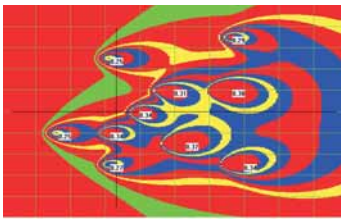
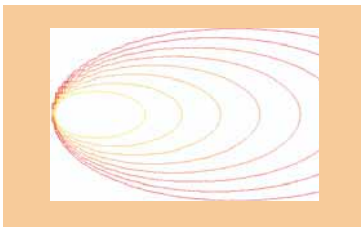
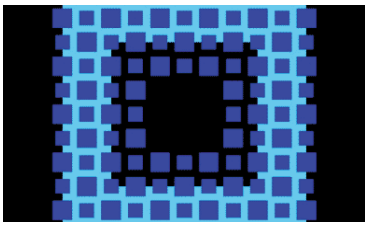
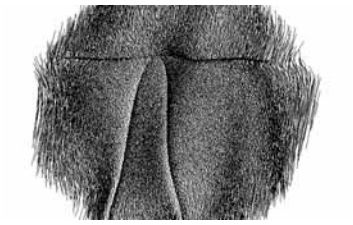
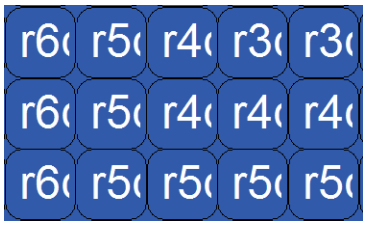
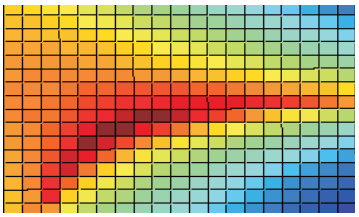
Simulation News Europe


Issue 44/45, December 2005

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ARGESIM

Issue 44/45, December 2005

Dear readers,

This SNE issue comes with a new layout. The new layout should also underline opening of SNE towards alternative modelling approaches, to computational engineering and to scientific computing in the Notes Section, and the opening towards simulation-related societies in the News Section. Together with the new layout, both editorial boards have been reorganised personally and organisationally, and the editorial affairs are intended to be run around the year, and not only the month before publishing a SNE issue. This new structure eases especially the editorial work for the Notes Section of the regular SNE issues and for the SNE Special Issues. We hope, the readers enjoy the new SNE, and the contributors appreciate the new editorial structure.

Not only the layout, but also the content of this issue reflect the development of SNE. Five Technical Notes and three Short Notes show a broad variety from modelling issues (prawn infection, pedestrian dynamics, artificial consumer markets) via evaluation of network simulators towards spatial analysis tools, Open Modelica and modelling libraries. Furthermore, the new Comparison 'Pollution in Groundwater Flow' addresses mainly modelling techniques and solution techniques, and does not emphasise on the software used. This change of the goal of the Comparisons is also underlined in solutions to the comparison 'Restaurant Business Dynamics' in this issue. And last but not least, the Comparison Section starts reporting and documenting also other comparisons and benchmarks, like the MATHMOD Yo-Yo Challenge, a benchmark established in this issue.

We are glad, that some societies have sent in more information – not only for the news section, but also for the Simulationists Corner, for the Book Reviews, etc. The News Section publishes detailed actions and plans of EUROSIM, including the idea of inviting simulation-related societies and groups to join EUROSIM as associate membe, an idea supported by the new EUROSIM President B. Zupancic and by some EUROSIM Societies.

We thank all authors and members of the editorial boards for their co-operation. Deadline for the next issue, SNE 46, July 2005, is June 1, 2006.

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

SNE 44/45 in Five Minutes

Content

SNE Editorial Board

SNE - Simulation News Europe – is advised by two Editorial Boards, the one taking care on reviewing and handling of Technical Notes, Shortnotes, Software Notes, Book and Journal Review, sand of Comparison and Benchmark Notes (called SNE Editorial Board), and the other one organising and taking care on reports from EUROSIM, EUROSIM societies, International Societies, and of Industry News (called SNE News Editorial Board – see News Section).

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Spatial Analysis and Developing Tool - a New Software for Landscape Analysis

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Landscape-analysis software must apply dynamic-system models from different specific fields (econo mics, ecology) to each of a large set of points on a landscape grid. The new SAMT/DESIRE program package combines SAMT, a small grid-based geographical information system (GIS) with the dynamic system simulation program DESIRE. The new software package employs the GIS program for data handling and landscape modeling, while DESIRE provides fast interactive modeling and simulation of dynamic submodels. The two programs interact through shared memory.

1 Introduction

Land-use problems are necessarily multidisciplinary, since many different factors interact to change landscape features and land use. Analytical tools for land-use simulation must therefore account for ecology-related and economic variables and provide a framework for convenient integration of different models. We have tried to go beyond existing geographical information systems with new software that permits concurrent interactive modeling of conditions at many different points of a simulated landscape.

SAMT/DESIRE can construct relations among landscape data using expert knowledge (fuzzy-set models) and neural-network models. The DESIRE subsystem, a user-friendly environment for very fast interactive modeling and simulation of dynamic systems, formulates differential-equation or difference-equation models e.g. of population or plant-growth). DESIRE then replicates (vectorizes) such a model at many points of a landscape grid and exercises all the replicated models in a single simulation run. Both programs are freely available under the Open Software Foundatioin's General Public License (GPL).

These techniques are, moreover, combined with improved data-analysis programs like 3D-visualization (NURBS [3], Splatter technique [9] etc.) to permit convenient interactive modeling.

Spatial Analysis and Modeling Tool
The SAMT (Spatial Analysis and Modeling Tool) [4] portion of the software package is a simple geographical information system (GIS).
SAMT declares and stores landscape properties at a grid of geographical points as a set of arrays of numbers. Each array contains data values representing:

- properties of the landscape (landscape features) at each grid point,
- altitude, physical data like tempe rature, soil moisture, biomass of a species,...

SAMT can assign and calculate funcions relating landscape features at different grid points, say

$$q_1 = q_2 + q_3 \; q_1 = cos(q_2) \qquad q_1 = calc(q_2, q_3, \ldots)$$

Functions like calc (q_2, q_3, ...) can be numerical expressions, or they may be regression functions obtained, e.g. from neural-network or fuzzy-set models.

SAMT can also assign grid-point data values that depend on data at other grid points, such as the distance of each grid point to another selected grid point, which might represent the location of city or a bird's nest; it also could find the shortest distance to a river or road.

Furthermore SAMT can accumulate statistics (mean, standard derivation, histogram etc.) over a set of grid points. Last but not least, SAMT can draw maps that show grid point data values in different colors, or show contour lines and three-dimensional plots of different landscape features.

2.1 Dynamic-system Modeling Part

To study how landscape features change with time, SAMT needs landscape feature values only at fairly widely spaced sampling times (communication times) $t = t_0, t_0 + c_{int}, t_0 + 2\, c_{int}..$; the communication interval c_{int} might be a day, a month, a year, etc. DESIRE, however, can increment the time in smaller steps Δt to emulate continuous changes. DESIRE relates current and future data values at each grid point by ordinary differential equations. We can, instead, relate current and future feature values at different sampling times by difference equations, or by combinations of differential and difference equations.

$$\frac{d}{dt} q_i = f\left(q_1, q_2, ..., p_1, p_2, ..., a_1, a_2, ...\right),\ i = 1, \ldots, n$$

For each grid point, the feature values q_1, q_2,... state variables starting from a given initial values. p_1, p_2,...are feature values related to the state variables by defined-variable assignments

$$p_1 = g_1(p_2, p_3, ...; q_1, q_2, ...; b_1, b_2, ...; t)$$
$$p_2 = g_2(p_1, p_3, ...; q_1, q_2, ...; b_1, b_2, ...; t)$$

which must not involve recursive algebraic loops. a_1, a_2,...b_1, b_2,... are fixed parameter values associated with each grid point.

The differential equation system above for each grid point is solved by numerical integration to produce time histories of the feature values $q_i = q_i(t)$ and $p_i = p_i(t)$. Such an equation system might, for instance, model the growth of a crop, or the population dynamics of competing plant species at a point of the landscape.

SAMT lets you enter, display, and manipulate the database of grid-point features q_i and p_i, but the program was not designed to generate landscape-feature time histories by solving differential equations. This is left to DESIRE, a computer program specifically designed to solve large differential equation systems.

SAMT and DESIRE are loaded independently and communicate through data arrays and command codes in semaphore-protected shared memory. SAMT sends system parameters and initial values of landscape features to DESIRE

DESIRE then solves the differential equations and returns landscape-feature values to SAMT at periodic sampling times. Both DESIRE and SAMT can generate time-history graphs and listings, and SAMT can produce time-variable maps. The entire simulation of an evolving landscape can be controlled by DESIRE commands, by SAMT dialog-window controls or by an interpreted experiment protocol script.

2.2 DESIRE

DESIRE [5] can read typed or programmed equations and differential equations in a natural mathematical notation. On a `drun` command, DESIRE then immediately compiles and solves the problem with a choice of integration rules and produces time-history graphs or listings.
Similar programs have long been used for simulating dynamic systems like aerospace vehicles, but DESIRE is particularly convenient for interactive modeling [6]. Fast code for time-history solutions is compiled at runtime, but interpreted commands like

```
reset
gain=gain + 0.2
drun
```

let you modify your model and then try a new simulation run. Such interpreted commands can also be combined into useful experiment-protocol programs (scripts) that control multirun simulation studies, e.g. statistics evaluation (Monte Carlo simulation), and for parameter optimization or modelidentification.

2.2.1 Evolution at multiple grid points: the vectorizing compiler

Landscape evolution involves similar system equations (1) with different parameters and initial conditions at many points of a landscape grid. If there are not too many grid points (say up to 1000), DESIRE can define

an *n*-dimensional array (vector) for each state variable q_i, for each defined variable p_i (landscape feature vectors), and for each parameter a_i and b_i (parameter vectors) with array declarations

```
STATE p1[ n] ,p2[ n] ,...
ARRAYq1[ n] ,q2[ n] ,.., a1[ n] ,a2[ n] ,..,
          b1[ n] ,b2[ n] ,...
```

We then effectively replicate each model equation *n* times by programming vector equations [7] corresponding to each scalar equation (1), for $i = 1, ..., n$:

$$\textbf{\textit{Vector}}\ dq_i/dt = f_i(q_1,q_2,...; p_1, p_2,...; a_1,a_2,...; t)$$
$$\textbf{\textit{Vector}}\ p_1 = g_1(p_2,p_3,...; q_1,q_2,...; b_1,b_2,...; t)$$
$$\textbf{\textit{Vector}}\ p_2 = g_2(p_1,p_3,...; q_1,q_2,...; b_1,b_2,...; t)$$

DESIRE's vectorizing compiler automatically compiles each vector equation into *n* corresponding scalar assignments, one for each grid point, for example

$$dq_{i,k}/dt = f_i(q_{1,k}, q_{2,k},...; p_{1,k},p_{2,k},...; a_{1,k},a_{2,k},...;t), \quad i=1,2,.., \quad k=1,2,...,n$$

All the derivative values dq_i/dt are fed to a suitable integration routine. Vectorizing compilers produce efficient code, since there is no vector-loop overhead. Such compilers were originally developed for fast Monte Carlo simulation on supercomputers [8].

DESIRE brought this technique to inexpensive personal computers, where it also replicates neurons in artificial neural-network simulations and solves other problems. A simple personal computer can often solve thousands of differential equations in a fraction of a second.

2.2.2 A closer look at the complexity of input data

A grid based GIS, though, may have to handle many millions of grid cells, too many for DESIRE's vectorization. But spatial data often contain a lot of redundancy. In practice, data are often quantified [11], so that only a discrete set of values are available. This is, for example, the case for fields in an agricultural used region (with a set of products like wheat, rye, corn, or potatoes); for soil types (every soil type is linked with a row of a table containing soil information like texture, profile data, etc.); and for climate regions like “arid”, ”semiarid” etc. (that means there are many grids with the same value).

Such a ‘lumping into classes’ of input data can be used to reduce the amount of calculations dramatically. The number of required calculations is:

$$n = nx_1 * nx_2 * ... nx_n$$

with nx_i is the number of elements in the set x_i.

For three inputs with 8 fruits, 6 soil classes and 2 climate regions we need for example: n=8*6*2=96 calculations. The number of grid cells was 54.000 (with 100m*100m), for this region.

Sometimes such quantization is not possible. Every grid cell represents a floating point number. This is true, for instance, when different geographical elevations are stored in grid cells. Another example is the representation of distances between grid cells and points (nesting places for birds, location of wind power stations etc.) or distances between grid cells and lines (roads, rivers etc.). A final important example involving continuous data demonstrates the so called moving-window technique, [12], which calculates

$$q_i = f(x,y) = \iint_{A(x,y)} g(x,y)dxdy$$

Here $A(x,y)$ is an area around the point (x,y), and $g(x,y)$ is a function depending on spatial modeling problem. For simple problems, $g(x,y)$ can be the mean or the median for all points in a region $A(x,y)$. This technique produces a spatial abstraction of data at one point (Not only the value at the point, but also values in a neighborhood of the point are important).
In such cases geographical data are not lumped into classes, and the simplification can not be used. Here a critical look at the quality of the spatial data may help. The accuracy of spatial data is often low because of errors in data collection, misinterpretation of remote sensing, etc.

2.2.3 Data exchange between SAMT and DESIRE

DESIRE obtains landscape-feature data from SAMT and must simulate a dynamic process at each grid point. To avoid overloading DESIRE with data from too many closely-spaced grid points, we can feed DESIRE with data lumped into classes and return the result to SAMT.

This ‘lumping into Classes’ means:

$$d_q = (p_{max} - p_{min})/(n-1),$$
$$p_{max} = \max\{q_i\}, p_{min} = \min\{q_i\}$$

With n number of classes, d_q is the difference between the classes. SAMT interpolates between these data. For the two-dimensional case, SAMT employs the following interpolation algorithm:

$$a_1 = q_{i,j} + (a - x_i) / (x_{i+1} - x_i)*(q_{i+1,j} - q_{i,j})$$
$$a_2 = q_{i,j+1} + (a-x_i) / (x_{i+1} - x_i)* (q_{i+1,j+1} - q_{i,j+1})$$
$$q = a_1 + (b-y_j) / (y_{j+1} - y_j) * (a_2 - a_1)$$

with $q_{i,j} = f(x_i, y_j)$ calculated value at the begin of the interval $[(x_i,x_{i+1}),(y_j,y_{j+1})]$; $q_{i+1,j} = f(x_{i+1},y_j)$, etc.; a and b are values in the interval $[(x_i,x_{i+1}), (y_j,y_{j+1})]$.
The values a and b represent the inputs. SAMT takes these inputs from every grid cell and interpolates, using the results from DESIRE, the output grid.

3 Example

Here is a toy example that demonstrates the interaction between SAMT and DESIRE. A simple logistic function was used to model the growth process of biomass:

$$\frac{d}{dt}x = K\,x\,(B - x)$$

x represents the biomass, K is a growth constant and B describes a limitation of the growth process. In the example, K represents the growth effective temperature (which is related to the the elevation) and B stands for the soil quality stored in SAMT. In a real simulation K and B depends on the weather, agricultural management, the soil water content, etc.

The input grids are indicated in Figure 1, while Figure 2 shows the results. The soil map exhibits regions with equal soil quality.
As decribed above, we used pre-classified soil data and we reduced computations by feeding DESIRE with elevation data lumped into classes.

The K value was derived from elevation data and a classification from 0.0008 to 0.0013 with 10 classes was used.

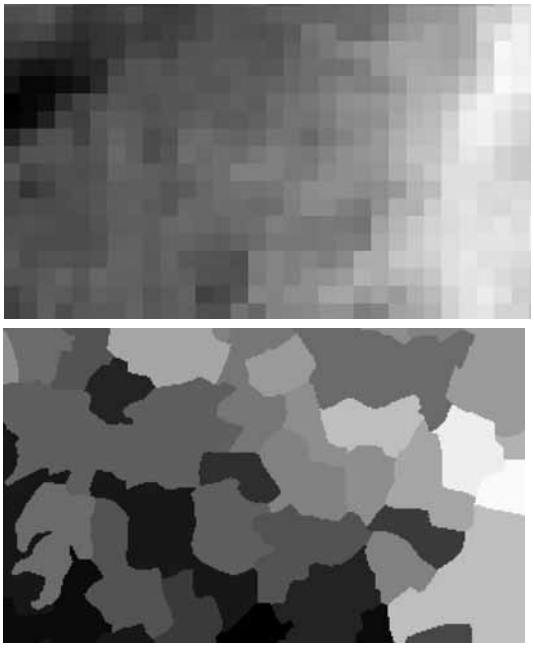

Figure 1: Input grid, K - parameter and soil quality

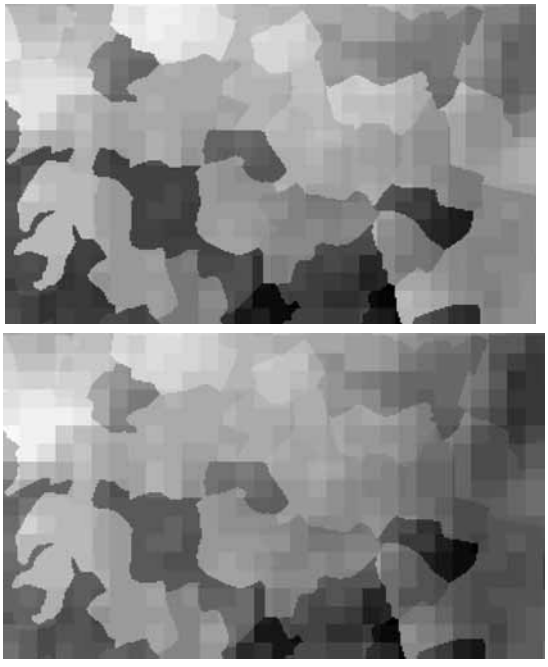

Figure 2: Output grid, biomass after 150 days and biomass after 200 days

The result shows how the biomass varies with time. In the first map, the soil quality was dominant; in the second map we can also see the effect of temperature profile.

Such maps can serve as inputs for follow-on simulations, say of wildlife-habitat quality [13].

4 Conclusions

DESIRE simulations can help to develop (spatial) models and

- estimate parameters and make sensitivity analysis of models
- simulate processes along a lines (streams, rivers)
- simulate dynamics (see example)

DESIRE's efficient vector compiler handles simulations at 1000 or more landscape grid points. DESIRE's time-history displays let you check the progress of the calculation and verify results.

This is far easier than modeling with C++ programs. The scripting language of DESIRE's experiment-protocol program, much like old-fashioned BASIC, is easy to learn. SAMT/DESIRE added a new graphical user interface for DESIRE; this includes a new editor with syntax highlighting, improved file management, jump to the line with the error, and improved graph plotting.

SAMT/DESIRE serendipitously combines geographical information and dynamic system models.
We can also use SAMT's neural-network and fuzzy-logic subsystems [1] as independent toolboxes or to generate inputs for DESIRE differential-equation models.

5 Application and Future

SAMT has been successfully applied to projects in Germany, Switzerland and Mexico. In particular, SAMT was used to optimize the location of wind power plants with a view to reduce their detrimental effects on bird populations. Another SAMT application investigated possible landscape changes due to renewable primary products.

Future applications of the new SAMT/DESIRE combination will investigate effects of new technologies (e.g. example genetically modified plants, alternative energy production) on the environment.
One plan is to investigate the migration of copper compounds from Swiss house roofs into streams and rivers, considering diffuse-matter transport from the roofs, matter transport in streams or rivers, and chemical, biological processes affected by the copper migration.

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The OpenModelica Modeling, Simulation, and Software Development Environment

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Modelica is a modern, strongly typed, declarative, and object-oriented language for modeling and simulation of complex systems. This paper gives a quick overview of some aspects of the OpenModelica environment – an open-source environment for modeling, simulation, and development of Modelica applications.
An introduction of the objectives of the environment is given, an over-view of the architecture is outlined and a number of examples are illustrated.

1 Introduction

The OpenModelica environment described in this paper has several goals, including, but not limited to the following:

- Providing an efficient interactive computational environment for the Modelica language.
- Development of a complete reference implementation of Modelica in a (currently) extended version of Modelica itself.
- Providing an environment for teaching modeling and simulation. It turns out that with support of appropriate tools and libraries, Modelica is very well suited as a computational language for development and execution of both low level and high level numerical algorithms, e.g. for control system design, solving non-linear equation systems, or to develop optimization algorithms for complex applications.
- Language design, e.g. to further extend the scope of the language, e.g. for use in diagnosis, structural analysis, system identification, etc., as well as modeling problems that require extensions such as partial differential equations, enlarged scope for discrete modeling and simulation, etc.
- Language design to improve abstract properties such as expressiveness, orthogonality, declarativity, reuse, configurability, architectural properties, etc.
- Improved implementation techniques, e.g. to enhance the performance of compiled Modelica code by generating code for parallel hardware.
- Improved debugging support for equation based languages such as Modelica, for improved ease of use.
- Easy-to-use specialized high-level (graphical) user interfaces for certain application domains.
- Visualization and animation techniques for interpre-tation and presentation of results.
- Application usage and model library development by researchers in various application areas.

In this paper we briefly present a few of the subsystems, as well as some architectural aspects of the environment. Further, we will give examples of the usage of the interactive session handler, the DrModelica note-book, and the debugging support.

1.1 Environment Overview

The OpenModelica environment consists of several interconnected subsystems, as depicted in Figure 1.

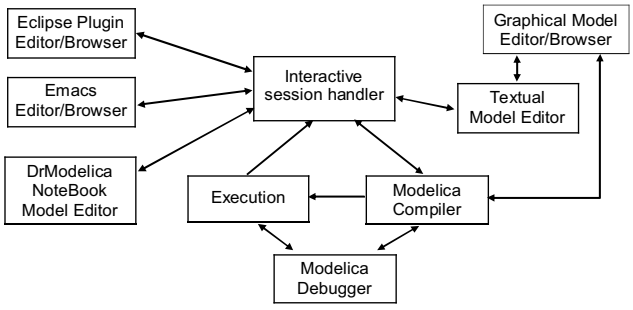
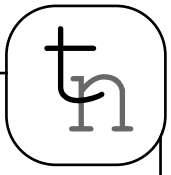


Figure 1: The architecture of the OpenModelica environment.

Arrows denote data and control flow. Several subsystems provide different forms of browsing and textual editing of Modelica code.



The debugger currently provides debugging of an extended algorithmic subset of Modelica. The graphical model editor is not really part of OpenModelica but integrated into the system and available from MathCore [6] without cost for academic usage.

The following subsystems are currently integrated in the OpenModelica environment:

- An **interactive session handler**, that parses and interprets commands and Modelica expressions for evaluation, simulation, plotting, etc. The session handler also contains simple history facilities, and completion of file names and certain identifiers in commands.
- A **Modelica compiler subsystem**, translating Modelica to C code, with a symbol table containing definitions of classes, functions, and variables. Such definitions can be predefined, userdefined, or obtained from libraries. The compiler also includes a Modelica interpreter for interactive usage and constant expression evaluation. The subsystem also includes facilities for building simulation executables linked with selected numerical ODE or DAE solvers.
- An execution and run-time module. This module currently executes compiled binary code from translated expressions and functions, as well as simulation code from equation based models, linked with numerical solvers. Limited event handling facilities are included for the discrete and hybrid parts of the Modelica language.
- **Emacs textual model editor/browser.** In principle any text editor could be used. We have so far primarily employed Gnu Emacs, which has the advantage of being programmable for future extensions. A Gnu Emacs mode for Modelica has previously been developed. The Emacs mode hides Modelica graphical annotations during editing, which otherwise clutters the code and makes it hard to read. A speedbar browser menu allows to browse a Modelica file hierarchy, and among the class and type definitions in those files.
- **A Eclipse plugin editor / browser / compilation manager.** The Eclipse plugin provides file and class hierarchy browsing and text editing capabilities, rather analogous to previously described Emacs editor / browser. Some syntax highlighting facilities are also included. The Eclipse framework has the advantage of making it easier to add future extensions such as refactoring and cross referencing support. A compilation manager is also included.
- **DrModelica notebook model editor.** This subsystem provides a lightweight notebook editor, compared to the more advanced Mathematica notebooks available in Math Modelica. This basic functionality still allows essentially the whole DrModelica tutorial to be handled. Hierarchical text documents with chapters and sections can be represented and edited, including basic formatting. Cells can contain ordinary text or Modelica models and expressions, which can be evaluated and simulated. However, no mathematical typesetting or graphic plotting facilities are yet available in the cells of this notebook editor.
- **Graphical model editor / browser**. This is a graphical connection editor, for component based model design by connecting instances of Modelica classes, and browsing Modelica model libraries for reading and picking component models. The graphical model editor is not really part of OpenModelica but integrated into the system and provided by MathCore AB [6] without cost for academic usage. The graphical model editor also includes a textual editor for editing model class definitions, and a window for interactive Modelica command evaluation.
- **Modelica debugger**. The current implementation of the debugger [7] provides debugging for an extended algorithmic subset of Modelica, excluding equation-based models and some other features, but including some meta-programming and model transformation extensions [8] to Modelica. This is conventional full-feature debugger, using Emacs for displaying the source code during stepping, setting breakpoints, etc. Various back-trace and inspection commands are available. The debugger also includes a data-view browser for browsing hierarchical data such as tree- or list structures in extended Modelica.

1.2 Implementation Status

The current version of the OpenModelica environment (Jan 2006) allows most of the expression, equation, algorithm, and function parts of Modelica to be executed interactively, as well as to being compiled into efficient C code. The generated C code is combined with a library of utility functions, a run-time library, and a numerical DAE solver. An external function library interfacing a LAPACK subset and other basic algorithms is under development.

Not all subsystems are yet integrated as well as is indicated in Figure 1. Currently there are two versions of the Modelica compiler, one which supports most of standard Modelica including simulation, and is connected to the interactive session handler, the notebook editor, and the graphic model editor, and another meta-programming Modelica compiler version which is integrated with the debugger and Emacs, supports meta-programming Modelica extensions [8], but does not allow equation-based modeling and simulation. Those two versions are currently being merged into a single Modelica compiler version.

2 OpenModelica Client-Server Architecture

The OpenModelica client-server architecture is schematically depicted in Figure 2, showing two typical clients: a graphic model editor and an interactive session handler for command interpretation.

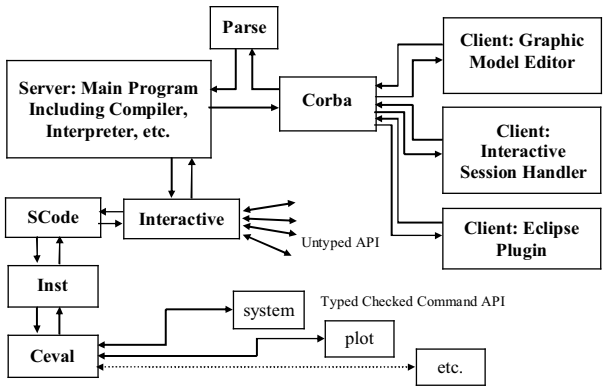


Figure 2: Client-Server interconnection structure of the compiler/interpreter main program and interactive tool interfaces

Commands or Modelica expressions are sent as text from the clients via the CORBA interface, parsed, and divided into two groups by the main program:

- **All kinds of declarations of classes**, types, functions, constants, etc., as well as equations and assignment statements. Moreover, function calls to the untyped API also belong to this group – a function name is checked if it belongs to the API names. The Interactive module handles this group of declarations and untyped API commands.
- **Expressions and type checked API commands**, which are handled by the Ceval module. The reason the untyped API calls are not passed via `SCode` (a module generating an intermediate form of the abstract syntax tree) and `Inst` (which performs symbolic instantiation of components) to `Ceval` is that `Ceval` can only handle typed calls – the type is always computed and checked, whereas the untyped API prioritizes performance and typing flexibility. The `Main` module checks the name of a called function name to determine if it belongs to the untyped API, and should be routed to `Interactive`. Moreover, the `Interactive` module maintains an environment of all interactively given declarations and assignments at the top-level, which is the reason such items need to be handled by the Interactive module.

3 Simplified Overall Structure of the Compiler

The OpenModelica compiler is separated into a number of modules, to separate different stages of the translation, and to make it more manageable. The top level function is called main, and appears as follows in simplified form that emits flat Modelica (leaving out the code generation and symbolic equation manipulation):

```
function main
  input String f  "file name";
protected
  Absyn  ast;
  SCode  scode1;
  SCode  scode2;
algorithm
  ast := Parser.parse(f);
  scode1 := SCode.elaborate(ast);
  scode2 := Inst.elaborate(scode1);
  DAE.dump(scode2);
end main;
```

The simplified overall structure of the OpenModelica compiler is depicted in Figure 3, showing the most important modules, some of which can be recognized from the above main function. The total system contains approximately 40 modules.

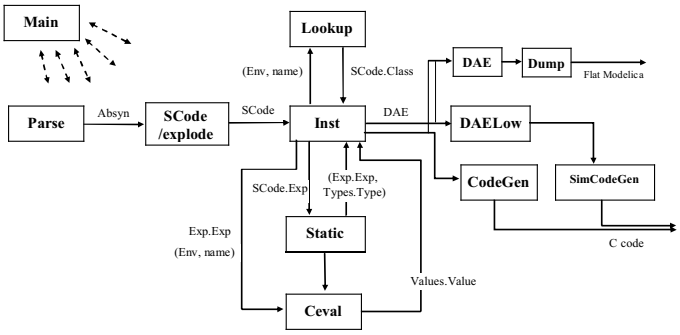


Figure 3: The Modelica compiler decomposed into modules and data flow connections

The parser generates abstract syntax (`Absyn`) which is converted to the simplified (`SCode`) intermediate form. The code instantiation module (`Inst`) calls Lookup to find a name in an environment. It also generates the DAE equation representation which is simplified by `DAELow`. The `Ceval` module performs compile-time or interactive expression evaluation and returns values. The `Static` module performs static semantics and type checking. The `DAELow` module performs BLT sorting and index reduction (see Chapter 18 in [2]). The DAE module internally uses `Exp.Exp`, `Types.Type`, `Algorithm.Algorithm`; the `SCode` module internally uses `Absyn`.

4 Interactive Session with Examples

The following is an interactive session using the interactive session handler in the OpenModelica environment. (Also called `WinMosh.exe` (under Windows) or `mosh` (under Linux) – the Modelica Shell).

The Windows version which at installation is made available in the start menu as `OpenModelica->OpenModelica Shell` responds with an interaction window shown in Figure 4.

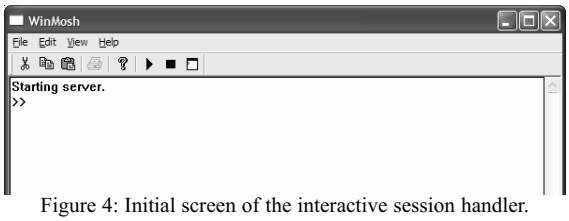


Figure 4: Initial screen of the interactive session handler.

We enter an assignment of a vector expression, created by the range construction expression `1:12`, to be stored in the variable `x`. The value of the expression is returned.

```
>> x := 1:12
 {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12}
Look at the type of x:
>> typeOf(x)
"Integer[]"
```

The function `bubblesort` is called to sort this vector in descending order. The sorted result is returned together with its type. Note that the result vector is of type `Real[:]`, instantiated as `Real[12]`, since this is the declared type of the function result. The input `Integer` vector was automatically converted to a `Real` vector according to the Modelica type coercion rules. The function is automatically compiled when called if this has not been done before.

```
>> bubblesort(x)
{12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1}
```

It is also possible to give operating system commands via the `system` utility function. A command is provided as a string argument. The example below shows the `system` utility applied to the UNIX command `cat`, which here outputs the contents of the file `bubblesort.mo` to the output stream. However, the `cat` command does not boldface Modelica keywords – this improvement has been done by hand for readability.

```
>> system("cat bubblesort.mo")
function bubblesort
  input Real[:] x;
  output Real[size(x,1)] y;
protected
  Real t;
algorithm
  y := x;
  for i in 1:size(x,1) loop
    for j in 1:size(x,1) loop
      if y[i] > y[j] then
              t := y[i];
              y[i] := y[j];
              y[j] := t;
      end if;
    end for;
  end for;
end bubblesort;
```

It is also possible to enter a function directly into the session handler.

```
>> function MySqr input Real x; output Real y;
 algorithm y:=x*x; end MySqr;
Ok
```

And then call the function:

```
>> b:=MySqr(2)
4.0
```

Another built-in command is `cd`, the change current directory command. The resulting current directory is returned as a string.

```
>> cd("..")
"/home/petfr/modelica"
```

We load a model, here the whole Modelica standard library:

```
>> loadModel(Modelica)
true
```

We also load a file containing the `dcmotor` model:

```
>> loadFile("M:/modeq/VC7/Setup/testmodels
/dcmotor.mo")
true
```

It is simulated:

```
>> simulate(dcmotor,startTime=0.0,
stopTime=10.0)
record
     resultFile = "dcmotor_res.plt"
end record
```

We list the source code of the model:

```
>> list(dcmotor)
"model dcmotor
Modelica.Electrical.Analog.Basic.
               Resistor r1(R=10);
Modelica.Electrical.Analog.Basic.Inductor i1;
Modelica.Electrical.Analog.Basic.EMF emf1;
Modelica.Mechanics.Rotational.Inertia load;
Modelica.Electrical.Analog.Basic.Ground g;
Modelica.Electrical.Analog.Sources.
                 ConstantVoltage v;
equation
  connect(v.p,r1.p);
  connect(v.n,g.p);
  connect(r1.n,i1.p);
  connect(i1.n,emf1.p);
  connect(emf1.n,g.p);
  connect(emf1.flange_b,load.flange_a);
end dcmotor;
```

We plot part of the simulated result, the output is shown in Figure 5.

```
>> plot({load.w,load.phi})
true
```

Clear all loaded libraries and models:

```
>> clear()
true
```

List the loaded models – but nothing left:

```
>> list()
""
```

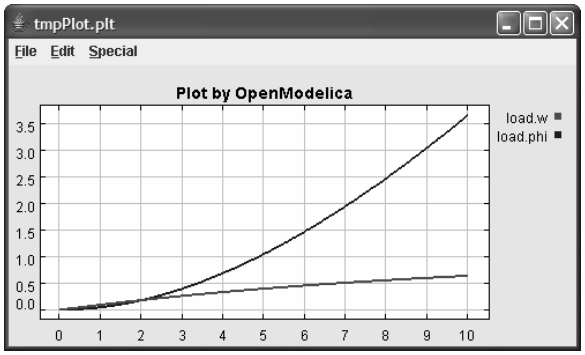


Figure 5: Plot of the simulated `dcmotor` model.

We load another model, the `Influenza` model:

```
>> loadFile("M:/modeq/VC7/Setup/testmodels/
Influenza.mo")
```

It is simulated:

```
>> simulate(Influenza,startTime=0.0,
stopTime=3.0)
record
     resultFile = "Influenza_res.plt"
end record
```

The simulated population is plotted (Figure 6).

```
>> plot({ Infected_Popul.p} )
true
```

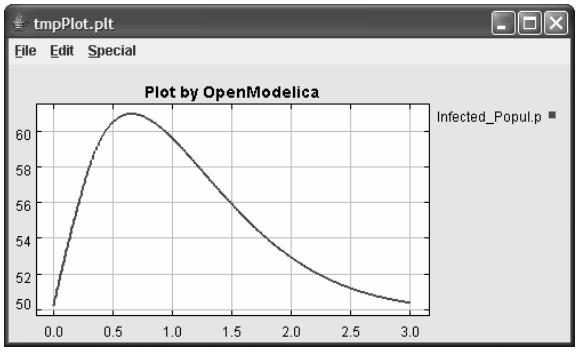


Figure 6: Plot of the Influenza model.

4.1 Commands for the Interactive Session Handler

The following is the complete list of commands currently available in the interactive session handler.

- `instantiateModel`(*modelname*)

Perform code instantiation of a model/class and return a string containing the flat class definition.

- `simulate`(*modelname*)

Translate a model named *modelname* and simulate it.

- `simulate`(*modelname*[,`startTime=`<*Real*>][,`stopTime=`<*Real*>][,`numberOfIntervals=`<*Integer*>])

Translate and simulate a model, with optional start time, stop time, and optional number of simulation intervals or steps for which the simulation results will be computed. Many steps will give higher time resolution, but occupy more space and take longer to compute. The default number of intervals is 500.

- `plot` (*vars*)

Plot the variables given as a vector, e.g. `plot({ x1,x2} )`.

- `list()`

Return a string containing all loaded class definitions.

- `list` (*modelname*)

Return a string containing the class definition of the named class.

- `listVariables()`

Return a vector of the names of the currently defined variables.

- `typeOf` (*variable*)

Return the type of the variable as a string.

- `clear()`

Clear all loaded definitions.

- `clearVariables()`

Clear all defined variables.

- `timing(`*expr*)

Evaluate expression *expr* and return the number of seconds (elapsed time) the evaluation took.

- `cd()`

Return the current directory.

- `cd(`dir)

Change directory to the directory given as string.

- `system` (*str*)

Execute *str* as a system(shell) command in the operating system; return integer success value. Output into *stdout* from a shell command is put into the console window.

- `readFile` (*str*)

Load file given as string *str* and return a string containing the file content.

- `runScript` (*str*)

Execute script file with file name given as string argument *str*.

- `loadModel` (*classname*)

Load model or package of name *classname* from MODELICAPATH.

- `loadFile` (*str*)

Load Modelica file (`.mo`) with a name given as string argument *str*.

- `saveModel` (*str, modelname*)

Save the model/class with name *modelname* in the file given by the string argument *str*.

- `help()`

Print this helptext (returned as a string).

- `quit()`

Leave and quit the OpenModelica environment

5 DrModelica Notebook and Textual Model Editor

The OpenModelica electronic notebook and model editor subsystem [11,12] can be used as a textual modeling interface for Modelica, or as a Modelica tutoring system, i.e., a simplified version of the DrModelica tutoring system for teaching Modelica.

However, the OpenModelica notebook facility is work in progress, which currently is only partially completed.

The simplified OpenModelica electronic notebooks are however still able to handle the full DrModelica tutorial material. It is advanced enough to represent hierarchical documents, simple type setting, text editing, etc. This is exemplified by Figure 7, showing the DrModelica main page (start page) in the teaching material.

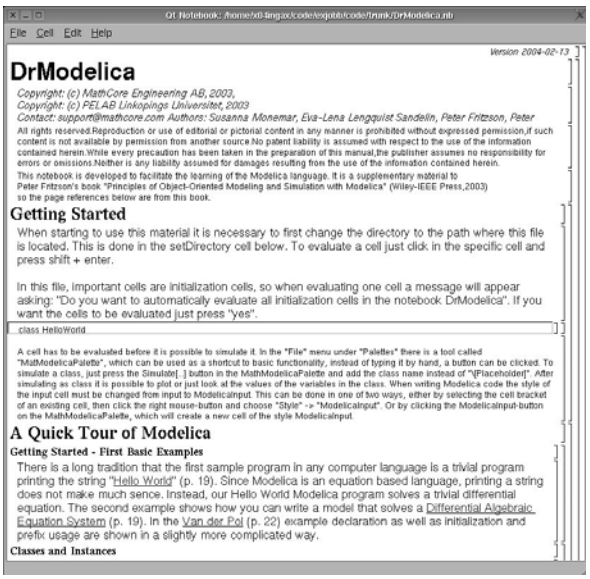


Figure 7: The start page (main page) of DrModelica in the OpenModelica notebook system.

5.1 OpenModelica Notebook Commands

The current prototype of OpenModelica notebooks includes, but is not limited, to the following operations:

- Opening and closing groups of cells by double clicking the hierarchical tree view (to the right).
- Evaluation of Modelica code, commands, and expressions in input cells by typing SHIFT+RETURN. The evaluation results are shown in a created output cell.
- Opening and loading notebook files stored in XML-format Command: CTRL+O).
- Opening and loading notebook files stored in Full-Form Mathematica notebook format.
- Saving notebook files in XML format.
- Terminating the notebook subsystem (ALT+Q or ALT+F4).
- Select a cell, by a single click on the cell in the tree view to the right.
- Possibility to edit the style template to change the appearance of different cell types.
- Move cursor, by CTRL + UP ARROW or CTRL + DOWN ARROW.
- Close current document (CTRL+W).
- Select and copy text inside a cell.

6 Modelica Algorithmic Subset Debugger

This section presents a comprehensive Modelica debugger [7] for an extended algorithmic subset of the Modelica language. This replaces debugging of algorithmic code using primitive means such as print statements or asserts which is complex, time-consuming and error- prone.
The debugger is portable since it is based on transparent source code instrumentation techniques that are independent of the implementation platform.
The usual debugging functionality found in debuggers for procedural or traditional object-oriented languages is supported, such as setting and removing breakpoints, single-stepping, inspecting variables, back-trace of stack contents, tracing, etc.
In this section we present parts of the debugger functionality by showing a debugging session on a short Modelica example. The functionality of the debugger is shown using pictures from the Emacs debugging mode for Modelica (`modelicadebug-mode`).

6.1 The Debugger Commands

The Emacs Modelica debug mode is implemented as a specialization of the Grand Unified Debugger (GUD) interface (`gud-mode`) from Emacs. Because the Modelica debug mode is based on the GUD interface, some of the commands have the same familiar key bindings.
The actual commands sent to the debugger are also presented together with GUD commands preceded by the Modelica debugger prompt: `mdb@>`.

If the debugger commands have several alternatives these are presented using the notation:

```
alternative1|alternative2|....
```

The optional command components are presented using notation: `[ optional]`.
In the Emacs interface: `M-x` stands for holding down the `Meta` key (mapped to `Alt` in general) and pressing the key after the dash, here `x`, C-x stands for holding down the `Control` (`Ctrl`) key and pressing `x`, `<RET>` is equivalent to pressing the `Enter` key, and `<SPC>` to pressing the `Space` key.

6.2 Starting the Modelica Debugging Subprocess

The command for starting the Modelica debugger under Emacs is the following:

```
M-x modelicadebug <RET> executable <RET>
```

6.3 Setting / Deleting Breakpoints

A part of a session using this type of commands is shown in Figure 8 below. The presentation of the commands follows.

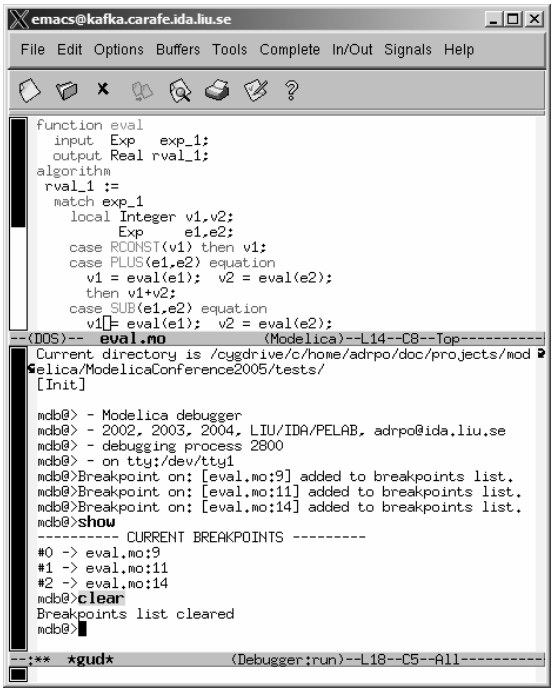


Figure 8: Using breakpoints

To set a breakpoint on the line the cursor (point) is at:

```
C-x <SPC>
mdb@> break on file:lineno|string <RET>
```

To delete a breakpoint placed on the current source code line (`gud-remove`):

```
C-c C-d
C-x C-a C-d
mdb@> break off file:lineno|string <RET>
```

Instead of writing break one can use alternatives

```
br|break|breakpoint.
```

Alternatively one can delete all breakpoints using:

```
mdb@> cl|clear <RET>
```

Showing all breakpoints:

```
mdb@> sh|show <RET>
```

6.4 Stepping and Running

To perform one step (gud-step) in the Modelica code:

```
C-c C-s
C-x C-a C-s
mdb@> st|step <RET>
```

To continue after a step or a breakpoint (gud-cont) in the Modelica code:

```
C-c C-r
C-x C-a C-r
mdb@> ru|run <RET>
```

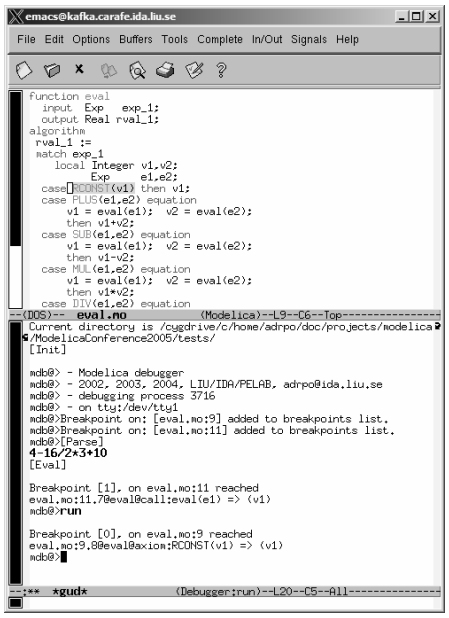


Figure 9:Using command run.

Examples of using these commands are presented in Figure 9.

This is only a brief presentation of a subset of the debugger functionality. See the OpenModelica Users Guide for a more complete description.

7 Modelica Development Tooling (MDT) Eclipse Plug-In

The Modelica Development Tooling (MDT) Eclipse Plug-In [13] integrates the OpenModelica compiler with Eclipse. MDT, together with the OpenModelica compiler, provides an environment for working with Modelica development projects.

The following features are available:

- Browsing support for Modelica projects, packages, and classes
- Wizards for creating Modelica projects, packages, and classes
- Syntax color highlighting
- Syntax checking
- Browsing of the Modelica Standard Library

7.1 Installation

The installation of MDT is accomplished by following the below installation instructions. These instructions assume that you have successfully downloaded and installed Eclipse (HTTP://WWW.ECLIPSE.ORG):

1. Start Eclipse
2. `Select Help->Software Updates->Find and Install...` from the menu
3. Select 'Search for new features to install' and click 'Next'
4. Select 'New Remote Site...'
5. Enter 'MDT' as name and 'HTTP://WWW.IDA.LIU.SE/LABS/PELAB/MODELICA/OPENMODELICA/MDT' as URL and click 'OK'
6. Make sure 'MDT' is selected and click 'Finish'
7. In the updates dialog select the 'MDT' feature and click 'Next'
8. Read through the license agreement, select 'I accept...' and click 'Next'
9. Click 'Finish' to install MDT

7.2 Configuring the OpenModelica Compiler

MDT needs to be able to locate the binary of the compiler. It uses the environment variable OPENMODELICAHOME to do so.

If you have problems using MDT, make sure that OPENMODELICAHOME is pointing to the folder where the Open Modelica Compiler is installed. In other words, OPENMODELICAHOME must point to the folder that contains the Open Modelica Compiler binary. On the Windows platform it is called `omc.exe` and on Unix platforms it is called `omc`.

7.3 Using the Modelica Perspective

The most convenient way to work with Modelica projects is to use to the Modelica perspective. To switch to the Modelica perspective, choose the `Window` menu item, pick `Open Perspective` followed by `Other..` Select the `Modelica` option from the dialog presented and click `OK`.

7.4 Creating a Project

To start a new project, use the `New Modelica Project Wizard`. It is accessible through `File->New-> Modelica Project` or by right-clicking in the Modelica Projects view and selecting `New->Modelica Project`.

7.5 Creating a Package

To create a new package inside a Modelica project, select `File->New->Modelica Package`. Enter the desired name of the package and a description of what it contains.

Figure 10: Creating a new package.

7.6 Creating a Class

To create a new Modelica class, select where in the hierarchy that you want to add your new class and select `File->New->Modelica Class`. When creating a Modelica class you can add different restrictions on what the class can contain. These can for example be `model`, `connector`, `block`, `record`, or `function`.

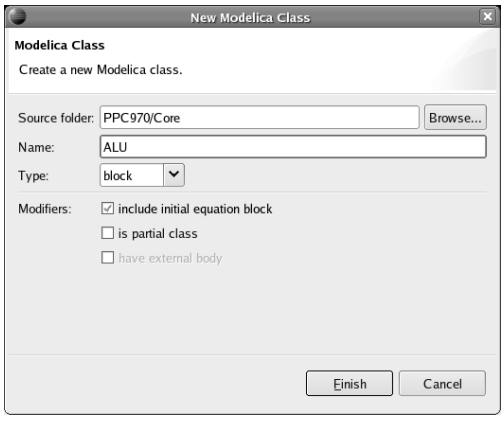


Figure 11: Creating a new class.

When you have selected your desired class type, you can select modifiers that add code blocks to the generated code. '`Include initial code block`' will for example add the line '`initial equation`' to the class defined before.

7.7 Syntax Checking

Whenever a Modelica (`.mo`) file is saved by the Modelica Editor, it is checked for syntactical errors. Any errors that are found are added to the Problems view and also marked in the source code editor.

Errors are marked in the editor as a red circle with a white cross, a squiggly red line under the problematic construct, and as a red marker in the right-hand side of the editor.

If you want to reach the problem, you can either click the item in the Problems view or select

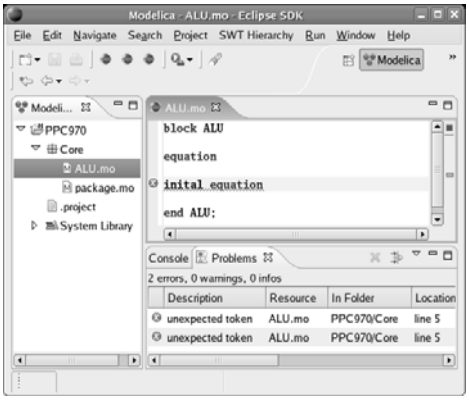


Figure 12. Syntax checking.

8 Conclusion

We have presented some aspects of the OpenModelica environment, including facilities for modeling, simulation, and debugging Modelica code. A number of objectives of the OpenModelica environment were given and some example illustrated.

It has been shown that the OpenModelica environment includes many valuable features for engineers and researchers, and it is the only Modelica environment so far with good support for debugging Modelica algorithmic code as well as support for meta-programming integrated in the lan-guage.

We believe that this open source platform can be part of forming the foundation of the next generation of the Modelica language and environment development efforts, both from a research perspective and a system engineering usage point of view.

9 Acknowledgements

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Spatial Modelling Approaches in DEVS Simulation Systems for Pedestrian Dynamics

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Modelling and simulation of pedestrian dynamics can be performed at different levels: microscopic, mesoscopic and macroscopic. For microscopic and mesoscopic simulation, it is absolutely necessary to model also the spatial behaviour. Discrete Event Simulation (DEVS) is a widely used approach for modelling and simulation of dynamic discrete systems. Classical straightforward modelling approaches, based on abstract classical queuing systems, do not take into account the spatial distributions primarily. But modern object-oriented DEVS tools allow modelling of a spatial distribution primarily by means of topological attributes as well in active and passive objects. This contribution discusses the 'spatial' features of DEVS simulation systems. The chosen simulation tool, Enterprise Dynamics, offers a high flexibility due to its programming language that allows adding further spatial functionality to the provided elements.

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1 Pedestrian Dynamics Modelling

Since the nineties there has been a growing interest in understanding and modelling pedestrian behaviour, especially in case of emergency situations. In many large-scale simulations pedestrians are an integral part of the transportation and traffic system. On microscopic and mesoscopic level, these simulations are mainly based on a process flow approaches based on discrete event simulation, and specialized for transportation and traffic systems at modelling level. On macroscopic level these models reflect the ideas of (discrete) fluid dynamics ([1]).

Midst of the nineties other modelling approaches for traffic systems became popular, one of them cellular automata models (Nagel and Schreckenberg, [2], 1992). Another approach is microsimulation. Blue and Adler ([3], 1998) have applied microsimulation, mainly based on agent-based approaches, to model pedestrian flows and demonstrated that these models produce acceptable fundamental results. Basic information is provided in a survey by Axelrood ([4], 1997).
In connection to fluid dynamics, Helbing, Monar, and Schweitzer ([5], 1994) proposed research on the microsimulation of pedestrian crowds. This 'social force model' of pedestrian dynamics describes the influence of environment and other pedestrians on individual behaviour. However, the social force is not exerted on pedestrian, but rather describes the concrete motivation to act, fluctuating in different situations. The social forces are different from forces in physics that the effect of social forces come about not by momentum transfer but information exchange via complex mental, psychological and physical processes.

2. Modelling Approaches

Approaches to pedestrian dynamics simulation may be classified with respect to level of granularity, and with respect to modelling approaches. Three levels can be identified, from individual-based modelling up to highly aggregated average states.
Microscopic level. In microscopic simulations, each pedestrian ('particle') represented individually. The interaction between pedestrians is given by local rules for temporal and spatial behaviour.
Macroscopic level. In macroscopic or field-based simulations, particles (pedestrians) are aggregated into fields. The corresponding mathematical models are partial differential equations (very similar to fluid equations), which need to be discretised for computer implementations. The interaction rules are global laws, similar to conservation laws in physics.

Mesoscopic level. It is possible to combine microscopic and field-based methods, which is sometimes called smooth particle hydrodynamics (SHP).
In SPH, the individuality of each particle is maintained. During each time step, particles are aggregated to field quantities such as density, then velocities are computed from these densities, and then each individual particle is moved according to these macroscopic velocities. Interaction rules are as well global as well as local.

The following modelling approaches are found in literature and application.

Equation-based continuous model approach (EQU). Equations similar to fluid dynamics equations represent aggregated states like pedestrian density, average velocity, etc. Update of time is naturally given by the differential calculus. In case of PDEs, also the spatial pattern is taken into account. This approach may be used at macroscopic and mesoscopic level.

Cellular automaton modelling approach (CA).
Two-dimensional cell arrays define a static spatial pattern, where the states in the cells represent pedestrians staying in the cell, entering the cell, leaving the cell, etc. Usually a fixed-step time update is performed, based on local interaction rules: the states in each cell are updated in fixed order, taking into account the states of neighbouring cells. This approach may be used at macroscopic level.

Agent-based modelling approach (AB).
CA modelling may be seen as simplification of AB modelling. While cells are fixed in space and updated in fixed temporal and spatial order, agents can move in space, can communicate and interact locally with neighbours or globally, etc. Time update depends on the implementation: object-oriented approaches support this approach, as objects (agents) communicate by means of messages. This approach may be used at microscopic and mesoscopic level.

Discrete Event System modelling approach (DEVS).
Entities (pedestrians or groups of pedestrian) are flowing through processes (queues and service stations). Depending on their attributes, the states of the processes are changed based on events created by the entities. Time update is automatically given by the time events created by the entities. Spatial patterns are not directly supported. This approach may be used at microscopic and mesoscopic level.

3 DEVS Modelling for Pedestrian Dynamics

The important items of the modelling approaches are space pattern, time update, and update order.
DEVS modelling is based on time event update with event lists and priority lists for changes within the change of states. But spatial patterns are not supported directly.

Modern DEVS simulation systems make use of the object-oriented paradigm, which allows adding spatial patterns, which can be created, changed and destroyed dynamically. These active objects can also deal with spatial coordinates, etc.
In principle, at the object-oriented level AB modelling and DEVS modelling become similar more and more. Consequently it is worth to investigate the features of DEVS simulation systems for modelling and simulating pedestrian dynamics.

3.1 The Scenario

The following investigations regard a classical scenario: an area of defined size with a certain number of exit doors that represents a train platform, incoming doors that represent doors of an incoming train, where people enter the area and head towards the exit (Figure 1).

Figure 1: Scenario - train platform with exits and obstacles

The main focus is on the movement of people through this area. Obstacles in the area may constrain this movement and may change the movement (more details see [6]).

3.2 DEVS Modelling – Classic Elements (DEVS-CE).

The basic Elements of a DEVS are servers and queues. In this first approach of modelling the movement of people through a given area toward an exit a model consisting of servers and queues is build.
Classic DEVS as Enterprise Dynamics (used in these investigations) do offer only basic routines and functions to describe the movement of elements. For usually the way of such an element is given by its passing through other elements as servers and queues.

Enterprise Dynamics (ED) offers the `travelto` and the `moveto` function to let an element (atom) move from a starting position (x_0, y_0, z_0) to a desired destination (x_d, y_d, z_d).

When using a DEVS for this kind of simulation especially the possibility of collisions has to be taken into account. The basic idea is now, to cover the area of interest by a 'field' of servers (and queues), adding up to form the topology of the given area.

Spatial Patterns. The area is cut into single places. Each place has eight adjoining places ('cells'), building a structure similar to a honeycomb (Figure 2).

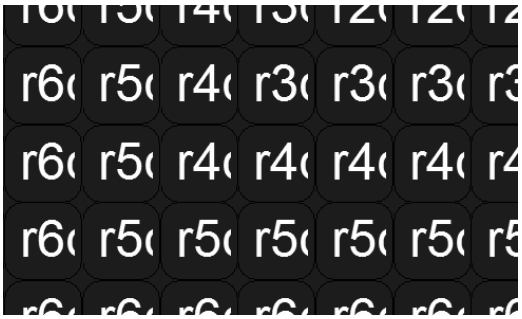

Figure 2: Places represented by servers forming a spatial pattern

The places are represented by servers, the cycle time of each server gives the time the person needs to pass through and depends on the persons individual attributes as well as the position of the cell in regard to the exits. People walking through this area pass through these places, choosing the next place to go to according to implemented rules.

In principle, this modelling approach for the spatial topology is similar to modelling approaches with cellular automata, whereby a server mirrors a cell. Here, the entities are active objects, changing the state of a server or cell, resp., on the basis of a time event mechanism. A classical state update of cellular automata works on an equally spaced time pattern.

Pedestrian Movement / Time Update.
In DEVS time does not pass continuously but in irregular time steps depending on the event list, containing all future events. So the movements of a person can be reduced to be a sequence of events. We can identify two different events: entering a place, and exiting a place.

Between entering and exiting will always pass a certain time, depending on the persons walking speed as each place does represent a certain walking distance, but exiting one place and entering another happens simultaneously. These two events will be consecutively repeated until the person has reached its destination.
Parts of the area where people are not supposed to walk due to obstacles like benches or other reasons (Figure 3) can be easily marked. It is only necessary to set the capacity of the corresponding places to zero to ensure they can not be entered.

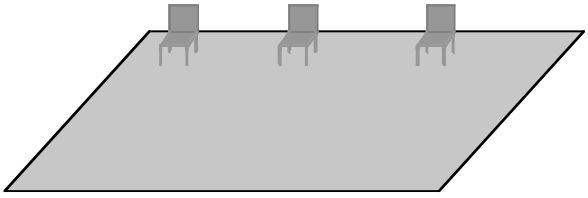

Figure 3: Area with benches, benches represented by servers with capacity zero

Modern simulation tools like Enterprise Dynamics allow generating this and other topologies automatically from databases.

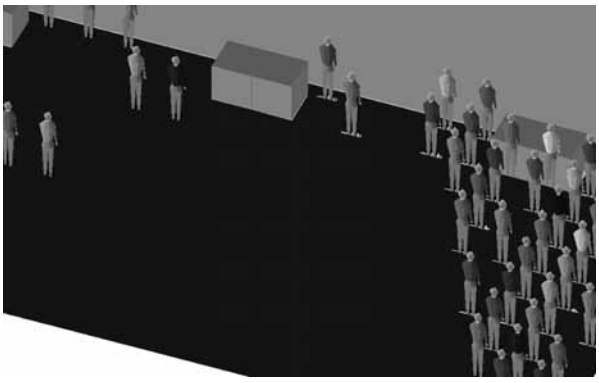

Figure 4: Pseudo-3D Visualisation of the topology shown in Figure 2 and 3.

Attributes of Peoples (Pedestrians).
Each person is modelled as a single element (entity) within the simulation, carrying its own attributes as size, speed, and the current spatial position.
They choose the exit they wish to use depending on the distance between their own position and the position of the exits. This decision is repeatedly done, so a change of direction might occur if the way to the chosen exit is blocked.

On this way, they are passing the (fixed) places, depending on their decisions and on the fact, which place is free. Here also elements from physical models can be used, e.g. changing speed with respect to the status in the next place, etc.

Collision Modelling.
As the capacity of each single place is set to 1 and each place represents exactly one position in space it is not possible for two elements to share the same position. If the next place a person would need to pass through to continue its way towards the exit is already occupied it will enter the next free place instead, rerouting itself. If none of the adjoining places is free the person is unable to move until one is vacated.

Drawbacks.
Using servers to represent each single position in the two dimensional space has one major drawback: to represent an area of even small size a huge amount of servers is needed. That slows down simulation time. In principle, the spatial distribution of a server equals the area a person needs to stand.

3.3 DEVS Modelling - Spatial Objects (DEVS-SO)

Enterprise Dynamics (as other modern object-oriented DEVS simulators) has its own programming language developed to offer a high flexibility in using and expanding its functionality. It is called 4d script in allusion to the fact that any element in Enterprise Dynamics has four dimensions: its coordinates in the three dimensional space and its velocity. This language allows creating and moving spatial objects, extending the capabilities of classical entities dramatically.

In principle, this feature is a first step towards agent-based approaches. The basic modelling idea is now, to model the pedestrian by such spatial objects, which are moving and allocating places.

Spatial Patterns in DEVS-SO.
The topology is similar to the one used in the first approach but instead of using servers to build up the walking area only the area itself is regarded now. It is once more cut into small places; once more each place has eight adjoining ones. But now the information whether these places are free or occupied is stored in a table where each cell corresponds to one of these places. Instead of setting capacities to zero to ensure a certain place may not be entered now it only needs to be marked as unavailable.

Movement / Time Update.
Movements of people are now reduced to only one reoccurring event: the next step. Time between these events once more depends on the walking speed.

The continuous movement of a walking person is now broken down in jerky leaps from one position to the next. The person no longer moves from one server into another. Instead it only changes its location, moving from its current position to the next. The decision in what direction the next step is going to be taken is now based on the calculation of a direction vector that is calculated each time another step is taken.

Additionally it has to be checked whether the destination is already occupied by another person. In the first approach this was not necessary due to the usage of the servers – their basic functionality already covered this problem.

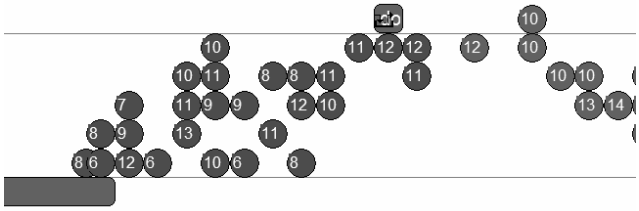

Figure 5: 2D Visualisation of Movement of Spatial Objects

Drawbacks.
In this approach, simulation time could be reduced significantly. The only major drawback is that modelling with spatial objects is a much more complex modelling technique and needs deep knowledge of the basic simulator language.

Conclusion

DEVS can be used for spatial pedestrian and evacuation dynamics, if the DEVS simulation tool offers features for spatial descriptions on the modelling level, and for complex attributes for the entities or active objects.

In general, two approaches are reasonable and successful. The DEVS-CE approach only uses classic features of a DEVS, trying to keep changes to them to a minimum. The result is a model where the movement restrictions are easily represented by the attributes of the servers, which cover the area under investigation.

The DEVS-SO approach presented reflects the ideas used in approaches based on cellular automata and agent based systems, but keeps all advantages of tested event mechanisms of DEVS systems, including collisions and individual velocities of entities.
It offers a higher flexibility in implementing rules for peoples' movements but requires a higher amount of programming work.

An enlarged version of this contribution can be found in [20].

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ECOLIB - A New Library of Models for Simulation and Control of Ecological Systems and Environment Protection

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In this paper is presented a new library of models for simulation and control of ecological systems and environment protection. The library includes mathematical-heuristic models of aquatic ecosystems, terrestrial ecosystems and atmosphere, describing hydrological processes, biochemical processes and and diffusion processes. The library includes complex models as for instance: the model of a river delta, soil system model, a forest ecosystem model, an agro-ecosystem model, model of some population dynamics models, models of diffusion of pollutants in urban atmosphere, and others. Simulation and control results are presented.

1. ECOLIB – An Overview

The purpose of the new library of models for simulation and control of ecological systems and environment protection is to assist the experts (biologists, ecologists, physicists, engineers and economists) to take scientific founded decision. In our opinion is necessary that the complex system of environment management be supplied with such a library, including models for aquatic, errestrial and atmospheric environment.
Aquatic environment module of the library includes models for simulation and control of lakes, rivers, water canals and river deltas, describing hydrological processes, bio-chemical processes, biodiversity, water pollution, i.e. dispersion of industrial chemical pollutants in rivers.

Terrestrial environment module of the library includes models for simulation and control of soilsystem, biochemical processes, biodiversity in agro ecosystems and forest ecosystems.

Atmospheric environment module of the library includes models for simulation and control of air pollution, i.e. models for simulation and control of diffusion process of industrial chemical pollutants in urban atmosphere as for instance: sulphur dioxide - SO_2 , nitrogen dioxide - NO_2, carbon monoxide - CO, particle (powders) of heavy metals, carbon, cement etc.

The control problem is to maintain the state variables $x_i(k)$, $i = 1, 2, ..., n$; $k = 0, 1, ..., k_f$ in the suboptimality intervals $[x_{i,min}, x_{i,max}]$. The control model is a fuzzy one. State variables $x_i(k)$ belong to one or another of the intervals given in Table 1.
In this table the following definitions for fuzzy relations hold: $dx_i(k) = x_i(k) - x_i(k\text{-}1)$; *VS* = Very Small, *S* = Small, *O* = (sub) Optimal, *L* = Large, *VL* = Very Large, *Z* = Zero, are qualitative values (in the sense of fuzzy set theory). The state variables x_i belong to qualitative set: $\chi = \{ VS , S , O , L , VL\}$, the derivatives dx_i belong to: $d\chi = \{-L, -S, Z, S, L\}$.

Interval x_i	$< x_{i,min} - \varepsilon$	$[x_{i,min} - \varepsilon, x_{i,min})$	$[x_{i,min}, x_{i,max}]$	$(x_{i,max}, x_{i,max} + \delta]$	$> x_{i,max} + \delta$
x_i	*VS*	*S*	0	*L*	*VL*
Interval dx_i	$< -\alpha$	$[-\alpha, 0)$	0	$(0, \beta]$	$> \beta$
dx_i	*- L*	*- S*	*Z*	*S*	*L*

Table 1: Qualitative values of state variables and its derivatives

The set of fuzzy knowledge-based rules, useful in control of the complex system result

$$< if\ (x_i(k) \text{ is } \chi_i)\ \&\ (dx_i(k) \text{ is } d_{\chi i})$$
$$\text{then new Control Law is}$$
$$u_i(k+1)= u_i(k) +K_{ui}\ \delta_{ui}(k) >,\quad i=1,2,...n$$

We emphasize that the increment $\delta u_i(k)$ can be computed by using fuzzy sets theory, while K_{ui} is given by expert and / or by simulation.

Starting from the general form of a fuzzy control rule and using both the Table 1 and K_{ui}, we can automatically generated the fuzzy control rules. We underline that for each state variable $x_i(k)$ there are 25 fuzzy control rules and per total $25n$ rules, $i=1,2,...,n$. The set of the 25 rules for fuzzy control of the state variable $x_i(k)$ is:

$$< if\ (x_i(k) \text{ is } VS)\ \&\ (dx_i(k) \text{ is } -L\ )$$
$$\text{then new Control Law is}$$
$$u_i(k+1)= u_i(k) +K_{11}\ \delta_{ui}(k) >$$

$$< if\ (x_i(k) \text{ is } VS)\ \&\ (dx_i(k) \text{ is } -S)$$
$$\text{then new Control Law is}$$
$$u_i(k+1)= u_i(k) +K_{12i}\ \delta_{ui}(k) >$$
$$.....$$

$$< if\ (x_i(k) \text{ is } VL)\ \&\ (dx_i(k) \text{ is } L)$$
$$\text{then new Control Law is}$$
$$u_i(k+1)= u_i(k) +K_{55}\ \delta_{ui}(k) >$$

Fuzzy control rules for $x_i(k)$ can be seen as generatorof all fuzzy control rules, for $i=1,2,...,n$. Simulation and control models can also evaluate the environment risk that some natural and /or anthropic calamities or disasters occurs.
The principle of risk evaluation is based on suboptimality intervals of state variables, given be experts (see Table 1). If a state variable is $x_i(t)$ and the suboptimality interval is $[x_{i,\,min}, x_{i,\,max}]$, the environment risk is risk $\rho_i\,(k)$.
By using Table 1 and the expert knowledge, the set of fuzzy knowledge-based rules, useful in environment risk evaluation of high complexity systems result in:

$$< if\ (x_i(k) \text{ is } \chi i)\ \&\ (dx_i(k) \text{ is } d\chi_i)$$
$$\text{then enviroment risk}$$
$$\text{is } \rho_i(k) >,\quad i = 1,2,...,\ n$$

There $\rho_i(k)$ belongs to qualitative set {*Z, ES, VVS, VS, S, MS, SM, M, L, VL, VVL, EL*}, where: *Z* = Zero; *ES* = Extremely Small, *VVS* = Very Very Small, *VS* = Very Small, *S* = Small, *MS* = Medium Small, *SM* = Small Medium, *M* = Medium, *L* = Large, *VL* = Very Large, *VVL* = Very Very Large, *EL* =Extremely Large. Per total there are 12 qualitative values to evaluate the risk that the state $x_i(k)$ surpass the upper limit $x_{i,max}(k)$ and the same for lower limit $x_{i,min}(k)$; if we add the value *Z* = Zero, we obtain a total of 25 qualitative values.

Starting from the general form of a fuzzy rule of environment risk evaluation given above we can automatically generate the fuzzy evaluation rules of environment risk.

We emphasize that for each state variable $x_i(k)$ there are 25 fuzzy evaluation rules and per total $25n$ rules ($i=1,2,...,n$). The set of the 25 rules for fuzzy evaluation of environment risk of the state variable $x_i(k)$ is:

$$< \text{if } (x_i(k) \text{ is } VL\ )\ \&\ (dx_i(k) \text{ is } L\ ),$$
$$\text{then the risk that}$$
$$x_i(k) > x_{i,max}(k) \text{ is: } \rho_i(k) = EL >$$

$$< \text{if } (x_i(k) \text{ is } VL\ )\ \&\ (dx_i(k) \text{ is } S\ ),$$
$$\text{then the risk that}$$
$$x_i(k) > x_{i,max}(k) \text{ is: } \rho_i(k) = VVL >$$

$$< \text{if } (x_i(k) \text{ is } VS\ )\ \&\ (dx_i(k) \text{ is } -L\ ),$$
$$\text{then the risk that}$$
$$x_i(k) > x_{i,max}(k) \text{ is: } \rho_i(k) = Z >$$

Fuzzy evaluation rules of environment risk $\rho_i(k)$, for $x_i(k)$ can be seen as generator of all fuzzy evaluation rules, for $i=1,2,...,n$.

The functions of the library for simulation and control of ecological systems and environment protection are:

- to supply models able to assist the users in simulation and control experiments regarding the environment systems: ecological systems, environment protection systems, sustainable development systems a. s.o,
- to help users to create new simulation and con trol models for ecology and environment protec tion,
- to assist environment systems managers to take the best, scientifically founded, decisions.

- Models' library includes models for hybrid simulation and control for aquatic and terrestrial systems, and atmosphere.

Among models of aquatic module of the library we can mention:
Hydro (simulation and control of hydrological processes, especially water circulation),
Delta (simulation and control of hydrological processes, biochemical processes and biodiversity of a river delta),
Pelican (numerical simulation and control of dynamics of pelican population from a river delta system),
Cormorant (simulation and control of dynamics of cormorant population from a river delta system),
Sea Side (simulation and control of complex hydro-bio-chemical processes in an ecological sea side system), and
Dispersion (simulation and control of industrial chemical pollutants dispersion in a river)

Terrestrial ecology modules of the library includes models as:
Soil (simulation and control of complex biophysical and biochemical processes from soil system and agro-ecosystems), and
Forest (simulation and control of complex bio-physical and biochemical processes and biodiversity of forest ecosystems).

From module of models of the library concerning air pollution we can quote:
Diffusion (simulation and control of industrial chemical pollutants diffusion, as: SO_2, NO_2, CO, toluene, ethyl acetate, heavy metals powders etc, in city atmosphere)..

The models operate independently or in connection with a MS Access database.

2. Simulation and Control Results

By using ECOLIB models' library simulation and control results have been obtained with real data biological, fizico-chemical, meteorological, hydrological climatic parameters, resulted from direct measurements and heuristic coefficients given by experts. Some illustrative examples are given below. The figures represent control and simulation results obtained by using models of library.

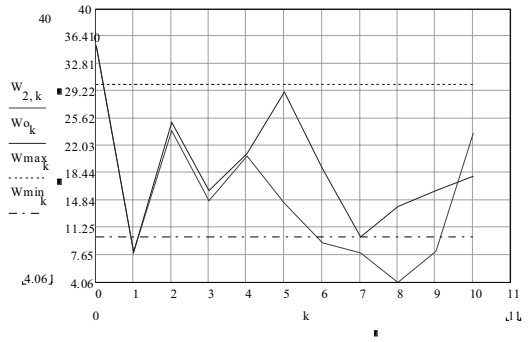

Figure 1:Module Hydro; water refreshing factor of a lake of the Danube Delta (uncontrolled regime - lower curve, controlled regime upper curve)

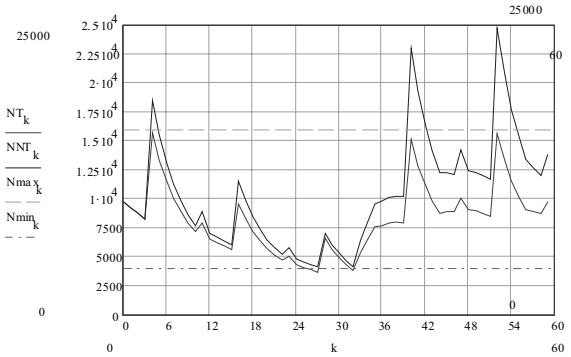

Figure 2: Module Cormorant; simulation and control results of population dynamics of Danube Delta, cormorant population

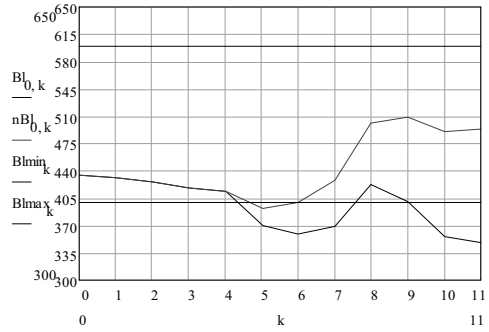

Figure 3: Module Forest; wooden biomass of a forest in the Carpathian Mountains (uncontrolled regime - lower curve, controlled regime - upper curve)

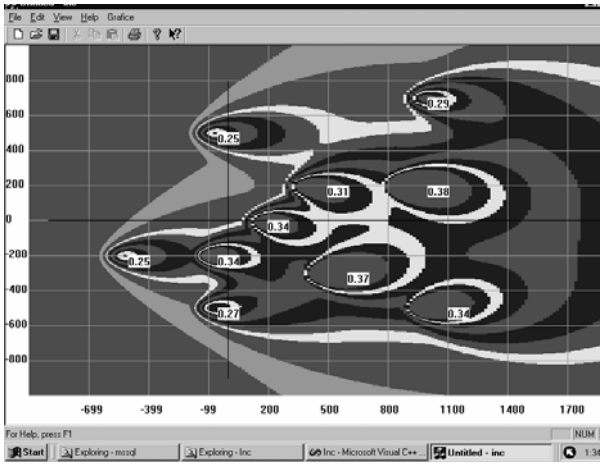

Figure 4: Module Dispersion; isoconcentration map of the SO_2 pollutants in Bucharest city

Application Area
Models' library was created to help specialists concerned with development of environment systems, management and Decision Support Systems with applications in ecology, environment protection and sustainable development of environment systems. The library addresses researchers, designers, analysts and programmers, those interested in informatics systems and /or applications, teachers, students, Master students, Ph.D.students interested in applied Informatics to environment, ecology, hydrology, forestry, agriculture and economy.

Technical Characteristics
Models library has been generated in two versions: a version by using Mathcad 2001 Professional and a version by using the programming language Visual C++ (in way of development).

Hardware Requirements
ECOLIB can be run on any Pentium II/300MHz or upgrade, 32 MB RAM, on Windows95 /Windows 98 or upgrade, with graphic resolution: 1024/768. Programming languages: Mathcad 2001 Professional, Visual C++, and (optionally) MS Access.

Delivered terms and associate support services
National Institute for Research and Development in Informatics (ICI) provides the software, the documentation and necessary technical assistance. The programs are delivered on diskettes or CD-ROMs and the documentation is available in hard copy or in electronic version.

User References
Models library has been tested, validated and implemented in: research projects for the Danube Delta - Institute for Research and Design "Danube Delta", ICPDD, Tulcea and some projects for air quality control in the Bucharest City - Research Center for Air Quality, LACECA, Bucharest and E-LECTROZIN-PROJECT, Bucharest.

Internet Address for detaild software information
HTTP://WWW.RNC.RO/INFOECO

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Small PC-Network Simulation – A Comprehensive Performance Case Study

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The simulation of distributed systems nowadays becomes more and more important. Forster, Gojmerac and Breitenecker [8] evaluated two chosen simulators for their usage of simulating small PC-networks.
In this contribution, the evaluation is extended to eight simulators or simulation languages, resp., whereby nine more or less different modelling approaches are used. First the simulators are briefly introduced, then the modelling procedures for the small pC network is described.
An evaluation section compares runtime, efficiency and learning and training time for all seven simulators, with partly astonishing results. More details and sources of this comparative evaluation can be found at the following site: HTTP://WWW.ECS.TUWIEN.AC.AT/~DA/SIMCOMP/

1 The Small PC-Network Problem

We consider two small networks of several workstations connected via a bottleneck link. Every workstation is considered a Poisson source (Figure 1 shows this scenario).

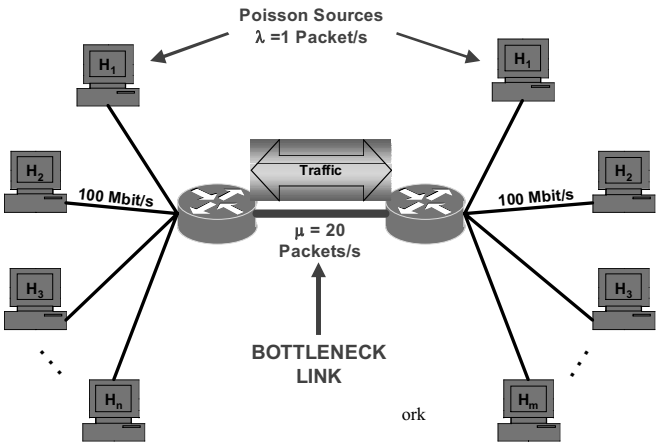

Figure 1: small PC - Network Scenario

Therefore it sends constant-size packets with exponentially distributed inter-departure times (λ= 1 packet per second) to the other network over the bottleneck link. The link has a bandwidth of 20 packets per second. This corresponds to a queuing system M/D/1-K where K is the queue size (not including the server).
Three sets of simulations were studied corresponding to three different numbers of workstations (18, 20, 22) participating in the network. For each set of simulations we varied the range of the queue size inside the routers from 1 to 200 packets in order to investigate the impact on the packet loss statistics.

2 The simulation tools

We chose the network simulation tools OMNet++ [5], QualNet [6] and ns-2 [4]. For comparison we also took a look at the industrial process simulator Enterprise Dynamics (ED) [2], the general purpose simulator AnyLogic [1], the discrete general purpose simulation software GPSS World [11], and a discrete event simulation extension for Python, SimPy [7].

All simulators are based on the discrete event simulation principle. While QualNet, ED and AnyLogic provide a graphical user-interface for the design and experimentation phase, OMNet++, ns-2, GPSS World and SimPy need textual model specification input. Besides, OMNet++, ns-2, ED, and AnyLogic provide a graphical user interface for visualizing the experimentation results.

While ns-2, SimPy and OMNet++ are free for academic use one has to obtain licenses for the other simulators.

2.1 OMNet++ V3.1
OMNet++ is a component-based, modular and open-architecture simulation environment originally developed at the Technical University of Budapest. It includes a GUI for the interactive controlling of simulation runs (experiments). Since it provides low-level access to all parts of the simulator, it can be easily customized using C++ modules. There exists a comprehensive INET framework covering the common TCP/IP protocol as well as Ethernet.

Last but not least it also supports wireless and mobility-based network simulations. Since the whole simulator is based on C++ and every simulation is compiled into a host-based executable it is not portable but quite fast. It supports the Windows Visual C++ and the common Unix gcc compilers.

2.2 QualNet V3.8
QualNet is a comprehensive set of tools with all the components for custom network modelling and simulation projects. It is a commercial offspring of GloMoSim [3] which was developed at the University of California, Los Angeles (UCLA). It uses the Parallel Simulation Environment for Complex Systems (PARSEC) as underlying tool.
Its GUI is based on Java and therefore portable, while the simulator itself is compiled as a host-based executable, which guarantees a portable user interface with good simulation speeds. Since it targets real-world simulations all modules have a set of parameters which need to be adjusted and cannot be avoided. Thus, the simulator is not the best for theoretical simulations.

2.3 The Network Simulator – ns-2 V2.28
The network simulator ns-2 is another discrete event simulator targeting at networking research. Like OMNet++ it has no graphical design option but a GUI for visualizing simulations runs. It is based on the scripting language OTcl which is an objective extension of Tcl. All modules can either be written in OTcl or in C++. Besides ns-2 already includes a large library of common modules, which are usually sufficient for simulating common networks. The simulator is written in C++ and can be used on systems with the GNU C-compiler gcc. Thus ns-2 is running on various Unix derivatives as well as in CygWin under Windows. The simulator is free for research and educational usage.

2.4 Enterprise Dynamics V6.1 Build 497
Enterprise Dynamics is not a native network simulator but is rather designed for simulating industrial processes. However the parts used in industrial processes are quite similar to the ones needed for network simulation and so Enterprise Dynamics was suitable for our considered problem as well. The so-called logistics suite contains components, which can be used for modelling also communication networks.

Enterprise Dynamics includes interfaces for the whole simulation loop inside a single GUI and achieves flexibility by providing its own scripting language 4DScript which originally was derived from Pascal. It is, however, restricted to Windows only.

2.5 AnyLogic V5.3.1
AnyLogic is the only tool of this survey, which is not limited to discrete event simulation. It provides continuous and hybrid simulation techniques as well. However for this survey only the discrete simulation parts of AnyLogic were used.

AnyLogic is another commercial product, which provides a sophisticated GUI for modelling as well as experimenting. It is based on Java and therefore all modules allow additional user-defined Java code for advanced usage. Even AnyLogic is based on Java it is only available for Windows.

2.6 SimPy V1.6
SimPy is neither a network simulator itself nor does it have primitives for simulating network components. It is just a process-based discrete event simulation extension for Python. However our considered problem still has a very easy solution using SimPy and, therefore, we considered this simulator as well.

2.7 GPSS World
GPSS World is a 'high powered general purpose computer simulation environment, designed for recurring use by simulation professionals. It is a comprehensive modelling tool covering mainly discrete computer simulation. It is designed to deliver answers quickly, without requiring unnecessary preparation of elaborate visualizations. Users can expect emphasis on debugging and data analysis in an easily remembered user interface' - the advertisement say. In principle, it is the 'old' GPSS in an modern simulation environment. GPSS was the first simulation language using some kind of object-oriented structures.

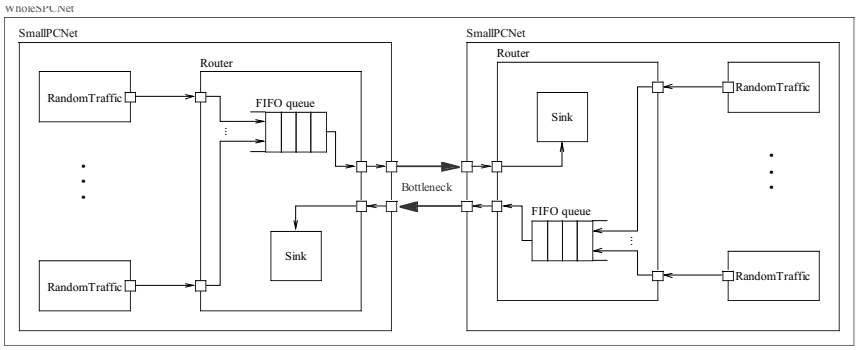

Fig. 2: Model implementation in OMNET++

Also new GPSS is object oriented. Its inhabitants include Model Objects which are used to create Simulation Objects. Simulation Objects, in turn, are used to play out simulations and create Report Objects.

Finally, Text Objects can be used as Include-files to support code sharing and a user source code library and they are often used as files which can be read from or written to by the simulation. GPSS World is based on the GPSS, which has been designed already in the sixties!. It comes with a Windows environment for all kind of modelling and evaluation purposes.

3 Random Number Generation

The key for good stochastic experimental results is the random number generator. Therefore it is important for larger simulations to be based on good random number generators. Thus we also looked into the implementations of the random number generators of all the simulation tools above.

OMNet++ and SimPy are using the Mersenne Twister algorithm [10] which provides a period of 2^{19937}-1. ns-2 is currently using a combined multiple recursive generator proposed by L'Ecuyer [9]. AnyLogic uses the Java internal `java.Random` class for random number generation, and this class currently uses a simple linear congruential generator with a 48-bit seed value. Such a generator is also used by the simulation language PARSEC which QualNet is based on.

ED is using an own implementation of a classical multiplicative-congruential with three independent seed values. The GPSS World Pseudo-random number generation algorithm is based on Lehmer's multiplicative-congruential algorithm, with a maximal period of 2^{31}-1.

4 Implementation

Since every simulator requires a custom problem specification, we will shortly describe the specific implementations below.

4.1 OMNet++

We created three simple C++ modules for simulating the Poisson source, the router queue and a sink consuming the packets. These three modules were combined into two instances of a small PC network, which were connected by a bottleneck link. Figure 2 shows the relation between the modules and their connections. Inside the FIFO queue we counted the packets which arrived and which were lost due to queue overflow. With these values the packet loss ratio of the network was calculated.

4.2 QualNet

For simplicity we only simulated the workstations of one small PC network with several hosts and traffic generators. For the other side of the bottleneck link we just implemented one consuming node. So the complexity of the simulation was cut by half.

Every workstation was implemented as a separate host which includes one traffic generator producing network traffic to the consuming node (on the other side of the bottleneck link). Since QualNet targets real-world simulations we were forced to assign concrete values to every module and link. Therefore we used 100 Mbit/s links between the hosts and the router. The bottleneck link was specified with a bandwidth of 80040 bit/s. The additional 40 bit/s were needed for the 2 bit link level header simulated by QualNet since it does not allow the link level header to be zero. So the bottleneck was able to exactly transmit 20 packets per second.

The traffic generators at the hosts generate packets with 472 Bytes of data plus 28 Bytes for the IP-and UDP-headers. So the resulting packets were 500 Bytes big. The router queue was set to a multiple of 500 Bytes to be able to hold exactly the desired amount of packets.

4.3 The Network Simulator ns-2

The implementation inside ns-2 was very close to the one shown in [8]. It should be only mentioned that the queue sizes of the nodes were set to $K+1$, since ns-2 always considers the packet in processing also to the queue limit, i.e. a queue-limit of 5 in ns-2 corresponds to a queue-size of 4 elements.

```
#Create links between the nodes
#Capacity of 80 kbit/s and packet
#size of 00 bytes correspond to a
#link capacity of 20 packets/s
$ns duplex-link $n0 $n1 80kb 100ms Drot
$ns queue-limit $n0 $n1 5
$ns queue-limit $n1 $n0 5

#Initialize queue monitors ……..
#Create Null agents and attach to routers
set null0 [ new Agent/Null]
$ns attach-agent $n1 $null0 ……..

#Create users attached to the first node
for { set m 1} { $m < 21} { incr m} {
      set udp($m) [ new Agent/UDP]
      $ns attach-agent $n0 $udp($m)
      set onoff($m) [ new Traffic/Expoo]
      $onoff($m) set packetSize_ 500
      $onoff($m) set idle_time_ 1
      $onoff($m) set burst_time_ 0
      $onoff($m) set rate_ 500000000
      $ns at 1 "$onoff($m) start"
      $ns connect $udp($m) $null0
      ……..
```

Table 1: Model Implementation in ns-2 (part)

4.4 Enterprise Dynamics

Since ED is an industrial process simulator the base objects were products instead of packets. The so-called logistics suite offers classical components with stations like queues and work stations, which handle entities. Hence we have entity sources simulating the workstations which send the products into a queue by exponential inter-departure times.

The problem is to map the situation of a PC network onto an appropriate logistic model. Here two approaches have been used.

For people coming from communication engineering, it is obvious to use a logistics network consisting of parallel sources, which compete in front of a multiplexer unit, which itself then routes entities (packages) to a router queue; the sending via the bottleneck may be implemented by a simple delay component (Figure 3 – slow ED model, ED(1)).

To simulate the dropped packets we just created a product queue of size 1 which has two possible exits. The first exit leads to our router queue. This is prioritized and always used, if our router queue is not already full. The second exit leads to our dropped packets sink. Behind the router queue we have a server which processes 20 products per second. This server then sends the products to another sink. The number of products arriving at the two sinks were used for calculating the packet loss.

This model approach is similar to that used in AnyLogic, see Figure 4. In ED, it turns out that this approach is inappropriate, because it results in very long execution times. The reason is the use of a multiplexer in front a queue, which hampers the event-managing of ED's queue components essentially.

The better alternative is to use a relatively simple component of ED, the multiple server with a queue in front, which serves all inputs. This component has a much better performance, and does reports about bulked packets internally (implementation ED(2)).

4.5 AnyLogic

We re-implemented the model of [8] but omitted the HostToRouterLink, since it only delays the messages by this delay and therefore has no impact on the results. However simulation speed was increased by this measure. AnyLogic offers a standard library (used here), but also special libraries for logistics, pedestrian dynamics, etc.

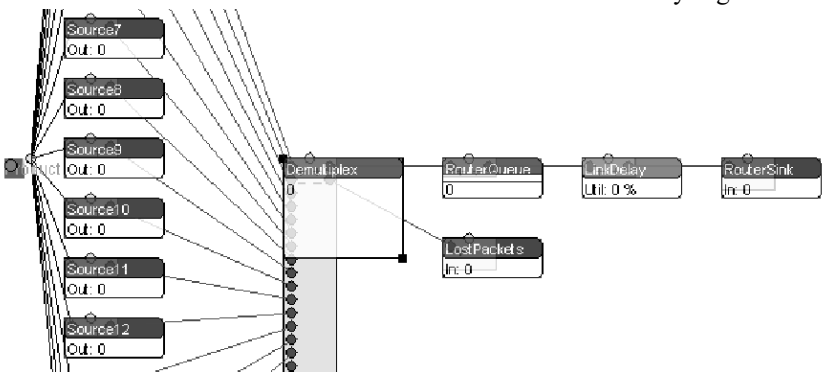

Figure 3 : Model implementation in ED (similar to AnyLogic) – inefficient implementation ED(1)

4.6 SimPy

Since SimPy is a process-based simulator, we created two different processes. The first process Host just creates messages with exponential inter-departure times. At these times the process just calls a procedure of our second process Router to transmit the message to this process. Inside the Router process a queue with the specified size is maintained, where the process removes the first entry with a rate of 20 packets per second. The Router keeps track of received and dropped pakkets and therefore can supply the packet loss ratio at the end of the simulation.

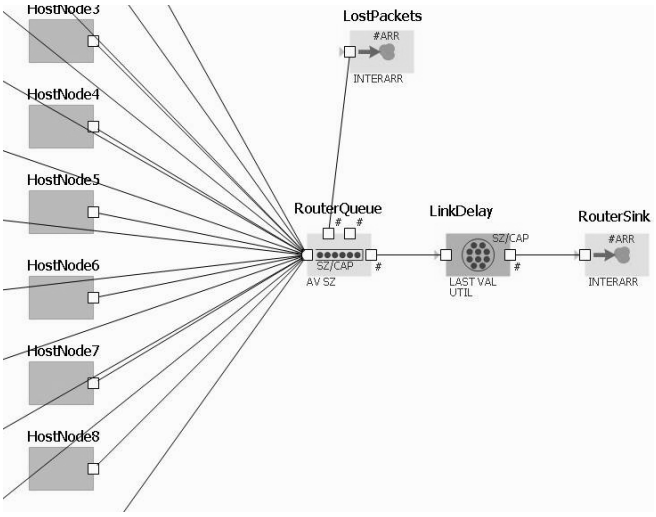

Figure 4: Model implementation in AnyLogic

4.7 MicroGPSS

A GPSS World Model is a sequence of *Model Statements*. A Model Statement may be a Command or a Block Statement. Block Statements can create Transactions. In this case the packets are created by 18 up to 22 GENERATE Blocks. The router of the system is modelled by the STORAGE (multiple server) Command. TEST and QUEUE Blocks are used to implement the queue size and to calculate the packet loss. An ADVANCE Block delays the progress of the packet transaction to real-ize the router speed.

5 Results

Due to the different simulation speeds, we did not simulate the same number of seconds on every simulator. However the simulation results for the packet loss were very close together for all simulators.

Figure 5 shows the packet loss results for three different simulation sets. All simulation results seem to be equal, only the simulations with less simulated time (as can seen inside the brackets after the simulator name) seem to have a larger variance.

In general, it is reassuring, that all simulators give the almost same correct results (compared with results from analytic analysis with queue theory). Clearly, with a queue size of 20 a service of 20 stations should be possible, with minimal loss.

6 Performance Evaluation

The performance results were all evaluated on the same PC (a Pentium4 2.4GHz without hyper-threading with 1GB RAM). The results shown in Table 2 were evaluated with 22 hosts and a queue size of 200 packets. All tests except for AnyLogic, Enterprise Dynamics and GPSS World were executed using Fedora Core 3 with Linux 2.6.12-1. AnyLogic, Enterprise Dynamics and GPSS World were evaluated on a Windows XP Professional SP 2.

Since the two-sided models generate approx. twice as many events, the runtime of a one-sided model is considered to be half of the measurements of a two-sided model.

In Table 3 we can see the relative performance of the simulators. OMNet++ is by far the fastest simulator for our problem. The performance of SimPy is quite low since it is only a scripting language, which is interpreted during the execution but its performance is close to the Java-based AnyLogic.

Simulator	Simulated seconds	Sim. sides	Runtime
OMNet++	1000000	2	4min
ns-2	1000000	2	6min 44s
QualNet	1000000	1	6min 41s
MicroGPSS	1000000	1	4min 05s
ED(2)	100000	1	1min 38s
AnyLogic	100000	1	3min 29s
SimPy	100000	1	4min 30s
ED(1)	10000	1	2min 11s

Table 2: Performance of simulators

The results for Enterprise Dynamics show, how important an appropriate choice of model components is: while the ‘communication’ – like implementation is very slow, the implementation with a predefined multiple server is reasonable for an object-oriented tool. It is also interesting, that the ‘old’ simulator GPSS has the best results for a classical DEVS system!

Simulator	Simulated sec per real -time sec
OMNet++	8328.8
ns-2	4949.0
MicroGPSS	4081.6
QualNet	2493.8
ED(1)	1020.4.
AnyLogic	477.74
SimPy	370.73
ED(2)	76.34

Table 3: Performance of simulators

We took a closer look to the parameter-dependent runtime of the simulators. The runtime complexity of the modelling system depends much on the specific queue implementation. So OMNet++ has a pure $O(1)$-implementation while Enterprise Dynamics can have $O(1)$ or a $O(K)$ one.

Experiments analysed now these dependency, given in Figure 6. The Figure shows the dependency of runtime from the queue size. The performance factor drawn on the *y*-axis is the runtime at the specific queue-size divided by the runtime for 22 hosts and a queue size of 200 (like already shown in Table 2). So e.g. a performance factor of 0.5 indicated half the runtime of the one in Table 2.

Since concrete values fluctuated quite much we used Bezier curve approximation for better overview. However simulators like Enterprise Dynamics or SimPy seemed to have a rather stable runtime performance, while OMNet++ and ns-2 had big fluctuations between runs. SimPy is the only simulator which is slower for small queue sizes. Enterprise Dynamics seems to have a direct linear relationship between queue size and runtime, in case of the inefficient implementation ED(1), while the efficient implementation has an almost stable efficiency of 1. While OMNet++ had the biggest fluctuations in runtime it seems also to be nearly constant on average under variations of the queue size. AnyLogic and ns-2 had just slight increased runtime. Very interesting were the very stable results for the 'old' simulator GPSS World, which had the most stable results for the efficiency measure (between 0.98 and 1.02 !). Due to license problems these investigations could not be performed with QualNet.

7 Modeling Time and Vocational Adjustment

Based on our experiences during this survey, we estimated the times for vocational adjustment to the simulators and creating the concrete model. Table 4 shows this approximated times. The time for creating the automated queue size variation experiment was also included into the modelling time. Basic knowledge of Python, C++, Java and Tcl is assumed.

Simulator	vocational adjustment	modelling time
OMNet++	2 weeks	10 hours
ns-2	3 weeks	4 hours
QualNet	1 week	4 hours
GPSS World	4 days	3 hours
AnyLogic	2 days	3 hours
SimPy	1 day	3 hours
ED	1 day	2 hours

Table4: Vocational adjustment and modelling time

18, 20 and 22 hosts (90%, 100% and 110% link utilization)

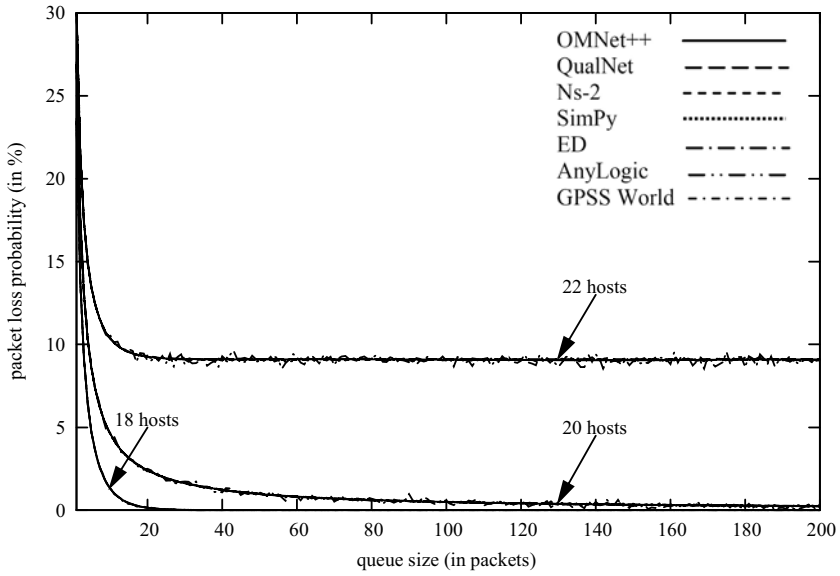

Figure 5: Simulation result – packet loss probability for versus number of queue size

8 Conclusion

Every simulator has its advantages and disadvantages. It depends on the requirements of the simulation problem and on the amount of simulation runs or time needed to be able to interpret the results.

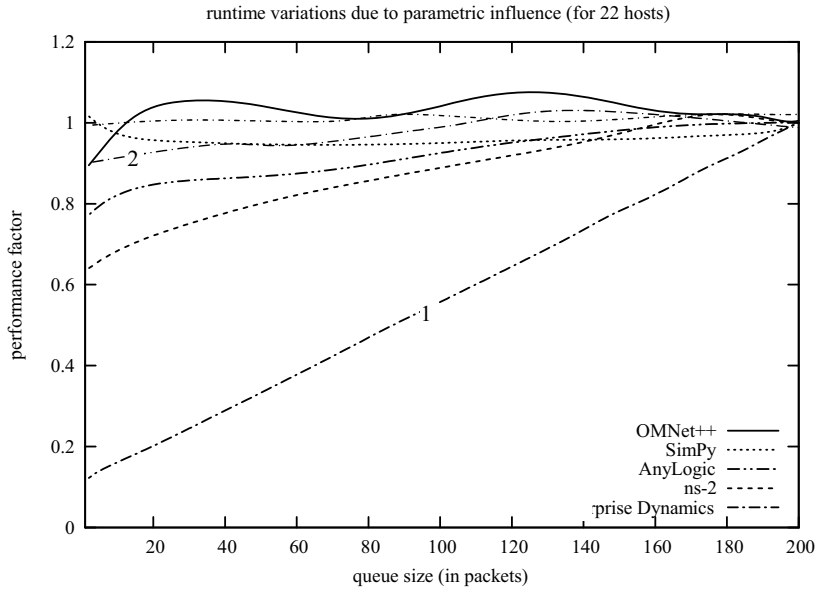

Figure 6: Dependency of runtime from queue size, measured by performance factor (runtime at specific queue-size divided by the runtime for 22 hosts and a queue size of 200)

Without much knowledge of programming languages QualNet and ED are leading to fast solutions. However the automated evaluation of various queue sizes needed some adaptation and deeper insights of the simulator in both cases. Still if you have only a small model and are fine with Windows, Enterprise Dynamics resp. AnyLogic would be the easiest system if you do not need a large amount of simulation runs or time. Since QualNet targets practitioners it is not the best simulator for theoretical problems, but could be a great asset if you are planning to simulate a real-world network.

If you are already familiar with Python, SimPy can provide a fast approach for small simulation problems. All advantages of Python can be used and the simulation can easily be integrated into a larger simulation system. Still, if simulation speed is one major goal you have to consider using OMNet++ or ns-2. Both simulators provide the possibility to write custom modules in C++. While OMNet++ is very open and non-restrictive, ns-2 has some restrictions and a fixed system layout you have to cope with. However ns-2 also supports the implementation of modules in the scripting language OTcl and therefore can be used for quick prototyping, while OMNet++ always needs to recompile if the internals of a simple module change.

Even if these two simulators provide the best performance, their vocational adjustment is by far the highest of all compared simulators. You need to understand the internal structure to be able to successfully create simulations.

Last, but not least a comment on GPSS World. Very often GPSS has been said to be dead. But it turn s out, that it is up to now the fastest DEVS simulator, which can be also used for runtime-consuming studies.

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A Mathematical Model for Controlling Infection of Prawn

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Several diseases are major problems affecting profduction of freshwater prawns. Over harvested prawn population fail to recover even after considerable veterinary treatments. The reasons are unclear but may involve genetic changes in life history traits that are detrimental to population growth when natural environmental factors prevail. This characteristic is probably due to the comparatively lower amounts of total biomass in production ponds relative to marine shrimp enterprizes. However, as stokking rate and biomass per unit area increase, the potential for disease related mortality correspondingly increases.

Viral diseases in prawns, such as gill associated virus (*GAV*) and yellow head virus (*YHV*) have caused huge in losses to this fast expanding industry and devastated prawn farming operations. *GAV* is now known to be present at low levels in healthy prawns without ill effect, but when the prawn is stressed by poor water conditions, overcrowding or other diseases, the virus multiplies and the infection becomes lethal. The virus is not at all harmful to humans though it affects farm production. Many research teams concluded that *GAV* and *YHV* are closely related, but come from two different viral populations. Since *GAV* is present in almost all farmed black tiger prawns and there is no easy way to eradicate it, researchers believe that the answer lies in managing conditions on the farm to avoid stressing the stock and breeding prawns that are virus free. On the basis of these knowledge we propose a mathematical model that would help us to encounter this type of problem.

Mathematical model

We consider a model system of two nonlinear ordinary differential equations describing disease progression process among the prawn population. This model is of interest because it combines a two compartment process of harvesting and introducing new species with a standard *SI* model. Viral outbreak not only has led to massive deaths among the prawn themselves, but also it affects the economy. Environmental stressors have been targeted as the probable cause of this situation.

Extremely high temperature, massive algae growth, high salinity, pollution, and low dissolved oxygen level are all conditions which can lead to epidemics.

In this article we neglect the initial cause of the outbreak and focus on the dynnamics and interactions of the sick and susceptible prawn with its control. The model is based on these assumptions: (1) The entire prawn population is divided into two disjoint classes, susceptible prawn, S, and infected prawn, I; (2) In the absence of infection, the prawn population grows logistically; (3) Infected prawns are unable to reproduce due to short lifespan and infected prawns do not recover; (4) Susceptible and infection prawns are harvested at constant rates.

We develop these assumptions into a model and then find its equilibrium points. Numerical experiments are then carried out to confirm and visualize the equilibrium analysis. In the development of our model, we assume that the mixing rate between susceptible and infected follow the law of mass action. We write the system as a set of differential equations:

$$\begin{aligned} \frac{dS}{dt} &= rS(1-\frac{S}{K}) - \beta SI - q_1 HS \\ \frac{dI}{dt} &= \beta SI - dI - q_2 HI \end{aligned} \qquad (1)$$

There, $S = S(t)$ are numbers of susceptible species, $I = I(t)$ are the numbers of infective species, r is intrinsic growth rate of susceptible, K is the environmental carrying capacity, β is incidence rate or force of infection, d is the death rate of infective, q_1, q_2 are the catchability rates; $H(t) = H$ is assumed to be constant rate of harvesting (effort) and t is the time. All the parameters in these models are non-negative. The system equations have to be analyzed with the following initial conditions: $(S_0, I_0) \geq 0$. This model is well-posed in the sense that the existence, uniqueness and continuous dependence on initial conditions of the solutions are evidently satisfied.

To make the system dimensionless, we consider the following change of variables

$$S \to \frac{r}{N}S,\ I \to \frac{r}{N}I, t \to Nt, \alpha = \frac{\beta K}{r},$$
$$\delta = \frac{K}{N}(d + q_2 H),\ N = K(r - q_1 H)$$

The equilibria of the reduced system (2) are $E_0(0,0)$, $E_1(1,0)$ and E*(δ/α, (1- δ/α)/α) with $\delta < \alpha$, resulting in $H < r(\beta K\text{-}d)/(q_2 r+\beta K q_1)$ - implying $H<r/q_1$ and $\beta K < d$.

$$\frac{dS}{dt} = S(1-S) - \alpha SI, \quad \frac{dI}{dt} = \alpha SI - \delta I \tag{2}$$

Now after changing then origin as $u_1 = S - S^*$, and $u_2 = I - I^*$, (where S^*, I^* indicate the interior equilibrium point) the linearized system is

$$\frac{du_1}{dt} = -S^* u_1 - \alpha S^* u_2, \frac{du_2}{dt} = \alpha I^* u_1 \tag{3}$$

The corresponding characteristic equation becomes $\lambda^2 + S^*\lambda + \alpha^2 S^* I^* = 0$. That indicates the system will be always locally stable whenever the interior equilibrium $E^*(S^*, I^*)$ exists, i.e., $\delta < \alpha$. When δ increases, that is, the death rate due to infection increases and it is near to α, then the interior equilibrium E^* tends to axial equilibrium E_1. Hence one of the species, though it is infectious one, is extincted, and stable system becomes unstable saddle.

So, our suggestion is that whenever disease spread rapidly, periodically selective harvesting (on the basis of mesh size of the net) is advisable besides constant harvesting, and the system equations become:

$$\begin{aligned} \frac{dS}{dt} &= S(1-S) - \alpha SI - \gamma_1 \cos(\omega t) S \\ \frac{dI}{dt} &= \alpha SI - \delta I - \gamma_2 \cos(\omega t) I \end{aligned} \tag{4}$$

Here γ_1, γ_2 are the rates of harvesting. One can deal the nonautonomous system as autonomous system by substitute $\omega t = z$ and that leads to a chaotic system depending upon the parameter involved in it.

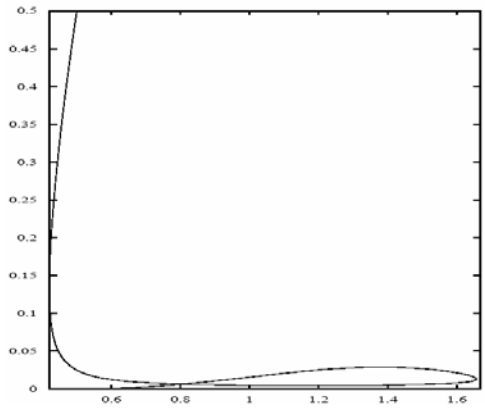

Figure 1a: Phase diagram $I(t)$ over $S(t)$ for $\gamma_1 = 0.6$, $\gamma_2 = 0.5$, $K_1 = 0.1$

To control the chaos, it will be worthy to introduce more new species (those are susceptible). We deal with the system (Eq. 4) introducing new species at a constant rate and hence the ultimately modified system would be:

$$\begin{aligned} \frac{dS}{dt} &= S(1-S) - \alpha SI - \gamma_1 \cos(\omega t) S + K_1 S \\ \frac{dI}{dt} &= \alpha SI - \delta I - \gamma_2 \cos(\omega t) I \end{aligned} \tag{5}$$

Here K_1 is the rate of introduction of new species. It is noteworthy, $K_1 S$ represents the external perturbation proportional to the density of the species S (see [1]).

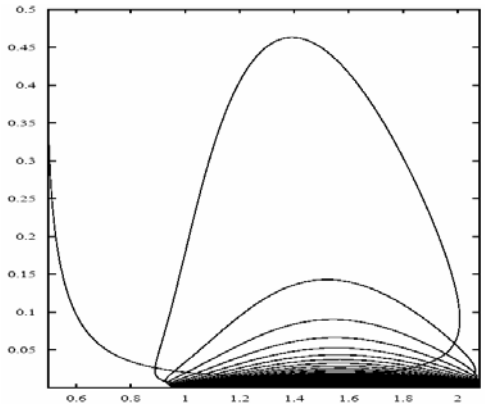

Figure 1b: Phase diagram $I(t)$ over $S(t)$ for $\gamma_1 = 0.6$, $\gamma_2 = 0.5$, $K_1 = 0.5$

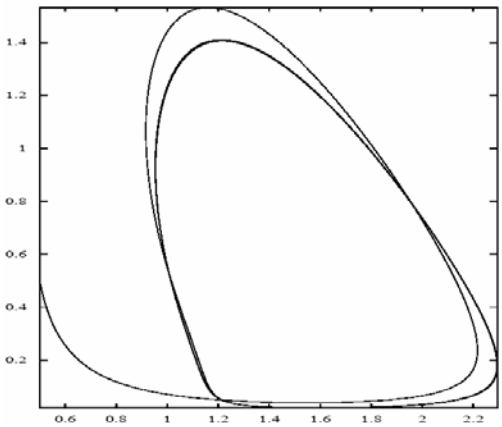

Figure 1c: Phase diagram $I(t)$ over $S(t)$ for $\gamma_1 = 0.6$, $\gamma_2 = 0.5$, $K_1 = 0.9$

Simulation Results

Here we focus the problem when the system undergoes to unstable situation i.e., $\delta \geq \alpha$. On the basis of hypothetical set of parameter values, we simulate our system (Eq. 5) with initial value (0.5,0.5) using XPPAUT [2] and present our findings through the phase portraits.

We examine several values of γ_i, i = 1, 2, and range of values of K_1.

We only consider the case when $\alpha < \delta$ in the following discussion. For example, α = 1, δ = 1.5, the steady state becomes unstable without periodic harvesting.

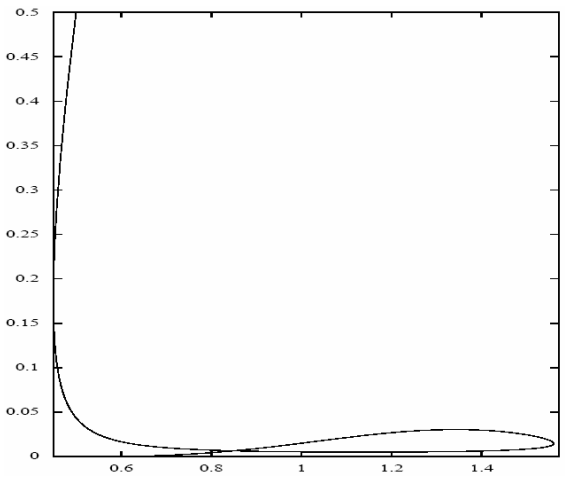

Figure 2a: Phase diagram $I(t)$ over $S(t)$ for $\gamma_1 = 0.5$, $\gamma_2 = 0.6$, $K_1 = 0.1$

After introducing periodic harvesting with $\gamma_1 = 0.6$, $\gamma_2 = 0.5$ the system remains stable around the axial equilibrium $E^{\#}(S^{\#},0)$ for $0 < K_1 < 0.9$.

It is observed that as K_1 increases the equilibrium point $S^{\#}$ also increases from 0.4 to 1.3 as depicted in the Figure 1 (a-c). Furthermore, the system again becomes unstable for $K_1 \geq 1.0$.

Different range of values of K_1 are observed for different values of γ_i. Considering $\gamma_1 = 0.5$ and $\gamma_2 = 0.6$, $E^{\#}(S^{\#},0)$ remains stable for $0 < K_1 < 0.8$. As before, the equilibrium point $S^{\#}$ in-creases from 0.6 to 1.3 (see Figure 2 (a-c)) as K_1 increases and becomes unstable for K1 ≥ 0.9.

When both γ_i are same e.g., $\gamma_i = 0.5$, $E^{\#}(S^{\#},0)$ is stable for $0 < K_1 < 0.8$, whereas for $\gamma_i = 0.6$ the system will be stable for $0 < K_1 < 0.9$.

It is noteworthy in all above cases $S^{\#}$ increases as K_1 increases. Numerical simulation shows when external perturbation is applied to the evolution equation of susceptible variable, the effciency of inducing control varied.

Summary

Using the *SI* system as the model, we have shown that the emergent dynamical response of nonlinearly interacting multivariable systems to external perturbation depends on the strength of the perturbation that determines their evolution in time.

These results are also important in the context of any biological systems where many different factors in a complex environment can perturb each of the underlying variables differentially [3, 4, 5, 6].

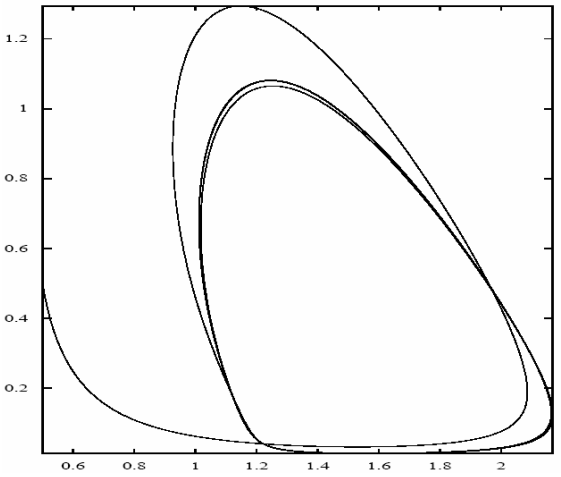

Figure 2b: Phase diagram $I(t)$ over $S(t)$ for $\gamma_1 = 0.5$, $\gamma_2 = 0.6$, $K_1 = 0.5$

In this scenario, our results, using simpler model system, shows that the dynamics of the population can exhibit different behavior based on the level at which the perturbation affects and it may not be obvious by looking at the over all population behavior to predict the level of influence of the perturbation.

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A System Dynamics Library for MODELICA

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This work represents a new System Dynamics library realized in Modelica 2.1 beta standard. All standard elements were implemented referring to the definition from Jay Forrester [1]. Furthermore, it was focused on colour-coding for more user-friendliness and on implementation of units for the particular flow types, which supports the interpretation of the simulation results. As environment for the Modelica standard Dymola, a commercial surface from Dynasim was chosen.
The library is intended to be used to model and simulate problems in socio-economic fields. The user-friendly, hierarchical structure of the designed Modelica library enables the implementation of the influence of widespread data and manifold data structures and, at the same time, clarity of the model can be maintained. Thus, it is possible to include also non-technicians directly in the process of modelling.

1 System Dynamics

In general, Operations Research (OR) offers standard methods to solve problems in the socio-economic area. However, Jay Forrester was convinced that OR deals with the problems of failure or success of a company only to an unsatisfying extent. Thus, he developed the theory of System Dynamics in the late 1950s and beginning of 1960s. This approach became famous when it was used as method for the World Models of the Club of Rome [2]. The method of System Dynamics (SD) seems to be an adequate tool to analyze and understand the structure of coupled socio-economic systems. Nowadays, the SD approach is widely used in research and development, e.g. environmental pollution models, energy supply models, population models, economic and finance systems.

Modeling in SD can be arranged in the following way: First a mental model is developed. Out of this model, causality graphs are generated to get the system in structured form. Afterwards, implementation in a simulator is performed by means of standardised blocks – levels, rates, flows, and auxiliaries.
Besides, it is often necessary to outline alternative model structures. Each step is more or less backward connected to the first two parts.

This shows the strong iterative structure of the SD modelling process. In practice it is started with a simple model and the complexity is increased in every iteration step.
The following components (see Figure 1) represent the basic elements of the SD's point of view.

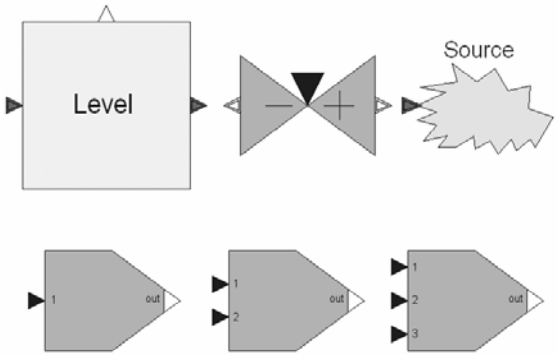


Figure 1. Representation of the basic elements in the SD description language

For explanation of the exponents it is helpful to imagine an example, which could be a bath tub with faucet and drain. The first component in Figure 1 represents a level, which defines an accumulative compartment. In the example the level would be represented by the bath tub. It is clearly seen that the amount of water in litres at time point t_i+1 is the amount at t_i plus the water running into the bath tub in the time slice Δt ($\Delta t = t_{i+1} - t_i$), minus the water quantity running out through the drain.

The second component in Figure 1 represents a valve, which defines the volume flow. The valve would be a faucet or a drain. The third component in Figure 1 represents a source or sink. It describes the boundary of a model to the environment. The fourth component in Figure 1 represents control blocks with different number of inputs. In theory they are called rates or auxiliaries. These elements control the values of the parameters for the components level, flow, and sink and source.
Note that in the example, in contrast to hydraulic systems, the amount of output per time unit need not depend on the amount of water or caused pressure in the bath tub, because SD is not based on the power principle. Instead, any desired relation can be defined to describe the correlation between the particular components.

2 Modelica

Modelica [3] was chosen as modelling standard because it has a more adequate structure compared to other general purpose tools like Simulink or ACSL.

Important features of an object oriented modelling and simulation environment like Modelica with simulator Dymola are:

- A-causal model building.
- General purpose tool, equivalently usable for modelling of mechanical, electrical, chemical, etc. systems.
- Also useable for logical and Petri Net applications and self defined structures.
- Modeling of various kinds of complex systems in-cluding units based on international standard ISO 31-1992 or self defined units of various kinds. These units can be very abstract, like e.g. *public well being*.
- Hierarchical structure of models.
- Easy and efficient way for submodel connections through connectors (more general then input-output connections known in block oriented simulation tools).
- Symbolical and numerical solving of systems of equations.

3 The Library

The elements of the designed SD library can be defined in three categories, as given in Table 1.

1st group	Elements through which the flow variable is running	- Level - Source/Sink - FlowUpDown
2nd group	Rates and auxiliaries for control of the flow	- Rates - Data source - State events
3rd group	Additional components	- First order - Third order - TimeShift

Table 1. Element groups in the Modelica SD library

3.1 Connectors

Ten different connectors were implemented. The first connector `MoneyInput` is used to define an input for money flow into a component. It is defined by the Modelica program shown in Table 2.

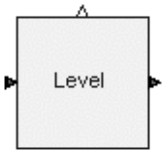
```
connector MoneyInput
   parameter Integer n=1
    "Dimension of signal vector";
     class Money = Real ( unit="Euro");
   input Money signal[n];
end MoneyInput;
```

Table 2: Source code for connector MoneyInput, graphical appearance information omitted

The unit is defined by a class being is also a component, but one hierarchical step deeper. There is no ISO 31-1992 unit predefined in the Modelica. There exists also a similar connector structure with different graphical shape to define the `MoneyOutput`. Other connectors are defined for material, persons, equipment and orders.

4.2 Library components

Level. A level represents an accumulative component. It has two connectors for flow, and also data output which represents the value of the accumulated extent (Modelica source given in Table 3).




```
model MoneyLevel
 parameter Real xstart=0.0 "initial value";
 Real x(start=xstart)=state "state variable";
 SdConnectors.MoneyInput flow1;
 SdConnectors.MoneyInput flow2;
 Modelica.Blocks.Interfaces.RealOutput state;
  equation
  der(x) = flow1.signal[1] + flow2.signal[1];
end MoneyLevel;
```

Table 3: Modelica source code Level component, graphical appearance information omitted

Source. This element shows the system boundaries and is also used as sink. As it is used like an open wire there exists no equation section.

FlowUpDown. This component represents a valve. A valve defines the flow through it, which is in our case settled by a data input. The flow does not depend on any hydraulic laws, it is just an abstraction.

```
model FlowUpDownPerson
 SdConnectors.PersonnelOutput flow down;
 SdConnectors.PersonnelOutput flowup;
 Modelica.Blocks.Interfaces.RealInputs;
  equation
  s = flowdown.signal[1];
 flowup.signal[1] = -flowdown.signal[1];
end FlowUpDownPerson;
```

Table 4: Modelica source code FlowUpDown component, graphical appearance information omitted

Rates. This group of elements is used to define the value of the control parameters for the FlowUp-Down elements.

For that reason abstract class of elements with *n* inputs and one output are defined. Because work is done with data and not with flow-variables we work in this group only with data connectors from the Modelica 2.1 standard library. The output of our component is connected with another input of a component from the class Rates, or is directly used as control input in a valve.
On the one hand abstract components are defined; on the other hand also concrete examples are implemented in the library. Table 5 shows an implemented program for a non-linear function based on the abstract model `Dec_3`:

```
model Evaluation
  extends Dec_3;
equation
  r=u1*(u2-u3)/u2*u3;
end Evaluation;
model.Dec_3
protected
   input Real u1=InPort1;
   input Real u2=InPort2;
   input Real u3=InPort3;
   output Real ;
public
    Modelica.Blocks.Interfaces.RealInput
                                  InPort1;
    Modelica.Blocks.Interfaces.RealInput
                                  InPort2;
    Modelica.Blocks.Interfaces.RealInput
                                  InPort3;
    Modelica.Blocks.Interfaces.RealOutput y;
  equation
    y=r;
end Dec_3;
```

Table 4: Modelica source code for `Dec3_` model and inherited class

First order system. A first Order system includes only components of the 1st and 2nd group and is included in the library because it is often used. Figure 2 shows the ICON layer and the underlying graphical model

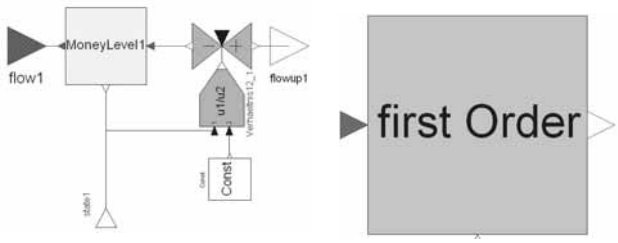


Figure 2. `first Order` Modelelica Library: icon and graphical model

4 Test Example: Lotka-Volterra-Laws

In the following the correctness of the library is shown with the Lotka-Volterra-law for one sort of predators and one sort of prey.

Here an easy form without any influence of weather, other prey or different sorts of predator is considered. Only a time delay in the population of the brigand is used. This means that an increase in the prey population changes the number of hunting animals after a short wile.
Figure 3 shows the graphical model set up with the SD library, implemented in Dymola. The System Dynamics approach makes the model self-explaining. In Figure 3 also the advantages of colour-coding of the different flows can be seen – it makes the system easier readable. This advantage becomes more important in big models.

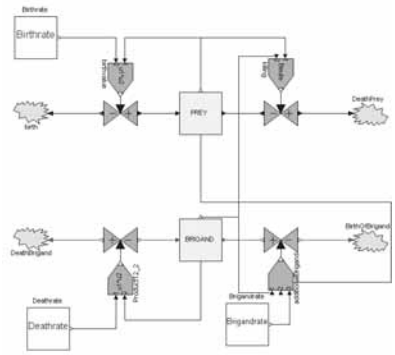


Figure 3. Predator-prey model built up with SD Modelica library

It should be noted, that the SD library allows also using components of other libraries. The model is validated by comparing the results (shown in Figure 7) with a sample solution [4].

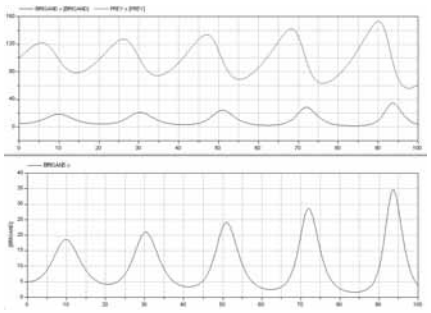


Figure 4. Validated result of Modelica SD Library model for predator-prey system

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Modelling Artificial Consumer Markets

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Motivation. Mathematical modelling and simulation in Economics get an increasing relevance due to the lack of experiments which normally cannot be made in a real-world economy. So here the model of an *Artificial Consumer Market* is presented. First the model can be used to generate artificial market data with known properties to benchmark statistical methods for data analysis. Additionally the model can been used to test diverse hypothesis regarding marketing strategies. From a technical point of view different modelling approaches have been used to validate the strengths of different implementations modelling the required properties (e.g. Agent-based models, Cellular Automata, Hybrid Approaches, etc.)

Model of the Continuous Artificial Consumer Market (CACM)

In contrast to many discrete approaches of consumer markets (e.g. Buchta/Mazanec [1]) in this model time is continuous. The temporal development of the quantities in the CACM is described by differential equations. To derive the evolvement of a specific quantity the differential equations have to be integrated numerically over time. In this study in order to resolve the numerical integral a simple Euler integration method with a constant discretisation has been used. The discretisation can be chosen arbitrarily (it should be smooth enough).

The continuous model is designed to emulate the consumer behaviour concerning different brands acting in a segmented market. All firms offer the same type of product but emphasize different attributes which leads to a positioning of each firm in the product attribute space. The consumers are split up in groups of special aspiration patterns and each consumer group has a specific ideal point which constitutes the desired features, the so called aspirations. At the beginning of the simulation the consumer perceptions regarding the product features are located in the origin. Due to the firms' advertising efforts the perceptions which are related to the emphasized physical properties of the product are moving in a direction induced by the advertising claim.

To decide in favour of a brand the consumers consider price-weighted perceptions which are called attitudes. The brands are rated by the consumers by measuring the distance between aspirations and attitudes. In particular the distance represents an inverse measure of the utilities of each consumer for each product. The choice process is based on this utility measure.

Dynamics of the perceptions / attitudes

The brand-specific advertising budgets affect the growth process of the consumers' perceptions / attitude concerning the position of the firms in the market. Therefore an s-shaped log-reciprocal advertising impact function *aif* is used:

$$aif(b_j) = e^{\alpha - \frac{\beta}{b_j}}$$

The attitude dynamics are driven by the advertising budgets b_j invested weighted by the price p_j of the product. The differential equation consists of two parts where the first describes the perceptions' growth of the advertised attributes starting at 0 up to 1 dependent on the actual relative advertising budget.

The second part describes the decay due to the forgetting of the product attributes by the consumers. The appropriate function $\Phi(.)$ defines the forgetting rate. In the following the indices i denote the aspiration groups, j the brands, k the product attributes and t the time.

The differential equation responsible for the temporal modification of the attitudes A of those attributes which are advertised is the following:

$$\frac{dA_{ijk}(t)}{dt} = \frac{1}{p_j(t)}\left[aif(b_j)(1 - A_{ijk}(t)) - \phi(t,b_j)A_{ijk}(t)\right]$$

The function of the forgetting rate is formulated for relative budgets. Non-advertised budgets are declined with a constant rate b_0 - i.e. $\Phi(t, b_j) = \Phi_0$, and advertised attributes with:

$$\phi(t,b_j) = \frac{1}{1 + \Lambda(t,b_j)}$$

$$\Lambda(t,b_j) = b_j(t) \cdot \int_{start}^{t} \frac{b_j(\tau)}{\sum_j b_j(\tau)} \cdot e^{-\phi_0(t-\tau)} d\tau$$

The function Λ describes a mathematical convolution of former budgets with weighting function $exp(-\Phi_0(t-\tau))$ which is chosen in such a way that smaller weights are imposed on past relative budgets than on actual budgets. To calculate the actual value for the forgetting rate an Euler integration method is used where the same stepsize as for the integration of the perception rates is chosen.

Ideal-point model

To measure the satisfaction of a consumer with a product the distance between the appropriate aspiration point and the attitude, thus the price-weighted perceptions, is determined by using the Euclidian norm. The utility of the consumers in aspiration group i with respect to each product j can be measured with the aid of the proportional distance between the appropriate aspiration point of the aspiration group and the attitude corresponding to brand j. The utilities uti are calculated by dividing with the maximum distance. Thus the smaller the distance the higher is the utility.

The volume of the market share MA_{ij} of brand j is calculated from the consumers of aspiration group i and the market shares of each aspiration group i must sum up to 1. To calculate profits for each brand in the market the sales must be determined first, where $N_{C,i}$ denotes the number of consumers in segment i, the profit for the brand j, which serves as a target function in optimization tasks:

$$MA_{ij} = \frac{uti_{ij}}{\sum_i uti_{ij}} \qquad sales_{ij} = N_{C,i} \cdot MA_{ij} \cdot p_j$$

$$profit_{ij} = \left(\sum_i N_{C,i} \cdot MA_{ij} \right) \cdot p_j - b_j$$

Applications

The model mentioned above has been used to simulate the evolvement of an artificial consumer market under several hypotheses. Based on the defender model of Hauser/Shugan [2] optimal defensive strategies to react on a new market entry have been analyzed using this simulation model. The defender model has a long tradition in marketing research – but the mostly usual requirement of analytical solutions needs strong simplifying assumptions which can be relaxed using a simulation model. Stylized facts as the distribution of the consumers' aspiration pattern or the market maturity can be integrated easily.

So a wide range of research questions can be proved using this model. Using simulation optimal price and advertising budget decisions can be determined under realistic market conditions [3]. The model has been also implemented using an agent-based approach, which allows a higher degree of interactions between the customer and firm agents but using the mentioned evolvement of the attitude for each customer agent [4]. Without giving more detail, Figure 1 shows the possibilities of presenting results with the models under investigation.

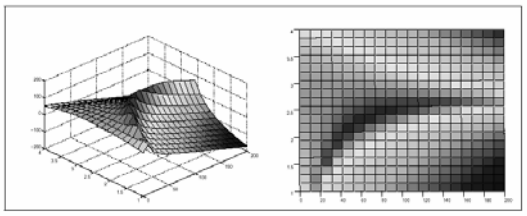

Figure 1: Surface plots of the profits of the incumbent for several price-budget combinations under a fixed entrance strategy in a homogeneous market

A similar feature can be implemented using cellular automata which allow modelling a local microstructure around each customer. The rules of the CA and the update of the cells in each generation define a dynamic diffusion process describing a world-of-mouth process within a proper range. Additionally a hybrid implementation - using the local structure of cellular automata to model the world-of-mouth and differential equations to model the general advertising effects - has been used in an actual study [5].

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Software Notes

DESIRE: Open Software / SAMT Integration / Publications
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The latest DESIRE simulation package, portable (and free, including a comprehensive manual and source code, under the General Public License) is beginning to run in Europe as well as in the US. This is convenient and fast for control-system applications, vectorised Monte Carlo simulations, and neural networks. DESIRE's main limitation is that it will solve only differential equations and difference equations but not differential-algebraic (DAE) systems.
As other genuine compiling simulation languages, DESIRE is also available under a comfortable graphical environment. DESIRE has been integrated into the SAMT package. SAMT is a small grid-based geographical information system (GIS) for spatial analysis. SAMT/DESIRE makes use of DESIRE for simulation in the timedomain, so that now distributed time-depemdent systems can be analysed in SAMT (see this SNE). On the other hand, SAMT may only be used as graphical environment for DESIRE with better experimentation features. SAMT/DESIRE comes on CD under KNOPPIX, and can be started directly from CD.

DESIRE Information / Publications
In the following abstracts of publications are listed, which show the broad variety of DESIRE.

Solving 5991 Differential Equations under Micro-soft Windows (Math. and Computers in Simulation, 47:571-582, 1998)
New simulation software combines Editor Windows for convenient modeling and file manipulation with a Command Window that automatically switches to full-screen color graphics while a simulation runs. Under Windows 95, the new program preempts the CPU, so that Windows does not compromise solution speed during the time-critical simulation runs. Windows multitasking works at all other times. Extra-fast runtime compilation and Pentium-optimized machine code let you quickly try and compare different models programmed in multiple editor windows. You can also program your own special dialog windows for data entry, model changes, and note keeping.
Large problems can include up to 20,000 first-order differential equations, plus neural networks and fuzzy logic.
As an example, we solve the telegrapher's partial differential equation (delay-line equation) by the method of lines. We solve thousands of simultaneous differential equations first in scalar form and then using DESIRE's compact vector notation.

New, Faster Algorithms for Supervised Competitive Learning: Counterpropagation and Adaptive-resonance Functionality
(Neural Processing Letters, 9:107-117, 1999)
Supervised competitive learning with Hecht-Nielsen's one-way counterpropagation implements pattern associators or function generators. These often learn to associate input and output patterns much more quickly than backpropagation networks. But simple competitive learning cannot separate closely spaced input patterns. Practical counterpropagation, then, requires some sort of adaptive-resonance -like functionality which prevents neighboring patterns from 'stealing' each other's templates.
We implement such 'pseudo-ART' functionality with a new, simple, and fast algorithm which requires no pattern normalization at all. Competition can be based on either Euclidean or taxicab-norm matching. In the latter case, the new algorithm emulates fuzzy ART. We apply the pseudo-ART scheme to several new types of counterpropagation networks, including one based on competition among combined input / output patterns. Noise-free examples produce perfect pattern association in fairly difficult problems (closely-spaced function table, spiral discrimination) as well as character-bitmap recognition. We also discuss effects of noise on ART functionality, and specifically on counterpropagation networks.

Simplified Function Generators Based On Fuzzy-Logic Interpolation (Simulation Practice and The-ory, 7:709-717, 2000; SNE 2001)
We replace the classical procedure for recursive linear interpolation with a technique based on simple fuzzy-set logic. This approach makes it much easier to construct multi-input interpolation procedures. The resulting function generators produce the same output as the classical formulas with slightly fewer CPU cycles if we precompute and store some coefficients before the simulation. Lin and Zhang's algorithm, which precomputes and stores more interpolation-polynomial parameters, is even faster but requires much more runtime storage in the case of large function tables.

Interactive Solution Of Partial Differential Equations by The Method Of Lines (Mathematics and Computers in Simulation, 1644,1-10,1999)
A convenient, generally applicable technique for programming Method-of-lines solutions of linear or nonlinear partial differential equations employs a new implementation of W. Schiesser's general-purpose differentiation operators. A novel vector compiler reads a vector equation or differential equation and produces efficient code for *n* corresponding scalar equations without causing any runtime loop overhead. Simulations can combine partial and ordinary differential equations. Programs compile and run immediately on a mouse click to permit truly interactive modeling and simulation. Originally designed for experiments with Monte Carlo simulation, neural networks, and fuzzy logic, the new runtime compiler easily generates many different Method-of-lines algorithms for partial differential equation systems. As a simple example, we exhibit the complete solution of a heat conduction problem with one space dimension.

Using A Runtime Simulation-Language Compiler To Solve Partial Differential Equations By The Method Of Lines (SAMS, 37:141-149, 2000)
One simple and easily readable vector differential equation can represent many scalar differential equations. Our new vector compiler can read a vector differential equation and automatically compiles in-line code for the n corresponding scalar differential equations, without causing any runtime loop overhead. Applications include Monte Carlo simulation of hundreds of replicated dynamic system models in a single computer run, neural network simulation, and method-of-lines solution of partial differential equations. We demonstrate a compact program solving of a simple parabolic partial differential equation with one space dimension.

Teaching Pattern Recognition with Simulated Neural Networks (Proc. 1998 SCS MULTICON)
We outline part of an industrial-refresher course on neural networks. Specifically, we compare different techniques for pattern recognition, using simulation programs to demonstrate them. We begin with two-layer and three-layer linear perceptrons and add thresholding and a Haken competitive layer to suppress noise. We mention backpropagation and proceed to very powerful counterpropagation schemes which employ recently developed simplified adaptive-resonance- type functionality.

A New Algorithm for Fast Adaptive-resonance Emulation (Neural, Parallel & Scientific Computa-tions, 8:49-54, March 2000)
After a brief review of competitive learning and adaptive resonance theory (ART), we present a new, greatly simplified scheme for fast adaptive-resonance- type learning. Template matching can be based on Euclidean or taxicab distances; in the latter case, the new algorithm emulates 'fuzzy' ART. Unlike most ART implementations, the new algorithm needs no input pattern normalization at all. Where input normalization or other nonlinear operations can improve noise immunity, we can add an input preprocessor. Computer simulations exhibit good pattern separation in fairly difficult problems, which include the classical spiral-discrimination problem with additive noise.

Model-replication Techniques for Parameter-influence Studies and Monte Carlo Simulation with Random Parameters (Mathematics and Computers in Simulation, 67/6, 501-513, 2004)
Modern computers produce large volumes of simulation results so quickly that their management becomes a formidable task. We describe interactive computer software for replicating simulation models with different parameters. A single simulation run then produces results for hundreds of models with different parameter values without the loop overhead imposed by repeated simulations.
One can arrange corresponding values of model-parameter values and model performance measures in corresponding arrays suitable for use in commercially available spreadsheet and relational database programs for further processing and archival storage, or produce a Monte Carlo sample of model runs with random parameter values and compute statistics such as various averages or probability estimates as functions of simulation time in a single simulation run.

A Simulation-Model Compiler For All Seasons (Simulation Practice and Theory, 9:21-25, 2001)
A new runtime simulation model compiler quickly reads, compiles, and immediately solves vector differential equations and difference equations as well as scalar equations for dynamic system models. Vector assignments compactly model nonlinear as well as linear matrix / vector relations for many problems in physics, control systems, neural networks, and fuzzy logic.

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The key feature is that the new vector differential equation solver can replicate a dynamic system model many times and then simulates hundreds of such models in a single simulation run, e.g. for Monte Carlo studies. Also, partial differential equations (e.g. for a heat exchanger) can be solved together with ordinary differential equations. Portable C code runs on UNIX or LINUX workstations. A fast machine language version for personal computers (Windows 98 and NT) directly utilizes the Pentium floating point hardware stack, which is automatically continued into memory.

Fast Monte Carlo Simulation of Noisy Dynamic Systems on Small Digital Computers
(Simulation News Europe, 2002)
We describe personal computer programs for conventional repeated-run Monte Carlo simulation and for replicated-model ('vectorized') Monte Carlo. New software automatically replicates screen-entered differential-equation models and permits very fast estimation of statistics such as averages, distribution densities, and test statistics. We develop noise-sampling techniques that work correctly with both fixed- or variable-step digital integration and propose a new heuristic test of pseudorandom-noise quality. Replicated-model Monte Carlo examples include a nonlinear control system and a classical random walk study. The latter required double precision, floating-point solution of up to 20,000 simultaneous ordinary differential equations. Inexpensive personal computers complete such tasks in tens of seconds.

Real Statistical Experiments Can Use Simulation-Package Software (Simulation Practice and Theory 13 : 39-54, 2005)
The significance of statistical measurements depends on the sampling distributions of statistics like sample averages, sample variances, and statistical relative frequencies. In practice, sampling distributions are usually not measured but inferred from probability models. But for meaningful statistics education, and also for research, it is useful to study real sampling distributions, i.e. actual samples of hundreds or thousands of statistics each computed from hundreds or thousands of data values. That requires massive data processing, but we show that personal computer simulation package software can do such jobs in seconds if we reduce program-loop overhead.
Specifically, we exhibit compact and readable programs that create true sampling distributions by system replication (vectorized Monte Carlo technique) and demonstrate very fast recursive and dot-product averaging.
We estimate sample averages, sample variances, and probability densities of statistics. Runtime displays that plot not only statistics but also their sample averages and variances as functions of sample size provide remarkable insight into the real world behavior of measured statistics.

Open Source Modelica

The Open Source Modelica is a new project at Linköping University. The goal of the project is to create complete Modelica modeling, compilation and simulation environment based on free software distributed in source code form intended for research purposes.

The project's aim is to create a complete Modelica modeling, compilation and simulation environment based on free software distributed in binary and source code form.

In December 2005 Open Modelica 1.3.1 was released. Some of the new feaures are:

- The New BSD (Berkeley) open-source license for the source code.
- Support for hybrid and discrete-event simulation (if-equations, if-expressions, when-equations; not yet if-statements and when-statements).
- Parsing of full Modelica 2.2
- Vectorization of function arguments
- Automatic index reduction.
- An improved window-based interactive command shell (WinMosh).
- A free implementation of an Open Modelica note-book (OMNOtebook), for electronic books with course material, including the DrModelica interactive course material.

The source code is now available for download:

HTTP://WWW.IDA.LIU.SE/~PELAB/MODELICA/OPENMODELICA.HTML

Comparison, Evaluation and Benchmarking of Simulation Software

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Modelling and simulation has become the third pillar of gaining knowledge, replacing or supporting essentially the classic pillars theory and experiment. Modelling and simulation of a process makes use of a simulation software, and quality of results and investigation time depend dramatically on the choice of the most appropriate simulator. Consequently, a basis for this choice or at least serious hints are necessary.

General Evaluation
Special hints for the choice of a simulator depend substantially on the present time. If a publication with such hints is published, it is already obsolete. Consequently, only general hints can be given, and methods can be shown, how to compare features of simulators and approaches to modelling and simulation.
The following categories for evaluating software are important and give general hints:

- Flexibility to model a variety of systems
- Hierarchical modelling structures, modelling libraries
- Different modelling approaches
- Debugging aids, execution speed, links
- Support for animation and run time graphics
- Appropriate statistical capabilities: random number generation, input probability distributions, output analysis, experimental design
- Numerical capabilities: ODE and DAE solvers, Jacobian calculation, eigenvalue analysis, optimisation, etc.
- Symbolical capabilities: non-causal modelling, index reduction, sensivity analysis

Banks ([1]) gives also some warnings, like ‘Execution speed is really important, because also development time counts’, or ‘Beware of advertising claims and demonstrations’, or ‘Beware of checklists with yes and no as the entries for features’.

Feature Comparisons and Benchmarking
It is evident, that the choice of a simulator must be based on the knowledge of the features of a simulator for the planned simulation project. It is necessary to get known, how the simulator works with the planned project or with a similar and analogue process. This leads to the necessity to compare simulation software on a more or less standardised basis.

In the 1980s, in general two methods for comparing simulation software were developed.
The **Checklist Method** lists desired features, and for each simulator ‘yes’ or ‘no’ entries are put in the lists (feature comparisons). There are two major disadvantages: first, very often it is important, how a particular feature is implemented, and not the existence itself; second, such checklists are becoming obsolete very quickly. Nowadays the development cycle for a new release of simulation software is less than two years, so such a checklist must become obsolete in very short time. The checklist method may be seeen as formalisation of a list of special hints for choosing a simulator, and, as given before, it is not the best method.
The **Benchmark Method** makes use of so-called benchmarks. The term benchmark may have different meanings, in general a benchmark is a more or less normalised test of the quality of product, of a process, etc. Benchmarking means, measuring and comparing products like bycicles or software, in order to choose the most appropriate product for a certain purpose. In modelling and simulation, benchmarks like PHYSBE, Pilot Ejection, etc. – are well known. They check certain features of simulators, based on fixed models with defined expriments. These bechmarks are complex, so that it takes time, if more simulators have to be benchmarked for a certain purpose.
Until the midst of the nineties, benchmarks for general pupose simulation software were up-to-date. In the last ten years the emphasis of benchmarking has shifted towards special purpose simulators, like wastewater treatment processes, or performance modelling of networks ([2], [3]). Especially in process simulation and and in powerplant simulation there was a claim for standardised benchmarking. Up to now, benchmarks are not officially standardised (ISO), industrial standards are given eg. by SPEC benchmarks. Benchmarks may be restricted also only to a certain class of problems or applications, e.g. on hybrid systems. At the web here a lot of sources can be found, which often link to the *ARGESIM Comparisons* (see later).

Choice by Decision-Support
Another possibility is to standardise and to automatise the choice based on decision support software. From 1998 on, at Brunel University a decision support tool called *SimSelect* was developed ([4]), that provides a support to the users when selecting simulation software. Following a specification of user's requirements, the system queries a database and finds a simulation package as well as alternatives suitable to the user. The problem with this system is maintainance, and the quality of data provided by distributor of simulation software.

ARGESIM Comparisons.
At Vienna University of Technology, in 1990 comparisons for simulation software were set up, which try to overcome the disadvantages of checklists on the one side, and the complexity of benchmarks on the other side.
These comparisons, now called *ARGESIM Comparisons of Modelling and Simulation Techniques and Tools* are published in the journal *Simulation News Europe* (SNE). These software comparisons developed towards small benchmarks not only for simulation tools but also for modelling tools and for modelling techniques. Furthermore, the solutions – many of them with source codes – may be used as examples in simulation courses, etc.
At present a project on a classification of the solutions (up to now almost 300 solutions with about 35 simulators) is done. Key words should characterise a specific solution: method or approach, generally modelling technique, methods used in the tasks, etc. A database will support this classification ([5], [6]). Up to now 20 Comparisons were defined:

- C1 Lithium-Cluster Dynamics – stiff systems
- C2 Flexible Assembly System – DEVS
- C3 Generalised Class-E Amplifier
- C4 Dining Philosophers I – very general
- C5 Two State Model – state events
- C6 Emergency Department – care logistics
- C7 Constrained Pendulum – events / hybrid
- CP Parallel Simulation Techniques
- C8 Canal-and-Lock System – complex logic
- C9 Two Tank Fuzzy Control
- C10 Dining Philosophers II – deadlocks
- C11 SCARA Robot – DAEs, state events
- C12 Collision of Spheres – general
- C13 Crane with Embedded – sensors, observers
- C14 Supply Chain
- C15 Clearance Identification
- C16 Restaurant Business Dynamics
- C17 Epidemic Spatial Dynamics
- C18 Neural Networks vs. Transfer Functions
- C19 Pollution in Ground Water Flow

Definitions and solutions are available at the website WWW.ARGESIM.ORG. Two projects are ongoing: i) evaluation of the solutions with a database, and ii) documentation of the modelling procedure and system and modelling backgrounds for educational use.

The ARGESIM comparison have become a big success, up to 300 solutions are available. The comparisons became world-wide accepted small benchmarks for general purpose simulators, for object oriented simulation libraries, for application-oriented simulators (not for higly-specialised simulators), and partly also for for computer numeric systems and for computer algebra systems. Many web links are addressing the *ARGESIM Comparisons* as recognised small benchmarks.

Special Benchmarks
Frome time to time special benchmarks appear. They are related to certain events or certain occasions. Elder simulationists may remember the *Coffeepot Benchmark*, set up by R.Huntsinger on occasion of bad coffee at a simulation conference. Unfortunately this benchmark was not documented officially.
Another special benchmark, the *MATHMOD Yo-Yo Simulation Challenge*, was initiated at the 4th MATHMOD Conference in Vienna. Participants had opportunity to train their skilfulness with a real yo-yo (a promotion gadget). On occasion of 6th MATHMOD Conference Vienna (February 2006) the *Yo-Yo Benchmark* will be published officially. This benchmarks checks hybrid features, state events and mechanical modelling. A definition is published in SNE 44/45, December 2005.

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ARGESIM Comparisons of Modelling and Simulation Techniques and Tools – Simulation Benchmarks

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ARGESIM started in 1990 the series *Comparison of Simulation Software* in the journal *Simulation News Europe* (**SNE**). These software comparisons developed towards benchmarks not only for simulation tools but also for modelling tools and for modelling techniques and modelling approaches.
The new comparisons *Restaurant Business Dynamics, Spatial Dynamics of Epidemic*, *Transfer Functions vs. Neural Net Models*, and *Ground Water Flow* address also non-classical modelling techniques, like agent-based simulation, neural nets and cellular automata. They can be analysed by various software systems, not only by simulation systems. Furthermore, they underline the importance of spatial dynamics, coupled with temporal dynamics. The solutions allow comparisons of different modelling approaches, of features of simulators, of development of simulators, etc. Furthermore, the solutions – many of them with source codes – may be used as examples in simulation courses, etc.
The ARGESIM Comparisons have proven a big success: up to now 291 solutions have been published in SNE, and the comparison models are used worldwide as examples and benchmarks in teaching.

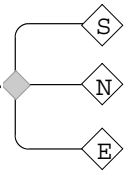
Development of the Comparisons
ARGESIM, the *Working Group Simulation* at Vienna University of Technology takes care on definition of these comparisons, on publication of the solutions and of evaluation of the solutions. Since 2004, work on a data-based driven evaluation and classification is going on, to be presented in a new ARGESIM web server (end 2006).

The principle idea of the ARGESIM Comparisons is a mixture of a general simple comparison of features within 'yes/no' – tables and of the well-known benchmark problems, which are relatively big (like PHYSBE).
The *ARGESIM Comparisons* are based on relatively simple, easily comprehensible processes. Different modelling techniques and their implementation as well as features of modelling and experimentation within simulators, also with respect to application area, are compared.
The comparisons solutions have to consist of two parts. The first part is the description of the model and of the modelling procedure with the simulator used, and the second parts has to present the procedure and the results of three so-called tasks, which are experiments with the model – from simple to complex.

The comparisons started in 1990, and since that time there have taken place new developments in software and algorithms.

Consequently also the comparisons developed further on, from comparisons of simulation software towards comparisons of modelling and simulation techniques and tools. This development is based on following facts:

- Nowadays different modelling approaches are offered by simulators – it makes sense to work on different solutions with the same simulator.
- The paradigm of Classes and Objects has changed software engineering dramatically. Also in modelling and simulation OO approaches give better insight into structures. Consequently, OO approaches may give better insight into the modelling procedure – it makes sense to compare classical and OO approaches.
- Hybrid approaches become more and more important; and as simulators offer environments with complex features, hybrid approaches can now be set up easily. Hybrid processes may be tackled by different hybrid modelling structures - it makes sense to compare these approaches, from total hybrid decoupling of models until complete overall models.
- Symbolic computation is an alternative to analysis in the time domain. Nowadays Computer Algebra Systems can analyse also nonlinear systems and can handle complex semi-numerical tasks and pure numerical tasks. Furthermore, they usually offer a very good environment for experimenting with models. It makes sense, to include Computer Algebra Systems, and to specify also tasks with analytical background.
- For modelling and simulation of discrete processes, not only classical discrete simulation systems, based on DEVS, can be used. It makes sense to look also for different or alter native approaches, like Petri nets and Markov chains, and to make use also general statistical tools and environments.
- Furthermore, in the OO world of Java a lot of libraries for discrete process modelling are available, which start to compete with classical simulators - worth to consider.
- The classic basis of continuous modelling and simulation was analysis and simulation in the time domain, and spatial dynamics was shifted to the world of finite differences, finite volume, and finite elements.



Nowadays it is necessary to combine these 'different' worlds by 're-considering' the coupled temporal and spatial dynamics. Consequently, it makes sense to study the different approaches for incorporating also spatial behaviour in the ARGESIM Comparisons.

- Although non-classical modelling techniques did not replace the classical ODEs, DAEs, and PDEs, alternative methods like Cellular Automata, Agent-based Approaches, and Fuzzy and Neural Models have become very important for certain classes of problems.
  Consequently it makes sense, to extend the range of the ARGESIM Comparisons also towards these alternative approaches and to compare them with classical ones.
- And last but not least, many simulators have been developed continuously. So it makes sense to solve a comparison from time to time with the new version of a specific simulator, to show the advances and new features of the system.

ARGESIM Comparisons as Education Tool

It has turned out, that the ARGESIM Comparisons are a valuable source for demos, exercises, or benchmark studies in education on modelling and simulation. As the comparisons tend towards modelling approaches, they can be used not only in simulation software classes, but also in more or less general classes on modelling in natural sciences, in computer science and computer engineering, etc.

Up to now, the model descriptions for all comparisons were given, as ODE, DAE, DEVS, or in another form. For education it is necessary, to study also the analytical modelling procedure, the derivation of the model, and the background of the laws which govern the model.
Within a project for master theses and PhD theses, ARGESIM will extend the comparison definitions by information on modelling procedure, on the physical background, etc.

In order to make an ARGESIM comparison a self-contained part of a lecture, each comparison should consist of

i. Model description and derivation
ii. Application area and background
iii. Comparison definition
iv. Various solutions
v. Various implemented models (sources)

SNE will start with this completion of the comparisons in SNE Issue 46: a contribution on physical background and laws for modelling for Comparison 1 'Lithium Cluster Dynamics', is in preparation.

Comparison Definitions

Up to now 20 comparisons were defined. The following list shortly introduces the comparisons and sketches special problems (SP), which could be observed for a special comparison. Clearly, some defined tasks seem to be simple, but they prove tricky, so that they must cause 'problems' in implementation.

C1 Lithium-Cluster Dynamics, SNE 0 (11/1990),
checks integration of stiff systems, parameter variation, and steady state calculation.
SP: loops with logarithmic increments, correct double – logarithmic plots, steady state calculation

C2 Flexible Assembly System, SNE 2 (3/1991),
discrete system, compares features for submodel structures, control strategies, and optimisation.
SP: complex control strategies, analytical considerations before modelling very helpful, optimisation avoidable

C3 Generalised Class-E Amplifier, SNE 2 (7/1991),
simulation of electronic circuits, table functions, eigenvalue analysis, and complex experiments.
SP: use of same model for analytical and numerical analysis, up to now accuracy, table function evaluation vs. piecewise functions

C4 Dining Philosophers I, SNE 3 (11/1991),
general comparison, involving not only simulation but also analysis e.g. by Petri nets, etc.
SP: network analysis for deadlocks, simultaneous events, results difficult to compare

C5 Two State Model, SNE 4 (3/1992),
checks high- accuracy features and state event handling.
SP: analytical approach possible, but ill-conditioned; fully discrete approach possible, accuracy of state event handling

C6 Emergency Department - Follow-up Treatment, SNE 6 (11/1992),
discrete system, tests features for modelling, concepts of availability and complex control strategies.
SP: no strict separation of entities and resources, complex routing and priority problems

C7 Constrained Pendulum, SNE 7 (3/1993),
checks features for hybrid modelling, comparison of models, state events, and boundary value problems.

SP: choice of states, different levels of hybrid approaches,

CP Parallel Simulation Techniques, SNE 10, (3/1994),
deals with the benefits of distributed and parallel computation for simulation tasks; three test examples test parallelisation techniques.
SP: results not encouraging wrt parallelisation, very often direct programming necessary

C8 Canal-and-Lock System, SNE 16 (3/1996),
discrete system, checks features for complex logic control, validation and variance reduction.
SP: complex logic control, analytical considerations necessary; support for advanced statistical analysis necessary

C9 Fuzzy Control of a Two Tank System, SNE 17, (7/1996),
asks for approaches and for implementations of modules for fuzzy control.
SP: support for fuzzy control, two-dimensional calculations for control surface, pure discrete approach possible

C10 Dining Philosophers II, SNE 18 (11/1996),
reviews discrete simulators with respect to concurrent access to resources with deadlocks.
SP: discrete random variables, simultaneous events, deadlock recognition

C11 SCARA Robot, SNE 22 (3/1998),
deals with implicit and hybrid systems with state events.
SP: implicit model, different approaches for collision event and action

C12 Collision of Spheres, SNE 27 (11/ 1999),
allows numerical or analytical analysis as well as continuous or discrete approaches
SP: broad variety of approaches (numerical - continuous, numerical – discrete, numerical – analytical, analytical – symbolic), collision limit

C13 Crane Crab with Embedded Control, SNE 31 (3/2001), revised SNE 35/36 (11/2002)
checks techniques and features for embedded digital control with sensors and with observer-systems
SP: discrete control coupled with sensor diagnosis and observers, complex experiments

C14 Supply Chain, SNE 34 (7/2002)
addresses discrete simulators - features for supply chain systems (messages, strategies)
SP: distinction between material flow and order flow, distance-dependent control strategies

C15 Clearance Identification, SNE 35/36 (11/2002),
checks identification features (based on measu red data) and influences of noise
SP: identification algorithms, short-term input functions (Dirac-like), support of statistics

C16 Restaurant Business Dynamics, SNE 40 (5/2004),
addresses agent-based simulation as well DEVS approach and classical programming
SP: renaissance of activity scanning, coordination of run samples, optimisation

C17 Spatial Dynamics of Epidemic, SNE 41/42 (12/204),
analyses temporal and spatial behaviour of the process by cellular automata models
SP: proper features for cellular automata in simulation systems, comparison of spatial/ temporal results with pure temporal results

C18 Neural Networks vs. Transfer Functions, SNE 43, (7/2005),
compares transfer function modelling and neural net modelling for given data of a nonlinear process
SP: proper features for neural net modelling in the simulation system, combination of transfer functions with neural nets for parameter tuning

C19 Ground Water Flow, SNE 44/45, (12/2005),
studies the flow of contamination in the ground water in 2D-space and time, allowing different modelling approaches for the spatial behaviour (numerical PDE solution, discretisation to ODEs, cellular automata, etc.)
SP: features for description of spatial dynamics, combination of spatial/temporal behaviour with temporal behaviour of control inputs

Solutions

Not only readers of SNE, but also all simulationists are invited to participate in these comparisons by providing a "solution" with the simulator under investigation.

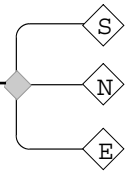
A solution should consist of:

i. a short description of the simulator,
ii. description of modelling technique,
iii. model description,
iv. results of the three tasks,
v. and additionally we ask for model sources

The printed solution should fit into one page of SNE – templates are found at our web page. Solutions sent in are reviewed. Table 1 shows a summary of comparison solutions.

A little bit of statistics:

- 20 comparisons
- 40 SNE issues
- 291 comparison solutions
- 7.3 solutions / SNE issue
- most popular comparisons:
  C7 – 14.1%, C1 – 13.1%, C2 – 11.3%



SNE	COMPARISON																				
	Sum	C1	C2	C3	C4	C5	C6	C7	CP	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19
0		Def																			
1	5	5	Def																		
2	8	4	4	Def																	
3	10	4	3	3	Def																
4	13	1	5	5	2	Def															
5	8	4	-	1	1	2															
6	5	-	2	-	2	1	Def														
7	7	1	2	1	2	-	1	Def													
8	5	-	1	-	-	-	1	3													
9	5	-	-	-	-	-	2	3													
10	7	1	2	-	-	-	1	2	D/1												
11	8	2	2	1	-	1	-	-	2												
12	7	1	-	1	-	-	-	2	3												
13	4	-	-	-	-	-	-	3	1												
14	6	3	-	1	-	-	-	2	-												
15	2	-	-	1	-	1	-	-	-												
16	3	1	-	-	-	-	-	1	-	D/1											
17	6	-	-	1	-	1	-	1	1	1	D/1										
18	5	-	-	-	-	-	-	2	2	-	-	D/1									
19	6	-	-	-	-	-	-	-	1	1	1	3									
20	5	-	-	-	-	-	-	1	-	1	1	2									
21	10	-	1	-	1	-	1	5	-	-	-	2									
22	10	1	-	1	-	1	-	5	-	1	-	-	D/1								
23	5	-	2	-	-	-	-	-	-	-	2	-	1								
24	7	1	-	-	1	-	-	2	-	-	-	1	2								
25	7	-	1	-	-	1	-	-	-	-	3	1	1								
26	11	2	1	2	1	1	-	1	-	-	1	1	1								
27	5	-	-	1	-	-	-	-	-	-	2	1	-	D/1							
28	7	-	-	2	-	1	-	-	-	-	2	-	-	2							
29/30	11	1	1	1	1	-	3	-	-	-	-	1	-	3							
31	6	-	-	-	-	-	-	1	-	-	-	-	1	3	D/1						
32/33	10	-	1	-	-	-	-	1	-	-	2	1	-	4	-	D/1					
34	5	1	1	-	-	-	1	-	-	-	-	1	-	1	-	-					
35/36	13	2	-	-	1	2	-	3	-	-	-	1	-	-	2	1	D/1				
37	11	-	1	-	-	1	-	2	-	-		2	-	-	2	2	1				
38/39	14	1	2	1	1	1	3	-	1	-	-	1	1	-	1	-	1				
40	9	-	1	2	-	1	1	-	-	-	-	-	1	-	-	1	1	D/1			
41/42	9	1	-	-	-	-	-	-	-	1	-	1	-	1	-	1	1	2	D/1		
43	8	-	-	-	1	-	-	1	-	1		1	-	-	1	-	1	1	-	D/1	
44/45	8	1	-	-	-	1	1	-	-	-	-	-	-	1	-	-	-	2	-	1	D/1
Total	291	38	33	25	14	16	15	41	12	7	15	21	9	16	7	6	6	6	1	2	1
	Sum	C1	C2	C3	C4	C5	C6	C7	CP	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19

Figure 1: Definitions and solutions of ARGESIM Comparions in SNE - per issue, per comparison, summed up for comparisons and issue, and summed up in total

Pollution in Groundwater Flow - Definition of ARGESIM Comparison C19

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Since many years the demand for pure water is increasing, as well for human consumption as well as an ingredient in industrial processes. In many regions, the surface water available does not suffice, so more and more ground water has to be used. Exploring existing ground water bodies uncovers unfortunately many polluted areas, sometimes with unknown pollutant sources. In this exploration, data can only be gathered via wells, which is expensive and sometimes not possible. Therefore, modelling and simulation of a polluted groundwater body can help in various cases: determination of the pollution plume, localisation of the pollution source, planning of facilities for decrease of pollution, etc.

Basis for modelling is the transport equation, describing the pollution concentration, a PDE with constant or state-dependent parameters and more or less complex boundary conditions. Consequently different modelling approaches and solution techniques can be applied, from classical discretisation methods via FEM to alternatives techniques like cellular automata, and Monte-Carlo methods. In simple cases also approximating analytical solutions may exist. In reality, the choice of a modelling method or solution technique, resp. may also depend on the data available, and on the aim of the simulation.

This comparison investigates different modelling methods and different solution techniques for three tasks with increasing degree of difficulty.

PDE Model for pollution concentration

Basis for modelling is the transport equation, describing the concentration $c(t, x, y)$ of a pollutant in the saturated zone of a homogenous two-dimensional ground water body. A simplified version of the transport equation is

$$\frac{\partial c}{\partial t} - \frac{u}{R}\frac{\partial c}{\partial t} = \frac{\alpha_L u}{R}\frac{\partial^2 c}{\partial^2 x} + \frac{\alpha_T u}{R}\frac{\partial^2 c}{\partial^2 y} - \lambda c$$

Table 1 shows parameter values being typical for the slow flows under investigation.

pore velocity in x - direction	u	$u=10^{-5}$ m/s
dispersivity	$\alpha_T = \alpha_L$	0.05 m
retardation factor	λ	0
degradation	R	1
thickness of the saturated flow	h	10m
effective porous volume	n_e	0.25
input rate of pollutant mass	M	2 mg/s

Table 1: Parameter values for pollution spread

The effective porous volume n_e is the fraction of the water bearing stratum (aquifer) that really contains water, e.g. a cubic meter of material with an effective porous volume n_e = 0.1 can contain up to 100 liters – this maximum is reached in the saturated zone (considered in these investigation). The h = 10 meters of soil therefore represent 2.5 meters of water.

Assuming a steady source of pollutant M in (0, 0) on an infinite area allows the approximating solution for the parameters given in table 1:

$$c(x,y,t) = \frac{c_0}{4\sqrt{\pi\alpha}\sqrt{r}} e^{\frac{x-r}{2\alpha}} \operatorname{erfc}\left(\frac{r-ut}{\sqrt{2\alpha ut}}\right)$$

$$c_0 = \frac{M}{hn_e u}, \quad r = \sqrt{x^2+y^2},$$

$$\operatorname{erfc}(x) = 1 - \operatorname{erf}(x)$$

Here it is assumed that the concentration is constant in the z - direction, and that retardation factor equals 1 (no retardation). For other parameter configurations, numerical techniques must be used in order to calculate a solution.

Task a: Simulation of unaffected pollution spread

Under simplified conditions, the concentration of pollution spreads from the source into x - direction like a plume (Figure 1). There exist a lot of approaches and numerical techniques for solving the transport equation. Aim of this task is to compare a numerical solution based on any technique with the approximate analytical solution for the simple case under investigation

For this purpose, an rectangular area with -10<= x <=60, -20<= y <=20 is to be chosen, with constant pollution source M = 2.0 mg/s in (0, 0) - other parameters see Table 1, with observation period of 150 days, and without pollution at starting.

Results should be compared with the analytical approximation at the line (50, *y*) at $t = 50$, $t = 100$, and $t = 150$ days (absolute values, differences).

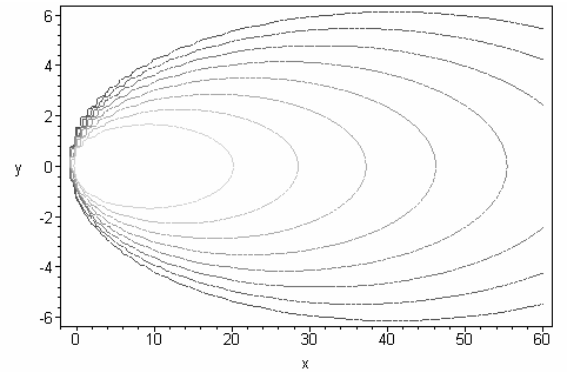

Figure 1: Pollution spreading from a pollution source, isolines

Task b: Pollution reduction by facilities

Main goal is to reduce or to eliminate the pollution. If the pollution source cannot be influenced directly, facilities can be set at certain locations reducing the pollution locally (wells with chemical substances, pumps blowing in oxygen for precipitation, etc.).
In the surrounding of such facilities locally elimination of the pollution takes place, reflected by an increase of the degradation parameter in the transport equation in a neighbourhood of the location.

The task is now, to investigate the influence of a facility with two plants starting with the steady state solution $c(x, y, inf)$. With K_0 being the modified Bessel function of second kind, and with c_0 and r as before, the steady state solution is given by

$$c(x, y, \infty) = \frac{c_0}{2} e^{\frac{x}{2\alpha}} K_0\left(\frac{r}{2\alpha}\right)$$

The facility consists of two plants situated at (40, 5) and (40, -5). Their influence on the pollutant is modelled by a change of the degradation parameter λ to the value of $\lambda = -10^{-6} ln 10$ in a circle neighbourhood with a radius of 5 m. The implication of this change is that the concentration drops to 10 percent for a control volume travelling exactly 106 seconds in one of those neighbourhoods. Figure 2 sketches the situation.

The task is now, to model this setup appropriately and to simulate the system starting from the steady state solution. As result, a plot of the lines (30,*y*), (40,*y*), and (50, *y*), -20 <= y <= 20 for $t = 100$ days should be shown.

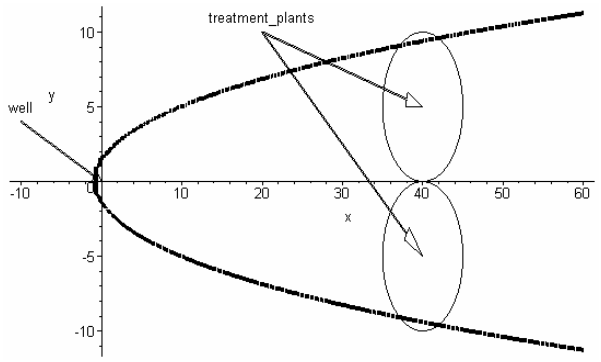

Figure 2: Boundary of pollution (thick line), influence areas of plants (thin circle lines)

Task c: Controlled pollution reduction by facilities

To minimize costs for operating the plants and to allow for maintenance, the hours of operation must be limited. A reasonable strategy lets the plants operate only during night and at weekend, so that maintenance can be done at regular working hours, and so that the cheaper electric energy during the night hours can be used.

This strategy can be modelled by a periodical change of the degradation parameter λ from $\lambda = -10^{-6} ln 10$ (plants on) to $\lambda = 0$ (plants off).

Task is now, to model this strategy appropriately and to simulate the system starting from the steady state solution with the following strategy: facilities are active Monday to Friday from 0 to 8am and from 8pm to 12 pm, and at weekends around the clock.

As result, plots against time are now appropriate: plot the concentration at (50,0), i.e. $c(50,0,t)$ for $0 <= t <= 150$ (days) for switched operation given above together with concentration for continuous operation (task b).

Solutions – Requirements and Structure

Solutions of any kind are appreciated, from FEM approaches to cellular automata, from discretisation methods to Monte Carlo methods, using simulators, libraries, packages or direct programming.
The solution should fit into one page SNE and consists of a description of the modelling approach, and of modelling and implementation details and results of the three tasks.

Solutions (to be sent to *sne@argesim.org*) may be accompanied by detailed PDF- or HTML – documentation and source code of the programs to be put on the ARGESIM server HTTP:/WWW.ARGESIM.ORG.

A Random-Walk – based Approach to ARGESIM Comparison C19 'Pollution in Groundwater Flow'

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G. Höfinger, ARCS Research Austria

Solution Approach: For this solution, a special Monte-Carlo method, a random walk (RW) in 2D is used. The pollutant is modelled as a finite number of particles with coordinates (x,y) and a concentration c. In each discrete time step Δt each particle is assigned a deterministic convective movement and a probabilistic dissipative movement:

$$x_{t+1} = x_t + u\Delta t + Z_x(2u\alpha\Delta t)^{\frac{1}{8}}, \quad y_{t+1} = y_t + Z_y(2u\alpha\Delta t)^{\frac{1}{8}}$$

Z_x and Z_y denote normally distributed random variables with $(\mu,\sigma)=(0,1)$. Each particle is assigned an appropriate amount of pollutant depending on the step size, on the source and on the depth of the aquifer.
Following [1], this approach converges under certain conditions to the solution of the transport equation.

Task a: Simulation of unaffected pollution spread.
Using a vector-oriented tool like MATLAB, a RW algorithm can be implemented in a few lines:

```
particles(time,:,1)=particles(time-1,:,1)+
          randn(1,perstep,1)*mult+xspeed;
particles(time,:,2)=particles(t-ime1,:,2)+
          randn(1,perstep,1)*mult;
```

There `particles` is a two-dimensional array for the coordinates, `mult` denotes the dissipative proportion and `xspeed` the convective fraction of the transport. For start, particles are fed into the system at (0,0). Calculation of the analytic solution (AS) is supported by MATLAB's standard function `erfc`.
The results show i) a qualitative coincidence between RW solution and AS solution for 50 days , a good quantitative coincidence at 100 days (Figure 1), and ii) no difference of RW solutions at 100 days and 150 days (a drawback of the RW method).

Task b: Pollution reduction by facilities.
Using MATLAB's `BesselK` function and using numeric integration, the concentration for each square of 1 x 1 m square is computed, so that an initial distribution of particles corresponding to the steady solution (SSL) is generated. Influence of the plants is modelled by varying the concentration (extension of the array of the particles).

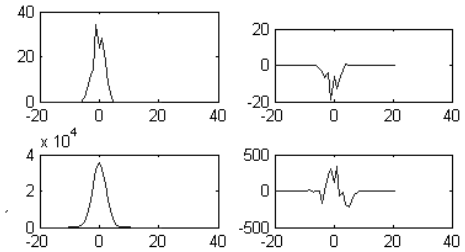

Figure 1: Concentration solution of RW (left) and absolute difference RW-SSL (right) for (50, y), t =50 (upper curves) and for (50, y), t = 100 (lower curves)

In each time step, particles inside the circles change their concentration by $\exp(\lambda\Delta t)$. Results (Figure 2) show the decreased concentration for the lines after the plants.

Due to the nature of RW, these solutions do not depend on the initial distribution (SSL), as all particles generated from SSL leave the given rectangle -10 <= x <= 60, -20 <= y < =20 before t = 100 days.

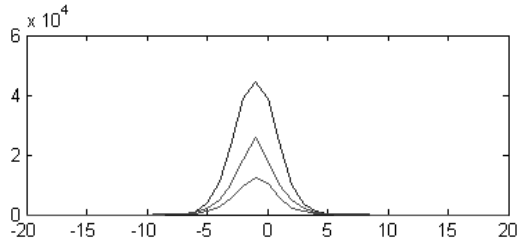

Figure 2: Decreasing concentration of pollution for (*30,y*), (*40,y*), and (*50,y*) at t =100 days

Task c: Controlled pollution reduction by facilities
To model the control of the plants, a boolean function switches on and off the reduction factor used before. Results (Figure 3) show, that pollution concentration during switched operation is 2.5 times higher than concentration during continuous operation. In switched operation, oscillating bebaviour can be observed (upper curve). The oscillations in continuous operation are due to the random nature of RW.

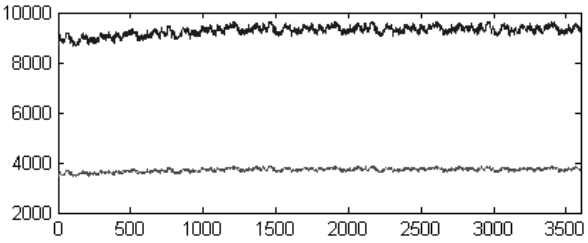

Figure 3: concentration at (50,0) for 0 to 3600 hours in mg, switched operation - upper curve, continuous operation - lower curve

[1] Kinzelbach, W., 1986. Groundwater Modelling - An Introduction with Sample Programs in BASIC, Elsevier Science Publ., Amsterdam

A numerical Solution to ARGESIM Comparison C5 'Two State Model' with SAMT/DESIRE

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Simulator: SAMT/DESIRE is a simulator included in the GIS system SAMT. DESIRE originally was written by Granino Korn and was distributed as commercial version for Windows and as free version (OPEN DESIRE) for Linux. OPEN DESIRE was included in SAMT to perform geographical analysis of spatial data, but SAMT can be just used as a graphical user interface for DESIRE. SAMT/DESIRE comes on CD with a Knoppix Linux distribution, so also Windows users can boot Linux and SAMT/DESIRE directly from CD. DESIRE is a very fast simulator, handles also vector and matrix ODEs and neural nets.

Model. In DESIRE a complete simulation program consists of a so called experiment protocol program and (usually) one DYNAMIC segment with the ODE model. In the experiment protocol all parameters and initial values are set and the number and way of calls of the DYNAMIC segment is specified (Table 1).

DESIRE provides no state event handling. Consequently a hybrid approach is chosen:

- the simulation (started by `drun`) stops, if the `limit` is reached (`term` in DYNAMIC)
- in the experiment protocol the parameters `c2` and `c4` are changed
- the simulation is restarted (`drun`)
- this sequence is controlled in a `while` – loop

```
210 irule 4 | TMAX = 6 | DTMIN=10^(-15)
220 DT=10^(-12) | ERMAX=10^(-11) | NN=100000
290 STATE y1, y2 | y1=4.2 | y2 = 0.3
300 c1=2700000 | c3 = 3.5651205
320 c21=0.4 | c41 = 5.5 | c22= -1.25 | c42=4.33
340 c2=c21 | c4=c41 | eps1=c21-c22 | eps2=c41-c42
370 actst=1 | limit=5.8 | plm=-1
400 drun |write t, y1
440 while t<5.05
450   actst=abs(actst-1) | plm=-(actst-0.5)*2
470   c2=c22 + actst*eps1 | c4=c42+ actst*eps2
490   limit = limit + plm*(-1.7)
500   drun | write t, y1
530   end while
540 ------------------------------------------
550 DYNAMIC
560 d/dt y1 = c1 *  (y2 + c2 - y1)
580 d/dt y2 = c3 *  (c4 - y2)
590 term plm*(limit-y1)
```

Table 1: Mixed Model / Experiment description in DESIRE

Task a – Plot of State and Trace of Switching Times with Standard Accuracy. DESIRE offers ODE solvers for stiff systems, but stepsizes become too large to meet a switching point. Therefore a Runge-Kutta 4/2 with stepsize control and maximal stepsize is used. Figure 1 shows the result for $y_2(t)$ with switching times 1.10833, 2.12972, 3.05421, 4.0756, and 5.00009 for standard accuracy.

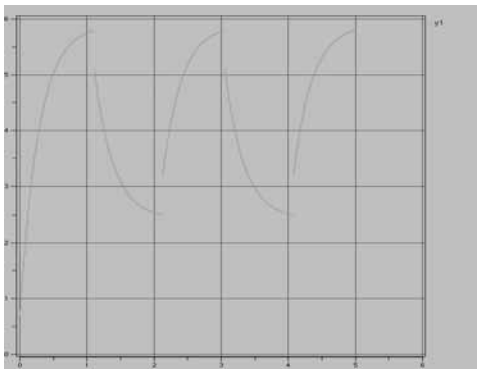

Figure 1: State plot with switching points, task a

Task b - Trace of Switching Times with Higher Accuracy. Even with very small error tolerance and further tuning of the integration parameters no better results are obtained. As a state event algorithm is missing, the integration of the ODEs is stopped, as soon as the state has exceeded the limit, and not as soon the state reaches the limit (the difference is about the stepsize.

Task c – Plot of State and Trace of Switching Times at High-Frequent Switching. Interestigly, DESIRE has no problems with high-frequent occurrence of switching points (Figure 2). No model changes are necessary; clearly, the while loop is passed much more frequently, giving switching points within accuracy of the stepsize:
1.10833, 1.12177, 1.23565, 1.24909, 1.36291….
……., 4.81337, 4.92719, 4.94063

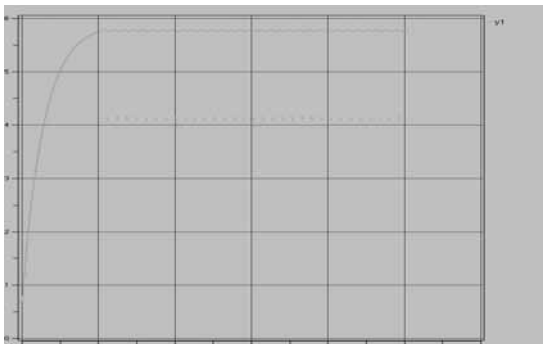

Figure 2: State plot with high-frequency switching, task c

Classification: Numerical Approach without state event handling
Version: SAMT/DESIRE 1.0

A Transaction-Oriented Approach to ARGESIM Comparison C6 'Emergency Department- Follow-up Treatment' using GPSS World

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Simulator. GPSS World is a high powered general purpose computer simulation environment, designed for recurring use by simulation professionals. It is a comprehensive modelling tool covering mainly discrete computer simulation. GPSS World is based on the well known very fast compiling simulator GPPS, controlled by a comfortable Windows environment.

GPSS World is object oriented, based on so-called transactions (of entities through blocks). Its inhabitants include *Model Objects* which are used to create Simulation Objects. *Simulation Objects*, in turn, are used to play out simulations and create *Report Objects*. Finally, *Text Objects* can be used as include-files to support code sharing and a user source code library and they are often used as files which can be read from or written to by the simulation.

Model: An emergency department is modelled, where four kinds of causalities are admitted for patients. Their way trough Causality Ward, X-ray and Plaster Room depends on the severity of their wounds.
Figure 1 shows the textual model environment of GPSS World. There several BLOCK commands can be written to model all needed transactions.

C6 task a.gps

```
            GENERATE   (EXPONENTIAL(1,0,18))
            QUEUE      qall
            ASSIGN     ent,0
            ASSIGN     cw,2
            ASSIGN     rvalcw,(UNIFORM(1,0,1
regist      SEIZE      regstr
            ADVANCE    V$timereg
            RELEASE    regstr

patient     ASSIGN     rval,(UNIFORM(1,0,1))
            TEST GE    P$rval,0.35,first
            TEST GE    P$rval,0.55,second
            TEST GE    P$rval,0.6,third
```

Figure 1: GPSS World model, routing of patients (entities) through stations (blocks)

Special values are assigned to the generated transactions, telling which kind of patient the transaction represents. Depending on these values, the transaction makes their way trough the system. Every time a patient transaction exits a treatment point, new values are assigned.

The statistical evaluation is automatically performed by GPSS World and shown in the report after the simulation. Therefore QTABLE commands and QUEUE Blocks are used.

Task a – Classical Sequential Strategy.
Depending on the type of patient the treatment time takes between 93 and 209 minutes, with overall treatment time of 381 minutes (detailed results in Figure 1).

Task b - Doctors' Exchange Strategy.
As soon as the queue before causality ward 2 contains more than 20 patients the more experienced doctor takes over.
This strategy yields an increase of treatment times for all types of patients, for the standard deviation, and also for the overall treatment time.

In task a and in task c the doctors are realized by STORAGE Blocks. In this case four FACILITY Blocks have to be used to model each doctor, in order to model independent treatment times. The changing of the doctors is implemented by TEST and SAVEVALUE Blocks.

Task c - Priority Strategy.
The patient transactions get the PRIORITY 1 if they are leaving the causality wards after treatment. Depending on this marks, a priority ranking is established in the queues (standard feature in GPSS World).
Results show a decrease in treatment time for patients of type 1 and 3, an increase for the others. The standard deviation and the overall treatment time decrease (Table 1).

mean time	task a	task b	task c
patient 1	199	214	120
patient 2	94	102	134
patient 3	209	220	140
patient 4	93	99	116
Std.dev. (1-4)	83	92	72
ov.treat.time	381	414	364
close hour	13:51	14:24	13:34

Table 1: mean treatment times of individual patient types, standard deviation for patients 1-4, and mean for overall treatment time - depending on routing strategy

Classification: Transaction-oriented DEVS Approach
Version: GPSS World 2005, Student Version

Am Alternative Identification Approach to ARGESIM Comparison C15 'Clearance Identification' using MATLAB

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Simulator: MATLAB is commonly used software, which allows easy vector and matrix manipulation and rapid prototyping. Version 6.5 of MATLAB, in conjunction with the Optimization Toolbox, was used for simulation as well as parameter identification of the given model.

Model: The system of differential equations was solved analytically with some help of MATLAB's symbolic toolbox and then coded in MATLAB functions. In order to implement the bolus injection correctly, the homogeneous ($f(t)=0$) and inhomogeneous systems were solved separately and connected at $t = \tau$.

Task a - Simulation of the System. For the three different bolus injections, Table 1 and Figure 1 show the results, calculated by evaluation of the analytic solution functions.

$\tau_1 = 0.5$	$\tau_2 = 3$	$\tau_2 = 240$
$x_1(1.5) = 320.90$	$x_2(4.5) = 302.58$	$x_3(240) = 145.26$

Table 1: Values of x_1 for different bolus injections

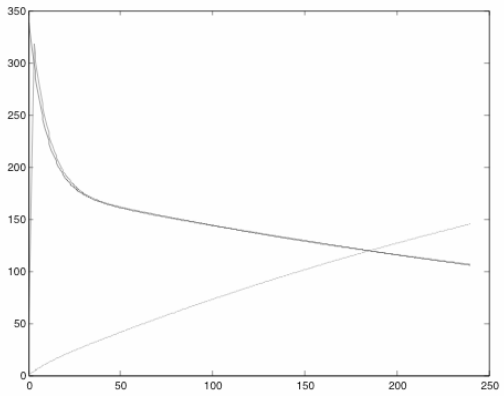

Figure 1: Simulation results for different τ

Task b –Identification. For identification, an alternative approach for measuring the error was used. The main idea was to make use of the Euclidean distance in $\boldsymbol{R}^2$ instead of $\boldsymbol{R}^1$ for constructing the error criterion, thus also allowing for inaccuracy in time instants. Therefore the usually used criterion E_p was replaced by $E_{p,s}$:
The hidden parameters s_i were introduced for modelling the normal distance.

$$E_p = E(\vec{p}) = \sum_{i=1}^{n} (c(t_i;\vec{p}) - c_i)^2$$

$$E_{p,s} = E(\vec{p},\vec{s}) = \sum_{i=1}^{n} ((c(t_i;\vec{p}) - c_i)^2 + (s_i - t_i)^2$$

$$\vec{p} = (k_{01}, k_{12}, k_{21}, V_1) \quad parameters$$

$$\vec{s} = (s_1, s_2, \ldots, s_n) \quad hidden\ parameters$$

$$(c_i, t_i)\ \ 1 \le i \le n \quad measurements$$

There is no local minimum of $E_{p,s}$ as long as the points on the graph of $c(t)$, belonging to the time values s_i, do not represent locally closest points to (c_i, t_i). The minimization of $E_{p,s}$ for p_i and s_i was done using MATLAB's function `lsqnonlin` (Levenberg-Marquardt algorithm).

The resulting parameters are k_{01} =0.0031, k_{21}=0.0244, k_{12}=0.0385, and V_1=8.67. The resulting maximum of c was 286.34, clearance 26.7 and the residuum 109.68. Figure 2 shows the resulting plot of $c(t)$.
The blue crosses mark the measurements; the red crosses mark the identified values of $(s_i, c(s_i))$. Confirming our considerations, these identified values nearly gave the points were the normal distances are reached.

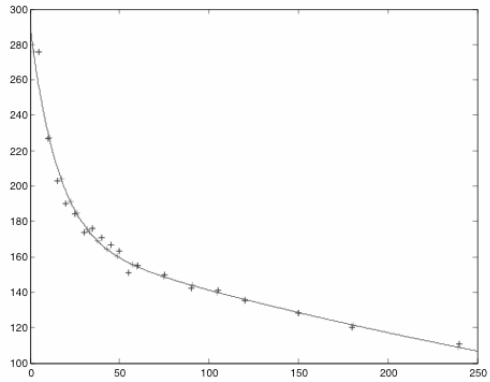

Figure 2: Measurements and identified function

Task c- Error Estimation. Data are disturbed by adding random vectors, for each set of disturbed data the identification procedure is performed. Results after 1000 identifications are given in Table 2

	k_{01}	k_{12}	k_{21}	V_1
mean	0.00308	0.03853	0.02488	8.63667
std.dev.	0.00036	0.00486	0.00352	0.20756

Table 2: Statistics for identification of parameters with disturbed measuments

C15 Classification: Analytical / numerical Approach, Alternative Identification
Version: MATLAB Rel 13 SP2

A List-Programmed Solution of ARGESIM Comparison C16 'Restaurant Businesses Dynamics' using Maple

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Simulator. MAPLE has been developed as a symbolic formula manipulation program, and is now also a numerical analysis tool. It has become one of the most used programs in this area.

Model. This comparison aims to simulate and optimize a discrete dynamic system and was programmed directly using MAPLE (version 9.5). At the beginning of the simulation, persons are randomly distributed over a rectangular area.

The people density of each cell is once calculated. The restaurant density is also calculated at the beginning, but updated each time a restaurant closes down or opens a new restaurant. Each time step represents one day. After seven days each restaurant pays a fixed running cost and the weekly tax to the government. According to the profit, restaurants open new restaurants or close down with given probabilities.

As size of Maple lists can be changed, lists have been used to store data about restaurants' coordinates and weekly revenue. Also for persons a Maple list has been stored to keep a list of `restaurants` in range. The algorithm in Table 1 shows how the variable `restaurants` updates when a restaurant opens a new restaurant:

```
While restore> 0 do
Place: =[ uniform[ 0, 20](1),uniform[ 0, 20](1)]:
Restaurants: = [ op (restaurants),
 [ cell index [ 1, opt cell] [ 1] +place [ 1],
  cell index [ 1, opt cell] [ 2] ¡ place [ 2], 0]]:
Restore: =resttoopen¡1:
End does:
```

Table: Update of restaurant number, Maple code using lists

Task a - Time Domain Analysis. The system was simulated for 1, 5 and 10 years, results shown in Figure 1. In the sub-task, multiple (50) simulation runs have been accomplished and got six restaurants as the average value of number of restaurants after the 5th year.

Task b - Maximization of Tax Income. To maximize the tax rate was varied in a loop from 5% to 60% with a step width of 1%, with time domain simulation over three years.

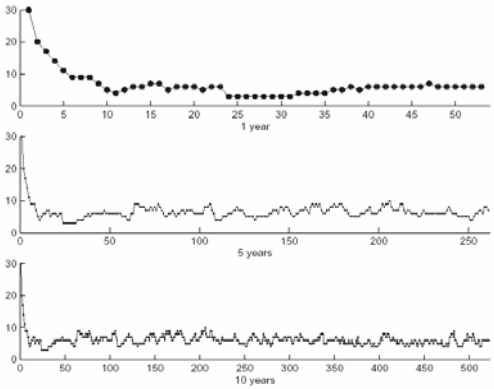

Figure 1: Number of restaurants over time, for an observation period of 1 year (uuper curev), 5 years, and 10 years (lower curve).

The highest tax income for the government is reached by a tax rate of 34%. The highest tax income for the government is reached by a tax rate of 34%. At very low or high tax rates the government reaches less tax income, except some outliers. Results are given in Figure 2

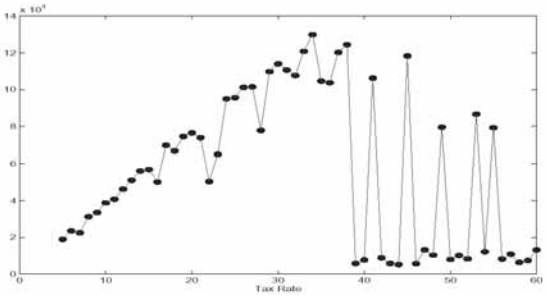

Figure 2: Tax Income over tax rate, observation 3 years

Task c - Maximization Restaurants' Revenue. First the system was simulated over one year, for each value of the parameter *k* (steps of ½). Then this procedure was repeated 3 times, in order to make the stochastic influence smaller. The averages for the revenues are shown in Figure 3 (optimum for k = 1).

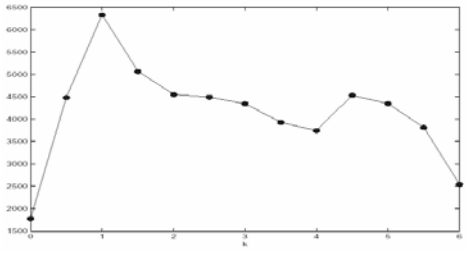

Figure 3: Restaurants' revenues over distance parameter k

C16 Classification: Directly Programmed Solution
Version: Maple 10.1

A DEVS – Approach to ARGESIM Comparison C16 'Restaurant Business Dynamics' using MatlabDEVS

Olaf Hagendorf, Gary Colquhoun, Liverpool John Moores University
Thorsten Pawletta, Sven Pawletta, Wismar University
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Simulator: The MatlabDEVS Toolbox is a DEVS Simulator realized as an object oriented Matlab Toolbox. With the usage of Matlab the simulator shares all advantages and disadvantages of this well known and widely used SCE. The toolbox implements to the greatest possible extent the Abstract Simulator introduced by Zeigler ([1]). It was extended by port definitions and capabilities to simulate dynamic structures by a formalism introduced by Pawletta et. al. ([2]).

Model: The model is implemented as a structure variable coupled DEVS model `MODEL`. This coupled model contains the following atomic models:

- two generators `gen_people` `gen_week` (one for the people going out to eat, another to force the calculation at the end of a week
- a model `switch` to choose a restaurant for a person from the list of possibilities
- a varying number of `restaurant` models (after initialisation 30, then changing)

Figure 1 shows a graphical representation of the model `MODEL` after some weeks of simulation. Through the usage of a *Dynamic Structure* instead of an ordinary DEVS model the *Real World* structure is always mapped in a one to one manner. The simulator needs ca 2300s to simulate 10 years, with a dependency on the number of restaurants.

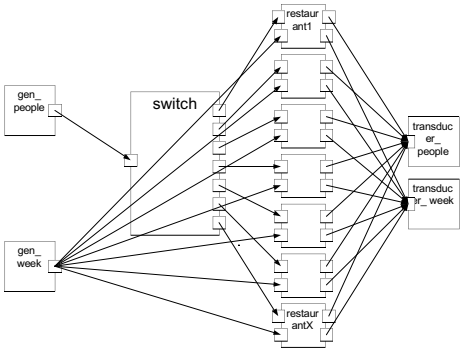


Figure 1: Representation of `MODEL`

Task a - Time Domain Analysis. The warm up period is finished after ca 30 weeks. Figure 2 shows the development of the mean number of restaurants over a simulation time of 10 years and 50 runs.

Results after 5 years are min 3.42, max 4.2, mean 4.24, standard deviation 0.129, and variance 0.026.

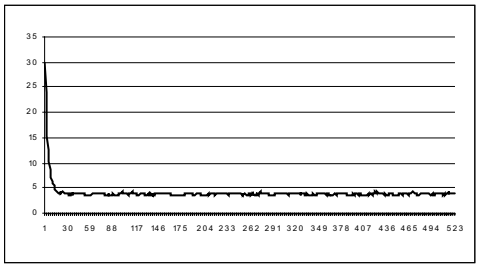


Figure 2: Development of mean number of restaurant in 10 year simulation time

Task b - Tax Income Maximisation. It is possible to use the built-in Matlab optimisation functionality. In this case the `fminbnd` method is suitable. It determined the best tax rate at 39.23%. Figure 3 shows the mean tax income in the tax range from 1% to 99%

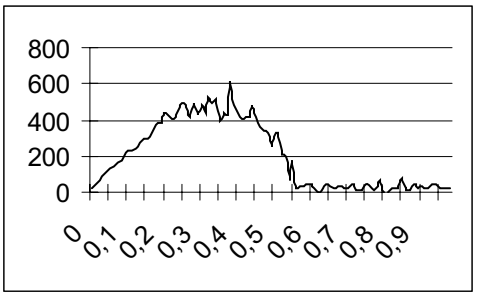


Figure 3: Mean tax income over tax rate fractions

Task c - Restaurants' Revenue Analysis. The simulation with varying parameter *k* did not have an obvious maximum. The results, shown Figure 4, have two very close maxima (difference of only 2.2%)

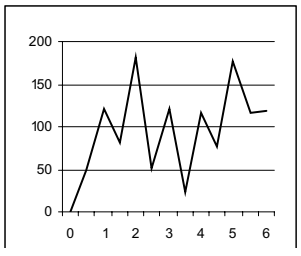


Figure 4: Restaurant revenues over distance parameter *k*

[1] Zeigler B.: Theory of Modelling and Simulation. Wiley-Interscience, Academic Press, 2000

[2] Pawletta Th., et al.: A DEVS Based Approach for Modeling and Simulation of Hybrid Variable Structure Systems. Lect. Notes in Control & Informat. Sciences No. 279, pages 107-129, Springer

A NN - Toolbox-based Solution to ARGESIM Comparison C18 ‚Neural Nets / vs Transfer Functions' with MATLAB/SIMULINK®

Günther Zauner, Julia Funovits, TU Vienna
Guenther.Zauner@gmx.at, julia.funovits@gmx.at

Simulator: MATLAB is a widely used software tool based on numerical vector and matrix manipulation. This comparison was solved with SIMULINK, which is a MATLAB-toolbox for graphical modelling and numerical simulation of continuous and discrete systems.

Task a - Identification with linear model. A discrete transfer function block was implemented in Simulink, and the MATLAB function `fminsearch` was used to identify the parameters of the 2nd order discrete-time model (given below).
Figure 1 shows that the general system dynamics can be described by the linear model (given below), but details are not matched:

$$G(z) = \frac{0.5441z^2 - 0.5405z}{1.044z^2 - 1.6285z + 0.5891}$$

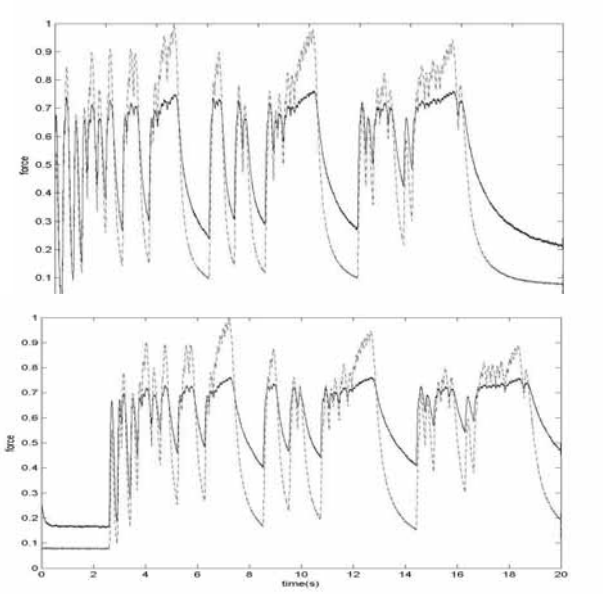


Figure 1: Simulated (solid line) compared with measured force (dashed line); training set- above, validation set- below

Task b - Linear model with ANN in parallel. A network structure with seven neurons in the first layer and one neuron in the output layer was described in SIMULINK (using the Neural Network Blockset) in parallel to the linear discrete model (Figure 2).

After training, the neural net 'compensates' the nonlinearities in the data, which cannot be matched by the linear model, well. Results are similar to task c, also with similar least square error.

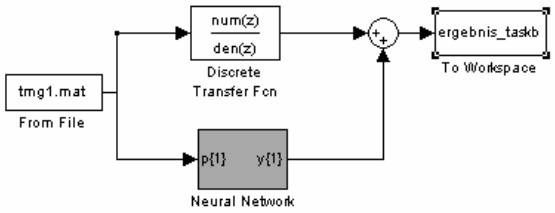


Figure 2: Top-level model representation of task b.

Task c - Identification with dynamical ANN. Again, the network, now a dynamical one, can be directly described and trained in SIMULINK (Figure 3).
The network input is the measured muscle thickening and the target is the muscle force. The results are presented in Figure 4.

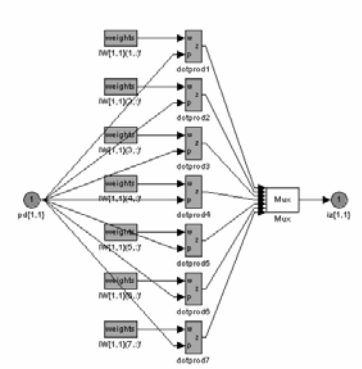


Figure 3: Structure of the first layer of the dynamical Neural Network in SIMULINK.

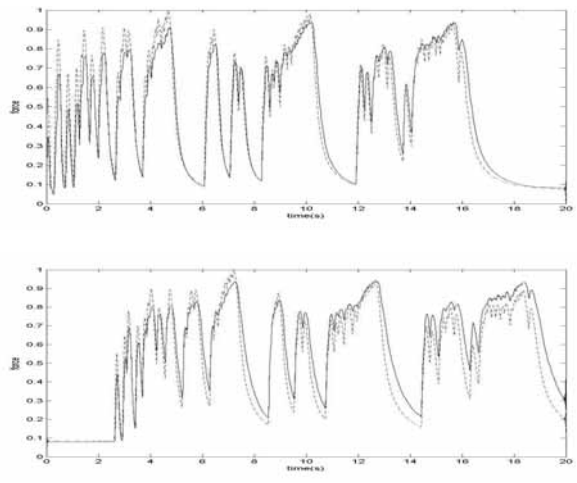


Figure 4: Simulation of the neural network model (solid line) compared with measured force (broken line).
Training set- above, validation set- below.

C18 Classification: Graphical NN Toolbox - Approach
Version: MATLAB / Simulink Rel. 14 SP2

The MATHMOD YoYo – Simulation Challenge - a News Benchmark for Modelling and Simulation

H. Ecker, F. Breitenecker, Vienna University of Technology; *Horst.Ecker@tuwien.ac.at*

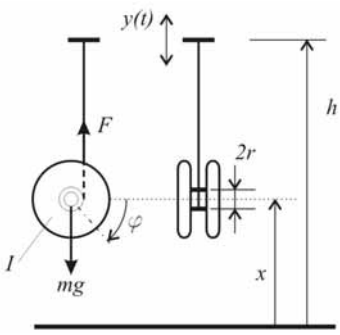
In the 1980s, the first comparisons and benchmarks for simulation software appeared, Checklist and Benchmarks (PHYSBE, Pilot Ejection, etc.). In 1990 ARGESIM started the so-called *ARGESIM Comparisons*, well-known test examples not only for simulation software, but also for modelling. Frome time to time special benchmarks appear, like the Coffeepot Benchmark, set up by R. Huntsinger on occasion of bad coffee at a simulation conference.

Another special benchmark, the *MATHMOD Yo-Yo Simulation Challenge* was initiated at the 4th MATHMOD Conference in Vienna, 2003. Participants had opportunity to train their skilfulness with a real yo-yo play, a promotion gadget (see Figure left).
On occasion of 6th MATHMOD Conference Vienna (February 2006) the Yo-Yo Challenge is started officially.

The yo-yo is a well know toy around the world and since a long time (evidence around 500 B.C. in ancient Greece). Although a yo-yo may look very simple, modern yo-yos can have mechanical parts inside, like bearings and clutches, which make it possible for experienced yo-yo players to do amazing tricks.

System Model. From the viewpoint of modelling and simulation even the simplest yo-yo is quite challenging. In general a basic yo-yo has to be considered as a free rigid body with a flexible string attached to it. A full mechanical model would require 6 degrees of freedom just for the yo-yo body. Equations of motion are coupled and nonlinear if large deflections are considered in all directions of motion. Discontinuities occur in the model, when the motion is restricted by the fully extended string.

Control. Operating the yo-yo adds another level of complexity. A control system has to be added, which should represent the human yo-yo player, including his vision system and tactile sensors. At least appropriate state variables of the model need to be processed in a feedback loop of a controller with a suitable control strategy.



Modelling. However, rather simple models can be derived, when only the vertical position of the yo-yo is considered. Upon fully unwinding the inextensible string, an impact will occur at the bottom position, reverting the vertical motion of the yo-yo, while the rotational motion is maintained.
A simple form of yo-yo operation is to move the upper end of the string periodi-cally in the vertical direction.
Real world yo-yo players feel challenged by mastering tricks with their toy on different levels of difficulty.

Yo-Yo Challenege. The idea of the MATHMOD Yo-Yo Simulation Challenge is similar: to create computational models of increasing complexity simulating the dynamic behaviour of a yo-yo.
One may start out from a very simple single-degree of freedom system as outlined above. It will show the basic vertical motion of spinning downwards, the state event of an impact with energy loss, and the upward motion after the bounce back. Model fidelity can be enhanced by adding features like aerodynamic damping and friction between the yo-yo and the string, the effect of de- or increasing the spool radius, the lateral (pendulum) motion, and others.
Of course, a more realistic model would also include a control system, allowing at least operating the yo-yo continuously within a certain vertical range. A really impressive model might even be able to simulate some of the tricks one can do with a yo-yo, for example to operate the upper end of the string in such a way that the center of gravity always stays at nearly the same altitude while the yo-yo winds and unwinds the string..
Data. Only very few data are necessary to describe a simple yo-yo model. For the MATHMOD yo-yo one may assume a mass of 0.03 kg and a mass moment of inertia of about 1.0E-5 kgm^2. The radius of the axle is 5mm and the length of the string is 1 meter.

Call for Solutions. Simulationist, mechanical engineers, control engineers, etc. are invited to participate and to develop and implement a model of the dynamics of a yo-yo play with modelling method, modelling software, and simulation software of their choice. Solutions should be sent to sne@argesim.org, to be published in SNE and / or at the ARGESIM website WWW.ARGESIM.ORG.

[1] Jin, H.-L., Zackenhouse, M.: Yoyo Dynamics: Sequence of Collisions Captured by a Restitution Effect. Trans. of ASME, Vol. 124, (2002), pp.390.

[2] Zlajpah, L.: Robotic yo-yo: modelling and control strategies. To appear in Robotica in 2006.

From Simulation to Algorithmic Art

Vlatko Ceric, University of Zagreb; *vceric@efzg.hr*

In October/November 2005 I had my first exhibition of computer graphics in Zagreb, Croatia. Soon after that I put graphics from the exhibition on the Web and informed about that my friends and colleagues who were not able to attend the exhibition. Among others I sent this information to Professor Felix Breitenecker. In his reply Felix sent me an unexpected offer – he asked me to write a story about my new 'profession' (his words) for the *Simulation News Europe* and to present some of my graphics. I decided to accept this offer, and here is a short story about my work in computer graphics.

The story starts during my work on master degree in physics at the Institute of Physics in Zagreb. At about 1973 we got the first table programmable calculator, and after a while I realized that I was spending quite some time in writing programs for it. Finally I decided to leave Institute and to start working with computing. In 1974 I was already employed in the computing group at the civil engineering enterprise that was using IBM 1130 computer (later IBM/370). Besides everyday job in developing computer programs and running various applications, I spent some time in de-veloping computer graphics produced on printer so that graphics consisted of letters, numbers and special symbols.

In the mid and late 1970th I privately purchased Commodore 64 small computer equipped with the BASIC programming language. Since the output was on the TV screen, it was possible to program continuous graphics with colours. It was a real fun, and I spent many nights programming graphics – my family liked them, but I was not showing them in public. It is interesting that on this slow machine graphics were emerging on the screen gradually, which gave the effect of nice animation!

I was occasionally working with computer graphics after that, e.g. in University Computing Centre in Za-greb where I was working from 1979 – 1989, and where I started working with computer simulation on UNIVAC 1100 mainframe. In 1989, when the era of personal computers was well underway, I moved to the Faculty of Economics, University of Zagreb, but neither high quality graphic cards nor colour screens were available for some time yet. At the end of 2000, when my first grandson Vilim was a little over one year old, I started worrying that in a few years he will play on a PC with some cruel games.

And I thought that I might develop some more creative software with graphical, dynamic and interactive character for him. I purchased Liberty BASIC programming language and I did a part of the job for my grandson. However, in the meantime I discovered that I was spending more and more time developing computer graphics since hardware and software finally had excellent potential for doing that. After a year or so I discovered that Mathematica software has exceptional programming and graphical abilities, and after that I am working with both of these programming tools. I developed several dozen of different type of graphics, some of them discrete and some continuous, some in black and white and some in colour.

I was producing these graphics when I was not too busy with 'serious' job, and I was working just for myself, so that only a few members of my family have seen them. Graphics appeared only on the computer screen and I printed just a few of them, e.g. for my late mother. My friends were quite surprised with the exhibition and asked me why I was keeping this activity as a secret. But actually I didn't hide anything - I was just working for my own pleasure.

It was in early 2005 when my son Ranko who graduated visual arts suggested me to show these graphics in public. Then I presented some of the graphics to the owner of the Canvas gallery in Zagreb; after he saw them he simply asked me when I want to make an exhibition in his gallery! This was quite a surprise for me, and I got the necessary momentum to start working on a series of graphics that could form a coherent collection. It was not as easy as it seemed to me, so I spend a couple of months before I formed the first coherent series of graphics with help of the gallery owner. But I learned the lesson, and I was able to form the second graphical cycle alone.

I had to learn a number of other things about graphics, too. First of all, there is this huge problem with difference in colours when you see them on the screen and when one prints them; this difference appear since screen is the source of the light while paper absorbs and only partially reflects light. Therefore it is virtually impossible to get the same colour effect on the screen and on the paper.

Another thing that I had to learn is how serigraphy is functioning, since one of the graphical cycles was planned to be realized in this technique. For example, some colours can cover some other colours, but cannot cover others. So the process of preparing graphics for serigraphy has to be carefully planned.

Now a few words about creation of graphics on the computer. From the very beginning of developing computer graphics my principle was to create them exclusively by programming, without any subsequent intervention on it (with Photoshop or similar tools). Therefore I was using only general purpose rather than specialized graphically oriented programming languages. I want graphics to be fully contained in the algorithm of the computer program that generates it, so that all my efforts are concentrated in constructing the appropriate algorithm.

However, one can hardly do it at once, with the first version of the program; after you produce a graphic and see it on the screen, then you check its aesthetic value and typically want to make some change; so you try to make an appropriate change in the program, check the resulting graphic, etc. So, it is an iterative process in which you constantly mix the rational component required for programming, and the irrational one required in checking the visual appearance of the graphics generated by the program code.

Such computer graphics are named 'algorithmic art', since graphics are fully based on computer pro-grams that contain precise algorithmic description of the way graphic is to be produced. A comment of my colleague from Budapest after he saw the exposition was quite interesting: his view was that I was not working something completely different than computer modelling, but that I rather found a different way of expression. And it seems to me that this may be not too far from the truth.

My computer graphics could be divided into two classes: constructivist and complex ones. For constructivist type of graphics one has to have a rather precise idea of how the graphic should look like, and try to build an algorithm that will generate a construct that was imagined. However, this doesn't mean that the author doesn't need to try various alternatives of structures and colours. Example of this type of graphics in my exhibition was a Cartesian rhythm series of graphics (that were produced as serigraphy) - see first picture at right.

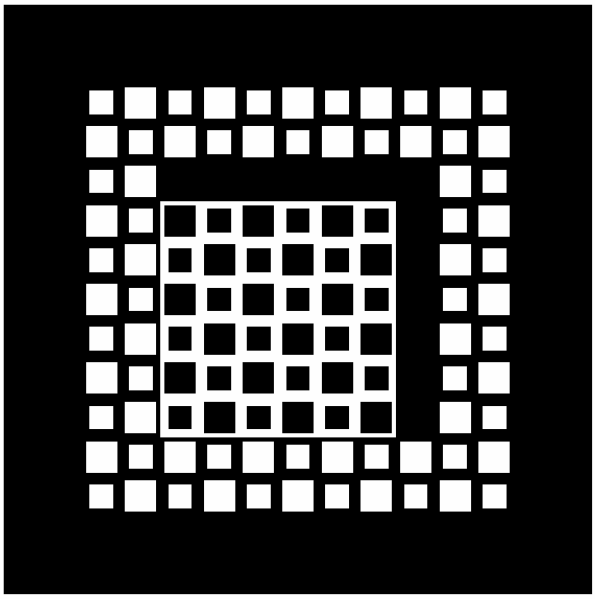
Second type of graphics I am developing is more complex graphics based on algorithms consisting of different mathematical constructs. Let me mention here that my experience shows that a complex graphical form doesn't always require a complex algorithm; moreover, more complex algorithms doesn't by any means guarantee more interesting graphics. In any case, for this kind of graphics it is far more difficult to predict precisely what the output will be, so that they require much more experimentation, especially in obtaining a series of consistent graphics. Example of this type of graphics on my exhibition was an Evolution series of graphics (that were produced as ink-jet prints) - see 2nd picture below..

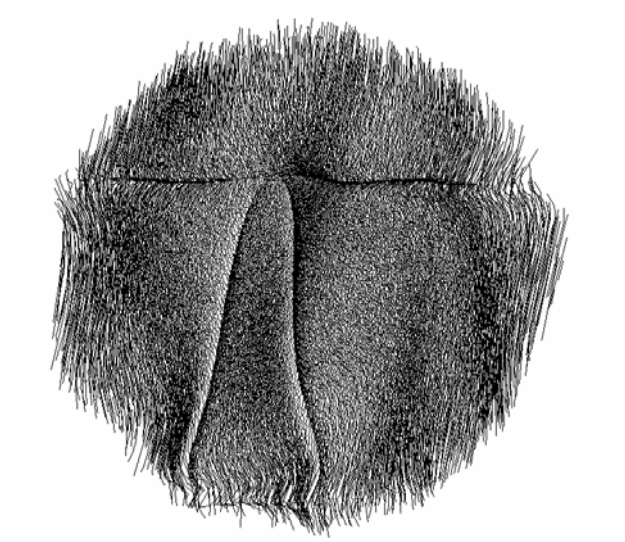
At the end, if some of you would like to see all the graphics from the exhibition and find more information about it, here is the Web address:

HTTP://FREE-ZG.HTNET.HR/VCERIC/GRAPHICS/

These Web pages also contain information about algorithmic art, as well as about important artists from this field.

Vlatko Ceric: Professor at Graduate School of Business and Economics in Zagreb, co-founder and first president of the Croatian Simulation Society (CROSSIM)

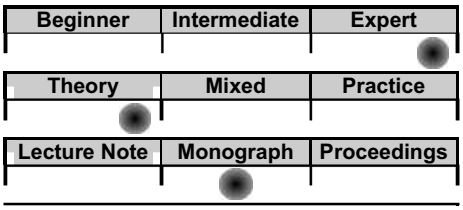




The Mathematics of the Bose Gas and its Condensation

Elliot H. Lieb, Robert Seiringer, Jan Philip Solovej, Jakob Yngvason; Birkhäuser Verlag 2005; ISBN 3-7643-7336-9

This book contains a survey of the mathematically rigorous results about the quantum-mechanical manybody problem that have been obtained by the authors in the past seven years. It addresses a topic that is not only rich mathematically, using a lot of techniques of mathematical analysis, but is also one with strong relations to current experiments on ultracold Bose gases and Bose-Einstein condensation. The book provides an entry into an active area of ongoing re-search.
The mathematical study of the Bose Gas goes back to the first quarter of the twentieth century, with the invention of quantum mechanics. The Indian physicist S.N. Bose provided good ideas for describing the statistics of photons. Einstein applied these ideas to massive particles, such as a gas of atoms, and discovered the phenomenon that we now call Bose-Einstein condensation.
There are still mathematical problems open for the description of the Bose-Einstein condensation and this book summarizes the most important rigorous results that have been obtained by the authors in the last years.



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Continuum Thermomechanics

Alfredo Bermúdez de Castro
Birkhäuser Verlag 2005; ISBN 3-7643-7265-6

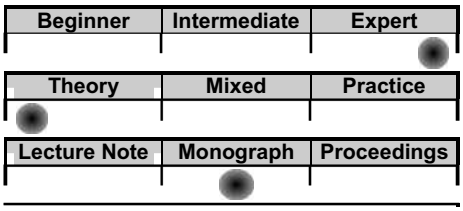
The purpose of this book is to give a modern and unified approach to continuum mechanics and thermodynamics in a rigorous mathematical framework.

The target groups are students, researchers and engineers interested in these fields or in mathematical modelling and numerical simulation in solid and fluid mechanics, acoustics, heat transfer, chemistry or combustion.

The book contains an introduction to the fundamentals in continuum thermomechanics which includes not only the most used equations in solid and fluid mechanics but also the precise definition of the classical mechanical and thermodynamical parameters characterizing the material behaviour as well as many thermodynamical equations relating them.

Solids and fluids are introduced in a unified approach as a particular case of a general material. Thus the model linearization can also be made in a unified way and afterwards the obtained linear models are specialized for fluids. This leads to the classical models for linear vibrations of thermoelastic solids and for wave propagation in fluids
Through the general approach it is possible to present such different applications as acoustics or equilibrium chemistry.

This book has been used for many years as a textbook for graduate and undergraduate mathemat-ics students at the University of Santiago de Compostela.



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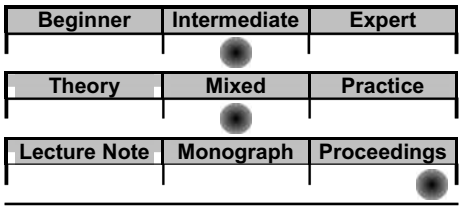
Nonlinear Hyperbolic Equations, Spectral Theory, and Wavelet Transformations

(Eds.) Sergio Albeverio, Michael Demuth, Elmar Schrohe, Bert-Wolfgang Schulze, Birkhäuser Verlag 2003, ISBN 3-7643-2168-7

Part of the series “Advances in Partial Differential Equations”, this book focuses on recent developments in nonlinear hyperbolic equations.

The first and longest part of the book was written by P. Popianov from Sofia, who studies singularities of solutions of several classes of nonlinear PDEs. He gives a survey of known theory and presents own work.
There are articles on L_p - L_q decay estimates for Klein-Gordon equations, questions of local existence of solutions, spectral theory, wavelet transformations, Gabor transformations (and interpolation between them), singular fibrations and index theory.
It is quite interesting that in a book, nearly completely written in English, the paper of Xiaonan Ma (Formes de torsion analytique et fibrations singulières) is written in French.



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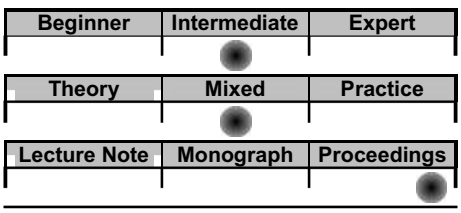
Trends and Applications in Constructive Approximation

(Eds.) Detlef H. Mache, Joszef Szabados, Marcel G. de Bruin, Birkhäuser Verlag 2005, ISBN 3-7643-7124-2

This book is a collection of papers from the 4th IBoMAT meeting in Witten-Bommerholz on Constructive Approximation. The conference topics reached from theoretical aspects of various types of approximation over interpolation to neuro fuzzy methodes, RBF networks and industrial applications.
The book contains a lot of information about the meeting, as for example a list of participants with contact adresses, the timetable of the meeting and some photos of the participants.
As the papers in the book are from different authors in different fields of research, they vary from very theoretical (e. g. some error bounds for interpolation operators) to applications (e. g. Novel Simulation Approach for Instationary Fixed-bed Processes)



Gerhard Höfinger ; *gerhard.hoefinger@tuwien.ac.at*

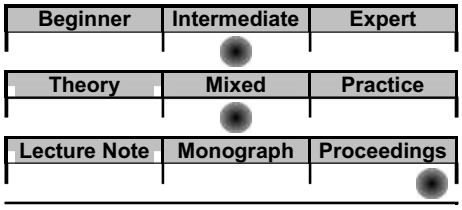
Applications of Agent Technology in Traffic and Transportation

Franziska Klügl, Ana Bazzan, Sascha Ossowski (Editors)
Whitestein Series in Software Agent Techologies
Birkhäuser Verlag Basel 2005, ISBN 3-7643-7258-3

Building user-friendly and effective transportation systems is a big challenge in the 21st century and not an easy one as a big number of autonomous entities needs to be simulated and/or controlled. This book contains revised versions of the papers presented at the Workshop on Agents in Traffic and Transportation (ATT) at the International Conference on Autonomous Agents and Multiagent Systems (AAMAS) hold in New York on July 20th, 2004, where new developments in applications of agent-based technologies in traffic and transportation were reported.
The papers give an overview of recent advances in agent-based transportation systems. In the 13 works both a state-of-the-art survey and reports on cutting-edge research in the field are included.
The contribution by Davidsson et al. gives a consistent view of the research effort made in the area of agent-based approaches to transport and traffic management. Perugini et al. present a provisional agreement protocol that facilitates the planning required in transportation scheduling problems. They also offer an approach which allows partial quantity and route bids as well as backtracking if an infeasible solution is encountered. Dorer and Calisti from Whitestein Techologies put forward an agent-based approach to solve dynamic multi-vehicle pickup and delivery problems with soft time windows. Ossowski et al. outline design guidelines for the construction of agent-based decision support systems (DSS).

Yin and Griss describe SCATEAgents, an agent-based intelligent, flexible and context-aware multi-modal traveller information system. The other contributions of the book deal with overcoming the Braess Paradox, analyse the effect of route information sharing on traffic congestions or focuse on the problem of effective real-time traffic light control using agent technology. Furthermore, a collaborative driving system using teamwork for platoon formations is presented, a simulation model to account for the effect of secondary activities on route choice is proposed, a multiagent simulation for the generation of individual activity programs is described, it is reported on how the abstraction approach of mul-tiagent systems can be used to represent the complexity inherent in the urban traffic domain and last but not least a message-based simulation framework for different kinds of mobility simulations is presented.

To sum it all up, this book offers useful information about developments in agent-based technologies and can serve as an inspiration for further work in this area.



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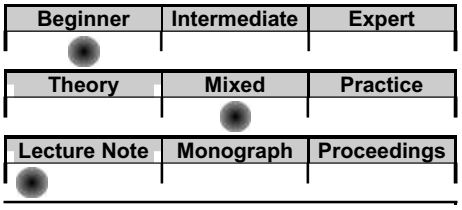
Nonlinear Partial Differential Equations for Scientists and Engineers

Lokenath Debnath, Birkhäuser Verlag Boston 2005, ISBN 0-8176-4323-0, 2nd Edition

'It seems to be one of the fundamental features of na-ture that fundamental physics laws are described in terms of great beauty and power. As time goes on, it becomes increasingly evident that the rules that the mathematician finds interesting are the same as those that nature has chosen.' ..... Paul Dirac

In this publication a background of fundamental ideas, results and methods essential to understanding specialized literature in the vast area of partial differential equations is provided. The author first tries to interest and, furthermore, to prepare readers to undertake research projects on nonlinear wave phenomena, reaction-diffusion phenomena, soliton dynamics, nonlinear instability and other nonlinear real-world problems.
This book is a very useful introduction to nonlinear partial differential equations and to the basic methods that have been found useful for finding the solutions of these equations. The author developed the book as a result of many years of experience teaching partial differential equations at the senior undergraduate and / or graduate levels but it is also suitable as a research reference. It provides useful working knowledge of the most important analytic methods of the solutions of the equations. The main emphasis of the book is on the development of the required analytical skills on the part of the reader rather than the importance of more abstract formulation with full mathematical rigor.
The first chapter gives a broad coverage of the essential standard material on linear partial differential equations and their applications to prepare the reader for study and research in nonlinear partial differential equations. In this edition many new topics, examples and exercises are included and some recent exciting developments of the subject are added. A systematic mathematical treatment of linear and nonlinear partial differential equations is presented in the most straightforward manner, with worked examples and simple cases carefully explained with physical significance. There are many exercises included, which support deeper understanding. Solving them is supported by answers and hints given to selected exercises. Furthermore, short tables of integral transforms are provided in chapter 13 for additional help to the reader.
This book is aimed at the reader interested in a broad perspective on the subject. It provides new ideas, remarkable observations and new evolution equations for ambitious readers and, nonetheless, basic ideas, useful methods to solve the equations and fundamental knowledge enable also graduate level students to get an idea about this fascinating subject.



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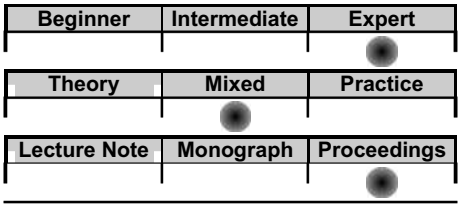
Modeling, Simulation, and Optimization of Integrated Circuits

Proc. Conference Mathematisches Forschungsinstitut, Oberwolfach, Nov. 25 – Dec. 1, 2001

K. Antreich, R. Bulirsch, A. Gilg, P. Rentrop (Eds.)
Birkhaeuser 2003; ISBN 3-7643-2192-X

In November 2001 the Mathematical Research Centre at Oberwolfach, Germany, hosted the third Conference on Mathematical Models and Numerical Simulation in Electronic Industry. It brought together researchers in mathematics and electrical engineering, and scientists working in industry.
In contrast to the two preceding conferences, which concentrated more on device and process simulation, in this conference two new topics were introduced. On the one hand Co-Simulation (i.e., the coupling of different simulation tools with strongly varying time scales and electromagnetic effects) and on the other hand the introduction of concepts, which are of potential interest for chip design.
The contributions to this volume try to bridge the gap between basic and applied mathematics, research in electrical engineering, and the needs of industry. They can be classified into the following topics:

- Device Simulation and Applications
- Circuit Simulation and DAE's
- Coupling of Devices and Circuits
- Circuits with Stochastic Sources
- Advanced Mathematical Tools



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Modern Developments in Multivariate Approximation

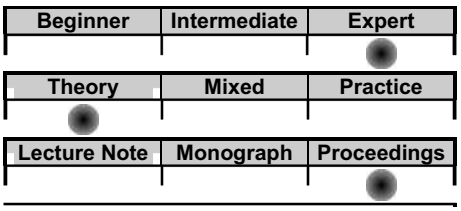
Proc. 5th International-Conference, Witten-Bommerholz (Germany), September 2002

W. Haussmann, K. Jetter M. Reimer, J. Stoeckler (Eds.) ; Birkhaeuser 2003; ISBN 3-7643-2195-4

This book is a collection of proceedings from the main topics and talks presented at the Fifth International Conference on Multivariate Approximation. This conference took place from the 22nd to the 27th September 2002 at the guesthouse of the University of Dortmund.
The main topics covered, from 49 participants coming from 10 different countries, were:

- Applications of multivariate approximation in finance
- Approximation and stable reconstruction of images, data reduction
- Multivariate splines for Lagrange interpolation and quasi-interpolation
- Radial basis functions
- Spherical point sets
- Refinable function vectors and non-stationary subdivision
- Applications of adaptive wavelet methods
- Blending functions and cubature formulae
- Singularities of harmonic functions

This volume contains a selection of eighteen peer-reviewed articles. Being the participants of the conference only mathematicians the book appears as an academic text in which it is hard to go through without guidance. I would therefore suggest it only to who knows already the subjects and wants to upgrade its knowledge about a specific field.



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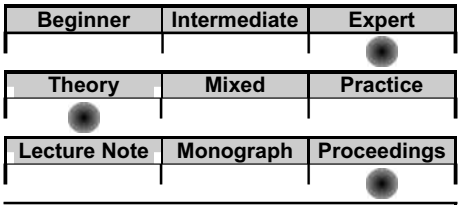
Sturm-Liouville Theory – Past and Present

Werner O. Amrein, Andreas M. Hinz, David B. Pearson (Editors); Birkhäuser Verlag 2005, ISBN 3-7643-7066-1

In 2003 a colloquium and workshop was held in Geneva to commemorate the 200th anniversary of the birth of Charles François Sturm. This book is a collection of twelve refereed articles relating to the second part of the colloquium, which was devoted to Sturm-Liouville Theory. It aims at giving an overview of the development of Sturm-Liouville theory from ist historical roots to present day research. The authors are among the world's leading experts in this field.

The text is particularly strong on the spectral the-ory of Sturm-Liouville equations, which has given raise to a major branch of modern analysis. Other current aspects discussed are oscillation theory for differential equations, approximation of singular boundary value problems by regular ones, applications to systems of differential equations and extension of the theory to partial differential equations and to nonlinear problems.
A unique feature of the book is a comprehensive catalogue of Sturm-Liouville differential equations, covering more than fifty examples, together with their spectral properties. Many of these examples are directly connected with problems in mathematical physics.
This book is addressed to researches as well as advanced students and those interested in the historical development of mathematics.



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Physics – A System Dynamics - Approach

Physik -Ein systemdynamischer Zugang für die Sekundarstufe II

Borer, Frommenwiller, Fuchs, Knoll, Kopascsy, Maurer, Schütz, Studer, Walker; in German
Sauerländer (2000), ISBN 3-7941-4422-8

The main goal of this book is to present the System Dynamics point of view of physics. It is designed for education and is starting with a motivation section in which first examples are presented to the reader. All examples are represented in the VENSIM notation and, thus, easy readable.

Chapter 1 deals with hydraulic systems. The start-up presents the basics and the chapter ends with a model for a spring-loaded accumulator with a volume depending capacity.

Chapter 2 is focusing on electrical circuits. Again the structure of system dynamics is used to model electrical behaviour, in example the electrical charge of a capacitor plate. The main focus is not to get a lot of detail information, like equations on a higher level, but illustrates necessary basics.

Chapter 3 depicts dynamical models. Mass balances and transport processes as well as chemical potential are focused on in the first part. In the second part energy transport and a final dialysis model are presented.
Finally, a predator-prey model is implemented in VENSIM. Chapter 4 summarizes mechanics (momentum and kinetics). All subsections strongly focus on damper modelling and lead to the final section where a real model is defined. This structure motivates the reader to go on.

Chapter 5 and 6 deal with temperature dynamics and optics. In the optics part the author is mainly interested in solar radiation and an application for modelling of a photovoltaic panel.

In each chapter questions for self-control are offered. The answers can be found in the appendix A.1. Furthermore, there are given tables on the main units and notations.

In summary this book is a good alternative to a standard textbook for physics as well as for system dynamics applications. The structure is clearly arranged and supports either refreshing or understanding the necessary basics.

Beginner	Intermediate	Expert
●		
Theory	**Mixed**	**Practice**
	●	
Lecture Note	**Monograph**	**Proceedings**
●		

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Equations in Physics
Die Gleichungen der Physik

Sander Bais, Birkhäuser (2005) ISBN 3-7643-7235-4

This book, written by Sander Bais tries to give an understanding of basic physical equations, as well in classical as in modern physics. On the one hand it addresses to physicists and natural scientists, because it shows the beauty of physical equations in a very purely way. The author also provides a lot of background information i.e. from the historical point of view or explains how these equations are used in other science disciplines.
On the other hand this book also addresses to ordinary people, who are no scientists by profession or education, but have strong interests in physics and nature. All equations are explained in their simplest form, and the entire mathematical background that is necessary for understanding is given in the first chapter.
The author himself explains in his foreword that this book is not tended to be a textbook; moreover, he tries to present physical equations in all their elegancy and turns the reader's attention to interpretations and conclusions of the presented equations.
An intermediate reader would recognise a bit annoying, that all the equations that are presented in this book are not written in the same system of units. Therefore it would have been convenient if the author had translated his pure equations also to the SI-system form, at least the SI-form should have been noted in the margin.
All together, 'Die Gleichungen der Physik' is a very nice gift book for colleagues and friends who have a very strong interest for physics. But it is not a book that someone would buy just for himself.

Beginner	Intermediate	Expert
●	●	●
Theory	**Mixed**	**Practice**
●		
Lecture Note	**Monograph**	**Proceedings**
	●	

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Bond Graphs – A Methodology for Modelling Multidisciplinary Dynamic Systems

Wolfgang Borutzky, SCS Publishing House, 2005,
438 p, ISBN 3-936150-33-8;
ASIM Frontiers in Simulation FS 14.

The author gives in this book a comprehensive state-of-the art representation of bond graph modelling in-cluding results scattered over research articles and PhD theses. The author did also much more than translating his German book on bond graphs into English, he updated topics – and he included much new material. Karnopp, one of the fathers of bond graph modelling, said once in a seminar 'Bond graphs - either you love it, or you hate it.' The author loves them and he admits, to have a passion for them. But he stays objective and reports also about problems, and misunderstandings.

The content follows first a classical structure, in the second half of the book recent developments in modelling and in applications are given. Chapter 1 gives a short review about modelling approaches, from classical block diagrams and signal flow diagrams up to object-oriented paradigm.
Chapter 2 presents the fundamentals of bond graph based physical modelling, whereby the author underlines the fact that bond graphs allow to develop non-causal models also at a qualitative level. Chapter 3 investigates the derivation of mathematical equation-based models from bond graphs, sketching algorithms for causality assignment. The following two chapters deal with DAE models and bond graphs. First, relations between bond graph structures and DAE properties (index, etc.) are investigated. Then also a sketch of numerical algorithms for DAE systems is given, together with a short review of the tearing algorithm of Pantelides for index reduction, and – astonishing – how tearing of algebraic constraints can be supported by additional controlled sources in the bond graph.

Chapter 6 presents the bond graph as a core model, which allows not only to derive ODE and DAE mod-els, but also transfer function models, and structural information about the system.
New developments and results about bond graph modelling und structure variable systems are dis-cussed in chapter 7. The author presents first bond graph methods, like extended element characteristics, changing degrees of freedom by sinks of invariant causality, and variable causality bond graphs.

For specialists, the combination of bond graphs with Petri nets, which control change of degrees of freedom, is of big interest. Chapter 8 discusses bond graph modelling of multibody systems, concentrating on the works of Breedveld and Bos.

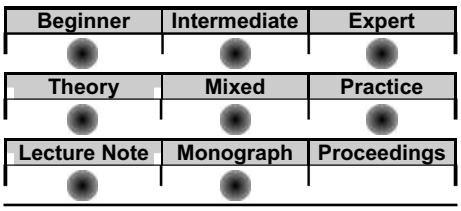
The chapter on distributed parameter systems concentrates also mainly on multibody systems and investigates approaches using approximations with a lumped parameter bond graph model (Karnopp et al. with modal analysis; Pelegay et al. with finite elements).
Chapter 10 gives an overview on the advanced topic of classical and pseudo bond graph modelling of open thermodynamic systems.

The last chapter on automated modelling with bond graphs has been revised and extended essentially. Beneath true bond graph modelling software, the modelling language Modelica is discussed: relations of bond graph junctions and the Modelica port philosophy, bond graph modelling in Modelica, bond graph libraries in Modelica, etc.

In the conclusion the author again underlines the view of the bond graph community: 'bond graph modelling: not a 'usual' modelling approach, but a modelling method and philosophy from qualitative word models via classical modelling to DAEs, multibody systems and distributed parameter systems, open for new theories like pseudo bond graphs in open thermodynamic systems'.

The work, the author has put into this book, is enormous. In sum, he cites 347 references – especially for topics of the second part of the book a very valuable source of qualified references.

The only problem with the book is, how to match a review into the scheme: beginners or experts, theory or practice ? As exception this book must be qualified as a source of knowledge for beginners to experts, in theory and practice for bond graphs. It can be really highly recommended.



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Journal Reviews

Mathematical and Computer Modelling of Dynamical Systems

Methods, Tools and Applications in Engineering and Related Sciences

Published By: Taylor & Francis
Frequency: 6 issues per year
Print ISSN: 1387-3954
Online ISSN: 1744-5051
2004 Impact Factor: 0.292

Aims and Scope

The analysis and improvement of performance in complex systems, the adaptation of plants to new demands or conditions, and the design of 'optimal' systems are a few of the challenges confronting engineers and systems scientists today. In many cases solutions to problems in areas such as these may be found through the use of appropriate mathematical models. The derivation, combination, simplification and validation of models are the main topics of this journal which provides an international forum for the presentation of new ideas in modelling and for the exchange of experience and knowledge.

Original work will be published as regular papers or short notes dealing with a range of topics including the following, for example:

- Processes and methods for model formulation, identification, development, reduction and validation
- The relationship between computational / simulation methods, the underlying mathematical forsimulation and real-world modelling problems
- Modular modelling
- Learning networks in modelling
- Uncertainties in modelling

Consequently, computer simulation and description of mathematical methods are restricted to the field of modelling and to the consequences of modelling. Modelling of the task including the modelling of the dynamic system, of restrictions, of goals etc. and the implications of the model used on solution and on solution methods are of primary interest.

Special Issues

In 2006, a Special Issue on Bond Graph Modelling will appear (Volume 12, Number 2-3 / April-June 2006):

Bond graphs in model matching control,
D. Vink, D. Ballance, P. Gawthrop
Bond graph modelling,
Wolfgang Borutzky and Peter Gawthrop
A pedagogical analysis of bond graph and linear graph physical system models,
Stephen Birkett, Jean Thoma, Peter Roe
Equilibrium set investigation using bicausality,
Eric Bideaux, Wilfrid Marquis-Favre, Serge Scavarda
Relations between two bond graph approaches to sensitivity analysis and study of robustness,
W. Borutzky, G. Dauphin-Tanguy, C. Kam
Bond graph modelling for chemical reactors,
F. Couenne, C. Jallut, B. Maschke, P.C.Breedveld, M. Tayakout
Modelling flexible body systems: a bond graph component model approach,
Vjekoslav Damiæ
Mechatronic bond graph modelling of an automotive vehicle,
Wilfrid Marquis-Favre, Eric Bideaux, Olivier Mechin, Serge Scavarda, Franck Guillemard, Marc Ebalard
Modelling and reduction techniques for studies of integrated hybrid vehicle systems,
Loucas S. Louca and B. Umut Yildir
Luenberger observers for linear time-invariant systems modelled by bond graphs,
César Pichardo-Almarza, Ahmed Rahmani, Geneviève Dauphin-Tanguy, Marisol Delgado
Structural analysis of switching systems modelled by bond graph,
Ahmed Rahmani and Geneviève Dauphin-Tanguy

D. Karnopp - University of California, USA; *N. A. Kheir* - Oakland University, USA; *L. Ljung* - Linköping Univ. Sweden; *J. V. R. Prasad* - Georgia Inst. of Technology, USA; *W. Schiehlen* - Univ. Stuttgart, Germany; *K. Schlacher* - Univ.Linz, Austria; *S. Tzafestas* - National Technical University of Athens, Greece; *R. Viertl* - Vienna University of Technology, Austria; *M. Zeitz* - Univ. Stuttgart, Germany

Mathematical and Computer Modelling of Dynamical Systems is abstracted and indexed in Applied Mechanics Reviews; Asian Science Citation Index - Applied Sciences Abstracts; British Library Inside; Current Mathematical Publications; EBSCO Databases; GEOBASE; INSPEC®; International Abstracts in Operations Research; ISI CompuMath Citation Index®; ISI Current Contents® - Engineering, Computing and Technology; ISI Science Citation Index Expanded™; Mathematical Reviews/MathSciNet; New Jour; Sci-Base; Scopus™; Zentralblatt MATH/Mathematics Abstracts and Zetoc.
More information can be found on the following website:

Information at web or from Editor-in-Chief:
HTTP://JOURNALSONLINE.TANDF.CO.UK/LINK.ASP?ID=103108
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JOS – Journal of Simulation

A new publication of the OR Society of UK, launching in 2006
Published By: Palgrave Macmillan Ltd, Houndmills, Basingstoke, Hampshire, RG21 6XS, England
Frequency: 2 issues per volume
Print ISSN: 1747-7778
Online ISSN: 1747-7786

Journal of Simulation aims to publish both articles and technical notes from researchers and practitioners active in the field of simulation. In JOS, the field of simulation includes the techniques, tools, methods and technologies of the application and the use of discrete-event simulation. JOS will examine a wide range of domains including for example, manufacturing, service, defence, health care and general commerce. JOS will particularly seek topics that are not 'mainstream' in nature but interesting and evocative to the simulation community as outlined above. Particular interest is paid to significant success in the use of simulation. JOS will publish the methodological and technological advances that represent significant progress toward the application of simulation modelling-related theory and/or practice.

Other streams of interest will be practical applications that highlight for the researcher insights into the contemporary practice of simulation modelling; articles that are tutorial in nature or that largely review existing literature as a contribution to the field, and articles based on empirical research such as questionnaire surveys, controlled experiments or more qualitative case studies.

Major topic areas:
- Case studies of simulation application
- Design and Analysis of experiments
- Verification and validation
- Modelling of human factors
- Logistics and transportation simulation
- Supply chain simulation
- Insights into the application of simulation modelling in various domains
- Conceptual modelling
- Simulation software and technology
  Parallel and distributed simulation

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SIMULATIONISTS

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Dr. Jürgen Wöckl is Assistant Professor at the Vienna University of Economics and Business Administration, Institute for Production Management (Head: Prof. Taudes).

Being fascinated in physics and science, Jürgen Wöckl studied 'Physics and Economics' at the Technical University of Vienna. At the end of his master study he got contact to the group of Prof. Breitenecker and to the ASIM at the conference in Ham-burg 2000 and since this time he is an active member of ASIM. His fascination in mathematical modelling and simulation arose and last till these days.

His studies at the Technical University of Vienna encourage his interests in physics, mathematics and economics supplemented by biology and biotechnology. So these subjects still form his main focus on modelling and simulation.
The diploma thesis dealt with modelling and simulation of processes of biological wastewater treatment in collaboration with the Austrian Research Centers (ARC) and this focus has been continued in the following doctoral study in applied mathematics at the Institute of Analysis and Scientific Computing (Prof. Breitenecker) of the Technical University of Vienna. This simulation models dealt with hybrid approaches combining continuous equations (ODEs) and discrete events.

Parallel to this fundamental education in modelling and simulation, Jürgen Wöckl joined a research program at the Vienna University of Economics funded by the Austrian Science Foundation (FWF) called 'Adaptive Information Systems and Modelling in Economics and Management' (Prof. Mazanec).

Here his interest in economic models, statistics and management science has been extended and these are still the main topics of his actual research focus.
Mathematical modelling and simulation in Economics get an increasing relevance due to the lack of experiments which normally cannot be made in a real-world economy. Jürgen Wöckl's research approach ranges from marketing models to optimization problems in production management, logistics and supply chain management. Especially to deal with market models, an artificial consumer market has been developed to allow a simulation of optimal defensive strategies in the case of a market entry given different market scenarios. Here several game theoretic assumptions have been proven using both deterministic and stochastic simulation models, allowing more complex and realistic market settings than cases requiring analytical solutions.

Market models will stay in the main focus of his re-search work - motivating different model approaches. So Cellular Automata are used in combination with ODE and SDE leading to hybrid systems and self-learning agent-based models to describe systems with a high degree of interactions. These models facilitate the research of optimal decision-making in a highly interactive environment. In business research beside dynamical simulation data analysis is a major issue, and so he focuses especially on methods for statistical model estimation and concepts like inferred causation. Here Markov-Chain-Monte-Carlo – estimation methods are used, complementing his research activities. Additionally modelling and simulation creates a need of applicable software and IT solutions and so his work is also relating to software design and the implementation of mathematical programming tools.

Currently his research focus has been endorsed by models dealing with optimal pricing strategies and supply chain management. Here on the one hand econometric models and time series are used additionally to estimate life cycles and optimal mark down pricing and on the other hand deterministic and stochastic methods are used solving problems related to operation research. Though his methodical focus turns increasingly toward topics like data mining and statistical learning, modelling and simulation will stay an important part of his future research work.

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Anton Jaklic is a researcher at the Institute of Metals and Technology in Ljubljana, Slovenia. He was born 1970 in Ljubljana. He studied electrical engineering at the University of Ljubljana at the Faculty of Electrical engineering where he graduated in 1994. For the diploma thesis he was involved in development of the system for automatic determination of characteristic points in hip rentgenographs. The system was used for statistical analysis of rentgenographs at the Department of Orthopaedic Surgery, Medical Centre Ljubljana.
In 1994, he started working at the Institute of Metals and Technology in Ljubljana in the Heat Engineering Laboratory.

In 1995 he got the status of young scientist and got the fellowship from the Ministry of science of Slovenia for postgraduate study. He finished the postgraduate study in 1998 at the Faculty of Electrical Engineering in Ljubljana with the master's degree. The title of his master's degree thesis was *Informatization of the reheating process in the pusher type furnace by mathematical model*. In his work he developed a 2D real-time simulation of steel slab pusher heating furnace.
In 2002 he received PhD at the University of Ljubljana. In his doctoral thesis *The Role of View-factor at Optimal Reheating in a Continuous Furnace* the complex radiation heat transfer mechanisms in gas-fired industrial furnaces are simulated by Monte Carlo Method. He developed 3D simulation model of gas-fired industrial furnace which accounts the complex radiation geometry of the furnace. By using the simulation model he studied the dependence of space between billets in the furnace on the furnace productivity. As a result the optimal space which gives the highest productivity of the furnaces was determined.

His research work is both theoretical and practical. The Institute has close research cooperation with the University of Ljubljana and with the Slovenian steel industry. The cooperation between academic institutions and industry allows him to transfer his modelling and simulation knowledge to industrial praxis.

His main interest is development of real-time simulations for industrial gas-fired reheating furnaces.
Calculations in the model base on mathematical model, which includes main physical phenomena appearing during the reheating process in a natural-gas-fired industrial furnace. The heat exchange between the furnace wall, the furnace gas and the billet surface is calculated using the three temperature model of Heiligenstaedt. The thermal radiation is the main heat-transfer mechanism in a high-temperature re-heating furnace. The geometry of the furnace enclosure plays an important role in the radiation heat transfer calculation. The geometry is described in the model in view-factor matrix form. He successfully developed and implemented two real-time simulation models of industrial furnaces:

In 2003 he implemented the real-time simulation model for Allino walking-beam furnace in Metal Ravne d.o.o. steelwork in Slovenia. In 2005 he has been for 6 months a guest researcher at the R&D department in Acroni Steelwork in Slovenia, where he implemented a real-time simulation model of slab reheating process in a pusher furnace for re-heating of steel-slabs. Both models are used in regular production process.

His main theoretical interest is simulation of radiation heat transfer mechanisms in gas-fired industrial fur-naces. Now he is working on real-time simulation models using Monte Carlo radiation algorithms with the account of radiation and absorption of CO2 and H2O gasses in the furnace on the base of HITRAN (high-resolution transmission molecular absorption database) and HITEMP (high-temperature spectro-scopic absorption parameters). He is working on implementation of the real-time simulation model on OFU walking-beam furnace for steel-billets reheating in Štore Steel steelwork in Slovenia.

The next step of using simulation models of industrial furnaces is to use them in close loop for second level furnace automation. One of the main questions in model based furnace control is searching for optimal heating curves for different steel grades. This is going to be researched in detail in the proposed project to EU commission, where his laboratory is going to be one of the partners in the project. Up to now he was involved in more than 30 industrial, applicative and European projects.

Anton Jaklic, *Anton.jaklic@imt.si*

SNE Reports and News Section

CONTENT

SNE REPORTS EDITORIAL BOARD

HTTP://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 other societes and to individuals active in the area of modelling and simulation. SNE is registered with ISSN 1015-8685. Circulation of printed version is 3000 copies.

SNE Web – recent issue of SNE are also available via internet at HTTP://WWW.ARGESIM.ORG. Members of EUROIM Societies have access to the SNE Archive.
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.).

EUROSIM SOCIETIES

EUROSIM

Federation of European Simulation Societies

HTTP://WWW.EUROSIM.INFO

General Information

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

EUROSIM Board

EUROSIM is governed by a board consisting of one representative of each member society, president and past president. The President is proposed by the society organizing the next EUROSIM Congress. Secretary and Treasurer are elected between the members of the Board.

Representatives for the official EUROSIM publications (journals SIMPRA and SNE) are also invited to the EUROSIM Board Meetings.

At the EUROSIM'04 Congress the EUROSIM Board appointed new officers for a three years period: B. Zupancic (president), P. Fritzson (secretary), F. Breitenecker (treasurer+SNE), Y. Hamam (past president), J. Halin (SIMPRA), F. Maceri (Savastano award).

EUROSIM Publications: SIMPRA / SNE

SNE. EUROSIM societies are offered to distribute to their members the journal *Simulation News Europe (SNE)* as official membership newsletter. SNE is a membership newsletter (with information from the societies) as well as a "technical" journal with reviewed contributions. (Technical Notes, ARGESIM Comparisons, Short Notes etc.).

SNE's Notes Section publishes technical notes (fully reviewed), short notes (reviewed), and software notes on general overviews or new developments, on new software and hardware, on new applications and methods, and book reviews on recent books in modelling and simulation and in related areas.

Furthermore **SNE** presents *Simulation Centres*, introduces *Simulationists* and reviews recent books on modelling and simulation and related topics.

SNE's special series *Comparison of Modelling and Simulation Technique and Tools* (ARGESIM Comparisons) gives a comprehensive overview on developments in application and implementation. These comparisons have become well-known benchmarks for modelling and simulation. In 2006, SNE starts with an opening of the comparison section. First, the comparison definitions will be complemented by contributions on the modelling procedure and on the mathematical, physical and general background, and second, SNE will also report about other benchmarks.

SNE reports in the News Section about EUROSIM, EUROSIM societies, SCS Europe and about other International Simulation Societies and Simulation Groups. Furthermore, basic information on EUROSIM societies is mirrored at the new designed EUROSIM website.
In 2006, SNE starts with a new layout, and also with a new organisational structure (editorial boards, continuing editorial office, and much more. More information at HTTP://WWW.ARGESIM.ORG

SIMPRA. Members of EUROSIM societies can subscribe the official EUROSIM scientific journal *Simulation*

Modelling Practice and Theory (SIMPRA) at a significantly reduced price. Information about recent issues and special issues may be found in this SNE issue elsewhere. More information is available at WWW:
HTTP://EES.ELSEVIER.COM/SIMPAT/

Report from the 26th EUROSIM Board Meeting, March 6, 2005, Hamburg
Seven societies were present (ASIM, CROSSIM, CSSS, ISCS, SIMS, SLOSIM, UKSIM). Editors-in-Chiefs of SIMPRA and SNE also participated.

Some points from the report of the president:

- Internal rules were in some parts old fashioned, not all accepted decisions were included, some inconsistencies. At Ex. Board Meeting in Ljubljana members went carefully through internal rules and proposed changes.
- Presence of societies' representatives at Board meetings is very important; each society should try to find money for one board meeting per year. Board meetings should be planned one year in advance.
- Similar directions as before, but better to have few realized events than many planned events that are not realized.
- EUROSIM is an umbrella. Active societies mean active EUROSIM. So we must motivate societies' activi ties.
- EUROSIM need to be more active in coordination of events. We need better information of events and other societies' activities (through WEB, SNE).
- More events under co-organization or sponsorship of EUROSIM. There are already many events: many ASIM events, UK SIM conference, MOSIS conference by CSSS, MATHMOD in Vienna, SIMS conference, SimSafe, BIoMedSIm, Modelica conferences, conference of ISCS, MOSIM conference in France, ITI conference by CROSSIM. EUROSIM must become a trademark, which will help to attract more attendants. EUROSIM must maintain e-mailing list.
- Decision: Societies must discuss about the possibilities to organize events as EUROSIM events and send proposals.
- SNE and SIMPRA are our highlights. Nice progress can be noticed during last few years. Both publications must promote EUROSIM and EUROSIM must promote publications. Special issues must take EUROSIM events into account – especially EUROSIM congresses.
- EUROSIM Congress is also the highlight. It should become the main modelling and simulation event in Europe. It should have the main priority for the national societies. The societies must not plan other model ling and simulation events at the time around the congress. Minimal number of participant is 200-300.
- Industrial impact. We must permanently try to attract industrial companies and people from industry.
- Associated Groups are enabled with changed internal rules. These are groups dealing (also) with modelling and simulation. One identified candidate was Modelica Association and talks with its representative started.

Reports of the Editor-in-Chiefs SIMPRA, SNE
Editor in chief of SIMPRA Jürgen Halin will ask EUROSIM member societies for the proposals of some additional reviewers. 7-8 special issues are in preparation and app. 60 papers at different stages of review. Felix Breitenecker again exposed the problem that societies send information for SNE too late. Due to this reason the last issue was significantly delayed. In the future the deadlines should be respected.

After EUROSIM Board Meeting in Hamburg

EUROSIM on the WEB
HTTP://WWW.EUROSIM.INFO

ARGESIM set up a server with a content management system using TYPO3 – a freeware from Scandinavia. Member societies can (and have to) continuously update their pages. Each society can update and upload files, etc. using a password. The pages can be read by everybody, later some parts will be available only for members with appropriate password.

Modifications of Internal Rules
Internal rules were carefully checked on EUROSIM Executive Board Meeting in Ljubljana in Nov. 2004. All societies received the proposal for modifications and had one month for remarks. No remarks were sent to the president.

The modifications of the internal rules were accepted, except the formulation of voting for changes of bylaws. which stays in the old definition. Some modifications:

- Term simulation in several parts replaced with modelling and simulation
- Consistently used terms EUROSIM Board, EUROSIM Executive Board, EUROSIM Congress
- More precise description of EUROSIM Publications
- EUROSIM observer society must have WEB page.
- Associated groups were introduced
- Future president was introduced
- Introduction of the possibility of voting through teleconferencing

EUROSIM Congress 2007 in Ljubljana
Next congress will take place on September 9-13, 2007 in Ljubljana, Slovenia. Sessions, special sessions, poster session, tutorials, keynote speakers and exhibitions are planned. During the conference one afternoon will be reserved for an excursion to the Adriatic Sea. The full conference fee will be approx. 400 EURO.

Societies are asked:

- not to plan other events at that time
- to do the best for promotion (dissemination of posters, leaflets, …)
- to send proposals for IPC members, congress areas (topics of interest)
- to send ideas for keynote speakers, special sessions, tutorials, sponsors, exhibitors.

The next Board Meeting will be after MATHMOD conference in Vienna (Feb. 8-10 2006) on Feb. 11, 2006.

Any other business
The EUROSIM board was not finalized (renewed) in Paris, Sept. 2004. Member societies can still propose new board members and proxies. Document for Savastano award was explained by Franco Maceri. He will prepare a final version.

Award for the best SIMPRA paper will be given at Ljubljana Congress for the period Jan. 1, 2004- Dec. 31, 2006. The award will be the subscription for SIMPRA journal for 1 year. The committee will be: Franco Maceri, Jürgen Halin, EUROSIM president or a person nominated by him.

President will send the invitation for the organization of the 7th EUROSIM congress in 2008. Deadline for applications will be Dec. 31, 2005. The decision will be taken on the 27th Board Meeting in Vienna, Feb. 2006.

Borut Zupancic, EUROSIM president
borut.zupancic@fe.uni-lj

Associated Groups/Societies
EUROSIM welcomes Associated Groups. International and regional societies or sections of societies, organizations, application groups, user groups etc. having a significant interest in modelling and simulation are invited to co-operate with EUROSIM. Examples might be groups promoting specific modelling and simulation methods and technologies, an operational research society, an electrical engineering institution, an ecological or medical society, etc. Reciprocal arrangements may exist in respect of registration and other meetings fees. Some benefits:

- Reduced conference fees at EUROSIM Congress, EUROSIM Conferences and EUROSIM Events.
- Special reduced subscription fee for journal SIMPRA.
- Journal SNE with Technical Notes and News under the same conditions as for member societies. Older of SNE can be downloaded from EUROSIM server free of charge.
- Associated group can be presented on the EUROSIM Web page as other member societies: own folder, arbitrary links, information (Proceedings,News, ARGESIM Comparisons) can be down loaded.
- Associated group has right for SNE corner.
- Associated group is welcome to organize EUROSIM events. EUROSIM trademark can help in promotion of the event and consecutively in attracting more attendants. EUROSIM logo can be used in documents.
- EUROSIM can support appropriate groups activities (promotion of events, support in standardization efforts, …).
- Exchange of mailing lists.

Borut Zupancic, EUROSIM president
borut.zupancic@fe.uni-lj

Report of the EUROSIM president about activities after the Board meeting in Hamburg, March, 2005

Cooperation with Modelica Association
I had contacts with the president of Modelica Association Mr. Martin Otter during Modelica 2005 Conference in Hamburg, March 2005 and also later through email. I invite him to think and to discuss in the Modelica board about the possibility that Modelica becomes EUROSIM associated group. I described the benefits of both parts – the corresponding text is on our WEB (HTTP://WWW.EUROSIM.INFO/INDEX.PHP?ID=7). Up to now I did not get any concrete answer beside some provisional agreement for cooperation (mutual WEB links, …)

Contacts with Chinese Association for System Simulation (CASS)
EUROSIM was invited to be the cosponsor of Asia Simulation Conference 2005, October 24 to 27, 2005, Beijing, China. I accepted the invitation to be the member of IPC.

Contacts with Japan Society for Simulation Technology (JSST)
The next Asian Simulation Conference 2006 will take place from Oct. 30- Nov. 1, 2006 at *Meiji University*, Tokyo, Japan. EUROSIM was invited to be the co-sponsor and I was invited to be the member of IPC. I also plan to visit this conference.

Contacts with Latvian simulation society
I met the president of Latvian simulation society (LSS) Mr. Yuri Merkuryev in March 30, 05 in Ljubljana. We informed each other with the situation in our societies. Latvian society and the president are very active in ECMS European Council for Modelling and Simulation – a successor of the former SCS EUROPE. He was also the chair of the ECMS 2005 in Riga. I invited the president Merkuryev to discuss within LSS society about the possibility that LSS becomes the EUROSIM member. I also informed him about EUROSIM 2007 in Ljubljana and he promised an active role of LSS also in this context. Later I had also several contacts through email. According to that reply information we can expect the application of LSS for EUROSIM observer status in near future.

Contacts with Czech and Slovak Simulation Society
I visited 39th International conference MOSIS'05 - April 19-21, 2005, Hradec nad Moravcí where I was invited by CSSS as the keynote speaker.
had fruitful discussions with many members of CSSS (president Jan Štefan, Mikulas Alexik, Miroslav Snorek). I had also a chance to promote the EUROSIM 2007 congress in Ljubljana.

Contacts SCS-EUROSIM
During the Summer Computer Simulation Conference in July 2005 in Philadelphia I had a discussion with the president of The Society for Modeling & Simulation International (SCS) François Cellier.

The president of SCS François Cellier and the president of EUROSIM Borut Zupancic during SCSC conference in Philadelphia, July 2005

The first part of the discussion was devoted to mutual information of SCS and EUROSIM. We both presented very openly also the problems of both societies. Prof. Cellier informed me about the organisational problems of SCS in Europe.

The second part of the discussion was devoted to possibilities for better cooperation. We do not need a new cooperation document because a Cooperation agreement already exists. It is much more important to start with concrete although small actions. Here are some possibilities:

- Links on our WEB pages can be organized so that one page can supplement other and vice versa.
- Calendar of events: important events of both societies can be included.
- Exchange of important information in official publi cations of both societies: Modelling and Simulation (SCS) and Simulation News Europe (EUROSIM) – regular corners with actual information.
- I also proposed any cooperation in the exchange of mailing lists in order to better promote and inform simulation community with modelling and simulation events.

We also discussed about the possibilities to cooperate in organization of conferences. There are some possibilities:

- Cooperation in International program committees.
- Cooperation with organization of special sessions (EUROSIM session on SCS conference and vice versa).
- Organisation of co-located events (EUROSIM+SCS).
- A reduced conference registration fee for members to conferences of the other organization, i.e., EUROSIM members would be entitled to member registration rates at SCS events and vice-versa.

Prof. François Cellier accepted the invitation of Slovenian Society for Simulation and Modelling SLOSIM to be the keynote speaker at the EUROSIM 2007 Congress in Ljubljana.

I had also a discussion with Agostino G. Bruzzone, the general chair of the Summer Computer Simulation Conference in Philadelphia and both agreed that better cooperation is needed and that we shall put some effort to establish better cooperation in the future. As Agostino Bruzzone has a strong simulation group in Italy (and he is also the founder and the president of the Liophant simulation) I asked him to establish better links with the ICSC - Italian Society for Computer Simulation.

He also invited EUROSIM to cooperate in the organization of some conferences he chairs (e.g. International Mediterranean Modelling Conference I3M).

We know that SCS organisation in EUROPE is changing. There are in my understanding several successors of the former SCS EUROPE. EUROSIM would like to cooperate with all modelling and simulation associations, societies and organizations. With regard to SCS we are not looking for the cooperation only with European part of SCS but with the SCS in general.

Contacts with EUROSIM Observer Societies

I asked observer EUROSIM members to be active in EUROSIM organization and to think about their observer status which is in my understanding a transitional phase. I am glad that after a longer period all three societies (ROMSIM, PSCS, AES) are expected to attend 27th EUROSIM Board meeting in Vienna in Feb. 06. I received also the letter of the ROMSIM president Prof. Stanciulescu. He also informed me that in current situation ROMSIM prefer to have observer status.

In the early years of EUROSIM

As the foundation and the development of EUROSIM are not appropriately documented I asked several colleagues which were active in EUROSIM from the very beginning (Franco Maceri, Jürgen Halin, Richard Zobel) to write a text which would be published also on EUROSIM WEB.

EUROSIM WEB page

WWW.EUROSIM.INFO

After ARGESIM and Felix Breitenecker set up the WEB page in TYPO3 system and also put some initial information, I (and my co-workers) spent lot of time putting in useful information. It is quite obvious that EUROSIM will need some other ways (and also some money) in the future with regard to the maintenance of the WEB. I ask again all societies to put in their own information.

Borut Zupancic, EUROSIM president
borut.zupancic@fe.uni-lj

Conferences - EUROSIM Congress

EUROSIM societies organise national and international conferences and workshops, with the common trademark EUROSIM Conference. For details please refer to the announcements of the societies.
The EUROSIM Congress is arranged every three years by a member society of EUROSIM.
EUROSIM'04, the 5th EUROSIM congress, took place in Noisy-le-Grand, near Paris, France in Sept. 2004.

EUROSIM'07

6th EUROSIM Congress
Sept. 10-14, 2007, Ljubljana, Slovenia
www.eurosim2007.org

Organizer of the EUROSIM 2007 Congress

The 6th congress will be organized by the Slovene Society for Simulation and Modelling SLOSIM in close cooperation with German speaking modelling and simulation society ASIM and other simulation societies.

Topics of Interest

The scope includes all aspects of continuous, discrete (event) and hybrid modelling, simulation, identification and optimisation approaches. So the common denominator is problems solving with modelling and simulation in a way that can be useful also for solving other problems in similar or different areas. Contributions from technical (engineering) areas but also from nontechnical areas are welcome.

The list of topics includes (but is not limited to):

- **M&S Methods and Technologies:**

modelling and simulation of complex systems, large scale systems, distributed systems, hybrid systems, hierarchical systems, stochastic systems, control systems, expert systems, adaptive systems, fuzzy systems, decision support systems, scheduling, knowledge based systems, real time systems, queuing systems; parallel processing concepts; high performance computing; modelling and simulation system architectures; neural networks; model validation and verification; simulation life-cycle evolution; genetic algorithms; man-in-the loop simulation; hardware-in-the loop simulation; data mining; bond graphs; simulation with Petri nets; discrete event simulation; statistic modelling; component based modelling; object oriented modelling; mathematical/numerical methods in simulation; graphical modelling; visualisation, graphics and animation; modelling and simulation tools; WEB based simulation; human behavior representation techniques; virtual reality and virtual environments;

- **M&S Applications: aerospace; automotive** systems and transportation; agriculture; architecture; biopharmacy/biomedicine/bioinformatics/genomics; business; applied chemistry; civil engineering; communications; ecological and environmental systems; economics/econometrics; education; energy; electrical engineering; geophysical systems; industrial processes; logistics; manufacturing systems; maintenance / reliability; marine systems, materials modelling and simulation, mechanical engineering; mechatronics; meteorology / climate; military systems; organisational processes; pharmacy; power systems, applied psychology; process engineering, social sciences; robotics; seismism; traffic / transportation; training simulators; water management; ...

Congress Venue

The congress will take place in Ljubljana, the capital city of Slovenia, at the Faculty of Electrical Engineering, University of Ljubljana. A part of the congress will be organized also at the Adriatic coast area.

Ljubljana – Your Host City

Ljubljana, the capital of Slovenia which is the member of the European Union, is the heart of the political, economic, cultural and scientific life of Slovene nation. It was build on the place of a Roman city Emona. Numerous churches, theatres, museums, galleries, the Medieval castle, give Ljubljana a reputation of being a modern and one of the most beautiful towns in Europe. Especially impressive are some works of the famous architect Joze Plecnik.

For more information, please contact:
Prof. Borut Zupancic, chair of the congress
borut.zupancic@fe.uni-lj.si
Prof. Rihard Karba, chair of the IPC
rihard.karba@fe.uni-lj.si

EUROSIM contact

Information about **EUROSIM** and **EUROSIM societies** may be found at EUROSIM's WWW Server: HTTP://WWW.EUROSIM.INFO. Personal information can be obtained also from the EUROSIM officers.

F. Breitenecker
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ASIM ASIM ASIM

ASIM - Buchreihen / ASIM Book Series

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

bisher erschienen / up to now appeared (Auszug / partly):

- U. Rüde (Hrsg.): Proc. 18. Symp. Simulationstechnik, Erlangen, 2005 - **NEW**
- W. Borutzki: BondGraphs – A Methodology for Modelling Multidisciplinary Dynamic Systems - **NEW**
- 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

bisher erschienen / up to now appeared (Auszug / partly):

- Th. Preiß: Relationale Datenbanksysteme als Basis für Modellbildung und Simulation von kontinuierlichen Prozessen
- Th. Fent: Applications of Learning Classifier Systems for Simulating Learning Organizations
- H. Ecker: Suppression of Self-excited Vibrations in Mechanical Systems by Parametric Stiffness Excitation - **NEW**
- M. Gymesi: Simulation Service Providing unter Verwendung von Web Service Technologie - **NEW**
- J. Wöckl: Hybrider Modellbildungszugang für biologische Abwasserreinigungsprozesse - **NEW**

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:
ASIM / Dr. Ingrid Bausch-Gall, Wohlfahrtstrasse 21b, D-80939 München
Fax: +49-89-3231063, or online: info@asim-gi.org, www.asim-gi.org

SCS SCS SCS

ARGESIM REPORT ARGESIM REPORT

ASIM - German Simulation Society
Arbeitsgemeinschaft Simulation

HTTP://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 30 institutional or industrial members

From the ASIM Board
At the last board meeting in Hannover, November 2005, extensions of new ASIM website were presented. These extensions will help in administration of the ASIM working groups, of the ASIM events, and of the ASIM publications. Another important topic was a discussion about the structure of the annual ASIM conference. From 2006 on, a new structure with more attractivity for people from industry will be implemented.

ASIM Publications

SNE – Simulation News Europe
ASIM is publishing (co-publishing) SNE, which is regularly published and sent to all ASIM members (as part of their membership; 900 issues) an to all other member societies of EUROSIM (500), and which is spread for promotion (500 issues).

SNE – Special Issues
From 2006 on, the ASIM working groups will publish special issues with state-on-the-art reports on modelling and simulation in their workscope. These series will be started in 2006 by the working group *Methods in Modelling and Simulation.*

ASIM Nachrichten
In 2005, the ASIM Nachrichten have been replaced by an electronic newsletter – ASIM Newsletter. The first newsletter was emailed in December 2005. Please send recent information to be roundmailed to the editor, Th. Pawletta, University Wismar, *pawel@mb.hs-wismar.de.*
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ASIM Mitteilungen
The trademark *ASIM - Mitteilungen* stands for all publications of the ASIM working groups. Each publication of a working group gets an identification as *ASIM – Mitteilung,* independent of the publisher, and independent of the publication medium (print, CD, web). For instance, the working groups *Simulation of Technical Systems* and *Methods in Modelling and Simulation* report about their spring meetings as well in a printed booklet (ASIM self-publishing or published by the hosting university), as well as on CD, and as well as on the ASIM website (download of CD) – all with same identification number.
The working group *Simulation in Production and Logistics* publishes the Proceedings of their biannual conference at Springer Verlag, and it is planned to compose an abstract volume for web publication (different identification numbers).
At present a database with all *ASIM – Mitteilungen* is set up, to be used in connection with the ASIM website for download for ASIM members.

ASIM Books
ASIM co-operates with the European Publishing House (previously SCS Europe Publishing House) and with ARGESIM (ARGE Simulation News, TU Vienna) in publication of two book series *Fortschritte in der Simulationstechnik – Frontiers in Simulation* and ASIM/ARGESIM/SCS book series *Fortschrittsberichte Simulation – Advances in Simulation*. In these series the Proceedings of the annual ASIM conferences, status reports of the working groups, and PhD theses are published.

ASIM Website
At present the new ASIM website is tested and extended by databases. The webpage is driven by a content management system (TYPO3).
The member data base is included into the web, with interactive change for members and query and newsletter distribution for the working groups.
Please note, that changes in the member database are not saved immediately, the changes are fed forward to the head of the working group (the member belongs to) for confirmation. Assignment to another working group cannot be done interactively.
More details in the next issue.

ASIM Working Groups

Working Group Structure. The reorganisation of the Working Groups is now finished. The new structure was approved by the GI board in December 04.

WG GMMS
The ASIM working group *Methods of Modeling and Simulation* met in March 2005 at University Wuppertal. Proceedings of this meeting are available as *ASIM Mitteilung* in electronic form at the ASIM website.

ASIM GMMS Workshop 2006
Survey on Methods and Application of
Modelling Methods
February 22 – 24, 2006; München

In 2006, the annual workshop will take place at Campus Garching of Technical University Munich. Information from the organiser, H. Bungartz, *bungartz@in.tum.de*, or from following the website:
HTTP://WWW5.IN.TUM.DE/WORKSHOPS/ASIM.HTML

The working group will also co-organise a joint meeting with the working group *Simulation of Technical Systems*.

The working group is itself installing research groups on specific topics, like education, scientific computing, structural-dynamic systems, etc.

WG SUGMB
The ASIM working group *Simulation in Environmental Systems and Medicine, Biology and Biophysics* co-operates since many years with other working groups of GI (Gesellschaft für Informatik) in the area of environmental simulation. The working group is running two annual workshop series, the one on *Simulation in Environmental Systems*, and the other one on *Modelling and Simulation of Ecosystems.*

For 2006, the next workshop in these series is prepared for Leipzig (info: HTTP://WWW.IBGW-LEIPZIG.DE/ASIM/):

ASIM SUGMBB Workshop 2006
Simulation in Environmental Systems
March 22 – 24, 2006; Leipzig

For October 2006, the next workshop in the series *Modelling and Simulation of Ecosystems* is scheduled again in Kölpinsee, Usedom.

The working group is publishing Proceedings of the meetings in the series *Umweltinformatik* at Shaker Verlag. It is intended to make these books electronically available to ASIM members or to produce separately a booklet with abstracts (both *ASIM - Mitteilungen*).

WG STS
The working group *Simulation of Technical Systems* met in March 2005 in Berlin. Proceedings of this meeting are available as ASIM - Mitteilung in electronic form at the ASIM website.

In 2006, the working group is organising a workshop in Munich:

ASIM STS/GMMS Workshop 2006
Modelling of Technical Systems
February 20 – 21, 2006; München

The workshop emphasises on exchange of experience between industry, university and research centres. Information about this workshop, organised by Ingrid Bausch-Gall, from *asimMuenchen@Bausch-Gall.de* or at HTTP://WWW.BAUSCH-GALL.DE/FGT

WG SPL
The working group *Simulation in Production and Logistics* organised in October 2004 the very successful bi-annual conference *Simulation in Production and Logistics.* These conference series will be continued with the next conference in Kassel in 2006:

12th ASIM Conference
Simulation in Production and Logistics
September 26 – 27, 2006, Kassel

Every two years the conference of the ASIM working group *Simulation in Production and Logistics* presents recent developments and interesting applications of simulation. This largest European conference for simulation in production and logistics is well balanced between research, development and industrial application. Scientific innovation is discussed as well as the successful application in every day's business.
Thus, companies, which not having used simulation before, will receive a first impression of different ways of using simulation. Furthermore, they will be enabled to choose their own way of using simulation and to estimate the potential asset to their own enterprises.

Contributions to the following topics are expected:

- Simulation in Logistics and Supply Chain Management
- Digital Factory
- Simulation in Production and Sustainable Production
- Simulation of Organizational Structures and Business Processes
- Optimization and Experiment Planning Distributed Simulation
- Cost Analysis Methods
- Simulation and Visualization
- Simulation Methods and Tools

Deadlines are:
- March 15, 2006: Abstract Submission
- April 15, 2006: Notification of Acceptance
- June 01, 2006: Full Paper Submission
- July 01, 2006: Notification Full Paper Review
- July 31, 2006 Final Paper Submission

The Proceedings of the conference will be published at Springer Verlag. It is intended to compile an abstract volume in electronic form to be available from the ASIM website. More info about this conference (organiser Sigrid Wenzel) from *asim@uni-kassel.de* or at the website HTTP://WWW.UNI-KASSEL.DE/FB15/IPL/PFP/ASIM06SPL/.

The working group organises also one-day meeting in industry, at research centres or at fairs. The net meeting will be organised on occasion of LogiMat fair in Stuttgart:

ASIM SPL Meeting
Simulation in Production and Logistics
Digital Logistics
March 29, 2006, LogiMat 2006, Stuttgart

Information at the ASIM website at following entry WWW.ASIM-GI.ORG/INDEX.PHP?ID=192>

WG SBW
The working group *Simulation in Business Administration* continues its tri-annual conference series in 2006:

ASIM SBW Conference
Simulation as Operational Decision Support
March 13 – 15, 2006, Braunlage, Harz

Information is available from the organiser J. Biethahn via email *jbietha@uni-goettingen.de* or at the website HTTP://WUB113.WISO.UNI-GOETTINGEN.DE

WG SVS
The working group *Simulation of Traffic Systems* plans a meeting on the occasion of the SIMVIS conference, Magdeburg, March 2-3, 2006. Recent information at HTTP://WWW.SIMVIS.ORG

ASIM Conferences

ASIM organises the annual ASIM Conference, the ASIM working groups organise annual workshops (up to 100 participants) and bi-annual conferences (more than 100 participants. ASIM cooperates in organising the three-annual EUROSIM Congress. Furthermore, ASIM co-organises local conferences, e.g. the annual ASIM Workshop *Simulation in Automotive* in Wismar

A special co-operation was established with the annual conference series *SIMVIS – Simulation and Visualisation* in Magdeburg (March) and with the three-annual conference series *MATHMOD - Mathematical Modelling* in Vienna (February).

ASIM Conference - Symposium Simulation Technique
In 2005, the annual ASIM Conference took place at University Erlangen, organised by U. Rüde (general chair) and R. Rimane. A report will be published in the next issue of SNE.

In 2006, the ASIM conference will be organised by at University Hannover by Helena Szczerbicka and Rainer Rimane.

ASIM 2006
19th Symposium on Simulation Technique
September 11 – 14, 2006, Kassel

ASIM 2006 will present:
- Invited talks on new developments and trends
- Presentations and posters on all topics of modelling and simulation
- Workshops on current topics
- Exhibition of hardware and software for simu lation
- Tutorials on new methods
- User group meetings on software tools

ASIM 2006 will deal with all kind of modelling and simulation:
Modelling and simulation methods. Model Design and Validation, Object-oriented modelling and simulation, Numerical methods, Parallel and symbolic algorithms, Optimization methods, Stochastic modelling techniques, Petri nets, Agent-based systems, Artificial intelligence, Bond graphs
Hardware and Software, Simulation Tools: Discrete, continuous, hybrid, and distributed simula-tion; Tools for modelling and simulation, Visualisa-tion and virtual reality, Grid-based simulation, Sys-tems for teaching and learning, Computer architectures and computer networks, High performance computing
Applications: CAD/CAM/CIM, Production technique, Systems of flow of material and logistic, Production systems, Technical systems, Vehicle and aircraft dynamic, Flow simulation, Logic and circuit simulation, Communication techniques and computer networks, Ecology and environment, / Geo and environmental sciences, Biology, Medical technology, Medicine, Physics, Chemistry, Material sciences, Management and business processes, Economics, Social sciences, Education

Conference language will be German and English, the deadlines are:

- May 15, 2006 Abstract submission
- June 16, 2006 Notification of acceptance
- August 15, 2006 final paper submission

More information is available via email from *asim2006@cs.fau.de* or at the conference website at HTTP://WWW10.INFORMATIK.UNI-ERLANGEN.DE/ASIM2006

In 2007, SLOSIM, the Slovenian Simulation Society will organise the **EUROSIM Congress**; ASIM will be not only co-sponsor, but will also co-organise this event, so that in this year the annual ASIM Conference will be skipped.

SIMVIS Conferences

ASIM is co-organiser of the annual international conference SIMVIS in Magdeburg. Next Conference is:

SIMVIS 2006
17th Simulation and Visualization Conference
March 2 – 3, 2006, Magdeburg, Germany

The Conference *Simulation and Visualization* 2006 is open to everyone with interest in the fields of simulation, modelling and visualization. The goal of this conference is the presentation of new research and innovative applications. In addition SIMVIS provides meeting place for simulation and visualization practitioners, researchers, and vendors working in all disciplines and in the industrial, governmental, military, and academic sectors. The conference program is being organized into tracks that reflect the current state of the SimVis field as well as the mix of interests and professional orientations of conference attendees.

In 2006, both invited speakers are coming from Vienna. Helwig Hauser (Scientific Director of the VRVis Research Center, Vienna) will give a survey on discrete simulation and visualisation; Felix Breitenecker (Vienna University of Technology, ASIM President) will give an overview on the development of continuous and hybrid simulation.

More information about SIMVIS can be found at HTTP://WWW.SIMVIS.ORG

MATHMOD Conferences

ASIM is co-organiser of the tri-annual conference series MATHMOD in Vienna. Next Conference is:

MATHMOD 2006
5th Symposium on Mathematical Modelling
February 7 – 10, 2006, Vienna

This symposium deals with all kinds of mathematical modelling. ASIM members are organising special session at this conference. The conference is organised by Inge Troch and Felix Breitenecker.

More information on **MATHMOD 2006** is available via email from *Inge.Troch@tuwien.ac.at* or at the website HTTP://WWW.MATHMOD.AT

ASIM Wismar Workshops

At University Wismar a regional workshop on technical aspects has been established. Next Workshop is:

3rd ASIM Workshop
Modelling, Control and Simulation in Automotive
May 18 – 19, 2006, Wismar

An essential goal of the workshop is the exchange of experience between developers and users regarding different problems of modelling, simulation, control and diagnostics of technical processes. Furthermore, special emphasis is put on the automotive area. Particularly problems of control design for mechatronic systems as well as for combustion drive trains and gasoline-electric power trains should be contemplated.

Contributions shall be as application-oriented as possible. Nevertheless, presentations of new theoretical approaches with application potential for the areas described above are appreciated, too.

Thematic Emphasis concentrates at:

- Modeling and simulation of technical processes
- Control and diagnostic techniques for application with mechatronic systems, especially with combustion engines
- Sensors and measuring methods for acquisition of control-relevant data in automotive
- Tools for simulation and development

Deadlines are

- March 17, 2006: registration of participants with con tributions and abstract submission
- April 21, 2006: final paper submission
- May 12, 2006: registration of participants without contribution

More information from the organisers: Th. Pawletta, C. Deatcu et al. via email *c.deatcu@mb.hs-wismar.de* or at HTTP://WWW.MB.HS-WISMAR.DE/CEA/ASIMWS/

Modelica Conference Series.

ASIM members and ASIM working group are strongly involved into the Modelica Conference. Next Modelica Conference will take place in Vienna, September 4 – 5, 2006. Info see:

HTTP://WWW.MODELICA.ORG/EVENTS/MODELICA2006

ASIM Conference Calendar

MATHMOD 2006
5th Vienna Symposium on Mathematical Modelling
February 8 – 10, 2006; Vienna, Austria

ASIM – STS Workshop 2006
February 20 – 21, 2006
Munich, Germany

ASIM – GMMS Workshop 2006
February 22 – 24, 2006
Munich, Germany

SIMVIS 2006
17th Conf. Simulation and Visualisation
Meeting ASIM-SVS
March 2 – 3, 2006; Magdeburg

ASIM SBW Conference
Simulation as Operational Decision Support
March 13 – 15, 2006
Braunlage, Harz, Germany

ASIM – SUGMBB Workshop2006
Simulation in Environmental Systems
March 22 – 23, 2006; Leipzig, Germany

ASIM – SPL Meeting
March 29, 2006; LogiMat, Stuttgart

ASIM WismarWorkshop
Modelling, Control and Simulation in Automotive
May 18 - 19, 2006; Wismar, Germany

MODELICA 2006
5th International Modelica Conference
September 4-5, 2006; Vienna

ASIM 2006
19th Symposium Simulation Technique
September 11 – 14, 2006, Univ. Hannover, Germany

12th ASIM Conference
Simulation in Production and Logistics
September 26 – 27, 2006;
Kassel, Germany

6th EUROSIM Congress
Sept. 10-14, 2007, Ljubljana, Slovenia

ASIM Info and Contact

GMMS Methods in Modeling and Simulation, P.Schwarz, FhG Dresden, *schwarz@eas.iis.fhg.de*
SUGMBB Simulation in Environmental Systems and Medicine, Biology, Biophysic; J.Wittmann, Univ. Hamburg, *wittmann@informatik.uni-hamburg.de*
STS Simulation of Technical Systems, A. Wohnhaas, debis Systemhaus GEI, *Achim.Wohnhaas@t-systems.com*
SPL Simulation in Production and Logistics, S.Wenzel, Univ. Kassel, *s.wenzel@uni-kassel.d*e
SVS Simulation of Transport Systems, U. Brannolte, Univ. Weimar, *Ulrich.Brannolte@bauing.uni-weimar.de*
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www-Information: HTTP://WWW.ASIM-GI.ORGEmail:
info@asim-gi.org (for information)
admin@asim-gi.org (for administration)

CROSSIM - Croation Society for Simulation Modelling

General Information
CROSSIM - CROatian Society for SIMulation Modelling was founded in 1992 as a non-profit society with the goal to promote knowledge and use of simulation methods and techniques and development of education and training in the field of simulation modelling. CROSSIM is an affiliate of SCS since 1994 and a full member of EUROSIM since 1997.

Membership
CROSSIM has only individual members and three categories of membership are recognized according to statutes: regular, honorary and student members.
Information, Contact Address

The updated information about Society is available from **EUROSIM** website at:
HTTP://WWW.EUROSIM.INFO

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Activities
The Society is engaged in dissemination of information on simulation as well as in organization of meetings, courses and workshops. CROSSIM cooperates with the University Computing Centre, Zagreb, in organization of an international conference Information Technology Interfaces (ITI) and in publishing of the Journal of Computing and Infor-mation Technology (CIT). All information concerning CIT is available at
HTTP://CIT.SRCE.HR/HOME.HTML

Past Events
During last years several candidates in different fields obtained their master and PhD degrees with theses that employed simulation modelling. Most recently Teo Manestar Blazic, MD obtained his MSc degree in medicine at Zagreb University Medical School by thesis entitled *"A simulation model of telomere influence on the development and growth of cancer - testicular seminoma and nonseminoma example".*

Coming Events
28th International Conference Information Technology Interfaces ITI 2006 will be held in Cavtat near Dubrovnik on June 19-22, 2006. The Conference will take place at the luxurious five star Croatia hotel in Cavtat (HTTP://WWW.HOTELI-CROATIA.HR), only 10 minutes (6 km) from Dubrovnik International Airport.

ITI 2006
28th Conference Information Technology
Interfaces, June 19 - 22, 2006
Cavtat near Dubrovnik, Croatia

The Conference is relatively small, but it has a long tradition (since 1974) of creating an inspiring, productive and pleasurable atmosphere for interdisciplinary communication among researchers, scholars and professionals from various sub-fields of ICT arena. ARGESIM and CROSSIM are among Conference co-operating institutions.
ITI Conference is scientific, multidisciplinary conference, but each year there is a special topic for the conference. In 2006 this special topic is "E-learning: Opportunities and Challenges for Learning and Teaching". There are twelve other topics of inter-est and among them is a session on Modelling, Simulation and Optimization which will be chaired by Professor Zelimir Kurtanjek from Zagreb University Faculty of Food Technology and Biotechnology.

Deadline for papers/posters abstracts submission is February 1, 2006 and the deadline for camera ready final full papers/posters abstracts is May 1, 2006 while May 20 is a deadline for the registration/publication fee for authors of accepted papers/posters as well as for the hotel reservation and deposit.
Conference registration, paper submission and hotel reservation can be done through internet at:
HTTP://ITI.SRCE.HR/.

Jadranka Bozikov, *jbozikov@snz.hr*

CSSS - Czech and Slovak Simulation Society

General Information

CSSS (The Czech and Slovak Simulation Society) has about 130 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 about modelling and simulation activities in Europe to its members, informing the members about publishing in the field of modelling and simulation. Since 1992 CSSS is a full member of EUROSIM.

Past Events

The 27th International Workshop „Advancements in Simulation Systems“ (ASIS'2005) took place from 6th to 8th of September in Pøerov, Czech Republic. About 42 participants from Czech and Slovak republics attended the conference.

The 7th International Workshop "Modelling and Simulation in Management Informatics and Control" (MOSMIC 2005) took place from 11th to 13th tof October 2005 in Zilina, Slovak Republic and was organised by the Faculty of Management Informatics and Control, University of Zilina, Slovak Society for Applied Cybernetics and Informatics, Bratislava and CSSS and sponsored by EUROSIM. Some 20 participants from Czech republic and Slovak republic attended the conference. The chairman of the international program committee was prof. Mikulas Alexik.

Coming Events

The 3rd International Workshop NETSS „New Trends in System Simulation“ will take place in the Moravian town Vranov u Brna, Czech republic on February 22-23, 2006. The chairman of the international organising committee is Dr. Ing. Jan Stefan.

NETSS'2006
3rd International Workshop
„New Trends in System Simulation“
February 22 - 23, 2006
Vranov u Brna, Czech republic

The 28th International Workshop „Advancements in Simulation Systems“ (ASIS'2006) will take place in the Moravian town Prerov, Czech republic on September 12-14, 2005. The chairman of the international organising committee is Dr. Ing. Jan Stefan.

ASIS 2006
27th International Workshop
„Advancement in Simulation Systems“
September 12 - 14, 2006
Prerov, Czech republic

The 7th International Scientific Conference on *Electronic Computers and Informatics'2006* will take place on September 20-22, 2006, in Herlany, Slovak Republic. One of the topics is focusing on Modelling and Simulation of the Systems. The general chair of the conference is prof. Jelšina, Technical university of Košice, chair of organisation committee is doc. Jan Baca, email: *jan.baca@tuke.sk*.

Electronics Computers and Informatics 2006
7th International Scientific Conference
September 20 - 22, 2006
Herlany Slovak Republic

Information

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AES Spanish Simulation Society

No news received.

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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, and the Chinese Association for System Simulation and the Japanese Society for Simulation Technology. The Steering Committee of DBSS consists of the following members: A.W. Heemink (TU Delft), Chairman, L. Dekker, Vice-Chairman , W. Smit (E&E Consultants, Inc.), Secretary and Treasurer, Th.L. van Stijn (Royal Dutch Meteorological Institute/KNMI).
Membership - Information
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:

- Euro 34,- individual member or Euro 68,- institutional member, which means that you will receive the news letter Simulation News Europe two times a year (one double, one single issue).
- Euro 68,- individual member or Euro 114,- institutional member, which means that you will receive the Journal Simulation Practice and Theory eight times a year, and 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. .
Please mention your name, affiliation and address (including email, fax and telephone), and indicate whether you are interested in the personal or institutional membership and contact **DBSS**:

Dutch Benelux Simulation Society
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FRANCOSIM - Société Francophone de Simulation

FRANCOSIM was founded in 1991 and aims to the promotion of simulation and research, in industry and academic fields. Francosim operates two poles.

Pole Modelling & simulation of discrete events systems
To improve the necessary synergy between industry and academia workers in the area of system modelling, the pole co-organises the series of conferences MOSIM (Modelling and simulation).

Pole Contact: Professor Henri Pierreval,
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pierreva@ifma.fr

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 fourth BioMedSim event was organized in May 2005 in Linköping, Sweden in collaboration with the Scandinavian Simulation Society (SIMS). The fifth will take place in Jordan in spring 2007.

Pole contact: Yskandar Hamam, président
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MOSIM Conferences
Francosim's MOSIM Conference series is now an essential place for French-speaking researchers in Computer Science and Operations Research working on various aspects of modelling and simulation.

MOSIM '06
Modelling and Simulation Conference, April 2006
Rabat, Marocco

The next edition of the MOSIM conference will be organized in Rabat in Morocco (April 2006) by two engineering schools: the EMI (Ecole Mohammedia d'Ingénieurs) and the ENIM (Ecole Nationale de l'Industrie Minérale).

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 at 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 postgraduate students studying economy, informatics and electrical engineering. PhD students participate in various simulation research projects aimed at methodological basic research as well as applications of simulation mainly in the fields of traffic, economic and interdisciplinary problems. In the town of Gyõr at the Széchenyi István University 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. Lately a new specialization called "Compter Science in Economy" was started, where simulation is also taught as a basic subject.
Our efforts mentioned are intended to contribute to the dissemination of the various aspects of the methodology and application of simulation for the young generation. We have participated at EU-ROSIM 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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PSCS - Polish Society for Computer Simulation

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 262 members. The Board consisting of the following persons: Andrzej Tylikowski (President), Leon Bobrowski and Andrzej Chudzikiewicz (Vice Presidents), Zenon Sosnowski (Secretary), Zdzislaw Galkowski (Treasurer), Roman Bogacz, Jaroslaw Rybicki, Andrzej Grzyb (Members).

Activities
The main activities of the Polish Society for Computer Simulation are annual conferences known as „PSCS Workshops on Simulation in Research and Development": Mielno (1994), Warszawa (1995), Wigry (1996), Jelenia Gora (1997, 1998), Bialystok & Bialowieza (1999), Zakopane – Koscielisko (2000), Gdansk-Sobieszwo (2001), Osiekik/ Koszalina (2002), Zakopane (2003), and Bialystok & Augustow (2004).
The annual **PSCS Workshop** on Simulation in Research and Development took place on September 15 -18, 2005, in Sarbinowo Morskie k. Koszalina, Poland. The 54 papers of the workshop covered a broad area, e.g. simulation in mechanical engineering, simulation in mathematical problems, artificial intelligence.

Publications. Proceedings of the **11th PSCS Workshop** on 'Simulation in Research and Development', L. Bobrowski and A. Tylikowski (Eds.), Warszawa, 2005, (in Polish). The price is 30.- PLN.

Coming Events
Prof. Z. Strzyzakowski will organize the 13th PSCS Workshop on „Simulation in Research and Development", September, 2006 in Bieszczady, Poland. Info: *zstrz@data.pl*

13th PSCS Workshop
„Simulation in Research and Development "
September 15 – 18, 2005

Information, Contact Address
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Z. Sosnowski, zenon@ii.pb.bialystok.pl

SLOSIM Slovenian Society for Simulation and Modelling

HTTP://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. Currently it has 73 members from Slovenian universities, institutes, and industry. It promotes modelling and simulation approach to problem solving in industrial as well as in academic environments by establishing communication and cooperation among the corresponding teams.

News

In the last period the following activities can be itemized:

- SLOSIM Executive board meeting took place in December at the Faculty of Electrical Engineering where the past actions were presented to the members and analysed as well as some plans for the year 2006 were discussed.
- The members of the Society were animated to participate at the MATHMOD 06 Congress in Vienna which resulted in three sections that will be organised by the SLOSIM members and in several individual contributions.
- The vice-president of SLOSIM dr. Leon Zlajpah will be the invited lecturer at the MATHMOD06 Congress.
- On the traditional Slovenian ERK 05 conference, two sections with 12 contributions were organized by the members of SLOSIM accompanied also with some individual contributions by the members.
- The lectures of two foreign experts, dr. Hector Chiacchiarini from Bahia Blanca, Argentina, and dr. Doris Saez from Santiago de Chile, were organized in December for the members of SLOSIM.
- Members of SLOSIM took part in the celebra tion on the occasion of big renovation of the *Laboratory of Modelling, Simulation and Control* and *Laboratory of Automation and Informatisation of Processes* at the Faculty of Electrical Engineering, University of Ljubljana.
- The SLOSIM members were promptly informed about the interesting events in the field of modelling and simulation.
- The leaflets of EUROSIM 07 congress were distributed in some corresponding world meetings and universities.
- The SLOSIM members are planned to be active participants in the boards of EUROSIM 07 congress as well as in all other activities connected with the organization of the event.

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ISCS - Italian Society for Computer Simulation

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: Ing. Mario Savastano (Chairman), Prof. Franco Maceri (Vice Chairman), Dr. Paola Provenzano (Secretary), Prof. Pasquale Arpaia (Treasurer).

ISCS Information

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Paola Provenzano
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ROMSIM - Romanian Modelling and Simulation Society

ROMSIM has been founded in 1990 as a non-profit society, devoted to both theoretical and applied aspects of modelling and simulation of systems. ROMSIM currently has about 100 members from both Romania and Republic of Moldavia. The main objectives of ROMSIM are: development of new methods and instruments of modelling and simulation of systems, development of new application of model-ling and simulation of both natural systems and those created by man, development of education and train-ing in the field of modelling and simulation of systems. An other important objective of ROMSIM is organization of national scientific events in the field of model-ling and simulation and participation at international conferences. In April 1999 ROMSIM has been accepted as an observer member of EUROSIM.

Past Events
ROMSIM has developed in the last time a lot of activities in both scientific and information field. An important contribution was given by some ROMSIM members to the scientific organization of the EUROSIM Congress 2004 in Paris. Five papers have been presented by six authors, in different field of modelling and simulation of systems.
An editorial event to be mentioned is the editing of a Special Issue of the Journal Studies in Informatics and Control by a team of ROMSIM. The Special Issue was dedicated to 'Fuzzy Systems and Logic: Theory and Applications in Simulation and Control' with editors Prof. Paul Flondor and Dr. Mircea Sularia.

Present and Coming Events
ROMSIM is involved in organization of the EUROSIM Congress 2007, Ljubljana. Four members of ROMSIM have been proposed to be members of the IPC. At the same time ROMSIM encouraged members to prepare and submit papers at this Congress. Two members of ROMSIM will attend the MATHMOD Conference, Vienna, February 2007. ROMSIM will be represented at the EUROSIM Board Meeting, Feb. 2006 in Vienna.
ROMSIM is involved in organization of the periodic scientific seminary titled 'Fuzzy Systems and Fuzzy Logic'; 15 to 20 specialists attend the reunion of the seminary. The seminary present and discuss both theoretical and applied contributions of participants, in the field of fuzzy sets, fuzzy logic and fuzzy systems. We emphasize that the founder of this seminary was the well-known fuzzy expert Prof. C. V. Negoita.

Publications
We emphasize also the activity of ROMSIM members in the field of publishing books, monographs and articles in international and/or Romanian journals. Some monographs are to be published in a new Series titled *Technologies of Information*, of Technical Publishing House, Bucharest and articles will be published in the Romanian journals.

Two editorial events must be emphasised:

- Modelarea Sistemelor de Mare Complexitate (Modelling of High Complexity Systems), by Florin Stanciulescu, printed by the Publishing House Editura Tehnica Bucharest, in Romanian with the contents and an abstract in English. We mention that this book has received the prix "Grigore Moisil" of Romanian Academy (www.academiaromana.ro).
- Modelling of High Complexity Systems with Applications, by Florin Stanciulescu, including a CD with 12 MathCAD applications, printed by the English Publishing House WIT Press, Southampton

At the same time members of ROMSIM have published articles in Romania Journal for Informatics and Automatics, as dr. Florin Hartescu, math. Zoe Radulescu and other.

Seminary Chaos, Fractals and Applications
Starting with October 2002, at the Faculty of Automatics and Computer Science of the Polytechnic University of Bucharest, a monthly seminar about chaos, fractals and applications takes place. About 30 members (professors, researchers, graduate and undergraduate students) from various fields like engineering, medicine, mathematics, physics, chemistry and biology are involved. The main organizer is proof. Redo Codrescu from Polytechnic University. The group already organized the First South-East European Symposium on "Interdisciplinary Approaches in Fractal Analysis-IAFA 2003. This Symposium was a success due to the large cooperation between Romanian researchers and researchers from many other countries. There were about 50 papers presented from which at least 20 from the guests.

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SIMS - Scandinavian Simulation Society

HTTP://WWW.SCANSIMS.ORG

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. Iceland will be represented by one board member. The SIMS annual meeting takes place at the annual SIMS conference or in connection to inter-national simulation conferences arranged in the Nordic countries.

SIMS Structure

SIMS is organised as federation of regional societies. There are FinSim (Finnish Simulation Forum), DKSIM (Dansk Simuleringsforening) and NFA (Norsk Forening for Automatisering).

Membership, SIMS Board

- Peter Fritzson, chairman
- Jørn Amundsen, Erik Dahlquist, Brian Elmegaard, Kaj Juslin, Esko Juuso, Bernt Lie, Kim Sörensen
- Vadim Engelson is SIMS coordinator for practi cal matters

The position of Iceland will be filled later.

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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 HTTP://WWW.SCANSIMS.ORG

Past Events

The **46th SIMS Conference** was held in Trondheim, Norway in October 13-14, 2005. The conference was organised by the Norwegian University of Science and Technology (NTNU). The response of the call for papers resulted in a large number of submissions reflecting current trends and developments in modelling and simulation.

The papers were selected through a two phase procedure based first on abstracts and the on draft papers. The programme consisted of 40 papers and 4 keynote presentations. More than 60 participants attended the conference.

The plenaries provided insight on sensitivity analysis of differential algebraic equations, testing with hardware in loop and new possibilities in supercomputing. The programme contained both theoretical studies and practical applications in industry. Mathematical modelling and numerical methods were applied in various systems. Computer simulation of heat and fluid flow including distributed parameter systems was an important area. Simulation studies were connected to control engineering and process optimisation. The main applications were in oil and gas industry, energy sector, biological and environmental engineering and mechanical engineering. New features of programming tools and model portability issues were also handled. Presented papers will be considered for publication in the EUROSIM scientific journal 'Simulation and Modelling - Practice and Theory' (SIMPRA) published by Elsevier Science. The annual meeting of SIMS was held during the conference. A change of the bylaws to include Iceland was approved in the meeting. The change is now binding.

The Workshop on New Trends in Automation was organised by DKSIM Malardalen University in Vasteras, Sweden, June 20, 2005. The programme consisted of four keynote presentations and two workshops:

- Applications within process industries like bio technology /pharmaceutical/ food/ pulp and paper/ power plant-area.
- Pros and cons with outsourcing

More than 40 participants attended the workshop. Next year there will be a new workshop with conference in the same way, but also including peer reviewed papers as a complement.

The **16th Automation Seminar Days** were organised by the Finnish Society of Automation in Helsinki in September 6-9, 2005. The Automaatio 05 Fair in conjunction with the Automation Seminar Days makes up the most important automation industry event in Northern Europe. It has traditionally taken place every second year. The Seminar Days serve as a forum for professionals in the field of automation. FinSim contributed to this event. There were several papers on modelling and simulation. More than 250 participants attended the seminar days.

The **Danish Simulation Day** on Simulation of fuel cells was organised by DKSIM in Aalborg Nov. 16, 2005.

Erik Dahlquist organized a **Conference / Workshop New Trends in Automation**, June 20, in Västerås, Sweden. Keynote speakers, 45 attendees, Frank Doyle invited from U. Santa Barbara.

Coming Events

47th SIMS Conference
September 28-29, 2006
Helsinki, Finland

The **47th Scandinavian Conference on Simulation and Modelling** will be organized by Finnish Simulation Forum (FinSim) in Helsinki, Finland, September 28-29, 2006.
The purpose of SIMS 2005 is to cover broad aspects of modelling and simulation and scientific computation. It will be of interest for model builders, simulator personnel, scientists, engineers, vendors, etc. The scientific program will consist of technical sessions with submitted and invited papers, and is open for poster sessions and vendor demonstrations.
Presented papers will be considered for publication in the EUROSIM scientific journal 'Simulation and Modelling - Practice and Theory' (SIMPRA) published by Elsevier Science. Further information will be available on the SIMS web page HTTP://WWW.SCANSIMS.ORG

Control Systems 2006
June 6-8, 2006
Tampere, Finland

Following a long series of biannual events with rich history extending back to the 1980s, the **Control Systems 2006 Conference** will be held in Tampere, Finland June 6-8th, 2006 with the workshop of COST Action E36 Modeling and Simulation in the Pulp&Paper Industry on June 5th as a pre-event. COST Action is a European Commission sponsored form of networking, the present workshop being open to participants outside the EU as well. Further information is available on the SIMS web page HTTP://WWW.SCANSIMS.ORG

1st IFAC Workshop on Applications of Large Scale Industrial Systems ALSIS'06
August 30-31, 2006
Baltic Sea, Helsinki and Stockholm

The ALSIS'06 Workshop will be arranged as a cruise between two Scandinavian capitals, Helsinki and Stockholm in August 30-31, 2006.
The Applications of Large Scale Industrial Systems, the first workshop of its kind in IFAC, cover such systems as mill- and company-wide systems, communication systems, environmental systems, intelligent manufacturing systems, and so on. Large scale system theory provides methodologies to deal with complexity in modelling, control, and design of such systems.

The Workshop is a forum for scientists and especially practitioners aiming to discuss new developments and results in the area of large scale industrial systems. The special emphasis is on industrial applications (chemical and petrochemical industries, metallurgical industries and pulp and paper) and development tools and methods applicable in industrial environment.

Further information is available on the SIMS web page HTTP://NTSAT.OULU.FI

5th Modelica International Conference
September 4-5, 2006
Vienna, Austria

The **International Modelica Conference** will be held at arsenal research in Vienna, Austria on September 4-5, 2006. The conference is organized by the Modelica Association and arsenal research. Further information is available from HTTP://WWW.MODELICA.ORG

SIMS Contact Address, Information

Updated SIMS web page:HTTP://WWW.SCANSIMS.ORG

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UKSim United Kingdom Simulation Society

HTTP://DUCATI.DOC.NTU.AC.UK/UKSIM/

General Information

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

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 until the next conference. For more information about the Membership please contact the Membership Secretary:

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Activities

The UK Simulation Society has held its annual meeting at Kingston University (London) in conjunction with the Kingston workshop on March 9. Important actions were taken as a result of the mee-ting to further develop the UKSim conference. The UKSim 2005 conference was declared an international conference and obtained the sponsorship of the IEEE UK-RI Computer Chapter. These important changes are expected to largely increase the number of papers as well as the level of international participation at the conference within the next one to two years. The actual conference under the name of 8th International Conference on Computer Modelling and Simulation (ICCMS) was held in Oxford, St. John's College, April 6-8.

The main actions for the near future will include strengthening the society's industrial links, reinforcing and extending the current international links, and promoting networking opportunities for members. To these effects, the 2007 conference will be held in the Far East and a series of workshops under the name of European Simulation Symposium will be launched by the end of 2007.

Coming Events

The nearest event will be the UKSim 2006 Conference co-sponsored by the IEEE UK & RI. The conference will be held at Oriel College, Oxford on April 4-6.

UKSIM 2006 Conference
April 4- 6, 2006
Oriel College, Oxford, UK

UKSIM is significantly involved in the organization of the European Simulation Multi-Conference (ESM) series recently renamed as the European Conference on Modelling and Simulation (ECMS) to reflect important changes in the organisation. The chairman of the society, Professor David Al-Dabass, is in fact the director of this conference series and several members of the UK Simulation board participate in conference and track chairing duties.

This year the ECMS conference was held in Riga, Latvia, on June 1-4 and was a major success, with over 160 papers and wide representation of delegates from all continents. The Society will strongly contribute to the organisation of the 2006 ECMS conference to be held in Bonn, on May 28-31.

ECMS 2006 Conference
May 28 – 31, 2006
Bonn, Germany

Publications

A special issue of the journal IJSSST on *Simulation in Technology, Processes and OR* is published later this year including a selection of extended papers from the corresponding ECMS 2005 track. Four other issues of the IJSSST including a wider selection of the best papers from the ECMS 2005 conference will be published early in 2006.

All issues are available online. An example issue may be found at:

HTTP://DUCATI.DOC.NTU.AC.UK/UKSIM/JOURNAL/VOL-5/NO-3&4/COVER.HTM

The society would like to encourage individuals and university libraries to subscribe to the journal. The cost of one full year subscription is £297 for individuals, and £495 for university libraries and in-stitutions.

Details are available on the website, or send a cheque or credit card details to Professor David Al-Dabass, Editor-in-Chief, IJSSST, School of Computing & Informatics, Nottingham Tent University, Nottingham, NG1 4BU.

INTERNATIONAL SOCIETIES AND RESEARCH GROUPS

MATHMOD Conference Series

HTTP://WWW.MATHMOD.AT

The MATHMOD Conference Series was started with the first MATHMOD Conference in February 1994. In 1997, 2000 and 2003 the series was successfully continued by the second, third and fourth MATHMOD conference. The series has established as well-accepted and high-standing tri-annual conferences on mathematical modelling and simulation.
The conference series is run by the Institute for Analysis and Scientific Computing (I. Troch) of Vienna University of Technology, in close co-operation with ARGESIM (F. Breitenecker).

5th MATHMOD Vienna
5th Vienna International Conference on Mathematical Modelling
February 8 – 10, 2006;
Vienna, AUSTRIA

The scope of the conference covers theoretic and applied aspects of the various types of mathematical i.e. formal modelling for systems of dynamic nature (deterministic, stochastic, continuous, discrete or hybrid, etc.). The conference will also deal with alternative modelling methods (e.g. cellular automata) and modelling for / in scientific computing.

The Scientific Programme will consist of Invited Lectures, Regular Sessions, Organised Sessions, Poster Sessions, and Tutorials. Social Programme will include Welcome Party, Heurigen Evening, Reception, Closing Party. Program for Accompanying Persons will include the Social Programme and Guided Tours in Vienna.

Date and Place:
Vienna University of Technology
Freihaus Building
Wiedner Hauptstrasse 8-10, A-1040 Vienna
February 8 -10, 2006 – All Sessions
February 7, 2006 - Workshops and Tutorials
For more information please visit
HTTP://WWW.MATHMOD.AT or contact the conference chair:
Prof. Dr. Inge Troch.
Inge Troch, *inge.troch@tuwien.ac.at*

ARGESIM
Working Group Simulation News

HTTP://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, 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
- **Regional Activities:**
  Publication of ASIM-Nachrichten,
  Administration for ASIM and for User Groups,
  ASIM WWW - Server, WWW - servers for ARGESIM and GI/ITTN
- **Local Activities:**
  Seminar Series *Modelling and Simulation*
  Simulation software support at Vienna University of Technology,
  Various simulation projects

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.

ARGESIM Information

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ECCOMAS

HTTP://WWW.ECCOMAS.ORG

ECCOMAS is an organisation grouping European Associations with interests in the development and applications of computational methods in science and technology.

ECCOMAS was created in 1993 with the aim of fostering basic and applied research and dissemination of activities in Europe in the field of Computational Methods in Applied Sciences.

ECCOMAS Council is formed by official representatives of National or Regional Scientific So-cieties or Organizations covering most of the European countries. Its main mission is to favour the exchange of information, and to promote the transfer between Research and Industry at the European scale.

Its fields of interest are the applications of Mathematical and Computational Methods and Modelling to major areas such as Fluid Dynamics, Structural Mechanics, Semi-conductor Modelling or Electro-magnetics. Multidisciplinary applications of these fields to critical societal and technological problems encountered in sectors like Aerospace, Car and Ship Industry, Electronics, Energy, Finance, Chemistry, Medicine, Biosciences, Environmental sciences are of particular interest.

ECCOMAS Events

The main event organized by ECCOMAS is a large European conference taking place on a four year cycle and addressing scientists and engineers both in and outside Europe. The main objective of these conferences is to provide a forum for presentation and discussion of state-of-the-art in scientific computing applied to engineering sciences. Equal emphasis is given to basic methodologies, scientific development and industrial applications.

The previous ECCOMAS Congresses were held in Brussels in 1992, Paris 1996, Barcelona 2000 and Jyvaskyla, Finland on July 2004. The **ECCOMAS 2004 Congress** attracted over 1100 participants. The next edition, **ECCOMAS 2008** Congress, will take place on June 30 - July 5, 2008 in Lido Island, Venezia, Italy.

The ECCOMAS Congress includes invited lectures, Invited Special Technological Sessions (STS), contributed papers from Academy and Industry and Minisymposia. Proceedings of the ECCOMAS Congresses are widely disseminated in Europe.

ECCOMAS also organises large conferences devoted to structures and fluids. The III European Conference on Computational Solid and Structural Mechanics (CSSM 2006) will take place in the Laboratório Nacional de Engenharía Civil (LNEC) in Lisbon, Portugal, on June 4 - 8, 2006. The IV **ECCOMAS CFD** Congress will take place in Egmond aan Zee, NL, on September 5-8, 2006.

These series of global meetings are complemented with more focused thematic conferences on state of the art topics in computational science and engineering organised with the support of ECCOMAS.

More recently several ECCOMAS Committees in scientific areas such as CFD, Structures, Electro-magnetics, Chemistry, Mathematical and Numerical Methods and CAD/CAM have been set up.

ECCOMAS Associations and Representatives

- ACME - Association for Computational Mechanics in Engineering, UK;
- AIMETA - Associazione Italiana di Meccanica Teorica e Applicata, Italy;
- APMTAC - Associação Portuguesa de Mecanica Teórica, Aplicada e Computacional, Portugal;
- BFUT - Board of the Swiss Federal Institutes of Technology, Switzerland;
- BNCM - Belgian National Committee for Theoretical and Applied Mechanics, Belgium;
- CEACM - Central European Association for Computational Mechanics, Central Europe;
- CSMA - Computational Structure Mechanics Association, France;
- FMS - Finnish Mathematical Society, Finland;
- GACM - German Association of Computational Mechanics, Germany;
- GAMM - Gesellschaft für Angewandte Mathematik und Mechanik, Germany;
- GAMNI/SMAU - Groupe pour l'Avancement des Méthodes Numériques de l'Ingénieur / Société de Mathématiques Appliquées et Industrielles, France;
- GRACM - Greek Association for Computational Mechanics, Greece ;
- HSTAM - Hellenic Society for Theoretical and Applied Mechanics, Greece;
- IACMM - Israel Association of Computational Methods in Mechanics, Israel;
- IMA - Institute of Mathematics and its Applications, UK;
- ISSEC - Irish Society of Scientific and Engineering Computations, Ireland;
- NMC - Netherlands Mechanics Committee, The Netherlands;
- NOACM - Nordic Association for Computational Mechanics, Denmark, Norway, Finland, Estonia, Latvia, Lithuania, Sweden;
- ONIV - Association for Scientific and Engineering Computations, Russia ;

- PACM - Polish Association for Computational Mechanics, Poland;
- SEMA - Sociedad Española de Matemática Aplicada, Spain ;
- SEMNI - Sociedad Española de Métodos Numéricos en Ingeniería, Spain;
- SIMAI - Società Italiana di Matematica Applicata e Industriale, Italy;
- TNCTAM - Turkish National Committee on Theoretical and Applied Mechanics, Turkey;

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Pekka Neittaanmäki, University of Jyväskylä, Department of Mathematical Information Technology, Finland; Vice President; e-mail: *pn@mit.jyu.fi*

Prof. Pedro Díez, Universitat Politécnica de Catalunya, Barcelona, Spain; Secretary; e-mail: *pedro.diez@upc.es*

ISSEC Irish Society for Scientific and Engineering Computation

ISSEC - Irish Society for Scientific and Engineering Computation
ISSEC was formed at an evening meeting on 21st February 1992 called by Prof. John Miller. The meeting was held at the Lecture Theatre in Enterprise Ireland (then EOLAS), Glasnevin and was kindly hosted by Dr. Brendan Finucane. The society was founded to act as a focal point for people with a com-mon interest in aspects of scientific and engineering computation.

Areas of technical application include:
- solid mechanics
- bioengineering/biomechanics
- fluid mechanics
- fracture/damage of materials/structures
- electrical/electronic engineering
- dynamics & vibrations
- neuroscience
- thermodynamics
- wave motions & acoustics
- imaging
- molecular modelling
- industrial applications of mathematics

while those enabling numerical and computational techniques that are of interest include:
- high performance computing
- nonlinear numerical methods
- numerical analysis
- grid computing
- innovative numerical algorithms
- meshing methods

ISSEC organises an Annual Symposium each May, at which its members and others interested in aspects of computation may congregate and interact in an informal environment.

ISSEC is affiliated to the European Community on Computational Methods in Applied Sciences (ECCOMAS), which has the aim of fostering basic and applied research and disseminating activities in Europe in the field of Computational Methods in Applied Sciences.

ECCOMAS Council is formed by official representatives of National or Regional Scientific Societies or Organizations covering most of the European countries. Its main mission is to favour the exchange of information, and to promote the transfer between Research and Industry at the European scale. Its fields of interest are the applications of Mathematical and Computational Methods and Modelling to major areas such as Fluid Dynamics, Structural Mechanics, Semi-conductor Modelling or Electro-magnetics. Multidisciplinary applications of these fields to critical societal and technological problems encountered in sectors like Aerospace, Car and Ship Industry, Electronics, Energy, Finance, Chemistry, Medicine, Biosciences, Environmental sciences are of particular interest.
The main event organized by **ECCOMAS** is a large European conference taking place every second year and addressing scientists and engineers both in and outside Europe. The main objective of these conferences is to provide a forum for presentation and discussion of state-of-the-art in scientific computing applied to engineering sciences. Equal emphasis is given to basic methodologies, scientific development and industrial applications. Members of **ISSEC** are entitled to reduced fees when attending **ECCOMAS** organised events.

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ECMS - The European Council for Modelling and Simulation

ECMS The European Council for Modelling and Simulation, formerly known as SCS European Council, is an independent forum of European academics and practitioners dedicated to research, development, and applications of modelling and simulation.
The ECMS encourages its members to play active role in defining European research and development priorities in modelling and simulation through participation in ECMS conferences, contribution to community initiatives in modelling and simulation and a willingness to serve the ECMS members if elected to the Board. The ECMS encourages active collaboration with other simulation forums, such as the SCS, while offering a corporate representation of interest/priorities of European simulationists on the international scene.

ECMS Activities. The European Council for Modelling and Simulation serves all countries in Europe by organizing conferences and workshops, by organizing courses and tutorials, and by publishing books, CD-Rom publications, and conference proceedings. The two main conference series held in Europe are:

- European Conference on Modelling and Simulation (ECMS) - in June
- European Symposium on Modelling and Simulation (ESMS) - in October

These conferences were previously referred to as ESM and ESS respectively. In addition, conferences and workshops on various topics are organized or co-sponsored, such as the annual Agent Based Simulation conference (ABS) and the Harbour and Maritime Simulation workshops (HMS).

The ECMS is directed by the Board whose members serve for a period of three years. At present the board consists of Andrzej Bargiela (UK, Chairman), Yuri Merkuryev (Latvia, Secretary and Director of ESMS), David Al-Dabass (UK, Treasurer and Director of ECMS), Khalid Al-Begain (UK, Director of ASMTA), Miguel Angel Piera (Spain, member).
Info: *office@scs-europe.net*

Upcoming Conferences

20th ECMS Conference
20th European Conference on Modelling and Simulation
May 28 – 31, 2006
Bonn, Germany

ECMS 2006 will build on the following tracks and collocated conferences.

- High Performance Computing in Simulation
- Simulation of Intelligent Systems
- Simulation of Complex Systems
- Bond Graph Modelling, Vision and Visualisation
- Modelling and Simulation Methodologies
- Simulation in Industry, Business and Services
- Computational Modelling and Simulation in Science and Engineering
- Discrete Event Modelling and Simulation in Production, Logistics and Transport
- Simulation in Education/Teaching Simulation
- Computer Games and Simulation
- Simulation Application in Industry
- A special conference on Analytical and Stochastic Modelling Techniques and Applications, ASMTA 2006

The Scientific Programme of the conference will feature a keynote address and plenary speeches given by highly recognised personalities, parallel sessions and tutorials on Sunday, 28th May in the afternoon. Furthermore, there will be a best paper award.
The Social Programme will include a welcome party on Sunday, 28th May, in the evening, a conference dinner, guided tours to the cities of Cologne and Bonn, and a visit of one of the research centres being part of a network of cooperating institutions of higher education and research centres in the Bonn-Cologne region.
Bonn can be conveniently reached by airplane, railway, or by car.

Important dates:

Paper Submission: (Jan. 30, 2006) - extended	
Notification of Acceptance:	March 8, 2006
Registration & Manuscripts	April 10, 2006
Conference	May 28 – 31, 2006

For information about ECMS 2006, please check the conference web site or contact the conference chairs:

HTTP://WWW.SCS-EUROPE.NET/CONF/ECMS2006/
HTTP://WWW2.INF.FH-BRS.DE

General Chair:
Wolfgang Borutzky, *ecms2006@inf.fh-brs.de*
General Programme Chair:
Alessandra Orsoni, *a.orsoni@kingston.ac.uk*

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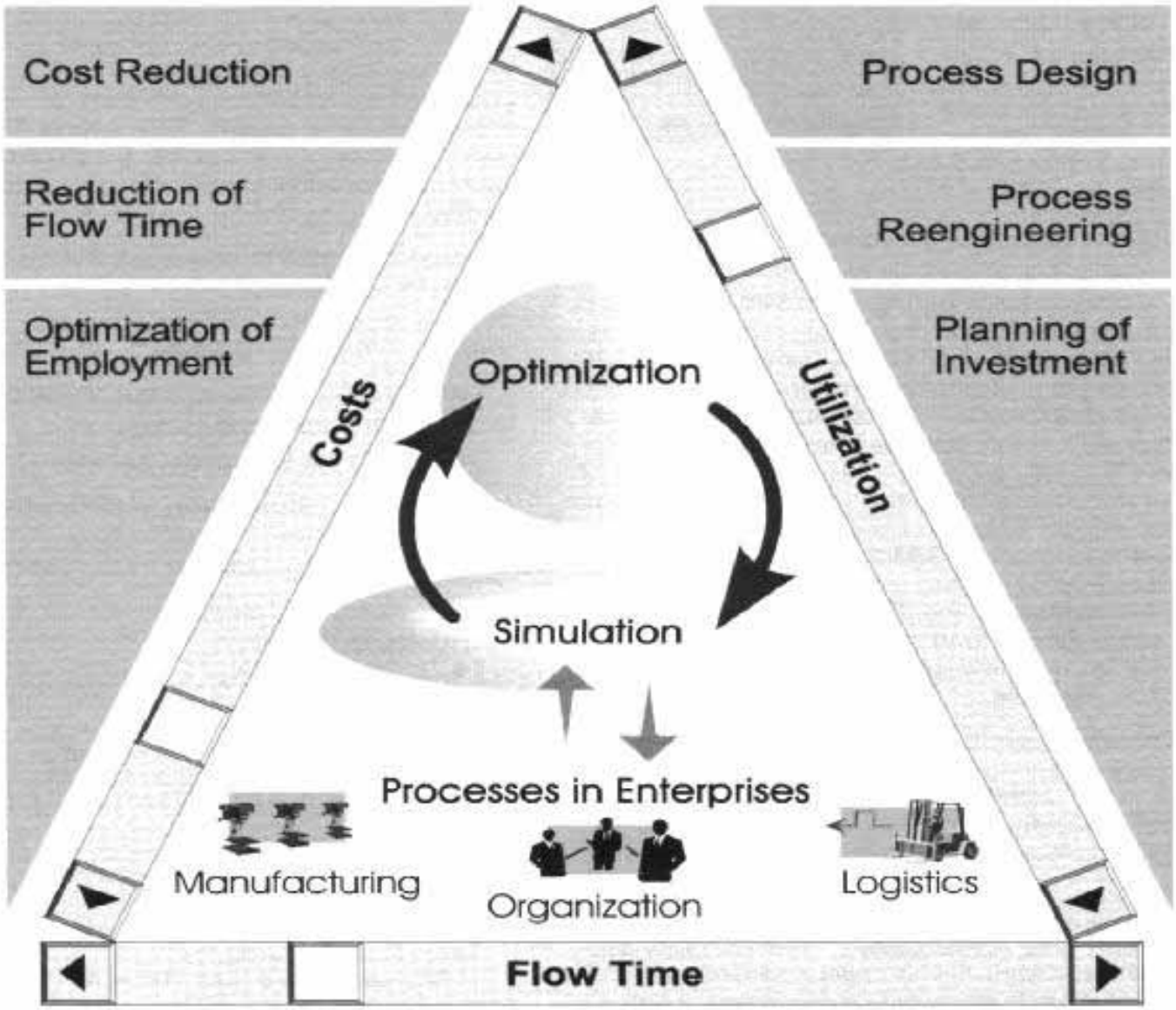

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More details and references you can find in www.dualis.net, www.simsolution.de, and www.sim-serv.com

USE-eNET: An International Experiment in Modelling and Simulation Education

USE-eNET (US-Europe e-Learning NETwork in Science and Engineering) is an international project involving four European universities and four universities in the USA. The work is funded by the European Commission, through the Directorate General for Education and Culture, and by the US Department of Education, through the Fund for the Improvement of Postsecondary Education **(FIPSE)**. Its aims are twofold. One aim is to develop on-line resources in the field of modelling and simulation that will create new opportunities for graduate students in computing science and engineering to gain international experience. **USE-eNET** also aims to provide the basis for a generic environment suitable more generally for development of inter-university and multi-disciplinary courses in which modelling and simulation techniques can play a useful pedagogical role.

The approach adopted involves development of a general design framework for a combined e-learning and simulation environment that should be capable of meeting the needs of a wide range of academic disciplines. A prototype set of course modules and case studies dealing with modelling and simulation topics will be produced during the two-year period of the project to illustrate the concepts. These course modules will include a student team-project element, involving the use of simulation, to be undertaken on a transatlantic basis with European students and American students collaborating at every stage.

The requirements for an e-learning system suitable for international and interdisciplinary cooperation on the scale envisaged far exceed those encountered in developing courses in the conventional setting of a single instructor and a single institution. For example, course materials must be developed in a modular form so that they can be combined in different ways to meet the needs of individual programmes in the different institutions.

Students will gain international experience mainly by interacting through the transatlantic team projects. These group activities are also intended to prepare students for working in large international companies or other organisations that operate in a distributed fashion, with centres, offices or manufacturing sites in a number of locations in different time zones. The primary objective in the team projects will be to use modelling and simulation tools in the solution of well-defined problems appropriate to the disciplines of the students involved. Each group will ideally involve equal numbers from Europe and the USA. Since the students will never all be in the same place at the same time, computer-based communication methods will be used for group discussions and to maintain contact within the group. Students will themselves be expected to put forward proposals about how the tasks should be divided up between members of the group and will be required to use a common set of tools in doing the work.

The European partners in the USE-eNET project are:
The University of Hamburg (Prof. Dr. Dietmar P.F. Möller, Department of Computer Science), the University of Glasgow (Prof. Dr. D.J. Murray-Smith, Department of Electronics and Electrical Engineering), Budapest University of Technology and Economics (Prof. Dr. Andras Javor, Department of Information Management) and the University of Aarhus (Prof. Dr. Jens Dørup, Section for Health Informatics). In the USA the network involves California State University, Chico (Prof. Dr. Roy E. Crosbie, College of Engineering, Computing Science and Technology), the University of Nebraska, Lincoln (Prof. Dr. Hamid Vakilzadian, College of Engineering and Technology), the University of Alabama, Huntsville (Prof. Dr. Bernard J. Schroer, Office of Vice President for Research) and the University of Louisville (Prof. Dr. Gary Loyd, Department of Anaesthesia).

Several of the partner universities have collaborated in earlier projects, including the **USE-ME** project (United States-Europe Multicultural Education Alliance in Computer Science and Engineering), which was supported by the EU/US Cooperation Programme during the period 2000-2003 and involved exchanges of students, exchange of teaching staff and the development of new teaching material in the field of modelling and simulation.

It was the problems involved in sustaining conventional international student exchange schemes, such as **USE-ME**, that led to the successful **USE-eNET** proposal. The relatively small number of students able to participate in exchange programmes and the reluctance of many engineering and computer science students to consider a period spent overseas were important factors that pointed to the potential benefit of providing some other form of international experience. Through e-learning students can be exposed to ideas and methods of working of academic staff in other countries and through the transatlantic team projects students should be able to experience more directly some aspects of the culture of studying elsewhere.

David Murray-Smith
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McLeod Institute of Simulation Sciences - Hungarian Center

HTTP://WWW.ITM.BME.HU/MCLEOD

Based on the internationally acknowledged R&D work in simulation led by Professor Jávor since the 70's he was asked to establish the McLeod Institute of Simulation Sciences Hungarian Center and appointed as its director in 1995.

As simulation is an applied science the strategy of the Center is to undertake combined efforts in research and education in the field of simulation. An inductive-deductive approach is applied where for solving problems arising in various fields of application generalized methodologies and algorithms are elaborated, implemented in simulation software and applied for solving problems in various fields. The education is conducted in a way where beyond the lectures the graduate and postgraduate students are involved in the R&D work and projects. The main directions of simulation methodology where the Center is active are: discrete event simulation, high level Knowledge Attributed Petri Nets and intelligent agent controlled simulation.

The fields of application include the simulation of flexible manufacturing and quality controlled systems, traffic systems, problems of environmental pollution, micro- and macroeconomic systems, interdisciplinary and soft systems (as e.g. the development of regions), etc. The methodological results have been implemented in the **CASSANDRA** (**C**ognizant **A**daptive **S**imulation **S**ystem for **A**pplications in **N**umerous **D**ifferent **R**elevant **A**reas) simulation system that has been applied for solving problems in various EU, international and national projects.

The Hungarian Center was invited to participate in a Transatlantic project on simulation and e-learning, that started in November 2004 with the starting conference held in Washington.

The leading organizations are the University of Hamburg and the California State University in Chico, the other participants are the University of Glasgow, University of Nebraska in Lincoln, University of Alabama in Huntsville, University of Louisville in Kentucky and the University of Aarhus.

Professor Jávor also participated at the IST EU Conference in the Hague initiating the establishment of a research project consortium for the 6th framework program.

Donation of the first international PhD certificate given by the McLeod Institute of Simulation Sciences

The board of directors at the 2004 board meeting in San Jose decided that the PhD degrees – obtained at universitites where McLeod Institute of Simulation Sciences centers are operating and the PhD reserach work was undertaken in the field of simulation sciences under the supervision of the corresponding center - can be awarded by an international certificate.

Professor András Jávor handing over the international certificate to Gábor Szücs

The first certificate was awarded by the McLeod Institute of Simulation Sciences Hungarian Center to Gábor Szücs based on his thesis „Optimizing and Modeling Methods of Highly Sophisticated Systems by Artificial Intelligence Controlled Simulation, with Special Emphasis on the Investigation of Traffic Systems". Gábor Szücs is adjunct professor at the Budapest University of Technology and Economics and is engaged in simulation research since the establishment of the Hungarian Center, participating in various national and international projects.

The certificate was signed by Professor Agostino Bruzzone director of the McLeod Institute of Simulation Sciences and Professor András Jávor director of the Hungarian Center.

Within the framework of enhancing the cooperation among the various McLeod centers Professor Jávor has been invited by Professor Breitenecker director of the Vienna McLeod Center as an opponent of a PhD work prepared under the supervision of Professor Breitenecker in the field of simulation.

After having defended the thesis successfully Professor Jávor – also in his capacity of being associate vice director of the McLeod network – proposed that the candidate should also receive an international certificiate similarly to that mentioned above.

McLeod Institute of Simulation Sciences Györ Satellite Center

The Györ Center in Hungary was established in 2000. It is operating at the Széchenyi István University in the city of Györ. Prof. Dr. Péter Keresztes has been nominated as its director and Prof. Dr. András Jávor is its associate director.

At the University undergraduate, graduate and postgraduate courses in simulation are held. Recently projects with the application of simulation have been initiated. The work of the Györ Center is in close cooperation with the Hungarian Center.

In this satellite center symbolic simulation is dealt with under the supervision of Professor Keresztes in the field of microelectronics. Recently a new line of education "computer science in economy" has been introduced at the Széchenyi István University under the supervision of Professor Jávor, where the education of simulation is of great importance. Finally it should be mentioned that two students started their PhD work in the field of simulation.

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Modelica Association

HTTP://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, including but not limited to trademarks, the Modelica Language Specification, Modelica Standard Libraries, etc., which should be generally available for the promotion of industrial development and research.

Modelica is governed by a board: Martin Otter (Chairman), DLR Oberpfaffenhofen; Germany; Peter Fritzson (Vice Chairman), Linköping University, Sweden; Hilding Elmqvist (Treasurer), Dynasim AB, Lund, Sweden; Michael Tiller (Secretary), Ford Motor Company, Dearborn, U.S.A.

Modelica History. There have been several attempts to define object-oriented languages for physical modeling. However, the ability to reuse and exchange models relies on a standardized format. It was thus important to bring this expertise together to unify concepts and notations. The Modelica design effort was initiated by Hilding Elmqvist, Dynasim AB, and in December 2000, the first Modelica version, ver-sion 1.4, was available for applications. Further developments and extensions resulted in the present version Modelica version 2.2.

Modelica Tools

Dymola from Dynasim has a Modelica translator which is able to perform all necessary symbolic transformations for large systems (> 100 000 equations) as well as for real time applications. A graphical editor for model editing and browsing, as well as a simulation environment are included. Convenient interfaces to Matlab and SIMULINK exist.

MathModelica from MathCore Engineering provides a Modelica simulation environment which is closely integrated into Mathematica and Microsoft Visio. The tight integration with Mathematica also makes it possible to perform complex analysis tasks.

MOSILAB from the Fraunhofer-Gesellschaft is a newly developed Modelica simulator for complex technical systems. One innovative feature of MOSILAB is the

mapping of state-dependent changes of the model structure during the simulation experiment.
This enables, for example, simulation experiments with models of variable modeling depth or varying model physics. In 2006, interested Modelica users can obtain a beta-version of MOSILAB, which is currently under development. In the beginning of 2007, MOSILAB will be available as a commercial simulation tool, with educational licenses.

Open Modelica Project
The Open Source Modelica is a new project at Linköping University. The goal of the project is to create complete Modelica modeling, compilation and simulation environment based on free software distributed in source code form intended for research purposes.

The project's aim is to create a complete Modelica modeling, compilation and simulation environment based on free software distributed in binary and source code form. In December 2005 Open Modelica 1.3.1 was released with the following features:

- The New BSD (Berkeley) open-source license for the source code.
- Support for hybrid and discrete-event simula tion
- Parsing of full Modelica 2.2
- Vectorization of function arguments;
- Correct flattening of the Modelica Block library version 1.5 (except 2 models).
- Automatic index reduction.
- Updated Users Guide including examples of hybrid simulation and external functions.
- A free implementation of an OpenModelica notebook (OMNOtebook), for electronic books with course material, including the DrModelica interactive course material.
- An alpha version of the first Eclipse plugin (called MDT) for Modelica Development.

The source code is now available for download from HTTP://WWW.IDA.LIU.SE/~PELAB/MODELICA/OPENMODELICA.HTML

Modelica Conferences
Modelica conferences are held every 18 months. Modelica'2005 was organised in February 2005 at Technical University of Hamburg-Harburg, Germany (Local organizer: Prof. Schmitz). The Proceedings of the conference are freely available at the Modelica website. Every paper and poster presented at the conference can be downloaded as single PDF file. The order of the papers is according to the sequence of the sessions. Both published volumes of the proceedings are also available as single PDF Files.

Modelica 2006
5th International Modelica Conference
September 4 – 5, 2006; Vienna, Austria

The 5th International Modelica Conference will be held at arsenal research in Vienna, Austria on September 4th - 5th, 2006 organized by the Modelica Association and arsenal research.
It will bring together Modelica users, library developers, tool vendors, and language designers. The program will cover modeling of complex physical systems with Modelica in a wide range of research and industrial applications, peer-reviewed and selected by the Technical Program Committee. In addition to traditional paper presentations and poster sessions you have the choice of four Modelica tutorials for the beginner and the advanced.

Conference site is :

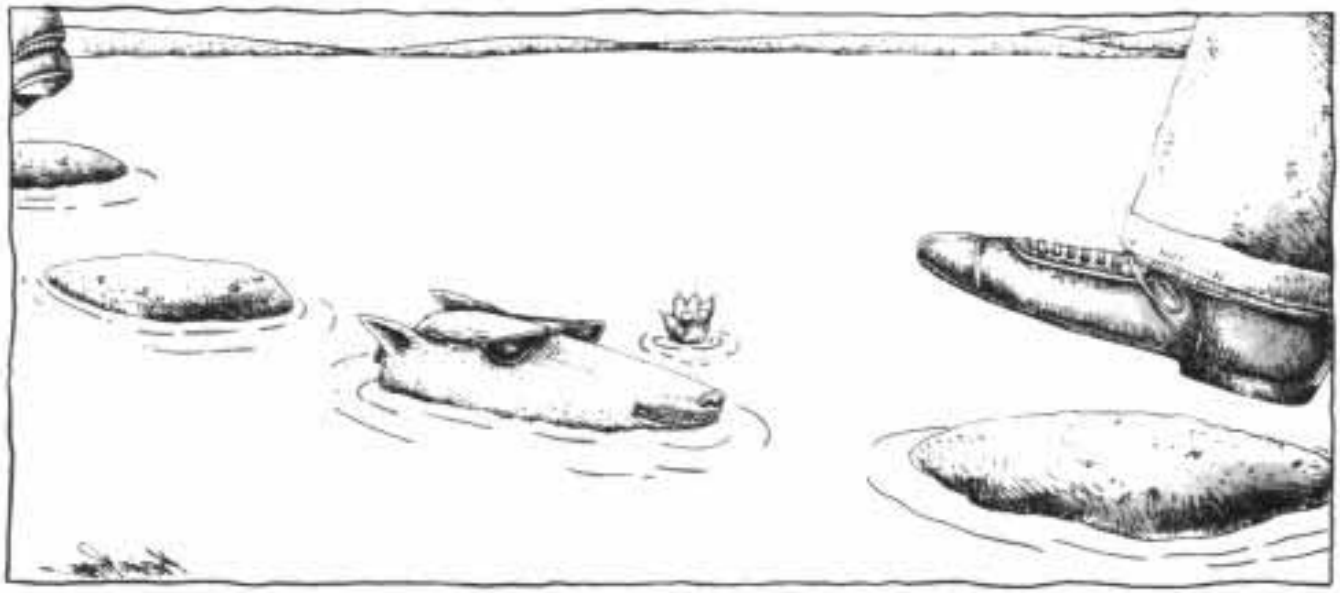
arsenal research,
Giefinggasse 2, A-1210 Vienna Austria.

Modelica Design Meeting:
There will be a Modelica design meeting after the conference. Please, contact the chairman of the Modelica Association, Martin Otter (Martin.Otter@dlr.de), if you wish to participate.

For further information browse through the Modelica website HTTP://WWW.MODELICA.ORG or contact directly *modelica2006@modelica.org.*

Information: HTTP://WWW.MODELICA.ORG

THE dependability of THE WOLVERINE is WELL-known in THESE parts.



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INDUSTRY NEWS

Enterprise Dynamics: Cooperation with SimPlan, Educational Offers

ED@SimPlan – Strong Players Coming Together

After more than 13 years of presence on the European simulation market the SimPlan Group has become one of the leading simulation solution providers in Germany and they're carrying out several hundred simulation projects per year in industries such as Automotive, Logistics, or Chemical. There is a tradition of using the simulation software that fits the requirements of their customers' best. Apparently, simulation service providers such as SimPlan are strongly dependent on the features of the simulation packages they are using.

Taken a lot of simulation concerning aspects into account SimPlan is continuously monitoring the development of simulation packages and their ven-dors. So, SimPlan is very impressed by the progress of Enterprise Dynamics and Incontrol during the past couple of years. On one hand there is software based on a modern and open object oriented concept being permanently improved with regard to the technical features and on the other hand there is Incontrol as software company with years of experience in discrete event simulation and clearly dedicated to one software product family. In combination with the fact that SimPlan had in 2004 the chance to join forces with another German-based simulation company, induSim, who has had a partnership with Incontrol as ED consultant and distributor since 1999, the decision was taken to make ED one of the key tools used within the SimPlan Group.

Since then, additional consultants at SimPlan have conducted projects with ED, and the partnership between SimPlan and Incontrol has been strengthened in some cooperative activities.

University programs –Enterprise Dynamics Academic

Discrete-event simulation is more and more part of the academic curriculum and Enterprise Dynamics is one of the most commonly used simulation platforms to be used in these courses. Enterprise Dynamics is not only easy-to-learn, but it also comes complete with many simulation objects that assist the student in building a well-constructed simulation model for virtually any type of training subject.

There are many materials available to assist universities and other academic institutes in their efforts to teach simulation:

- The Educational Suite is the same software that is normally available for the industry but with additional cases and training materials.
- Free Student Tutorials in English, German, French and Dutch.
- A special Teachers' Training to assist the teacher in getting started with a simulation course using Enterprise Dynamics.

Enterprise Dynamics
Planetenbaan 21, 3606 AK Maarssen
The Netherlands
Tel +31-346-552500, Fax - 552451
HTTP://WWW.ENTERPRISEDYNAMICS.COM

Scientific Computers – Maple News and MKS Toolkit

Maplesoft will be introducing a new Web community called **MaplePrimes.** The purpose of this exciting new site is to bring Maple users together in an environment where they can directly share experiences, tools and applications, and learn from other users. What is unique about this initiative is that it will be driven directly by the user community. Members will have access to personal blogging space as well as the ability to chat through moderated forums. Whether you're new to our community and have a product question or whether you're a seasoned veteran who wants to publish your research results, the new MaplePrimes will be the ideal site for dialog and interchange.
More information at HTTP://WWW.MAPLEPRIMES.COM. Maplesoft will be operating a public beta Web site and encourages you to join the adventure

Update to Maple 10.02

Scientific Computers, distributor for the German speaking area offers an update from Maple 10 or Maple 10.01 for all registered Maple Users, free of charge.
The Maple 10.02 update includes enhancements in a variety of areas, including these:

- Export facilities for Maple T.A.™, RTF, and MATLAB®
- Copy and paste with formatting
- Help System Navigation, and much more

MKS Toolkit 9.0 - The interoperability Solution
Scientific Computers distributes the MKS Toolkit. The MKS Toolkit 9.0 is an essential instrument for the interoperability among different platforms.
The MKS product family covers a number of products for the UNIX-Windows- interoperability, for the migration of applications from UNIX to Windows, the overall - platform development and system administration.

All these products are based on the MKS NuTCRACKER-platform. The MKS NuTCRACKER-platform consist of two parts, on the one hand there exists the NuTCRACKER workstation offers a lot of services on workstation platforms. On the other hand there exists a counterpart for servers, the NuTCRACKER-server.

There are several MKS-Toolkits for different needs and requirements available.

Scientific Computers GmbH
Friedlandstrasse 18, D-52064 Aachen
Tel + 49 (0241) 40008 - 0, Fax – 13
info@scientific.de,HTTP://WWW.SCIENTIFIC.DE

New MATLAB Toolboxes / MATLAB Automotive Conference

SimEvents – Modelling and Simulation of Discrete Systems
The Mathworks now offers SimEvents, a new product for modelling and simulation of discrete event systems.
With SimEvents it is possible to create a discrete-event simulation model in Simulink to model the passing of entities through a network of queues, servers, gates, and switches based on events. It is also possible to configure entities with user-defined attributes to model networks in packet-based communications, manufacturing, logistics, mission planning, supervisory control, service scheduling, and other applications.
SimEvents is able to model systems that are not time-driven but that are based on discrete events, such as the creation or movement of an entity, the opening of a gate, or the change in value of a signal.

Key Features:
- Enables entity-based, discrete-event simulation
- Provides libraries of queues, servers, switches,
- Includes generators for entities, events, and signals
- Supports hybrid simulation of models that con tain both event-based and time-based execution components
- Automatically collects common statistics, such as delay and throughput

SimEvents works with Stateflow to represent systems containing detailed state-transition diagrams that may produce or be controlled by discrete events. SimEvents and Simulink provide an integrated environment for modelling hybrid dynamic systems containing continuous-time, discrete-time, and discrete-event components. Typical examples occur in sensor networks and other distributed control applica-tions.

MathWorks International Automotive Conference 2006 - Call for Papers
The MathWorks invites automotive engineers, researchers, and scientists to submit papers for the 2006 International Automotive Conference in Stuttgart, Germany. This conference will bring automotive manufacturers and suppliers together with MathWorks industry experts to exchange ideas on new technologies, workflows, and successful implementations of Model-Based Design with MATLAB and Simulink.
The conference, which will be in English, will feature:

- The latest technologies for developing production ECU software using Model-Based Design
- Customer presentations and case studies
- Demonstrations of partner products based on MATLAB, Simulink, and Real-Time Workshop
- Open discussion opportunities with MathWorks senior development managers
- Insight into MathWorks latest directions in the automotive industry

Date & Venue of this conference is May 16-17, 2006, Cultural and Congress Centre Liederhalle (KKL), Berliner Platz 1 D-70174 Stuttgart, Germany.

Detailed information can be found at
HTTP://WWW.MATHWORKS.COM.
The Mathworks GmbH
Friedlandstr. 18, D- 52064 Aachen
Tel +49 -241-47075-0, Fax – 12
info@mathworks.de, HTTP://WWW.MATHWORKS.DE

CIM Ireland

HTTP://WWW.SIMULATION.IE

CIM Ireland is a growing indigenous company. It provides expertise in workflow simulation modelling and manufacturing design to clients, across all busi-ness sectors. To date, CIM Ireland has saved companies hundreds of millions of euro and use a variety of simulation packages.

Established in 1994, CIM Ireland is generally agreed to be the forerunner in commercial simulation modelling in Ireland and has an ever growing client base.

CIM Ireland has helped companies redesign and grow their business systems; from warehousing and distribution through manufacturing to the whole business process.

CIM offers the following services:
- Internal and open courses
- Model development and system design
- Package selection
- Both onsite and e-support

CIM Ireland Ltd.
Brooklawn, Salthill
Galway, Rep. of Ireland
Tel + 353-91-770737, Fax – 526979
Feargal.Timon@simulation.ie,
HTTP://WWW.SIMULATION.IE

Isee Systems- Formerly High Performance Systems

isee systems (formerly High Performance Systems) is in business to improve the way the world works, by creating Systems Thinking-based products that enable people to increase their capacity to think, learn, communicate, and act more systemically.
isee systems is the world leader in Systems Thinking software. Founded in 1985 by Barry Richmond, then a Professor at Dartmouth College the company has grown into a thriving, privately-held corporation with substantial global reach in business, education, and government markets.

In 1987, the Company was awarded the Jay Forrester prize when it was the first to introduce an icon-based model building and simulation tool, **STELLA**.

STELLA brought computer simulation-based model-building to the mass market. In 1990, the company introduced iThink for business simulation.

isee systems also created the first Management Flight Simulator in 1991, pioneered introduction of the first Learning Environment in 1995, introduced the first Learning Lab and the first conversational systems thinking workshop in 1999. Each of these new product lines significantly advanced the state of the art in systems thinking.

isee systems has brought Systems Thinking to thousands of individuals and organizations in over 80 countries across the world

isee systems, inc.
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Tel + 49 (0241) 40008 - 0, Fax – 13
info@iseesystems.com,
HTTP://WWW.ISEESYSTEMS.COM

Controllab News

In the development of machines, the design and implementation of control software becomes more and more important. The technical knowledge needed for this task is often underestimated.

Controllab Product B.V. (CLP) is an engineering company with over 10 years of experience in the field of high-end control. CLP has the capabilities to cover the complete design and implementation process of any machine control.
CLP is the developer and distributor of the modelling and simulation package 20-sim. The software is sold worldwide and is being used in industry as well as academic institutes. The first version of 20-sim was brought on the market in 1995.

From this moment on, 20-sim has been improved systematically by CLP in cooperation with the customers. For this purpose CLP has a fixed team of software developers and modelling experts.
20-sim is a modelling and simulation program that runs under Microsoft Windows. With 20-sim you can model and simulate the behaviour of dynamic systems, such as electrical, mechanical and hydraulic systems or any combination of these.

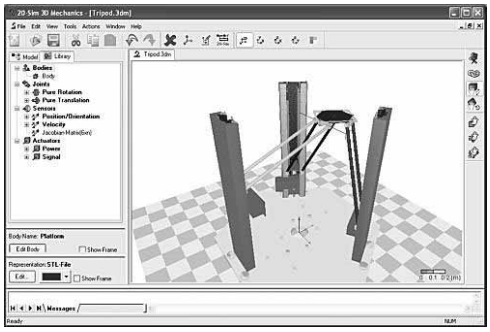

Figure: 20-sim 3DMechanics model of a Tripod

20-sim fully supports graphical modelling and allows designing and analyzing dynamic systems in an intuitive and user friendly way.

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7522 NB Enschede, The Netherlands
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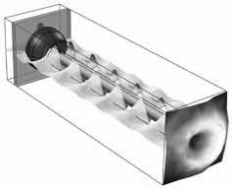
info@controllab.nl,
HTTP://WWW.CONTROLLAB.NL

COMSOL Multiphysics

64-bit Support in COMSOL FEMLAB
Significant performance enhancements and the ability to address new classes of problems are highlights of version 3.2a of COMSOL Multiphysics, a scientific-modelling package used in all areas of engineering, research, development and higher education.
Support for 64-bit Windows greatly increases the size of models the software can handle; major improvements to the package's functionality, espe-cially in the area of electromagnetism, remove performance barriers, and the COMSOL Reaction Engineering Lab is going into customer shipments.

As users learn how to apply modelling software, they want to tackle larger, complex, real-world problems, which until now have sometimes bumped up against the memory limitations of earlier versions of Windows.
With the 3.2a release, though, COMSOL Multiphysics runs under Windows XP Professional x64 Edition, which supports as much as 128 GB of RAM and 16 terabytes of virtual memory.

With this extra memory, users can expect to see few out-of-memory error messages (except for very complex problems with extensive multiphysics couplings).



Another advantage is that with this extra memory, the software can now solve a great many more problems with a direct rather than an iterative solver. For instance, the program's default direct linear-systems solver, UMFPACK, is popular because it runs quikkly, is reliable, and is straightforward to work with; users need not worry about the setups needed for the precondition that iterative solvers require.

However, UMFPACK must place the system matrix it solves in contiguous memory, which even in a 32-bit environment can be far less than the amount of total free memory. With 64-bit Windows, though, users can expect to find far larger segments of contiguous memory, dramatically increasing the size of problems UMFPACK can solve. And for problems that still won't fit into a direct solver, the iterative solvers can tackle those of a size far larger than before.

COMSOL Multiphysics Conferences 2005
COMSOL offers a Special Edition User Presentation CD with contributions from all COMSOL Multiphysics Conferences 2005 for free. Shipping can be ordered from COMSOL's website HTTP://WWW.COMSOL.COM.
The CD contains hundreds of papers and presentations from the conferences in Birmingham (United Kingdom), Boston (United States), Frankfurt (Germany), Milan (Italy), Paris (France), Stockholm (Sweden), and Oslo (Norway).

The CD includes 229 papers, 137 user presentation slides, 44 keynote presentation slides, and 30 ready-to-run models.

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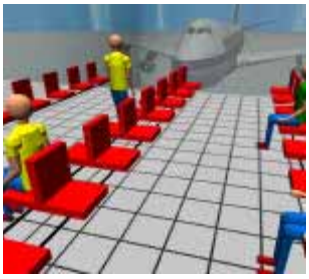
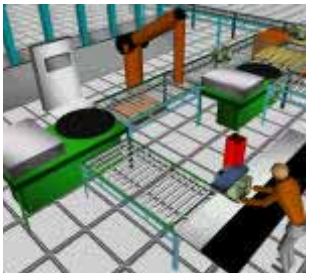


Enterprise Dynamics®, built by the people that brought Taylor to the market, is today's leading simulation software. Our software combines the powerful Enterprise Dynamics® Engine and many ready-to-use building blocks grouped into Enterprise Dynamic Suites for specific lines of business. Enterprise Dynamics® meets the latest standards in dynamic engineering and can be integrated into your existing system.



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