be represented in a pure DES world view; the reverse is not true.

The remainder of this paper is organized as follows. First we will discuss Simkit's implementation of the Event List, then the primary templates for constructing simulation components, the SimEntity interface and the SimEntityBase class. Next, we show how Simkit starts and stops simulation execution, followed by a simple example. Following a brief description of the listener patterns used in Simkit, we present more examples. Then we show how Simkit implements two advanced features of Event Graph modelling, cancelling edges and passing parameters to events, with illustrative examples for each. Finally, Simkit's random variate generation framework is briefly discussed.

Event List Implementation

All DES frameworks require an implementation of a Future Event List (FEL) to operate.

Simkit implements a FEL in a class called simkit.Schedule that consists entirely of static methods and variables. The Schedule class has a variable representing the FEL using a Java class called java.util.-SortedSet, which contains objects of type SimEvent. Each SimEvent object contains data on which event it represents and what time it is scheduled to occur.

The SortedSet object uses a Comparator based on a sequence of criteria, the first being the scheduled time. In cases of ties, the SimEvent object can be given a priority.

Simkit attempts to hide the details of the FEL from the simulation modeller. Instead of directly placing events on the FEL, the programmer invokes the wait-Delay() method on an instance of simkit.SimEntity-Base, as described in the following section.

The execution of the event consists of a callback from Schedule to the SimEntity instance that originally scheduled it.

SimEntity and SimEntityBase

Simkit provides an abstract class and an interface to help encapsulate the Future Event List activities (scheduling events and processing events).

The SimEntity interface specifies a set of methods that must be implemented by any class designed to interact with the FEL and with other simulation objects. SimEntityBase is an abstract class that implements most of the functionality for interacting with the FEL. Recall that there are just two constructs in Event Graphs: the event (node) and the scheduling edge (Schruben, 1983).

Each event in a Simkit model is implemented as a user-defined "do" method in a subclass of SimEntity-Base. A "do" method is simply a method starting with the string "do".

Scheduling edges are executed using a method called "waitDelay()" that had various signatures. The simplest has signature (String, double), where the first argument is the name of the event (without the "do") and the second argument is the amount of simulated time between when the event is scheduled and when it occurs, that is, the delay associated with scheduling that event. The boolean edge condition is implemented by wrapping the waitDelay() call in an "if" test.

For example, the basic Event Graph construct (Schruben, 1983; Buss, 2001), is shown in fig. 1.

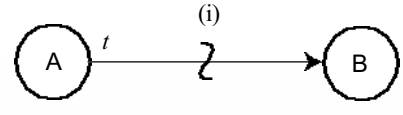


Figure 1. Basic Event Graph Construct

The event graph in fig. 1 is interpreted as follows: "When event A occurs, then if condition (i) is true, event B is scheduled to occur after a delay of t simulated time units." The Simkit code corresponding to figure 1 is implemented in Simkit in the following code snippet:

```
public void doA() {
     <code to perform state transition for event A>
    if (i) { waitDelay("B", t);  }  }
```

The order of execution in a "do" method is, by convention, identical to that in Event Graphs: first perform state transitions, then schedule events (if any).

Note that the first argument in the waitDelay() call above is a String that is the event name, not the method name. Simkit uses Java's reflection to determine the corresponding method. When waitDelay() is invoked, SimEntityBase creates a SimEvent and adds it to the FEL. Each SimEvent contains a reference to the object that created it. When that event "occurs" the Event List invokes a callback method on the object that scheduled it called "handleSimEvent(SimEvent)." Normally, the programmer does not have to deal with this method, however. The SimEntityBase class implements the handleSimEvent() method to invoke the "do" method indicated by the data in the SimEvent.

When the SimEntityBase instance receives the event, it attempts to find a matching "do" method for that event based on its name. In the example above, when the event with name "B" is received from the Event List, the scheduling object prepends the string "do" and tries to find a method called "doB()". If such a method is found, it is invoked. If no such method is found, then SimEntityBase returns to the FEL algorithm with no error.

Event Graphs have only one "keyword" - the event called Run. The Run event is analogous to the main method in C or Java programs. The Run event is placed on the event list at the start of the simulation run. That way the FEL always starts the run in a non-empty state.

Simkit implements the Run event by adopting the convention that every SimEntityBase, upon instantiation, is examined for the presence of a doRun() method. If the method is found, then a Run event is scheduled to occur at time 0.0. If no Run event is found, then there is no error. While Simkit encourages the use of the Run event to initiate the simulation, it is not required. However, if the Run event is not used, the modeller must put events on the Event List "by hand" prior to the onset of the simulation run.

In Simkit, the Run event is only used to schedule the first events. Simkit requires an additional initialisation method, reset(), that is responsible for (re-) initialising the state variables to their initial values.

A call to Schedule.reset() just prior to starting the simulation run invokes reset() on every subclass of SimEntityBase that has been instantiated.

Thus, each simulation object only has to be responsible for initialising its own state variables. Initialising state variables is separate from initial scheduling so that the first events that occur can reasonably assume that all objects have been set to their legitimate initial state.

Starting and Stopping

The simulation run is controlled by the Schedule class, which also houses the FEL. Schedule initiates the run when there is a call to its startSimulation() method, which executes FEL.

The simulation continues executing until the FEL is empty. There are essentially four ways in Simkit by which this can occur:

1. the FEL empties naturally of its own accord;
2. there is an explicit call to Schedule.stopAtTime (double) before Schedule.startSimulation() is invoked;
3. there is a call to Schedule.stop-OnEvent(String, Class[], int) before Schedule.startSimulation() is invoked; and
4. there is a call to Schedule.stopSimulation() anywhere in the program

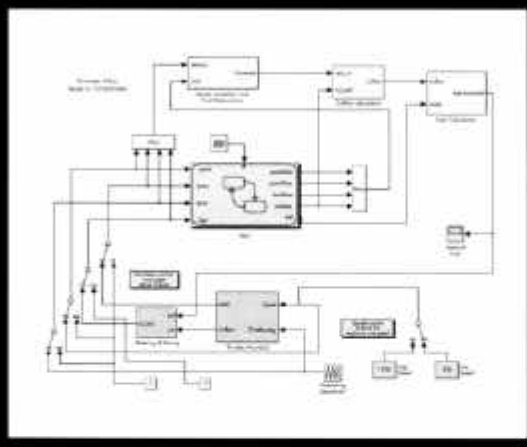
If the FEL empties of its own accord, then the simulation ends. The Schedule.startSimulation() method returns to where it was invoked. Typically, report methods are then invoked, depending on how the simulation run was configured. The value of simulated time (simTime) stays the same as last executing event, but can be set back to time 0.0 with a call to Schedule.reset().

A call to Schedule.stopAtTime(double) schedules a Stop event, that just invokes Schedule.stopSimulation(). For example, Schedule.stopAtTime(10.0) stops the simulation at time 10.0 and leaves time at 10.0 when the run is over.

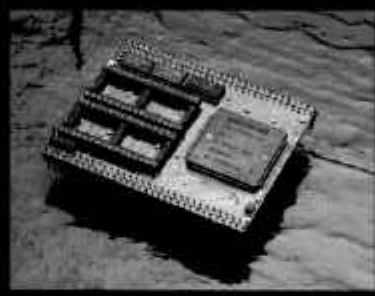
A call to Schedule.stopOnEvent(String,Class[], int) or Schedule.stopOnEvent(String, int) causes the simulation run to end after there have been a certain number of events of the specified name occurring. For example, invoking Schedule.stopOnEvent ("Arrival", 10) will cause the simulation to end after the 10th Arrival event has occurred. Similarly, Schedule.Stop OnEvent("Arrival", new Class[] { Job.class }, 10) stops the simulation after the 10th Arrival(Job) event has occurred.

Example: The Arrival Process

The Arrival Process is the simplest nontrivial Event Graph, essentially the "Hello World" of Event Graphs.



Das Bild oben zeigt ein Modell für eine Einspritzanlage in Simulink und stellt die Möglichkeit dar, ereignisorientierte Blöcke aus Stateflow mit dynamischen Blöcken in einem Modell zu verbinden.
Mit dem Real-Time Workshop und dem Stateflow Coder kann aus einem solchen Modell automatisch ANSI-C-Code generiert werden. Durch die offene Architektur des Real-Time Workshop ist es möglich, diesen Code auf unterschiedlichster Echtzeit-Zielhardware (DSP-Boards, Microcontroller etc.) zu implementieren.



ECHTZEIT PER MAUS-KLICK!

Simulink-Modelle für Echtzeitimplementierungen in C-Code übersetzen.

Echtzeit- und Stand-alone- Simulation.

Mit dem vom Real-Time Workshop erzeugten Code können sowohl Stand-alone Simulationen mit maximaler Geschwindigkeit als auch Hardware-in-the-Loop-Simulationen im Echtzeitbetrieb durchgeführt werden.

Rapid Prototyping.

Die automatische Codegenerierung und Automatisierung von Kompilieren, Linken und Laden gibt Ihnen eine sehr schnelle und effiziente Möglichkeit, den grafisch entwickelten Algorithmus direkt in Verbindung mit der Zielhardware zu testen und zu optimieren.

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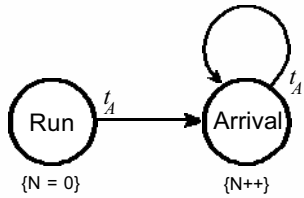

Figure 2. Arrival Process Event Graph

The initialisation of a Simkit simulation run breaks the Run event into two parts: the initialisation of state variable values and the scheduling of initial events on the Event List. The initial state values are set in a method called reset(), while the scheduling of initial events is done in the doRun() method. Recall that the Run event is placed on the Event List at the start of the simulation run.

The reset() method is typically not directly invoked, but rather is invoked by a call to Schedule.reset(). This has the effect of invoking reset() on all SimEntityBase instances that have been created. Thus, Schedule.reset() is like a big "reset" button on the simulation model. The modeller does not have to keep track of every SimEntityBase that has been created.

The Simkit implementation of the Arrival Process is shown in fig. 3 (the complete code for all examples is in the Appendix).

```
private RandomVariate interarrival;
protected int numberArrivals;
public void reset() {
     numberArrivals = 0; }
public void doRun() {
     waitDelay("Arrival", interarrival.generate());}
public void doArrival() {
     firePropertyChange("numberArrivals
          ",numberArrivals, ++numberArrivals);
     waitDelay("Arrival", interarrival.generate());
}
```

Figure 3. Simkit Code Snippet for Arrival Process

The Arrival Process class maintains a single state variable, numberArrivals, that counts the cumulative number of arrivals since time 0.0. The state variable is incremented by one upon the occurrence of each Arrival event. The reset() method therefore initialises numberArrivals to zero and the method doArrival() increments the value and schedules the next Arrival event, after a random delay. The doRun() method simply schedules the first Arrival event.

When the state variable numberArrivals is incremented, a PropertyChangeEvent is fired. That is, an instance of a PropertyChangeEvent is dispatched to all objects that have registered as PropertyChangeListeners to the ArrivalProcess instance. This feature is useful for separating the code to model the state of the system from the code to compute any statistics, graphs, or any other output-related task.

Running a Simkit model thus consists of the following tasks:

1. Instantiate desired objects
2. Register SimEventListener objects
3. Register PropertyChangeListener objects
4. Set stopping time or stopping criteria
5. Set the mode of the run (verbose/quiet, single-step/continuously running)
6. Reset all SimEntityBase instances
7. Start the simulation

Depending on the simplicity or the complexity of the model, some of these steps may be omitted. For the Arrival Process model, we will implement these tasks in a pure execution class - that is, a class consisting of only a main() method.

```
//1. Instantiate objects
    ArrivalProcess arrival = new ArrivalProcess(…);
//4. Stopping criterion: at time 10.0
    Schedule.stopAtTime(10.0);
//5. Verbose mode on
    Schedule.setVerbose(true);
//6. Reset all SimEntityBase instances
    Schedule.reset();
//7. Start simulation
    Schedule.startSimulation();
```

Figure 1. Execution Code for Arrival Process Test

Note the use of the RandomVariate instance variable in the code in fig. 3. The code in fig. 3 does not show how an instance of interarrival is obtained. We will discuss Simkit's approach to random variate generation below.

For now, it is sufficient to note that an instance of RandomVariate has a method called generate(), and each invocation of the generate() method returns a new random variate having a particular distribution.

Listener Patterns

Simkit uses two "Listener" patterns to implement its component interoperability. The SimEventListener pattern is used to connect simulation components (instances of SimEntityBase) in a loosely coupled manner. As described above, SimEvents are always invoked by a callback from the FEL to the scheduling object that ultimately invokes the corresponding "do" method. The SimEvent is then dispatched to every SimEventListener that has explicitly been registered interest in that object's SimEvents.

A related pattern, the PropertyChangeListener pattern, comes into play whenever a state variable changes value. In that case, a PropertyChangeEvent is dispatched to registered PropertyChangeListener objects. The purpose of PropertyChangeEvents is to support generic observation of the simulation state trajectories, as well as any function thereof.

SimEvent Listener Pattern

The mechanism by which two simulation components are linked is the SimEventListener pattern. Every SimEntity implements the SimEventListener interface that defines a callback method. An instance of a SimEventListener registers interest in hearing a SimEntity's simulation events with the addSimEventListener(SimEventListener) method. Whenever a SimEvent occurs for the SimEntity instance, notification is dispatched to all registered SimEventListeners via the callback method processSimEvent(SimEvent).

The behaviour of a SimEventListener as implemented in the processSimEvent(SimEvent) method can be completely customized to suit the simulation modeller's needs. Most of the time, the modeller will be content with the default behaviour as implemented in the (abstract) SimEntityBase class. That behaviour is that whenever a SimEvent is heard, the object attempts to find a matching "do" method. If one is found, then it is invoked, if none, nothing happens.

The SimEventListener pattern is useful in implementing component-based simulation models (Buss, 2000). For our introductory purposes in this paper, we will not use the SimEventListener pattern.

Property Change Listener Pattern

One capability provided by Java is the ability to fire PropertyChangeEvents whenever certain instance variables change value. This capability is provided by classes in the java.beans package, part of the standard Java 2 environment. The java.beans package contains a class, PropertyChangeEvent that is dispatched to objects interested in the property, and an interface, PropertyChangeListener, that provides a common callback method from the source of the PropertyChangeEvent.

The java.beans package also has a helper class, PropertyChangeSupport, that can register and unregister PropertyChangeListeners and can act as a proxy for firing the PropertyChangeEvents. PropertyChangeEvents are different than SimEvents and do not directly interact with the FEL.

SimEntityBase maintains an instance of PropertyChangeSupport and provides a method firePropertyChange(), with various signatures, to dispatch PropertyChangeEvents to its registered PropertyChangeListeners. The convention adopted by Simkit models is that every state change is accompanied by a corresponding firing of a PropertyChangeEvent.

For example, in the Arrival Process above, instead of simply incrementing the numberArrivals state variable, the following code is typically used:

```
firePropertyChange("numberarrivals",
    numberArrivals, ++numberArrivals);
```

This is using the firePropertyChange(String,int, int) version. The String argument is the name of the property, the first int parameter is the "old value" of the property – the value before the state change was made, and the second int parameter is the "new value" of the property – the value after the property was changed. Notice that the variable as the increment operator as a prefix rather than a postfix, since the value of the expression is the incremented value in this case, which is what is desired.

If the Simkit program adopts the convention of firing a PropertyChangeEvent for every state change, then an effective decoupling occurs between the model and the observation of the model (graphing results, estimating measures of performance, etc.). The model itself does not need to estimate any statistics at all. Instead, separate PropertyChangeListener objects can be created that perform estimation, analysis, or plotting results.

A second type of PropertyChangeListener event is supported by Simkit, the IndexedPropertyChangeEvent. The IndexedPropertyChangeEvent is defined in Simkit, since Java beans do not support indexed PropertyChangeEvents. The IndexedPropertyChangeEvent is useful whenever the state changing is indexed, as in an array. The index of the property that had changed is included with the IndexedPropertyChangeEvent. Since IndexedPropertyChangeEvent subclasses Java's PropertyChangeEvent, any PropertyChangeListener is able to "hear" it. An example of its use is in the model of a transfer line discussed in the following section.

More Examples

Multiple Server Queue

An Event Graph for the multiple server queue defines two state variables: Q=the number of customers in the queue and S=the number of available servers (event graph in fig. 5).

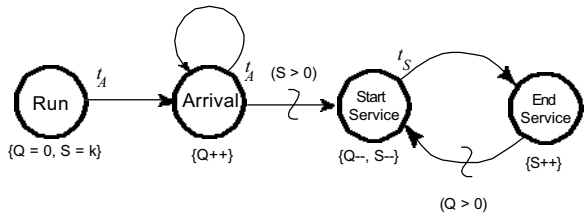

Fig. 5: Event Graph for Multiple Server Queue

The Multiple Server Queue is implemented in Simkit by creating a MultipleServerQueue class that defines "do" methods corresponding to the events in figure 5: doRun(), doArrival(), doStartService(), and doEndService().

The Simkit code for these methods is shown in figure 6.

```
public class MultipleServerQueue
        extends SimEntityBase {
    private int totalNumberServers;
    private RandomVariate interArrivalTime;
    private RandomVariate serviceTime;
    protected int numberArrivals;
    protected int numberInQueue;
    protected int numberAvailableServers;
    protected int numberServed;

    public MultipleServerQueue(int numberServers,
            RandomVariate iat, RandomVariate st) {
        totalNumberServers = numberServers;
        this.setInterArrivalTime(iat);
        this.setServiceTime(st);
    }
    public void reset() {
        super.reset();
        numberArrivals = 0;
        numberInQueue = 0;
        numberAvailableServers =
             totalNumberServers;
        numberServed = 0;
    }
    public void doRun() {
        firePropertyChange("numberInQueue",
             numberInQueue);
        firePropertyChange(
             "numberAvailableServers",
             numberAvailableServers);
        waitDelay("Arrival",
             interArrivalTime.generate());
    }
    public void doArrival() {
        firePropertyChange("numberInQueue",
         numberInQueue, ++numberInQueue);
        waitDelay("Arrival",
         interArrivalTime.generate());
        if (numberAvailableServers > 0) {
            waitDelay("StartService", 0.0);
        }
    }
    public void doStartService() {
        firePropertyChange(
         "numberAvailableServers",
         numberAvailableServers,
          --numberAvailableServers);
        firePropertyChange("numberInQueue",
          numberInQueue, --numberInQueue);
        waitDelay("EndService",
         serviceTime.generate());
    }
    public void doEndService() {
        firePropertyChange(
         "numberAvailableServers",
         numberAvailableServers,
             ++numberAvailableServers);
        firePropertyChange("numberServed",
         ++numberServed);
        if (numberInQueue > 0) {
            waitDelay("StartService", 0.0);
        }
    }
```

Fig. 6: Code for MultipleServerQueue Class

The code in fig. 6 shows instance variables that correspond to the parameters and the state variables of the Event Graph model.

By convention, parameters are defined to be private whereas state variables are defined with protected access. Thus, subclasses can change state variables but the data are still encapsulated.

Parameters typically have both “setter” and “getter” methods, whereas state variables only have “getter” methods. For brevity, these methods have not been shown in figure 6.

Edge Boolean conditions are implemented by wrapping the waitDelay() call inside an “if” block, with the Boolean condition on the “if” corresponding to the Boolean edge condition.

This is illustrated in the Arrival event scheduling of the StartService event and the EndService event scheduling the StartService event.

Tandem Queue Model

A tandem queue model has two servers in series. All entering customers start service at the first server. Modelled as a multiple server queue. Customers completing service at the first server require service at the second server with probability p or leave the system with probability 1-p. The Event Graph for this system is shown in figure 7 (see Buss, 2001).

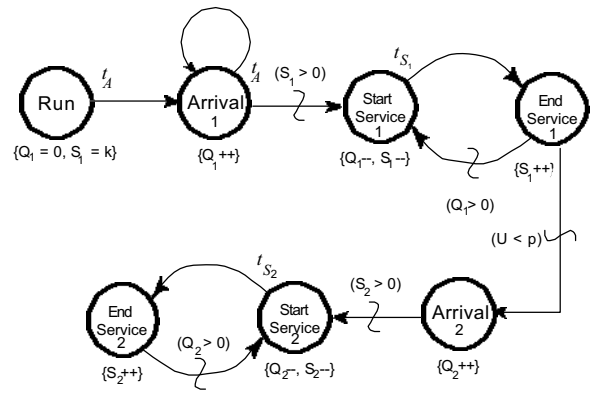

Fig. 7: Tandem Queue Event Graph

Implementing this model in Simkit is a straightforward extension of the multiple server queue discussed above.

The state variables are now Q1 and Q2, the number in queue for the first and second station, respectively, and S2 and S2, the number of available servers at the first and second station.

The methods are likewise an obvious modification of those for the multiple server queue. The one change is in the EndService1 event, which adds the scheduling of the Arrival2 event with probability p. This functionality is shown in figure 8.

```
protected double probToSecondServer;
protected RandomNumber rng; . . .
public void doEndService1() {
     firePropertyChange("numberAvailableServers1",
         numberAvailableServers1,
         ++numberAvailableServers1);
     if (numberInQueue1 > 0) {
         waitDelay("StartService1", 0.0); }
     if (rng.draw() < probToSecondServer) {
         waitDelay("Arrival2", 0.0);
     } }
```

Fig. 8: Code Snippet for TandemQueue Class

Modeling Cancelling Edges

Cancelling edges are used in Event Graphs to remove previously scheduled events from the event list. Cancelling edges are implemented in Simkit with the interrupt() method. By convention, cancelling edges for an event are executed after state transitions but before scheduling edges.

The interrupt() method in Simkit behaves slightly differently than in "pure" Event Graphs because of the object-oriented nature of Simkit. The interrupt() method applies to the instance on which it is invoked, rather than globally as in the Event Graph world view. This gives the simulation modeller finer-grained control over cancelling events.

The signature of an interrupt is (String, Class[]), where the String argument is the name of the event to be cancelled and the Class[] array represents the arguments on the event – that is, the signature of the "do" method corresponding to the cancelled event. The second argument may be omitted if a zero-parameter event is being cancelled.

Server with Failures

A model to illustrate cancelling edges is the server with failures (Buss, 2001). Here a single server operates continuously while processing jobs as they arrive. The server fails after a certain (random) time of operation (regardless of the time spent processing jobs) after which it immediately begins repair. After a (random) repair time, the server is available to process jobs again. It is assumed that a job in process when a failure occurs goes back to the queue and is issued a new service time when the server becomes available again (Event Graph for this model shown in fig. 9).

This model can be implemented in Simkit by subclassing the MultipleServerQueue class described above. The code for the Simkit program for the Server with Failures model is shown in fig. 10 As before, the constructor and accessor methods are omitted for brevity.

In fig. 10, only the next pending EndService event that has been scheduled by that instance of ServerWithFailures will be removed from the event list. If there is no such pending event then nothing happens.

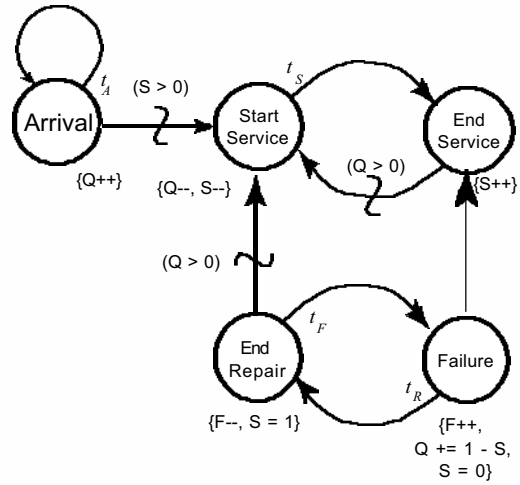

Fig. 9: Server with Failures Event Graph

```
public void doRun() {
        super.doRun();
        waitDelay("Failure",
             timeToFailure.generate(), 1.0);   }
    public void doFailure() {
        int temp = this.getNumberInQueue();
        numberInQueue +=
             1 - numberAvailableServers;
        firePropertyChange("numberInQueue", temp,
              numberInQueue);
        temp = getNumberAvailableServers();
        numberAvailableServers = 0;
        firePropertyChange(
             "numberAvailableServers", temp,
             numberAvailableServers);
        failed = !failed;
        firePropertyChange("failed",
             new Boolean(!failed),
             new Boolean(failed));
        interrupt("EndService");
        waitDelay("EndRepair",
             repairTime.generate());
       }
    public void doEndRepair() {
        failed = !failed;
        firePropertyChange("failed",
             new Boolean(!failed),
             new Boolean(failed));
         numberAvailableServers = 1;
         firePropertyChange(
             "numberAvailableServers", 0, 1);
        if (numberInQueue > 0) {
            waitDelay("StartService", 0.0);
        }
        waitDelay("Failure",
             timeToFailure.generate(), 1.0);
     }
```

Fig. 10: Simkit Code for Server with Failures

In the state transition for the Failure event (doFailure() method) firing the PropertyChangeEvents for the state variables is slightly more lengthy that in previous models. For clarity, the interrupt call that implements the cancelling edge in figure 9 is shown in bold in figure 10.

Since the state transitions cannot be done "in place" with the increment or decrement operators, the old value of the state variable is saved in a temporary variable and passed as the second argument in the firePropertyChange() method.

The waitDelay() statement to schedule the Failure event has a third argument that is the priority of the scheduled event. The default priority is 0.0, so setting the priority of the Failure event to 1.0 ensures that it will occur before any StartService or Arrival events scheduled to occur at the same time.

Note that subclassing MultipleServerQueue was made possible by the fact that the state variables in MultipleServerQueue were declared to have protected access rather than private.

Passing Parameters on Edges

An important feature of Event Graphs is the ability to pass parameters on scheduling edges. This enables information about the simulation's state at a particular simulation time to be transmitted to a future event in a kind of "time capsule."

Parameters on edges are represented in Event Graphs by putting them in a box on the edge, as shown in fig. 11 The corresponding scheduling edge must have an argument that matches the parameters, and vice versa. Cancelling edges can "pass" parameters too, but the meaning is slightly different. When a cancelling edge has a parameter, then the next event that matches both the name *and* the value of the parameter is cancelled (simply: removed from the FEL).

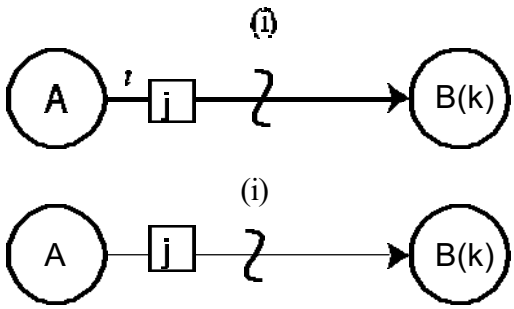

Fig. 11: . Parameters on Edges

Simkit passes parameters using a variant of waitDelay() that adds a third argument of type Object[]. This array of objects should have the values to be passed to the scheduled event so that the signature of the corresponding "do" method is matched. All primitive arguments are wrapped in Java's Object equivalents. That is, a double argument is passed as a Double object, an int argument is passed as an Integer object, etc.

The Simkit code for the scheduling edge in figure 11 is as follows (assuming that j and k are both primitive integers):

```
public void doA() {
    <state changes for event A>
    if (i) {
        waitDelay("B", t,
            new Object[] {new Integer(j)});
    }
}
public void doB(int k) {...}
```

Similarly, the Simkit code for the cancelling edge in figure 11 is as follows:

```
public void doA() {
    <state change for event A>
    if (i) {
        interrupt("B",
            new Object[]{new Integer(j)});
    }
}
public void doB(int k) {...}
```

Note the syntactic difference between j and k here in both the code and in the Event Graph. The value passed on the scheduling edge, represented by "j", is an expression, whereas "k" on the event B is a format parameter. Note also that the expression "j" must be computable at the event A. That is, "j" must be a function of state variables, model parameters, and parameters that may have been passed to A. Thus, event B can use "k" in any expression it defines.

The signature for the doB() method could be Integer (the object wrapper for the primitive int) instead of the int with the same effect. However, care must be taken to not overload "do" methods with the primitive and the corresponding object wrapper types.

The Transfer Line Model

The Event Graph model for a transfer line is as follows (Buss, 2001). Arriving customers are processed by n workstations in a series, each consisting of a multiple-server queue. Upon completion of service at each workstation, a customer proceeds to the next workstations and departs the system when service at the last workstation is complete (event graph fig. 12).

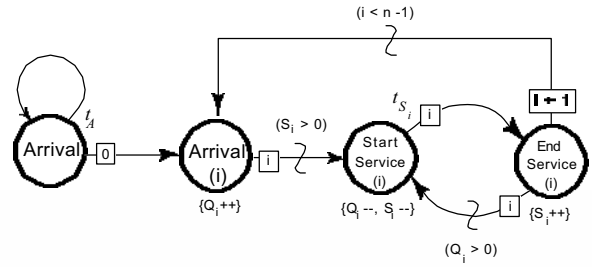

Fig. 12: Transfer Line Event Graph

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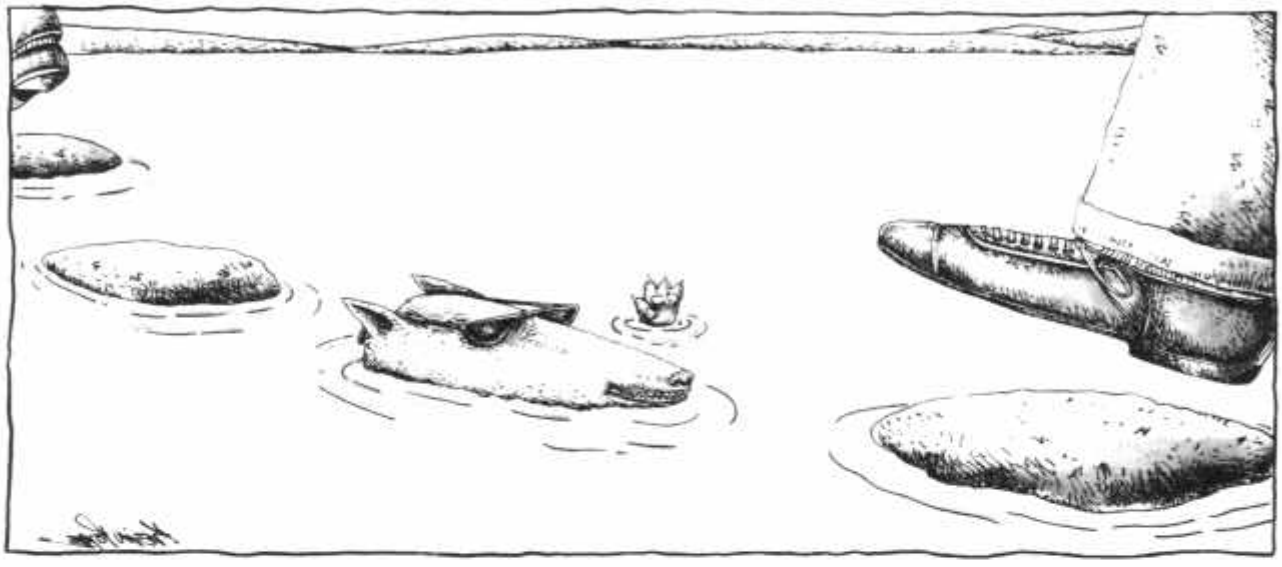

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The Simkit implementation of the transfer line in figure 12 is essentially identical to the multiple server queue model in figure 6, except that the scalar state variables in the multiple server queue model are now replaced by arrays. Also, since the events have parameters, the corresponding "do" methods have signatures that match. These arguments correspond to the index of the workstation at which the event "occurs." For example, doArrival(int i) means that a job arrives to workstation i.

```
public void doRun() {
      for (int i = 0; i < numberInQueue.length;
         i++) {
          fireIndexedPropertyChange(i,
              "numberInQueue", numberInQueue[i]);
      }
      for (int i = 0; i < numberInQueue.length;
         i++) {
          fireIndexedPropertyChange(i,
         "numberAvailableServers",
          numberAvailableServers[i]);
      }
      waitDelay("Arrival",
         interArrivalTime.generate());
   }
   public void doArrival() {
      firePropertyChange("numberArrivals",
         ++numberArrivals);
      waitDelay("Arrival",
         interArrivalTime.generate());
      waitDelay("Arrival", 0.0, new Integer(0) );
   }
   public void doArrival(int i) {
      fireIndexedPropertyChange(i,"numberInQueue",
             new Integer(numberInQueue[i]),
             new Integer(++numberInQueue[i]));
      if (numberAvailableServers[i] > 0) {
          waitDelay("StartService", 0.0,
              new Integer(i) );
      }
   }
   public void doStartService(int i) {
      fireIndexedPropertyChange(i, "numberInQueue",
          new Integer(numberInQueue[i]),
              new Integer(--numberInQueue[i]));
      fireIndexedPropertyChange(i,
         "numberAvailableServers",
          new Integer(numberAvailableServers[i]),
           new Integer(--numberAvailableServers[i]));
      waitDelay("EndService",
             serviceTime[i].generate(),
             new Integer(i) );
   }
   public void doEndService(int i) {
      fireIndexedPropertyChange(i,
         "numberAvailableServers",
          new Integer(numberAvailableServers[i]),
         new Integer(++numberAvailableServers[i]));
      if (numberInQueue[i] > 0) {
          waitDelay("StartService", 0.0,
              new Integer(i) );
      }
      if (i < getNumberWorkstations() - 1) {
          waitDelay("Arrival", 0.0,
              new Integer(i + 1) );
      }
   }
```

Fig. 13: Code for Transfer Line Model

Note that the Event Graph in figure 12 has two Arrival events, one with no parameters and one with a parameter. These are implemented in the Simkit code by overloading the doArrival method (see figure 13.

Collecting Statistics

Simkit uses the PropertyChangeListener pattern for collecting statistics from a simulation model. This pattern provides a great deal of flexibility for what gets collected, how it is collected, and which measures of performance are estimated. This approach also enables a clean separation between implementing the dynamics of the model and gathering data. The model can thus be created without any concern, which statistics are to be estimated, and the model classes will not contain any code involved with statistics.

All a model class must do is make sure it fires a PropertyChangeEvent whenever a state variable changes its value. This facility is provided by the SimEntityBase class by means of the firePropertyChange() method. The first argument in firePropertyChange() is the name of the property being fired, a String, and the second is the new value of the property, which can be a primitive, or an object.

Data gathering is performed by classes that implement the PropertyChangeListener interface. This interface is part of the standard Java library in the package called java.beans. The PropertyChangeListener interface specifies a a single callback method, propertyChange(PropertyChangeEvent). The PropertyChangeEvent object passed to the listener contains two key pieces of data: the name of the property that has changed in the source object (a String) and the new value of the property (an Object). What the listener does with this information is, of course, completely dependent on the implementation of the PropertyChangeListener class. Note that as many listeners can be registered with a source of PropertyChangeEvents as desired (up to the limits of the Java virtual machine, of course). It is possible for a PropertyChangeListener to register for just a single property.

Two simple classes for data collection that are used in Simkit models are SimpleStatsTimeVarying and SimpleStatsTally. Instances of these classes compute summary statistics for a single property of the time-varying or tally type, respectively. The instance is registered as a PropertyChangeListener with an object that fires a PropertyChangeEvent with the given name.

When a SimpleStats object "hears" a PropertyChangeEvent, it checks to see whether the property name is identical to the one it is listening for. If so, then it updates its counters with the new property value it retrieves from the PropertyChangeEvent. This value must be an instance of Java's Number class.

For example, the MultipleServerQueue fires PropertyChangeEvents for properties named "numberInQueue" and "numberAvailableServers" (see fig. 6). Since these are time-varying state variables, to collect statistics on them two instances of SimpleStatsTimeVarying are created. One is configured to listen for a property called "numberInQueue" and the second for a property called "numberAvailableServers." Whenever a a firePropertyChange() method is invoked in a MultipleServerQueue instance, a PropertyChangeEvent is dispatched to all registered listeners (here each of the two SimpleStatsTimeVarying objects).

The code to instantiate the two SimpleStatsTimeVarying instances, and register them as PropertyChangeListeners to an instance of MultipleServerQueue is shown in fig. 14. This code can be written in a main() method or in a simulation "executive" class.

```
MultipleServerQueue msq =
    new MultipleServerQueue(...);
SimpleStatsTimeVarying niqStat =
    new SimpleStatsTImeVarying("numberInQueue);
SimpleStatsTimeVarying nasStat =
    new SimpleStatsTImeVarying(
        "numberAvailableServers);
msq.addPropertyChangeListener(niqStat);
msq.addPropertyChangeListener(nasStat);
```

Fig. 14: Code to Instantiate and Register Listeners

In this example two PropertyChangeListeners are listening to one object firing the PropertyChangeEvents. It is also possible for a state variable to change in more than one object. In that case, one listener can simply be registered with all the objects responsible for that property. When the simulation ends (or during the simulation run, if needed) basic sample statistics can be obtained from the SimpleStats objects using the appropriate "getter" method. For example, getMean() returns the sample mean, getVariance() the sample variance, etc.

Running the multiple server queue with the two SimpleStats listeners as in fig. 14 can result in output like that shown in fig. 15.

```
Multiple Server Queue with 2 servers
Service time distribution is Gamma (2.5, 1.2)
Arrival Process with Exponential (1.7) interarrival
times
Simulation ended at time          1000.0000
There have been 614 customers arrive to the system
There have been 607 customers served
Average Number in Queue           4.0739
Average Utilization               0.9166
```

Fig. 15: Output Example from Multiple Server Queue Model

In the output in fig. 15, only the estimated averages were produced by the SimpleStatsTimeVarying object; the rest was simply custom-written report template for this model.

The loose coupling between the model's state and the gathering of data enables a considerable degree of flexibility in what can be done with the model without editing or recompiling the simulation classes. For example, suppose a plot of the trajectory for a given state variable is desired. A PropertyChangeListener class can be written that listens for the given state variable property and plots the next observation when the PropertyChangeEvent is heard. No invasive editing of the original source code is required to add substantially different features to the overall model.

To illustrate, suppose a more detailed trace of certain state variable is required for debugging purposes. Simple class called PropertyChangeFrame is a PropertyChangeListener that can be registered to listen to the MultipleServerQueue (in addition to the SimpleStatsTimeVarying instances already registered). The PropertyChangeFrame simply writes the event and the state change whenever it "hears" the PropertyChangeEvent (screen capture see figure 20).

Generating Random Variates

Simkit's design permits much flexibility for generating random variates used in the simulation models. The underlying design goal was to enable the modeller to change any random variate in a model to any desired probability distribution without having to recompile the model. This was to extend to classes generating random variates implemented *after* the compilation of the original model.

Simkit uses a combination of a RandomVariate interface and an abstract factory that is called to produce instances of the desired implementation using only "generic" data–that is, Strings, Objects, and numbers. A full discussion of Simkit's design for generating random will be presented elsewhere.

Obtaining Simkit

The latest version of Simkit, including the source code, can be downloaded from the World Wide Web at diana.gl.nps.navy.mil/Simkit/. The source code for the examples presented in this paper may be obtained from the above URL as well. Simkit is copyright under the GNU Public License (GPL), which permits its use without any licensing fee.

Conclusions

This article has presented a basic introduction to Simkit, an object-oriented, component-based platform that can be used to create discrete event simulation models using Event Graph methodology. Since Event Graphs can be used to represent any discrete event system, there are no theoretical limitations to the DES models that can be implemented in Simkit.

The loose coupling in Simkit's component architecture facilitates a significant degree of reusability of simulation components. The Listener patterns used to implement the loose coupling give the modeller a great degree of flexibility in adding new features to existing models without invasive changes to the source code. Simulation models using Simkit can be built and executed on any Java 2-enabled platform.

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Appendix

The complete source code for the ArrivalProcess class discussed above is shown below.

To run the example, make sure that you have jdk1.2 or greater and that the simsystem.zip file is on the classpath. The source code should be in a subdirectory called examples. To compile for the command line, change to the directory just above examples and enter (if running on Unix or a Unix-like OS, change the slash to a forward slash):

```
javac examples\ArrivalProcess.java
java examples.ArrivalPro
```

```
package examples;
import simkit.SimEntityBase;
import simkit.random.RandomNumber;
import simkit.random.RandomVariate;
import simkit.random.RandomNumberFactory;
import simkit.random.RandomVariateFactory;
import simkit.random.CongruentialSeeds;
public class ArrivalProcess extends SimEntityBase {
    private int numberArrivals;
    private RandomVariate interArrivalTime;

    public ArrivalProcess(String distribution,
        Object[] parameters, long seed) {
        interArrivalTime =
         RandomVariateFactory.getInstance(
              distribution, parameters, seed);
    }
    public void reset() {
        super.reset();
        numberArrivals = 0;
    }

    public void doRun() {
        super.reset();
        firePropertyChange("numberArrivals",
             numberArrivals);
        waitDelay("Arrival",
             interArrivalTime.generate());
    }
    public void doArrival() {
        firePropertyChange("numberArrivals",
             ++numberArrivals);
        waitDelay("Arrival",
             interArrivalTime.generate());
    }
    public void setSeed(long seed) {
         interArrivalTime.getRandomNumber().
             setSeed(seed);
    }
    public long getSeed() {
         return interArrivalTime.getRandomNumber().
         getSeed();
    }
    public static void main(String[] args) {
        SimEntityBase arrival =
            new ArrivalProcess(
             "simkit.random.ExponentialVariate",
             new Object[] {new Double(3.2)},
             CongruentialSeeds.SEED[0]);
        simkit.Schedule.reset();
        simkit.Schedule.setVerbose(true);
        simkit.Schedule.stopOnEvent("Arrival", 5);
        simkit.Schedule.startSimulation();
    }
}
```

Fig. 20: Screen Capture of Property Change Frame

Property Change Frame

[0.000	Run	] examples.MultipleServerQueue.1 numberInQueue: null -> 0
[0.000	Run	] examples.MultipleServerQueue.1 numberAvailableServers: null -> 2
[0.655	Arrival	] examples.MultipleServerQueue.1 numberInQueue: 0 -> 1
[0.655	StartService	] examples.MultipleServerQueue.1 numberAvailableServers: 2 -> 1
[0.655	StartService	] examples.MultipleServerQueue.1 numberInQueue: 1 -> 0
[1.106	Arrival	] examples.MultipleServerQueue.1 numberInQueue: 0 -> 1
[1.106	StartService	] examples.MultipleServerQueue.1 numberAvailableServers: 1 -> 0
[1.106	StartService	] examples.MultipleServerQueue.1 numberInQueue: 1 -> 0

SHORT NOTES

Causality is Undefinable - Toward a Theory of Hierarchical Definability

.... Lofti A. Zadeh, father of fuzzy logic and soft computing, promotes a new concept of definabilty
…. definability covers crisp, fuzzy, random, etc.
…. causality is undefinable in this sense
…. Contribution from the BISC mailing list

Attempts to formulate mathematically precise definitions of basic concepts such as causality, randomness, and probability have a long history. The concept of ***generalized definability*** that is outlined in the following suggests that such definitions may not exist. Furthermore, it suggests that existing definitions of many basic concepts, among them those of stability, statistical independence and Pareto-optimality, may need to be redefined. In essence, definability is concerned with whether and how a concept, X, can be defined in a way that lends itself to mathematical analysis and computation.

In mathematics, definability of mathematical concepts is taken for granted. But as we move farther into the age of machine intelligence and automated reasoning, the issue of definability is certain to grow in importance and visibility, raising basic questions that are not easy to resolve.

To be more specific, let X be the concept of, say, a summary, and assume that I am instructing a machine to generate a summary of a given article or a book. To execute my instruction, the machine must be provided with a definition of what is meant by a summary. It is somewhat paradoxical that we have summarization programs that can summarize, albeit in a narrowly prescribed sense, without being able to formulate a general definition of summarization. The same applies to the concepts of causality, randomness, and probability. It may be argued that these and many other basic concepts cannot be defined within the conceptual framework of classical logic and set theory.

The point of departure in our approach to definability is the assumption that definability has a hierarchical structure. Furthermore, it is understood that a definition must be unambiguous, precise, operational, general, and co-extensive with the concept it defines.

c - Definability

The hierarchy involves five different types of definability. The lowest level is that of *c-definability*, with *c* standing for crisp.

Thus, informally, a concept, X, is c - definable if it is a crisp concept, e.g., a prime number, a linear system, or a Gaussian distribution. The domain of X is the space of instances to which X applies.

f - Definability

The next level is that of *f - definability*, with *f* standing for fuzzy. Thus, X is a fuzzy concept if its denotation, F, is a fuzzy set in its universe of discourse. A fuzzy concept is associated with a membership function that assigns to each point, u, in the universe of discourse of X, the degree to which u is a member of F.

Alternatively, it may be defined algorithmically in terms of other fuzzy concepts. Examples of fuzzy concepts are small number, strong evidence, and similarity.

It should be noted that many concepts associated with fuzzy sets are crisp concepts. An example is the concept of a convex fuzzy set. Most fuzzy concepts are context-dependent.

f.g - Definability

The next level is that of *f.g - definability*, with *g* standing for granular, and *f.g* denoting the conjunction of fuzzy and granular.

Informally, in the case of a concept, which is f.g - granular, the values of attributes are granulated, with a granule being a clump of values that are drawn together by indistinguishability, similarity, proximity, or functionality. f.g - granularity reflects the bounded ability of the human mind to resolve detail and store information.

An example of an f.g - granular concept that is traditionally defined as a crisp concept, is that of statistical independence. This is a case of misdefinition - a definition that is applied to instances for which the concept is not defined, e.g., fuzzy events.

In particular, a common misdefinition is to treat a concept as if it were c - definable, whereas in fact it is not.

PNL - Definability

The next level is that of *PNL-definability*, where *PNL* stands for *Precisiated Natural Language*. Basically, PNL consists of propositions drawn from a natural language that can be precisiated through translation into what is called precisiation language.

An example of a proposition in PNL is: “It is very unlikely that there will be a significant increase in the price of oil in the near future”.

In the case of PNL, the precisiation language is the Generalized Constraint Language (GCL). A generic generalized constraint is represented by Z is R, where Z is the constrained variable, R is the constraining relation and r is a discrete-valued indexing variable whose values define the ways in which R constrains Z.

The principal types of constraints are:

possibilistic ($r = blank$);
veristic ($r = v$);
probabilistic ($r = p$);
random set ($r = rs$);
usuality ($r = u$);
fuzzy graph ($r = fg$);
and Pawlak set ($r = ps$).

The rationale for constructing a large variety of constraints is that conventional crisp constraints are incapable of representing the meaning of propositions expressed in a natural language - most of which are intrinsically imprecise - in a form that lends itself to computation.

The elements of GCL are composite generalized constraints that are formed from generic generalized constraints by combination, modification, and qualification.

An example of a generalized constraint in GCL is ((Z is R) and (Z,Y) is S) is unlikely.

Undefinability - Amorphicity

By construction, the Generalized Constraint Language is maximally expressive. What this implies is that PNL is the largest subset of a natural language that admits precisiation.

Informally, this implication serves as a basis for the conclusion that if a concept, X, cannot be defined in terms of PNL, then, in effect, it is undefinable or, synonymously, amorphic.

In this perspective, the highest level of definability hierarchy, which is the level above PNL - definability, is that of *undefinability* or *amorphicity*. A canonical example of an amorphic concept is that of causality.

More specifically, is it not possible to construct a general definition of causality such that given any two events A and B and the question, "Did A cause B?" the question could be answered based on the definition.

Equivalently, given any definition of causality, it will always be possible to construct examples to which the definition would not apply or yield counterintuitive results.

In dealing with an amorphic concept, X, what is possible - and what we generally do - is to restrict the domain of applicability of X to instances for which X is definable.

For example, in the case of the concept of a summary, which is an amorphic concept, we could restrict the length, type, and other attributes of what we want to summarize. In this sense, an amorphic concept may be partially definable or, p - definable, for short. The concept of p - definability applies to all levels of the definability hierarchy.

Summary

The theory of hierarchical definability is not a theory in the traditional spirit. The definitions are informal and conclusions are not theorems. Nonetheless, it serves a significant purpose by raising significant questions about a basic issue--the issue of definability of concepts that lie at the centre of scientific theories.

About BISC – BISC Mailing List

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RBF-Networks for Identification of Patient Pharmacokinetics and Pharmacodynamics

.... outlines parameter identification in pharmacokinetic models by means of special neural nets: RBF – networks – Radial Basis Function networks
.... shows advantages of RBF – models in control of depth of anaesthesia
.... comments implementation in MATLAB

Motivation

The response of the critically ill patient to the drugs necessary to sustain the vital physiological functions shows a strongly nonlinear dynamic behaviour. In order to guarantee an optimal dosage of the drugs it is desirable to have a precise model of the patient at hand. Simulation of this model with actual or virtual inputs enables the physicians to predict the patients reactions and to adjust their decisions accordingly.

Although there are already well established model structures for this purpose their parameters vary considerably between patients. Therefore, the identification of model parameters becomes mandatory to obtain an accurate patient model.

We use Radial Basis Function (RBF)-Networks to identify and model the patient's pharmacokinetics and pharmakodynamics. Although the model structure and parameters have no direct physiological meaning the model is capable of both off-line and on-line identification of nonlinear systems.

Patient Model and Data Synthesis

Testing the performance of an identification algorithm requires either

- the knowledge of the true system parameters,
- or undisturbed input-output data sets.

Since the parameters of the RBF-model cannot be compared to those of a physiological model we use simulated data sets from a standard propofol model [1,2]. Propofol is used for the control of depth of anaesthesia (DOA) and the DOA may be measured by processing EEG signals (the so called BIS-value).

The model consists of two different parts, joined by a serial connection:

1. Pharmacokinetics: A linear dynamic part, which models the distribution and elimination of the drug within the different body tissues.
2. Pharmacodynamics: A nonlinear static part, which represents the patients reaction to drug concentration at the effect site (central nervous system).

The patient model can be seen in figure 1 where also the separation of input-output data into identification and validation data is depicted. Since all real measurements are corrupted by disturbances a zero-mean Gaussian noise $n(k)$ was added to the identification output data only.

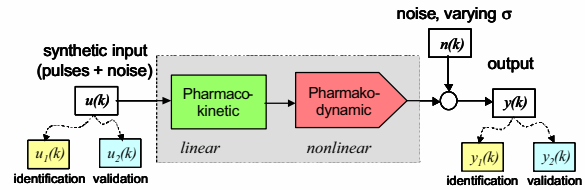

Figure1: Identification and validation data synthesis using the physiological propofol model.

Although the model parameters were chosen for a specific drug (propofol) the procedures and methods outlined here are also valid for other physiological patient-drug interactions since the same model structure is used for other drugs too.

RBF-Identification

The basic structure of an RBF-network is given in figure 2. Delayed inputs $u(k)$ and outputs $y(k)$ enter the net through a linear input-layer without weights. In the hidden-layer the Euclidean distances between this so called input-vector $\boldsymbol{x}(k)$ and the centers $\boldsymbol{c}_i$ of the basis functions are computed and weighted with a nonlinear basis function $\boldsymbol{\Phi}$. The output-layer is a single linear neuron where the weighted outputs from the hidden layer are accumulated.

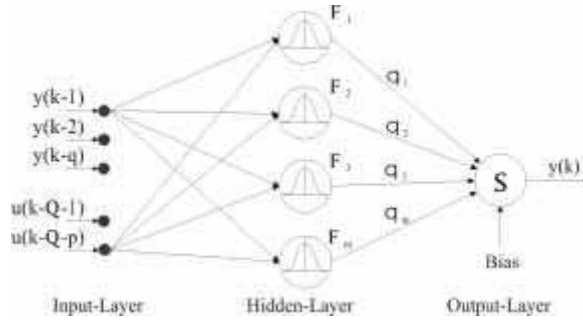

Figure2: Identification and validation data synthesis using the physiological propofol model.

The identification of a nonlinear dynamic system with an RBF-network can be structured in 4 steps:

1. Selection of suitable radial basis functions. Here the Gaussian distribution function was utilized.
2. Computation of center locations ci.
   Several different approaches exist, we used orthogonal estimation.

3. Choice of the spread-parameter. This usually involves a simple gradient search.
4. Optimisation of the linear weighting parameters i. This last step can be solved by standard least squares methods since the output shows a linear dependency on the i parameters.

Finding the proper locations of the centers c_i is the main design problem. Once the basis function Φ has been chosen as a Gaussian suitable centers for this function have to be determined.

We employed an orthogonal estimation algorithm [3], where the centers are chosen from the existing input-output data sets according to their importance for reducing the output error. Step 4 of the above list is easily implemented with a least squares solver.

The RBF-identification algorithm was programmed in MATLAB version 5.3 although a specialized function `newrb` for training of RBF-networks exists. The `newrb` –function did not perform well in two respects:

1. Neurons in the hidden-layer are added iteratively during the training.
   For a given performance (similar to the orthogonal estimation algorithm) a considerably larger number of neurons were necessary.
2. For a given number of basis functions (15-35) the performance was poor compared to the algorithm utilized here.

Validation and Results

After a model structure has been chosen and the parameters have been identified the performance of the new model must be assessed with dedicated validation data. In the upper part of figure 3 the identification is plotted as a block diagram with the estimated model parameters as result.

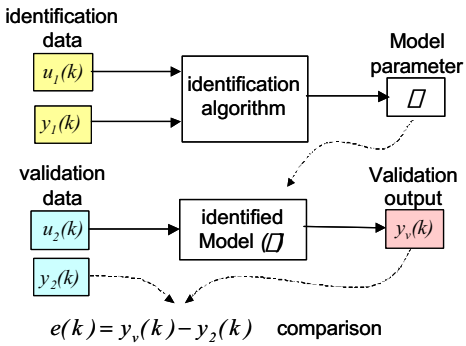

Figure 3: Identification and validation

The predicted output from this model is compared with the ideal and undisturbed output from the original simulation (see figure 1). This validation procedure is depicted in the lower part of figure 3.

Since nonlinear dynamic systems of the structure given in figure 1 are known to pose great difficulties for identification algorithms the operating range of the BIS - value was divided in three regions and three individual models were identified for each region. Results obtained with validation data for all operation regions can be seen in figure 4.

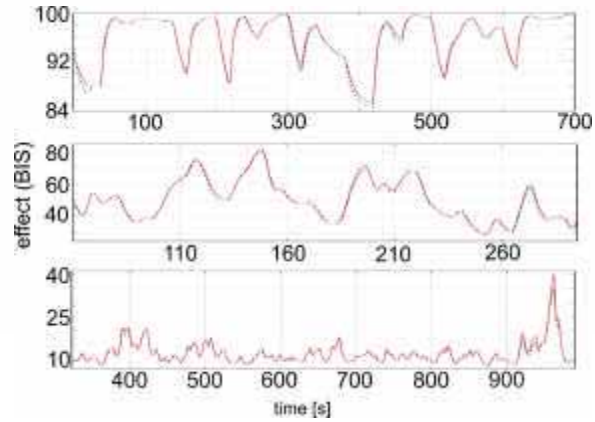

Figure 4: Validation results for operating region 1 (top), region2 (middle), and region 3 (bottom)

Obviously the RBF-Networks (solid line) are able to reproduce the system dynamics even in the presence of measurement noise. Operating range 2 corresponds to a nearly linear part of the static nonlinearity, therefore, only 17 neurons in the hidden layer were necessary. For the strong nonlinear regions 1 and 2 considerably more basis functions became necessary (25 and 35, respectively). Nevertheless, these numbers are still smaller than those obtained with the function provided by MATLAB.

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Simulation of Neural Structures and Processes Underlying Alzheimer's Disease

.... introduces the modelling concept of repeated pattern of specialized neurons for mental representations and processes
…. sketches disadvantages of classical artificial neural nets and of neuron behaviourial descriptions for modelling complex mental functions.
…. applies the concept to simulate phenomena of Alzheimer desease

Modelling concepts

Simulation of neural structures for complex mental phenomena is widely dominated by artificial neural networks, roughly following the principles as described by Rumelhart & McClelland (1986) [1]. It is well known that these simulations (including later developments like pulsed neural networks), lack biological adequacy and are limited to imitate - in a superficial form - the output, not the functioning of intelligent systems.

Neuronal simulations in biology which are not artificial neural networks are mainly intended to simulate single neurons and very small networks in many details; and thus work at a level of abstraction which does not encourage the modelling of more complex mental functions.

For many purposes, in various fields of research i.e. psychiatry, psychology, linguistics etc., theories about the real functioning of mental processes are crucial. We believe that it may not be possible to develop such theories without the extensive use of simulation techniques. Simulation allows the combination of a great number of different factors and to obtain results which may not be deduced by mere reflection.

The simulation tool has to be biologically adequate, and yet should nevertheless be simple enough to realize fairly complex structures. We therefore confine the model neuron to some functionally essential parameters: threshold value, different strengths of synapses, speed of signals on individual connections, duration of excitatory postsynaptic potentials, duration of the refractory period, and some parameters influencing learning processes.

In earlier publications concerning linguistic processes, it has been shown by simulation that neural representations cannot be 'distributed', in the sense of Rumelhart & McClelland, and that a 'localist' approach will lead to interesting consequences for the study of many different aspects of mental phenomena.

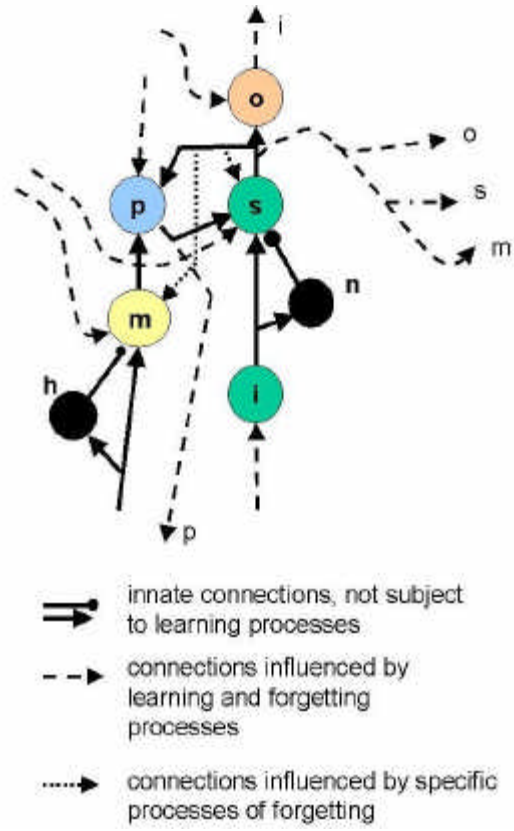

Figure 1: Repeated patterns of specialized neurons for modelling mental functions

This includes mental phenomena like language acquisition, memory processes, and pathologies like stuttering, aphasia or Alzheimer's disease [2]. We assume that mental representation and processes are based on a repeated pattern of specialized neurons as depicted in figure 1.

Within the limits of this short note it is not possible to further explain the architectural principles of the models. But it is important to note that all architectural details are based on thorough investigations of language processing needs and the available neural structures in the cortex.

Analysis of Alzheimer disease

Concentrating on Alzheimer's disease, there are many known phenomena, which are specific enough to allow (at least preliminary) diagnosis. But nevertheless, we do not understand the basis of this pattern.

Patients in the early stages of Alzheimer's disease, often exhibit problems with establishing episodic memory traces, while other memory functions remain intact.

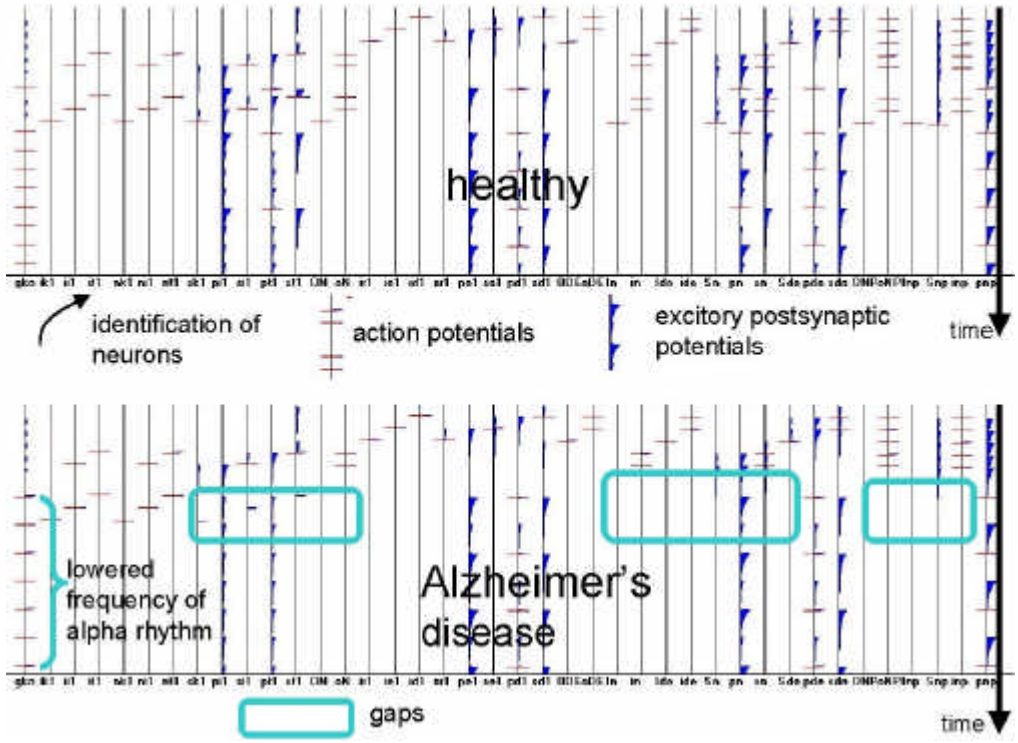

Figure 2: Output of a simulation of syntactic processes in language perception: comparison of the reactions of "healthy" structure and of a structure with lower frequency of alpha rhythm shows significant gaps in the pattern of neural activities

They are impaired in understanding sentences, which demonstrate difficulties typically for spoken language (anacolutha). There are also difficulties in generative naming tests, and a lowered frequency of the alpha rhythm in the EEG. In later stages of the disease, a significant loss of specific function cells is observed, with more global effects on the behaviour of the patients [3].

We have demonstrated by simulations that the syntactic effects of Alzheimer's disease emerge if we only lower the frequency of the alpha rhythm. (N.B., this implies a thesis about the functioning of this signal which also is a result from simulation experiments in the field of natural language processing.)

A graphical output of a simulation of syntactic processes in language perception, using a fairly complex unimpaired neural structure and the phonetic input of the German phrase "der Ti äh Tick" (where "äh" is a hesitation signal), is shown in figure 2 (only few cells are displayed).

A comparison of the reactions of this "healthy" structure, and of a structure exhibiting lower frequency of alpha rhythm (with exactly the same syntactic input) shows significant gaps in the pattern of neural activities (see again figure 2).

The crucial point is that the same mechanism produces problems with episodic memory, naming disturbances, problems of orientation in new situations, as well as several other phenomena which occur in Alzheimer's disease, as may be shown by appropriate simulation experiments.

Results of simulations may serve as a basis for further scientific investigation concurrent with classical approaches.

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Objective Spatial Analysis of Meteorological Fields using the Optimum Interpolation - Algorithm

.... sketches importance of correctly distributed spatial data for weather forecast models
…. introduces an algorithm – optimum interpolation - to reconstruct objectively the fields of the meteorological elements at the nodes of a regular spatial network

In order to guarantee an easier mathematical treatment, it is desirable to interpolate the irregularly distributed observations of meteorological stations to a regular grid. In fact, numerical weather prediction cannot do without spatial analysis (i.e. interpolation.)

Objective Analysis can be defined formally as follows: "Objective analysis includes the development and realisation of methods which make it possible to use the measurement data of meteorological stations to reconstruct objectively the fields of the meteorological elements, or at any rate to specify their values at the nodes of some type of regular network."

These data may then be used as initial data for a numerical prediction of the meteorological fields.

Objective analysis procedures do not rely on the judgement of a human analyst. Many different methods such as the nearest neighbour method, the arithmetic mean, spline surface fitting etc. have been proposed and applied, but today statistical interpolation methods are state-of-the-art. In particular, the Optimum Interpolation method (OI) is a powerful and widely spread technique. Theoretically, it should provide the best result, as it minimises the expected analysis error variance.

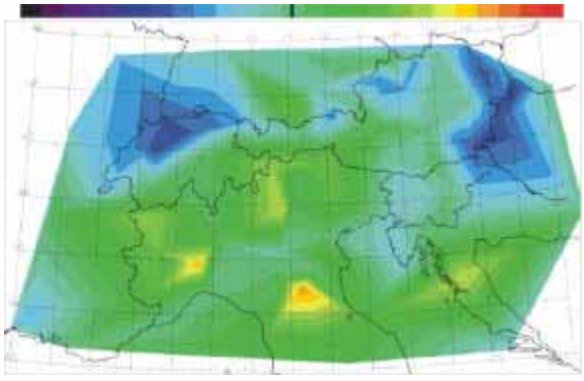

Figure 1: Correlation of Zurich with all other ALPCLIM stations

However, over Alpine area, large - scale application of the OI is often difficult due to orography. For example, during a typical foehn event with intensive precipitation on the southern border of the Alps but warm and dry air north of the main Alpine divide, measurements taken at a northern station, are not representative for rather near southern stations.

Consequently, in order to provide results of suitable quality, the complex influence of the Alps has to be understood and included in the analysis as good as possible. This can be done best by using simplifying models, which portray the information extracted from data in an idealised way.

Optimum Interpolation

The statistical interpolation algorithm can be formulated in several ways. In the analysis scheme considered here, the values of the variables analysed will be either those produced by an observing instrument or the difference between such values and guess or forecast values. In fact, the analysis might be improved if a preliminary estimate of the analysis could be obtained from a previous numerical forecast or the climatological field (the mean true field). The basic form of the analysis equation is

$$f_A(\vec{r}_i) = f_B(\vec{r}_i) + \sum_{k=1}^{K} W_{ik}\left[f_O(\vec{r}_k) - f_B(\vec{r}_k)\right]$$

where $f(\vec{r})$ is the variable to be analysed at the location $\vec{r}$, $f_A(\vec{r}_i)$ is the analysed value of f at the analysis grid point $\vec{r}_i$, $f_B(\vec{r}_i)$ the background value of f and $f_O(\vec{r}_k)$ and $f_B(\vec{r}_k)$ are the observed and background values at the observation station $\vec{r}_k$. K is the number of observation stations, and the W_{ik} are the weight functions which are determined in a way that they minimise the expected analysis error variance.

The problem is that, in order to find weights W_{ik} that minimise the analysis error, you have to know the differences between observation and truth and background an truth (the error); and since the truth cannot be known precisely it must be estimated. This involves the use of background error and observation error covariance matrices for the determination of the weights. The latter task is quite tricky and it influences the quality of the algorithm's final performance.

Implementation of the OI algorithm

We need both an appropriate tool for visualising meteorological fields in good quality and a suitable

implementation of the OI to perform computations and to simulate different modifications in the OI algorithm.

In meteorology, FORTRAN as a programming language is still in use. A great number of computing routines have been written in Fortran and since they meet everyday needs they are widely spread even today.

For visualisation, IDL (Interactive Data Language) is used with preference. IDL is a complete computing environment for the interactive analysis and visualisation of data. It includes a powerful language with numerous mathematical analysis and graphical display techniques.

ALPCLIM data

At the Central Institute for Meteorology and Geodynamics, Vienna (ZAMG), Alpine climate data have been collected for many years. They are known to be of good quality. The so-called ALPCLIM data provided by ZAMG contain homogenised climate data of 86 Alpine stations. Since ALPCLIM data are available on a regular grid as well, they are predestined to serve as quality control for grids created with OI.

Application of OI over the Alps:

Interest lies in examining the performance of the OI over the Alps in detail and to improve the algorithm in such a way that we get optimal results. Modifications mainly include an appropriate choice of the mentioned observation error and background error covariance matrices, and this requires an employ of autocorrelation functions which make explicit use of ensemble spatial correlation structure of the whole field.

For 86 Alpine stations, a correlation analysis has been performed. The results show that the monthly temperature anomalies with regard to the monthly mean over the period 1901-1998 have a high spatial correlation and that factors like geographic location similarity affects the correlation more than the distance. This may get evident, considering figure 1 which shows the correlation of Zurich (Switzerland) with all other ALPCLIM stations. In spite of greater distances, Zurich has a better correlation with a number of northern Alpine stations than with much nearer southern Alpine ones. The influence of the Alps is clearly visible in this figure. There can now be taken explicit use of the ensemble correlation structure by fitting the autocorrelation function to the specific correlation data.

Quality Tests:

Monthly temperature anomalies regarding the 20th century mean at 86 stations were picked out of the ALPCLIM data and interpolated to 105 grid points. For each month of a 42 - year period, each station was left out once and then used to calculate the interpolation error at its location.

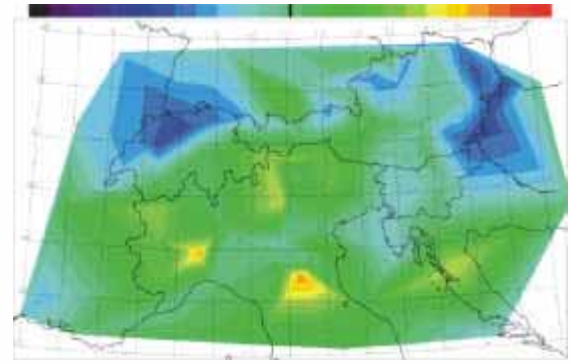

Figure 2: spatial distribution of the RMS - interpolation error over the ALPCLIM region

Results proved to be encouraging: The mean interpolation error at the locations of the stations varies between -0.003 K and +0.003 K. Obviously, Optimum Interpolation has indeed minimised the mean analysis error. In order to facilitate further investigations, the RMS - error at the locations of all stations was calculated as well. It is plotted in figure 2. Regions with minimal RMS - error (~0.25 K) are situated exclusively outside the main Alpine divide.

Some relatively large interpolation errors occurred at locations where error maxima can be explained by their geographical surroundings (e.g. influence of foehn in Bologna).

Experiments with anisotropic autocorrelation functions, which simulate a stronger correlation gradient in meridional direction than in zonal direction (as it is implied by fig. 1), have not brought considerable results yet. One reason might be, that the Optimum Interpolation algorithm in the present form is highly resistant against parameterisation of the autocorrelation function. Since the results that were obtained so far turned out to be were satisfactory, it is justified to renounce on further experiments with autocorrelation functions.

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[4] Gandin - Objective Analysis of Meteorological fields. Leningrad,1963. Gidrometeorologichskoe Izdatel'stvo, Jerusalem 1965

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SIMULATION CENTRES

FOMAAS – Research Center for Multidisciplinary Analysis and Applied Systems Optimisation

Siegen, Germany

www.fomaas.uni-siegen.de

Aims

FOMAAS is an abbreviation for „Forschungszentrum für Multidisziplinäre Analysen und Angewandte Systemoptimierung“ – „Research Center for Multidisciplinary Analysis and Applied System Optimisation“. The center was founded in 1992 at the University of Siegen as an interdisciplinary institute with research contributors from the engineering sciences, applied mathematics and computer science. The general aim of FOMAAS is the modeling, analysis, simulation and optimization of complex systems by computer-aided methods.

By „complex systems“ not only complex engineering applications like railway vehicles, aircrafts, buildings or production plants are meant but also large multidisciplinary systems that occur in economics, water management and supply or biotechnology. All these systems have in common that methods from the engineering, computer and mathematical sciences must be integrated to achieve practically useful solutions. All FOMAAS activities are based on this common methodological platform to deal with complex systems.

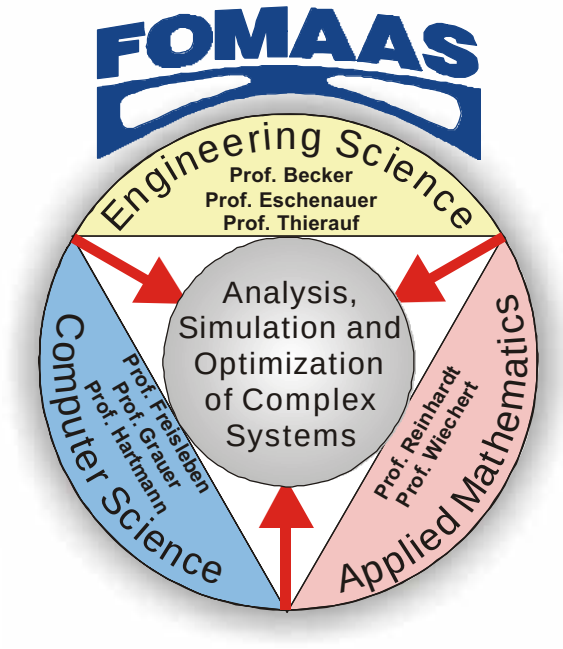
The developments of FOMAAS aim at practical applications in an industrial environment. Various cooperations with different companies ensure that the methods are applied and refined under realistic conditions.

Several software systems developed by the FOMAAS members are used by the industrial partners. Last but not least there is a significant transfer of information and methodological know how into industry.

Structure

Without the expertise of specialists who contribute their specific domain knowledge all the methodological and computational efforts will be fruitless.

Thus in order to reach the ambitious goals of FOMAAS profound knowledge of the application domain must be brought together with mathematical and conceptual modeling, systems analysis and simulation as well as software engineering and high performance computing.

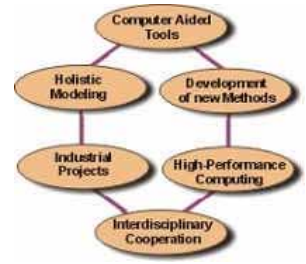


Domain knowledge from mechanics, civil engineering, process engineering and economics is readily available at FOMAAS.

The current staff of FOMAAS is shown in the figure above. If required, bilateral cooperations with other research groups complement these resources.

Concept

FOMAAS is characterized by



- the consequent application of scientific software tools which are not only simulation tools like multibody simulators or finite element analysis but also computer algebra systems, scientific computing environments, modelling tools, graphical visualization tools and optimisation programs.
  Complete problem solutions for practical applications require the combination of all these methods.
- the multidisciplinary modelling approach which does not only take into account the single parts of a system but also their interrelations.
  Many industrial developments are never finished because the global requirements of a complex system have not been sufficiently considered in the development of its parts.

- the development and application of simulation based multidisciplinary optimisation methods, which take into account all the constraints and contradictory design goals encountered in practical applications.
- the application in industrial projects, which guarantees that the developed methods, tools and results do not remain in the academic society but are really applicable under practical requirements.
- the interdisciplinary cooperation of different experts, which is a necessary condition for the successful management and optimisation of complex systems. For this reason FOMAAS integrates specialists from various application domains with experts from applied mathematics and computer science.
- the development of new methods for modelling, simulation and optimisation, which are still working when commercially available solutions reach their limitations. To this end large software systems (particularly for optimisation) are developed and maintained by FOMAAS. This requires a close integration of application domain knowledge and modern software engineering methods.
- the usage of network computing facilities by connecting standard workstations and PCs in order to solve large simulation and optimisation problems. This cheap alternative to dedicated high performance computers like massive parallel systems has the advantage that it is readily available in every academic and industrial surrounding.

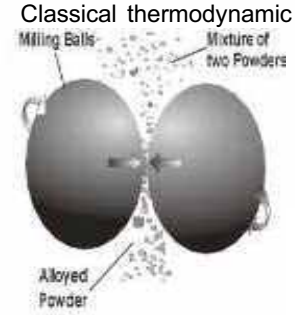
Projects

The following FOMAAS projects are currently being worked on:

- Structural Mechanics: train components, aircraft design, sheet metal forming
- Materials Science: composite structures, oxide fuel cells, mechanical alloying
- Process Simulation: cement clinker burning, high energy ball milling, laboratory automation, metabolic modelling
- Civil Engineering: earthquake damage, groundwater management
- Metabolic Engineering: metabolic flux analysis
- Network Computing: evolutionary algorithms, load balancing, parallel optimization algorithms
- Inverse Problems: solution of ill-posed problems, heat conduction problems

From the Projects: Modeling and Simulation of the Mechanical Alloying Process

The development of methods and processes for the production of new materials with hitherto unknown physical and chemical properties is an important current research area. One main goal is the rational design of materials, that is the targeted production of materials with given properties. Under this aspect, a promising class of new products are the so-called nanostructured materials, which are composed of different crystallites at the nanometer scale.



Classical thermodynamic models are not applicable here, because nanostructured materials constitute a metastable phase far from the thermodynamic equilibrium.

Thus, mathematical modelling and simulation of the instationary process dynamics can help to gain a quantitative understanding of the different mechanisms in the milling process. A first attempt to model the process was undertaken at the macroscopic level of particle size distributions, which is also the classical approach to describe milling processes.

A simulation program was implemented to solve the arising integro-differential equation numerically. The process parameters are then obtained by parameter fitting to measured particle size distributions. It was already possible to reproduce the experimentally observed dynamics of a single-phase system with Ag3Sn powder.

FOMAAS Information

FOMAAS publishes a status report every two years. Future reports can be sent on demand.

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EUROSIM SOCIETIES

EUROSIM
Federation of European Simulation Societies

www.eurosim.info

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

At present **EUROSIM** has ten full members and three observer members:

- **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 (UK, Ireland)
- **AES** – Asociación Española de Simulación (Spain; observer member)
- **PSCS** – Polish Society for Computer Simulation (Poland, observer member)
- **ROMSIM** - Romanian Society for Modelling and Simulation (Romania; observer member)

The EUROSIM Congress is arranged every three years in Europe. EUROSIM'01, the 4th EUROSIM congress, took place in Delft, The Netherlands, June 26-29, 2001 (see congress report in this issue. The next congress, EUROSIM'04, will take place in September 2004 in Paris.

EUROSIM is governed by a Board consisting of one representative of each member society, plus the organizer of the last and next EUROSIM Congress (past president and president).

At the EUROSIM'01 Congress the Board elected new officers for a three years period: Y. Hamam (president), L. Dekker (past president), M. Savastano (treasurer), P. Fritzson (secretary), J. Halin (SIMPRA), F. Breitenecker (SNE), F. Maceri (member).

EUROSIM societies are offered to distribute to their members the journal Simulation News Europe (SNE) as official membership journal:

www.argesim.org/SNE, www.eurosim.info/SNE/

Furthermore members can subscribe the scientific journal Simulation and Modelling, Practice and Theory (SIMPRA) at a significantly reduced price:

www.elsevier.nl/locate/simpra/

More information about EUROSIM and EUROSIM societies may be found at EUROSIM's WWW Server. Due to technical reasons the web address of EUROSIM has changed. Instead of a .org – domain now a .info domain is used: www.eurosim.info

Letter of the President

Dear colleagues,

Since last June I have the pleasure and the honour of assuring the presidency of the EUROSIM. I would like to thank the society members for their trust, and hope be up to their expectation.

I would like to seize this occasion to felicitate Professor Len Dekker, the previous president, for the excellent work during his presidency that culminated with the high quality conference in Delft.

Our federation can only advance with the effort of our member societies. At this point I would like to ask all members to contribute to making is a platform for exchanging experiences and for advancing knowledge.

This objective depends on all of us. The high quality tools at the disposal of EUROSIM, SNE, SIMPRA and the Congress, are efficient and of excellent quality. This, however, needs to be reinforced by the continuous proposition of specialised conferences by member societies.

For EUROSIM to advance we have to get new societies to our federation. Contacts with Spain, I hope, should soon lead to having a new active member within our society. We should also improve our collaboration with other simulation societies in Australia, Japan and China.

In June we have renewed the both the Board and the Executive Board. I hope that the new boards will work efficiently so that EUROSIM lives.

Up to your expectations,

Yskandar Hamam, President of EUROSIM
hamamy@esiee.fr

ASIM German Simulation Society
Arbeitsgemeinschaft Simulation

www.asim-gi.org

ASIM (Arbeitsgemeinschaft Simulation) is the association for simulation in the German speaking area. ASIM was founded in 1981 and has now about 700 individual members, and 20 institutional or industrial members.

News and Developments

The ASIM board met in April 2001 and in September 2001 at University Paderborn. Main discussion points were: conferences ASIM 2001 and ASIM'2002, other conferences to come, the activities of the working groups, ASIM publications, co-operation with SCS Europe and some organisational issues.

Next meeting of the ASIM board will be on November 26th in Rostock. Subject will be preparation of ASIM 2002, cooperation amongst the working groups, cooperation with other organizations, etc. Please contact the speaker, if you feel an important issue should be discussed there.

ASIM Working Groups

A discussion on working groups took place. While some working groups are very active and consequently have many members, some working attract only few people to workshops and cannot attend more members, due to various reasons.

The big working groups organise themselves workshops and conferences, and they cooperate with societies and groups of their application area, regionally and internationally.

In order to promote ASIM, and in order to support the small working groups, ASIM will be present at some conferences of application areas and ASIM will try to contact groups or societies in the specific application area.

The bigger working groups (Methods, Technical Systems, and Production and Logistics...) cooperate with VDI/VDE and partly with other groups from GI (ASIM itself is a subgroup of GI, the German Society for Informatics). Cooperation with GOR (Society for Operation Research), with societies in area of biomedical engineering and with KI - groups of GI could provide support for the smaller ASIM working groups.

ASIM Promotion

ASIM is aware of the fact, that modelling and simulation has become a widespread method, which is not only found in simulation groups. Many application societies are running themselves successfully working groups on modelling and simulation. If in the German speaking area such groups in application societies exist, it makes no sense to set up a new ASIM working group with the same focus. It also turns out, that the smaller ASIM working groups are faced with such working groups in other societies.

As it makes no sense to reinvent the wheel again,

- ASIM intends to co-operate with such working groups on level of ASIM working groups,
- and ASIM will actively seek contacts with other societies and groups.

This year the first steps have been done. ASIM took part at the international Trade Fair and Knowledge Exchange on Applied Simulation and Visualisation SIM'2001, Freiburg / Breisgau, Germany, June 2001 (see report in this SNE issue). This event opened the doors to cooperation with people from CFD (computational fluid dynamics). Furthermore ASIM organised there a workshop on *Education in Simulation*. It is intended to continue this cooperation at the next Trade Fair SIM2003.

ASIM also was present at the annual GI congress, Vienna, in order to get contacts with other GI subgroups. ASIM will continue these efforts next year.

Conferences

ASIM organises the annual ASIM Conference, the ASIM Working Groups organise workshops (up to 100 participants) and conferences (more than 100 participants. ASIM cooperates in organising the three-annual EUROSIM Congress.

ASIM and SCS Europe will continue the cooperation at conferences based on co-sponsoring of ESM and ESS conferences (but not of the many other conferences of SCS Europe BVBA). Some organisational problems are to be solved, e. g. the cooperation with local chairs and conference fees (at ASIM conferences e.g. due to voluntary work and support from university infrastructure conference costs can be much lower).

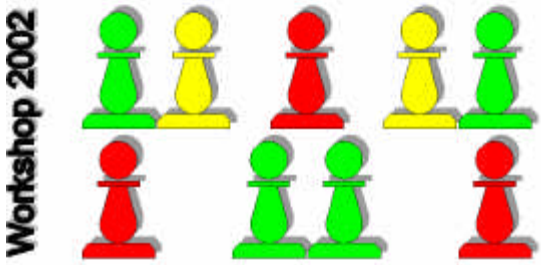
ASIM also supports the annual international conference series, the long-running series *SIMVIS Simulation and Visualisation* (Magdeburg, Germany), and the new series Agent-Based Simulation (Passau, Germany).

With respect to international simulation conferences, the board suggested again,

Workshop 2002

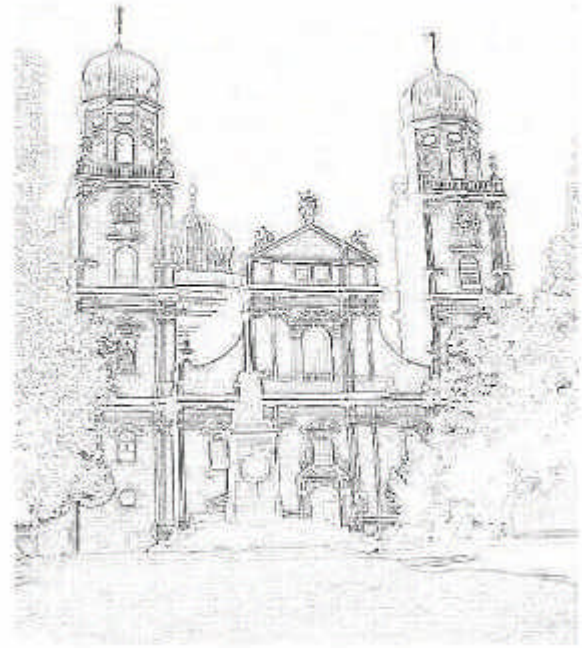
3rd International
Workshop on
Agent-Based Simulation

Agent-Based Simulation 3



April 7-9, 2002

University of Passau
Passau, Germany



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Further Information:

http://www.or.uni-passau.de/workshop2002

- that the competition of too many simulation conferences (especially how it happened around the EUROSIM Congress 2001 in June 2000) is contraproductive,
- and that the EUROSIM Congress should be scheduled in September (as from 1993 - 1995) in order to have more ASIM participants (in June there are no university holidays, furthermore end of June / begin of July exams are scheduled).

In order to support this plans, ASIM is willing

- to skip the annual ASIM conference in 2004, if the EUROSIM Congress EUROSIM'04 (Paris) takes Place in September, and
- to continue this conference strategy for further years.

ASIM also would support joint conferences and congresses: smaller EUROSIM societies could organise events together. Furthermore, there are up to now unofficial contacts between SLOSIM and ASIM for c cooperation in organising the congress EUROSIM'2007.

Because Modelling and Simulation is dealt with not only in ASIM and other simulation societies, ASIM will be present also at simulation tracks of conferences from various applications and on trade fairs and exhibitions.

This year, ASIM was present at SIM'2001 in Freiburg and at GI Conference in Vienna. Next year ASIM will be present (up to now) at Operations Research 2000, Klagenfurt, Austria, and at EMBEC'02 (2nd European Medical & Biological Engineering Conference) in Vienna (announcements in this SNE).

Coming Events

ASIM 2001 was a real highlight this year. Over 250 people met in Paderborn to exchange their ideas, listen to the presentations. The technical program was impressive, both in depth and in the number of application areas. A detailed report is to be found below.

ASIM 2002 will be held in Rostock in September 2002. The organization team has been build and covers many experts in the field of simulation. We expect an exciting conference, also with touristic highlights. A call for papers has been send to all ASIM members. A detailed announcement can be found below. Info also at web: asim.informatik.uni-rostock.de

ASIM SPL 2002. The ASIM working group *Simulation in Production and Logistics* is organising in 2002 the 10. Fachtagung Simulation in Produktion und Logistik. This bi-annual conference has become very successful (more than 200 participants, many from industries) is organised in Duisburg, March 6- 8, 2002. Info: www.uni-duisburg.de/FB7/FG11/Asim.html

SIMVIS'2002. ASIM cosponsors the conference series *Simulation and Visualisation*. The next conference will take place Feb. 28 – March 1, 2002, in Magdeburg. Info: www.simvis.org

AB-SIM'2002. Organised from ASIM members, this conference series *Agent-Based Simulation* will take place next in April 7-9, 2002, in Passau. Web Info: www.or.uni-passau.de/workshop2002/

SCS Conferences ESM'2002 (March 2002) and ESS'2002 (October 2002) with ASIM participation please refer to www.scs-europe. org.

In order to promote ASIM and ASIM Working Groups, cooperation (organisation of simulation tracks and tutorials) with the following international conferences will take place:

- International Conferences on Operations Research OPERATIONS RESEARCH'2002, Klagenfurt, Austria, September 2 – 5, 2002 Info: www-sci.uni-klu.ac.at/or2002/
- EMBEC'02, the 2nd European Medical & Biological Engineering Conference will take place in Vienna, December 4 –8, 2002. Info: www.embec.org

For meetings of the working groups, please see below or ASIM – Nachrichten 2001/3, which are mailed with this SNE.

Publications

ASIM is publishing (co-publishing) ASIM-Nachrichten and SNE (Simulation News Europe). Both journals are regularly published and sent to all ASIM member (as part of their membership 700 issues) and spread for promotion (500 issues).

Furthermore, the ASIM working groups report in so-called ASIM - Mitteilungen about their meetings, about special developments, etc - either as ASIM self-publication or as publication in series of other publishers (e.g. ARGESIM Reports).

ASIM co-operates with SCS Europe and with ARGESIM (TU Vienna) in publication of two book series:

- ASIM/SCS book series „Fortschritte in der Simulationstechnik – Frontiers in Simulation"
- ASIM / ARGESIM / SCS book series „Fortschrittsberichte Simulation – Advances in Simulation"

ASIM/SCS book series „Fortschritte in der Simulationstechnik – Frontiers in Simulation"

New Working Group Status Report. In March 2001 the new book „Simulation Technischer Systeme - Berichte aus der Fachgruppe" (in German Language) has been published (Ingrid Bausch-Gall ed.).

Each of the 10 authors (author groups) is very experienced in the specific area and all authors work for industrial companies or have a strong industrial background. The authors report in detail about one of their current simulation application. App. 280 pages, 41 Euro for ASIM/SCS members, 51 Euro for others + mailing.

Also available in these series are other status reports (monographs) of ASIM working groups and the Proceedings of the annual ASIM conferences:

- Proceedings of „Simulationstechnik – 13. Symposium in Weimar“, Sept.1999 (ed. Georg Hohmann). ISBN 1-56555-130-3, 476 p.
- „Modellierung, Simulation und Künstliche Intelligenz“ (editors: Helena Szczerbicka, Thomas Uthmann). ISBN 1-56555-128-1, 471 p.
- „Referenzmodelle für die Simulation in Produktion und Logistik“ (editor: Sigrid Wenzel). In this multi-expert compendium a survey is given on common „reference models“ in various fields of application, processes and structures. ISBN 1-56555-182-6
- Proceedings “Simulationstechnik – 14. Symposium in Hamburg September 2000” (editor Dietmar P. F. Möller), ISBN: 1-56555-189-3
- Proceeedings “Simulationstechnik - 15. Symposiums in Paderborn”, Sept. 2001, (ed. F. Dörrscheidt), ISBN: 3-936150-10-9

As there are plans from working groups to publish further Status Reports in these series, financial matters had to be discussed: the working group has to take care on a certain number of subscriptions or an equivalent sell of a bulk of books, in order to guarantee a financial basis for the book, and in order to keep the price for the book lower.

All books may be ordered from ASIM or from the SCS European Publishing House, or via Internet

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SCS Europe Publishing House
R. Rimane, Erlangen,
Tel./Fax: +49-9131-66247
admin@asim-gi.org
rimane@cs.fau.de
www.asim-gi.org, www.scs-europe.org

ASIM / ARGESIM / SCS series Fortschrittsberichte Simulation - Advances in Simulation

This series is open for publication of PhD theses, habilitations, software guides, etc.

While the series „Advances in Simulation“ is similar to „Frontiers in Simulation“ with respect to layout and printing, the series „Fortschrittsberichte Simulation“ is a low-cost series with special offers for bulks.

New books are available in this series:

- E. Hajrizi: Intelligentes Online – Planungs- und Steuerungssystem für Flexible Produktionssysteme basierend auf Simulation und Optimierung mit genetischen Algorithmen. 2001, ARGESIM-Verlag, ISBN 3-901608-60-5
- Th. Fent: Applications of Learning Classifier Systems for Simulationg Learning Organizations, 2001; ARGESIM – Verlag, ISBN 3-901608-56-7
- S. Pawletta: Erweiterung eines wissenschaftlich-technischen Berechnungs- und Visualisierungssystems zu einer Entwicklungsumgebung für parallele Applikationen, ISBN 3-901608-57-5, 2000.
- Ch. Almeder: Hydrodynamic Modelling and Simulation of the Human Arterial Bloodflow; ISBN 3-901608-58-3, 2000.
- Th. Preiß: Relationale Datenbanksysteme als Basis für Modellbildung und Simulation von kontinuierlichen Prozessen, ISBN 3-901608-59-1, 2000.

All these books may be ordered from ASIM:

ASIM / I. Bausch-Gall, Munich
Tel.: +49-89-3232625, Fax: +49-89-3231063
www.asim-gi.org/publikationen/
www.scs-europe.org

Reports from the Working Groups

Most ASIM working groups meet in spring 2001. Detailed reports about the meetings appear in the ASIM Nachrichten.

Working Group *Methods in Modeling and Simulation* will meet again in spring 2002. An invitation will follow soon. Subjects will cover the theoretical and software basis of simulation. A detailed list is found in ASIM Nachrichten.

Working group Simulation in *Production and Logistics* will meet again on January 8th, 2002 at Fraunhofer IPK in Berlin. The next conference will be held on March 6th to 8th, 2002 in Duisburg (see above). Local organizer is Prof. Dr. Bernd Noche (for info mail to b.noche@uni-duisburg.de). A call for papers has been send to all ASIM members.

Working Group *Simulation of Technical Systems* will meet on March 4th -5th 2002 at FH Bielefeld. Subjects will cover amongst others: electronics in automotive applications, VHDL-AMS, new mathematical methods.

Working Group *Simulation of Environmental Systems* met on March 25th to 27th in Münster. A detailed report can be found in ASIM-Nachrichten. The next workshop will be on March 7th and 8th 2002 in Cottbus.

Contact Addresses of Working Groups

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(Simulation and Artificial Intelligence)
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Email: hsz@informatik.uni-hannover.de
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SUG *Simulation in den Umwelt- und Geowissenschaften*
(Simulation of Environmental Systems)
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SMBB *Simulation in Medizin, Biologie und Biophysik (Simulation in Medicine, Biology and Biophysics)*
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STS *Simulation Technischer Systeme*
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SPL *Simulation in Produktion und Logistik*
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SBW *Simulation in der Betriebswirtschaft*
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SVS *Simulation von Verkehrssystemen*
(Simulation of Transport Systems)
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Report ASIM'2001

The 15th ASIM conference on simulation techniques took place in Paderborn from 11 to 14 of September 2001. About 250 participants could be welcomed to ASIM 2001 in Paderborn.

ASIM 2001 was organised by the Institute of Control Engineering in the Department of Electrical Engineering and Information Technology at the University of Paderborn. Chairman of the ASIM 2001 conference was Prof. Dr. Frank Dörrscheidt. The scientific conference program consisted of about 110 papers including 22 posters and four plenary lectures. Furthermore, 16 companies and institutes joined the exhibition of simulation software and services.

ASIM ASIM ASIM

ASIM - Buchreihen / ASIM Book Series

Reihe Fortschritte in der Simulationstechnik / Series Frontiers in Simulation – with SCS

kürzlich erschienen / recently appeared:

- D. P. F. Möller (Hrsg.): Proc. 14. Symposium Simulationstechnik, Hamburg, Sept. 2000
- K. Panreck, F. Dörrscheidt (Hrsg.): Proc. 15. Symp. Simulationstechnik, Paderborn, 2001
- W. Borutzki: Bondgraphen – Eine Methodologie zur Modellierung multidisziplinärer dynamischer Systeme;
- H: Szczerbicka, T. Uthmann (Hrsg.): Modellierung, Simulation und Künstliche Intelligenz
- S. Wenzel (Hrsg.): Referenzmodelle für die Simulation in Produktion und Logistik
- I. Bausch-Gall (Hrsg.): Simulation technischer Systeme – Stand und Entwicklungen

Schwerpunkte / Topics:

- Statusberichte über Simulation in den ASIM Fachgruppen / Status Reports
- Allgemeine Monographien / General Monographs
- Proceedings der ASIM Tagungen / Proceedings of Conferences

Reihe Fortschrittsberichte Simulation / Series Advances in Simulation – with ARGESIM / SCS

kürzlich erschienen / recently appeared:

- S. Pawletta: Erweiterung eines wissenschaftlich-technischen Berechnungs- und Visualisierungssystems zu einer Entwicklungsumgebung für parallele Applikationen
- Ch. Almeder: Hydrodynamic Modelling and Simulation of the Human Arterial Bloodflow
- Th. Preiß: Relationale Datenbanksysteme als Basis für Modellbildung und Simulation von kontinuierlichen Prozessen
- E. Hajrizi: Intelligentes Online – Planungs- und Steuerungssystem für Flexible Produktionssysteme basierend auf Simulation und Optimierung mit genetischen Algorithmen
- Th. Fent: Applications of Learning Classifier Systems for Simulating Learning Organizations

Schwerpunkte / Topics:

- Spezielle Monographien (Dissertationen, ...) / Special Monographs (PhD-thesis, ...)
- Erweiterte Berichte der ASIM Fachgruppentreffen / Workshop Proceedings
- Handbücher für Simulationssprachen, Berichtband / User Guides, Reports

Preis / Price: EUR 20.- (ASIM-Mitglieder EUR 15.-) + Versandkosten

Bestellung, Information, Informationen für Autoren / Info, Orders:

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SCS SCS SCS

ARGESIM REPORT ARGESIM REPORT

Thanks to the organisers: K Panreck, A. Kossmann, F. Dörrscheidt

Excursions have been carried out to the company Hella KG (HLS), one of the largest suppliers for car lightning and electric equipments, and to the Heinz Nixdorf Computer Museum (HNF), containing the worldwide largest exhibition on the history of information technologies. The social program included a rustic dinner in a historic small village.

ASIM was represented by the ASIM office team from ARGESIM (TU Vienna), offering new ASIM / SCS publications and other proven services (above).

ASIM 2002

16. Symposium Simulationstechnik, Rostock, Sept. 10-13, 2002

ASIM.informatik.uni-rostock.de

The ASIM 2002 will take place at the University of Rostock from September 10-13. The organizing committee is chaired by Prof. Dr.-Ing. Djamshid Tavangarian (Department of Computer Science).

The topics of the conference cover all aspects of modelling and simulation. This includes:

- Modelling and Simulation Methods,
- Simulation Hardware and Software,
- Simulation Tools
- Applications

The ASIM 2002 offers:

- Plenary lectures for new developments and trends
- Lectures and posters on all topics of modelling and simulation
- Practitioners forums for special applications
- Workshops about all current topics
- Exhibition of simulation soft- and hardware
- Tutorials
- User group meetings

Apart from the general poster session an additional poster session for student contributions is planned. There graduates will have the possibility to present the results of their research. There will be an award for the best presentation.

Social program. Detailed planning will be given later.

Location.

Medieval foundation of the town in the year 1218. The town used to be a member of the "Hanse", a league of towns, which formed and influenced the political and economical life in Northeast Europe for more than three centuries. In the late Middle Ages and the Renaissance, Rostock won a lot of cultural influence mostly due to the foundation of the first university of North East Europe in 1419. Since the time of the Hanse, Rostock is the most important economic centre in Mecklenburg. Today, the town counts about 200.000 inhabitants, about 14000 students study at the university. Rostock offers its visitors a widespread range of cultural events.

Further information can be found at

ASIM.informatik.uni-rostock.de

www.asim-gi.org

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CROSSIM

Croatian Society for Simulation Modelling

rudjer.irb.hr/~crossim

CROSSIM (The Croatian Society for Simulation Modelling) was founded in 1992. Since 1994 it is an affiliate of SCS, and since April 1997 a full member of EUROSIM.

General

CROSSIM is a non-profit society with the following 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. CROSSIM has currently 68 individual members from both universities and industry. The majority of them are situated in Zagreb, the capital of Croatia, but active members come also from regional centres (Split, Rijeka, Osijek, and Varazdin). There are a few international members as well.

The president, vice-president and a representative in international organizations represent the Society. The executive board consists of the president and 8 members. Prof. Vlatko Ceric was the founding president of CROSSIM, and his successors, as elected presidents, were Mladen Mauher, Tarzan Legovic, Vesna Bosilj Vuksic and Jadranka Bozikov who was elected in March 2001. The General Assembly of the Society meets once a year.

Information, Email List

Initial CROSSIM www site is accessible at rudjer.irb.hr/~crossim. The e-mail distribution list serves for communication among members. Everybody can send an e-mail to all of the members at once using the list address crossim@carnet.hr

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Activities

Cooperating in the organization of the international conference Information Technology Interfaces (ITI), which traditionally has a strong modelling and simulation section.

Cooperating in publishing Journal of Computing and Information Technology (CIT), an international journal covering the area of computer science and engineering, modelling and simulation and information systems. All the information concerning CIT is available at URL www.srce.hr/cit/home.html

Organization of simulation seminars and workshops on a regular basis. Members are encouraged to present their ongoing work in order to discuss the problems and exchange the experiences.

Work on scientific projects in discrete and continuous simulation, and applications of simulation in such diverse fields like engineering, economy, biology, medicine, health care, ecology etc.

Past Events

23rd International Conference *Information Technology Interfaces ITI 2001* was held on June 19-22, 2001 in Pula. 177 participants, including 118 from 29 foreign countries, and 59 from Croatia, attended the conference. 67 papers written by 146 authors have been accepted for presentation and printed in the Conference Proceedings. Among them there were 14 papers in the section *Modelling, simulation and optimisation.*

A few seminars were held in 2001. The last of them was entitled *"Embryonic brain development as a system dynamics model".*

Coming Events

ITI 2002
24th Conference *Information Technology Interfaces,*
June 24-27, 2002, Cavtat near Dubrovnik.

24th Conference *Information Technology Interfaces ITI 2002* will be held on June 24-27, 2002 in Cavtat near Dubrovnik. Cavtat was a host of the conferences from 1980 to 1991 when the war against Croatia started and conference has been moved to Pula, the 3000 years old city on the North Adriatic. Now conference returns to a small, charming town Cavtat and its luxurious five star hotel *Croatia* after 10 successful, memorable years in Pula. All the information about *ITI 2002* is available at www.srce.hr/iti.

In 2002 we are going to celebrate the 10th anniversary of our Society. We plane to publish a booklet that will include the list of all members and bibliography of published papers and to reconstruct CROSSIM www site.

J. Bozikov
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DBSS

Dutch Benelux Simulation Society

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 cooperation with its members and is further affiliated with SCS International, IMACS, the Chinese Association for System Simulation and the Japanese Society for Simulation Technology.

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 two times a year (one double, one single issue).

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 two times a year (one double, one single issue).

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.

For institutional members counts that they can join national "DBSS events" with three persons against the reduced fee.

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

Dutch Benelux Simulation Society
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Delft University of Technology, ITS - twi
Mekelweg 4, NL - 2628 CD Delft
The Netherlands,
Tel: + 31 (0)15 2785813
Fax: +31 (0)15 2787209
a.w.heemink@its.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.

The Steering Committee of DBSS exists of the following members:

A.W. Heemink (TU Delft): Chairman
L. Dekker: Vice-Chairman
M.J. Dekker-Genemans: Secretary
W. Smit (AKZO NOBEL): Treasurer
Th.L. van Stijn
(Ministry of Public Works/RIKZ): Member

DBSS has organised the EUROSIM 2001 Congress SHAPING FUTURE WITH SIMULATION, June 26 - 29, 2001, Delft The Netherlands. A detailed report can be found elsewhere in this SNE issue.

Marja Dekker-Genemans
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CSSS

Czech and Slovak Simulation Society

CSSS (The Czech and Slovak Simulation Society) has about 150 members in 2 groups connected to the Czech and Slovak national scientific and technical societies (Czech Society for Applied Cybernetics and Informatics, Slovak Society for Applied Cybernetics and Informatics -SSAKI).

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. Since 1992 CSSS is a full member of EUROSIM.

Information

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FRANCOSIM
Société Francophone de Simulation

FRANCOSIM was created in 1991 and aims to the promotion of simulation and research, in industry and academic fields. It has members from large French companies and members of Belgian and French universities. FRANCOSIM operates two poles, Modelling & simulation of continuous systems, and Modelling & simulation of discrete events systems

Pole "Modelling & simulation of discrete events systems"

The pole co-organises the series of conferences "MOSIM" (Modelling and simulation). The 1999 conference has led to the publication of a special issue of SIMPRA in 2000.

The third conference took place in April this year: *MOSIM'01, Industrial systems design, analysis and management, April 25-27, 2001, Troyes (France)* - see www.univ-troyes.fr/mosim01

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Pole "Modelling & simulation of continuous systems"

This pole has launched in 1999 a series of conferences on modelling and simulation in medicine and biology (BioMedSim). The first was organised in April 1999 (BioMedSim'99) and has led to the selection of several papers to appear in a special issue of Simpra. It has also co-organised in June 2001 the 2nd BioMedSim'01 in parallel with EUROSIM congress.

Pole contact: Y.Hamam (see coordinates below)

Information, Board

Due to the resignation of the President (Michel Lebrun), the vice-president Yskandar Hamam is presently acting president until the next assembly meeting.

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HSS Hungarian Simulation Society
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

At the Department of Information and Knowledge Management on the Faculty of Economic and Social Sciences of the Budapest University of Technology and Economics classes "Simulation and Modeling in Economy" and an other "Decision Making and Management using Simulation" as well as simulation laboratory practices are held for graduate and postrgraduate students studying economy, informatics and electrical engineering. Ph.D. students participate in various simulation research projects. These R&E activities are coordinated by the associates of the International McLeod Institute of Simulation Sciences Hungarian Center (MISS/Hungary).

In the town of Gyor at the Szechenyi Istvan University of Applied Sciences the discipline of simulation is also taught. Here the class "Simulation Methodology and Applications" is studied by undergraduate students of informatics, electrical and traffic engineering. The Hungarian MISS Satellite Center is located in this university. The establishment of a doctoral school within which there is a program on simulation is in preparation. With regard to this a cooperation with the MISS Satellite Center (director Prof. F. Breitenecker) at the Technical Univ. Vienna is envisaged. Our efforts mentioned are intended to contribute to the dissemination of the knowledge for the young generation.

We have participated at EUROSIM and SCS conferences and presented our simulation results. Our members have been and are successfully participating in national and EU simulation projects.

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ISCS

Italian Society for Computer Simulation

www.iscs.it

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, which recently was elected anew. New chairman is Mario Savastano from University Napoli. Detailed information will be given in the next SNE.

Membership

At present ISCS counts 129 members: 13 institutional, 4 honorary, 110 regular and 2 affiliate.

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

Information, Mailing List

For further information or application for membership, please contact (prel. info address):

ISCS - c/o CNR - IRSIP
Mario Savastano
Via Claudio 21, I – 80125 Napoli, Italy
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We recall that an electronic mailing list has been constituted for persons interested in the ISCS activities. In order to be included in such list, it suffices to send an E-mail message (Subject: ISCS mailing list) containing name, affiliation and address (surface and electronic) to the following address:

cortelle@info.uniroma2.it

To spread information to Italian simulation community, you are invited to send E-mail messages to above given email address; your information will be forwarded to all the addresses of the mailing list.

Detailed information will be given in the next issue.

SIMS

Scandinavian Simulation Society

browse.to/sims

www.ida.liu.se/~pelab/sims

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 practical matters are taken care of by the SIMS board consisting of two representatives from each Nordic country.

The general goals for the society are the following:

- Further the science and practice of modelling and simulation in all application areas
- Be a Scandinavian forum for information interchange among modelling and simulation professionals and non-professionals in Denmark, Finland, Norway and Sweden
- Be a channel for information exchange between the Scandinavian modelling and simulation community and the international modelling and simulation communities.

The society pursues its goals by:

- Arranging technical and scientific meetings and symposia
- Supporting lecturing and publication
- Collecting and disseminating information
- Maintaining contacts with national and international organizations with similar purposes

The SIMS annual meeting takes place at the annual SIMS conference or in connection to international simulation conferences arranged in the Nordic countries.

SIMS 2002 Conference

SIMS 2002 will be held in Oulu, Finland (September 2002).

SIMS Structure

SIMS is organised as federation of regional societies. There are FinSim (Finnish Simulation Forum) and MoSis (Society for Modelling and Simulation in Sweden), and now SIMS has also national organisations in Norway and Denmark as members.

SIMS 2001 - 42nd Scandinavian Conference on Simulation and Modeling, Porsgrunn, Norway, October 2001

Scandinavian Simulation Society arranged its 42nd annual conference at Telemark University College in Porsgrunn, Norway October 8-9 2001.

Close to 50 participants gathered to listen to 27 presentations and two invited speakers.

Four companies showed their simulation software. The programme, a list of participants, some photos to remember the gathering, etc. are shown on www-pors.hit.no/tf/sims2001/sims.htm.

Bernt Lie, the chairman of the organizing committee, reports: "I'm happy with the number of participants and their eager participation in the discussions. In particular, I find the mixture of stimulating invited speakers, open minded Ph.D.-students, industry participants and exhibitors of simulation tools fruitful for spreading new simulation techniques among the various fields that utilize simulation. I look forward to an even more stimulating SIMS 2002 conference in Oulu, Finland in 2002."

Membership, SIMS Board

Peter Fritzson, chairman
Bernt Lie, vice chairman
Arne Jakobsen, secretary
Kaj Juslin, treasurer
Björn Bergström
Esko Juuso, Falko Wagner, Anne Elster

You can contact the chair of the SIMS board, Prof. Peter Fritzson (Linköping University, Sweden),

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To become a member of SIMS you should join one of the SIMS member organizations, as specified on the SIMS web page, e.g. MoSis, the Society for Modelling and Simulation in Sweden, or FinSim, the Finnish Simulation Forum.

Contact Address, Information

Updated SIMS web page with news and recent information:

browse.to/sims
www.ida.liu.se/~pelab/sims

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AES

Spanish Simulation Society

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SLOSIM

Slovenian Society for Simulation and Modelling

msc.fe.uni-lj.si/SLOSIM

General information

SLOSIM (Slovenian Society for Simulation and Modelling) was established in 1994 and became the full member of EUROSIM in 1996. It has 88 members from both Slovenian universities, institutes and industry as well and aims the promotion of modelling and simulation in industrial and academic environments and to facilitate communication among corresponding groups.

Recent events

Lectures within ERASMUS

From April 9- April 12, 2001 Prof. Felix Breitenecker, TU Vienna had lectures for graduate students but also for SLOSIM members from the field of discrete simulation.

On April 11, 2001 Prof. Breitenecker gave a lecture for SLOSIM members. The lecture was entitled: Simulation-QUO VADIS. The summary:

- Simulation: Once upon a time ....
- ODE model, nonlinear ODE solvers, queuing theory, coupled systems event, systems state machines, time domain analysis.
- Simulation nowadays: hybrid Systems, physiological systems, co – simulation, PDE solving, unconventional modelling, event scheduling, Petri nets, fully automatized factory, production process planning, parallel simulation of coupled models, applications.

SLOSIM Board Meeting

On April 11, 2001 SLOSIM had a regular board meeting (see picture below).

Some problems concerning the EUROSIM federation were discussed before the annual board in Delft.

Prof. Borut Zupancic was appointed to be the SLOSIM representative in EUROSIM board for the next triennial period and Prof. R. Karba the deputy.

Prof. Felix Breitenecker, the editor of Simulation news Europe was invited to participate this board. He explained his view to the development of simulation organization in Europe and to the future of Simulation News Europe.

EUROSIM Congress Delft

On June 25, 2001 Prof. Borut Zupancic participated the EUROSIM board meeting in Delft. He also headed the group of SLOSIM participants

ERK Conference Portoroz, Sept. 2001

SLOSIM was one of the co-operative societies in the organization of the traditional tenth jubilee **ELECTROTECHNICAL AND COMPUTER CONFERENCE ERK'2001** in Portoroz, Slovenia (Adriatic Coast).

The conference took place from Sept. 24 to Sept. 26, 2001. There were app. 240 papers in preprints, more than 200 presented. The program consisted of 6 invited lectures, 32 conference sessions, 1 student session and some other events. The session part consisted of the following tracks:

- Electronics (2 sessions),
- Telecommunication (3),
- Automatic control (2),
- Simulation (3),
- Power engineering (5),
- Measurement (3),
- Computer science (5),
- Artificial intelligence (2),
- Robotics (1),
- Pattern recognition (3),
- Biomedical engineering (2),
- Advances in engineering education (1).
- Special student session.

SLOSIM was responsible for three simulation sessions, which covered methods and algorithms in continuous and discrete event area but also applications in both areas (simulation of cement mill, billets cooling, arterial network, simulation of manufacturing and production systems, …).

There were seven contributions from the Technical University Vienna presented by members of ASIM. So traditional good relations between SLOSIM and ASIM resulted also in more concrete cooperation.

Future plans

Candidature for EUROSIM Congress 2007. SLOSIM expressed several times during EUROSIM board meetings its willingness to organise the EUROSIM congress.

SLOSIM board set its EUROSIM representative a task to make an official candidature for EUROSIM CONGRESS 2007 during next EUROSIM board meeting.

There were also unofficial discussions between representatives of SLOSIM and ASIM to organise the congress in Slovenia in close cooperation of both societies. These ideas will be discussed during forthcoming board meetings of both societies.

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PSCS

Polish Society for Computer Simulation

General Information

PSCS (The Polish Society for Computer Simulation) was founded in 1993 in Warsaw. PSCS is a scientific, non-profit association of members from universities, research institutes and industry in Poland with common interests in variety of methods of computer simulations and its applications.

At present PSCS counts 237 members. The Board of third cadence consisting of the following persons directs the affairs of the PSCS:

- Andrzej Tylikowski - President
- Leon Bobrowski - Vice President
- Andrzej Chudzikiewicz - Vice President
- Zenon Sosnowski - Secretary
- Kazimierz Furmanik- Treasurer
- Roman Bogacz
- Jaroslaw Rybicki
- Zygmunt Strzyzakowski

Activities

The main activities of the Polish Society for Computer Simulation are annual conferences known as „PSCS Workshops on Simulation in Research and Development".

The PSCS Workshops were organized in: Mielno (1994), Warszawa (1995), Wigry (1996), Jelenia Gora (1997, 1998), Bialystok & Bialowieza (1999), Zakopane – Koscielisko (2000).

Past Events

The annual PSCS Workshop on Simulation in Research and Development took place on August 30 – September 1, 2001 in Gdansk- Sobieszewo, Poland.

The 80 papers of the workshop covered the following areas: simulation in mechanical engineering, simulation in mathematical problems, artificial intelligence and simulation, simulation in transportation, neural nets and simulation, simulation in automation and control, military simulation, simulation tools.

The general assembly of PSCS members was held at the last PSCS workshop on August 31, 2001. This meeting, besides representing an interesting forum to discuss and promote the activity of the society, was the occasion to present and approve the new PSCS Bylaw.

Publications

Proceedings of the 7th PSCS Workshop on „Simulation in Research and Development", R.Bogacz, E. Kolodzinski and Z. Strzyzakowski (Eds.), Warsaw, 2000, (in Polish). The price is 20,- PLN.

Coming Events

Prof. T. Krzyzynski will organize the 9th PSCS Workshop on „Simulation in Research and Development" in August/September 2002.

For information please contact Prof. T. Krzyzynski directly:

tkrzyz@tu.koszalin.pl

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ROMSIM

Romanian Modelling and Simulation Society

ROMSIM - ROmanian Modelling and SIMulation Society, has been founded in 1990 as a non-profit society devoted to both theoretical and applied aspects of computer modelling and simulation of systems. At the beginning the number of founders members was fourteen but in the last years the number of members has increased to over hundred, both from Romania and Republic of Moldavia. During the EUROSIM meetings in Paris, April 19, 1999 *ROMSIM* has been accepted as observer society.

During his existence *ROMSIM* has developed specific activities as information of his members about the new methods and results in modelling and simulation and about the calendar of international events in modelling and simulation but also on related fields as system theory, and its applications (with particular reference to large scale and complex systems, knowledge -based systems, neural and fuzzy systems), control systems theory and its application. As a result of the activities developed by *ROMSIM* some members of the society developed models' libraries for computer simulation and control with application in different fields of activities as follows: ecological systems and environment protection, electro-hydraulic control systems, macroeconomic systems a.s.o.

Activities

But the main effort of *ROMSIM* has been the organisation of its own scientific events and/or the support of some other scientific events. We will present shortly this activity (details in previous issues of SNE).

In 1995 *ROMSIM* members have participated at the 2nd triennial EUROSIM Congress, 1995, organised by ASIM in Vienna. Many ROMSIM members have been participated with communications. We mention also the participation at the 3rd triennial EUROSIM Congress, 1998 organised by SIMS, Finland.

Some *ROMSIM* members have also participated at the 15 IMACS Congress '97 in Berlin, Western MultiConference '99 in San Francisco, ENVIROSOFT'96 Conference in Como, European Control Conference-ECC'93 in Groningen, ECC'95 in Rome and will attend ECC'99 in Karlsruhe. Some ROMSIM members organised Invited Sessions at these Conferences.

In 1998, together with the Research Institute for Informatics and the Operational Research Society, *ROMSIM* has been organised the Seminary: *Calculul de Inalta Performanta/ High Performance Computing,* Bucharest, 1998. ROMSIM members have presented 16 communications. Two round tables have been organised, under the title: *High Performance Computing (*over 60 attendants).

Members of *ROMSIM* have participated at the IMACS World Congress, in Lausanne, Switzerland, 21-25 August 2000, by organizing a Scientific Session and presenting some communications. *ROMSIM* members have participated to the seminary on *Fuzzy Systems*, organised regularly each week, at the Research Institute for Informatics- Bucharest, from 1995.

During the period 2000-2001 *ROMSIM* contributed to the organisation of 4th triennial EUROSIM '2001 Congress in Delft, distributing of the members Posters, Call for Papers and news about the Congress. Two ROMSIM members were active members of the Scientific Committee of EUROSIM Congress 2001. A Tutorial (of the under signed) and six scientific communications have been presented.

On the other hand *ROMSIM* contributed to the organization of *9th IFAC Symposium on Large Scale Systems: Theory and Applications,* Bucharest, 18-20 July 2001. Some ROMSIM members presented communications at this Symposium. The undersigned participated as Chairman of a Session at *European Control Conference*, Porto, Portugal, 1-4 September 2001, presenting also a scientific communication.

An other priority of ROMSIM members is the publication of articles in scientific journals, both Romanian Journals as *Romanian Journal of Informatics and Automatics* and *Studies in Information Technology and Automatics,* and International Journals, as SIMPRA, SNE-Simulation News Europe, SAMS-Systems Analysis, Modelling, Simulation a.s.o.

ROMSIM is interested to co-operates with all societies members of EUROSIM but also with international societies, in participating to realisation of European projects and/or organising of scientific events, e.g. Workshops dedicated to a precise delimited subjects in computer system analysis, modelling, simulation and control, with application in such fields as: biology, ecology and environmental protection (relate for instance to: European River Deltas ecosystems, Black Sea ecosystem, air quality control in the big cities), but also in other fields like electro-hydraulic systems, macroeconomic systems a.s.o.

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UKSIM

United Kingdom Simulation Society

ducati.doc.ntu.ac.uk/uksim/

General Information

The UK Simulation Society has over 100 members throughout the UK from both universities and industry. It is active in all areas of simulation and it holds a biennial conference as well as regular meetings and workshops.

Conferences

The last UKSIM conference held in April 2001, at Emmanuel College in Cambridge, was very successful. More details about this conference are provided in a separate report published in this SNE issue.

In May the Operational Research Society - Simulation Study Group and UKSIM organised a Joint One Day Meeting at Warwick Business School, University of Warwick, Coventry, with the theme *Simulation Output Analysis*.

Publications

The UKSIM is publishing the International Journal of Simulation: Systems, Science & Technology, for more details please refer to the journals corner in this SNE issue and to the web site:

ducati.doc.ntu.ac.uk
uksim/journal/issue-1/cover.htm

Membership, Information

Membership of the UK Simulation Society is very good value at only £20 per year including a subscription to Simulation News Europe.

Those who attend the biennial conferences get free two-year membership untill the next conference. For more information about the Membership please contact the Membership Secretary:

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SCS

Society for Modeling and Simulation International

www.scs.org
www.scs-europe.org

SCS Structure

SCS is the international multidisciplinary forum dedicated to research, development, application and education in modelling and simulation. Since it's founding in 1952 as Society for Computer Simulation, the world changes and topics related to simulation become more complex and methodology oriented. Due to that the Society decide during the annual Board of Directors Meeting at the Summer Computer Simulation Conference 2000, held at Vancouver, to change its name to Society for Computer Modeling and Simulation.

The Society operates since 1952 a headquarter in San Diego, California, USA. and since 1985 an European SCS Office in Ghent, Belgium. The later was changed in 1994 into SCS Europe BVBA, which now is the organisational and financial organisation behind the SCS European Council, which was established in 1991.

SCS Europe

SCS Europe BVBA runs the SCS European Publishing House, which cooperates very close with ASIM, the German speaking Simulation Society, with members from Austria, Germany and Switzerland. Moreover SCS Europe BVBA organises international recommended scientific conferences on computer modelling and simulation and related fields.

The flagships of which are the "European Simulation Multiconference" (ESM) and the "European Simulation Symposium" (ESS), and several smaller conferences on specific topics. ESM and ESS are very well accepted by conference participants, shown by the figures of about 180 to 250 participants.

In 2000 SCS Europe BVBA and ASIM agreed, due to the successful cooperation in the common publication activities, to start a closer cooperation in international conferences. The first ESS/ASIM Joint Conference was the ESS 2000, held in Hamburg. The second was the ESM 2001 in Prague, where ASIM Members took over track chairs and organised sessions.

SCS ESM and ESS Conferences

SCS Europe is running the almost classical conference series ESM (European Simulation Multiconference; in June) and ESS (European Simulation Symposium; in October/November). Sites (prel.) are:

- 2001 ESM'15 Prague
- 2001 ESS'13 Marseille
- 2002 ESM'16 Darmstadtt
- 2002 ESS'14 Dresden
- 2003 ESM'17 Budapest
- 2003 ESS'15 Portugal

ESM'2001, which was held this year in Prague in June of this year followed in the tradition of our great ESM events. A total number of 185 presentations were given over a three-day period, complemented with three invited presentations and four tutorials. The Proceedings are a massive 1180 pages and are now available from SCS-EUROPE.

ESS'2001. Some 190 submissions have been accepted for presentation at the ESS'2001 conference, hold at the hotel Mercure Marseille, October 18-20. The final programme featured 160 presentations, 3 tutorials on DEVS, a DEVS workshop and 2 keynote presentations.

ESM'2002 will be held at the Fachhochschule in Darmstadt, Germany, from June 3-5, 2002. General Conference Chair: Dr. Hermann Meuth.

Themes for the ESM are: Methodology and Tools,, Artificial Intelligence and Neural Networks, High-Performance and Large-Scale Computing, Verification, Validation and Accreditation (VV&A), Economics and Operation Research, Complex Systems Modelling, Education and Gaming, Environment, Biology, Sociology and Medicine. The early bird submission deadline is December 15th, 2001.

These conferences, as well as the new series Agent based Simulation, is co-organised by ASIM, the German Simulation Society.

Agent Based Simulation 2002 will be held from April 7-9, 2002, at the University of Passau, Germany. The website is now online on; the first submission deadline is : Dec. 21st, 2001

www.or.uni-passau.de/workshop2002/

Other Conferences

ECEC'2002 and Euromedia'2002, will be held April 15-17, 2002, at Democenter, a research centre in Modena, central Italy. A number of visits are scheduled for the participants to Ferrari, Lamborghini, Maserati and Ducati.

Euromedia will feature five subconferences: WEBTEC-MEDIATEC-COMTEC-APTEC and ETEC; the early bird submission deadline is: Nov. 25th, 2001

FOODSIM'2002 will be held at the Blarney Park Hotel in, Blarney, Ireland, from June 17-18, 2002

A second joint **SCS-SISO-ITEC** event will be held in Europe from June 24-26, 2002 at the University of Westminster, London, UK.

If you plan to attend any of the conference mentioned above please contact for more information:

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SCS European Publishing House

The SCS European Publishing House publishes monographs and Proceedings in all areas of Modelling and Simulation. Furthermore, two series, "Advances in Simulation" and "Frontiers in Simulation" are published in cooperation with ASIM, the German Simulation Society.

This co-operation is still running well, new books have been published. In the following a list of the most recent books:

- Bernd Schmidt: SIMPLEX 3 -The Art of Modelling and Simulation. ISBN 3-936150-06-0, 524 pages, hardbound, English
- Bernd Schmidt: The Modelling of Human Behaviour. 105 pages, hardbound, full colour, English, ISBN 3-936150-11-7
- Y. Monsef: Modelling and Simulation of Complex Systems. ISBN 1-56555-118-4, 296 pages, hardbound, English
- Helena Szczerbicka, Thomas Uthmann: Modellierung, Simulation und künstliche Intelligenz. ISBN 1-56555-128-1, 471 pages, softbound, German
- Sigrid Wenzel: Referenzmodelle für die Simulation in Produktion und Logistik. ISBN 3-936150-07-9, 282 pages, softbound, German
- Wolfgang Borutzky: Bondgraphen - Eine Methodologie zur Modellierung multidisziplinärer dynamischer Systeme. ISBN 3-936150-09-5, 414 pages, softbound, German

SCS Publisher Bears (by Jutta Rimane)

- Ingrid Bausch-Gall: Simulation technischer Systeme - Berichte aus der Fachgruppe, ISBN 3-936150-08-7, 278 pages, softbound, German

If you are interested in the SCS / ASIM book series please contact the managing editor:

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Modelica Association – SCS TC

www.modelica.org

The Modelica Association is a non-profit, non-governmental organization with the aim of developing and promoting the Modelica modeling language for modelling, simulation and programming of physical and technical systems and processes. The Modelica Association owns and administrates incorporeal rights related to Modelica and acts as technical chapter of SCS and as technical committee of EUROSIM;.

Conference Modelica'2002

Modelica Association and DLR Oberpfaffenhofen organise the next MODELICA Conference:

Modelica'2002

2nd International Modelica Conference
Monday March 18 and Tuesday March 19, 2002
German Aerospace Center (DLR), Munich

The conference is planned for about 100 - 120 participants and will cover the topics such as Modelica development, libraries, implementations, etc.

First deadline ist December1, 2002. Information of any kinf from the local irganiser and from the website:

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INTERNATIONAL SOCIETIES & USER GROUPS

WUA-CFD
World User Association in Applied Computational Fluid Dynamics

www.wua-cfd.com

The general purpose of the Association is the encouragement of research into, the application of, and further education in Computational Fluid Dynamics (CFD).

The all-pervading presence of fluid flow phenomena in our technical surroundings as well as in nature itself renders an understanding of the dynamics of fluids an enormously important, eternally fascinating and also most challenging field of investigation.

The increasing power of computers - both hardware and software - brings us to the brink of a new technological age. The possibility of solving the Navier-Stokes equations numerically and thus predicting the behaviour of fluid flows, together with the help to visualize the details of the flow field, gives a new opportunity and tool to gain access to a new insight.

Since insight directly translates into productivity, CFD techniques are becoming increasingly involved in industrial design processes, delivering more and more potential to improve 'real-world-engineering'.

The World User Association serves as a forum for all applications in the CFD sector related to the needs and demands of industrial users with their everyday CFD problems.

Aims and Scope

Therefore, as an independent Association, the **WUA-CFD** has the following aims and purposes:

- To improve knowledge of CFD amongst industrial users.
- To promote the careful use of simulation by CFD in industrial and applied problems.
- To provide information on progress in application tools and advanced achievements in CFD, from both the hardware and software points of view.
- To help spread know-how in modelisation, tutoring in modelisation and numerical simulation.
- To suggest tools for actual quality assurance and recommendations for their implementation (calls/proposals for benchmarks, validation of codes etc.).
- To evaluate numerical software and physical modelisation.
- To help define visualisation standards and evaluation tools.
- To exchange know-how between users across different disciplines, developers and users, thereby building up a pool of exchange.
- To favour and encourage contacts between students, educational institutions and industry in CFD (e.g. sponsor fellowship etc.).

Activities

To achieve these aims and purposes, the **WUA-CFD** will undertake activities including:

- Call for benchmark and systematic collection of results in the field of applied CFD.
- Elaboration and publication of guidelines and suggestions for quality assurance in the CFD sector.
- Publication of reference works on case reports relating to benchmarking, arranged according to flow phenomena.
- Publication of application-related papers on typical and actual questions relating to CFD.
- Cooperation in national and international events in the CFD sector.
- Cooperation with international standards committees, development and dissemination of new, recognized standards.
- Organization of workshops, seminars, courses and any other activities approved by the Council.

All activities should culminate in a conference with exhibition, held every two years, commencing 1992. This two-years conference, the *World Fluid Dynamics Days*, are since 2001 incorporated into the *SIM 2001 Industrial Trade Fair for Simulation and Visualisation* (www.sim2001.com), see report in this SNE issue

Information

If you are engaged in CFD or intend to do so, we think that the aims of the **WUA-CFD** merge with yours and your needs. For further information do not hesitate to contact the secretary.

Secretary of WUA-CFD, Dr. Axel Müller
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LSC - Liophant Simulation Club

st.itim.unige.it/liophant

The Liophant Simulation Club is a Chapter of the Society for Computer Simulation International (SCSI).

Aims and Scope

The Liophant Simulation Club is an association born in Genoa University to promote and diffuse the simulation techniques and methodologies; the Club promotes exchange of students, sabbatical years, attendance to International Conferences, organisation of courses and stages in companies to apply the simulation to real problems. The Club promotes Students/Teachers exchanges in order to improve international co-operation.

Activities

The beginning of a new millennium means for Liophant Simulation Club (LSC), the European Local Chapter of Society for Computer Simulation International, a great opportunity to make everyone see how simulation could be more and more useful in an increasing number of application fields. To spread simulation and enlarge its use all over the world, LSC has started a series of innovative projects that involve now old and new partners.

SIREN Network

One of the first new initiatives of LSC, in Cooperation with DIP, Genoa University (Italy), was to create a network of people interested in simulation for industry, exchanging information, news & material and establishing a common baseline for simulation studies and future standards. This project began in May 2000 with the first SIREN (Simulation Report & Networking) Meeting, with more than 60 attendees coming from Academy, Industry, Governments, Institutions, and Research Centres. One of the incoming needs of Italian audience was noticed to be a more detailed vision on the principles of simulation. So, Liophant and DIP with the collaboration of McLeod Institute for Simulation Sciences, organised a series of three–days courses on Modelling & Simulation, each one with different topics, such as M&S Basis, High Level Architecture, Verification, Validation and Analysis, etc.

The attendance was very various, coming from shipbuilding, aerospace industry, retail companies, research centres, local authorities and universities.

Over 100 people attended the courses held during the last solar year, listening to lectures and experiencing on exercises and case studies.

Teachers came from various affiliations: DIP, that has experienced a long tradition on simulation projects, McLeod Institute of Simulation Sciences, Boston College, NASA, NCS (with whom Liophant has a Co-operation Agreement), DMSO, Aegis Technologies, California State University, University of Central Florida, Riga Technical University and so on.

Siren and HMS Logos: Two Events Periodically Organised by LSC

Now Liophant is going to start a new series of such courses, introducing also some new topics such as Simulation to Manage & Control ERP Systems, Simulation Project Management, Simulation For Logistics. Meanwhile, the SIREN Network developed to more than 100 persons and will be present in Turin during the conference *Virtuality 2001*.

HMS Conference

But another conference in the simulation field is very important for LSC: yearly the Club and its partner DIP organise together the event HMS (Harbour, Maritime & Multimodal Logistics Modelling & Simulation).

In 1999 it was held in Genoa and in 2000 it took place in the wonderful frame of Portofino. This year HMS will be in Marseille, France, in cooperation with DIAM – IUSPIM Engineering School, and in 2002 will come back to Italian Riviera. Liophant is proud to make possible each year this great event that allows simulation experts from all over the world to meet and present their own works and researches in the field of logistics. The other aim of LSC is to allow students and young researchers interested in simulation to go abroad and work on concrete projects with experts both of the Industrial and both Academic world, or to participate to international conferences and events.

This year some Liophant Members have been able to participate to conferences and Stages in Innsbruck, Salzburg, Prague, Orlando, Dublin, Montreal and Detroit.

IEPAL Project

But one of the greatest opportunities in this field was the approval of the IEPAL Project, that Liophant & DIP have started in cooperation with Boston College, NCS, Stevens Institute, Bradley University, DIAM – IUSPIM, University of Magdeburg and CFLI.

The arrival of REX Transatlantic in NYC, 1932: the winner of the blue ribbon becomes the symbol of IEPAL Project (see above).

IEPAL (Intensive Educational Project in Advanced Logistics) is a project funded by European Community and US Department of Education, which allows students from EC and USA to travel on both sides of the Atlantic Ocean. The participants will attend innovative Courses in Logistics and Simulation within Academic partners and they will get industrial experience by the stages organised by the Industrial Consortiums.

LSC is also involved as supporting partners in another Simulation Project: WILD (Web Integrated Logistics Designer), an HLA tool for the management of a very complex project with many sub contractors geographically distributed: the construction of a series of small executive airplanes. This project, financed by Italian Ministry of Research and University, involves DIP and other Universities: such as Bari, L'Aquila, Milan, Naples, Florence, Salerno.

Other Projects are in course of development with other partners, such as projects for remote education in Information Technologies for Logistics; meanwhile the number of Liophanters increases all over the world if really we are entering the Age of Simulation, LSC is ready!

Information

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Chiara Briano, LSC General Director
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The Liophant is a Mythological Being that only Simulation can bring back to Life !

WSC Winter Simulation Conference Organisation

www.wintersim.org

The Winter Simulation Conference (**WSC**) is the premier international forum for disseminating recent advances in the field of system simulation, with the principal focus being discrete-event simulation and combined discrete-continuous simulation. In addition to a technical program of unsurpassed scope and quality, WSC provides the central meeting place for simulation practitioners, researchers, and vendors drawn from all disciplines and from the industrial, governmental, and academic sectors.

The congress is co-organised by various groups, e. g. INFORMS and SCS.

WSC'01, Dec. 10 – 13, 2001
Arlington, Virginia, USA

WSC'01 takes place in Arlington, December 10 – 13, 2001. The 2001 Winter Simulation Conference features a comprehensive program ranging from introductory tutorials to state-of-the-art research and practice. The conference includes student presentations, exhibits, and training sessions by software/ hardware vendors, business meetings for professional societies, user groups, a general reception, and a spouse's program.

The conference offers the following types of contributions:

- Introductory Tutorials, Advanced Tutorials
- Software Tutorials, Modelling Methodology
- Analysis Methodology
- Manufacturing Applications
- Military Applications
- Applications in Logistics, Transportation, and Distribution
- Focused Mini-tracks, Poster Session
- Ph.D. Student Colloquium

For any questions concerning the WSC '01 contact the program chair or visit WSC's website:

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I M A C S

IMACS - The International Association for Mathematics and Computers in Simulation

www.cs.rutgers.edu/~imacs/

IMACS - The International Association for Mathematics and Computers in Simulation is an organisation of professionals and scientists concerned with computers, computation and applied mathematics, in particular as they apply to the simulation of systems. This includes numerical analysis, mathematical modelling, approximation theory, computer hardware and software, programming languages and compilers. IMACS also concerns itself with the general philosophy of scientific computation and applied mathematics.

IMACS is one of the international scientific organisations (with IFAC, IFORS, IFIP and IMEKO) represented in FIACC, the five international organisations in the area of computers, automation, instrumentation and the relevant branches of applied mathematics. Of the five, IMACS (which changed its name from AICA in 1976) is the oldest and was founded in 1956.

IMACS organises local and international scientific symposia and conferences, and sponsors publications in its fields of interest.

IMACS Publications

IMACS publishes three journals. The main journal is *Mathematics and Computers in Simulation*, published by Elsevier Science Publishers, containing articles of general interest in the fields of modelling and simulation, a book review section and the "News of IMACS".

The other journals are *Applied Numerical Mathematics and Journal of Computational Acoustics*.

Information on IMACS

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MATHMOD Conference Series

www.argesim.tuwien.ac.at/MATHMOD/

The MATHMOD Conference Series was started wth 1st MATHMOD in February 1994 and with 2nd MATHMOD, in February. In February 2000 the 3rd MATHMOD took place, continuing and increasing the success of the conference series.

Therefore the series will continued with the 4th MATHMOD conference in February 2003.

4th MATHMOD Vienna

Fourth International Symposium
on Mathematical Modelling

February 5 - 7, 2003, Vienna

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, etc.).

Comparison of modelling approaches, model simplification, modelling uncertainties, 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, and learning networks in modelling, fitting models to real processes, model reduction.

Contributions to topics given above are welcomed. The preliminary deadlines for full contributions are:

- Submission of Abstracts: September 1, 2002
- Notification of Authors: October 15, 2002
- Full Paper due: December 15, 2001

Furthermore, it is planned to have a Short Paper Section and a Poster Session. All contribution will be published in Proceedings (ARGESIM Publisher), CD-ROM and printed abstracts.

Four invited lectures and a very interesting social programme (Welcome Party with Wine Tasting, a traditional Heurigen Evening and a Reception) will make 4th MATHMOD Vienna a very attractive conference.

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IFMBE

International Federation for Medical and Biological Engineering

www.ifmbe.org

The International Federation for Medical and Biological Engineering, IFMBE is primarily a federation of national and transnational organisations. These organizations represent national interests in medical and biological engineering.

Aims and Scope

The objectives of the IFMBE are scientific, technological, literary, and educational. Within the field of medical, clinical and biological engineering IFMBE's aims are to encourage research and the application of knowledge, and to disseminate information and promote collaboration.

IFMBE is affiliated with the International Union for Physical and Engineering Sciences in Medicine

History and Development

In 1959 a group of medical engineers, physicists and physicians met at the 2nd International Conference of Medical and Biological Engineering, in the UNESCO Building, Paris, France to create an organization entitled International Federation for Medical Electronics and Biological Engineering. At that time there were few national biomedical engineering societies and workers in the discipline joined as Associates of the Federation. Later, as national societies were formed, these societies became affiliates of the Federation.

In the mid-sixties, the name was shortened to International Federation for Medical and Biological Engineering. Its international conferences were held first on a yearly basis, then on a two-year basis and eventually on a three-year basis, to conform to the practice of most other international scientific bodies.

As the Federation grew, its constituency and objectives changed. During the first ten years of its existence, clinical engineering became a viable subdiscipline with an increasing number of members employed in the health care area. The IFMBE mandate was expanded to represent those engaged in Research and Development and in Clinical Engineering. The latter category now represents close to half of the total membership.

In June 1997, the Federation reached an estimated 25,000 members in 43 affiliated organizations. The category Honorary Life Member is given to individuals who have served the Federation in various ways as affiliate members.

Observer status may be temporarily granted to a society or organization (pending the determination of their definitive application) to attend the General Assembly. The Federation actively looks at ways to assist national or regional groups encountering some difficulties in qualifying for affiliation.

The IFMBE has also achieved a close association with the

International Organization of Medical Physics
www.medphysics.wisc.edu/~empw/iomp.html

Its international conferences, commencing with the 11th in 1976 have been aligned or combined with those of the IOMP. The two international bodies have established the

International Union for Physical and Engineering Sciences in Medicine
www.ifmbe.org/iupesm.html

Activities

Divisions. Specialized Divisions are established to address continuing and long term needs. A charter of Specialized Divisions has been developed which details procedures and policies.

Division *of Clinical Engineering* has been established with members elected by the member organizations. Meetings are held at the IFMBE regional of international meetings. A bulletin "Clinical Engineering Update" is published as an insert to the MBEC News on a regular basis. Monographs produced by the Division are for sale through the Secretariat.

A *Division for Health Care Technology Assessment* has been established with the election of Board members having taken place in 1993.

Working Groups. Working Groups are established in a special area. A charter outlines policies and procedures. Working Groups have clearly defined objectives, and are usually limited in size to ensure effective and dynamic progress. They have a maximum period of operation of three years.

Current Working Groups are

- Working Group for Cellular Engineering
- Regional Activities are dealt with by the Working Group on Asian-Pacific Activities and the Working Group for European Activities.

Also Working Groups of Southern Africa, Latin America (CORAL) are present:

- Working Group for Developing Countries
- Working Group for Developing Countries in Transition

Publications

Medical and Biological Engineering & Computing

www.iee.org.uk/Publish/Journals/ProfJourn/MBEC

This bimonthly Journal of the International Federation for Medical & Biological Engineering (IFMBE) contains technical papers on biomechanics, biomedical engineering, clinical engineering, computing and data processing, modelling, instrumentation, medical physics and imaging, physiological measurement, rehabilitation engineering and transducers and electrodes. The editorial content is refereed by an international panel of experts.

Medical and Biological Engineering & Computing as well as Cellular Engineering is sold to hospitals, universities and research establishment throughout the world. A reduced subscription rate is available to all IFMBE members. For enquiries, please contact the editor-in-chief:

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alan.murray@ncl.ac.uk

IFMBE News

ifmbe-news.iee.org

IFMBE News is a fully electronic newsletter, which contains both information on the activities of national affiliates and on forthcoming scientific meetings as well as features on new developments within the field. The newsletter appears on the web page ifmbe-news.iee.org and articles can be down loaded and read. You can also download a PDF-formatted electronic newsletter.

From the latest issue (*IFMBE News*, No. 50, September 2001:

- Vienna Resolution Formation of an Umbrella Organisation for Medical and Biological Engineering in Europe
- Invitation to participate in Working Group on Neuroengineering
- Open Invitation to All Interested Parties to Participate: Performance and Sustainability Indicators for Clinical Engineering Services
- Call for Papers EMBEC'02 Second European Medical and Biological Engineering Conference Vienna (Austria) 4-8 December 2002
- Co-operation of Visegrád countries in biomedical engineering education
- BIOSIGNAL 2002: 16th biennial international EURASIP conference Brno, Czech Republic, 26-28 June 2002
- Conference on eGovernment: "From Policy to Practice" 29-30 November 2001 Charlemagne, Brussels
- Medical and Biological Engineering the theme of INNOVATION AWARDS and INNOVATION FORUM held on 7-8 December 2001 in Monaco

Articles for the next issue of *IFMBE News* should be sent to

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niilo.saranummi@vtt.fi

Conferences

Besides annual meetings in Stockholm and internal workshops the association organises or sponsors resp. international conferences and congresses:

- CHEMEXPO 2002, Feb. 12 - 14, 2002
  Expo Centre, World Trade Centre, Mumbai, India
  www.chemexpo2002.com
- 12th Nordic-Baltic Conference on Biomedical Engineering, Reykjavik, Iceland, June 18-22, 2002
  www.nervus.is/nbc02/

- The 4th International Workshop On Biosignal Interpretation
  June 24-26th,2002 Villa Olmo, Como, Italy
  www.bsi2002.polimi.it

- World Congress on Medical Physics and Biomedical Engineering, August 24 – 29, 2003, Sydney Convention and Exhibition Center

Information about IFMBE

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Conference EMBEC'02

www.embec.org

The 2nd EMBEC'02 is following the 1st EMBEC'99, the successful first joint meeting of the European constituents of the International Federation for Medical and Biological Engineering (IFMBE) with nearly 1100 participants from 55 countries.

EMBEC'02
2nd European Medical & Biological Engineering Conference

Vienna (Austria), December 04-08, 2002

Advancement of Medicine and Health Care through Technology -the Challenge to Biomedical Engineering in Europe

The 2nd EMBEC'02 will again be hosted by Vienna, this unrivalled city with its still living tradition in culture, music, architecture and science. Due to its unique position in the heart of Europe, Vienna is the right place to welcome the worldwide Biomedical Engineering community.

All BME related topics will be considered in the scientific program. Distinguished experts will present the most recent state of science and technology. The European IFMBE constituents have been invited to use the EMBEC'02 as platform for demonstrating their special activities. Presentations may be either in oral or poster form. The main program will be supplemented by special sessions, workshops, and tutorials

Scientific Program

All BME relevant topics will be considered in the scientific program. The following list is not complete

- artificial organs, gait and motion analysis
- bio impedance , home care technology
- bionics, image processing
- biomaterials, intelligent instrumentation
- biomechanics, lasers in medicine
- biosignal processing, medical imaging
- biotelemetry, medical informatics
- cardiovascular mechanics, medical robotics
- clinical engineering, minimal invasive surgery
- computers in medicine, modelling and simulation
- education, physiological system analysis
- electrotherapy, rehabilitation technology
- expert systems in medicine, telemedicine
- functional electrostimulation, tissue engineering

Special Sessions

Special sessions will be provided on challenging subjects. All European IFMBE constituents as well as other organizations or individuals are requested to organize special sessions in the framework of EMBEC'02. Details will be found in the updated homepage.

Tutorials

As with EMBEC'99, Tutorials will be offered for applications, techniques, software, and other subjects. Among them, the tutorial „Modelling in Biomedical Engineering -Biomedical Systems Modelling" will give an introduction in the area of modelling and simulation of biomedical systems.

Call for Papers

Abstracts shall be submitted in accordance with the special **Abstract Form** that can be requested from the conference secretariat or be downloaded from Internet. Reviewing will be performed by the International Scientific Advisory Board and individual Session Organizers. **Full papers** will be published in a special issue of the new IFMBE book series.

Deadlines:

- Submission of Abstracts: March 15, 2002
- Notification of Acceptance: June 15, 2002
- Submission of Full Papers: Sept. 15, 2002

Organisers

The EMBEC'02 takes place under the patronage of (preliminary list)

- International Union for Physical and Engineering Sciences in Medicine (IUPESM)
- International Federation for Biomedical Engineering (IFMBE)
- Austrian Society for Biomedical Engineering (ÖGBMT)

Information

For all correspondence concerning the scientific part of EMBEC'02 please contact the General Chair, for all correspondence concerning registration, hotel accommodation and payment please contact the Congress Office:

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Tel + 43-316-873-7390, Fax: -316-46 53 48
hutten@ibmt.tu-graz.ac.at

MONDIAL CONGRESS
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Tel: ++43-1-588 04-0, Fax ++43-1-586 91 85
embec02@mondial.at

WSES – World Scientific and Engineering Society

www.worldses.org

About WSES

The World Scientific and Engineering Society (WSES, pronounced WorldSES)_is a world, scientific, non-profit organization that, in accordance with its Articles, *promotes the development and the unified consideration of new mathematical methods and computational techniques as well as their applications in science and engineering.* Also, in accordance with the Organization's Articles, WSES supports, in general, the research and the diffusion of the scientific and engineering knowledge, especially in the areas of mathematics and computer science and their interaction to other sciences (physics, chemistry, biology, medicine, engineering, earth sciences, space sciences etc.).

Also, in accordance of its Articles, WSES signs research projects, grants scholarships and prizes, organizes international conferences (20-30 per year), seminars, publishes journals and books and carries out autonomous scientific/engineering research or collaborates with universities and state or private research centers and institutions.

WSES is a World Society, World for its friends, World for its Conferences, World for its Scientific Projects, World for its collaborations, but also World for the unifying consideration of the various branches of science that use the same mathematical or computational methodologies.

In accordance with her Articles, WSES supports the research and the dissemination, dispersion and diffusion of the scientific and engineering knowledge, especially of mathematical methods and computational techniques and their interaction to:

Physics, Chemistry, Earth Sciences, Biology
Biochemistry, Biophysics
Electrical Engineering, Mechanical Engineering
Chemical Engineering, Civil Engineering
Naval Engineering, Oceanic Engineering
Aerospace Engineering, Biomedical Engineering
Military Engineering, Education and Multimedia
Economics, Acoustics and Music
Law, Sociology, Psychology, Politics, Medicine

Publications

Books

WSES Press publishes textbooks, monographs and Proceedings of WSES conferences in various areas of science and engineering, e. g.:

- Advances in Neural Networks and Applications, ISBN 960-8052-26-2
- Advances in Fuzzy Systems and Evolutionary Computation, ISBN 960-8052-27-0
- Problems in Applied Mathematics and Computational Intelligence, ISBN 960-8052-30-0
- Systems and Control: Theory and Applications, ISBN 960-8052-11-4
- Neural Networks and Fuzzy Logic for Industrial Applications, ISBN 960-8052-13-8
- Computational Intelligence and Applications (dedicated to L. Zadeh), ISBN 960-8052-03-3

For further information and orders contact
www.worldses.org/wses/New_Books.htm

Journals

There exists a collaboration with the following journals (for detailed information refer to the URLs:

- INTERNATIONAL JOURNAL OF COMPUTER RESEARCH
  www.softlab.ntua.gr/~mastor/IJCR
- INFORMATICA
  orca.st.usm.edu/informatica
- NEURAL NETWORKS WORLD

News Letters

WSES releases special News Letters for the Area and Sub-area of your research and professional interest. These News Letters publish:

- New Faculty Positions.
- Short Announcements or Short Questions to all of us on topics relevant to Mathematical Methods and Computational Techniques.
- Conference Announcements.
- Announcements for Workshops, Short Courses Announcements for New Books and Journals, for Special Issues in Journals, Special Sessions in Conferences.
- Post-Doctoral Positions, and others

.

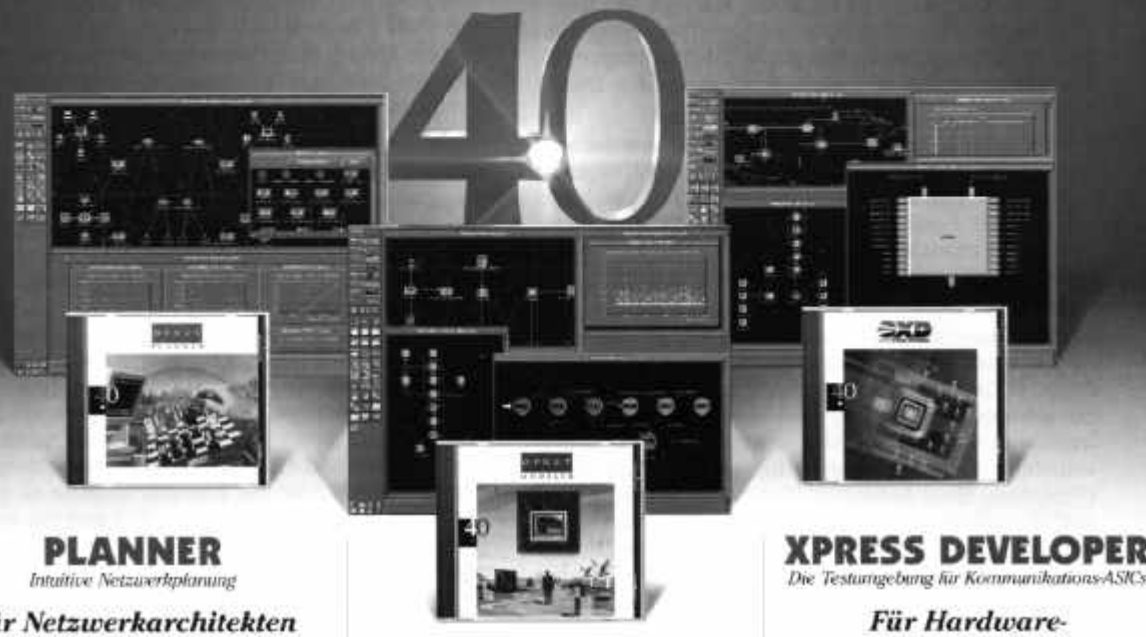
The newsletter is free (via WWW), furthermore the reader can publish his own announcements for a New Faculty or Research or Post-Doctoral Position, etc, special issue in a WSES affiliated journal, special session in a WSES sponsored conference, etc. For subscription contact

www.worldses.org/wses/wses1.htm

Das neue Release 4.0

OPNET

Bewährte Simulations-werkzeuge für Netzwerkprofis.



PLANNER

Intuitive Netzwerkplanung

Für Netzwerkarchitekten und Designer

Simulieren Sie die Leistungsfähigkeit Ihres bestehenden Netzwerkes für den Fall, daß Sie neue Anwendungen starten, Ihre Netzwerktopologie erweitern oder neue Technologien einsetzen.

Eine Drag und Drop Umgebung, die keine zusätzliche Programmierung in C-Code erfordert. Viele Beispielapplikationen und umfangreiche Bibliotheken mit einer großen Anzahl von Standardprotokollen zeichnen den OPNET Planner aus.

MODELER

Das leistungsfähige Simulationswerkzeug

Für System- und Netzwerkarchitekten

Modellieren und simulieren Sie Ihre geplanten Netzwerkentwürfe in einer Netzwerkumgebung, die Ihnen die Flexibilität bietet, Ihre eigenen Protokolle, Algorithmen und Systemcharakteristika zu definieren.

Detaillierte, auf Standards basierende Protokollmodell-Bibliothek, einschließlich TCP/IP, OSPF, RIP, Frame Relay, ATM, X.25, Ethernet, Token Ring, FDDI, uvm...

XPRESS DEVELOPER

Die Testumgebung für Kommunikations-ASICs

Für Hardware-Entwickler

Ein völlig neuartiges Softwarepaket, das die Technologie der Co-Simulation nutzt, um Schaltungsentwürfe im Zusammenhang mit Netzwerken oder verteilten Systemen zu überprüfen.

Die Fähigkeit von OPNET, Netzwerke exakt zu simulieren, erlaubt den Hardwareentwicklern, realitätsnahes Netzwerk-Verkehrsaufkommen und Protokolle als Stimulus ihrer Schaltungsmodelle einzusetzen. Das Ergebnis ist eine schnellere, präzisere und leistungsfähigere Testumgebung für Schaltungsentwürfe in VHDL und VERILOG. Integriert mit ModelSim von Mentor Graphics.

Software mit Zukunft

scientific COMPUTERS

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www.scientific.de
info@scientic.de

MIL3
Modeling Technologies for the Third Millennium

Confe ences

erence is
alternately in North Ameri
occasional appea
(2000 Bergen, Norway; 2001 Atlanta, USA). These conferences, and the meetings of local chapters and nterest groups, introduce newcomers to the field, cti
and provide unparalleled networking opportunities.

Printed proceedings for most previous conferences can be ordered from the Society. Current and future conferences will make use of the World Wide Web to disseminate conference information and papers.

WSES – sponsored Events

All the WSES Sponsored Events will be being held in exciting places (Malta, Crete, New York, Skiathos, Tenerife, Cairns, Interlaken, Cancun, Miedzyzdroje etc) and will offer to the participants excellent Proceedings (with their papers), excellent luxurious Post-Conference books by WSES Press International Editions with their papers (different edition than the proceedings with different ISBN, hard cover, velvet paper, etc), possibility for journal publication, lectures by distinguished and famous scientists (VIPs in the areas covered by meetings), magnificent resort hotels and of course social and cultural activities of high academic standards !

Some coming events:

Differential Equations and Applications (DETA 2001), Cairns, Australia, December 17-21, 2001

- 3rd WSES Symposium on Mathematical Methods and Computational Techniques in Electrical Engineering (MMACTEE 2001), Athens, Greece, December 29-31, 2001
- Neural Network and Applications (NNA '02), Inter laken, Switzerland, February 11-15, 2002
- Fuzzy Sets and Fuzzy Systems (FSFS '02), Inter laken, Switzerland, February 11-15, 2002
- Mathematics and Computers in Physics (MCP '02), Cancun, Mexico, May 12-16, 2001
- 4th Mechanical Engineering Multiconference (former "Mathematics and Computers in Mechanical Engineering"), Cancun, Mexico, May 12-16, 2001
- 6th WSES Multi-Conference on Circuits, Systems, Communications and Computers (CSCC 2001), Rithymna Beach Hotel, Rethymno, Crete Island, Greece (July 7-14, 2002) (with IEEE)
- 6th WSES Conference on Computers, Rithymna Beach Hotel, Rethymno, Crete Island, Greece, July 7-14, 2002 (with IEEE)
- 4th WSES Conference: Neural, Fuzzy and Evolutionary Computation 2001, Rithymna Beach Hotel, Rethymno, Crete Island, Greece, July 7-14, 2002 (with IEEE)
- Power Engineering 2001, Rithymna Beach Hotel, Rethymno, Crete Island, Greece, July 7-14, 2002 (with IEEE)
- Multirate Systems and Wavelet Analysis 2001, Rithymna Beach Hotel, Rethymno, Crete Island, Greece, July 7-14, 2002 (with IEEE)
- Global Optical and Wireless Network conference, (GOWN '02), Miedzyzdroje, Poland, August 25-30, 2002

Membership

Join WSES and become part of the worldwide association between scientists and engineers working on mathematical methods and computational techniques and pursuing pure and/or experimental research in science and engineering. The numerous benefits make membership a worthwhile investment.

The members of WSES are also entitled to have:

- Reduced registration Fees for WSES Conferences.
- Two Books or two CDs published by WSES Press free.
- A 10% Discount for any other WSES-Press edition.
- Possibility (after review) to be chairman of a WSES Conference
- Possibility of Participation in some Research Projects (HIEST).

For the year 2001, the membership rates have been determined at 100$ for individuals and 200$ for companies or institutions.

The Registration form for WSES membership has been incorporated in the registration form of each WSES Sponsored Conference or Symposium. So, in order to become WSES member, you have to complete this form that you can receive if you have at least one paper accepted in one of WSES Sponsored conferences or symposia.

Contact

WSES European Office:
HIEST (Highest Institute of Education, Science and Technology), Ag.I.Theologou 17-23, 15773, Zographou, Athens, GREECE.

WSES US Office:
IMCS (Institute for Mathematics and Computer Science), 1337 Avenue of the Americas, New York, NY 10019, USA. www.worldses.org

ARGESIM Working Group Simulation News

Arbeitsgemeinschaft Simulation New

www.argesim.org

ARGE Simulation News (ARGESIM) is a non-profit working group disseminating information on simulation, organising activities in the area of modelling and simulation (e.g. courses, comparative studies), publishing journals and books in this area, and providing the infrastructure for the administration of EUROSIM and ASIM activities.

ARGESIM works at three levels:

- European and International Activities: Journal SNE (editing and publishing; printing and WWW - publication), ARGESIM Comparisons on Simulation Technique and Simulation Software, Publication of Books, EUROSIM WWW - Server, Calendar of Simulation Conferences, Simulation Hotlinks
- Regional Activities: publication of ASIM-Nachrichten and User Group Newsletters, administration for ASIM and for User Groups, ASIM WWW - Server, WWW - servers for Austrian Research Centres (medinet.org, etcanet.org)
- Local Activities: seminars "Modelling and Simulation", simulation software support at Vienna University of Technology, various simulation projects

ARGESIM supports ASIM, EUROSIM and other institution in promoting publications, in advertising, etc. ARGESIM also runs for ASIM and EUROSIM boothes at conferences congresses, etc.

ARGESIM at EUROSIM 2001, Delft

At the EUROSIM congress ARGESIM traditionally takes care of a booth, where congress participants get information on the EUROSIM societies

Delegation from Russia and Slovakia and guests at ARGESIM – EUROSIM booth

Furthermore, publications like SNE Simulation News Europe, SIMPRA, SCS – ASIM Book Series Frontiers and Advances in Simulation (Fortschritte in der Simulationstechnik), etc. were on display. People had also the opportunity to get samples of older SNE issues, which are becoming rare.

All EUROSIM Presidents and Marja Dekker gathered: Y. Hamam, F. Breitenecker, Marja and Len Dekker, K. Juslin, and F. Maceri (from left to right)

At EUROSIM'2001, Delft, June 2001, the ARGESIM - EUROSIM booth was a meeting place for participants and guests.

A coffee or a glass of wine helped to get into discussions, and so on. We were happy that so many people came, amongst them all EUROSIM presidents, the SLOSIM delegation and a delefation from Russia and Slovakia – see pictures.

Slovenian delegation with F. Breitenecker at ARGESIM – EUROSIM booth

ARGESIM at SIM'2001, Freiburg

ARGESIM organised an exhibition booth for ASIM at **SIM'2001** *Industrial Trade Fair and Knowledge Exchange on Applied Simulation and Visualisation*.

At the exhibition booth ASIM and ARGESIM presented publications (SNE – Simulation News Europe, ASIM – SCS Book Series Frontiers and Advances in Simulation, etc).

V. Hrdliczka (ETH Zürich), J. Wittmann (Univ. Hamburg and Ch. Almeder (TU Vienna) at ASIM – ARGESIM booth

Furthermore, with posters cooperative project with the ARCS (Austrian Research Center Seibersdorf) were introduced: modelling, simulation and visualisation of the human circulatory system, models for waste water management, etc.

Furthermore, ARGESIM displayed or distributed SNE at various other conferences.

Subcriptions SNE

Simulation News Europe is sent to most members of the simulation societies in EUROSIM, to the European SCS members and to User Groups, etc. A personal subscription for SNE is also offered - see info at the ARGESIM webpage. Please note, that SNE is now published two times a year, in spring (single issue) and in autumn (double issue)

www.argesim.org/SNE/subscribe

Information

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www.argesim.org

USE-ME

US-Europe Multicultural Education Alliance in Computer Science and Engineering

useme.informatik.uni-hamburg.de

USE-ME enables computer science and engineering students to step up on the job market by enhancing their employability through innovative international exchanges that involve internship and research experiences in universities, industry and in MISS Centres (MISS McLeod Institutes of Simulation Sciences as academic education in simulation part of the Society for Modelling and Simulation SCS).

What is USE-ME:

USE-ME is a consortium that received a three-year Fund for the Improvement of Postsecondary Education from the European Commission Directorate General for Education and Culture, and the U.S. Government Education Directorate FIPSE, for the development of international educational experiences for a graduate degree in computer modelling and simulation. The collaborative computer modelling and simulation graduate degree will be Internet based.

Participation in USE-ME provides students with crucial international savvy due to the international student exchange. Computer modelling and simulation is a multi-disciplinary field funded in computer science, engineering, and mathematics. A recent White House report identified it as one of the key enabling technologies of the 21st century. Its application is universal. At the same time, there is a high demand in industry for graduates trained in modelling and simulation programs.

How USE-ME works?

Students participate through an exchange program established between the universities in the European Union and the United States. Students belonging to a home institution go to an overseas host institution.

E.U. students travel to the U.S. after successfully completing three years towards their first degree. Their USE-ME studies include computer science and engineering coursework and a research thesis. They return and complete their degree.

U.S. students travel to the E.U. after successfully completing three years towards their first degree. Their USE-ME studies include computer science and engineering coursework and a research thesis. They return and complete their degree.

Participating Universities

University of Hamburg (EU Lead Institution)

With approximately 39,500 students, the University of Hamburg ranges fifth in size among Universities in Germany. It has about 830 professors engaged in teaching and research, and additional fulltime academic staff numbering 2,600.

There are also approximately 6,300 technical and administrative employees. About 1,000 part-time academic instructors teach at the University, and an equal number of additional academic and other employees are engaged in individual research projects.

www.uni-hamburg.de

University of Glasgow

The University of Glasgow is one of the UK's leading universities with an international reputation for its research and teaching and an important role in the cultural and commercial life of the country. With 16,500 full-time students, it is one of the country's largest universities. Employing more than 5,300 staff it is a major employer in the city and, with an annual turnover of £200M, it makes a substantial contribution to the local economy.

www.gla.ac.uk

Vienna University of Technology

The Vienna University of Technology was founded in 1815. It has over 22,000 students enrolled in its Engineering Schools (Faculties), the School of Sciences, and the School of Architecture und Regional Planning, with a scientific staff of about 2300 in all its Faculties. The University has an international outlook with special language courses offered in various languages, including English.

www.tuwien.ac.at

California State University, Chico, California

Founded 1887, CSU, Chico is one of the oldest campuses in the twenty-three member California state university system. Three components make CSU, Chico, a great university: The high quality of our academic programs, the accomplishments and achievements of our faculty, staff, and students, and our tradition of service to society. Full time students 13,000. Total students: 14,500 from 32 states, 58 nations. Faculty: 850. Staff: 1000.

www.csuchico.edu

University of Nebraska, Lincoln, Nebraska

Nebraska University is one of the top 50 American universities in the number of doctoral degrees granted annually. The University of Nebraska boasts 22 Rhodes Scholars and two Nobel laureates among its alumni.

Research is at the core of our teaching excellence and the foundation upon which all our missions rest. By using university research to address the state of Nebraska's unique challenges, NU is a full partner in the state's vitality.

www.unl.edu

Old Dominion University, Norfolk, Virginia

Independent institution since 1962, University status since 1969, Full-time staff: 607, Part-time staff: 414, Total students 19,000, 13,000 Undergraduate; 6,000 Graduate, International: 1,500 from 100 countries

Economic Outreach Initiatives: Applied Research Center, Center for Advanced Ship Repair and Maintenance, Langley Full-Scale Wind Tunnel, Technology Applications Center, Virginia Modeling, Analysis and Simulation Center.

web.odu.edu

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INDUSTRY NEWS

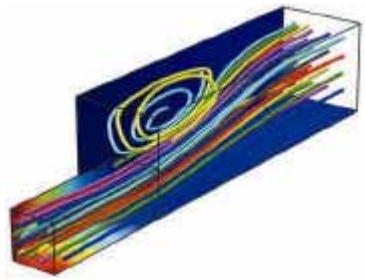
FEMLAB

www.comsol.de, www.femlab.com

FEMLAB is a powerful tool for modelling arbitrary systems of nonlinear partial differential equations. FEMLAB is based on MATLAB.

The simulation package FEMLAB can solve systems of coupled nonlinear partial differential equations, PDEs, through the Finite Element Method in 1D, 2D or 3D. FEMLAB offers a graphical user interface and CAD tools along with strong visualisation capabilities. The simple and robust graphical user interface (GUI) makes it easy to set up a model, run a simulation and visualize the results.

FEMLAB provides you with a number of libraries of predefined equations and equation systems, referred to as physics mode, for all fields of engineering and science. These physics modes describe phenomena such as heat and electrical conduction, structural mechanics, diffusion-convection-reaction processes, propagation of electromagnetic waves, fluid mechanics, to mention just a few. In addition to this, you are also able to define your own equations and systems of equations in the “PDE-mode”.



FEMLAB is designed for the general, along with the specialized user. In the equation-based mode, classical or generic PDEs are used to freely formulate and solve any problem with a general mathematical approach.

You can move seamlessly between this generic interface and the physics modes, which you can use to build models with properties that are tailored for the specific application area.

The GUI presents an elegant approach and platform for creating models, providing you with a quick understanding of the parameters driving your system, and how their variations impacts its performance. You can start by experimenting with the system geometry and parameters to gain a feeling for them. Then you can proceed to extend your model to advanced parametric studies or sophisticated design optimisation.

FEMLAB runs on top of MATLAB, the industry standard tool for technical computing. This gives you the freedom to combine modelling, simulation, and analysis with a host of numerous applications in engineering and science. You can save your FEMLAB model as a MATLAB M-file, and use it together with other MATLAB tools for control and optimisation.

FEMLAB is the first simulation package that can arbitrarily couple any number of nonlinear physical processes and solves them simultaneously—the true essence of Multiphysics. A chemical reaction, for instance, cannot take place without mass and heat transfer also participating. FEMLAB solves such a system of PDEs simultaneously, rather than sequentially, for an improved and rapid convergence.

The vast majority of engineering fields involves both time and spatial dependant variables, and is hence mathematically described by Partial Differential Equations, PDEs - "the laws of science". Electromagnetics, structural mechanics, fluid dynamics and chemical engineering are some examples of areas in which PDEs are used. In FEMLAB, you can easily solve strongly nonlinear coupled systems of PDEs using the proven Finite Element Method, with a high degree of flexibility and with unlimited post processing capabilities.

FEMLAB is designed for the general, along with the specialized user. In the equation-based mode, classical or generic PDEs are used to freely formulate and solve any problem with a general mathematical approach. You can move seamlessly between this generic interface and the physics modes, which you can use to build models with properties that are tailored for the specific application area.

The physics modes are comprised of predefined equations for most phenomena appearing in engineering and science, such as heat and electrical conduction, structural mechanics, diffusion, wave propagation and fluid flow.

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www.mathtools.net

Mathtools.net > is a technical computing portal for all scientific and engineering needs. The portal is free and contains over 20,000 useful links to technical computing programmers, covering MATLAB, Java, Excel, C/C+, Fortran and others. The welcome page offers main links to software tools, applications and learning and education, structured in various item:

- **MATLAB**
  Algorithms and Data structures, Astronomy, Biology and Medicine, Biotechnology, Books and Tutorials, Calculus, Chemometrics, Communication, Compilers, Computational geometry, Control...
- **Excel**
  Auditing, Accounting and organizers, Add-on functions, Algorithms and Data structures, Astronomy, Biology and Medicine, Book Keeping, Books and Tutorials, Cell Tools, Chemometrics, Communication...
- **Scientific C/C++**
  Algorithms and Data structures, Astronomy, Biotechnology, Books and Tutorials, Calculus, Chemometrics, Communication, Compilers, Compression, Computational geometry, Control...
- **Scientific Fortran**
  Algorithms and Data structures, Biology and Medicine, Biotechnology, Books and Tutorials, Calculus, Chemometrics, Communication, Compilers, Control, Converters, Data Analysis...
- **Scientific Java**
  Algorithms and Data structures, Astronomy, Biology and Medicine, Biotechnology, Books and Tutorials, Calculus, Chemometrics, Communication, Compilers, Computational geometry, Converters...
- **Visual Basic**
  Add-on functions, Biotechnology, Books and Tutorials, Converters, Database, Editors and IDE, FAQs, Games, Jobs, Mathematics, Newsgroups...
- **Applications and Industries**
  Aerospace, Astronomy, Automotive, Biology and Medicine, Biotechnology, Communication, Control, Data Acquisition, DSP, Electronics, Finance and Economics...
- **Learning and Education**
  Books and Tutorials, FAQs, Jobs, Newsgroups, Newsletters, Reference and documentation, Seminars Conferences and Tradeshows, Training and Courses, Universities...

The link **Learning and Education** links to a page, which list again group of links, indicating the number of links:

Mathtools.net > Learning > Books and Tutorials

- MATLAB *(424)*
- Visual Basic *(122)*
- C and C++ *(20)*
- Fortran *(18)*
- Other *(2)*
- Java *(58)*
- IDL+PVWave *(15)*
- Excel *(19)*

Further refinement points e.g. to a list of books on Java in various applications. All these links are cross-referenced, a book on MATLAB in Signal Processing may be also found from the main link **MATLAB** and from the main link **Applications / Control**.

A lot of time must be spent for updating this webpage, peoples are asked to report on new links, on broken links, etc. The site is also a source for finding university institutes, laboratories, research groups, ... - the link **Universities** lists more than 1500 entries:

- Computer Science Departments (865)
- Electronic Engineering Departments (703)

Contact:

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Enquiries to
feedback@mathtools.net,
Adding and removing links:
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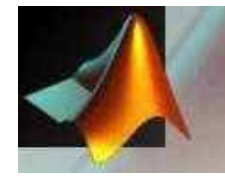
Which computer serves MATLAB best ?

www.mathworks.com



Very often a user is faced with following questions:

- How do I choose computer hardware, which optimises MATLAB 's performance ?
- How does the choice of computer hardware affect MATLAB's performance? For example:
  - How much RAM is enough ?
  - What processor is best ?
  - What system is best, UNIX, Windows?

Many MATLAB users need to optimise MATLAB's performance in order to complete involved computational tasks in minimal time. It is apparent that the performance of any application is dependant on the availability of system resources. Running MATLAB along with a number of other processes will degrade MATLAB's performance.

There are certain system requirements, which MATLAB needs to run properly. For recent information please follow this URL:

www.mathworks.com/products/system.shtml/Windows

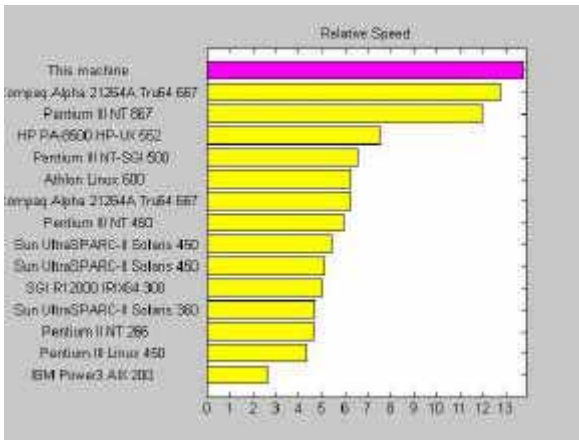
The benchmark "bench"

It is strongly suggested before you buy a configuration that you download a trial version of MATLAB and run "bench" on that configuration to help in your evaluation. Please note: You should not exclusively use "bench" for the evaluation, but you will gain a first approximation for the efficiency of the system.

Simply simply entering bench into the MATLAB command window starts the benchmark. The categories focused on in this benchmark are:

- LU: Linear algebra
- FFT: Computation
- ODE: Function calls
- Sparse: Computation
- 2D graphics
- 3D graphic

The benchmark calculates two tables, the one showing as bar chart the efficiency (relative speed) of the benchmarked system in comparison with other systems (see figure below).



The second table shows the individual computation times for the categories in comparison with other systems (see below). The benchmarked system is a PIII AMD 1.3 Ghz, 512 MB

	LU	FFT	ODE	Sparse	2-D	3-D
This machine	0.94	1.92	0.81	1.10	1.26	1.43
Compaq Alpha 21264A Tru64 667	0.96	1.59	1.36	1.50	1.72	0.63
Pentium III NT 667	1.43	1.75	1.05	1.43	1.75	0.94
HP PA-8600 HP-UX 552	1.10	2.80	1.06	2.06	2.25	3.70
Pentium III NT-SGI 500	2.63	3.22	2.34	2.79	1.18	1.13
Athlon Linux 600	1.67	2.90	2.21	2.44	2.93	3.92
Compaq Alpha 21264A Tru64 667	0.95	1.60	1.29	1.56	1.64	2.00
Pentium III Pentium II BLAS	2.77	2.93	2.61	2.91	4.52	1.74
Sun UltraSPARC-II Solaris 450	1.45	2.55	2.99	2.96	2.67	2.97
Sun UltraSPARC-II Solaris 450	1.42	2.84	4.01	3.95	3.80	3.58
SGI R12000 IRIX64 300	1.61	5.42	3.22	2.98	4.19	2.51
Sun UltraSPARC-II Solaris 360	1.55	2.82	4.94	4.53	4.41	3.19
Pentium II NT 266	3.08	4.03	2.76	3.26	1.71	4.69
Pentium III Linux 450	2.49	3.51	3.75	3.51	4.95	5.75
IBM Power3 AIX 200	1.52	1.86	2.77	3.60	4.66	22.25

Correlations performance – hardware/software

There are two types of correlation between performance and hardware / software. The list of strong correlations we understand better and can link strongly to changes in performance. The list of weak correlations we understand less and they typically have a more nebulous effect on performance.

Strong correlations:

Clock speed and processor family. Performance can mathematically be computed as follows:

$$Performanæ = \frac{Clock\ Rate}{\#\ CPU\ instr. \times cycles\ per\ CPU\ instr.}$$

The variables in the denominator are functions of the instruction set, addressing mode, and hardware implementation of the processor components.

Within a processor family the higher the clock rate the better the performance should be. The rate of change in performance is probably smaller at the higher clock rates because other system parameters such as main memory and bus speeds begin to play a critical role. So just going from a 600MHz Pentium to 1.1GHz Pentium will probably not show the corresponding change in performance.

In general you cannot compare the clock speeds of different microprocessor families. For example, many RISC microprocessors can execute multiple instructions per clock cycle. This means, even though their clock rates may be smaller than those that perform fewer instructions per clock cycle, they can potentially perform more work if kept busy.

Other necessary Hardware: A MATLAB application can only be as fast as the slowest hardware component involved such as a data acquisition card to read data in for real time simulation or a graphic card to display results instantly. To get the maximum performance out of MATLAB graphics use the fastest card that you can afford and one that implements as much of the OpenGL in hardware as possible.

Enough main memory (RAM): Adding more RAM than MATLAB will be using will understandably only have a negligible effect on performance since it is the working set size that determines how much memory you need and this varies tremendously on the application. Also, other applications running alongside MATLAB on the same system vary in usage of memory. We recommend a minimum of 128 MB of RAM for Windows systems. The speed in which RAM can be accessed is also an important factor.

Weak to nonexistent correlations:

Number of processors: Since MATLAB is not multi-threaded (except for Java) adding processors will not change the performance very much for one job. It should also be noted that the C and C++ Math Libraries are single threaded libraries. Hence even when a standalone executable is generated using the MATLAB Compiler and C or C++ Math Libraries, it will not be able to take advantage of the multiple processors on a given machine.

However, if you have many users of MATLAB sharing the same machine then having multiple processors can greatly improve the throughput of the system and the response time of each individual user of MATLAB.

Bandwidth of the system bus: This is a difficult area to assess. It becomes critical if you are moving large amounts of data in and out of main memory caused either by memory paging of large data sets or file I/O operations in support of database operations.

Amount of cache memory: Cache memory is fast but expensive and therefore usually limited. The cheaper but slower RAM becomes active whenever the cache memory is exhausted.

This is also difficult to assess without careful benchmarking. Unless special needs are identified, systems generally come with an adequate amount of cache memory for many common applications.

Other Investigations

Finally, one may consider posting a message to the newsgroup comp.soft-sys.matlab. This is a MATLAB user based newsgroup viewed by thousands daily. Another possibility is to look for other benchmarks, e.g. for the ARGESIM benchmarks on Simulation Technique, where a lot of MATLAB models can be found (www.argesim.org/comparisons).

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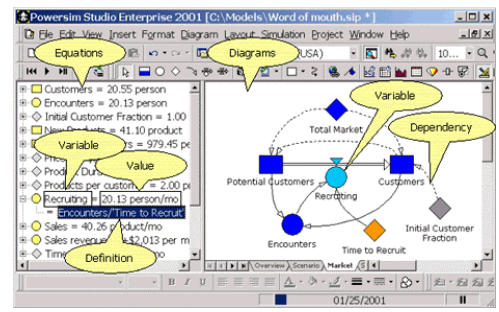
Powersim – New Developments

www.powersim.com

Powersim® Studio is Powersim's third generation software for business simulation, representing 15 years of development. Our first software, SimTek, was ready in 1987 and run on the MS-DOS platform. Six years later, we released Powersim Constructor, a 16-bit Windows application.

In 2000 the first release of Powersim Studio was ready, representing an entirely new platform for modelling and simulation on the Microsoft® Windows platform. Studio's 32-bit architecture allows for larger models and faster simulation, and the Microsoft® Office compatible user interface makes Studio intuitive and easy to use.

Studio's graphical modelling language makes models easy to follow and explain to others. In a Studio model, variables are visualized using graphical icons, and dependencies between variables are displayed using arrows. The transparent structure is one of the greatest advantages of Powersim models (see below).



Studio communicates directly with Microsoft® Excel and SAP® SEM (Strategic Enterprise Management), allowing models to import real business data and export future scenarios. Communication to other database systems can be set up using the Powersim® Studio SDK.

It is easy to create attractive simulator interfaces directly in Studio, even for non-programmers.

Products for Corporate users

Corporations typically have some users who develop solutions, and others making use of the solutions. For the model builders, we offer **Powersim Studio Enterprise**, which allows models to be shared with others.

Users, who do not need to modify the structure of a model, can acquire Powersim Studio Executive, and run models that have been created in the Enterprise version.

Powersim Studio Enterprise is typically used by teams to develop and analyse solutions to business problems. A modelling team will normally include some users with subject matter expertise and others with modelling expertise. Powersim consultants offer services to help customers create simulation models for solving business problems and communicating business solutions.

Powersim Studio Executive provides an easy-to-use set of options for setting up and running what-if scenarios. This edition does not require much technical knowledge from the end-user. In particular, users of Executive do not need to learn how to build or read models.

Powersim Studio SEM is a special edition of our software that is shipped together with SAP's SEM (Strategic Enterprise Management) product. Studio SEM runs embedded inside SAP's planning environment, and gives users shared access to data and models throughout the client organization.

Powersim Studio SDK (Software Development Kit) allows programmers to create stand-alone applications that embed Powersim simulations. SDK-based simulators can be developed to run under Microsoft® Windows, or in a browser environment on the Internet. The application programmer is free to take full advantage of the user interface capabilities of Windows and the Web in developing simulators with the SDK, and the resulting applications can interact with any other program or resource that is accessible in the network.

Products for Small Business and individual users

The small business editions are for users who build and use models without connecting to corporate databases or sharing models with others. For distribution of finished simulation models to end-users, and connection to corporate databases, we refer to our products for corporate users.

Powersim Studio Expert is used by modelling experts to build and analyse problems using simulation. The product allows for data exchange with Microsoft® Excel.

Powersim Studio Standard is for the modeller who does not need connection to external data.

Products for Academic users

The academic editions offer powerful functionality for education and research. For products that can be used commercially, we refer to our corporate and small business editions. Both the Research edition and the Student edition offer connection to spreadsheets.

Powersim Studio Research has no restriction on the number of variables that can be used. **Powersim Studio Student** has some restrictions on model size.

Information

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Scientific Computers shipping Maple 7 and OPNET 8.0

www.scientific.de
www.maplesoft.com
www.opnet.com

New Release Maple 7. Scientific Computers, distributor for the German speaking area, is pleased to present Maple 7, the newest version of the widely adopted Maple mathematical computation product line. Maple 7 began shipping on June 14, 2001, 15 days ahead of schedule.

Maple 7 is available for all supported platforms, including Windows, Macintosh, Linux and UNIX. New features include a sweeping range of new mathematical algorithms in key areas, such as differential equations and numerical computation, and enhanced Web connectivity, including comprehensive MathML 2.0 support, XML support and TCP/IP sockets-based access to online information.

Maple 7 is available for all supported platforms, including Windows, Macintosh, Linux and UNIX. New features include a sweeping range of new mathematical algorithms in key areas, such as differential equations and numerical computation, and enhanced Web connectivity, including comprehensive MathML 2.0 support, XML support and TCP/IP sockets-based access to online information.

Maple 7 introduces substantial increases in the depth and breadth of solution algorithms in key areas such as differential equations and numerical computation. It continues to lead with greater integration of key technology from the Numerical Algorithms Group (NAG) and other respected sources.

Standards-based features such as the most complete MathML 2.0 and TCP/IP Sockets connectivity open doors to a new era of open computing where different systems can talk and exchange data with each other … on the Web or on your desktop. Combined with countless features to offer more control and convenience for users at any level of experience.

New Release OPNET 8.0 OPNET Technologies, Inc. released OPNET 8.0, the eighth major release of the core technology underlying its Guru, Modeler, and Netbiz products.

OPNET 8.0 is unique in its ability to understand networks in their entirety, including applications, routers, switches, servers, and protocols for traditional, wireless, and optical technologies. OPNET sells focused software solutions to three distinct markets: ServiceProvider Guru is marketed primarily to service providers; IT Guru to enterprises; Modeler and Netbiz to equipment manufacturers.

8.0 releases of the ServiceProvider Guru, IT Guru, Modeler, and Netbiz products include an improved model library, and a new QoS-savvy hybrid simulation engine designed to radically improve the speed of detailed QoS analyses. With 8.0 also comes an improved workflow and ability to import and export self-documenting network models using XML.

As with previous OPNET releases, many of the new 8.0 capabilities are provided in modular extensions to the four products.

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Micro Saint Finds a New Home in Europe

www.adeptscience.com
www.maad.com

Adept Scientific, the UK's highly successful technical software supplier, has become the new distributor for Micro Analysis & Design's (MA&D) Micro Saint simulation software.

Founded in 1984, Adept has established itself as a leading provider of technical computing solutions.

The company focuses on supplying and supporting a high-quality range of complementary software and hardware products for scientific, technical, mathematical and industrial applications on desktop computers.

Adept's commitment to customer service combined with their technical team, most with backgrounds in mathematics, science or engineering, has made them the clear choice as MA&D's European distributor of Micro Saint.

Micro Saint is a general purpose, discrete-event simulation software product. Micro Saint's intuitive graphical user interface and flow chart approach to modelling make it a tool that can be used by ordinary engineers as well as simulation experts.

Micro Saint has proven to be an invaluable asset in both small businesses and large companies and in many areas including human factors, ergonomics, health care, manufacturing (chemical, petroleum, pharmaceutical, minerals and metals, power generation and many more), and the service industry.

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CONFERENCE REPORTS

EUROSIM 2001 Congress

SHAPING FUTURE WITH SIMULATION

June 26 - 29, 2001, Delft The Netherlands

The Congress was held in Delft, The Netherlands, from 26 to 29 June 2001, on the premises of the Technological University. In the Congress had been incorporated the *2nd Conference on Modeling and Simulation in Biology, Medicine and Biomedical Engineering*. Next to an extended abstract booklet the Proceedings were available on a CD. Besides the Scientific Program some other activities were organized which attracted much interest and some of these activities are further on reported in more detail. Also during the Congress a scientific and a commercial exhibition took place in parallel, and many discussions and contacts were made.

Entrance to Congress: Art with Stones

The Congress attracted more than 210 persons and 36 countries were represented. The first 15 countries with the number of participants between brackets were: The Netherlands (57), Italy (25), USA (17), Germany (16), Brazil (7), Japan (7), Canada (6), Switzerland (6), Romania (5), France (5), UK (4), Austria (4), Ireland (4), Sweden (4) and Slovenia (4).

Interestingly enough this Congress attracted many participants from other Professional Societies, especially members of the OR- world visited the Congress, and most likely this was caused by the theme of the Congress "Shaping Future with Simulation".

The concept of organization of this Congress to invite organizers of special sessions and tutorials appeared to be a success, and is most likely worthwhile to be considered for future EUROSIM Congresses. We received many positive reactions.

Financially the Congress ended with a small surplus, so we were able to transfer somewhat more money to EUROSIM and we have suggested to dedicate that money to an extra fund to assist visitors from less developed countries and students to attend other EUROSIM congresses. In the Delft Congress we had to be rather active in finding cheaper lodging places for some participants. In due time the Organizing Committee will have an evaluation meeting and we will formulate some recommendations for the Organizers of the 5th EUROSIM Congress which will be held in Paris in 2004.

A number of CD's with the Congress Proceedings is still available. Interested persons are requested to contact the Chairman of the Dutch Benelux Simulation Society.

Len Dekker opens EUROSIM 2001

Invited Lecturers

The invited speakers of the EUROSIM 2001 Congress have been asked to give their view on the main trends in simulation. One trend that can be observed in the science of simulation is that simulation systems get more and more complex. Of course, this became possible after the tremendous increase in computer power in the last decades.

Prof. dr. E. Shapiro gave in his presentation "The evolution of computer technology and the art of simulation" an overview of this evolution. Computations can now be performed with much more detail than 10 years ago. It has now also become possible to develop integrated simulation systems: systems where not just one single aspect of the problem is considered, but where many different aspects with their mutual influence, are taken into account.

As clearly demonstrated in the presentation of prof. H.G. Wind "Integration in water management: loose ends or knots?", the increasing complexity of integrated simulation systems gives rise to a number of new very interesting research areas.

Another new trend in simulation is the increasing importance of visualisation. Complex systems produce an overwhelming amount of results. Visualisation and animation methods are very important to gain insight into the system behaviour. Prof. dr. T. Ertl gave an overview of visualisation of simulation results in his presentation "Scientific visualisation of simulation results: new approaches between web-integration and virtual reality".

Model Validation is another research area of simulation. Complex simulation systems often show a very unexpected behaviour.

Sometimes the system appears to be chaotic. A question that rises in these cases is: Do these simulation results represent the real behaviour or are we observing numerical artefacts? A thorough validation of the system using data is very essential to answer this question. Model validation of simulation systems is, however far from trivial. This was the subject of the presentations of prof. dr. J. Wolfe "Who needs validity? Perspectives from the field of management education and development" with respect to management models and of dr. R. Todling "Unique features of the DAO data assimilation system" with respect to numerical modeling of the atmosphere.

Data is essential for validation of the simulation model and for improving the model. Prof. dr. T. Ören discussed this aspect in his presentation "Impact of data on simulation: from early practices to federated and agent-directed simulations". In the presentation of Prof. dr. E. Gelenbe "Simulation with learning agents" it was shown how information from the real system can be used to continuously adapt the simulation model to changing conditions.

Tutorial program at EUROSIM 2001

In the 4th International EUROSIM Congress 2001 a tutorial program was organized as an official part of the Congress program. The tutorials were presented by leading practitioners in the field of simulation from all over the world and could be attended for free by all congress participants.

The tutorial program had three categories. The first category concerned introductory tutorials and was meant to make newcomers to the field of simulation familiar with the fundamentals and concepts of simulation. It contained topics such as simulation in management (Heuvelmans, OASIS, The Netherlands), modelling and simulation (Halin, ETH Zurich, Switzerland), statistics (Kleijnen, Tilburg University, The Netherlands) and continuous simulation (Sydow, GMD First, Germany).

Meeting of five EUROSIM Presidents at the ARGESIM booth: Y. Hamam, F.Breitenecker, L. Dekker, K. Juslin, F. Maceri (from left to right)

The second category dealt with more advanced or specialized topics and aimed to broaden the knowledge of simulation of those participants who are already experienced in the field of simulation. In this category the following tutorials were presented: combination of simulation and optimisation (Glover, University of Colorado, USA), mathematical heuristic modelling (Stanciulescu, National Institute for R&D in Informatics, Romania) and the handling of complex societal problems (DeTombe, Delft University of Technology, The Netherlands).

The last category was interesting to newcomers, practitioners and researchers alike. Of course, all of them are interested in the newest developments on simulation hardware and software. These tutorials provided insight into the capabilities of the present simulation software and were presented by software or hardware manufacturers or specialized users: How can one make a good simulation model with the help of POWERSIM? A Scenario analysis (Heuvelmans, OASIS), the Arena product family (Bijlsma, Rockwell Automation) and simulation, modelling, analysis and visualization using Enterprise Dynamics (Byrman, In-Control Enterprise Dynamics).

The overall impression has been that this novelty in EUROSIM congresses (free tutorials as an official part of the congress program) has been a success. Most tutorials had more than enough audience that seemed to be satisfied by the contents and the presentation. The organization appreciates very much the dedication of the lecturers in preparing and presenting their tutorials, also for free. Thank you very much for this!

Session on Ethics

Besides the traditional themes, the EUROSIM 2001 Congress also introduced a stream on Ethics in simulation, which comprised two sessions and a survey of the Congress participants. In the first session were discussed real-world cases related to ethical problems typical for the simulation profession. The session included an animated discussion that stressed the need for clarification of the general requirements for ethical behaviour of members of simulation societies.

The possible elements of a Code of Conduct were presented and debated in the second session, as well as the results of the ethics survey. Although a formal voting did not take place, a clear majority of the participants agreed that a Code of (Ethical) Conduct for the Modelling and Simulation profession is urgently needed in order to safeguard the integrity of the profession, especially considering its increasing influence on the affairs of our society.

Further, the code should be global, and requires cooperation of the societies in all countries. SCSI and EUROSIM can support this cause by starting a website devoted to ethics in modelling and simulation. The website should incite debate concerning the relevant ethical issues, and provide guidance to practitioners.

The conclusions of the session were formulated by the chairman, Prof. M. Elzas, and in the mean time a letter with some recommendations has been sent to the president of EUROSIM.

Len Dekker, Past President hands over the EUROSIM umbrella to Y. Hamam, new President

Partners Program

During the EUROSIM 2001 Congress a partners program was organised by Mrs.Helga van Stijn. The approach was to offer a program on an informal basis, which allowed for changes due to participants wishes. Four cities were visited.

On Tuesday June 26, 2001 the residential city of The Netherlands, The Hague, was visited. A guide showed nice and historical places of this beautiful town. In the afternoon we visited the spectacular outdoor sculpture exposition at one of the nicest squares of The Netherlands, 'Het Lange Voorhout'. The theme was Carnaval des Animeaux, the carnaval of animals.

On Wednesday June 27 the excursion went by train to the largest harbour of the world, Rotterdam, which also is this year the Cultural Capital of Europe. A small part of the Rotterdam harbour was visited by boat. A water taxi brought the group to the famous Hotel New York, to have a nice lunch whilst observing the intriguing view on the rivers. From this place many people left Europe in the fifties to emigrate abroad. In the afternoon the Arboretum Trompenburg was visited, where a beautiful Nature contrasts this city of workers.

Thursday June 28 Utrecht, a town in the center of The Netherlands, was the goal. Utrecht is a beautiful old town. The Museum *van Speelklok tot Pierement* (National Museum from Musical Clock to Street Organ) was visited, which is beautifully situated in one of the many old churches. After a lunch in the shadow of the Dom tower, the highest church tower of The Netherlands, a guide showed us the most interesting places of the old town of Utrecht.

As apotheoses on Friday June 29 the *Porseleynen Fles* in Delft was visited. This is the factory, where the famous Delft blueware is produced.

Most of the travelling in these excursions was done by public transport and by foot. Sometime this had to be adapted to the possibilities of the participants. The partners program showed to be quite a success, which was underlined by a big applause for Mrs. Helga van Stijn during the Congress Dinner.

Visit at Maritime Simulation

Rotterdam June 27, 2001. Simulation has become an essential part of many activities, and sometimes is even the backbone. An example of this in the field of training is MSR, the Maritime Simulation facilities in Rotterdam. An excursion was organised to MSR to see simulation at work in practice.

In an introductory talk the goals of MSR were explained, as well as the facilities. MSR accommodates five Ship Bridge Simulators and one Vessel Traffic Services (VTS) Simulator. The three Full Mission Bridge Simulators, one with a visual field of view of 360 degrees and two of 225 degrees blind bridge simulators are used for both sophisticated research studies and for training purposes. All simulators are of modular design; any bridge can be shaped to the particular wishes of the client. A multi-station VTS Simulator forms an integral part of the facility and comprises state-of-the-art concepts concerning Vessel Traffic Management and Information Services for consultancy, operational research and training. In three groups the participants visited three facilities. A comprehensive explanation was offered by the staff members of MSR at each of the facilities. The participants were quite impressed and asked a lot of questions.

The VTS training improves the awareness and attitude/discipline of ships personnel regarding Vessel Traffic Services. A clear communication between vessel and shore based on sound procedures is imperative in rough marine situations. The possibilities, benefits and limitations of VTS were demonstrated. All situations in calamitous circumstances are simulated.

In one of the talks the staff of MSR showed the result of a research study. When a vessel is passing under a very low object, a vertically moving bridge is a solution. However, for some minutes the vessels crew has to navigate without seeing, because the cargo hinders the sight. This situation indeed is simulated very realistically, suitable for training purposes.

The 360 Ship Bridge Simulator offers a view, produced by many video beamers. A situation was simulated where the participants should navigate a large size vessel through the Rotterdam harbour in high wave conditions.

The simulated waves tended people to become seasick. It was quite hard not to get involved and to interfere with the captain's decisions. These and other situations are trained for all ports of the world. This is especially necessary if one wishes to avoid calamitous situation with a crew that most of the time is multi-lingual.

It was stunning to see what simulation is capable of doing, especially combined with powerful visualisation tools. We Thank MSR for this enlightening excursion.

Visit Medical Museum Delft

On June 27th, 2001 we visited with about 20 Congress participants this very small and most interesting Medical Museum, located at one of the canals near the center of Delft. The general manager of the museum, Dr. Griffioen, welcomed us and guided us through the museum, which appeared to have a very nice collection of medical equipment and instruments.

From a spirited discussion on nursing practices and the changes introduced by Florence Nightingale in the midst of the 19th century, we were guided to an old pharmacy, an old dentist chair, and many interesting medical artefacts and instruments. Since some participants of the 2nd Conference on Modeling and Simulation in Biology, Medicine and Biomedical Engineering attended this visit many interesting discussions could be held, and even some participants promised Dr. Griffioen to send him and/or look for some material for his collection.

Thanks to Marja Dekker for her excellent organisation

The museum is clearly a long-term project and Dr. Griffioen's enthusiasm guarantees success and a rapid expansion of the different displays. At the end of the visit we were introduced to all the developed electronic audio means for nearly deaf people since World War II, a most interesting collection. After two hours we had to finish this visit, though some participants hardly wanted to leave!

Iva and Wim Smit
Theo van Stijn
Henk de Swaan Arons
Arnold Heemink
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UKSIM 2001

Conference of the UK Simulation Society

Emmanuel College, Cambridge, 28-30 March 2001

UKSIM 2001 Conference was held from 28 to 30 March 2001, at Emmanuel College, Cambridge. Conference had about 80 participants form countries such as Germany, Austria, Hungary, Singapore, Greece, Italy and USA, as well as the UK of course. Papers were presented within 9 sessions covering Parallel and Distributed Simulation, Optimisation and ANN, Research and Industry, Engineering and Industry, Industrial and Human Systems, Simulation in Biomedicine and, finally, Business Processes and Collaborative Work. Papers presented within these session generated a great deal of interest and discussions, and provided an opportunity for initiation of future collaboration amongst participants.

The conference provided many opportunities for socialising, including a conference dinner in a stunning 17th century hall (named The Library), which culminated in an inspiring invited speech given by Professor Breitenecker who, among many other things, represented EUROSIM at the conference.

The distinguished scientific content, excellent conference facilities, delicious food, and beautiful surroundings contributed to the success of this conference. In fact, the participants were so pleased with the Conference that the same venue will be considered or a future joint EUROSIM/UKSIM event in 2003/5.

Copies of the UKSIM 2001 conference proceedings may be obtained from Dr David Al-Dabass, Department of Computing, Nottingham Trent University, Nottingham NG1 4BU, United Kingdom. More details are found at the conference website: ducati.doc.ntu.ac.uk /uksim/uksim'01/CFP-uksim'01.htm

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SIM'2001 Conference and Trade Fair

June 17 – 21, 2001, Freiburg

SIM 2001, the first Industrial Trade Fair and Knowledge Exchange on Applied Simulation and Visualisation took place in Freiburg / Breisgau, Germany, June 17 – 21, 2001. Special emphasis was given to enable an interdisciplinary discussion between experts and professionals with different core skills.

Conception of SIM'2001

SIM 2001 is a development of Löffler & Associates GmbH – Concept Engineering – in Switzerland and enjoys substantial support from major organisations: Hardware Companies (e.g. NEC, Compaq, HP, SGI, Sun Microsystems), Software Vendors (e.g. Fluent, MSC, CD-adapco), Research Institutes and Organisations (e.g. the German National Research Center for Information Technology, GMD, the IST-Programme of the European Union and the Arbeitsgemeinschaft Simulation, ASIM, Austria/Germany/Switzerland) support the establishment of SIM 2001 as the new European Market Platform. Their common goal was to push the competitiveness of the European Manufacturing Industry into a global lead position by promoting the efficient use of the new simulation and visualisation tools that are available.

The SIM 2001 Industrial Trade Fair is the international market place for applied simulation and visualisation. The hardware and software available, services and consultancy, as well as new technologies and applications for industry in simulation (CFD, FEM, Moulding, Crash, Kinematics, Process Simulation, Robotics, Logistics etc.) and Visualisation tools (3D-Visualisation, Virtual Reality, etc.) were presented.

Exhibition

The SIM 2001 Exhibition included the following product sectors:

- Computer Hardware, Supercomputers, Workstations, Distributed Computing Systems, PC's, and further hardware-developments (interfaces, mass storage systems, etc.).
- Simulation-Software: CFD, FEM, Molding, Crash, Weather, Climate, Kinematics, Product Simulation, Process Simulation, Simulation of Intelligent Systems (e.g. Robotics, Transport, Manufacturing), and further software in related fields.
- Exhibitors like SGI, Sun and Compaq presented hardware and visualisation and CFD software, simulation and visualisation software developers demonstrated new products.

Conferences

The trade fair with really very interesting exhibitors was accompanied by conferences and workshops on modelling, simulation and visualisation.

Simulation and Visualisation 2001 Conference, June 19, 2001

The Importance of Simulation and Visualisation for Industry in the Next Decade was underlined by contributions as:

- Virtual Insight: From Digital Data to Knowledge in Crash. J. Elberfeld, SGI, Munich
- Multidisciplinary Simulation Leading to Virtual Engine. G. Rainer, AVL List, Graz, Austria
- The Virtual Train – Simulation at the Research and Technology Centre of the Deutsche Bahn AG. Th. Lölgen, Deutsche Bahn AG
- Blow Molding Simulations for Plastic Fuel Tanks. A. Wüst, BASF, Ludwigshafen
- Simulation in Product Development: Application in Pharmaceutical Industry. D. Bruhnke, Promodel Corporation, Orem, Utah, USA

5th World Fluid dynamics Days 2001, Official WUA-CFD-Conference, *June 17-21, 2001*

CFD and the Economic Benefit in Manufacturing – was the theme of this two-annual conference of CFD – specialists. This conference was the core of SIM'2001; the idea of SIM'2001 was born, when this conference enriched the view to other disciplines.

Modelling and Simulation in Education, *June 20, 2001, 9am - 1pm*

In co-operation with ASIM and McLeod Center Europe this workshop focussed on educational aspects:

- Goals of Education in Discrete Modelling and Simulation at ETH-Zuerich
  V. Hrdliczka, Dept. of Industrial Engineering and Management, ETH Zürich
- Perspectives on Modern Education and Training in Modelling. D. P. F. Möller, Inst. f. Technical Informatics, University Hamburg,
- The WWW-based ARGESIM Comparison on Simulation Techniques - a Source for Education and Training in Modelling and Simulation.
  F. Breitenecker, Dept. Simulation,
  Vienna University of Technology
- Modelling and Simulation for Education and Training of Physicians: Blood Flow Models and Vascular Surgery; Ch. Almeder, Inst. for Operation Research, Vienna University of Technology
- Education and Training in Environmental Modelling using Cellular Automata. J. Wittmann, Inst. f. Technical Informatics, University Hamburg

During the workshop also the USE-ME project was introduced. USE-ME (US – Europe Multicultural Education Alliance in Computer Science and Engineering) enables students from computer science and computer engineering (emphasising on modelling and simulation) to take part in an Exchange Program between US Universities and European Universities: see webpage useme.informatik.uni-hamburg.de

ARGESIM – ASIM Presentation

ASIM and ARGESIM were present at SIM'2001 with a booth and with organising the fore mentioned workshop on education.

At the exhibition booth ASIM and ARGESIM presented publications (SNE – Simulation News Europe, ASIM – SCS Book Series Frontiers and Advances in Simulation, etc).

Furthermore, with posters cooperative project with the ARCS (Austrian Research Center Seibersdorf) were introduced: modelling, simulation and visualisation of the human circulatory system, models for waste water management, etc.

V. Hrdliczka, F. Breitenecker and Ch. Almeder
at the ASIM – ARGESIM booth.

Plans for SIM'2003

Because of the success, it is intended to organise in two years this event again. SIM'2003 will take place in Stuttgart, Karlsruhe, Basel, Hamburg, Frankfurt or Nürnberg.

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GOR – ÖGOR – SVOR Operations Research Conferences OR2002

www-sci.uni-klu.ac.at/or2002

OR2002 is the common conference of the German (GOR) the Swiss (SVOR) and the Austrian (ÖGOR) Operations Research societies. This joint conference takes place every four years, with previous conferences in Vienna (1990), Berlin (1994) and Zurich (1998). After three successful conferences OR2002 will take place in Klagenfurt, Austria:

OR'2002
Operations Research 2002
Sept. 2 – 5, 2002, Klagenfurt, Austria

There are many session dealing with modelling and simulation:

- Production, Logistics and Supply Chain Management, S. Helber (Clausthal), W. Jammernegg (WU Wien)
- Transportation and Traffic
  S. Voss (TU Braunschweig), U. Zimmermann (TU Braunschweig)
- Telecommunication und Information Technology
  A. Taudes (WU Wien)
- Continuous Optimization
  F. Jarre (Düsseldorf), J.-P. Vial (Genf)
- Stochastic and Dynamic Programming
  Römisch (HU Berlin), R. Schultz (Duisburg)
- Simulation
  F. Breitenecker (TU Wien), P. Chamoni (Duisburg)
- Control Theory, Systems Dynamics, Dynamic Games
  M. Schwaninger (St. Gallen), G. Tragler (Tu Wien)
- Econometrics, Statistics and Mathematical Economics
  W. Eichhorn (Karlsruhe), M. Luptacik (WU Wien)

ASIM will help to organise especially the session Simulation. Furthermore, ASIM intends to exhibit at the conference.

Dealines are March 31, 2002: submission of abstracts, May 31, 2002: early registration

Information

or2002@uni-klu.ac.at
www-sci.uni-klu.ac.at/or2002/

CALENDAR OF EVENTS

10.12.01 13.12.01 MODSIM 2001
International Congress on Modelling and Simulation, Canberra, Australia, fredg@cres.anu.edu.au, cres.anu.edu.au/~tony/modsim2001.html

17.12.01 21.12.01 DETA 2001
Differential Equations and Applications, Cairns, Australia, www.worldses.org

09.12.01 12.12.01 WSC 01
Winter Simulation Conference 2001, Arlington, Virginia, USA, pdwelch@att.net, www.wintersim.org

27.01.02 31.01.02 WMC 2002
Western Multiconference Modeling and Simulation, HEALTH SCIENCES SIMULATION, San Antonio, Texas, www.sla.purdue.edu/academic/soc/andersonj/call.html

11.02.02 15.02.02 FSFS '02
Fuzzy Sets and Fuzzy Systems (FSFS '02), Interlaken, Switzerland, www.worldses.org

28.02.02 01.03.02 SIMVIS 2001
Simulation and Visualisation 2002, Magdeburg, Germany, www.simvis.org

04.03.02 05.03.02 ASIM-STS 2002
FG -Treffen "Simulation Techn. Systeme", Bielefeld, Germany, www.sts.asim-gi.org,

06.03.02 08.03.02 ASIM-SPL 2002
10. ASIM-Fachtagung Simulation in Produktion und Logistik", Duisburg, Germanym info@asim-gi.org, www.spl.asim-gi.org

07.03.02 08.03.02 ASIM-SUG 2002
Workshop "Simulation of Environmental Systems", Cottbus, Germany, www.asim-gi.org

11.03.02 13.03.02 ASIM-SBW 2002
8. Symposium "Simulation als betriebliche Entscheidungshilfe", Braunlage, Harz, Germany, www.asim-gi.org

18.03.02 19.03.02 MODELICA 2002
Modelica Conference 2002 DLR München, Germany, Martin.Otter@dlr.de, www.modelica.org/Conference2002.shtml

21.04.02 24.04.02 ICCS 2002
The 2nd International Conference on Computational Science, Amsterdam, The Netherlands, www.science.uva.nl/events/ICCS2002

24.06.02 27.06.02 iEMSs 2002
Integrated Assessment and Decision Support, Lugano, Switzerland, www.iemss.org/iemss2002

24.06.02 27.06.02 ITI 2002
24th Conference Information Technology Interfaces, Cavtat, Duvrovnik, Croatia, www.srce.hr/iti

24.06.02 27.06.02 IEMSS 2002
International Environmental Modelling and Software 2002, Lugano, Switzerland, andrea@idsia.ch www.iemss.org/iemss2002

Juni 2002 ESM 2002
European Simulation Multiconference 2002, Darmstadt, Germany. www.scs-europe.com

September 2002 SIMS 2002
SIMS Conferences on Modelling and Simulation. Oulu, Finland, browse.to/sims

10.09.02 13.09.02 ASIM 2002
16. ASIM - Symposium Simulationstechnik, Rostock, Germany, info@asim-gi.org, www.asim-gi.org

03.10.02 05.10.02 HMS 2002
Harbour, Maritime & Multimodal Logistics Modelling and Simulation, Bergeggi, Italy, st.itim.unige.it/hms2002

Oktober 2002 ESS 2002
European Simulation Symposium 2002, Dresden, Germany, www.scs-europe.com

08.12.02 11.12.02 WSC 02
Winters Simulation ConferenceSan Diago, California, USA, www.wintersim.org

05.02.03 07.02.03 4th MATHMOD
4th IMACS Symposium on Mathematical Modelling - 4th MATHMOD, Vienna, Austria, inge.troch@tuwien.ac.at, simtech.tuwien.ac.at/MATHMOD

2004 EUROSIM 2004
5th EUROSIM Congress Modelling and Simulation, Paris, France, www.eurosim.info

SNE NEWS EDITORIAL BOARD

www.argesim.org/SNE/

SNE (Simulation News Europe) is the official membership journal of EUROSIM and sent to most members of the EUROSIM Societies as part of the membership benefits. Furthermore SNE is distributed to the members of SCS Europe, and to User Groups and for promotional purposes via ARGESIM.

SNE is registered with ISSN 1015-8685, continuing the ISSN 0929-2268.

If you have any information you want to see published, please contact the corresponding member of the editorial board (society news, conference announcements, conference reports, events, etc.).

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SIMULATION CENTRES

Control Laboratory - Drebbel Institute for Mechatronics

University of Twente
Twente, The Netherlands
www.rt.el.utwente.nl
www.rt.el.utwente.nl/drebbel

Control Laboratory

The 'Control Laboratory' is one of the ten chairs of the Faculty of Electrical Engineering. Besides the PhD–students, every year about 10-15 MSc–students take part in the research of the laboratory and obtain their MSc–degree. The research is carried out in the Drebbel Institute for Mechatronics. The Control Laboratory participates in the national research school DISC (Dutch Institute of Systems and Control).

The research of the group is application oriented. The main goal is to investigate the applicability of modern systems and control methods to practical situations. The theoretical base is mainly formed by projects in the fields of intelligent control and modelling and simulation of physical systems

Application, realisation and utilisation are realised in the following projects:

design of mechatronic systems
embedded control systems

Where applicable, developed methods and knowledge are made available in the form of software tools for modelling, simulation and control

Cornelis J. Drebbel Institute for Mechatronics

The Cornelis J. Drebbel Institute for Mechatronics coordinates the mechatronics research activities of a number of groups in the faculties of Electrical Engineering, Mechanical Engineering, Applied Mathematics and Computer Science of the University.

The Drebbel institute is a continuation of the former *Mechatronics Research Institute Twente* (MRCT), founded in 1989. The MRCT was a pioneer in mechatronics research in Dutch universities and has made the University of Twente known world wide as the pioneering mechatronics research center.

Especially the last five years mechatronics has been booming and explicit mechatronics education and research activities have started all over the world.

The research topics of the Drebbel Institute include:

- Mechatronic Design projects and tools
- Control Theory and Control Engineering
- Mechatronic measuring systems
- Embedded Control Systems

Within the Drebbel Institute about 20 PhD students are working on various research projects. Research topics of these PhD students include:

- Control of laser welding and Control of laser welding robots
- Hybrid Isolation of Construction sound Vibration Control with a Smart Disc
- Learning feed-forward control of linear motors
- Embedded Control Systems
- Stability aspects of learning feed-forward control
- Hybrid System, Non-Linear Control
- Adaptive Control, Infinite Dimensional Systems
- Measurements of Micro Wear
- Micro flow measurement
- Measurements of Body Dynamics,

International Master's Program on Mechatronics

Drebbel Institute and Control Laboratory of Twente University are responsible for the International Master's Program on Mechatronics.

The Faculty of Electrical Engineering of Twente University offers an International Master's Programme in the field of Mechatronics. The programme covers the wide field of Mechatronics from the electrical engineering perspective.

A programme of an individual student will consist of a coherent package of courses and laboratory works in the wide application area. This inevitably means that the individual programme will specialise in one application area; the programme is tailored to the personal preference.

Entry conditions are at least sufficient mathematics, physics and electrical/mechanical engineering background at high Bachelors level. As backgrounds of candidates might vary widely, there will be a starting course on fundaments of Mechatronic engineering and design practice and theory.

The programme is maximal 24 months with a thesis work of at least 31 weeks. The preceding coursework and associated lab work fit in one academic year (42 weeks). A possibility is foreseen for students entering the Master's Programme to obtain a Master's Degree after one year. In that case an entry into the PhD phase is possible after one year.

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Drebbel

Cornelius Jacobszoon Drebbel was born in Alkmaar (Netherlands) in 1572, as a son of a well-to-do farmer. He probably only had elementary education, which would have included Latin. He had no university education. As a young man he was apprenticed to the famous engraver Hendrick Goltzius in Haarlem.

Cornelis Drebbel after Hendrick Goltzius:
The Seven Free Arts: Geometry

In 1595 he settled at Alkmaar, where he devoted himself to engraving and publishing maps and pictures. He soon turned to mechanical invention, for in 1598 he was a granted a patent for a pump and a clock with perpetual motion.

In 1610 Drebbel visited the court of Emperor Rudolf II in Prague, at the Emperor's invitation. Rudolf gave him the title of Chief Alchemist after seeing his remarkable perpetual motion machine. Drebbel really only claimed that it could rewind constantly by atmospheric pressure changes. It had a sealed glass tub where liquid contracted and expanded to enable the clock to constantly rewind.

In the strict sense he was not a scientist but an inventor or practicing technologist.

Conference Mechatronics 2002

Drebbel Institute and Mechatronics Forum UK (IMECHE, branch of IEE) organise the conference Mechatronics 2002.

I MECH E

www.iee.org.uk/Manufacturing/Mechatronics

Mechatronics 2001

The 8th Mechatronics Forum International Conference

24th - 26th June 2002, University of Twente, Enschede, Netherlands

General Chair: Prof. Job van Amerongen, Drebbel Institute, University of Twente, Netherlands; Co-chair: Prof. Geoff Roberts, Mechatronics Forum, University of Wales College, Newport, UK

Scope and Topics

Mechatronics, a truly multi-disciplinary approach to engineering, has become the key to many different products and processes. The integration of mechanics, electronics, control and computing exploits and exceeds the relative advantages of single disciplines, and when they are integrated, the synergy ensures that performances reach unprecedented levels.

The Mechatronics Forum aims to continue the successful series of biennial conferences with the eighth offering, Mechatronics 2002, held in Enschede, the Netherlands. Recent venues were in Budapest (Hungary 1994), Minho (Portugal1996), Skövde (Sweden 1998) and Atlanta (USA, 2000). High quality papers are sought from the international Mechatronics community. Industrial contributions, particularly case studies describing state-of-the-art of technology, are especially welcome. Preference will be given to papers that highlight synergistic aspects in the application, analysis or simulation, and education.

Call for papers

Papers are invited on applications of mechatronics as well as the supporting theory and design tools Prospective contributors are invited to submit an extended abstract of around 1000 words.

Abstracts may be submitted by e-mail or post – e-mail is preferred.

Invited Sessions and Exhibition

Proposals for invited sessions are welcome. Space for exhibitions will be made available. Contact the organisation as soon as possible.

Address for correspondence and inquiries:

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BioMod Research Group

Freiburg i. Br., Germany

www.biomod.de

Aims and Scope

The aim of the group (BioMod: Biological Modelling and Simulation of Cortical Functions) is research on cortical structures and functions by use of neural simulations.

Foundation members of the BioMod Research Group began their work in close connection with the Neurolinguistic Laboratory of the University of Freiburg, Germany. The thematic focus of this organisation lies in the investigation of language pathologies and includes an extended range of empirical work with use of statistical methods. The restriction to pathologies and empirical investigations was not what we thought to be an appropriate and sufficient approach for questions of cognitive science or cognitive linguistics. Simulations were essential for us, so we decided to establish the BioMod Research Group focussing particularly on simulation experiments.

Along with the main interest on simulations we adopted a list of subjects which includes language pathologies, but is no longer confined to just this field. It seemed useful for us to consider other subjects such as the philosophy of science (to improve model reliability), as well as to include the broad range of linguistic theory outside linguistic pathology with the aim of a biological foundation and a real confrontation with the known properties of the brain.

Even though the BioMod research group originated in the field of linguistics, it seemed useful to include other areas of cognitive science, like music perception or memory, since we think that there are close connections and resemblances with our main interest of research.

Artificial neural nets are biologically inadequate. This is well known, but has not led to significant scepticism. We don't use simulation tools or models of this paradigm. Other biologically based systems of neural simulation are too complex and do not meet our requirements, therefore we have designed our own simulation programs which we continue to develop, without creating a mere bundle of separate functions.

Projects

All projects supported by the BioMod -Group aim to discover phenomena (mostly from the field of linguistics) by trying to simulate neural structures.

The most important principle, which qualifies the validity of modelling and simulation, is the principle of "precisability". This means that our models of linguistic processes must by definition be totally compatible with the actual knowledge in the fields of biology and medicine, whatever level of abstraction one may choose for comparison, even concerning single neurons and smaller intracellular structures and functions.

We expect, that this level of "biological adequacy", that not only lets us predict cognitive behaviour but aims to represent real functioning of the brain, will produce interesting new insights for researchers in the fields involved and will even have consequences concerning diagnosis and therapy of different brain-pathologies.

Simulating basic structures and processes of first language acquisition

The vast amount of books recently published in the field of language acquisition cannot override the lack of a precisely formulated theoretical background.

There still exist presentations of observable processes without the awareness of the necessity of explanations. Theoretically oriented work concerning developmental psychology is still based on Piaget and, in linguistics, on Chomsky's generative language theory; alternatives remain rudimentary (e.g. connectionist models).

We think that knowledge in all disciplines that are directly involved in brain research has dramatically expanded compared to the knowledge Lenneberg could make use of. We now should try to systematically exploit this corpus of knowledge.

There are many basic concepts of language learning to be found in various publications of the BioMod-Group. Combining these concepts and constructing compound models of early language acquisition is expected to deliver new insights in this large and complex field of research.

Aphasia

Current aphasiological research presents a mixture of phenomena, hypotheses, assumptions and speculations, all of which do hardly focus on causalities in the sense of biologically plausible explanations of the defect that ends in an aphasic phenomenon.

Therefore the huge amount of assumptions concerning the therapy of these deficits is highly speculative and shows little sensitivity concerning the biological properties of the apparatus that shall be "healed".

The aim of this project is to explain the cause of aphasic phenomena by biologically precise models and to apply these insights to therapeutical concepts. This close binding of the linguistic phenomena to the neurobiological deficits shall make it possible to make detailed and realistic assumptions to both, explanations of phenomena and therapy.

The project is currently limited to post-ischemic deficits. However, a general exclusion of other causes of aphasic language deficits is not intended.

The end of logic: Theory and methods of cognitive science

Cognitive sciences are currently dominated by a more or less productive methodological chaos - a mixture of methods originating in psychology, artificial intelligence and biology.

One can hold the opinion, that such a methodological multitude meets the interdisciplinary character of cognitive science.

Unfortunately, neither the empirical methods of psychology, nor the experimentation techniques of biology or the systemized approach of computer sciences build the central approach in this interdisciplinary framework. Can we therefore expect, that a combination of these will work properly?

We think that cognitive science, as we state it, needs it's own methods. The methodological approach proposed by the BioMod - Group is not systematically conceptualised yet. The aim of this project is to close this gap.

Music theory, music perception, music psychology, music aesthetics

Robert Jourdain's book "Music, the brain, and ecstasy" certainly mirrors the current state of research in the field of music perception in the brain, even despite Jourdain's journalistic simplifications and misinterpretations (e.g. the concept of the "grandmother-cell") have to be corrected.

However, comparable to the field of language research, background theories about neural architectures that underlie observable musical behaviour are highly vague and underestimated.

If we adopt the opinion that architectural principles in the neo-cortex for most, if not all fields of knowledge are similar in structure and functioning and, since music and language perception clearly share some common properties (both use the acoustic channel), it seems natural to compare the phenomena and underlying neural structures in music and linguistics.

This might open both fields to new insights and explanations.

Future projects are:

- Formulation processes in speech production
- Music perception
- Foundations of scientific argumentation
- Multiple personalities

Recent publications concern pathologies like schizophrenia, stuttering, Alzheimer's disease, lexical access in aphasia and more general subjects like forms of memory in neural models.

All projects are treated as parts of a whole. We therefore build our different models on the basis of the same repeated elementary neural structure that consists in a small network of neurons with different parameters and different functions. In all cases biologically adequate learning mechanisms are implied. This means, that our architectures are not as universal as current artificial neural networks, but contain really vulnerable hypotheses on cortical functions.

Mailing List, Internet Forum

The BioMod - Group is organising a moderated mailing list since October 2000. If you want to subscribe to the list, send an e-mail to the following address with following body-text (subject is ignored):

Majordomo@biomod.de

subscribe biomod <your_email_address>

If you have any theses to discuss, announcements or anything else that might be of interest for the BioMod - Group and the receivers of the mailinglist, please feel free to send these to the editor of the list:

biomod-editor@biomod.de

If you want to unsubsribe, send email to:

Majordomo@biomod.de

unsubscribe biomod <your_email_address>

Furthermore, the group offers a forum at the website, where German and English entries are welcome.

Contributions to the mailing list and to the website forum may be selected for publication at the website in the documents' corner.

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COMPARISONS OF SIMULATION TOOLS AND TECHNIQUES

Comparison Overview

Simulation News Europe (SNE) publishes a series on comparisons of simulation technique and simulation software. Based on relatively simple, easily comprehensible models different modelling techniques and their implementation as well as features of modelling and experimentation within simulation languages, also with respect to application area, are compared.

Definitions

Up to now 15 comparisons have been defined.

C1 Lithium-Cluster Dynamics, SNE 0 (11/90), checks integration of stiff systems, parameter variation, and steady state calculation.

C2 Flexible Assembly System, SNE 2 (3/91), discrete system, compares features for submodel structures, control strategies, and optimisation.

C3 Generalised Class-E Amplifier, SNE 2 (7/91), simulation of electronic circuits, table functions, eigenvalue analysis, and complex experiments.

C4 Dining Philosophers I, SNE 3 (11/91), general comparison, involving not only simulation but also analysis e.g. by Petri nets and, etc.

C5 Two State Model, SNE 4 (3/92), checks high accuracy features and state event handling).

C6 Emergency Department - Follow-up Treatment, SNE 6 (11/92), discrete system, tests features for modelling, concepts of availability, and complex control strategies.

C7 Constrained Pendulum, SNE 7 (3/93), checks features for hybrid modelling, comparison of models, state events, and boundary value problems.

CP1 Parallel Simulation Techniques, SNE 10, (3/94), deals with the benefits of distributed and parallel computation for simulation tasks; three test examples test parallelisation techniques.

C8 Canal-and-Lock System, SNE 16 (3/96), discrete system, checks features for complex logic control, validation and variance reduction.

C9 Fuzzy Control of a Two Tank System, SNE 17, (7/96), asks for approaches and for implementations of modules for fuzzy control.

C10 Dining Philosophers II, SNE 18 (11/96), reviews discrete simulators with respect to concurrent access to resources and with deadlocks.

C11 SCARA Robot, SNE 22 (3/98), deals with implicit and hybrid systems with state events.

C12 Collision of Spheres, SNE 27, November 1999, allows numerical or analytical analysis as well as continuous or discrete approaches

C13 Crane Crab with Embedded Control, SNE 31, checks techniques and features for digital control and linearisation

C14 Supply Chain, SNE 23/33 (11/2001), addresses discrete simulators wrt features for supply chain systems (messages, strategies)

Solutions

We invite all readers to participate in this comparison. Please, simulate the model(s) with any tool of your choice and send in a solution.

A solution should consist of: 1. a short description of the simulator, 2, modelling technique, model description, 3. results of the three tasks. Additionally we ask for: 1. suggestion for classification, 2. model codes, if available. The solution should fit into one page of SNE – templates. Solutions sent in are reviewed. Source codes of model and / or experiment description are highly appreciated.

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SNE	Comparisons														
	C1	C2	C3	C4	C5	C6	C7	CP1	C8	C9	C10	C11	C12	C13	C14
0	Def														
1	5	Def													
2	4	4	Def												
3	4	3	3	Def											
4	1	5	5	2	Def										
5	4	-	1	1	2										
6	-	2	-	2	1	Def									
7	1	2	1	2	-	1	Def								
8	-	1	-	-	-	1	3								
9	-	-	-	-	-	2	3								
10	1	2	-	-	-	1	2	Def/1							
11	2	2	1	-	1	-	-	2							
12	1	-	1	-	-	-	2	3							
13	-	-	-	-	-	-	3	1							
14	3	-	1	-	-	-	2	-							
15	-	-	1	-	1	-	-	-							
16	1	-	-	-	-	-	1	-	Def/1						
17	-	-	1	-	1	-	1	1	1	Def/1					
18	-	-	-	-	-	-	2	2	-	-	Def/1				
19	-	-	-	-	-	-	-	1	1	1	3				
20	-	-	-	-	-	-	1	-	1	1	2				
21	-	1	-	1	-	1	5	-	-	-	2				
22	1	-	1	-	1	-	5	-	1	-	-	Def/1			
23	-	2	-	-	-	-	-	-	-	2	-	1			
24	1	-	-	1	-	-	2	-	-	-	1	2			
25	-	1	-	-	1	-	-	-	-	3	1	1			
26	2	1	2	1	1	-	1	-	-	1	1	1			
27	-	-	1	-	-	-	-	-	-	2	1	-	Def/2		
28	-	-	2	-	1	-	-	-	-	2	-	-	2		
29/30	1	1	1	1	-	3	-	-	-	-	1	-	3		
31	-	-	-	-	-	-	1	-	-	-	-	1	3	Def/1	
32/33	-	2	-	-	-	-	1	-	-	2	1	-	4	-	Def/1
Total	32	29	22	11	10	9	35	11	5	15	14	7	14	1	1

C14 Supply Chain Management Definition

This comparison addresses discrete modelling and simulation. Supply Chain Systems are usually straight forward, but they have different downstream and upstream flows between factories, distributors and wholesalers. While the downstream flow characterises the flow of materials, the upstream flow represents the various orders, which often depend not only on the local material flow downstream, but also on the global status of the system.

The flow of orders may be modelled in many different ways:

- Templates for chain supply
- Message channels for modelling flow of orders
- Timeless orders represented by events directly
- Planning tables control order sequences

This comparison considers a relatively simple Supply Chain, consisting of four factories, of four suppliers, and of a group of wholesalers (fig. 1.)

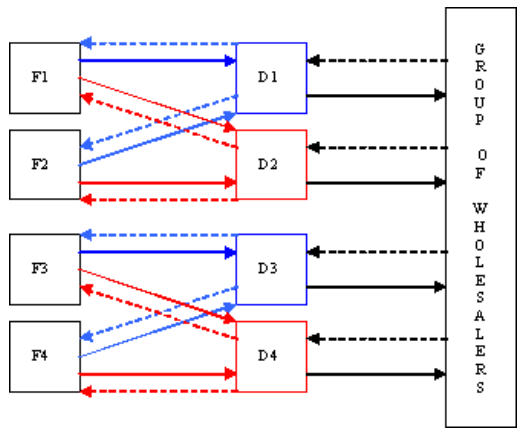

Figure 1: Supply chain with 4 factories, 4 distributors and a group of wholesalers

Factories

The 4 factories F_i are supposed to be supplied with unlimited raw materials. The factories produce 12 different products p_k (uniformly distributed) and supply the distributors. The factories do not produce all types of products; each factory only produces 6 different types of products (table 1). The interarrival time of products is distributed exponentially with parameter 600 seconds (independent of type of product).

The investigations consider a time horizon of 30 days, beginning at 00.00 at the 1st day and ending at 24.00 at the 30th day. The factories produce all the time around the day, starting at the 1st day, 00.00, ending with 30th day, 24.00 (after 720 hours).

F_1	F_2	F_3	F_4
p_1	p_7	p_4	p_{10}
p_2	p_8	p_5	p_{11}
p_3	p_9	p_6	p_{12}
p_4	p_{10}	p_7	p_1
p_5	p_{11}	p_8	p_2
p_6	p_{12}	p_9	p_3

Table 1: Production Plan

Distributors

The 4 Distributors D_i supply a group of wholesalers and order from the factories, following different order strategies. First, the factories produce for 7 days, so that they have a stock of products. Then the distributors start with their orders (i.e. on the 8th day, 00.00, or after 168 hours); at this time all distributors order 10 pieces per product, regardless of the ordering strategy used, to fill their storages.

Further orders are placed once a day, at 00.00. If an order cannot be fulfilled, it is postponed until the next day. An order is only considered fulfilled, if the whole amount of ordered products of one type is available. Furthermore, a supply lead time T_{ji} between distributor and factory (table 2) is must be taken into account.

T_{ij}	F_1	F_2	F_3	F_4
D_1	16	22	20	12
D_2	15	16	13	19
D_3	14	16.5	20	17
D_4	22	13	16.5	18

Table 2: Supply Lead Time in hours

Group of Wholesalers

A group of wholesalers orders stochastically products from the distributors (one product per order):

1. Distributor D_j is stochastically chosen, where $j \in \{1, 2, 3, 4\}$ is uniformly distributed
2. Time in between orders is uniformly distributed over the interval [600,3600] seconds (discrete)
3. Type of product (number k) is uniformly distributed, where $k \in \{1, 2, \ldots, 12\}$

The wholesalers start to place their orders to the distributors at the 9th day, 00.00 (after 192 hours).

All orders that cannot be fulfilled are neglected; the wholesalers do not repeat them some time later. But they are regarded at the distributors: the distributor, who could not deliver products of an order, orders these products additionally from the factories at next order time (00.00, next day), regardless which order strategy the distributor uses.

Delivery time from distributor to wholesalers is of no importance, this delivery time does not influence the behaviour of orders.

Products

The products p_k have no specific attributes, as weight or size. They are ordered from factories due to a fixed plan, (table 3, task a and task b) or depending on supply lead time (task c)

	D_1	D_2	D_3	D_4
p_1	F_1	F_1	F_4	F_4
p_2	F_1	F_1	F_4	F_4
p_3	F_1	F_1	F_4	F_4
p_4	F_1	F_1	F_3	F_3
p_5	F_1	F_1	F_3	F_3
p_6	F_1	F_1	F_3	F_3
p_7	F_2	F_2	F_3	F_3
p8	F_2	F_2	F_3	F_3
p_9	F_2	F_2	F_3	F_3
p_{10}	F_2	F_2	F_4	F_4
p_{11}	F_2	F_2	F_4	F_4
p_{12}	F_2	F_2	F_4	F_4

Table 3: Fixed order of products by distributors from factories

Each component in the supply chain tries to meet the demand (order) of the downstream component. Also, each supply chain member orders some amount from its upstream supplier. Once the order arrives, the supplier fills it only if the whole amount of products is available.

Model Approach

Give a short explanation of the model approach, especially how the orders and the order strategy are managed or implemented resp. (messages, events ?).

Task a: Simple Order Strategy

Each distributor daily orders a constant amount of 2 pieces per product at the same factory: D_1 and D_2 order at F_1 and F_2, D_3 and D_4 at F_3 and F_4 (Table 2).

Costs. Transport from factory F_i to Distributor D_j costs 10 € per hour of delivery per order (independent of number of products), the distributor's D_j storage costs are 1 € per product per day (essential is the number of stored products at next order time, where the storage costs are calculated as cost/day times number of stored products, independent from arrival or leaving time of an individual product).

Task a1: Simulate the system once for 30 days and show the stock of distributor D_1 over time.

Task a2: Perform 100 simulation runs, calculating maximum, minimum, mean and deviation of

- C = total cost of distributor D_1
- N = number of products delivered by distributor D_1, and
- R = relative costs of distributor D_1, R = C / N

Task b: On Demand Order Strategy

Of certain interest in this model is the influence of different ordering strategies of the distributors.

Instead of ordering a constant number of products (Task a), now the distributor orders as much as needed to meet the demand of the downstream component:

Each distributor accumulates the orders (for each product) of the wholesalers – fulfilled and not – over 24 hours (from 00.00 to 24.00 each day) and orders than this amount from the factories at the next order time (00.00, next day).

Task b1. Simulate the supply chain once for 30 days and show the stock of distributor D_1 over time.

Task b2. Perform 100 simulation runs, calculating maximum, minimum, mean and deviation of

- C = total cost of distributor D_1
- N = number of products delivered by distributor D_1, and
- R = relative costs of distributor D_1, R = C / N

Task c: Minimal Supply Time - Strategy

In the previous tasks the distributors place their orders at fixed factories (table 3). Now a distributor D_j tries to order at the factory F_m with the minimal supply lead time T_{jm}, (T_{jm} = min (T_{ji}, i =1,..,.4).

If the desired amount of products is not available, the factory next in ranking in regard to minimal supply lead time is chosen, and so on. If no factory can deliver, the order is postponed to the next day.

Task c1. Perform 100 simulation runs, calculating maximum, minimum, mean and deviation of

- C = total cost of distributor D_1
- N = number of products delivered by distributor D_1, and
- R = relative costs of distributor D_1, R = C / N

Task c2. Compute a comparative table, showing mean and deviation of C, N and R for all three order strategies.

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C14 Supply Chain Management - Taylor ED 3.4

Taylor ED (Enterprise Dynamics) is an object-oriented simulator for discrete processes. Processes, stations, entities, and also control of any kind are represented by *atoms* (objects). The *4Dscript Language* is the interface through which all Taylor ED functionality is controlled. It is used to define atom functionality, to create, run and analyse models, to define model logic, to control Taylor ED from outside, etc.

Model: The four factories (atoms *Fabrik*) store finished products in (built-in) storages. If an order is to be fulfilled the needed amount of products is taken from there and placed into dispatching units (atoms *Verteiler*), where they stay for the duration of the transport time. Then the products enter the distributor (atom *Distributor*) they were ordered from. Depending on the wholesalers' orders, products are then routed to the wholesalers (atom *Wholesaler*).

Fig. 1: Graphical model layout in Taylor ED 3.4

An event-based approach was used for simulating this supply chain. After initialisation, a timer triggers the distributors' order event each 24 hours. The order event checks the storages of the factory and – if the amount needed is available – the ordered products are moved to atom *Verteiler*; parts of code see below.

```
repeat(12,do(
  v:=count,
  if(cell(v,1,c)>0,do(
    if(v<7,do(
       sets(atombyname([produktion1],model)),
       c.prod:=1),do( ……
    if(content(out(v,s))>=cell(v,1,c),do(
       sets(out(v,s)), …..repeat(cell(v,1,c),do(
  sddb([tz],dist(att(6,c),c.prod),first(s)),
     setcell(v,1,cell(v,1,c)-1,c),
     moveatom(first(s),atombyname(concat
       ([verteiler_],string(att(6,c))),model))
  ))))))),createevent(86400,c,20)
```

Task a: Simple Supply Chain. This simple strategy (fixed orders per day) results in increasing stock for each distributor (fig. 2); storage costs become higher as the storage becomes fuller. The table shows costs and delivered products for distributor D_1.

Task a	min	max	mean	dev
C	30352 €	37983 €	34517 €	1440,14
N	200	257	225	12,59
R	119 €	185 €	154 €	14,6

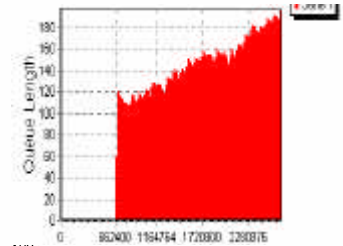

Fig. 2: Stock over Time (sec) of Distributor D_1 – Simple Order Strategy

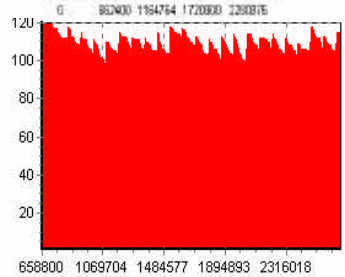

Fig. 3: Stock over Time (sec) of Distributor D_1 – On Demand Order Strategy

Task b: On Demand Order Strategy. The distributors record the wholesalers' orders during 24 hours, no matter if the order was fulfilled or not, and order this amount from the factories at next order event. The event code (left) is slightly extended. Result of the strategy: costs for distributors decrease, while stock stays almost constant (fig. 3, table).

Task b	min	max	mean	dev
C	25765 €	30901 €	28206 €	1195,35
N	196	257	227	13,28
R	119 €	185 €	154 €	14,6

Task c: Minimal Supply Time – Order Strategy. When ordering, the distributor tries to order at the factory with minimal supply lead time. The order event code (left) is extend by finding the factory with minimal supply lead time:

```
if(content(out(v,s))>=cell(v,1,c), ……
do(c.time:=min(c.time,dist(att(6,c),count)))),..
if(c.time<c.old_time,c.bestell_nr:=count))),
if(c.bestell_nr>0,do(…….
sets(out(v,atombyname(concat([produktion],
string(c.bestell_nr)),model))),
```

Simulation again shows a decrease of costs as the transport time goes down (table below)

Task c	min	max	mean	dev
C	22883 €	27307 €	25416 €	998,95
N	194	255	224	12,94
R	97 €	134 €	113 €	4,4

Comparison of the strategies (table below) shows, that the strategy with minimal supply time is the best also wrt deviations. Evaluation of the 100 runs was performed in EXCEL using Taylor's interface atoms.

	C_{mean}	C_{dev}	N_{mean}	N_{dev}	R_{mean}	R_{dev}
T. a	34517 €	1440,14	225	12,59	154 €	14,6
T. b	28206 €	1195,35	227	13,28	150 €	11,49
T. c	25416 €	998,95	224	12,94	113 €	4,4

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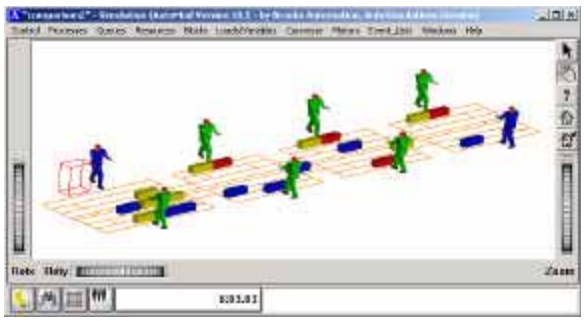
C2 Flexible Assembly System - AutoMod

Process-oriented Modelling

Simulator: AutoMod (www.autosim.com), a product of Autosimulations, recently acquired by Brooks Automation, is available for all Windows environments (95/98/2000 and NT): The AutoMod software can be used in almost any area of manufacturing and material handling. AutoMod provides true to scale 3-D virtual reality animation, user expert-based material handling templates for Conveyors, Path-based Vehicle Movement, Bridge Crane, etc. and a general propose template Process System for modelling resources, queues etc. The Spreadsheet Interface and an English-like simulation language provides flexibility to model process-intensive applications.

Model: The Flexible Assembly System is modelled by using the Conveyor and Process System Template. Each assembly station is represented by one resource and three accumulating conveyor segments. These stations are connected with two long conveyor segments (see next figure, 3D-View).

The logic of the model and the pallet are modelled with the Process System template Pallets are represented by the element "load" which will change the colours regarding to the current operating status. Two load attributes defined: LA_Time for calculating the throughput time of every pallet and LA_Operation for the current operation status of the pallet. Furthermore 9 counters are defined: C_TTP for calculating the total throughput and 8 counters (C_CNP) for calculating the current number of pallets in each station.

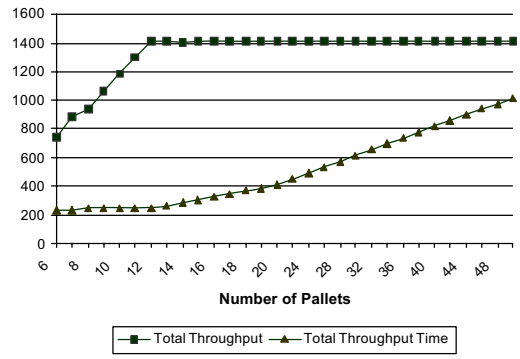


Task a Control Strategy – Statistical Evaluation. In front of every station control points (cp) on the conveying segments are defined. Every time the load (pallet) approaches one cp, three values are checked: the current status of load attribute LA_Operation, the new assigned status of LA_Operation after processing at the assembly station and the counter value of C_CNP. According to the values logical rules decide of the next travelling action.

The travelling priority for pallets leaving the stations is implemented by using the element block. Blocks are graphically placed on conveyor segments and can cause the stop of a load at this place.

AutoSimulation provide AutoMod with the tool AutoStat to perform statistical analyses, etc.

Task b Simulation Results – Throughput. AutoStat also performs run management for models and allows using different methods for Design of Experiments (DoE) such as Factorial and Taguchi Design. Results of simulations with different numbers of pallets are shown in next figure



Task c Simulation Results – Optimisation. AutoStat also contains sophisticated optimisation algorithms. In our model for a one-factor design (number of palettes), it was faster to perform the optimisation by hand (parameter loop with number of pallets. Results are shown in the table below.

Number of Pallets	Total Throughput (piece)	Average Througput Time (s)
6	745	232
7	882	228
8	941	245
9	1059	245
10	1185	243
11	1294	245
12	1412	245
13	1412	265
14	1404	287
15	1413	306
16	1412	326
17	1412	347
18	1410	367
19	1413	387
20	1412	408
30	1410	613
40	1411	816
50	1411	1015

The throughputs for 20, 30, 40 and 50 pallets are nearly the same. The optimum of is reached with 12 pallets with the objective of maximal throughput of pallets and minimal throughput time.

The model was not able to simulate more than 50 pallets and a throughput of more than 1413 pallets was never reached. One reason may be the implemented travelling priority causing travelling delays. A more likely reason is the very exact modelling of the layout, such as length of the pallets and conveying segments. The theoretical number of pallets on the two parallel conveyor belts simultaneously is 42.

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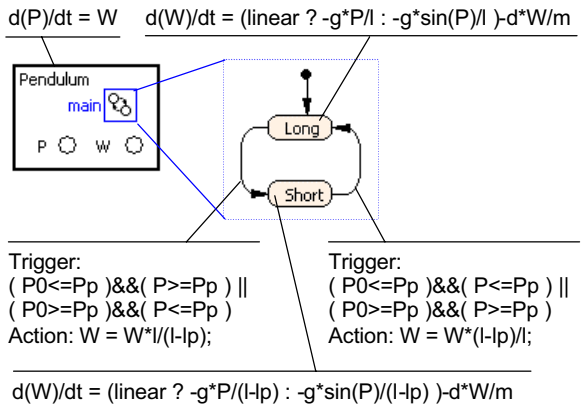
C7 Constrained Pendulum – AnyLogic

Hybrid Modelling Approach - Model Level

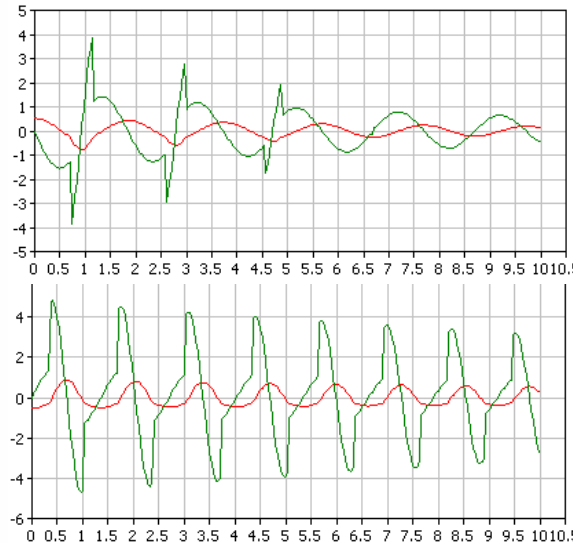
Simulator: AnyLogic (www.xjtek.com) is a general-purpose simulation environment for discrete, continuous and hybrid systems. It employs UML-RT structure diagrams for building hierarchical models in object-oriented way and *hybrid statecharts* for behaviour specification. The generated model is Java and can be extended with user's Java code. The simulation engine handles discrete events and dynamically changing sets of algebraic-differential equations. It automatically detects "change" (or "state") events. Debugging and visualization facilities are present.

Model: The constrained pendulum – essentially a hybrid system – is modelled by a hybrid statechart in a very natural and concise way, see figure below. The object Pendulum has two variables: angle P and angular velocity W. Obviously, the equation $d(P)/dt = W$ is always valid; therefore it is associated with the whole object. The statechart has two states corresponding to different rotation points. Each state has an associated set of equations, which are active only while the control resides in the state.
Transitions between the states are triggered by "change events" – Boolean expressions over variables. The two expressions specify the conditions of hitting and leaving the pin.

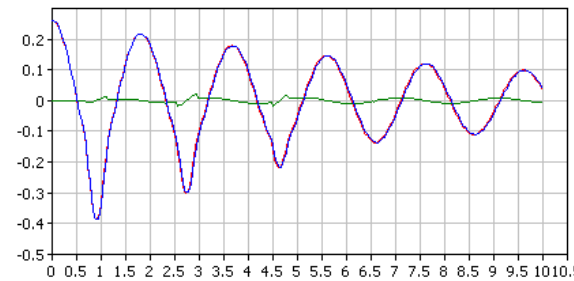


The hybrid statechart can be entered in AnyLogic model editor, and the simulation engine automatically detects change events, changes the working set of equations and readjusts the numerical methods.

Task a: Simulation of the System. The initial values of the variables are parameters of the object Pendulum, so the user can modify them in AnyLogic model viewer (debugging and experimenting environment). The plots showing the angle and the angular velocity are for the cases **a-i** and **a-ii** are given below.



Task b: Comparison linear / nonlinear model: Depending on the Boolean parameter *linear*, the model can represent either linearised or non-linearised case (conditional right-hand side of equations in the state machine). To compare the cases two instances of Pendulum object with different values of *linear* were created and run in parallel, results below.



Task c: Boundary value problem was solved in two ways. A binary search was implemented within AnyLogic environment as Java script, controlling the simulation. With precision set to 1e-7, and the initial boundaries of the velocity are [-3,-1], AnyLogic calculates the value -2.184699.

However, the problem can also be solved in one simulation run by using the target conditions ($P=-\pi/2$ and $W=0$) as initial values and inverting the sign of the damping factor. The velocity at the first cross of the original angle $\pi/6$ is the desired result. A "watchdog" statechart with a change event $P==\pi/6$ was used to detect the crossing. This method gives the value of -2.1846992117869215.

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C9 Fuzzy Control of a Two Tank System – AnyLogic

Hybrid Model / Algorithmic Fuzzy Control

Simulator: AnyLogic (www.xjtek.com) is a general-purpose simulation environment for discrete, continuous and hybrid systems. The modelling technology is entirely based on UML-RT, Java and differential-algebraic equations.

Model: The model is built up by modelling three states, conforming to UML (figure 1). "TwoTank1" and "TwoTank2" contain the system dynamics:

```
d(x1)/dt = 0.067*u-f
d(x2)/dt = f-0.0605*r*0.3*pow(x2,0.48)
```

The transitions in-between formulate the discontinuous behaviour of the turbulence parameter r. (laminar vs. turbulent). Within "FC2" the fuzzy controller is modelled. "FC2" is triggered every second.

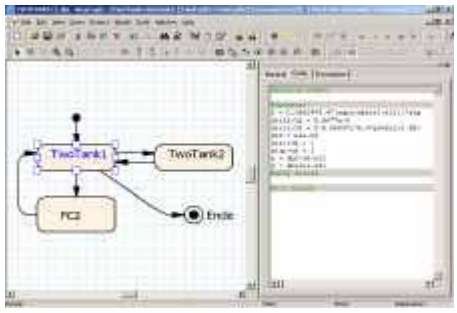

Figure 1: AnyLogic model statechart

Task a: Computation of Control Surface. The fuzzy controller is implemented by a set of membership functions. These are located in a transition from state "TwoTank1" to "FC2" ("FC1", "FC3"). The operators MAX for OR and MIN for AND are used for the rulebase, situated in state "FC2" ("FC1", "FC3").

```
if (ex2 < 0)
    {ex2mb1=1;}
 else if (ex2 >= 0 && ex2 <= 10)
    {ex2mb1=(ex2/(0-10)-10/(0-10));}
  else
    {ex2mb1=0;}
...
p1=min(ex2mb2,x1mb4)
p2=max(min(ex2mb2,x1mb3),min(ex2mb3,x1mb4))
u=(0*nl+1.25*p1+...+8.75*p7+10*p8)/
(nl+p1+p2+p3+p4+p5+p6+p7+p8)
```

For calculation of the control surface, instead of the dynamic model the parameter space is modeled by introducing a step function for x1 and a ramp function (for ex2), setting x1=0 to 70 and ex2=-70 to 70. There is no notable difference in calculation time between FC1 and FC2 (figure 2): t_{FC1} = 6 s, t_{FC2} = 6 s, ratio t_{FC1}/t_{FC2} =1 (P III, 500 MHz, 128 MB).

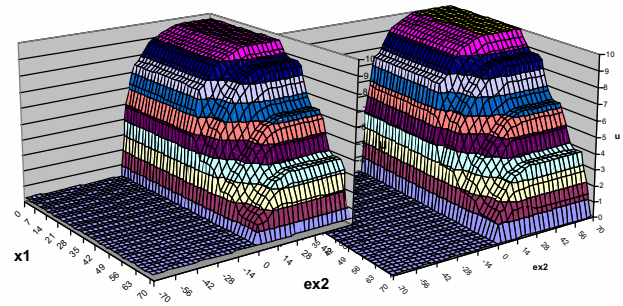

Fig. 2: Control surfaces FC1 (left), FC2 (right)

Task b: Simulation of the System. Using now the whole system for x2s = 25 cm for 1000 seconds, giving computation times t_{FC1} = 10 for FC1 and t_{FC2} = 11 (integration algorithm RK45), resulting in ratio t_{FC1}/t_{FC2} =0.9. State and control variables over time are shown in the following figures.

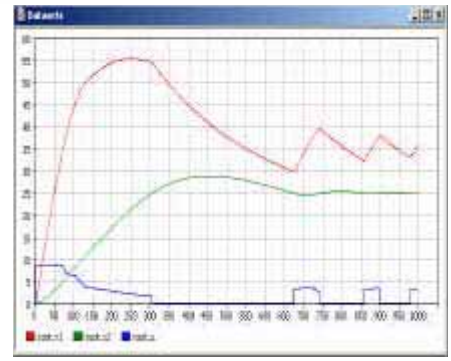

Figure 3: States and Control versus time, FC1

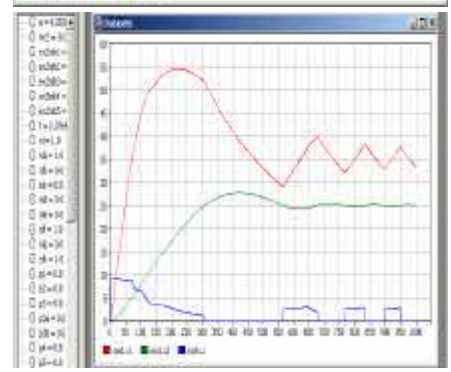

Figure 4: States and Control versus time, FC2

Task c: Weighted Fuzzy Control. FC3 is calculated, weighting simply the rulebase in the controller state. The results are very similar to those using FC2.

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C9 Fuzzy Control of a Two Tank System – Dymola

Continuous Model-Algorithmic Fuzzy Control

Simulator: Dymola (Dynamic Modeling Laboratory, www.dynasim.se) is a simulation tool, using Modelica as object oriented modelling language to support hierarchical structuring, reuse and evolution of large and complex models independent from the application domain. Modelling is based on differential and algebraic equations.

Model: The model equations of are implemented in the equation layer. No parts of Dymola´s libraries are used. Using the "sample" - construct the discrete control is modelled:

```
when sample(1, 1) then
  ex2=x2s-x2;
    if ex2 < 0 then
      ex2mb1=1;
    elseif ex2 >= 0 and ex2 <= 10 then
      ex2mb1=(ex2/(0-10)-10/(0-10));
    else
...
  u = (1/3*nl*0.5+1.25*p1...+
     (10-1/3)*p8*0.5)/
     (nl/2+p1+p2+p3+p4+p5+p6+p7+p8/2);
end when;

der(x1) = 0.067*u-0.06624*v1*
          sqrt(abs(x1-x2))*sign(x1-x2);
der(x2) = (0.06624*v1*sqrt(abs(x1-x2))*
           sign(x1-x2))-0.0605*r*v2*
          (abs(x2))^0.48;
```

Task a: Computation of Control Surface. As given above the fuzzy controller is implemented by a set of membership functions. The operators MAX for OR and MIN for AND are used for the rulebase. For defuzzification the center of gravity-method is applied:

```
p1=min(ex2mb2,x1mb4)
p2=max(min(ex2mb2,x1mb3),min(ex2mb3,x1mb4))
...
u=(0*nl+1.25*p1+...+8.75*p7+10*p8)/
(nl+p1+p2+p3+p4+p5+p6+p7+p8)
```

For calculation of the control surface, instead of the dynamic model the parameter space is modelled by a ramp function, setting x1=0 to 70 and ex2=-70 to 70 with 280 times higher ascent for ex2. Divergent from the task declaration 5601 lookups are calculated.

The calculation time for FC1 is t_{FC1}= 4.29 s, for FC2 t_{FC2}= 3.86 s (Pentium III, 500 MHz, 128 MB), ratio t_{FC1}/t_{FC2}= 1.11; graphic results in next figure.

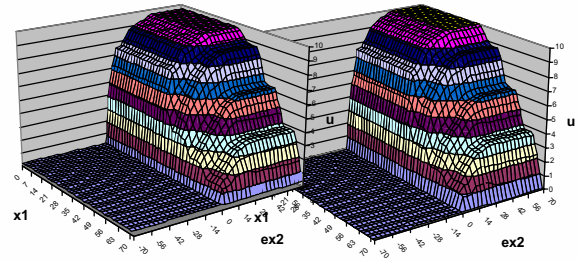

Fig. 1: Control surfaces FC1 (left), FC2 (right)

Task b: Simulation of the System. Using now the whole system for x2s = 25 cm for 1000 seconds, giving computation times t_{FC1} = 2.10 for FC1 and t_{FC2} = 2.06 (integration algorithm RK45), ratio t_{FC1}/t_{FC2} =1.02 (nearly equal).

State and control variables over time are shown in the following figures.

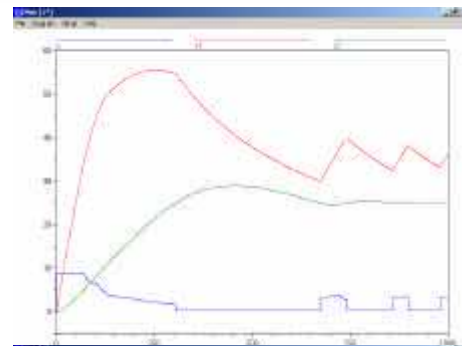

Figure 2: States and Control versus time, FC1

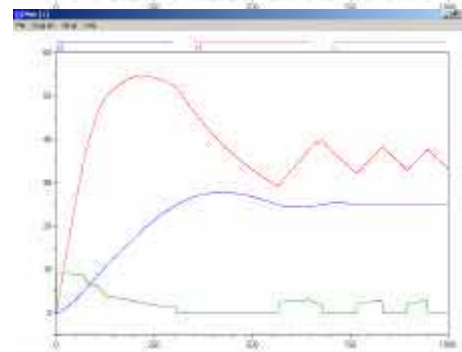

Figure 3: States and Control versus time, FC2

Task c: Weighted Fuzzy Control. FC3 is calculated, weighting simply the rulebase in the controller state. The results are very similar to those using FC2.

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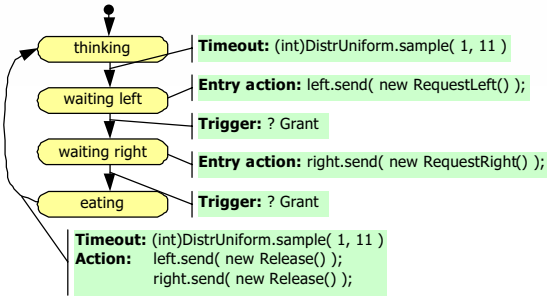
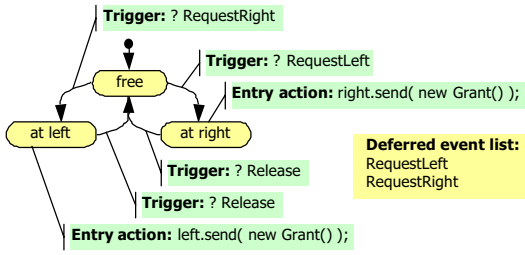
C10 Dining Philosophers II – AnyLogic

Simulator: AnyLogic (www.xjtek.com) is a general-purpose simulation environment for discrete, continuous and hybrid systems. It employs UML-RT structure diagrams for building hierarchical models in object-oriented way and *hybrid statecharts* for behaviour specification. The generated model is Java and can be extended with user's Java code.

Model: Implementation of the Dining Philosophers model in AnyLogic is very straightforward. There are three classes: Philosopher, Chopstick, and Table. The behaviour of Philosopher and Chopstick classes is naturally specified using statechart notation.



The chopstick statechart reacts on *RequestLeft* and *RequestRight* events and accordingly changes its state.



AnyLogic event scheduler handles simultaneous access situation (that is in fact several possible events to process) by randomly choosing one of the accessing entities. The current version of the tool does not provide possibility to assign priority to an event. However, it is possible to introduce such behaviour to the model by adding necessary code.

Task a Single Run – Utilisation Results

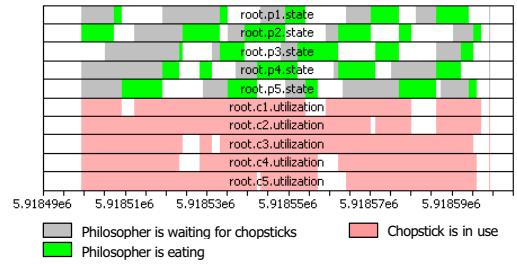
The model simulation gave chopsticks utilization rates shown in the table at the right.

	Utilisation
chopstick1	0.917475
chopstick2	0.917677
chopstick3	0.917570
chopstick4	0.917581
chopstick5	0.917363
total	0.914047

Next figure shows statistics of actions time per philosopher and the times for all philosophers together:

	Thinking		waiting		eating	
	mean	std.dev.	mean	std.dev.	mean	std.dev.
p1	5.50670	2.86941	11.1472	8.05305	5.49178	2.87256
p2	5.49037	2.87052	11.1613	8.05765	5.49531	2.86972
p3	5.50107	2.87375	11.1572	8.05010	5.49741	2.87052
p4	5.49901	2.87126	11.1531	8.05759	5.49176	2.86981
p5	5.50032	2.87147	11.1493	8.07832	5.48537	2.87022
O	5.49804	2.87100	11.1536	8.05934	5.49377	2.87085

The following Gantt chart illustrates state changes of philosopher and chopstick statecharts over time:



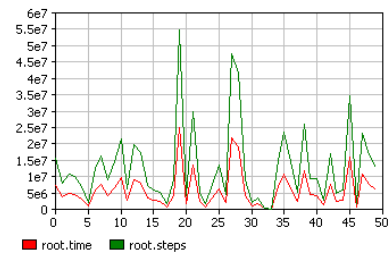
The thin grey line at the right of the chart represents a situation when all philosophers stop thinking and have taken their left chopsticks, causing the deadlock. AnyLogic tool provides automatic deadlock detection and immediately stops the simulation run.

Task b Multiple runs – deadlock observation: This task collects statistics of mean model execution time and number of steps taken before the deadlock situation happen (results for of 50 runs in table below).

Time Till Deadlock			
Count	50	Min	28413.0
Mean	5927127.52	Max	2.5074141E7
Deviation	5461891.91	Variance	2.9832263E13

Steps Till Deadlock			
Count	50	Min	62496.0
Mean	1.296137E7	Max	5.4855794E7
Deviation	1.194404E7	Variance	1.4266019E14

The following diagram shows simulation time and performed model steps distribution per simulations.



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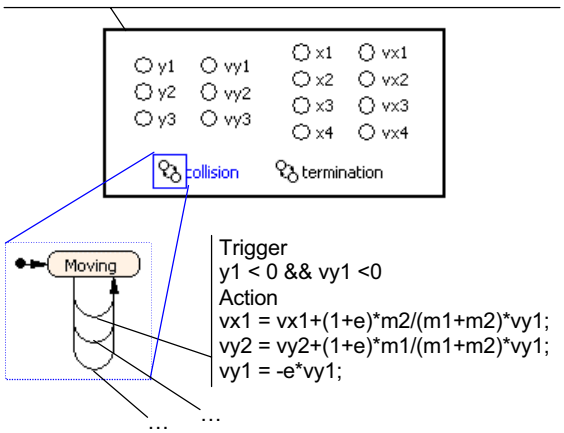
C12 Spheres' Collision – AnyLogic

Numerical simulation / Time-oriented Model

Simulator: AnyLogic (www.xjtek.com) is a general-purpose simulation environment for discrete, continuous and hybrid systems. It employs UML-RT structure diagrams for building hierarchical models in object-oriented way and *hybrid statecharts* for behaviour specification. The generated model is Java and can be extended with user's Java code. The simulation engine handles discrete events and dynamically changing sets of algebraic-differential equations. It automatically detects "change" (or "state") events.

Model: The system of colliding spheres is modelled as one AnyLogic object with several variables representing the positions of spheres ($x1$, $x2$, $x3$, $x4$), their relative distances ($y1$, $y2$, $y3$), and their absolute ($vx1$, $vx2$, $vx3$, $vx4$) and relative ($vy1$, $vy2$, $vy3$) velocities. The equations for motion of the spheres are associated with the object. The statechart has a single state and three transitions representing collisions of spheres. These transitions are triggered by "change events" – Boolean expressions over variables.

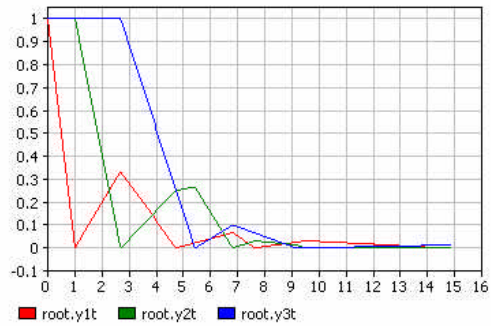
y1 = x2-x1-d	vx2 = vx1+vy1	d(x1)/dt = vx1
y2 = x3-x2-d	vx3 = vx2+vy2	d(x2)/dt = vx2
y3 = x4-x3-d	vx4 = vx3+vy3	d(x3)/dt = vx3
		d(x4)/dt = vx4



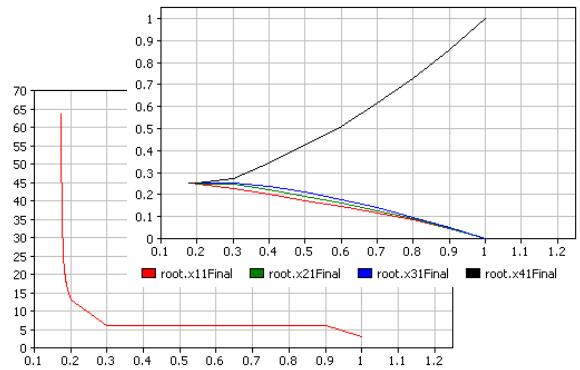
The hybrid statechart can be entered in AnyLogic model editor, and the simulation engine automatically detects change events, changes the working set of equations and readjusts the numerical methods.

Task a: Simulation of the System. a1: The following figure shows the distance-time functions $y1(t)$, $y2(t)$ and $y3(t)$ for $e = 0.2$, $d = 1$ and $a = 1$, $v0 = 1$ in time $0 \le t \le 15$ is shown on the diagram below.

Task a2. For the elastic case ($e=1$) the final velocities of the spheres are exactly $[0,0,0,1]$, for the quasi-plastic case ($e= 0.172$) $[0.25,0.25,0.25,0.25]$.



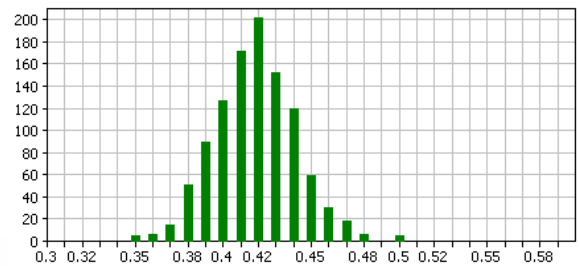
Task b: Variation of restitution coefficient: The number of collisions and final velocities as functions of the restitution coefficient presented in the picture below were obtained in a number of replications with varying parameter controlled by Java script.



Task c1: Boundary value problem. A binary search was implemented within AnyLogic environment as Java script. AnyLogic obtains the value of e = 0.5874011 with the precision set to 1e-7.

Task c2: Stochastic deviation of restitution. Using the built-in normal probability distribution for e AnyLogic has built the histogram shown below. The (built-in) statistical analysis gives the following results:

```
Mean 0.42317935397   Variance  4.54830611E-4
Min  0.35753660792   Deviation 0.02132675811
Max  0.50359726405   MeanConf  0.00132184616
```



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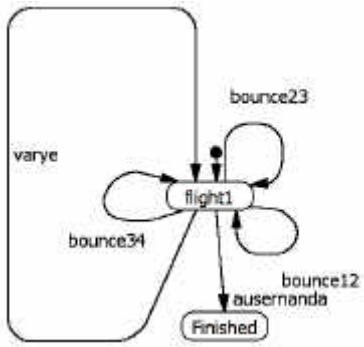
C12 Spheres' Collision – AnyLogic

Numerical simulation / Time-oriented Model

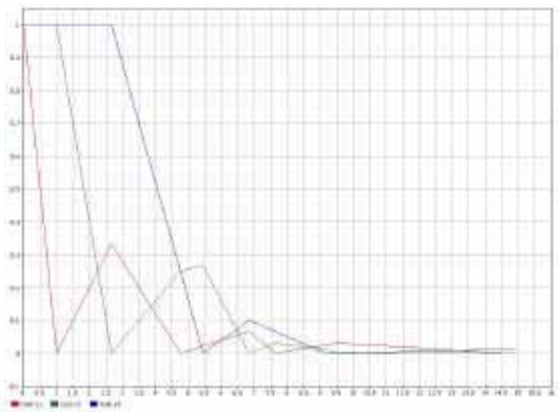
Simulator: AnyLogic (www.xjtek.com) is a simulator especially developed for large challenging systems with discrete, continuous and hybrid behaviour. The graphic model editor makes use of the UML-notation (state chart). The model description is translated into Java, and the resulting system is simulated in a graphical environment, the model viewer.

Model: The statechart below represents the motion of the spheres in *flight1,* which changes within the events *bounce12, bounce23* and *bounce34* (the bounces between sphere 1 & 2, etc.).

The big loop *varye* variates *e*, the restitution coefficient. AnyLogic does not make use of a separate experiment environment. Experiments can be implemented either in the model editor (parameter changes etc.) or directly in the resulting Java code. Here the variation of the restitution coefficient is modelled as parameter loop *varye* for tasks **a2**, **b** and **c**.



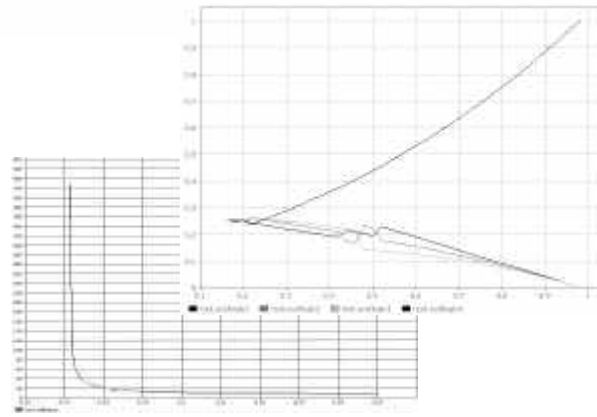
Task a: Simulation of the System. a1: Initial values are set in a workspace window. Simulation is started from a menu. The next figure shows the distance between the spheres in dependency on time by using the values *e*=0.2, *a*=1 and *v1(0)*=1.



Task a2. The quasi-plastic case is reached at *e*=0.171575. For *e*=1 final velocities are $vx_1=vx_2=vx_3=0$, $vx_4=1$. In the quasi-plastic case final velocities are $vx_1=vx_2=vx_3=vx_4=0.25$.

Task b: Variation of restitution coefficient: To solve the differential equations, the RK853 algorithm was used, *e* was decreased from 0.25 to 0.17 by steps of 0.002 and the collisions were counted, see next figure. The other figure shows the values of the final velocities *vx1, vx2, vx3* and *vx4* depending on *e* for the interval $0.17 < e < 0.25$.

Task c1: Boundary value problem. The boundary value problem *vx4=v0/2* again was implemented as parameter loop with different stepsizes: working with a step of 1E-10 we got *e*=0.5874010518 and *vx4*=0.4999999998.



Task c2: Stochastic deviation of restitution. The restitution coefficient *e* is now a normally distributed stochastic variate with mean 0.5 and standard deviation 0.005.

A loop varied the restitution coefficient according to these parameters. The final velocities vx_{4final} were written into a *dataset.* Being an element of the dataset, the statistical data can be accessed with *getStatistics().*

5002 samples using this variate resulted in the following values for vx_{4final} :

mean vx_{4final} = 0.421868612455048
variance: σ^2 = 1.1196663217194136 E –6
standard deviation : σ = 0.00105814286
confidence interval :
[mean +/- 2.932435951694475E-5]

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C12 Spheres' Collision - MATLAB

Numerical simulation / Time-oriented Model

Simulator: MATLAB is a widely used software tool based on numerical vector / matrix manipulation.

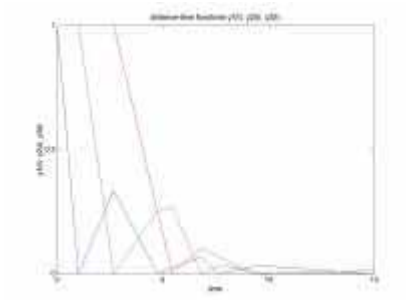
Model: In this solution, first the time of the next impact is analytically determined repeatedly.

```
if ydot(j)<0
time=abs(y(j)/ydot(j));
     if time<dt(i,1)
       dt(i,1)=time; dt(i,2)=j;
     end
  if dt(i,1)==0
     dt(i,1)=time; dt(i,2)=j;
  end
end
```

Second, the resulting time intervals between the collisions, together with the initial values, the positions and velocities of the spheres after the last collisions control a numerical integration (of the equations of motion). The algorithm calculates the positions of the spheres by solving numerically these differential equations (using MATLAB's algorithm `ODE23`):

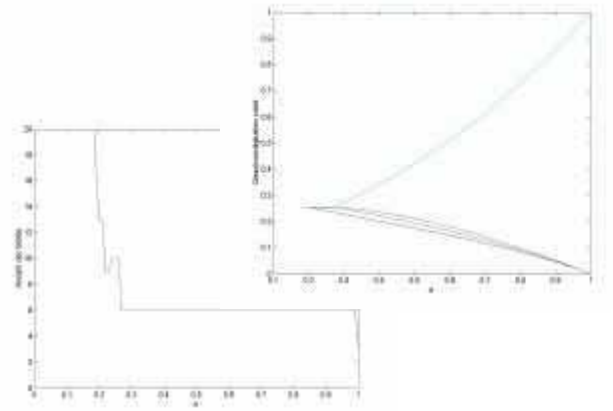
```
ODE23(@odefun_y,[0,dt(i,1)],y',[],ydot');
y=y_ode(size(y_ode,1),:);
function [ydot]=odefun_y(T,Y,ydot)

function [ydot]=hit23(ydot,e,m2,m3)
ydot(1)=ydot(1)+(1+e)*m3/(m2+m3)*ydot(2);
ydot(3)=ydot(3)+(1+e)*m2/(m2+m3)*ydot(2);
ydot(2)=-e*ydot(2);
```

Task a: Simulation of the System: a1: The following figure shows the distance-time functions for e = 0.2 (restitution coefficient), d=1 (diameter of the spheres), a=1 and x1dot=1.



Task a2: The quasi-plastic case is reached at e=0.18000 and the corresponding velocity vector is: xdot =[0.25 0.25 0.25 0.25].
For e=1 the final values of the absolute velocities are xdot=[0 0 0 1].

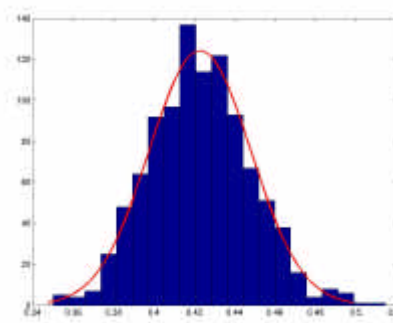
Task b: Variation of restitution coefficient: In the two-step algorithm described before an overall loop was added, which varies the restitution coefficients e in the interval [0.18 , 1] .In the following figures the number of collisions as function of the restitution coefficient and the final velocities as function of the restitution coefficient are given:



Task c1 Boundary value problem: The boundary value problem was solved iteratively giving following results: e= 0.58740105233735, with final value for v4: 0.49999613313878

Task c2 Stochastic deviation of restitution: After 1000 samples with the normally distributed stochastic variate with mean value 0,5 and standard deviation 0,05 the following statistical results are calculated e by means of standard MATLAB algorithms (the figure shows the resulting distribution as bar chart):

```
meanvalue =  0.42275547624156,
variance = 0.02513312861384,
95% confidence-interval:
[0.37518325257401; 0.47001779101334]
```



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C12 Spheres' Collision – Dymola

Numerical simulation / Time-oriented Model

Simulator: Dymola (Dynamic Modeling Laboratory, www.dynasim.se) is a simulation environment suitable for modelling various kinds of physical objects. It uses an object-oriented approach for modelling of large, complex and heterogeneous physical systems. A graphical editor and a specific language (Modelica) allow the user to construct models composed of mechanical, electrical and hydraulic subsystems out of predefined models.

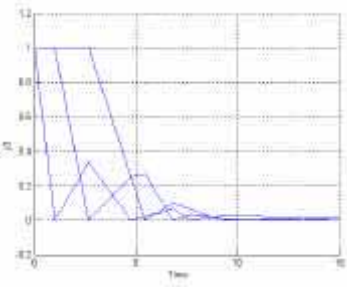
Model: With the following discussed hybrid model approach, the capability of Dymola to handle hybrid systems is tested. In this approach the implementation of the model is made in Dymola because of the simplicity of the Model, no need for a graphical based modelling is given. A hybrid model in Dymola consists of differential, algebraic and discrete equations. Furthermore it offers three variable step size algorithms for the numerical treatment of such Differential-Algebraic-Equations (DAEs).

The Dymola user manual suggests using the statement `when (cond) then` to handle events in continuous systems. To reinitialise a variable in case of an event Dymola provides the `reinit` statement. The implementation is then straightforward:

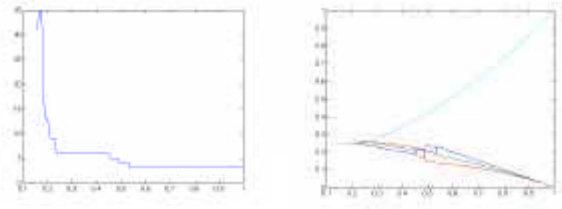
```
class Comparison12
 .. declaration of variables…

algorithm
when y1<=0
  reinit(x1p, x1p + (1+e)*m2/(m1+m2)*y1p);
  reinit(y2p, y2p + (1+e)*m1/(m1+m2)*y1p);
  …..
end
….other events …
equation
der(x1)  = x1p;
der(x1p) = 0;
… other equations…
end Comparison12
```

In Dymola, all differential, algebraic and discrete equations are treated as synchronous in time. Therefore in Dymola/Modelica the assumption is used that all equations in a model may potentially be active at the same time instant. It is easy then to construct conflicting equations. To handle this problem multiply events have to be implemented in the so-called "algorithm" section.

Task a: Simulation of the System. a1: The following figure shows the distance-time function for the parameter value e = 0.2. The DASSL - algorithm (DAE solver of Petzold) with relative accuracy 10^{-6} was used.



Task a2. For e = 1 the final velocities are v_1=v_2= v_3 = 0, v_4 = 1. The quasi-plastic case is reached for e = 0.154303. The following figures show the number of collisions and the final velocities as a function of the restitution coefficient e, which is varied from 1 to the quasi-plastic case.



Dymola itself offers a relatively poor script language, almost incapable of handling the tasks required (parameter loops, interpolation or optimisation, stochastics). Consequently all experiments were performed with help of the Dymola – MATLAB interface (for task b loops for the restitution coefficient e).

When a Dymola model is translated, an exe-File (the Dymola model) is created. Combined with the Dymola-MATLAB interface (various m-files) one can easily provide a MATLAB m-file for the experiments of all necessary tasks. For example, a simulation run of the Dymola model in MATLAB looks like

```
[s,n]=dymosim(simparams, inits, params)
```

There `simparams` is a vector of simulation parameters such as model name, starttime, endtime, algorithm, `inits` is the vector of initial values, `params` a vector of model parameters. Results are stored in a matrix `s`; the vector `n` includes all variables as strings.

Task c1: Boundary value problem -: Stochastic deviation of restitution. Instead of an iteration for e, the solution for e, e=0.587401 with end velocity v4 = v0/2, is interpolated from results from task b by means of splines (standard MATLAB feature).

Statistical deviations for e and statistical summaries for the end velocity are also done in MATLAB. For a normally distributed e the end velocity of the fourth ball is normally distributed with mean= 0.4243, dev= 0.0421. The confidence intervals are [0.4216<mean< 0.4269] and [0.0403<dev< 0.0440].

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BOOK REVIEWS

Genetic algorithms in engineering systems

A. M. S. Zaalzala, P. J. Fleming (Eds.),
The Institute of Electrical Engineering,
London, United Kingdom, 1997,
ISBN 0 85296902 3, 263 pages, Hardcover

This book comprises ten invited expert contributions on the theory and applications of genetic algorithms (GA) in a variety of engineering systems. In addition to addressing the simple formulation of GAs, the chapters include original material on the design of evolutionary algorithms for particular engineering applications.

The book starts with a broad survey of the current trends and techniques used in GAs, and the many variations from the original GA are discussed to illustrate how this powerful and versatile search and optimisation method is applicable to a broad range of activities.

The first chapter also includes a brief discussion of the biological origins of GAs. Chapter 2 looks at the range of representations levels at which algorithms can be applied to intelligent control systems, including evolving control parameters, complex structures and rules. Chapter 3 aims to illustrate how an existing GA can be modified. The chapter 4 is addressed through a fuzzy logic method, reported as part of a genetic algorithm search. The next chapters (5 to 10) present the applications of GA in several engineering systems: evolving the learning of neuronal networks, identify the parameters of nonlinear circuits, job shop scheduling, the motion planning of robotic systems, aerodynamic optimisation and finally the design of VLSI macro cell layouts.

A reach list of references is given in each chapter

This book is suitable for researchers and postgraduates who need to be up-to-date with developments in this important subject, as well as practitioners in industries who are eager to find how to solve their particular real-life problems.

Beginner	Intermediate	Expert
	●	●
Theory	**Mixed**	**Practice**
	●	
Lecture Note	**Monograph**	**Proceedings**
●		●

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Agent Based Simulation Workshop 2000

Christoph Urban (editor)
ASIM, SCS-Europe BVBA, Ghent, Belgium 2000

This volume contains the written contributions to the workshop 2000 on agent-based simulation, which took place in May 2000 in Passau, Germany. The collection starts with a brief overview of contemporary state of the art research in that field by Bernd Schmidt. He briefly sketches the differences and the intersections of applications of agent-based simulation in empirical science, engineering science, and theory.

After that the book becomes a relatively unstructured collection of articles ranging from high to law quality covering many fields such as e-commerce, negotiation, process control, production planning, traffic simulation,.... Ordering the contributions according to the handled topics could have extended the usability of the book and, thus, facilitating the search for readers who intend to find material matching their own research interests.

Nevertheless, since the range of the book is very broad, almost everybody working in the flied of agent-based simulation will find some ideas or references that may be useful stimuli for further work.

Beginner	Intermediate	Expert
	●	
Theory	**Mixed**	**Practice**
	●	
Lecture Note	**Monograph**	**Proceedings**
		●

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Automated Industry Processes (in German)
Automatisierte Industrieprozesse

Gerfried Zeichen, Karl Fürst, Springer-Verlag
Wien, ISBN 3-211-83560-1 218 pages

The topic of the book is the dealing with industrial processes in the production of products and services. The writers used their experience as tutor at the TU in Vienna and from projects in cooperation with the industry.

The authors wanted to set a high value on the following points:

- Linking-up of technical and organizational processes

- Finding solutions for parameters, which are hard to quantify
- Using the following scheme: recognize, realize, act, determine
- View the process of information in a firm and the dealing with the tools of information

The book could also be read from students in the first semesters. They should see how to use their knowledge in practice.

A detailed review in German can be found in ASIM-Nachrichten 2001/3.

Beginner	Intermediate	Expert
	●	
Theory	**Mixed**	**Practice**
	●	
Lecture Note	**Monograph**	**Proceedings**
	● ●	

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From Calculus to Chaos (in German)
Vom Calculus zum Chaos

David Acheson , Oldenbourg Wissenschaftsverlag, ISBN 3-486-24833-2, 292 pages

The book should show the use of the calculus, which was made since Newton. Basically these are problems of dynamics; in fact these are questions about the change of things in time.

To read this book you only need basics in differential equations. That's the reason, why also pupils could work with this book. The author tried to aerate the stuff with historic pictures of mechanics and well-known physicists and facsimiles of their original texts.

If you want to verify the examples with the computer you do not have to know about programming, because there are instructions and some examples how to program.

A detailed review in German can be found in ASIM-Nachrichten 2001/3

Beginner	Intermediate	Expert
● ●		
Theory	**Mixed**	**Practice**
	●	●
Lecture Note	**Monograph**	**Proceedings**
	● ●	

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Systems of Conservation Laws, Two Dimensional Riemann Problems

Yuxi Zheng, Birkhäuser Verlag Boston, Basel 2001, ISBN 0-8176-4080-0

This Book is published as volume 38 of the Birkhäuser series "Progress in Nonlinear Differential Equations and their Applications".

The author from the University of Indiana wrote a comprehensive text about a special kind of nonlinear partial differential equations namely the conservation laws. They occur in many physical areas, e.g. in gas dynamics. Almost all examples given in this book concern the compressible Euler equations, which are the main equations in the field of conservation laws. They are of hyperbolic type and lead to the so-called Riemann problem.

The Book is divided into 12 chapters. The first 4 chapters concern the one-dimensional theory of hyperbolic equations, whereas chapters 5 to 11 present the theory of the two dimensional Riemann problems.

The main focus of this Book is the analytical solution of the two dimensional Riemann problem. Not only the "standard" theory is presented, it also tries to introduce new aspects to the theory of Riemann problems suitable for graduate students and researchers. Therefore it is very suitable for getting familiar with the two dimensional theory of Riemann problems.

The one-dimensional theory is rather briefly described, only a review is given. Therefore it is only limited useful as an introduction to the basic theory of Riemann problems.

But also the numerical treatment is briefly failed but it presents enough bibliography to overcome this lack. Knowledge about the elementary theory of partial differential equations is necessary.

It is written in a clear, accessible style and provides good illustrations and emphasizes more recent results that will prepare readers to meet modern challenges in the subject.

Beginner	Intermediate	Expert
	●	●
Theory	**Mixed**	**Practice**
●	●	
Lecture Note	**Monograph**	**Proceedings**
	●	

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Advances in Software Tools for Scientific Computing

H.P. Langtangen, A.M. Bruaset, E. Quak (Eds.)
Springer Berlin, Heidelberg, 2000
ISBN 3-540-66557-9

This Book is an overview of the recent development in Software Tools for Scientific Computing. Eleven selected publications emphasize the introduction of object oriented programming paradigms into the field of Numerical Mathematics (dominated by Fortran programmers).

All articles in this book strongly deal with the object-oriented concept related to linear algebra, ordinary- and partial differential equations. It gives a survey how to apply programming languages like C++ and Java to scientific computing problems. Each article shows the usefulness of object-oriented methods and the way they change the development of large numerical codes.

First, each article gives the idea of underlying software design and abstractions. Recently available technologies, such as templates in C++ and Java are focused. Furthermore, several new topics are included as for example sparse girds, direct solvers, validated methods, and parallel ODE solvers. Generic programming (templates) shows how C++ programs reach efficiency on par with Fortran.

All chapters provide lots of ideas and very important, experience in the development and application of such tools.

The handling of more and more complex real-life numerical problems in all sorts of applications asks for introducing modern object oriented methods. This book is an important contribution to the necessity of exchanging ideas and experiences to overcome the old style programming paradigm with Fortran or C.

It is published as volume 10 of „Lecture Notes in Computational Science and Engineering“, edited by M. Griebel, D. Keyes, R. Nieminen, D. Roose and T. Schlick.

Beginner	Intermediate	Expert
●	●	●
Theory	**Mixed**	**Practice**
	●	●
Lecture Note	**Monograph**	**Proceedings**
		●

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Multicomponent Flow Modelling

V. Giovangigli,
Birkhäuser 1999
ISBN 3-7643-4048-7

“Multicomponent Flow Modelling” provides a complete interdisciplinary overview of multicomponent flow modelling and analysis.

The goal of this book is to give a detailed presentation of the governing equations - including the expression of multicomponent transport coefficients - obtained from the kinetic theory of gases.

It also discusses symmetric formulations of the governing equations, which are important from the theoretical and a numerical point of view, and a numerical point of view, and investigates equilibrium flows.

Another goal is to analyse the mathematical properties of the model, more specifically, to investigate thermo chemistry properties, the structure of multicomponent transport, and well posedness of the resulting system of partial differential equations.

Finally the book discusses the numerical simulation of reactive flows and presents complex chemistry-flame simulations.

Each chapter end with notes in which the authors discuss, in particular, various model generalizations.

Topics and features of the book are:

- Multicomponent transport fluxes
- Interdisciplinary modelling perspective
- Thorough discussion of the foundations and properties of models
- Numerical simulation of Multicomponent reactive flows

The book provides an essential interdisciplinary overview of multicomponent flow modelling for applied mathematicians, mechanical engineers, and physical scientists.

Beginner	Intermediate	Expert
	●	●
Theory	**Mixed**	**Practice**
	● ●	
Lecture Note	**Monograph**	**Proceedings**
	●	

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www.Bausch-Gall.de

Modern English for Mechanical Engineers (German / English)

Ein kurzweiliges Trainingsbuch

Georg Möllerke, Carl Hanser Verlag München, ISBN 3-446-21246-9, 120 pages

This book is for students and engineers, which want to extend their English. The articles are taken from the specialized press (New Scientist, Electrical Review, The Economist, U.S. News & World Report).

The book should help to learn English and it should also expand the knowledge of the reader. He hears from trends in technology without being perfect in English.

To relieve the reading the most important words are translated beside the original text. At the end of the book these words are listed in a dictionary.

A CD is included with the book. It should help to learn the pronunciation.

Beginner	Intermediate	Expert
● ●		
Theory	**Mixed**	**Practice**
	● ●	
Lecture Note	**Monograph**	**Proceedings**
	● ●	

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Nonlinear Physics with MAPLE for Scientists and Engineers – 2nd Edition

Richard H. Enns, George McGuire, Birkhäuser 2000, ISBN 3-8176-4119-X, 680 p.
CD-ROM included

This book gives an excellent introductory survey in the world of nonlinearity, an area of rapidly evolving modern research with applications to physics, chemistry, mathematics, computer science, biology, engineering, medicine and economics. Basic concepts and applied mathematical methods of nonlinear science as well as an introduction to some simple related nonlinear experimental activities are presented.

The CD-ROM provided with this book gives a wide variety of illustrative nonlinear examples solved with MAPLE. No prior knowledge of MAPLE or computer programming is assumed, the reader being gently introduced to MAPLE as an auxiliary tool as the concepts of nonlinear analysis are developed.

An accompanying set of experimental activities keyed to the theory developed in Part I of the book is given in Part II.

Chapter 2 and 3 of Part I begin by surveying different classes of nonlinear systems trying to convey some of the richness of the subject of nonlinear phenomena. To study these nonlinear systems the necessary mathematical tools are introduced in Chapters 4, 5 and 6 examining in detail topological, analytical (exact and approximate) and numerical approaches. Subsequent chapters on limit cycles (Ch. 7), forced oscillations (Ch. 8) and nonlinear maps (Ch. 9) are set out to explore in greater depth the nonlinear systems and concepts introduced in the survey chapters (Ch. 2, 3).

The last three chapters give an introduction to some of the analytical and numerical methods and underlying concepts that are important for the study of nonlinear PDE systems.

In Ch. 10 nonlinear PDE phenomena such as nonlinear diffusion, solitary wave solutions and nonlinear superposition are explored. Ch.11 explains how numerical simulations may be carried out for nonlinear diffusive and wave equations. The text ends with an optional chapter (Ch. 12) illustrating a conceptually powerful analytical technique, the inverse scattering method applied to the Korteweg-de Vries equation describing shallow water waves.

Beginner	Intermediate	Expert
●	●	
Theory	**Mixed**	**Practice**
	● ●	●
Lecture Note	**Monograph**	**Proceedings**
●		

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The Dynamics of Control

F. Colonius, W. Kliemann
Birkhäuser 2000, ISBN 0-8176-3683-8

This book provides a carefully integrated development of the mathematical connections between non-linear control, dynamical systems and time-varying perturbed systems for scientists and engineers.

The central theme is the notion of control flow with its global dynamics and linearisations presented in detail. The book's scope is comprehensive and includes the global theory of dynamical systems under time-varying perturbations, global and local dynamics of control systems and dynamical systems and the relevant numerical methods for global dynamics, linearisations and stability. Topics are developed with a

diverse and extensive selection of applied problems from control and dynamical systems.

Topics and features:

- Complete coverage of unified theory of control flows
- Wide array of motivating problems from control an dynamical systems to appeal to mathematicians, scientists, and engineers
- Relevant motivation and a listing of important definitions and results at beginning of each chapter
- A compilation of essential background information in four appendices
- Discussion of numerical methods

The two authors wrote this book with two audiences in mind: control theorists and dynamicists. They included appendices on “Geometric Control Theory” and on “Dynamical Systems” for readers who are not familiar with this material.

According to the authors the ideal reader start a book on the first page and finishes on the last page, but never doing that their selves they decided to begin each of the theoretical chapters with a section on problem formulation and main results including all relevant definitions and some motivation.

This text and self-study reference guide is a resource for the foundations and applications of control theory and non-linear dynamics. All graduates, practitioners, and professionals in control theory, dynamical systems, perturbation theory, engineering, physics and non-linear dynamics will find the book a rich source of ideas, methods, and applications.

Beginner	Intermediate	Expert
	●	●
Theory	**Mixed**	**Practice**
	● ●	
Lecture Note	**Monograph**	**Proceedings**
	●	

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Nonlinear Model Predicitive Control

F. Allgöwer F., A. Zheng A. (Eds.),
Birkhäuser Verlag AG Basel, 2000
ISBN: 3-7643-6297-9

Control of nonlinear systems is today a topic of high relevance and importance. Not only researchers at universities and similar scientific institutions are interested in this subject.

There is also an increasing industrial need for advanced control techniques, which address explicitly process nonlinearity and operational constraints, and the ever-demanding control performance requirement. New methods are and will be developed and require careful theoretic investigations in order to be applicable without risk.

Research on model predicitive control is at its early stage and consequently, many theoretical and implementation issues are open. Moreover, only very few industrial applications have been reported.

This situation is reflected by the fact that twelve of the 27 contributions of this volume deal with theoretic aspects, further eight are devoted to modelling and computational aspects and the remaining seven deal with applications.

The contributions of this volume were selected in a rigorous peer reviewing process from the contributions to a workshop (Ascona, June 2 - 6, 1998), which was organized to bring together recognized researchers from all over the world to assess the current state and to discuss future research directions.

Contributions to this volume cover a wide range of topics such as stability, robustness, feasibility, optimality, moving horizon state estimation etc. for systems of various natures. Time-discrete, time-continuous and hybrid systems are considered but also systems described by DAEs and a multiple model approach.

Form the point of view of computation, algorithms based on multiple-shooting or on parameterisation are discussed as well as the use of wavelet compression -- to mention again only a few. A polymerisation reactor, a digester, cement mills, combustion engines and an autonomous underwater vehicle are presented within the applications part which contains also an overview and a presentation of challenges and requirements for multi-zone control.

In summary, a volume, which is a must for researchers and a valuable overview for all, being involved in the control of nonlinear systems.

Beginner	Intermediate	Expert
	●	●
Theory	**Mixed**	**Practice**
	● ●	
Lecture Note	**Monograph**	**Proceedings**
		●

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Linear Differential Equations and Group Theory from Riemann to Poincaré

Jeremy J. Gray, Birkhäuser Boston 2000
ISBN: 0-8176-3837-7, 338 pages.

This book is a study of how a particular vision of the unity of mathematics, often called geometric function theory, was created in the 19th century. The central focus is on the convergence of three mathematical topics: the hypergeometric and related linear differential equations, group theory, and non-Euclidean geometry.

This work is said to be the only up-to-date scholarly account of the history of the mentioned branch of mathematics.

It also contains a selection of exercises that should make it possible to use the book as a companion to mathematics courses at the graduate level.

Beginner	Intermediate	Expert
		●
Theory	**Mixed**	**Practice**
●		●
Lecture Note	**Monograph**	**Proceedings**
	●	

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Introduction to physical modeling with Modelica

M. Tiller, Kluwer Academic Publishers, Boston, 2001 ISBN 0-7923-7367-7, 344 pages, Hardcover Companion CD; EUR 160.00

One of the weakest points of the new object-oriented modelling language *Modelica* was the lack of an introduction to help engineers and scientists understand the differences to other modelling concepts. Using many examples from the automotive industry, electrical, mechanical and chemical engineering this book explains the concept of physical modelling, i. e. using basic laws to describe physical systems, and shows how to formulate these principles in Modelica.

The Modelica language is presented in a series of examples that gradually grow more complex.

The companion CD contains the complete source code of the examples and a working version of the commercial tool Dymola. The reader can thus start with the given examples and modify them to get some practise with the tool and the language.

The first part of the book starts with basic models from several engineering domains and shows how they can be formulated as reusable component models in Modelica. Using a step-by-step procedure every example introduces a new feature of the language. In the following chapters modelling of nonlinear behaviour, use of arrays and analysis of hybrid systems is shown.

The second part presents material for advanced users. Among other topics the differences between block diagrams and acausal modelling are explained, guidelines for building libraries are given, setting of initial conditions is explained and how to manage the development process.

The emphasis of the presentation is on the engineering task of building a model, for more theoretical questions references are given.

In the appendix the book gives a short history of Modelica, the Modelica syntax and an overview of the Modelica Standard Library. Altogether the book gives a comprehensive introduction to physical modelling and the new language Modelica and can be recommended to engineers and scientists who have to create or use models of physical systems.

Beginner	Intermediate	Expert
●	●	
Theory	**Mixed**	**Practice**
	●	●
Lecture Note	**Monograph**	**Proceedings**
	●	

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Roulette (in German)

Computersimulation & Wahrscheinlichkeitsanalyse von Spiel und Strategien

Claus Koken, R. Oldenbourg Verlag, ISBN 3-486-24030-7, 149 pages

About 80 percent of adults in Germany play games of luck. Roulette-players are only a small part of these gamblers. They know, that the quote of profit at roulette is higher than at other games. That's the reason, why the roulette players think, that there must be a strategy to win against the bank.

What's the chance to win at roulette?

The book is about testing various strategies of gambling. Some of these methods are analysed with normal mathematic and other with simulation on the computer. The solutions should show the chances to win with the strategies.

A more detailed review in German may be found in ASIM-Nachrichten 2001/3.

Beginner	Intermediate	Expert
●	●	
Theory	**Mixed**	**Practice**
	●	●
Lecture Note	**Monograph**	**Proceedings**
	●	

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Solution Mining, Leaching and Fluid Recovery of Materials

Robert W. Bartlett, Gordon and Breach Science Publishers, 1995, ISBN: 2-88124-546-3, 276 p.

This book offers a wealth of information on the field of solution mining, the extraction of materials from the earth or from mining waste by leaching and fluid recovery. It is an extremely well written introductory text for students and professional engineers that is comprehensive and emphasizes current practice and theory.

Percolation leaching of fragmented ground is included, as well as true and modified *in situ* leaching. Solution mining of gold, copper and uranium ores, several salts extracted from evaporates and brines, and sulphur are covered.

Mineral leaching chemistry and kinetics, hydrology (including flow equations for various wellfields and other fluid recovery systems), environmental containment and solution mining simulation models are also discussed.

The reader of SNE will be especially interested in the closing chapter on simulation models. A variety of different approaches are presented and their application is shown in detail.

Beginner	Intermediate	Expert
	●	
Theory	**Mixed**	**Practice**
	●	
Lecture Note	**Monograph**	**Proceedings**
	●	

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SIMULATIONISTS - PERSONALITIES

This SNE corner follows two aims: to introduce young simulationists or simulationist of the rising generation, resp., and to report about awards and personal events. In both cases a curriculum vitae gives inside into the carrier of the simulationist:

Thorsten Pawletta

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Dr. Thorsten Pawletta is a Professor of Computer Science in the Department of Mechanical, Process and Environmental Engineering at the Wismar University of Applied Science (FH), Germany.

In 1986 he started his scientific work in the Research Institute of Industrial Automation at the Technical University of Wismar. There he was involved in developing process control strategies for the automation of overseas container terminals and offshore platforms. In 1991 he received the *Dr.-Ing.* degree in applied computer science from the Technical University of Wismar. From 1990 to 1994 he worked as assistant professor in the Department of Computer Science at the University of Rostock, where he teached courses on continuous and discrete event simulation, system identification and simulation of manufacturing systems. His research activities were focused on object-oriented modelling and simulation, and its application to agricultural and engineering systems.

Since 1994 Dr. Pawletta is working as a professor of computer science at the Wismar University of Applied Science. He is teaching courses on programming techniques, numerical methods, fundamentals of modelling and simulation, simulation of technical and manufacturing systems, and environmental system analysis for computer science and engineering students.

Dr. Pawletta has worked as a guest professor at the Canterbury University of Christchurch, New Zealand in 1995. Since 1998 he is visiting annually the Dublin Institute of Technology, Ireland, where he teaches engineering students in different fields of modelling and simulation.

His research interests are focused on modelling and simulation methodology - especially modelling and simulation of hybrid and structure-variable systems -, parallel and distributed simulation, and applications to engineering systems.

Together with the Institute of Automation at the University of Rostock he initiated and executed several research projects, for instance “Modeling and Simulation of Hybrid Systems with Discontinuous Structural Changes” - supported by the German Research Foundation within the KONDISK research program, “Modeling and Simulation of Assembly Operations of Large Mechanical Structures in Aircraft Manufacturing” - supported by Airbus Industries, and “Control of Material Handling Systems by Means of Process Coupled Real-Time Simulations” - supported by the German Ministry of Education and Research.

In the last five years six students supervised by Dr. Pawletta were awarded for their research contributions; four with local university awards; one with the Innovation Award of Mecklenburg/Western Pomerania and one with the Carl-Eduard-Schulte Award for Production Innovation of the German Engineering Society (VDI). Dr. Pawletta has published about 70 papers in national and international journals as well as conference proceedings. He is an active member of ASIM since 1991 and of SCS International since 1994.

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Dr. Sven Pawletta, Research Associate, Institute of Automation, Department of Electrical Engineering and Information Technology, University of Rostock and Adjunct Professor, Department of Electrical Engineering and Computer Science, Wismar Univ. of Applied Science (FH), Germany

He received the *Dipl.-Ing.* degree in electrical engineering from the University of Rostock in 1989, and started his scientific career as research assistant at the Chair of Automatic Control under Prof. Lampe. His first research topic was „Parameter Estimation with Incomplete Time Series“.

In 1992 he changed his research focus to simulation and became a fellow of the research project „Modeling and Simulation Environments for Environmental Systems“, which was supported by the German Research Foundation. In the course of the project execution he had to learn that many real simulation tasks can only be solved successfully with high-performance computing.

That cognition and his extensive experiences as control engineer with interpreter-based numerical software tools were the origin of a new concept in the field of distributed and parallel computing which he named Multi-SCE Approach (multiple scientific computing environments). From 1994 to 1997 he developed the theoretical framework and an application for the well-known system MATLAB/SIMULINK. His product – the DP Toolbox – received immediately considerable attention by the international community of MATLAB users. In 1998 he published the research results as doctoral thesis under supervision of Prof. Lampe (Univ. Rostock), Prof. Breitenecker (TU Vienna), and Dr. Schwarze (Fraunhofer Institute for Integrated Circuits), and received the *Dr.-Ing.* degree from the University of Rostock.

In the following years Dr. Pawletta was involved in several common research projects of the Institute of Automation, University of Rostock and the Department of Mechanical Engineering, Wismar University of Applied Science, which were supported by the German Research Foundation and the Ministry of Education and Research. Beyond that, he dealt with industrial projects with DaimlerChrysler, with Automotive Engineering GmbH and with Institute of Maritime Automatic Control Engineering and Navigation.

Beside his research activities, Dr. Pawletta teached courses and tutorials on different automatic control topics, network programming, and parallel and distributed simulation in the Department of Electrical Engineering and Information Technology at the University of Rostock. Since 2000 he is working as adjunct professor for system and network programming, and in August 2001 he received an appointment as a professor of application programming and multi-media systems, both at the Department of Electrical Engineering and Computer Science, Wismar University of Applied Science.

Dr. Pawletta is an active member of ASIM and GMUG since 1992. He has published about 50 papers in national and international journals as well as conference proceedings, and served as referee for the international journal Real-Time Systems and for the former ASIM working group Distributed Systems and Parallel Processes (now Methods in Modelling and Simulation).

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JOURNAL NEWS

SIMPRA - Simulation and Modelling - Practice and Theory

www.elsevier.nl/locate/simpra

EUROSIM scientific journal Simulation and Modelling Practice and Theory (SIMPRA) is EUROSIM's scientific journal, published by Elsevier Science.

It publishes high quality contributions on modelling and simulation. Instructions for authors and other information can be found on the journal's webpage.

Forthcoming papers

SIMPRA vol. 9, issue 1-2

- K. Thomaseth: A modeling tool for biomedical systems
- G.A. Korn: A simulation-model compiler for all seasons
- J. Kuljis, R.J. Paul: An appraisal of web-based simulation: whither we wander?
- J.A. Miller, P.A. Fishwick, S.J.E. Taylor, P. Benjamin, B. Szymanski: Research and commercial opportunities in Web-Based Simulation
- E. Yucesan, Y.-C. Luo, C.-H. Chen, I. Lee: Distributed web-based simulation experiments for optimisation

Special Issue

In due course a special issue will be published, which contains six expanded papers of selected papers from the second Conference on Simulation Methods and Applications (CSMA 2000), held in Orlando, October 2000. Guest Editors are Ratan Guha and Mostafa Bassiouni:

- G. D'Acquisto, M. Naldi: Computational costs for fast stochastic simulation techniques for Markovian fluid models in multiservice networks.
- Lee Tzong-Ru, Kao Jui-Sheng, Wu, Ching-Yi: Application of PDSS to improve the pricing efficiency of wholesale fish markets.
- J.V. Miro, A.S. White: Modelling an industrial manipulator - a case study.
- C.A. Murphy, T. Perera: The definition of simulation and its role within an aerospace company.

Submissions of manuscripts

Authors are kindly requested to submit their papers to the following address:

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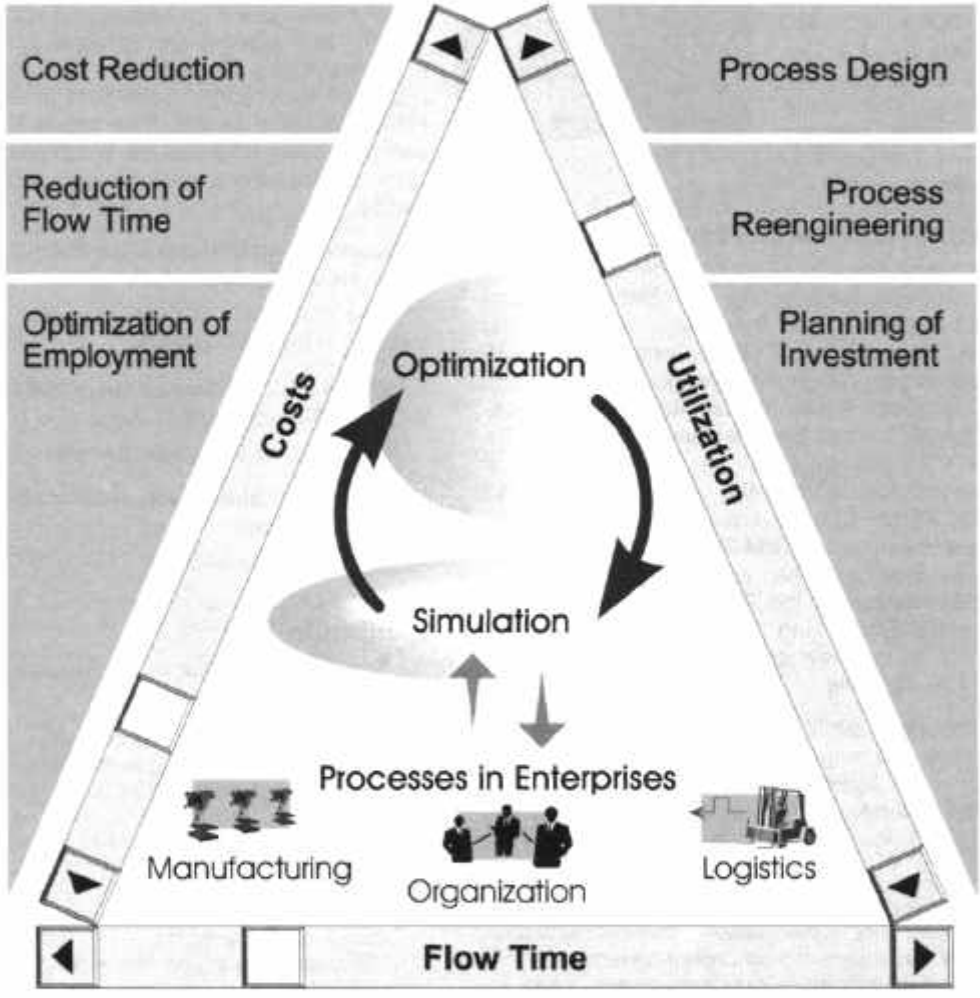

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Temperature modelling, Biomechanics

- Radio frequency perforation of cardiac tissue: modelling and experimental results. N. Shimko, P. Savard and K. Shah
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- Analysis of postural sway using entropy measures of signal complexity. A.M. Sabatini
- Automatic de-noising of knee joint vibration signals using adaptive time frequency representations S. Krishnan and R.M. Rangayyan
- Characterisation of three-dimensional anatomic shapes using principal components: application to the proximal tibia B.J. Hafner, S.G. Zachariah and J.E. Sanders
- Finite element analysis of brain contusion: an indirect impact study. H.M. Huang, M.C. Lee, S.Y. Lee, W.T. Chiu, L.C. Pan and C.T. Chen
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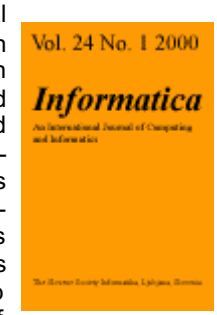

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  Margareta Vrtacnik, Vesna Ferk, Danica Dolnicar, Natasa Zupancic-Brouwer and Mateja Sajovec
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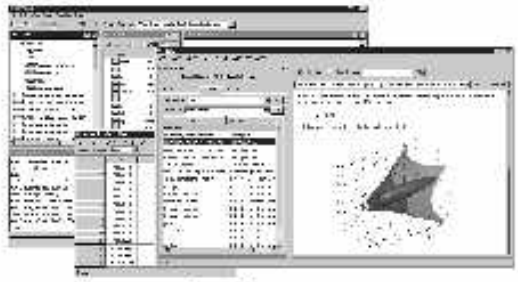

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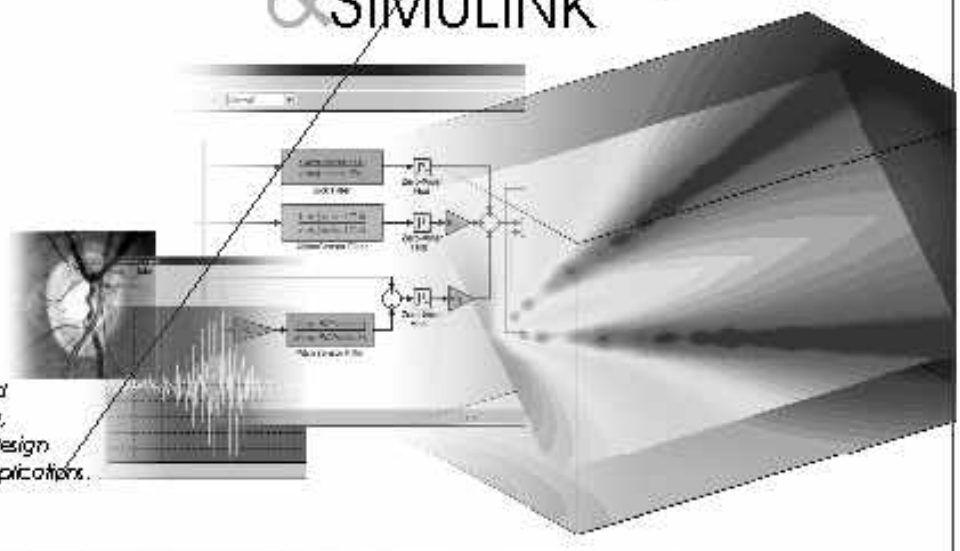

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