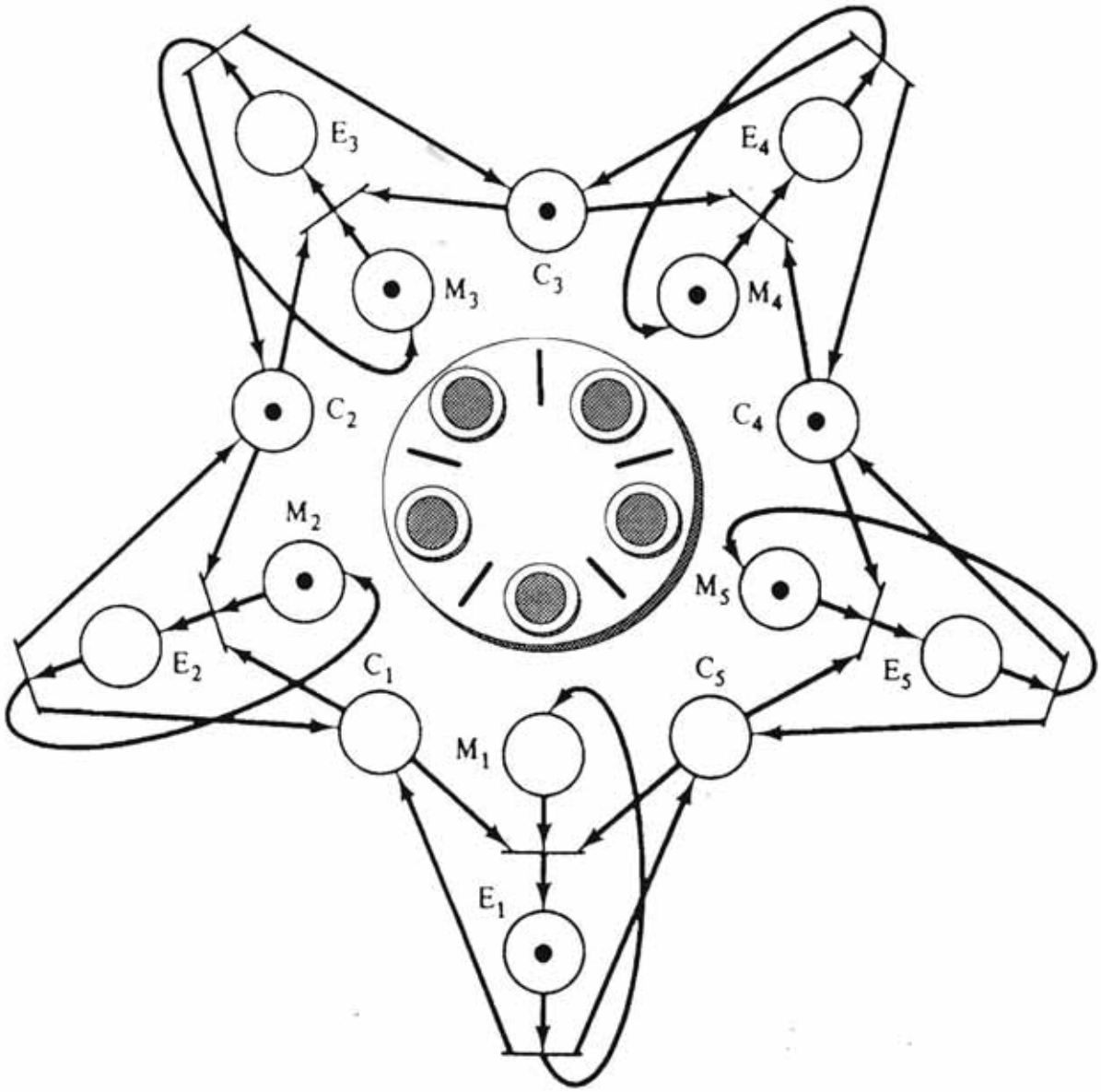
EUROSIM
Simulation News Europe

Number 3 | A European Forum on Simulation Activities | November 1991



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Readership Information

EUROSIM - Simulation News Europe is published on behalf of EUROSIM (the Federation of European Simulation Societies) three times a year by the "ARGE Simulation News", supported by the Scientific Academy of Lower Austria. Circulation is 2500. Printed by HTU-Druck, Wien, Austria. EUROSIM - Simulation News Europe is distributed by all member societies to their individual members. The price of EUROSIM - Simulation News Europe is covered by the membership fees of the societies. For receiving extra copies, for product announcements and for other organizational affairs please contact the editors.

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Editorial Board of the European Simulation Societies:

Editorial

Due to the numerous contributions from our readers and the big interest of advertising companies in our newsletter this issue has become quite comprehensive. We are able to keep the production price of the newsletter low due to the support by the Technical University of Vienna, the Scientific Academy of Lower Austria and the advertisements.

The introductory essay is by T. Schriber about "Perspectives on Simulation Using GPSS/H". The essay introduces ideas and principles of discrete simulation to non-experts in this field, using features and examples with GPSS/H.

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

Good news are that FRANCOSIM does now officially exist, we hope that the French speaking simulation community will succeed. The group in theUnited Kingdom has become independent of SCS and changed its name. We received some messages from former Yugoslavia and hope that next time we will have better news from our colleagues there. News from Latvia indicate that there are a lot of activities in this area.

Regular sections are information about international societies, book news, industry news and presentation of simulation centers.

You will find quite a lot of solutions to the software comparisons of the previous issues. We are happy that so many readers responded to our challenge. A new software comparison is introduced. You can still send in solutions for the previous comparisons. There are several software tools that have not yet been introduced.

Another possibility for active reader participation is the new "Discussion Forum". Readers are invited to start discussions and to participate in ongoing discussions.

The final call for papers for the ESC '92 Conference in Capri can be found on page 40. Please note that the deadlines have been changed. It is still possible to submit papers.

Thanks go to all authors who contributed to this issue.

All readers are kindly invited to send letters, comments, suggestions or contributions to one of the editors. Deadline for the next issue will be February 20, 1992.

The end of a year is coming soon, so we would like to wish you a Merry Christmas and success with your simulations in 1992!

F. Breitenecker, I. Husinsky

EUROSIM - Simulation News Europe

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

Editors: F. Breitenecker, I. Husinsky

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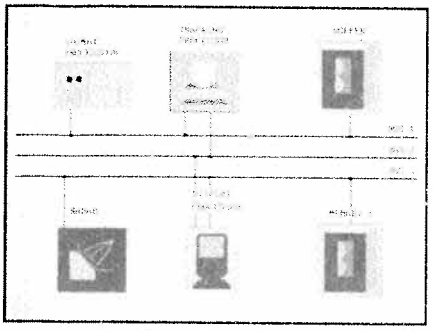

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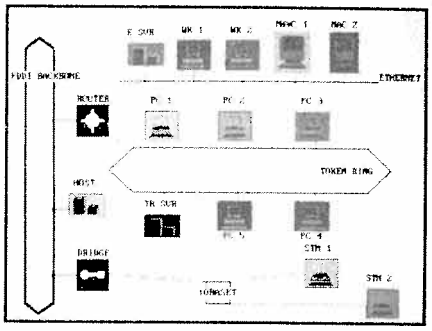

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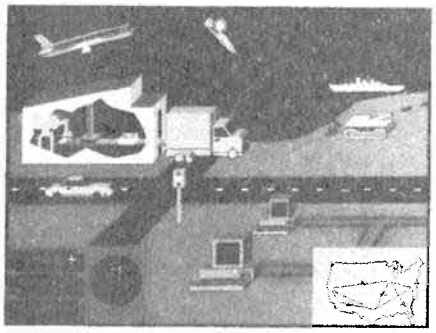

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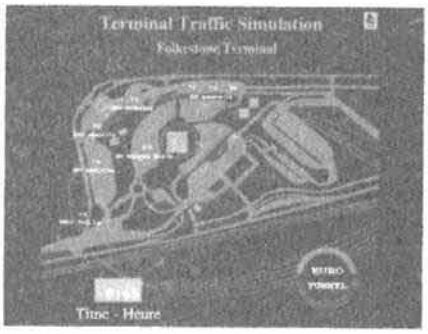

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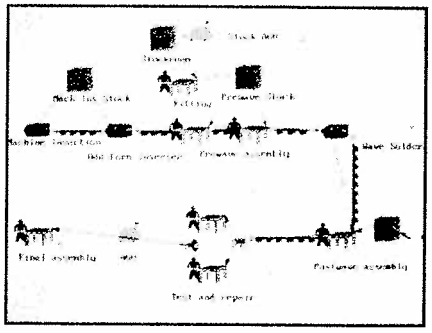

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Meurosim

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

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

Report on EUROSIM Board Meeting

On June 16th a EUROSIM board meeting took place in Copenhagen, during the ESM-Conference. It was hosted by SIMS. Present were Mr. Dekker (DBSS), Mr. Halin (ASIM), Mr. Juslin (SIMS), Mr. Lorenz (FRANCOSIM), Mr. Maceri (ISCS) and Mr. Zobel (UKSC); notices were sent by Mr. Breitenecker (ASIM) and Mr. Iazeolla (ISCS).

Three guests from the Czechoslovak System Simulation Club (CSSC) were present to inform the board on simulation in the CSFR. The bylaws of CSSC were officially registrated in 1990, in the near future CSSC will change the name to Czech and Slovak System Simulation Society. Mr. Maceri informed the guests about a letter of Mr. Plesko from Bratislava asking for contacts for founding a simulation group. CSSC wants to become a member of EUROSIM, an official letter asking for membership will be prepared.

The meeting continued without the guests. Mr.Lorenz (FRANCOSIM) informed the board about the status of FRANCOSIM: the society will soon be founded officially.

The minimum bylaws for founding EUROSIM as society formally are ready now, Mr. Zobel presented the draft. He will put it in a representable form and send it to the member societies asking for comments and changes (before the next board meeting).

Most interest was given to the preparations for the EUROSIM Conference in Capri (1992). Mr. Maceri gave an overview about the state of preparations. The Savastano Award will be assigned at this conference. For more information see the conference announcement in this issue.

It is planned to publish a scientific journal 'Journal of Simulation - Theory and Practice'. The first issue of this journal should be ready at the EUROSIM conference at Capri. After discussions with the publisher (Elsevier) the proposed contract will be changed slightly. Intensive discussion on this topic will be done at the next board meeting, where Mr. van Drunen, the scientific editor of Elsevier, will be present.

Also the publication of the newsletter EUROSIM - Simulation News Europe was discussed. As outlined in the last issue, the newsletter could be printed by Elsevier. Elsevier offered to add the newsletter to the planned journal and to print it as separate newsletter. Mr. Breitenecker and Mrs. Husinsky (newsletter editors) formulated points for confirmation and open questions. The board agreed, the points will be discussed at the next board meeting in presence of Mr.van Drunen.

Presentation of the Newsletter

As already outlined in the previous issues, the publication of **EUROSIM - Simulation News Europe** is supported by the Project Center for Simulation of the Scientific Academy of Lower Austria. This academy situated in the town of Krems in the beautiful Wachau valley will become a Post Graduate University within the next years. The Project Center for Simulation is situated in Wiener Neustadt, a town fifty kilometres south of Vienna. The Project Centre partly supplies the infra structure for the production of EUROSIM - Simulation News Europe and finances printing and distribution of the copies for the East European Countries.

In October 1991 the editors were invited by the Mayor of Wiener Neustadt, who thanked them for their work, especially for the support of the East European Contries, this promoting the idea of the European Community.

Wiener Neustadt has always had links to Hungary. In the 15th century a big part of Lower Austria was occupied by Matthias Corvinus, a Hungarian king. The inhabitants of Wiener Neustadt defended their town bravely before they had to open the town gates. But being ahead of his time Matthias Corvinus showed great generosity towards the besieged inhabitants and put up his residence in Wiener Neustadt. Trade and handicrafts florished because of generous laws and low (or no) taxes and customs - for a short period of time a small "common market" existed (resulting in higher income for all). In this sense Matthias Corvinus was an early European. Furthermore he presented a very beautiful renaissance goblet (*Corvinus-Becher*; insurance value 40 million Austrian shillings) to the town council of Wiener Neustadt in order to thank for the co-operation.

Continuing this tradition the meeting between the Mayor and the editors took place in the hall where this goblet is exhibited (see picture, from left: Mr. Wittmann (Mayor), Mrs. Husinsky and Mr. Breitenecker). The editors presented issues of EUROSIM - Simulation News Europe and described its purpose. The Mayor received copies for the library and for the city archive. The meeting was finished with a fruitful discussion on the importance of European activities for the Austrian industry.

Perspectives on Simulation using GPSS/H

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Abstract

A brief perspective on GPSS/H (General Purpose Simulation System/H, sometimes known from the developer's name as Wolverine GPSS/H) is presented. The approach taken in GPSS/H to model a one-line, one-server system is explained, implementation details are provided, and results are discussed. Suggestions for learning more about GPSS/H are given.

1. GPSS/H in brief

GPSS/H is a simulation modeling language used to build computer models for discrete-event simulations. (A discrete-event simulation is one in which the state of the system being simulated changes at only a discrete but possibly random set of time points, known as event times.) GPSS/H lends itself especially well to modeling systems in which discrete units of traffic compete with each other for the use of scarce resources, and is useful in determining how well such systems will respond to the demands placed on them. Wolverine GPSS/H has been applied, for example, to the modeling of manufacturing and material-handling systems, communication and computer systems, airport/airspace, highway, and transit operations and health-care systems, among others.

2. GPSS/H Semantics and Syntax

GPSS/H offers rich semantics with sparse syntax. For instance, only seven block statements (plus several run-control statements) are required to model a one-line, one-server queuing system in GPSS/H. These statements take such simple forms as "GENERATE 15.0,4.5" and "QUEUE DRILLQUE". No read, write, format, or test statements appear in the model. And yet, when a simulation is performed with the model, fixed-form, fixed-content output is produced, providing statistics for the server (e.g., number of times captured; average holding time per capture; fraction of time in use) and the waiting line (e.g., average contents; maximum contents; average time in line), etc. This limited example is roughly suggestive of the character of GPSS/H. A GPSS/H model for a one-line, one-server system is given here in Section 4.

The sparse syntax of GPSS/H, coupled with its block-diagram orientation, makes it possible for the beginner to learn quickly a usable subset of the language. Because Wolverine GPSS/H is rich and versatile, however, serious study is required to *master* the language.

3. A Sampling of GPSS/H Features

Here are some of the features provided in Wolverine GPSS/H:

1. Compatible implementations on a range of hardware platforms running from DOS machines through workstations to mainframes. Included among the DOS implementations are inexpensive and yet powerful Student DOS GPSS/H, Personal GPSS/H (which runs large models on 286 machines), and GPSS/H 386 (which uses extended DOS technology to circumvent the 640K DOS barrier and makes it possible with 2 or 4 megabytes of RAM to simulate with huge models on 386 or 486 machines).
2. Exceptionally high speed compilation and execution (Abed, Barta and McRoberts 1985).
3. Smooth, portable, inexpensive, vector-based post-simulation animation running on 286-or-better DOS machines with a math co-processor (Brunner and Earle 1991). (Wolverine GPSS/H animation is accomplished using Wolverine's Proof Animation, which provides animation of simulation models developed using nearly any simulation software or programming language. Proof Animation offers unlimited viewing orientations, presentation capabilities, optional two-way CAD translation, and an open architecture for maximum flexibility.)
4. An interactive-monitoring mode useful for tracing model operation to support model building and checkout.
5. A powerful control-statement language supporting such things as design of experiment, reading and writing external files, complex computations, production of customized reports, and man-in-the-loop simulations.
6. A set of rich features (including the already-mentioned file I/O and many programming, data storage, and computational capabilities) which mean the need to program in an external language such as FORTRAN or C, although supported, almost never arises.
7. Flexibility resulting from implementation of functionality both in block form and in control-statement form.
8. A unique indexing scheme for obtaining and controlling the 0-1 uniform random numbers used to sample from input distributions and facilitating the implementation of variance-reduction techniques; and an automatic report on the relative goodness of the random numbers used (Schriber 1991).

4. A GPSS/H Model for a one-line, one-server System

A Wolverine GPSS/H model for a one-line, one-server queuing system is presented in this section.

4.1 Statement of the Problem

In a manufacturing system, castings are sent to a drill, where each casting is to have a hole drilled in it. The interarrival time of castings at the drill is uniformly distributed over the interval 15.0 ± 4.5 minutes. The time required to drill a hole in a casting is 13.5 ± 3.0 minutes, uniformly distributed. Castings are processed in first-come, first-served order. Model this system in GPSS/H, making provision to collect queuing statistics for castings waiting their turn to be drilled. Perform a single simulation with the model, simulating until holes have been drilled in 100 castings. Briefly discuss the output produced at the end of the simulation.

4.2 Approach Taken in Building the Model

Consider the series of events experienced by a casting as it moves through the one-line, one-server system:

1. The casting arrives at the system.
2. The casting requests the drill.
3. The casting waits, if necessary, to capture the drill.
4. The casting captures the drill.
5. The casting holds the drill in a state of capture while a hole is drilled in the casting.
6. The casting gives up control of the drill.
7. The casting leaves the system.

Castings can be thought of as units of traffic (objects) that move through the castings-and-drill system. These units of traffic are conveniently simulated in GPSS/H by entities known as "transactions." Transactions are units of traffic that are created and introduced into a model from time to time, move along a path in the model as the simulation proceeds, and then are destroyed (leave the model). The experiences of transactions as they go through their life cycle in the castings-and-drill *model* are analogous to the experiences of castings as they go through the castings-and-drill *system*. Positioned on the path along which transactions move are *blocks*. Movement of a transaction into a block causes the block to be executed. By choosing appropriate types of blocks, the GPSS/H modeler can easily build an appropriate path (sequence of blocks) along which transactions can move to mimic the sequence of events outlined above.

The sequence of blocks begins with the type of block used to create transactions from time to time during a simulation and introduce them into a model, the GENERATE block. The time that elapses between introduction of consecutive transactions into a model by a GENERATE block is "interarrival time." In this model, the interarrival time is uniformly distributed over the interval 15.0 ± 4.5 minutes. (15.0 ± 4.5 describes the open interval ranging from 10.5 to 19.5.) The values 15.0 and 4.5 are provided in the model as GENERATE block *operands*. (In general, arbitrary interarrival-time distributions can be modeled at GENERATE blocks. This is done by using built-in or user-defined functions that describe the distribution, then specifying these functions as GENERATE-block operands. See Schriber 1991 for particulars.)

The sequence of blocks ends with a TERMINATE block. When a transaction executes a TERMINATE block, the block destroys the transaction. A counter can be used with TERMINATE blocks so that, after a specified destroy count has been reached (a count of 100 in this problem), a simulation will stop. (More generally, arbitrarily complicated stopping conditions can be specified in GPSS/H models.)

A SEIZE block is included in the sequence. A transaction requests control of a single server by trying to execute a SEIZE block. A SEIZE block operand is used to identify the single server. If the server is idle when a transaction requests it, the requesting transaction executes the SEIZE without delay and takes control of the server. But if the server is currently under the control of one transaction when another requests it, the requesting transaction cannot execute the SEIZE block. Instead, it remains in its current block and waits its turn to capture the server. In the simplest case, turns come in the order of first-come, first-served. (In general, arbitrarily complicated service orders can be specified in GPSS/H.)

A RELEASE block is also included in the sequence. A transaction which is in control of a single server gives up control by executing a RELEASE block. A RELEASE block operand is used to identify the server involved.

GPSS/H automatically collects (and then, when a simulation stops, prints out) statistical information about single servers modeled with use of SEIZE and RELEASE blocks. (See section 4.5.)

An ADVANCE block is used to delay movement of a transaction along its path for a specified simulated time. In this model, an ADVANCE block can be used to simulate the time required for the machine to drill a hole in a casting ("service time"). The service time in this model is uniformly distributed over the open interval 13.5 ± 3.0 simulated minutes. The values 13.5 and 3.0 are provided in the model as ADVANCE block operands. (Arbitrarily complicated service time distributions can be modeled at ADVANCE blocks. This is done by using built-in or user-defined functions which describe the applicable distribution.) By placing an ADVANCE on the path between SEIZE and RELEASE, simulated time delays between server capture and release can be modeled.

By executing a QUEUE block, a transaction initiates membership for itself in a *queue*, or waiting line. This membership continues until the transaction brings its queue membership to an end by executing a DEPART block. An operand is used at the QUEUE and DEPART blocks to indicate the particular queue involved. By placing a SEIZE between QUEUE and DEPART blocks, transactions will be members of a queue while waiting their turn to capture a server. GPSS/H automatically collects and then prints out statistical information about such queues. (See section 4.5.)

Seven types of blocks have been commented on in this section (GENERATE; TERMINATE; SEIZE; RELEASE; ADVANCE; QUEUE; DEPART). In total, there are *sixty five* types of blocks in Wolverine's GPSS/H. By appropriate use of these block types, models of complex systems can be built with considerable ease.

4.3 GPSS/H Block Diagram for the Model

The model described above is shown in the form of a block diagram in Figure 4-1. The block diagram consists of a sequence of seven Blocks. (Each block type in Figure 4-1 has its own unique, arbitrary geometry.)

The text appearing adjacent to the blocks in Figure 4-1 (e.g., "castings arrive"; "check into the drill queue") is not part of the model, but is simply commentary which has been (optionally) provided as documentation.

4.4 GPSS/H Model File

Figure 4-1 shows the *block diagram* for a Wolverine GPSS/H one-line, one-server model. To perform a simulation with this model, the *statement version* of the Figure 4-1 block diagram must be prepared and then supplemented with additional types of statements used to control compilation and execution of GPSS/H models. The resulting collection of statements must then be arranged in a model file. A model file is simply a computer file which can be used as the basis for performing one (or more) simulations.

Figure 4-2 shows a model file corresponding to the Figure 4-1 block diagram. The Figure 4-2 model file has been supplemented for discussion purposes here at the top with a row of column labels ("STMT #," "Label," "Operation," "Operands," and "Comments") and at the left with a column of statement numbers (1, 2, ..., 22).

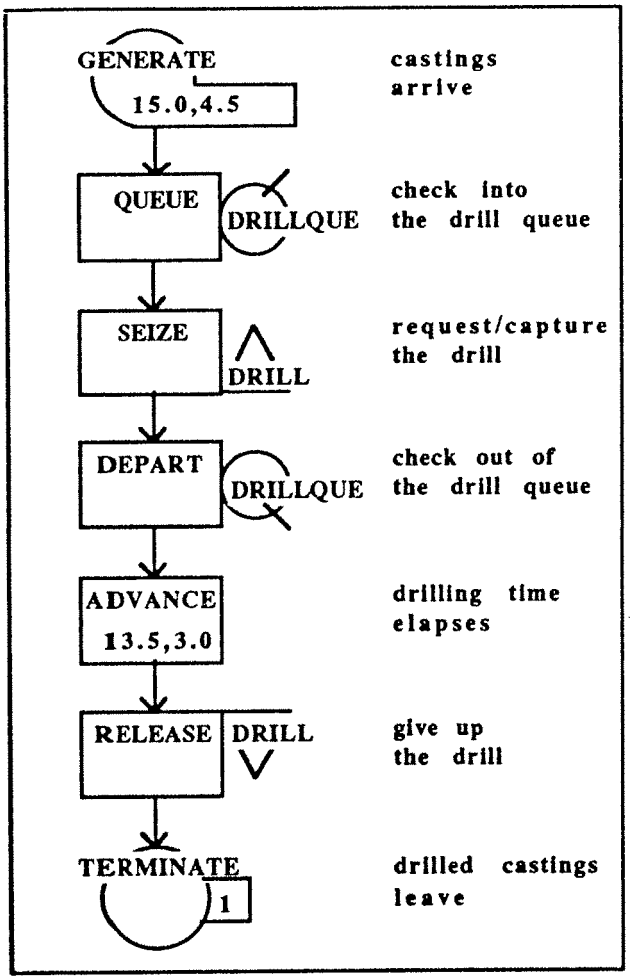

Figure 4-1: GPSS/H Block Diagram for a One-Line, One-Server Queuing System

```
STMT #  Label    Operation  Operands    Comments
     1  ********** One-Line, One-Server GPSS/H Model **********
     2          SIMULATE
     3  *                                      Base Time Unit: 1 Minute
     4  ************************************************************
     5  *       Model Segment 1 (Movement of Castings Through the System  *
     6  ************************************************************
     7  *
     8          GENERATE   15.0,4.5    castings arrive
     9          QUEUE      DRILLQUE    check into the drill queue
    10          SEIZE      DRILL       request/capture the drill
    11          DEPART     DRILLQUE    check out of the drill queue
    12          ADVANCE    13.5,3.0    drilling time elapses
    13          RELEASE    DRILL       give up the drill
    14          TERMINATE  1           drilled casting leaves
    15  *
    16  ************************************************************
    17  *       Run-Control Statements                               *
    18  ************************************************************
    19  *
    20          START      100         start the simulation;  proceed until
    21  *                              100 drilled castings have left
    22          END                    end of Model-File execution
```

Figure 4-2: A GPSS/H Model File for the Figure 4-1 Block Diagram

Statements 8 through 14 correspond to the Blocks in Figure 4-1. Each of these block statements consists potentially of a "Label" (no Labels are used in Figure 4-2), an "Operation," and zero or more "Operands," and can (optionally) include appended documentation text ("Comments"). For example, STMT #8 corresponds to the Figure 4-1 "GENERATE 15.0,4.5" block (where the "Operation" is GENERATE and the "Operands" are 15.0 and 4.5) and carries the optional appended comment "castings arrive."

Statements 2, 20 and 22 in Figure 4-2 are examples of statements used to control the compilation and execution of GPSS/H models. They have been specified in Figure 4-2 in such a way that when the model file is executed, only one simulation will take place. The simulation will stop when the 100th casting has been drilled.

Each model-file statement beginning with an asterisk (*) is a *comments statement*. In Figure 4-2, STMT #'s 2, 3 through 7, 15 through 19, and 21 are examples of such statements.

4.5 Selected Simulation Output

Selected output automatically produced at the end of the simulation when the Figure 4-2 model file was submitted for execution is displayed in Figure 4-3. The output in Figure 4-3 consists of: (a) clock values; (b) server statistics; and (c) queue statistics. Portions of this output are discussed below. (For a full discussion of similar output, see Banks, Carson and Sy 1989, Henriksen and Crain 1989, or Schriber 1991.)

(a) Clock Values

As indicated in Figure 4-3(a), GPSS/H maintains two simulated clocks: a RELATIVE CLOCK; and an ABSOLUTE CLOCK. Both clocks show that it took 1488.9+ simulated minutes to drill holes in 100 castings. (Limited space makes it impossible to explain here the difference between the two types of clocks, except to say that the RELATIVE CLOCK is associated with a Wolverine GPSS/H capability for reinitializing statistical aspects of a simulation without eliminating the presence of transactions in the underlying model.)

(b) Server Statistics

Figure 4-3(b) shows server (drill) statistics accumulated during the simulation. Several columns in the figure have been numbered here to make it easy here to refer to the information they contain. The meaning of the information in

```
RELATIVE CLOCK:    1488.9629      ABSOLUTE CLOCK:    1488.9629
(a) Clock Values

     (1)     (2)                        (3)       (4)
                --AVG-UTIL-DURING--
FACILITY     TOTAL   AVAIL   UNAVL   ENTRIES    AVERAGE   CURRENT   PERCENT   SEIZING
               TIME    TIME    TIME              TIME/XACT  STATUS    AVAIL     XACT
   DRILL       .917                       100      13.655    AVAIL     100.0
(b) Drill Statistics

     (1)        (2)        (3)        (4)        (5)          (6)
   QUEUE      MAXIMUM    AVERAGE    TOTAL      ZERO      PERCENT    AVERAGE
              CONTENTS   CONTENTS   ENTRIES    ENTRIES   ZEROS      TIME/UNIT
DRILLQUE             2       .215        101         42      41.6       3.172
(c) Queue Statistics
```

Figure 4-3: Selected Simulation Output

the several numbered columns will now be indicated by column number.

(1)The FACILITY column lists the identifier used in the model for the single server (the DRILL, in this case) for which statistics are being reported. (In GPSS/H, the *facility* entity is used to model single servers.)

(2)The --AVG-UTIL-DURING-- TOTAL TIME column shows the *fraction of total simulated time* that the server was captured. In this case, the DRILL was in use 91.7% of the time.

(3)The ENTRIES column indicates the number of times the server was put into a state of capture during the simulation. This statistic is a *capture count*. In Figure 4-3(b), the capture count is 100.

(4)The AVERAGE TIME/XACT column shows the average holding time per capture of the server.)

(c) Queue Statistics

Figure 4-3(c) shows queue (waiting-line) statistics accumulated during the simulation. Several columns in the figure have been numbered here to make it easy here to refer to the information they contain. The meaning of the information in the several numbered columns will now be indicated by column number.

(1)The QUEUE column lists the identifier used in the model for the queue (the DRILLQUE, in this case) for which statistics are being reported.

(2)The MAXIMUM CONTENTS column indicates the maximum length of the waiting line (this statistic has the value 2 in the case of the DRILLQUE).

(3)The AVERAGE CONTENTS column shows the average length of the waiting line (0.215 in the case of the DRILLQUE).

(4)The TOTAL ENTRIES column shows the count of the number of times transactions joined the waiting line (101 in the case of the DRILLQUE).

(5)The ZERO ENTRIES column shows the number of transactions which passed through the waiting line in zero simulated time.

(6)The AVERAGE TIME/UNIT column shows how much time transactions spent resident in the waiting line on average (3.172 in the case of the DRILLQUE). (Here, the term "UNIT" in the AVERAGE TIME/UNIT label means "transaction.")

5. Learning More About GPSS/H

The preceding material provides a glimpse of the particulars of discrete-event simulation using GPSS/H. Those interested in learning more about Wolverine GPSS/H can do one or more of the following:

1. Obtain and read an introductory GPSS/H textbook and experiment directly with the included models and Student DOS GPSS/H software. (Banks and Carson 1989 and Schriber 1991 can be obtained from the GPSS/H European representative, Scientific Computers GmbH, Franzstrasse 107, D-5100, Aachen, Germany, Tel: +49.241. 26041, Fax: +49.241.44983; Schriber 1991 can also be obtained from John Wiley & Sons, Inc., Baffins Lane, Sussex PO191UD, Chichester, England, Tel: +44.243. 77. 97.77; Fax: +44.243.77.58.78. The two books can also be obtained from the GPSS/H developer: Wolverine Software Corporation, 4115 Annandale Road, Annandale VA 22003-2500 USA, Tel: +1.703.750.3910; Fax: +1. 703.642.9634)
2. Obtain from the GPSS/H European representative or from Wolverine Software the free Proof Animation demonstration disk and view the sample animations based on GPSS/H modeling.
3. When attending a conference at which vendors of simulation software have booths in an exhibition area, talk with the people at the GPSS/H booth and look at GPSS/H demonstrations.
4. Attend an intensive Wolverine GPSS/H short course. (Contact the GPSS/H European representative or Wolverine Software for current information about scheduled course offerings.)

References

Abed, S.Y., T.A. Barta and K.L. McRoberts. 1985. "A quantitative comparison of three simulation languages: GPSS/H, SLAM, SIMSCRIPT." Computers & Industrial Engineering 9, 45-66.

Banks, J., J.S. Carson and J. Sy. 1989. Getting Started with GPSS/H (with Student DOS GPSS/H on an included disk). Wolverine Software Corporation, Annandale, Virginia USA.

Brunner, D.T. and N.J. Earle. 1991. Using Proof Animation. Wolverine Software Corporation, Annandale, Virginia USA.

Henriksen, J.O. and R.C. Crain. 1989. GPSS/H Reference Manual, Third Edition. Wolverine Software Corporation, Annandale, Virginia USA.

Schriber, T.J. 1991. An Introduction to Simulation Using GPSS/H (with Student DOS GPSS/H on an included disk). John Wiley & Sons Inc., Chichester, England, and New York, New York USA.

Author Biography

Thomas J. Schriber is Professor and Chairman of Computer and Information Systems in the Graduate School of Business at The University of Michigan, Ann Arbor, Michigan USA. He teaches, does research, and consults in the area of discrete-event simulation. A member of Who's Who in America, he has authored or co-authored several dozen articles, has authored or edited eleven books, and regularly teaches short courses on GPSS/H-based simulation. From 1977 to 1986 he was a member of the Board of Directors of the annual Winter Simulation Conference, serving as Board Chairman two years. His professional affiliations include the Arbeitsgemeinschaft Simulation, the Association for Computing Machinery, the Decision Sciences Institute, the Operations Research Society of America, the Society for Computer Simulation, and The Institute of Management Sciences.

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TECHNOLOGIES ARE EMERGING WHICH PROVIDE DYNAMIC AND EXCITING SOLUTIONS

ASIM

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

Reports from ASIM

The ASIM board met on the first evening of ASIMs annual conference to discuss current affairs and future activities. 13 of currently 14 board members were present.

Preparation of the *7th Symposium Simulationstechnik* was in good progress, about 350 persons participated at the conference. About half of the participants met already on this first evening. We all thanked Prof. Tavangarian for the work he had done. A report on this conference can be found below.

Next point of discussion was the 1993 conference "*8. Symposium Simulationstechnik*" in Berlin. Mr. Peter Schäfer of Daimler-Benz Forschungsinstitut presented the first call for papers. Organizers will be Mr. Schäfer, Prof. Sydow and Prof. Giloi. The call for papers has been distributed as well at the conference and can be obtained from the contact persons mentioned below or from Mr. Schäfer himself.

Thanks to the activities of Mrs. Husinsky and Prof. Breitenecker *ASIM-Mitteilungen* look much nicer now, ASIM has a letter paper and will soon have a folder to introduce ASIM shortly. Please contact Mrs. Husinsky if you need ASIM-folders to inform your colleagues about ASIM. The next issue of EUROSIM news will contain a list of available *ASIM-Mitteilungen* and their price.

Other subjects were status of EUROSIM, the 1992 Capri conference, activities of current working groups and the foundation of new working groups. Working groups have been encouraged to organize meetings together.

The board will meet again on Monday, December 16th. Please contact a board member if you feel that the board should discuss a special subject.

During the conference a new working group for "*Simulation in der Betriebswirtschaft*" has been founded. Speaker of this working group is Prof. Hummeltenberg of Universität Hamburg, co-founders are Prof. Biethahn of Universität Göttingen, Prof. Schmidt of Universität Passau and Prof. Witte of Universität Osnabrück. See "reports from the working groups".

ASIM plans to found other new working groups to cover additional important fields of simulation activities. Activities are in progress for "*Simulation von Verkehrssystemen*" and "*Graphische Darstellung von Simulationsergebnissen*". More information will be mailed to ASIM members as soon as it will be available.

ASIM general meeting

ASIMs general meeting was on Tuesday, September 24th, after the end of the sessions. Dr. Bausch-Gall reviewed shortly ASIMs last year and gave a survey on planned activities. Prof. Breitenecker gave a report on the current finances. Due to improved services, ASIM will need more income. Membership fees have been the same since ASIMs official foundation. Dr. Bausch-Gall asked for the consent to increase the membership fee to DM 30,00 per year. This was accepted by all participants.

Contact Adresses

Austria and membership administration:

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

Germany:

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

Switzerland:

PD Dr. Jürgen Halin
ETH Zürich, Institut für Energietechnik
Clausiusstrasse 33, CH-8092 Zürich
Tel: +41-(0)1/256-4608, Fax: +41-(0)1/262 2158 or 252 0192

ASIM Meetings to come

February 27-28, 1992: Meeting of the Working Group "*Simulationssoftware und -hardware*" at Zürich. For more information contact Dr. Halin.

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

March 26-28, 1992: 5th Ebernburg Working Conference. For more information contact Prof. D.P.F. Möller or Prof. O. Richter (TU Braunschweig, Institut für Geographie und Geoökologie, Langer Kamp 19c, W-3300 Braunschweig, Tel: +49-(0)531/3915627).

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

September 1992: Conference on "Simulation and User Benefit" in Aachen, organized by the Working Group "*Simulation in der Fertigungstechnik*". For more information contact Prof. Dr. A. Kuhn.

September 28-30, 1993: *8. Symposium Simulationstechnik* in Berlin. This is ASIMs 1993 German speaking conference. For more information contact Mr. Peter Schäfer, DAIMLER-BENZ AG, Forschungsinstitut, Alt-Moabit 91b, W-1000 Berlin 21. A first call for papers can be obtained as well from Dr. Bausch-Gall,

Other meetings with ASIM participation

November 21-22, 1991: "*Arbeitsgespräch Physik und Informatik; Informatik und Physik*" in München. This is a

first common meeting organized by Gesellschaft für Informatik (GI), Deutsche Physikalische Gesellschaft (DPG) and Informationstechnische Gesellschaft (ITG). For more information contact Dr. Ingrid Bausch-Gall.

Reports from the Working Groups

Working Group "Simulationsmethoden und Sprachen für parallele Prozesse"

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

Working Group "Simulationssoftware und -hardware"

The working group "*Simulationssoftware und -hardware*" will meet on February, 27 and 28, 1992 at the ETH Zürich.

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

Introductory lectures will give an overview of available methods and especially on available software for the solution of optimization problems (parameter optimization and function optimization). Advantages and disadvantages of the methods and software products shall be discussed and compared. Participants will report on their experiences with methods and software in typical applications.

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

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

Working Group "Simulation und künstliche Intelligenz"

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

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

Working Group "Simulation in Medizin, Biologie und Ökologie"

The 5th Ebernburg Working Conference, Advanced Simulation in Medicine, Biology and Ecology is to be held from March 26 to 28, 1992 at the old castle of Ebernburg, Bad Münster am Stein - Ebernburg. The workshop will be organized by the working group "Simulation in Medicine, Biology and Ecology".

Topics of the workshop are: Theory of dynamic nonlinear systems, modelling, simulation and identification of medical, biological and ecological systems and processes, knowledge based methods, neural nets, fuzzy-set theory, case studies, education.

Speaker of the working group: Prof. Dr. D. Möller, TU Clausthal, Institut für Informatik, Erzstr. 1, W-3392 Clausthal-Zellerfeld, Tel. +49-(0)5323/722402.

Working Group "Simulation technischer Systeme"

The working group met at the "7th Symposium Simulationstechnik" for about one hour. Main point of discussion was the meeting in Paderborn on March 9 to 10, 1992. This meeting in Paderborn will have parallel sessions to allow to specialize on special subjects. To show the importance of simulation of electrical and electronical systems one parallel session will deal mainly with this field.

Subjects of the meeting in Paderborn will be: simulation at Universität Paderborn, simulation at Hella, simulation of electrical and electronic systems, contributions of ASIM members. The meeting will be supported by HELLA KG Hueck & Co. in Lippstadt..

At the meeting at Paderborn the speaker of this working group will be elected. An invitation to this meeting will follow soon.

On the morning before that meeting German speaking user groups (SPICE and ACSL) plan to meet at the same location. For further information please contact H. Gall, Wohlfartstraße 21b, W-8000 München 45 (SPICE User Group) or I. Husinsky, TU Wien, EDV-Zentrum, Wiedner Hauptstr. 8-10, A-1040 Wien (ACSL User Group)

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

Working Group "Simulation in der Fertigungstechnik"

Along with the 7th "Symposium Simulationstechnik" held in Hagen in September 1991 another meeting of the members of the working group "Simulation in der Fertigungstechnik" (ASIM working group "Simulation in Production Technology") took place. Two major issues were to be discussed:

- formation of workshops within the working group in order to work on specific problems in the field of simulation in production technology, material handling and logistics (based on proposals made on an earlier working group meeting)
- preparation of the next conference organised by the working group in September 1992 in Aachen.

In total about 18 workshops were formed, whose two to four members each are supposed to meet three to four times within one year. Topics to be worked on are classified in three fields: Applications, Methods and Special Aspects. In the applications field issues like simulation of material flow systems, simulation in production control, simulation in robotics and simulation as testbed for control software shall be discussed. As methodological aspects data management in simulation, modelling and implementation as well as experiment planning and interpretation of results will be considered. Special issues are covered amongst others by workshops about costs and benefits of simulation in technical applications, an elaboration of a glossary for simulation and the writing of a visionary scenario, how simulation might be used in the next five to ten years.

The workshops will present their final results during the meeting envisaged for September 1992. The findings will be compiled in a handbook "Simulation in Production and Logistics" that shall be published late in 1992.

The next conference organised by the working group will be held on two days in September 1992 in Aachen and has the provisional title "Simulation and User Benefit". Like for the last conference in March 1991 in Hannover ("Simulation and Understanding") again around 120 participants are expected. Invited speakers will present papers about the costs and benefits of simulation applications, the accuracy required from simulation results with respect to the application case and the overcoming of the "single-purpose simulation": Simulation models will become a fixed component of future production and logistic facilities.

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

Working Group "Simulation in der Betriebswirtschaft"

Simulation in der Betriebswirtschaft (simulation in business management) is the name of a new working group of ASIM. The working group has been established during the 7th annual ASIM conference which has taken place from September 24 to 26, 1991, at Hagen, Germany.

Simulation techniques are a well-known and proven tool in business management. Traditional areas of application are production planning and control, material management and logistics, investment planning and so on. New fields of application grow from the integration of simulation techniques into computer integrated manufacturing (CIM) and by the connection with expert systems. These features and the new software technologies effect that simulation systems become intelligent decision support systems and an easily handable decision aid to the analyst, planner or decision maker at his job. This makes the acceptance of simulation easier. The simulation expert becomes more and more dispensable in formulating and simulating the actual pending problems. His work concentrates on the development, integration and maintenance of simulation systems and tools.

The working group has been initiated by the ASIM board, Prof. Witte, University of Osnabrück, and the organizing committee of the symposium "*Simulationsmodelle als betriebswirtschaftliche Entscheidungshilfe*" (simulation models as a decision aid to business management). The symposium takes place every two years at Maritim Hotel, Braunlage (Harz). The last symposium has taken place in March 1991.

The intention of the working group is the same as the one of the symposium, i.e. bringing together specialists and executives of the industry, science and administration and to promote and to stimulate the exchange of experience about simulation in business administration and adjacent areas. The initiators of the working group act upon the conviction that the biannual meetings and the other activities on the field of simulation applied to economics should be arranged under the cover of ASIM in this working group. This means that the gap between the biannual symposium has to be filled by the activities of the working group and the exchange of experience has to become a continuous flow. The workshops of the working group will take place especially in firms or institutes with experience in simulation.

At the symposium suppliers of simulation software, simulation users, and research scientists report on new developments of simulation tools, simulation techniques and applications in practice. The main topics of the meetings held so far were:

- Basic methods and tools: state of the art, simulation methodology and modelling, simulation languages and shells, statistic methods and evaluation and expert systems in simulation.
- Simulation on the computer: software tools, animation and user interface, RISC machines and high performance simulation, parallel simulation techniques and simulation on the PC.
- Applications of simulation in material and production management, computer integrated manufacturing (CIM), logistics, strategic planning, marketing, financing and investment.

The name of the working group is intended to strengthen the managerial and application oriented point of view. The working group will not be an exclusive scientific section, but the major part of its participants is intended to be practitioners. Though the notation " ... in business management" mainly announces applications in business administration people applying simulation to economics are welcomed as well.

Evidently there will be overlapping areas between this working group and others of ASIM. For instance, intersections may occur in the case of the working group "*Simulation in der Fertigungstechnik*" (simulation in production engineering). Such intersections give no reasons for discussing about demarcations but demonstrate the must of integration in a way as computer aided manufacturing and production planning and control are connected by computer integrated manufacturing (CIM). The same is true for the connection of physical distribution and marketing under computer integrated logistics (CIL).

The first workshop will take place in spring 1992. People interested in the activities of this working group please contact the speaker:

Prof. Dr. W. Hummeltenberg, Universität Hamburg, SAB/BDV, Von-Melle-Park 5, W - 2000 Hamburg 13, Tel: +49-(0)40 4123 4023 or +49-(0)4102 55044.

Conference Report on ASIM 91

ASIM regularly organizes conferences on scientific and technological progress as well as landmarking trends of development and innovative methods in the fields of simulation techniques and applications. In addition to the scientific use of such meetings it is the aim of the organizers to promote the exchange of ideas and experiences of experts and people in modelling and simulation in theory and practice.

The 7th symposium of simulation engineering took place in Hagen, Germany from September 23 to 26, 1991. Dr. Dj. Tavangarian of FernUniversität Hagen, Department of Com-

puter Science, was in charge of the organization and the scientific course.

About 350 persons (half of them coming from industry) from different European countries took part in this conference. Among them were more than 50 scientists from the former GDR.

The congress was opened by an invited lecture of Prof. Piloty, TH Darmstadt, which discussed several problems in the field of behavioural modelling of digital circuits and systems.

Within the framework of an invited presentation on the occasion of the 10th anniversary of the foundation of ASIM, Professor Giloi of GMD-FIRST, Berlin, introduced a new model for the programming of massive-parallel systems, which he called the "Model of Virtual Processors".

There were three other invited presentations: Prof. H. Rake of RWTH Aachen gave a survey of experiences in the analog and digital simulation of different aspects of control systems. Prof. R. Schehrer of the University of Dortmund discussed the distinctive features of algorithmic random number generators and the quality of simulation results. Prof. F. Breitenecker of TU Vienna held a presentation on "Progress in Simulation Engineering, Methodology, Implementation and Application". He gave a survey of the requirements for modern simulation languages and introduced a methodological concept which lays a description of methods above the well-known division in model description and experiment description.

Alltogether there were 118 contributions which were presented in 36 parallel sessions. Two crucial points could be found in this year's conference: On the one hand topics like simulation and modelling methods as well as tools for the design of microelectronic circuits were discussed. Several contributions dealt with the design of models, synchronization and the exchange of data in a combined use or in a linkage of different simulators. On the other hand topics about simulation techniques as well as simulators and exemplary studies in the field of manufacturing were discussed. Here the main topics were simulation in robotics and manufacturing.

Moreover sessions with topics of immediate interest and contributions from the fields of simulation engineering were offered. Among them were simulation in the fields of economics, social science, aerospace, mobile systems, artificial intelligence, expert systems as well as object oriented modelling, parallel algorithms and multibody systems.

All presentations were compiled in proceedings which were published by Friedr. Vieweg & Sohn, Publ. Co., Braunschweig.

The congress started with several tutorials and user groups. Many participants took part in study groups which dealt with special aspects of simulation.

Besides the scientific programme the good atmosphere and the social events, which included a cocktail reception and two banquets, helped to make the congress a success.

It was this atmosphere that stimulated an intensive exchange of ideas as well as lively discussions.

DBSS

DBSS Membership

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

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

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

Contact Addresses

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

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

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

The membership fee should be paid to:

Giro account 3582241
J.C. Zuidervaart
Leeuwerikplantsoen 27
2636 ET Schipluiden
The Netherlands

with the mention: DBSS membership.

If you changed address or your address is incomplete, please inform the acting secretary. If you are interested to contribute in future activities of DBSS or if you have ideas in this respect, please contact the acting secretary. Do you have information for 'EUROSIM-Simulation News Europe', please send it to the acting secretary.

Events in the foregoing period

DBSS members have been invited to attend a symposium entitled "Computer Graphics, Animatie en Monitoring". This event was held October 30th, 1991 in Delft. More information about this symposium will be published in the next number of EUROSIM - Simulation News Europe.

Coming events

It is planned to have a half or one day meeting in December 1991 on the subject "DIANA" and "Partool". The meeting will focus on the following topic in the domain of systems simulation: **Structural analysis through parallel finite element simulation with the software package DIANA.**

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

We wish you a happy Christmas and a fruitful simulation year 1992.

ISCS

General Information

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

The affairs of the ISCS are directed by a Steering Committee presently consisting of the following persons:

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

To the Steering Committee belong also F. Maceri and S. Tucci.

Membership

At present, the membership situation is the following: 114 members, 5 of which are institutional and 4 are honorary, 103 are regular members and 2 are affiliate ones.

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

Contact address

For further information of application for membership, please contact:

ISCS
c/o Dip.to di Ingegneria Elettronica
Università di Roma "Tor Vergata"
Via della Ricerca Scientifica
I-00173, Roma, Italy
Tel: +39-(0)6-72594.477/.478/.486
Fax: +39-(0)6-2020519
E-mail: IAZEOLLA@IRMENEA.BITNET

Activities

In the meeting held in September, the Steering Committee promoted the following activites:

1. The annual meeting of ISCS members is scheduled to be held on November 28th 1991 in Rome, at the Dipartimento di Ingegneria Elettronica, Università di Roma "Tor Vergata".

The Steering Committee proposed also to schedule the 1992 annual meeting of ISCS members during the European Simulation Congress (ESC'92) in Capri, between September 29th and October 2nd: this proposal will be evaluated in the next meeting.

2. At the 1990 ISCS annual meeting the creation of Simulation Working Groups was decided. First goal of these groups is to organize regular meetings between ISCS members interested in the same simulation field, in order to provide a forum for presentation of results, exchange of ideas and scientific discussions. In a second step, the Working Groups may establish contacts with other yet existing groups of European countries.

Until September adhesions to the Working Groups proposed in the 1990 ISCS annual meeting were collected. Now the Steering Committee, evaluating the interests showed by the ISCS members, has established the existence of the Working Groups here reported:

- Simulation in Industry and Management
- Simulation in Agriculture and Enviromental Sciences
- Simulation in Training and in Education
- Simulation in Biology and Medicine
- Simulation in Electrical Engineering
- Concurrent and Distributed Simulation
- Software and Hardware for Simulation
- Expert Systems and Simulation

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

The first meeting of the chairmen of the Working Groups is scheduled to be held at the annual meeting of ISCS members.

3. The ISCS is currently involved in the organization of the **4th European Simulation Congress**, which will take place in Capri, Italy, from September 29th through October 2nd, 1992. See also final call for papers on page 40.

4. The ISCS, under request of Prof. S. Tucci (general chairman of the congress and chairman of the working group "Simulation in Training and in Education"), is sponsoring the congress DIDAMATICA '92, wich will take place in Campobasso, from April 22nd to April 24th, 1992.

One of the sessions of the congress will be entirely devoted to the use of simulation in education.

FRANCOSIM

FRANCOSIM, *Société Francophone de Simulation* (French Speaking Simulation Society), aims to the promotion and development of simulation models, tools and methods as well as related techniques, in all human activities and notably in industry, research and education, and this especially in the international French speaking community.

Board of directors

It is a great pleasure for us to announce that FRANCOSIM byelaws have been officially registered in Roanne (France) the 8th of July 1991. The association does now officially exist in the form of "association loi de 1901".

Its board of directors is composed as follows:

Dr. Roger Temam	
Prof.University PARIS XI	President
Dr. Michel Lebrun	
Director IMAGINE	Delegated
Prof. University LYON I	President
Ir. Francis Lorenz	
Director LORENZ CONSULTING	Vice-President
Lecturer University LIEGE	Contact EUROSIM
Dr. Michel Nakhle	
Deputy Director CISI	Secretary
Lecturer University PARIS XI	
Dr. Pierre Guerin	
Consultant	Treasurer

Contact Address

For further information or application for membership, please contact Mrs. Fourneyron or Mr. Lebrun at the legal seat:

FRANCOSIM
c/o Maison de la Productique
Esplanade Diderot
F - 42300 Roanne, France
Tel. +33-77 71 20 00 (Mrs. Fourneyron)
Tel. +33-77 70 80 80 (Mr. Lebrun)

Activities

A first official activity is being planned for April 1992. It is a conference on discrete event modelling and simulation. More information can be obtained from the legal seat.

SIMS

Information on SIMS

The Scandinavian Simulation Society, SIMS, has about 260 members from Denmark, Finland, Norway and Sweden. For more than 30 years SIMS has served as the regional simulation society in Scandinavia, gathering individuals and organizations involved in simulation. The activities have been concentrated on arranging annual meetings and courses, delivery of information letters, and co-operation at European and international level in the field of simulation.

How to join SIMS?

If you or somebody of your Nordic colleagues are interested in simulation but not yet a member of SIMS, then just send an informal application or recommendation for membership to the SIMS secretariat:

M. Hänninen
Technical Research Centre of Finland
P.O.Box 208 (Tekniikantie 4),
SF-02151 Espoo, Finland
Tel: + 358 0 4561, Fax + 358 0 456 5000

SIMS 92 Simulation Conference
Simulation of Chemical and Power Plant Processes, June 10-12, 1992

The Conference is organized by SIMS, Technical Research Centre of Finland and Lappeenranta University of Technology.

Topics of interest include, but are not limited to: Modeling of physical phenomena and process components, Verification and validation of models, Engineering simulators, Training simulators, Man-machine interaction, Calculation of thermophysical properties.

The Simulation Conference is aimed to simulator personnel, modelers, researchers, software developers and engineers from chemical industry, power plant utilities, vendors, research organizations and universities.

An abundant number of papers covering the topics of the Conference is expected. The authors should submit an abstract describing their work to the secretary of the Program Committee by **31.12.1991**. Acceptance will be notified by 20.1.1992. The papers will be published in Research Papers of Lappeenranta University of Technology.

The official language of the Conference is English. The final program and the registration form will be published in February, 1992.

Program Committee: Prof. H. Kalli (Lappeenranta University of Technology), Mr. E. Patrakka (Teollisuuden Voima Oy), Mr. U. Linden (Imatran Voima Oy), Mr. K.I. Keskinen (Neste Oy), Dr. I. Turunen (Kemira Oy), Dr. S. Kaijaluoto (Technical Research Centre of Finland), Mr. M. Hänninen, secretary (Technical Research Centre of Finland)

Conference Secretariat: M. Hänninen, Technical Research Centre of Finland, P.O.Box 208 (Tekniikantie 4), SF-02151 Espoo, Finland, Tel: + 358 0 4561, Fax + 358 0 456 5000.

UKSS
United Kingdom Simulation Society

Formally United Kingdom Simulation Council (UKSC)

Following a resolution of the UKSC Steering Committee and a postal ballot of ALL UKSC Members and Affiliates, The Chairman of UKSC attended the SCSI Board of Directors Meeting and associated Committee Meetings with a clear mandate to dissolve the UKSC regional council of SCSI. The meetings were held during the Summer Computer Simulation Conference held in Baltimore, USA, July 1991. This was for several reasons namely: to permit SCS members in the UK to be integrated with the European membership, to allow the resulting independent UK simulation society to become a full member of EUROSIM, and to promote simulation in the UK.

At the Executive Committee meeting the UKSC Chairman proposed a motion to be put to the Board of Directors meeting that UKSC cease to be a Regional Council of SCS and become independant and that the existing UK SCS members become part of the European Simulation Council. The Executive Committee recommended that the motion be supported, subject to the existing UKSC SCS members being given initial favourable treatment in return for the independent UK society retaining existing moneys.

Subsequently at the full Board meeting the motion was passed unanimously. Further, in the discussion at that meeting CESC (Continental European Simulation Council) resolved to change its name to ESC (European Simulation Council), and this was also accepted. As a consequence of the dissolution of UKSC, the UKSC Chairman lost his seat as regional council representative on the Board for 91/92. However, the transfer of SCS members from UKSC to ESC gave ESC an additional seat, which was offered and accepted by the undersigned. ESC now has five full Board members for 91/92. Additionally, Prof. David Murray-Smith was elected a Director-at-Large, a position he has previously held.

Consequent to all of this, UKSC was provisionally renamed UKSS (United Kingdom Simulation Society) and is independent of SCSI. The new European Simulation Council (ESC) includes the SCS members in the UK, represented by the undersigned.

At the first meeting of the renamed UKSS, held in London on 17 September 1991, the following Committee was formed:

Chairman:	Richard N. Zobel
Vice-Chairman:	Mohammed Rahbar
Secretary:	Russell Cheng
Treasurer:	Adrian Magill
Membership Secretary:	Elizabeth Rimmington
Members:	David Murray-Smith (New Members)
	David Maclay (One Day Meetings)
	Sally Brailsford
	Geoffrey Smith
Co-opted Members:	Rob Pooley
	Rod Pugh

The members of the previous committee were re-elected with the exception of David Vint, who was willing but unable to continue as Secretary due to change of employment. The last three members were accepted on the basis of very welcome offers of support.

The Chairman and Committee would like to express their thanks to David Vint for his work on behalf of the Society, and hope that he might be able to consider his availability for office in the future.

The new name United Kingdom Simulation Society was confirmed.

The Chairman summarised the events leading to the change of status of the UK society (detailed above). It was noted that SCSI members had already received issues of EUROSIM - Simulation News Europe since the inception of this important European magazine. In addition, they had received notification of UK and European events and activities plus concessionary rates offered for conferences and meetings. It was agreed that this would continue for the remainder of this calendar year and represented good value for services rendered to SCSI members and accepted in the spirit of the agreement reached in Baltimore. SCSI members wishing to retain their membership of UKSS would be charged for the year beginning 1st January 1992. This arrangement will then bring the UK society into line with other European Simulation Societies with respect to independent European society membership and optional parallel membership of SCSI.

After extensive discussions on current and future finances, it was decided to set the membership fee for the new Society at a level based on current realistic costs. This reflected the real costs of organising meetings and mailing notices, costs of holding essential committee meetings, contribution towards the costs of essential international involvement, plus the costs of purchase and distribution of EUROSIM - Simulation News Europe. The latter includes copies required for promoting new membership.

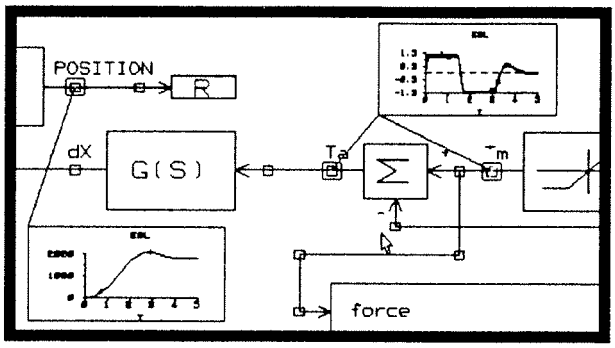
It was further agreed to create a corporate class of membership.

Further information on membership can be obtained from the Membership Secretary.

Notice of future one day meetings, UK conferences and involvement with other European and international events will be made in the next report.

Dr. Richard N. Zobel
Chairman UKSS
Department of Computer Science
University of Manchester
Oxford Road
MANCHESTER M13 9PL
United Kingdom

Mrs. E. Rimmington
UKSS Membership Secretary
Computer Centre
(Watts Building)
Brighton Polytechnic
Moulsecoomb
BRIGHTON BN2 4JG
United Kingdom



ESL: THE LANGUAGE OF SIMULATION

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

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

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

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

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

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

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

* Low cost evaluation copies available.

* Regular seminar and training course programme.

* Alternative textual or pictorial block model definition.

For more information contact:-

Dr J L Hay

ISIM SIMULATION
A Division of Salford University Business Services Ltd
Technology House
Salford University Business Park
Lissadel Street
SALFORD
M6 6AP
England

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

LSS - The Latvian Simulation Society

The Latvian Simulation Society (LSS) is a non-profit professional organization. It consolidates Latvian scientists and practical workers, whose professional interests lie in the field of computer simulation. LSS is headed by Professor Dr. Leonard A. Rastrigin (as Chairman) and Dr. Yury A. Merkuryev (as Vice-Chairman) and currently incorporates about 40 members. Their professional activities cover the following areas:

- Simulation of:
  small firms (LSS is especially interested in contacts and co-operation along this line);
  discrete event systems;
  continuous processes;
  manufacturing and transport large scale systems;
  manufacturing systems, scheduling and supervising manufacturing processes;
  robots, analyzing their controllability and planning optimal paths;
  medical aid after mass accidents (earthquakes, catastrophes, explosions, etc.);
  work of the fishing fleet.
- Knowledge based simulation.
- Optimization of simulation models: adaptive algorithms for planning correlated simulation experiments.
- Dialogue and animation procedures in simulation.
- Data base management in simulation systems.
- Automatization of simulation using Petri nets.
- PC systems for teaching simulation technology and training in simulation languages.

Any information concerning LSS and its activities may be obtained from the address given below.

LSS is the first professional simulation organization within the USSR. Naturally, it aims to help in setting up close contacts between soviet simulationists and the international simulation community. For instance, it is possible to arrange for publishing in well known soviet professional magazines:

- information about international and national simulation societies:
- information about future simulation events;
- scientific papers on simulation;
- advertisements on simulation software (don't forget about the almost unlimited soviet market!).

Those insterested in presenting their material please contact:

Dr. Yury A. Merkuryev
Dept. of Automatic Control Systems
Riga Technical University
1, Kalku Street
22635 Riga, Latvia, USSR
Fax: (0132) 212 206
E-mail: VSS@LAIKS.US.JET.LAT.SU

Czechoslovak System Simulation Club (CSSC)

Members of the CSSC Steering Committee met during the 4th North-Moravian International Symposium on Modelling and Simulation of System held at Vsetín on May 13-16, 1991. The CSSC membership reached 60, but Slovak representation is weak for the time being. The issue of the English translation of the club's name was raised. The current translation was suggested only as a provisional one with present modest conditions and possibilities in mind. After consultations with Mr. R. Zobel, the secretary of EUROSIM and chairman of UKSC, who participated in the Symposium, the attending members of the CSSC Steering Committee agreed on the translation "Czech & Slovak Simulation Society". However, as only one of the Slovak Committee members was present this change could not be accepted as definitive.

4th International North-Moravian Symposium on Modelling and Simulation of Systems

The Symposium was held on May 14 to 16 at the town of Vsetín, located amidst steep green hills of North Moravia. For Czechoslovak simulationists it was the 25th such conference. During the Symposium the annual meeting of CSSC members took place. Symposium participants came from 7 countries. 50 contributions from the following areas were presented:

- advances in simulation software and its applications

modelling and simulation in

- design and production
- nuclear energy engineering
- socioeconomic systems
- transport and industry
- ecology and health care.

Some contributions addressed also the relationship between simulation and expert systems, management of simulation work and use of simulation in the education system.

The Symposium under the auspices of Prof. T. Cermák, the rector of the Technical University in Ostrava, was sponsored by the software house SW Slusovice who opened an exposition of its products. Co-sponsors were EUROSIM and SCSI. Proceedings of the Symposium containing the contributions in English are distributed by SCSI (P. Geril, Ghent). The organizers announce that the 5th Symposium on Modelling and Simulation of Systems will be held in May 1993 in Olomouc, an old historical town in the center of Moravia.

CSSC Chairman :
Milan Kotva
Zeleny pruh 32
CS - 147 00 Praha 4
Tel: +42 2 464179

CSSC Secretary:
Frantisek Hauser
Tel: +42 2 2118 2346

Hungarian Simulation Group
IMACS Hungary

We are pleased to announce that a collection of extended versions of papers presented at the IMACS European Simulation Meeting on Problem Solving by Simulation that has been organized by IMACS/Hungary and held in Esztergom is due to be published in Volume 38 Number 5 and 6 in February/March 1992 in the journal "Mathematics and Computers in Simulation".

We are convinced that a close interaction between research and higher education activities is of great importance. In order to enhance the activity of young specialists in the field of simulation we intend to organize a seminar of both Hungarian and foreign graduate and post-graduate students studying in Hungary for presenting their research work in the field of simulation and provide a possibility for discussions and exchanging ideas.

Prof.Dr. A. Javor
Institute for Measurement and Computing Techniques
Central Research Institute for Physics
Hungarian Academy of Sciences
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Tel: +36 1 1699499, Fax: +36 1 1553894.

YUSIM

The editors received a letter from Dr. Vlatko Ceric from Zagreb in which he wants to inform the editors about two important decisions he made '*... because of the fearful war which is carried against the Republic of Croatia.*':

'*First, I definitely terminated all activities about the formation of the YUSIM - Yugoslav simulation society. Could you please inform about that the members of the EUROSIM board. I am contacting my colleagues in Croatia concerning the possible formation of the Croatian simulation society, and I will write to you soon concerning this possibility.*'

'*I also definitely retired from the Editorial board of the Yugoslav Journal of Operations Research. The same step is done as well by Dr. Luka Neralic from the University of Zagreb. Faculty of Economics, University of Zagreb, also resigned as one of the Publishers of the Journal.*'

Further information on the situation will hopefully be given in the next issue.

Prof. Vlatko Ceric
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Tel: +38 41 231 111, Fax: +38 41 235 633.

BIBA
Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaften

The interdisciplinary research institute BIBA (Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaften) was founded in 1981. Its objectives are to conduct research in engineering and applied work science, and to transfer the results of recent scientific progress to local and regional industries. Nowadays BIBA has a staff of some 50 scientists, supported by 20 technical and administrative personnel and around 60 students. BIBA is particularly, but not exclusively, focussing on problems of one-of-a-kind production and human factors.

This year we established a simulation laboratory where several commercial and prototype discrete event simulation tools can be demonstrated. At the moment the shopfloor simulators Witness, Dosimis, and Simple, and a prototype Petri net based general simulation tool are available, other will follow. In periodic seminars the ideas and advantages of simulation are presented to visitors from local industry, and the tools are shown. Advice is given to those companies that are willing to inroduce simulation into their own organisation, but because only a minority of potential users are able to buy such tools and to employ or train a person to work with them, BIBA is also ready to carry out simulation studies. (By the way, the comparison of discrete event simulation tools in Eurosim News, comparison 2, has been initiated and will be evaluated by BIBA.) Research work in this area aims at the integration of shopfloor simulation with other planning tools, e.g. CAD systems for generation of plant layouts, tools to support the generation of control software etc.

Two other activities in the field of simulation, both originating from participation in European research projects (ESPRIT, BRITE), have boosted the international reputation to BIBA:

The first one produced the so-called C-BAT (Cost-Benefit Analysis Toolkit). This is a set of software tools used for the justification of CIM investments, especially for small and medium sized enterprises (SME's). This toolset is currently being further developed in two ESPRIT projects. It comprises a strategic, a technical, and a financial modelling and simulation tool, and is open to the integration of other tools like shopfloor simulators. The strategic tool, known as CRIMP (Cross-Impact Analysis Tool) supports the evaluation of CIM investment from a global point of view, taking into account such intangible, hard to measure benefits as customer's goodwill, workers' statisfaction, or flexibility. The technical modelling tool provides an analysis of the company's operation (planning, production, etc.) in terms of functions, their inputs and outputs, control, and resources. It allows the calculation of such important performance parameters as unit cost, throughput time, or capacity utilisation. The financial model then explores how the required investment will affect the firm's balance sheets.

The second activity resulted in a simulation tool for the visualisation and validation of NC-programs for multi-axis machines. It allows an interactive design of the simulation environment and a realistic representation of the machining process. It allows the user to test programs off-line and therefore facilitates quick generation of error-free programs at a low cost.

The term "simulation" is not defined very precisely. Sometimes even production planning and scheduling systems are named simulation systems because they anticipate the future somehow. BIBA is also active in the field of production planning and control, but these activities will not be discussed here.

When talking about simulation, one usually thinks of the model to be simulated as a piece of software. BIBA is going to offer yet another kind of simulation: a simulated company. When an enterprise is willing to reorganize their operations and to introduce computer based technologies, like CAD/CAM or PPS, they may wish to test their future environment (not only the software tools!) in order to examine real-life situations in a scenario as similar as possible to the one they are expecting. Therefore BIBA will create an artificial scenario in such a way that its users interact with this "model" in almost precisely the same way as will the future users of these new technologies within the real enterprise. This allows them to become acquainted beforehand not only with the software they will have to use, but also with the new organization structure as a whole. We call this service "*Trainingsbetrieb*" (training company), but it differs from other similar projects in that the simulated company is designed anew for every new user in order to let him experience not just any, but "his" organisation.

Finally it should be mentioned that BIBA is closely co-operating with many other European simulation Centres, among them are VTT (Espoo, Finland) and UCG (Galway, Ireland) which have been introduced in earlier issues of this journal.

J. Krauth
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Bremer Institut für Betriebstechnik und
angewandte Arbeitswissenschaft
Postfach 33 05 60
W - 2800 Bremen 33.

Simulation in the Computer Science Department at Manchester University

There are known to be many and varied simulation activities within the University engineering and other departments, together those occuring at UMIST, the Polytechnic and the nearby University of Salford.

There are currently two major activites in computer simulation in the Computer Science Department and this report is confined to those activities.

The first and largest of these activities concerns the use of simulation in electronics. There is work proceeding on the design and implementation of a mixed mode simulator, combining the discrete event needs of logic with the continuous requirements of analog circuits and systems. This is at an early stage and aims to improve on existing tools restricted to piecewise linear approximations of non-linear circuit functions, and other limitations. There is also work on hardware for accelerating digital simulation algorithms. Another project concerns the use of physical parts for functionality with surrounding software for timing and interfacing (hardware modelling). The latter is of special interest for ASICs where parts often arrive too soon for effective model development and in any case the manpower required may not be justified relative to the number of parts the design is used in. Of related interest is work on information models abstracted from language descriptions which separates the information from syntactic desciptions, for comparison between elements in different systems such as EDIF and GDS2 and subsets of VHDL and VERILOG.

The second area is that of environments for the design and simulation of systems built with elements from mixed application areas. For example, a distributed control system may be built with elements from control engineering, mechanical and chemical engineering, communications, DSP, register level logic, computer systems, software engineering, etc. Such a broad brush inevitably employs both discrete event and continuous simulation elements.

The current simulation system is written in the object oriented programming system C++, for both development and execution speed. It employs a graphical user interface whereby the user selects objects represented by icons to construct the system to be simulated from a library. These are placed on the screen and interconnected to form a system. After checking and intialisation, simulation runs may be performed under specified conditions, and the results stored for subsequent analysis, re-run, and archive. Of special interest are the use of parallel high performance accelerators, re-use of objects, modification of objects and the development of a suite of object bases and associated editors and browsers, permitting the user to examine and select suitable elements for his system in mixed area applications. Although examples of such systems already exist for specific areas such as hydraulics, control and DSP, they tend to lack flexibility, speed, user friendliness and versatility in some combination for mixed area applications. The alternative of starting again for each project with a simulation language (powerful and flexible though they are) is becoming less attractive. Although still at an early stage of development, it is anticipated that simulation systems of the type being researched in the group will form the backbone of many simulators in the future.

Dr. Richard N. Zobel, Department of Computer Science, University of Manchester, Manchester M13 9PL, U.K.

Discussion Forum

This section is intended to stimulate discussion between readers. We start with a letter that we received initiating a discussion on simulation results. Please formulate your opinion on this topic and send it to the author. Reactions that are of general interest will be summarized and published in the next issues. Furthermore we invite all readers to start another discussion by sending a letter to the editors.

Wanted: Unexpect Results

or: **Simulation or Common Sense: Who is right?**

Probably every practitioner in the field of simulation has already faced the following situation: He has modelled a system using a computer based simulation tool, and after running it he realizes that the results are completely different from what common sense would expect. Now what to do?

On one hand everybody knows that it is very easy to build erroneous models, but on the other hand the dynamic behaviour of complex systems is not easily understood by common sense, and at least unexperienced users are likely to make wrong predictions. In fact even experts do so, and this is the reason why simulation is used at all. Nevertheless, the conflict is there and requires a solution other than just to say "The computer always is right". What we need is a method to show where the error is. To our knowledge no formal procedure exists, so for the moment we have to learn by examples.

We would therefore invite readers to send us examples of cases where you have faced this situation, and how you have solved it. And we are insterested in both solutions: the simulation results were wrong, or the results expected by the user were wrong. (I do not say this implies the other part is right, it may as well be wrong, too). If we can find a number of good examples where simulation has proven the opinion even of experts wrong, we can use these examples to demonstrate the power of simulation and to create a wider market for it. The other examples may help us to improve further simulation practice, which may in the end also lead to an increased demand. So please share your experience; send a description of your model, the calculated and the expected results, and tell us how you have come to a conclusion. Please direct your answer to

J. Krauth, BIBA, Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaft, Postfach 33 05 60, W - 2800 Bremen 33.

IMACS

IMACS TC-2 on Mathematical Modelling

IMACS TC-2 will deal with all aspects of mathematical modelling of systems. Any type of system to be modelled mathematically will be considered no matter whether it is deterministic or stochastic, continuous or discrete, whether it is a lumped parameter or distributed parameter system etc. Consequently, a broad variety of mathematical models will be taken into account. Therefore, the term "mathematical model" will include classical models such as differential or difference equations, Markov processes, ARMA models etc. But also more recent approaches such as Bond graphs or Petri nets will be discussed. Moreover, it is rather well known that the type of model to be used depends strongly on the task to be performed. Hence, such topics will be included in the committee work as well as questions about model simplification etc.

Committee work will be performed mainly by organizing conferences (workshops, symposia) and special sessions during IMACS Congresses. Meetings of committee members will take place primarily during such conferences or during an IMACS Congress, inbetween work will be continued via mail.

As a first step in this direction, a symposium will be held in Spring 1993 in Vienna.

Experts in one or several of the above mentioned topics who are volunteering to take active part in TC-2 are invited to contact the chairperson of TC-2, i.e.

Prof.Dr. Inge Troch
Technische Universität Wien
Wiedner Hauptstraße 8-10
A-1040 Wien, Austria

Their letter should contain a short scientific curriculum vitae and indicate in which respect they want to contribute to the committee work. Especially, experts from Asia and America as well as experts in stochastic and non-classical modelling are welcome.

Report on the 13th IMACS World Congress on Computation and Applied Mathematics

During July 22-26, 1991 the 13th IMACS World Congress on Computation and Applied Mathematics was held at Trinity College, Dublin. It was a big event with about 1000 participants from all over the world. The scientific contributions were arranged in several subject areas each being formed of several technical sessions as indicated in the following:

1) Computational Mathematics: Approximation theory - Special functions - Numerical validation - Tools and languages for scientific computation - Error analysis - Wavelets - Numerical analysis - Generation of numerical code using symbolic manipulation - Maple - Dirichlet and Delaunay tesselations - Computational geometry and robotics - Numerical optimization - Optimization - Multivalued processes - etc.

2) Ordinary and partial differential equations: Parallel ODE and PDE solvers - Numerical solution of stiff IVPs - Numerical solution of TPBVPs - Stability properties of numerical methods - Symmetry methods - Simulation and identification of thermal systems - Numerical methods for boundary eigenvalue problems - Adaptive grids in CFD - Theory, environment and computation for inverse problems - Inverse problems in PDEs/parameter identifications - etc.

3) Computational fluid dynamics and wave propagation: Numerical methods for singularly perturbed equations - Nonlinear problems in diffusive reacting flows - Computational acoustics - Irrotational fluid dynamics - Recent advances in computational fluid dynamics - Computational aerodynamics - Multiscale transport in porous media - Numerical aerodynamics - etc.

4) Parallel computing: General - Parallel/vector iterative methods - Solution of PDEs on massively parallel MIMD systems - Parallel numerical computing - etc.

5) Concurrent and supercomputing: Supercomputers - Progress of dataflow computation - Neurocomputing techniques - Use of parallel architecture for vision applications - etc.

6) Computational physics / computational chemistry and evolutionary systems: Molecular simulation - Continuum modelling - Simulated annealing - Numerical simulation of kinetic problems - Computational methods in kinetic theory - Analytical and numerical aspects of nonlinear evolution equations - Chaotic behavior - Computational plasma physics - etc.

7) Artificial intelligence and expert systems: Intelligent system simulation methodology - Pattern recognition - Expert systems in mathematical modelling - Intelligent image processing systems- Scientific interfaces - etc.

8) Modelling and simulation in systems analysis, control systems and robotics: Mechanical applications - Bond graph theory - Stochastic systems modelling - Stochastic compartmental models in socio-ecological research - Scientific Computation in robotics - Modelling and scientific computation in control engineering - Control of thermal systems - Control of distributed parameter systems - Qualitative and fuzzy control - Lyapunov functions stability domains - Large-scale systems stability - Qualitative and stability analysis of neural networks - Control of robots and industrial processes - Simulation software and methodology - etc.

9) Intelligent systems in control and robotics: Intelligents systems in fault diagnosis - Neural network application to control problems - Intelligent systems in robotics - Parallel techniques and Petri nets - Advanced robotic control -

10) Modelling and simulation of biomedical systems: DNA, RNA and protein - Epidemiology - Cell biology and cancer - Neural networks - Compartmental analysis - Bioresearch methods - Computation in the development and use of medical systems - Modelling aids epidemics - etc.

11) Modelling and simulation for electrical, electronic and semiconductor devices: Modelling of electrical machines - Control of electrical machines - Electrical drives - Computational electromagnetics - Field computation in electrical engineering - 3-D computational electromagnetics - Numerical aspects of semiconductor and circuit simulation - Mathematical models for integrated circuits - Multidimensional numerical simulation of semiconductor devices - Semiconductor device modelling - etc.

12) Computation for management systems: Qualitative simulation - Artificial intelligence in production planning and scheduling - Control of economic systems - Dynamic modelling of oligopoly and related problems - Computational methods in economic decision making - Dynamic modelling and control of national economics - etc.

13) Applications of modelling and simulation: Mathematical modelling - Computational methods in composite structures - Finite element methods for plates and shells - Singularities in solid mechanics - etc.

14) Environmental systems simulation: Decision support tools - Modelling and simulation of distributed environmental systems - etc.

15) Software forum

16) Poster session

All contributed papers as well as the invited papers were published in the four volumes of the Congress Proceedings. Probably, some remainders will be available upon request from the congress organizer, i.e.

> Prof.Dr. Miller, Trinity College, 26 Temple Lane, Dublin 2, Ireland.

The Congress was a good forum for exchange of ideas and had only one serious drawback: There was only little possibility and space to meet people outside the lecture halls and moreover, there was - contrary to previous IMACS world congresses - practically no evening program where ALL participants could come together in an informal way and would have had an occasion to meet interesting people not belonging to their own area of scientific interest. It is to be hoped that such evenings will be arranged again at forthcoming events!

I.Troch, Vienna

SCS

The Society for Computer Simulation (SCS) celebrates in 1992 its fourtieth anniversary. This will be celebrated by some special events, on which more in later issues. In this issue we will concentrate on the forthcoming regular SCS events. New SCS publications can be found in the section "Book News".

1992 Simulation Multiconference Orlando, Florida, USA April 6-9, 1992

This year's Multiconference features subjects like: AI and Simulation, the 25th Annual Simulation Symposium, and Managing Risk with Computer Simulation.

For further information please contact:
Brian O'Neill, SCS, P.O.Box 17900, CA 92177 San Diego, USA. Tel: +1- 619-277 3888, Fax: +1-619-277 3930, E-Mail: Mcleod@sdsc.bitnet.

ESM 92, European Simulation Multiconference York, United Kingdom, June 1-3,1992

Organized and sponsored by SCS, co-sponsored by: UKSS, ESC, EUROSIM, CASS, JSST.

We invite papers for presentation at the conference and for publication in the Conference Proceedings on the following subjects:

Simulation Methodology and Practice, Simulation in Aerospace, Simulation in Society, Simulation of Electronic Circuits and Systems, Industrial Simulation and Simulators, Simulation in Energy.

Deadlines and Requirements: Extended abstracts: December 21st, 1991, Notification of authors: January 30th, 1992, Camera ready copies: April 1st, 1992.

For demonstrations, tutorials and exhibits inquiries please contact the SCS European Simulation Office.

Registration Fees: BF 15000 for authors and members of simualtion societies, and BF 17000 for participants preregistered before May 1st, 1992. Registration at the conference itself will be BF 17000 , and BF 19000 respectively. Students: BF 5000.

York is an ancient seat of English power and historical city par excellence. The official headquarters and venue for the 1992 ESM will be the The Royal York Hotel, Station Road, York YO2 2AA. United Kingdom. (Tel: +44-904 653681, Fax: +44-904 623503). This hotel recently renovated to its former Victorian glory will offer the conference participants an unforgettable experience of the medieval city of York.

For further information please contact Ph. Geril at the address below.

Summer Computer Simulation Conference 1992, Reno, Nevada, USA, July 27-30, 1992

The 1992 SCSC will cover the following subjects: Simulation Methodologies, Computer Systems Modelling, Simulation in Education, AI in Simulation, AIKBS in Simulation, Robotics and CAD/CAE/CAM, Simulators and Simulation Use in Training, Government, Management and Social Science, Physical/Chemical/Engineering Applications, Biomedical Sciences, Environmental Simulation, Communication and Radar, Missile Systems, Strategic Defense Initiative (SDI) Applications, Aerospace Simulation, Emergency Planning and Historical Perspectives.

Deadlines: Abstract Submission: November 22, 1991, Notification of Acceptance: January 15, 1992, Full Paper Submission: March 6, 1992

For further information please contact:
Mr.Brian O'Neill, SCS, P.O.Box 17900, CA 92177 San Diego, USA. Tel: +1- 619-277 3888, Fax: +1-619-277 3930, E-Mail: Mcleod@sdsc.bitnet.

SIMTEC'92, Simulation Technology Conference International, Houston, Texas, USA

For further information please contact: Tony Sava, IBM Corporation, 1602 W.Hedgecroft Drive, Seabrook, TX, USA. Tel: 713.532.1088

ESS 92 European Simulation Symposium (Simulation and AI in Computer Aided Techniques), hosted by the Dresden University of Technology, Dresden, FederalRepublic of Germany, November 6-8, 1992

Organized and sponsored by: SCS, co-sponsored by: ESC, EUROSIM, CASS, JSST .

Scientific Program; The 1992 (SCS) European Simulation Symposium will have as its main theme Simulation and AI in Computer Aided Techniques. We invite contributions (full papers (30mins), short papers (20 mins), posters and practical demonstrations of tools), papers for presentation at the conference and for publication as full papers in the Conference Proceedings, and for publication as short papers in the Conference Handout, on the following topics:

New Modelling Concepts and Distributed Techniques, Integrated Product- and Process Modelling, Simulation and Optimization, Artificial Intelligence in Simulation, Simulation Research in the USSR.

Invited Papers by Dr. Ronald Mackay, Prof. Dr. L.F. McGinnis, Prof. Dr.-Ing. h.c. H. Grabowski, Prof. Dr. Ramana Reddy.

Deadlines and requirements: Extended abstracts: March 1st, 1992, Notification of authors: April 30th, 1992, Camera ready copies: July 31st, 1992.

For demonstrations, tutorials and exhibits inquiries please contact the SCS European Simulation Office.

Companies which have already shown an interest in exhibiting are Siemens, Nixdorf, CDC, IBM, Nestler GmbH, Simplex II, Breilmann, D-Plan Erlangen, Schlumberger and ISOMAC.

Registration Fees: BF 20000 for authors and members of simulation societies and BF 25000 for participants preregistered before July 31st, 1992. Registration at the conference itself will be BF 25000, and BF 27000 respectively. Students: BF 5000.

Dresden is one of the most important historical towns in Saxony, which took unfortunately centre stage in the course of the Second World War as the most devastated German city. The official headquarters and venue for the 1992 ESS will be the The Haus der Kultur und Bildung GmbH, Postfach 433, D-8012 Dresden, Germany (Tel: +37.51.4.84.50). Accommodation for participants will be available in the Hotel accross the road.

The Symposium will be immediately followed by the 8th Prague Symposium on Computer Simulation in Biology and Medicine. The transfer from Dresden to Prague will be organized within the social programme of the Dresden Symposium on November 8. For further information on the Symposium in Prague please contact Dr.Frantisek Hauser.

For more information about SCS please contact:

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Book News

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

New Publications from SCS

Object Oriented Simulation 1991, Edited by Raymond K.Ege: Object-Oriented methodologies and programming languages are becoming increasingly important in software engineering in general and in simulation in particular. This volume presents papers which explore the important role object-oriented design has assumed in such areas as discrete-event simulation, distributed simulation, graphical interfaces for simulation and knowledge simulation. (January 1991, Hardbound 220pp, $60 for non-members, $30 for SCS members)

Simulation in Business and Management, Edited by Jay Weinroth and Joe E.Hiller: The papers in this volume provide samples of the great amount of simulation work going on in the support of organizational management and entrepreneurial decision making. Included are a wide variety of applications from strategies for effective involvement of users to highly sophisticated programming approaches. (January 1991, Hardbound 250pp, $60 for non-members, $30 for SCS members)

Simulation in Engineering Education, Edited by Alfred Jones, Mark C.Ma and Hamid Vakilzadian: Mathematical modelling and computer simulation have been major tools in both research and teaching for different disciplines of engineering. The papers in this volume cover a broad variety of topics in engineering education including recent developments in AI and Object-Oriented programming that have matured for the educational simulation environment. (January 1991, Softbound 123pp, $40 for non-members, $20 for SCS members)

Toward Understanding the Environment, Edited by John McLeod: The motivation for solliciting, scheduling

for conference presentations, and publishing these papers is a firm belief that if our much publicized environmental problems are to be alleviated it will help if we understand better the systems in which problems are embedded, and furthermore, that computer modelling and simulation are powerful tools for developing understanding. (April 1991, Softbound 107pp, $40 for non-members, $20 for SCS members).

Modelling on Micros and Workstations 1991, Edited by Thomas A.Rathburn: Now in its tenth edition, this volume continues to explore the evolution of simulation using increasingly sophisticated hardware. A major portion of this conference is devoted to using workstations to perform simulations formerly relegated only to large mainframes. (January 1991, 200pp, $48 for non-members, $24 for SCS members).

Simulation in Emergency Management and Engineering, Edited by Jim Sullivan and Ben Clymer; Simulation in Healthcare, Edited by James G.Anderson: In one volume, this book contains current applications of emergency simulation for training, planning, and mitigation, as well as computer simulation for health care planners. Both sections of this book offer substantial work in fields that are rapidly becoming important areas for simulation work. (January 1991, Softbound 269pp, $48 for non-members, $24 for SCS members).

Artificial Intelligence and Simulation, Edited by Ranjeet J.Uttamsingh and A.Martin Wildberger: The papers in this volume describe applications which range over science, engineering, industry, with a special emphasis on manufacturing and agriculture. A number of hardware and software tools are also presented, both general purpose, and specialized to particular applications. The representation of knowledge is of major concern in all AI work. The emphasis in this volume is on its relations to the modeling of data and the interconnections between knowledge bases and data bases. (April 1991, Hardbound 161pp, $48 for non-members and $24 for SCS members)

Conference Proceedings: *Advances in Parallel and Distributed Simulation*, 1991 Edited by Vijay Madisetti, David Nicol and Richard Fujimoto; *1991 Summer Computer Simulation Conference Proceedings*, Edited by Dale Pace; *Ballistics Simulation II*, Edited by Michael J.Chinni; *24th Annual Simulation Symposium*, Edited by Ben Pinkowski; *Building Simulation 91 IBPSA Publication*, Edited by J.A.Clarke, J.W.Mitchell and R.C.Van de Perre; *Simulators VIII*, Edited by Ariel Sharon; *Modelling and Simulation 1991*, Edited by Erik Mosekilde.

Industry News

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

dSPACE GmbH specializes in digital signal processor (DSP) based hardware/software tools for high-speed real-time applications in control and hardware-in-the-loop simulation.

A single DSP, programmed in the C language, outperformed a 25 MHz 80386/387 (with cache) combination by a factor of over 120 in a vehicle simulation for ABS test and development. Parallelization provides even more computational power.

The PC/AT format processor boards are complemented by a versatile line of high-performance peripherals boards, satisfying every need for interfacing to mechanical or electronic hardware, which is to be connected to the simulated model.

Software tools to smoothen and automate the transition from the model to the experiment as well as interfaces to MATLAB and MATRIXx are available.

dSPACE is represented in various European countries, USA and Japan.

dSPACE GmbH, An der Schönen Aussicht 2, W - 4790 Paderborn, Germany, Tel: +49-(0)5251 1638-0 Fax: +49-(0)5251 66529.

ProModel, the market leading manufacturing simulation system in the USA, is now available in Europe. ProModel is used by many of the world's leading companies to model all types of production and material handling facilities. Pro Model's engineer-friendly approach to model building, flexibility and price makes it ideal for engineers who need results quickly.

ProModel has an Automatic Model Build facility to speed up model construction, statistical tabular and graphical reports produced automatically for easy interpretation, unique Schedule optimization feature for production planning and scheduling, and Multiple replication summary reports for running different model configurations. These provide extra statistical information including confidence intervals to show the effect of different scenarios on the simulation results.

ProModel is marketed in Europe by Production Modeling Corporation Of Europe (PMCE), from their UK headquarters. PMCE are actively seeking to appoint distributors for ProModel in Europe, who will provide marketing, support and training services locally. Companies interested in becoming ProModel distributors or who wish to find out more about ProModel should contact PMCE at the address below.

Production Modeling Corporation Of Europe, Barclays Venture Centre, University Of Warwick Science Park, Sir William Lyons Road, Coventry CV4 7EZ, England. Tel: +44-(0)203 693485, Fax: +44-(0)203 410156.

EUROSIM - Simulation News Europe started a series on comparisons of simulation software. Based on simple, easily comprehensible models special features of modelling and experimentation within simulation languages, also with respect to an application area, shall be compared.

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

In the future we plan to present a new comparison in the March and in the November issue each year. If you have an idea for a model to be compared in different simulation languages please contact the editors.

We invite all institutes and companies developing or distributing simulation software to participate in this comparison. Solutions of comparisons 1, 2 and 3 described in the previous issues will still be published.

Please, simulate the model(s) and send a report to the editors in the following form (on diskette, any word processing format):

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

Comparison 4: Dining Philosophers Problem

In this issue we introduce a more sophisticated software comparison. It is a discrete one, but there exist different approaches for modelling, analyzing and simulating the process under investigation.

In the old times there lived people, who had time to think over principles of the world, who were wise and who consequently influenced politics and morality and daily affairs: the philosophers. They had a lot of experience, they did not depend on trivial needs like women, money, friends, etc.

Usually they spent day and night together, discussing problems and trying to solve them. Sometimes they thought over problems without any discussion, they were meditating - and they forgot the world around.

But there is one thing they depended on: they had to eat sometimes a little (because thinking is a hard job, and it takes more energy to think over a complicated problem and to solve it than digging a hole through the earth ball from Austria to Australia). The philosophers usually ate simple food, because they were not longing for more, and they gave away all the money they earned in their lives in order not to be dependent on anything - so they were poor.

But eating sometimes caused big problems, and it is said in the old tales that a group of philosophers was starving - although they had full plates.

In order to become aware of this phenomenon, one has to know a little bit about the habits of philosophers. They usually meet in groups of five sitting around a large round table. Supposing they are Chinese philosophers with a bowl of Chinese food in front of them they are able to start eating whenever they want to with their bowl being filled frequently. But being poor they have only five chopsticks lying left to the bowls - and for eating Chinese food one needs two chopsticks (figure 1).

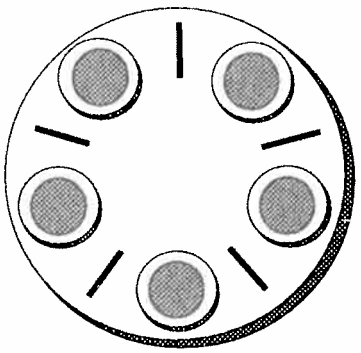


Figure 1: Philosopher's table

If a philosopher is hungry now, he first takes the chopstick to his left, then the chopstick to his right and he starts eating. Then he puts the chopsticks back on the table and starts thinking or meditating again.

It may now happen that every philosopher becomes hungry at the same time, and the five philosophers simultaneously take the left chopstick (when they are meditating, they forget the world around and so they do not become aware of the impending difficult situation), and then they try to take the chopstick at their right - but there is none. Their inflexible behaviour would cause them to starve. And that happened - according to the old tales.

In order to help the philosophers, one could now build up a model of their behaviour and could develop strategies in order to prevent them from starving, etc. The question is whether a philosopher would permit modelling and simulation as an appropriate problem solving tool: is it allowed to use models for gaining new knowledge? Some philosophers affirm this (e.g. Jaques in /1/).

By the way, this dining philosophers problems was first investigated by Dijkstra (/2/) and demonstrates the situation of parallel processes in a computer system which have to share resources - so the problem is not only sophisticated, it is more than relevant.

The problem of the dining philosophers is frequently discussed in the literature (e.g. /2/, /3/, /4/).

One approach to the problem is a description with Petri nets (/3/, figure 2). This approach allows an analytical investigation of the process. The following figure shows one possible Petri net model: Each philosopher may be represented by two places (M_i and E_i) representing the meditating and eating state, resp. Places C_i represent the chopsticks. In order to move from the meditating state to the eating state, both chopsticks (the one at the left and the one at the right)

must be available for a philosopher. It depends on the initial marking of the places, whether the problem is solved or causes a deadlock situation. In fig. 2 one philosopher is eating (indicated by a token residing in the place E_1), and the others are meditating (indicated by tokens in the places M_i $(i=2,3,4,5)$ so that three chopsticks are free (indicated by tokens in the places C_2, C_3 and C_4). After having finished eating one neighbour may start eating as well as a philosopher who is not neighbouring one of them. Of course exact firing rules have to be defined.

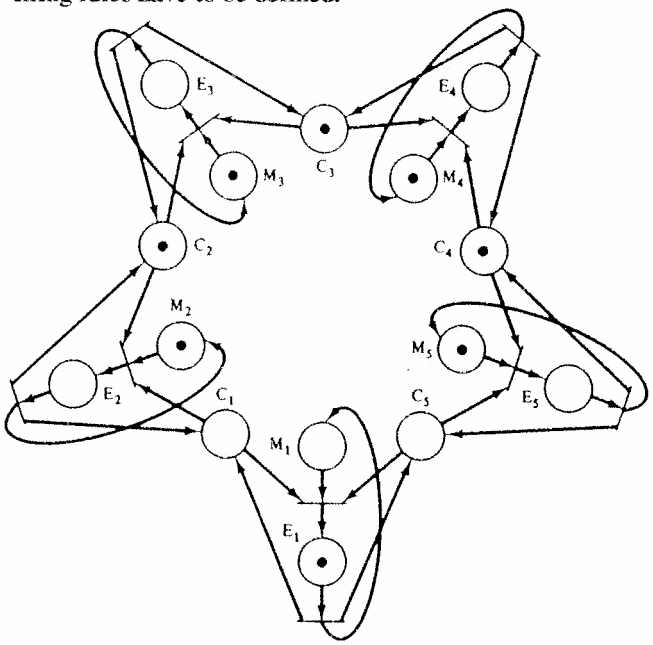


Figure 2: Petri net approach

Another approach is the simulation of the model in the time domain, for instance on the basis of process description or on the basis of delayed Petri nets. Once again the processes may be eating, meditating, etc.

Simulationist (especially 'discrete' ones) are invited to model and analyze and/or simulate the dining philosophers problem with the software tool of their choice - either on the basis of network analysis or on the basis of process (or event-) orientated simulation or on the basis of a mixed software tool. In contrary to the previous comparisons no fixed taks are asked to be solved or investigated. In order to assure comparable results only certain rules should be obeyed in refining the model within four steps (/4/):

a) First basis of the investigations is the Petri net model in fig.2., with the forementioned assumptions. In case of simulation suitable random time delays for the processes and initial conditions should be fixed.

b) For a first refinement a third philosopher's status "hungry" is to be introduced.

c) If a philosopher gives back the chopsticks, they are available, but they are dirty. So a cleaning process is to be introduced.

d) The philosophers should be able to communicate with their neighbours, if they are very hungry (request token).

For experimentation at least two situations should be considered:

1) Two basic situations (experimental conditions) should be investigated: 1.1) normal conditions (no conflicts, no deadlocks), 1.2) deadlock (starving)

2) Although the philosophers are wise, it is a situation involving human behaviour. One or two (or three) philosophers could make a conspiracy against the others (against one, two or three) to let them starve. Different strategies should be implemented.

Please feel free to analyze and/or simulate other interesting situations or to invent tricky strategies for whatever purpose (e.g. 'friendly' strategies in order to prevent from starving) or to use different software tools (analysis and simulation). We would also be glad to receive demonstration disks (with animation), which will be offerd to interested readers on request.

Hoping not to interfere with your Christmas holidays we ask you to take the challenge of this sophisticated comparison. It seems to be an appropriate problem suiting the season.

The EUROSIM - Simulation News Europe Editors.

References

/1/ Shakespeare W. The Globe Illustrated Shakespeare. Ed.H.Staunton (1810-1874). Edition 1983, Greenwich House, Inc., New York; p.894, 2nd column, lines 39-40.

/2/ Dijkstra E. 'Cooperating sequential processes' in F. Genuys (ed.), 'Programming Languages', New York: Academic Press, New York (1968), p. 43-112.

/3/ Peterson J.L. Petri Net Theory and the Modelling of Systems. Englewood Cliffs: Prentice-Hall (1981), ch.3.4 Computer Software.

/4/ Chandy K.M., Misra J.: Parallel Program Design - A Foundation. Edison Wesley (1988), chapter 12.

Giorgio Savastano Award

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

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

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

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

Prof. Franco Maceri, Dipartimento di Ingegneria Civile, Università di Roma "Tor Vergata", Via della Ricerca Scientifica, 1 - 00173 Roma, Italy

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

Comparison 1 - 386-MATLAB

MATLAB is a C-based general tool for mathematical and engineering calculations with limited capabilities for simulation of non-linear equation systems. Versions are available for PCs, workstations and mainframes.

Model Description: The model may be transformed to the vector/matrix equation

$$\frac{dx}{dt} = Ax + Bu \qquad \text{with } x^t = [r,m,f],\ u^t = [mf,f^2,p] \text{ and}$$

$$A = \begin{bmatrix} -d_r & 0 & 0 \\ d_r & -d_m & 0 \\ d_r & 2d_m & -l_f \end{bmatrix} \quad B = \begin{bmatrix} k_r & 0 & 0 \\ -k_r & k_f & 0 \\ -k_r & -2k_f & 1 \end{bmatrix}$$

and it is implemented in the following m-file:

```
function xs = lcdueb1(x)
p = par(1,7);
A = par(1:3,1:3);
B = par(1:3,4:6);
u = [x(2)*x(3) ; x(3)^2; p] ;
xs= A*x + B*u;
```

Results: All calculations were done on an IBM PS/S Model 80 (80386 processor with an 80387 numeric coprocessor) using 386-MATLAB. MATLAB contains two variable step integration routines based on the Runge-Kutta method: ODE23 and ODE45.

The routines as supplied result in the message 'SINGULARITY LIKELY' because of a too large initial Δt (one hundredth of $t_{final}-t_{start}$). This is corrected using the approach shown in the following instructions:

```
% First integrate using the ODE23 routine.
t0 = 0;
tf = 0;
dt = 0.1;
x0 = [9.975 1.674 84.99]';
ts = clock;
tol= 1.0e-4;
tra= 1; % Trace the integration on the screen.
while tf <= 10.0,
        t0 = tf ;
        tf  = t0 + dt ;
        if t0 > 0.01, tf = t0 + 9*dt; end
        if t0 > 0.99, tf = t0 + 10*dt; end
        diary off;
        [t,x1] = ode23('lcdueb1',t0,tf,x0,tol,tra);
        diary on;
        axis([-4 1 -3 2]);
        loglog(t,x1),...
        title('Lithium Cluster Dynamics under Electron Bombardement'),...
        xlabel(time, s'),ylabel('Cluster Concentrations'),...
        pause(10),hold on;
        x0 = x1(length(x1),:)';
        clear t x1;
end;
el = etime(clock,ts)
```

From table 1 it is evident, that 386-MATLAB is not a time efficient simulation tool, even though it does get the task done with high accuracy.

Simulations were also performed for five logarithmically spaced values of l_f from 100 to 10000. The results are shown in figure 1 as a double logarithmic plot of f versus t. This task was performed overnight and lasted 13,970 seconds including plotting.

Integration Method	File Type	Elapsed Time	Tolerance
ODE23	MEX-file	739s	10^{-4}
ODE45	MEX-file	563s	10^{-5}
ODE45	MEX-file	752s	10^{-6}
ODE45	MEX-file	579s	10^{-7}

Table 1: Comparison of simulation times for task a. The elapsed time includes display of t, Δt and x on the screen every integration interval, and for the first and second also plotting of the results on the screen.

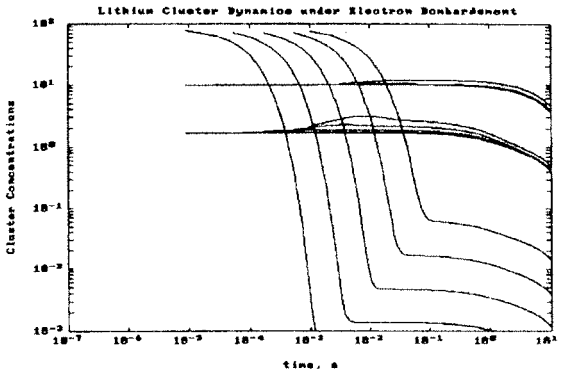


Fig. 1: r, m and f as a function of time for different values of l_f

The steady states for l_f = 1000 and two values of p are shown in table 2. The results were obtained with the following MATLAB instructions:

```
% Now calculate the steady states for two different values of p.
details = zeros(16,1);

details(1,1) = 2; % Collect statistical information on the solution.
% First solve for p = 0 - the trivial solution satisfies this case.
fpar(1,7)=0;
ts=clock;
[x1,termcode] = njfsolve('lcdueb2',[1 1 1]',details,fpar)
e6=etime(clock,ts)
% Then for p = 10000.
fpar(1,7)=10000;
ts=clock;
[x2,termcode] = njfsolve('lcdueb2',[1 1 1]',details,fpar)
e7=etime(clock,ts)
```

Inspection of the model reveals, that for p = 0 the origin is a solution to the steady state problem. The iterative solution of the steady state equations in this case gave better results and was much faster.

p_c	r_{ss}	m_{ss}	f_{ss}
0	≈0	≈0	≈0
10000	1000	10	10

Table 2: Calculation of steady states for different bombardement rates

Conclusion: Even though the problem could be solved using MATLAB the simulations took a large amount of time and several tricks were needed to work around array size limitation, especially using PC-MATLAB. However, a special simulation tool called SIMULAB has been developed with good interfaces to MATLAB. Both MATLAB and SIMULAB are developed by The MathWorks, Inc., and MATLAB has become the defacto standard for many applications within control engineering and signal processing.

Niels Jensen The PDDC Group, Department of Chemical Engineering, Technical University of Denmark; Lyngby, Denmark

Comparison 1 - SIMULAB

SIMULAB is a general purpose nonlinear dynamic simulation package which has been written as an extension to the widely used MATLAB software for scientific and engineering, numerical calculations. It is available to run under X-Windows on a wide range of Workstations, on Macintosh and will shortly be released for 386 PCs.

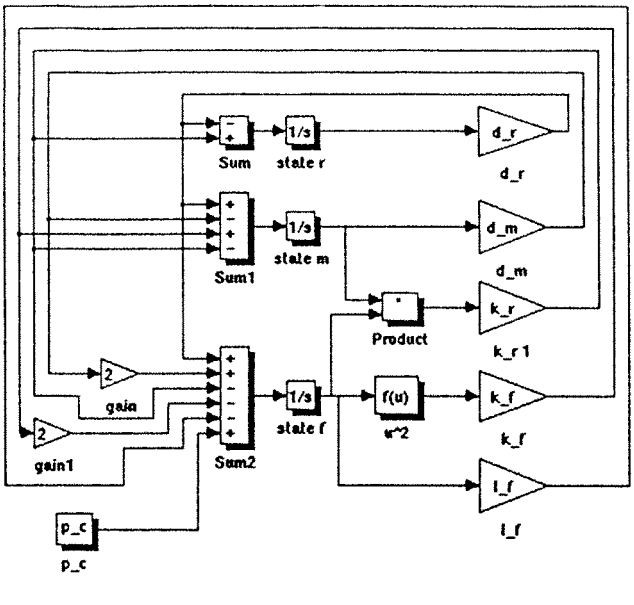
SIMULAB and MATLAB together provide a complete environment for both model development and simulation. Models may be developed in a block diagram window or as a file containing differential and algebraic equations, or using a combination of these two approaches. A block diagram model can be constructed within the menu and mouse driven environment by selecting and connecting up blocks from the standard libraries. If the required block is not in the SIMULAB library then it is usually an easy task to either customise an existing block or design a completely new one.

The menu driven interface generally provides the most rapid route for prototyping and model development but when traceability is important or for complex simulation runs, any of the menu or mouse commands may be run instead from the MATLAB command line or from a command file.

Flexibility and extendability are key features of the package, by using MATLAB function files, the user can automate simulation runs or even write new integration or analysis functions. All models are stored as text files allowing them to be easily transferred between different machine architectures and apart from available virtual memory, there is no limit to model size or complexity.

Model Description

The following figure shows a block diagram description of the Lithium-cluster model as implemented in SIMULAB. The parameter values are stored in the MATLAB workspace allowing successive simulation runs with varying parameter values to be performed with ease.



LIthium-cluster dynamics
under electron bombardment

Results

All calculations were performed on a Sun 4 Workstation running under X-Windows.

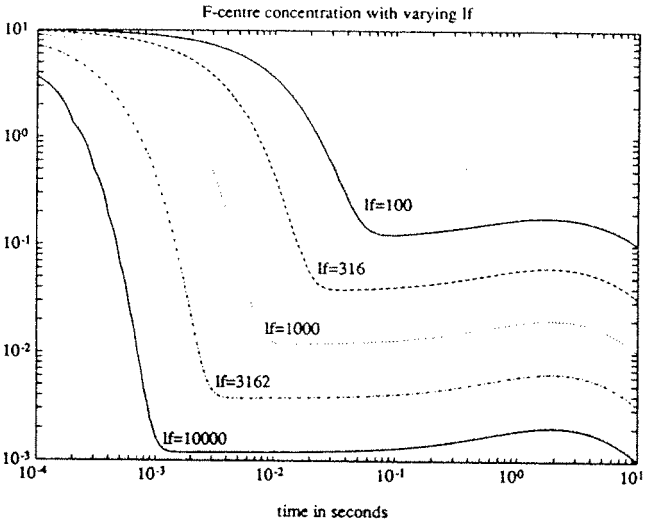
Comparison of computer time (task a)

Simulation runs with the various integration algorithms were all performed with variable step length algorithms, a relative error tolerance of 1e-3 and the minimum and maximum allowed step lengths set to 0.0001 and 1 seconds respectively. The table gives the simulation time for each method as well as the number of integration steps required to achieve the specified tolerance. The Linsim method is one which extracts the linear dynamics of a system leaving only the nonlinear dynamics to be simulated. This method is extremely efficient when the system to be simulated is linear or nearly linear.

Integration method	number of integration steps	computation time in seconds
RK fifth order	2732	10.40
Gear	47	0.37
Linsim	87	0.19
Adams	7363	45.80

Parameter variation of l_f (task b)

The system was simulated over 10 seconds with values of l_f equal to 100, 316, 1000, 3162 and 10000. The following shows a plot with a logarithmic scale on both axes of the variation of the concentration of F-centres against time.



Calculation of steady state (task c)

SIMULAB provides a trim function which allows rapid and straightforward calculation of the steady state. The following command returns the equilibrium value of the state vector x (as well as values of inputs, outputs and state derivatives)

```
[x u y dx] = trim('lithium_model')
```

The values for the individual states are:

p	r	m	f
1e4	1000	10	10
0	0	0	0

David Maclay, IAS Cambridge Control, Jeffereys Building, Cowley Road, Cambridge CB4 4WS, England. Tel: +44 (0)223 420722.

Comparison 1 - DYNAST

About DYNAST

DYNAST is a package for solving sets of nonlinear implicit-form algebro-differential equations as well as for analysis of block and/or port diagrams, which can be submitted also in a graphical form.

The advantage of the port diagrams stems from the fact that their structure corresponds directly to the structure of the modeled real dynamic systems. Models of fairly complex systems can be set up from submodels of real components stored in DYNAST submodel libraries in a kit-like way.

No compilation of problem specification is required and any algebraic loops in the diagrams make no problems. For linear or automatically linearized diagrams, DYNAST provides also frequency analysis and yields both the time- and frequency-domain results in a semi-symbolic form.

The IBM PC version is supported by a graphical user interface and documentation environment based on OrCAD, AutoCAD and TeX systems. There are DYNAST versions for eight-bit CP/M computers, minicomputers and mainframes.

DYNAST has been around for about six years and it is used already by numerous academic as well as industrial institutions for applications ranging from design problems in various engineering disciplines up to medicine diagnostics and economic predictions.

DYNAST is distributed by DYN, Nad lesikem 27, CS-160 00 Prague 6, CSFR, Tel: +42-2-311 79 04.

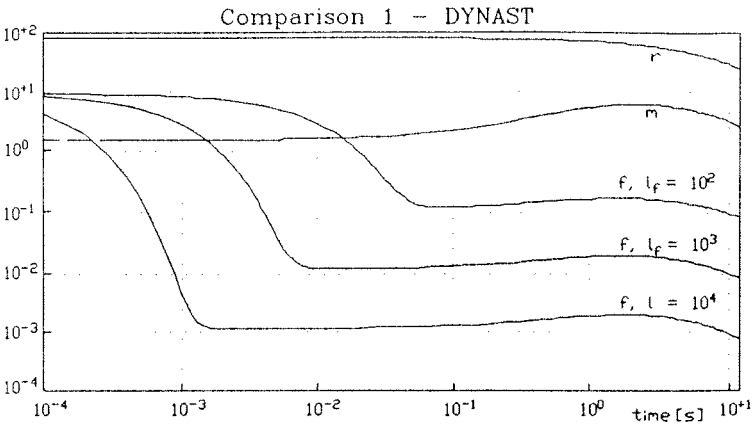
Results

All the tasks of the comparison 1 problem can be solved in one DYNAST run when specifying them by the following input data:

```
*SYSTEM; *: EUROSIM Comparison 1
kr = 1; kf = .1; lf = 1000; dr = .1; dm = 1; p = 0;
SYSVAR r, m, f;
0 = - VD.r - dr*r + kr*m*f;
0 = - VD.m + dr*r - dm*m + kf*f**2 - kr*m*f;
0 = - VD.f + dr*r + 2*dm*m - kr*m*f - 2*kf*f**2 - lf*f + p;
*TR; TR 0 12;                    :transient analysis for 0 < t < 12
INIT f = 9.975, m = 1.674, r = 84.99;
PRINT r, m, f; RUN eps = 1E-6;
MODIFY lf = 1E2;
INIT f = 9.975, m = 1.674, r = 84.99; RUN eps = 1E-6;
MODIFY lf = 1E4;
INIT f = 9.975, m = 1.674, r = 84.99; RUN eps = 1E-6;
RESET;
DC; PRINT r, m, f;               :steady-state analysis
MODIFY lf = 1E3; RUN;
MODIFY p  = 1E4; RUN; *END;
```

The following plot displays results obtained for the tasks a) and b).

The problem was solved on an IBM AT/386-387 of Norton computing index 30.1 using DYNAST version running both with and without numeric coprocessor.



The transient as well as the steady-state solutions were computed using the same algorithm, which is based on the combination of Gear's and Newton-Raphson's methods modified by Rubner-Petersen.

The task a) was solved in the time interval $0 < t < 12$s for two different values of the permissible relative truncation error: 1E-3 (default value) and 1E-6 (see the input data). In the former case the solution took 60 integration steps (0 of them rejected) and 66 iterations. The computation required 2.25s of CPU time. The last solution vector (at t = 12s) was:

r = 2.60340E+01 m = 2.85984E+00 f = 8.30013E-04

The latter, enhanced accuracy solution took 120 integration steps (3 were rejected) and 141 iterations. After CPU time of 4.45s the last solution vector was:

r = 2.60517E+01 m = 2.86178E+00 f = 8.30576E-03

All the computations were done with the default initial steplength equal to 1E-5 times the specified interval of time. Any decrease of this value did not have any effect on the final solution vector. The solution of task c) took just one iteration and required 0.16s of CPU time for p = 0. It resulted in the vector

r = 0.00000E+00 m = 0.00000E+00 f = 0.00000E+00

For p = 1E4 it took 3 iterations and 0.06s of CPU time only (no resetting of input data was necessary in this case). The result was:

r = 1.00000E+03 m = 1.00000E+01 f = 1.00000E+01

To verify the steady-state analysis results, the differential equations were solved with the permissible error 1E-6 in the interval $0 < t < 2000$s for p = 0 as well as for p = 1E4. The last solution vectors were

r = 3.05780E-14 m = 3.39755E-15 f = 9.85388E-18

and

r = 1.00000E+03 m = 1.00000E+01 f = 1.00000E+01

respectively. The former case statistics was 123 steps, 140 iterations and 8.24s. The latter case asked for 81 steps, 83 iterations and 5.87s.

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Comparison 1 - PROSIGN

PROSIGN (Process Design) is a software package designed for the simulation of continuous and discrete time nonlinear systems with a free number of inputs and outputs.

Modelling may be carried out in three different ways:

- graphically- -block oriented
  (based on the Standard-Library)
- graphically- - component oriented
  (based on libraries like Mechanic, Electric, ...)
- textual - equation oriented
  (based on PSL, the PROSIGN Simulation Language)

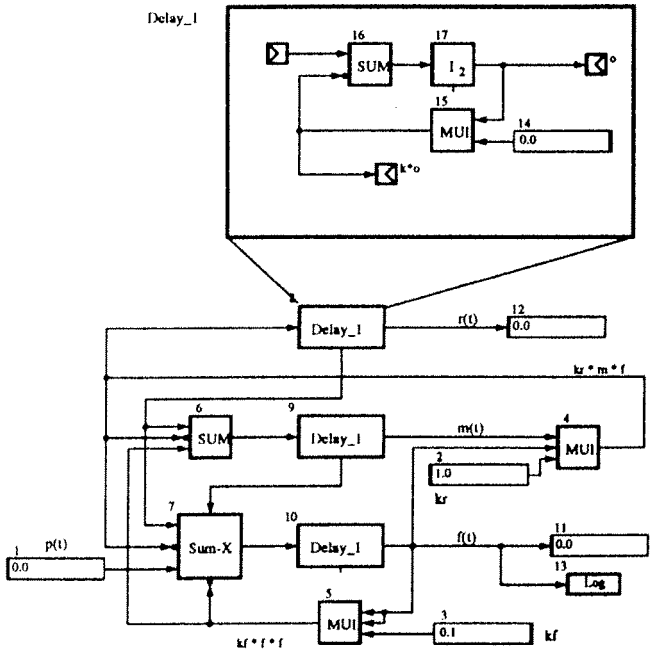
Since all methods can be combined, the use needn't choose one method. Using PROSIGN, modelling is always done in that way which is most time saving and most obvious with respect to the simulation problem to be solved.

PROSIGN works with fixed or variable step size, alternatively. In the variable case the calculations are performed with a userdefinable degree of accuracy.

A special feature of PROSIGN is the code generator producing Modula-2, Fortran or C codes.

Model description

The Lithium-Cluster model is built with elements taken from the PROSIGN standard library. The resulting block diagram is shown in the following figure:



Results

a) Computing Time:

Computing time depends on the integration method and the step size control. PROSIGN offers 8 methods of different orders which may be used with fixed or variable step size.

Here the variable case is chosen. The computing time for a 10 seconds simulation time is shown for 2 integration methods in the table below:

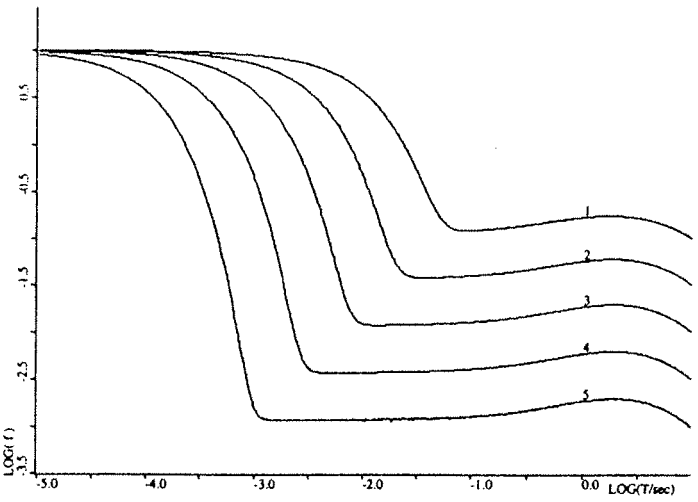
Algorithm	max. step size	computing time (sec)
2nd order (Simpson)	0.001	470
4th order (Adams-Bashforth)	0.0025	204

The generated Fortran program reduces the simulation time to 40 sec using the fixed step size 0.0005 sec in conjunction with the Simpson integration method.

b) Variation of Parameter l_f:

The following figure presents the results of the F-centre concentration against time.

Curve	lf
1	100
2	316.2
3	1000
4	3162
5	10000



c) Steady states:

The steady state values directly result from a PROSIGN steady state model. They are summarized in the following table:

p	r	m	f
0	0	0	0
10000	1000	10	10

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Comparison 2 - Micro Saint

Micro Saint is a full-featured, discrete event simulation software tool that includes iconic animation. It is designed to simulate any type of process that consists primarily of discrete activities (e.g., manufacturing systems, service systems, human-machine systems), although it includes features for limited continuous modeling. In Micro Saint, users interact with menus or graphical interface elements such as windows and dialog boxes to create their models (which are compiled automatically during model execution).

The activity network for the FAS model includes 51 activities in all, 24 of which are in subnetworks. Figure 1 shows the Micro Saint user interface and diagrams for the main network and the A1 subnetwork. The queues at the reentry points in the main network are sorted to ensure that reentering parts have priority, while the subnetwork queues representing waiting lines for each station are designated as First In, First Out (FIFO).

The constraints, timing, effects, and routing logic for each activity (or "task") are defined by expressions and menu choices.

Assumptions made in building the model

- The buffers in front of each station function as FIFO queues, with buffer length limiting queue size according to the following formula: buffer length/pallet length = max queue size
- A pallet moving along conveyer belt B1 can be paused momentarily if it reaches an Sy station at the same time as a pallet switching over from a B2 belt, which has priority.
- Station A6 emulates A3 if A3 is needed, otherwise A4 if A4 is needed, otherwise A5.
- The operation at station A1 is either loading or unloading, each of which takes 15 seconds.

The last assumption in the preceding list is not one we felt entirely comfortable with, since it makes A1 into a bottleneck station, but it seemed the most reasonable interpretation of the information provided (i.e., "Unprocessed parts are put on pallets in A1," "Finished parts are unloaded in A1," and the 15-second operation time for A1).

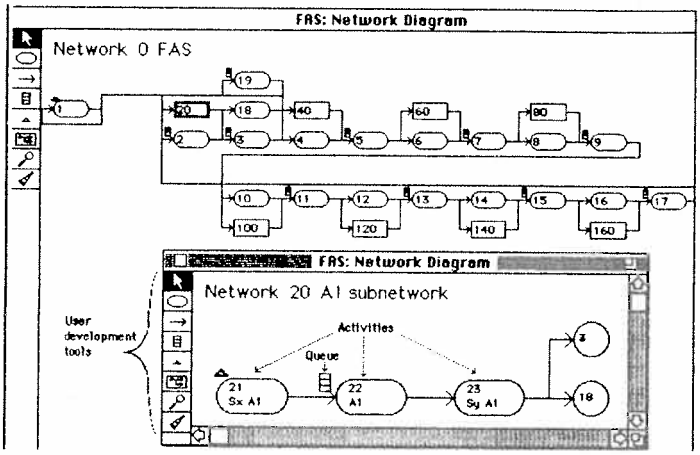
Results of running the model with 20, 40, and 60 pallets

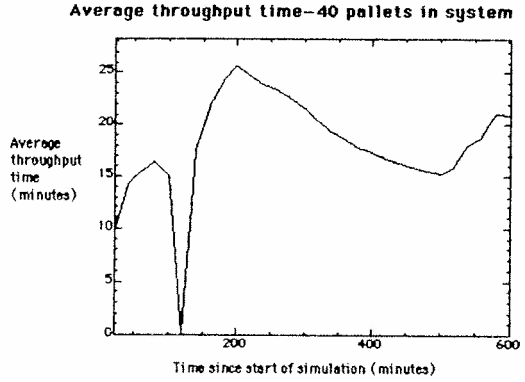
- Throughput stayed the same (2 parts output per minute) in all cases because task A1 (the entry and exit point, according to our assumption) acts as a bottleneck. Task A1 takes 15 seconds, so 4 parts can go through A1 every minute. Because a new part comes in through A1 for every part that leaves through A1, 2 of the 4 parts are coming in and 2 are going out.
- Average throughput time per part between the 120th and 600th minute increases when more parts are added to the system, as follows: 10.05 minutes for 20 parts in the system; 20.97 minutes for 40 parts; and 30.38 minutes for 60 parts.

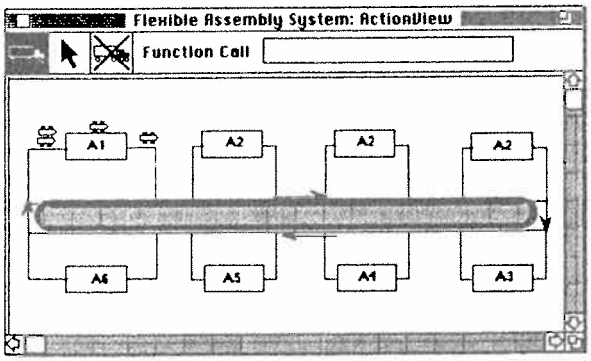
The graph in Figure 2, generated in Micro Saint, shows how average throughput time changed over the course of the simulation with 40 pallets in the system. The dip at time 120 occurs because the values used to calculate the average were zeroed at that point.

Development and execution times

- The model required 14 hours to design and develop and 11 hours to debug, generate graphs, and analyze data. We also spent 8 hours developing an iconic animation of the model for demonstration purposes (shown in Figure 3), but this animation was not necessary for data gathering or analysis.
- The model execution time varied depending upon the number of parts in the system. With 20 parts in the system, the model executed in 6 minutes on an i486 IBM PC compatible operating at 33 Mhz. With 60 parts in the system the model executed in 19 minutes on the same computer.







For information or comments, please phone or fax or write to: *Karen Ohlson or Ron Laughery, Micro Analysis and Design, 3300 Mitchell Lane, Suite 175, Boulder, CO 80301, USA. Tel: +1(303) 442-6947; Fax:+1(303) 442-8274*

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Comparison 2 - SIMUL_R

1. The Language

SIMUL_R is a compiling simulation language for continuous and discrete systems, the discrete part is called PROSIMUL_R. The system offers graphical and textual modelling, using one or more models in one simulation program. Examinations are done by using menus and/or a strong runtime interpreter.

The interpreter allows the usage of loops, command files (recursive, too) and arbitrary expressions with assignments and displaying. A special feature are user defined functions which enable the user to add new commands to the system (commands for steady state, zero search, continuous and discrete optimization, statistical evaluations are available as well).

A huge graphical library supports among others moving plots, 3D-plots, niveau lines, cross plots, animation for both, continuous and discrete systems.

SIMUL_R is an open system as it allows data input and output from and to other systems, including user input during simulation (by keys or graphical) as well as hardware in the loop.

PROSIMUL_R only knows one resource: the station. Everything else, like conveyors, is implemented as macros (so it is easy to add new functional objects to the system by writing new macros).

2. The Model

The model consists of one macro for the submodels and the DYNAMIC-section, which contains eight callings of this macro, with different parameters. The conveyors of this example, which are used as buffers, too, are implemented by PROSIMUL_R's TCONVEYOR_BUFFER macro.

Pallets are put into the system at the loading place for parts (Ax of A1). Old pallets coming to unload parts have priority over new pallets.

3. The Results

The table shows the results. SIMUL_R's discrete optimization command DOPTCONPAR computes 21 as optimum number of pallets. With 60 pallets and more the system blocks, because pallets cannot enter the circulation conveyor and the pallets on this conveyor move on it endlessly.

number of pallets	processed entities	mean of throughput time
1	138	208.3
10	939	306.7
20	1405	409.5
21	1409	429.5
22	1409	450.3
30	1405	614.2
40	1403	825.0

The figure shows the animation screen and the plot using the MS-Windows version of PROSIMUL_R.

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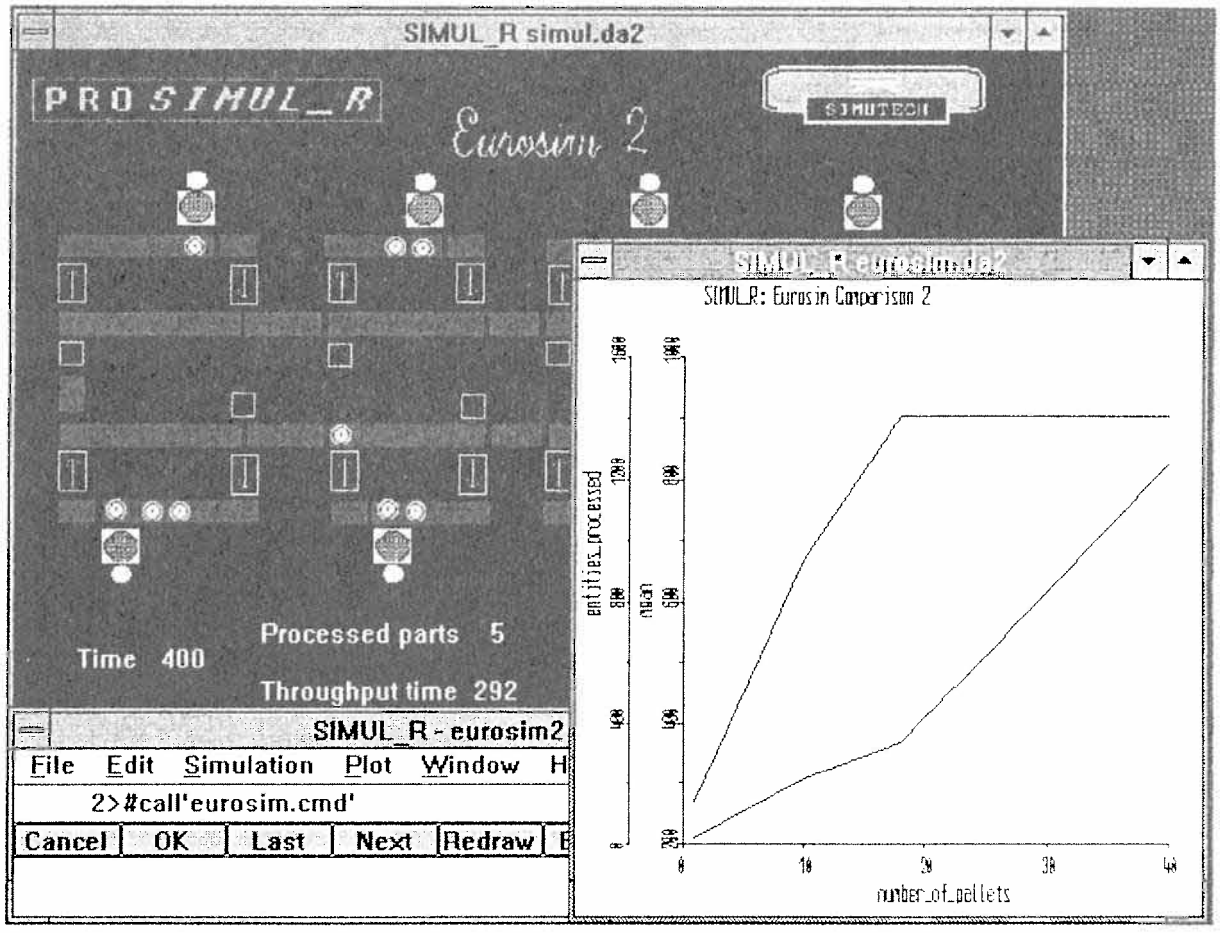

Comparison 2 - GPSS/H

1. Description of GPSS/H

GPSS/H is described in an article on page 5. Please refer to it for an overview of GPSS/H.

2. Observations about the FAS System

The following aspects of the Flexible Assembly System (FAS) being modeled are worth noting:

1. The maximum production rate is about 1409 units every 8 hours. The A2 stations are the bottleneck. (Each A2 station takes 61-1/3rd seconds to process one unit: 1-1/3rd seconds to move the unit onto the A2 station, then 60 seconds of operating time.)

2. The minimum time needed to assemble a unit is 229-2/3rd seconds (about 3.8 minutes). This time consists of 135 seconds of operation time, 20 seconds of shifting time, and 74-2/3rds seconds to travel 22.4 meters in one system lap in which one Station A2 and Stations A3, A4 and A5 are used, with two A2 Stations and the A6 Station being bypassed.

3. Model Description

The Comparison 2 problem checks two features of discrete event simulation languages:
- the possibility to define and combine submodels;
- the method to describe complex control strategies.

GPSS/H *macros* and *subroutines* provide tools for defining and combining submodels; and such things as *Boolean expressions* combined with *TEST blocks; GATE/Logic-Switch* combinations; and the ease of implementing *table-driven routings* thanks to *file I/O* and *matrices*, give GPSS/H the ability to handle complex control strategies easily. (Those who want to obtain the GPSS/H comparison model(s) should see Section 5.)

4. Model Verification

The model(s) were verified using the interactive monitoring feature of GPSS/H. This was done by setting traps on transactions (pallets) and tracing their movement through the system. Pallet movement was consistent with the rules described in the problem statement. For example, it was verified that the minimum time required by the model to assemble a unit is 229-2/3rds seconds.

5. Model Size and CPU-Time Requirements

Two GPSS/H models were built. The larger model, using no macros or subroutines, consists of 264 Blocks. The smaller model, using macros and subroutines, consists of less than 100 Blocks (and so can be executed under Student DOS GPSS/H!). Both models are included on the free animation disk (see Section 6). Also included on this disk is a GPSS/H model instrumented to produce the trace output file on which the animation is based.

Using the 264-block model, the 18-pallet simulation of Table 1 was run on a 33 MHz 80386 computer with a math co-processor and using GPSS/H 386 under MS-DOS 5.0. It took 20.4 CPU seconds to compile and execute the model. There were 263,507 block executions.

The same 18-pallet model was also run on the same hardware platform using Personal GPSS/H. Compilation and execution required 34.3 CPU seconds in this case. (GPSS/H 386 uses DOS extender technology not only to circumvent the 640K DOS barrier but also to process information in 32-bit chunks, whereas Personal GPSS/H works with information in 16-bit chunks. As a result, GPSS/H 386 is much faster than Personal GPSS/H.)

6. Animation of the Model

A GPSS/H comparison model has been animated using Wolverine's animation software, Proof Animation. The animation can be run on DOS 286 (or better) machines equipped with a math co-processor and DOS 3.0 or better. To obtain this animation on a disk at no cost, contact Wolverine Software Corporation, 4115 Annandale Road, Annandale, Virginia 22003-2500 USA; Tel: +1.703.750.3910; Fax: +1.703.642.9634. (The animation is self-contained in the sense that except for DOS, no other software is needed to view it.)

7. Experimental Results

Selected experimental results for the Comparison 2 are given in Table 1. These results were obtained by simulating for 2 hours, then reinitializing statistical aspects of the simulation, then simulating for another 8 hours. It was assumed that all pallets were empty initially and were positioned to be loaded at Station A1. Because all timings are dterministic, all correct models built under the same initial conditions and assumptions as the GPSS/H model(s) should produce the results in Table 1 (assuming the GPSS/H model(s) are correct), independent of the simulation software being used.

As shown in Table 1, the optimal feasible production rate (about 1409 units every 8 hours) is achieved (for all practical purposes) with 18 pallets.

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Number of Pallets	Jobs Completed in Final 8 Hours	Job Completion Time (Minutes) Mean	Std. Dev.	Number of Jobs Needing 1 or 2 or 3 or More Laps to Finish 1	2	3	>3	Number of Uses of Station A6
15	1350	5.33	0.89	1350	0	0	0	0
16	1350	5.69	0.89	1350	0	0	0	0
17	1371	5.96	0.82	1371	0	0	0	88
18	**1408**	**6.13**	**0.79**	**1408**	**0**	**0**	**0**	**293**
19	1409	6.47	0.53	1409	0	0	0	118
20	1409	6.82	0.50	1289	115	5	0	116
25	1408	8.52	2.75	682	300	180	246	252

Table 1: Selected Experimental Results

Comparison 3 - NAP2

The features of NAP2 and ANP3 have been introduced in EUROSIM - Simulation News Europe, Number 1 (March 1991) with comparison 1.

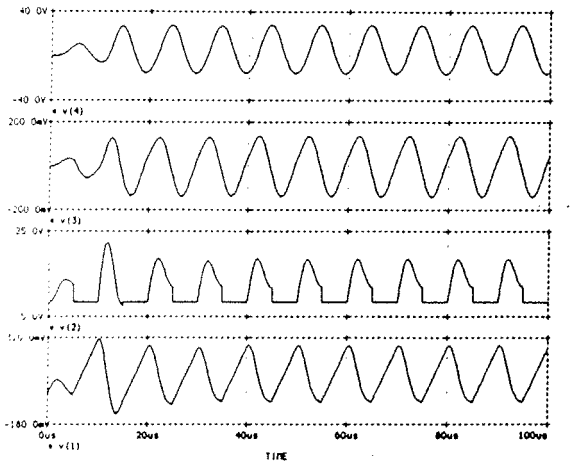
Task (a): The eigenvalues are calculated as the poles for the voltage transfer function VRL/VDC. The system is described in the ANP3 notation (ideal analog computer model), the results are:

```
*title task (a) calculation of the eigenvalues

       I22  0  2  -20    V C2 : 1/RT = 1/5e-2, Switch ON

       POLES     Sigma                  ±j*Omega
       P      -1.1303881489929D+05    -6.5835222046851D+05
       P      -1.1303881489929D+05     6.5835222046851D+05
       P      -6.2578276747491D+02     0.0000000000000D-01
       P      -1.1173175944106D+09     0.0000000000000D-01


*title task (a) calculation of the eigenvalues

       I22 = -200e-9       : 1/RT = 1/5e+6, Switch OFF

       POLES     Sigma                  ±j*Omega
       P      -5.8228418609882D+04    -5.3275019240598D+05
       P      -5.8228418609882D+04     5.3275019240598D+05
       P      -5.4708202465055D+04    -1.0407971978548D+06
       P      -5.4708202465055D+04     1.0407971978548D+06

CPU Time used for current job   1.76 secs.
```

Task (b): The simulation is performed by means of NAP2. Input data for the NAP2 program is based on the input for the ANP3 program by adding the time-dependent switch function table:

```
*circuit; *list 2, 9;
:   integrating capacitors
    C1 1 0  79.9e-6          : V1 = "IL1" = x1 ;
    C2 2 0  17.9e-9          : V2 = "VC2" = x2 ;
    C3 3 0 232.0e-6          : V3 = "IL3" = x3 ;
    C3 4 0  9.66e-9          : V4 = "VC4" = x4 ;
:   coefficients of the A-matrix
    I12 0 1  -1  V C2
    I21 0 2  +1  V C1
:   I22 0 2 -20  V C2 : 1/RT = 1/5e-2, Switch ON
:   FGT /TAB2/ P 10e-6,  0 20, 1e-15 200e-9, >
            5e-6 200e-9,  5.000000001e-6 20, >
                          10e-6       20 ;
    I22 0 2 -1*FGT(TIME)  V C2  : II22 = IR(t)
    I23 0 2  -1  V C3
    I32 0 3  +1  V C2
    I33 0 3 -52.4 V C3 : RL = 52.4, II33 = - "VL"
    I34 0 3  -1  V C4
    I43 0 4  +1  V C3
:   source  0 1 I            : VDC;  GVDC 0 1 0 J=5;
:   detector 4 0 V
: *output coef
: ---------------------
*time  0  100e-6
*TR vnall    *plot(50) v1, v2, v3, v4
             *plot(50) II22, II33
*run minstep=1e-20
*end
```

Figure 1 shows the state variables. It is seen that when the switch turns ON: R(t)=0.05 ohm a current spike of 109 ampere flows in the switch resistor because the voltage of the capacitor V(2) is 5.45 volts. The time constant is tau = R(t)*C2 = 0.05*17.9E-9 = 0.9E-9 sec. If you want to find the correct solution over a period of 100000E-9 sec you must allow the minimum stepsize of the integration scheme to be less than 0.1E-9. It is obvious that a variable step variable



order integration method is mandatory for this problem. The cpu time consumption was about 18 sec on an IBM compatible PC (Intel 80386/16 MHz). The number of integration steps was 924.

Task (c): The NAP2 model has to extended by three table functions for the different switching functions. Experimentation commands choose the varied inputs.

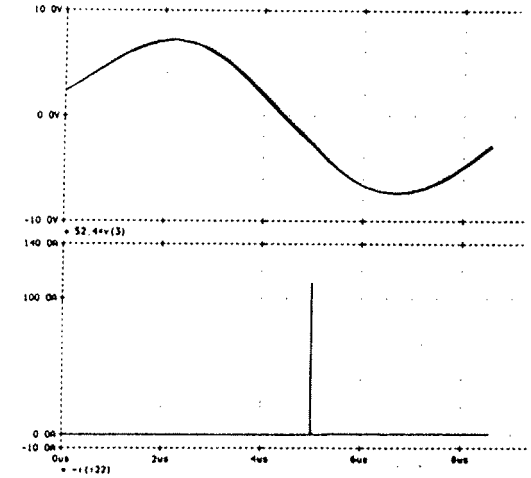
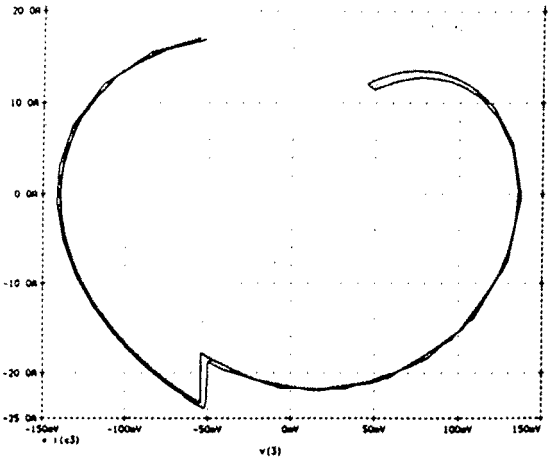


Figure 2 shows the phase plane curves of $dx_3/dt = VL3 = V2-V3$ as a function of $x_3 = IL3$. Figure 3 shows the current in the switch resistor $IR(t)=x_2/R(t)=i(gt)$ and the output voltage $VL=x_3*RL=v(L1)$. Furthermore the results show that the current spikes almost disappear when the rise/fall time TRF is greater than 1 pct of the period.



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Comparison 3 - ESACAP

Simulation carried out by means of the simulation program ESACAP.

A short description of ESACAP was given in connection with the comparison 1 of simulation software. In that example [1], it was shown how ESACAP could be used to specify and solve a problem formulated as a set of differential equations.

In the present comparison, as shown below, the problem is formulated mainly as a structure description, i.e. a specification of a network consisting of nodes and branches:

```
EVDC(1,0)=5;
LI(1,2)=79.9u;          GT(2,0)=1/RT;       C2(2,0)=17.9n;
L3(2,3)=232u;           C4(3,4)=9.66n;      RL(4,0)=3.4;
```

The switch is modelled as a time varying resistor RT the value of which can be specified as a simple tabulated (piecewise linear) function. However, in the present case it was desirable to sweep the rise/fall time through a certain range of values. Th ESACAP language allows the user to add procedural statements to the network description. As shown below, the switch resistance is obtaincd by an if-then-else construct. The exponent of the rise/fall time (EXPTRF) is a primary parameter that can be easily modified:

```
Period=10u; Halfper=Period/2;

EXPTRF=-15;
TRF=10**EXPTRF;          # Rise/fall time
t=MOD(TIME,Period);      #Period points

#***** Specification of switch-waveform ******

IF(t.LT.TRF) THEN
    RT=.005+t*(S1'-.05)/TRF;
ELSE
    IF(t.LT.Halfper) THEN
            RT=SM;
    ELSE
            IF(t.LT.Halfper+TRF)  THEN
                        RT=M+(t-Halfper)*(.05-SM)/TRF;
            ELSE
                        RT=.005;
ENDIF;
ENDIF;
ENDIF;
```

The first analysis is a frequency domain simulation in which the complex poles of the system response are found. ESACAP uses numerical interpolation techniques applied to the system response at a number of frequencies on a circle in the complex frequency plane [2]. The results are shown below:

Figure l shows the time domain solution initialized by the zero-solution. The current spikes are very high and the scale has been set to show the details of the current waveform.

Figure 2 shows part of a period from the periodic steady state solution. 5 sweeps are shown corresponding to the rise/fall times: le-l5, 1e-13, 1e-11, le-9, le-7. Only the solution for the value 1e-7 can be distinguished from the rest.

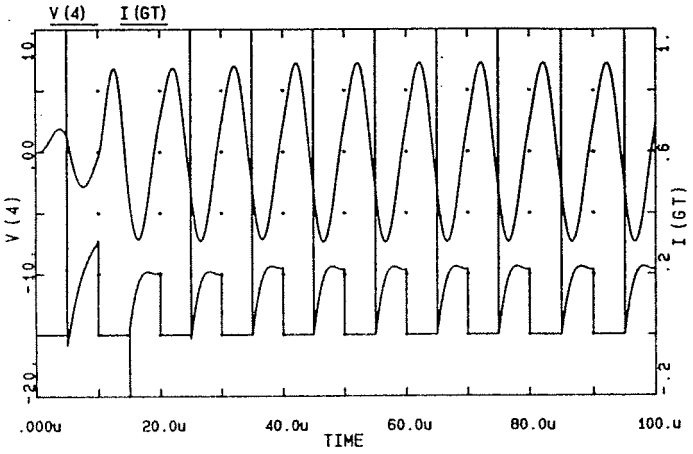

Fig.1 Time domain solution

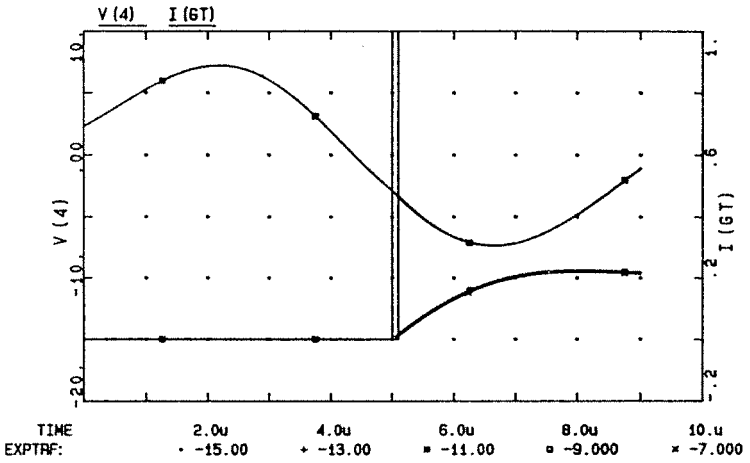

Fig.2 Periodic steady state solution

Figure 3 is a phase plane curve for the same analysis showing the L3-inductor voltage vs. current.

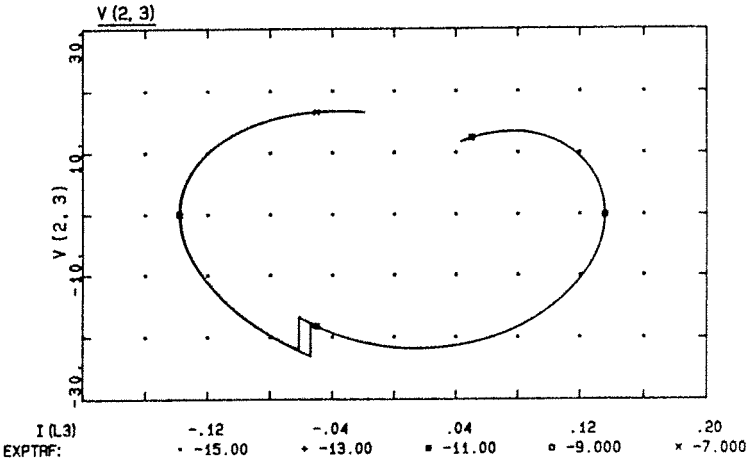

Fig.3 Periodic steady state solution,phase plane curves

References:

[I] P. Stangerup. Comparison of simulation software 1 - ESACAP. EUROSIM - Simulation News Europe, No.1 March 1991.

[2] J .Vlach & K . Singhal . Computer Methods for Circuit Analysis and Design. Van Nostrand Reinhold Company 1983 , New York, pp 210-228

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Comparison 3 - PROSIGN

PROSIGN (Process Design) is a software package designed for the simulation of continuous and discrete time nonlinear systems in various fields of applications.

Modelling may be carried out in three different ways: graphically- block oriented (based on the standard library), graphically- component oriented (based on libraries like Mechanic, Electric, ...), textual- equation oriented (based on PSL, the PROSIGN Simulation Language).

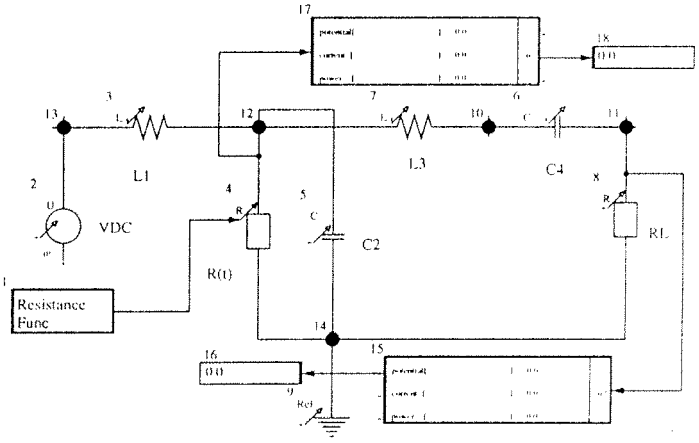
Since all methods can be combined, modelling should always be performed in that way which is most time saving and most obvious with respect to the simulation problem to be solved.

PROSIGN works with fixed or variable step size, alternatively. In the variable case the simulation results are calculated with a user-definable degree of accuracy. A special feature of PROSIGN is the code generator producing Modula-2, Fortran or C codes.

Model description

Block oriented modelling could also be applied here. However, since the procedure is already demonstrated in our Lithium-Cluster simulation report (see comparison 1), the component oriented method is used now.

It is easy to model the circuit, since no differential equation has to be entered or transfered into a block diagram. Directly taking the elements from the Electric library and connecting them graphically yields the simulation model (the function block "ResistanceFunc" realizes the resistance function R(t) and is composed of standard library elements):



Results

Task a): For system identification, system analysis and controller design purposes the software package PSIMOS is used. It constitutes an integrated extension to PROSIGN.

The desired eigenvalues result either as a consequence of an identification process or from direct calculations using the given state space equations.

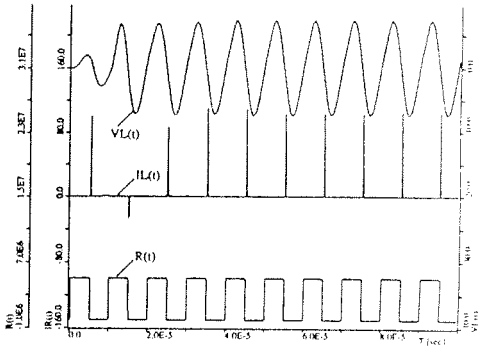
Eigenvalues corresponding to ON-state :

-1.117E9 -1.13E5+6.583E5j -1.13E5-6.583E5j -625.8

and OFF-state:

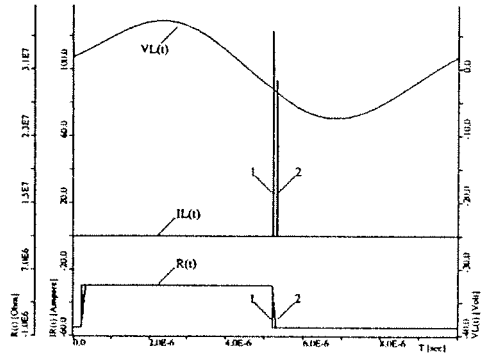
-5.823E4+5.327E5j -5.823E4-5.327E5j
-5.471E4+1.041E6j -5.471E4-1.041E6j

Task b): The figure shows the simulation results within the time interval [0,100E-6] sec.



Task c): Variation of Parameter TRF

The figure shows the curves in the desired time interval [0,10E-6] sec taking the final state of task b) at t=100E-6 as initial conditions.

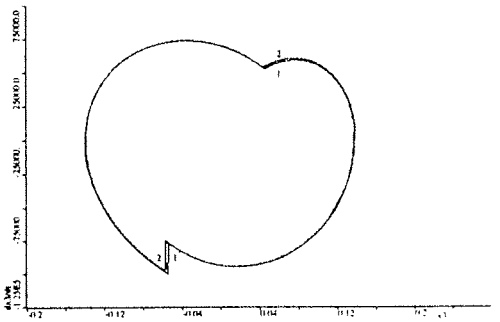


All curves for the resistor current show peaks when the resistance R(t) reaches the ON-state value 0.05 Ohm. The curves are grouped according to the following table

curve group	TRF (sec)	current peak (A)
1	1.0E-15	109
	1.0E-11	125
	1.0E-9	125
2	1.0E-7	109

Within group 1 the curves coincide to the point of indistinguishability. Only the curves for TRF=1.0E-7 sec (group 2) differ.

The desired phase plane curves with dx_3/dt as a function of x_3 can be seen in the following figure:



Helmuth Stahl, R&O Software-Technik GmbH, Planegger Straße 16-18, W-8034 Germering, Tel.: +49-(0)89 - 840080, Fax: +49-(0)89 - 8400813

EUROSIM '92

EUROSIM Simulation Congress
Capri, Italy, September 29 - October 2, 1992

Final Call for Papers

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

ASIM Arbeitsgemeinschaft Simulation, DBSS Dutch Benelux Simulation Society, FRANCOSIM Société Francophone de Simulation, SIMS Simulation Society of Scandinavia, UKSS United Kingdom Simulation Society

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

Conference Chairman: F. Maceri (Italy)

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

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

Scientific Program:

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

- Simulation languages / Simulation architectures
- Simulation methodologies
- Simulation of computer systems and networks
- Supercomputing in simulation
- Parallel and distributed simulation
- Simulation factory and automation
- Computational physics and chemistry
- Simulation in:
  - Aeronautics, Astronautics, Astrophysics
  - Automotive industry
  - Biology and medicine
  - Control Engineering
  - Earthquake engineering
  - Economy/business management
  - Education, Energy systems
  - Electrical Engineering (power plants)
  - Electronic design, Expert systems
  - Social sciences, Training
  - Transportation and traffic control

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

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

Exhibition

There will be an exhibition throughout the period of the Congress at the Conference site. Enquiries about the exhibition facilities are welcome. Tthe exhibition will have two sections, one for the commercial demonstrations and one for posters.

Registration Fees:

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

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

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

The official language of the Congress will be English.

Congress Secretariat:

Mrs. Antonella Di Chiara
Dept. of Civil Engineering
University of Rome "Tor Vergata",
Via della Ricerca Scientifica
I - 00173 Roma, Italy
Tel: +39-6-72594575, Fax: +39-6-72594586
telex: 622302 ROMCIV I

Deadlines and Requirements

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

Abstracts will be reviewed by members of the Scientific Committee and notification of acceptance or rejection will be sent by **February, 29, 1992**.

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

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

Calendar of Events

November 1991

21-22 **Arbeitsgespräch Physik und Informatik; Informatik und Physik**. München, Germany.
Contact: Dr. I. Bausch-Gall, Wohlfartstr. 21b, W-8000 München 45

28 **Annual Meeting of ISCS**. Rome, Italy.
Contact: ISCS

December 1991

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

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

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

January 1992

20-22 **6th Workshop on Parallel and Distributed Simulation**.
Newport Beach, California.
Contact: M. Abrams, Dept. of Computer Science, Virginia Tech, Blacksburg, VA 24061-0106, Tel: +1-703-231 8457.

20-22 **Simulation in Education for Business, Management, and MIS**.
Newport Beach, California.
Contact: J.E. Hilber, P.O. Box 17900, San Diego CA 92177, Tel: +1-619-277 3888.

20-22 **Simulation in Engineering Education**. Newport Beach, California.
Contact: H. Vaklizadian, Dept. of Electrical Engineering, University of Nebraska, Lincoln, NE 68688-0511,Tel: +1-402-472 1977.

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

20-22 **Object-Oriented Simulation**. Newport Beach, California.
Contact: T.G. Beaumariage, Arizona State University, Dept. of Ind. Management, ECG 303,Tempe, AZ 85207-596, Tel: +1-602-965 3193.

20-22 **Simulation in Health Care and Social Services**. Newport Beach, California.
Contact: J. G. Anderson, Dept. of Sociology, Purdue University, West Lafayette, IN 47907, Tel: +1-317-494 4703.

20-22 **Ethics and Simulation in the Service of Society**. Newport Beach, California.
Contact: H. Szczerbicka, c/o SCS, P.O. Box 17900, San Diego, CA 92177.

February 1992

27-28 **ASIM Working Group "Simulationssoftware und -hardware"**.
Zürich, Switzerland
Contact:. J. Halin, ETH Zürich, Institut für Energietechnik, Clausiusstrasse 33, CH-8092 Zürich, Tel: +41-(0)1/256-4608, Fax: +41-(0)1/262-2158.

March 1992

9 **ACSL User Group Meeting**. Paderborn, Germany
Contact: Mrs. I. Husinsky, TU Wien, EDV-Zentrum, Wiedner Hauptstr. 8-10, A-1040 Wien

9 **SPICE User Group Meeting**. Paderborn, Germany.
Contact: H. Gall, Wohlfartstr. 21b, W-8000 München.

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

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

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

26-28 **5th Ebernburg Working Conference**. Ebernburg, Germany
Contact: Prof.D. Möller, TU Clausthal, Institut für Informatik, Erzstr. 1, W - 3392 Clausthal-Zellerfeld, Tel: +49-(0)5323 722402.

April 1992

1-3 **5th Annual IMSL User Group Europe**. Munich, Germany.
Contact: IMSL User Group Liaison. P.O. Box 4605, Houston, Texas 77210-4605, USA

5-8 **IFAC Conference "Modelling and Control of Biotechnical Processes"**. Monterey, California.
Contact: Prof. M. Karim, Dept of Agri/Chem. Engg., Colorado State Univ., Fort Collins, CO 80523.

6-9 **1992 Simulation MultiConference**. Orlando, Florida
Contact: B. O'Neill, SCS, P.O. Box 17900, San Diego, CA 92177. Tel.: +1-619-277 3888, Fax: +1-619-277 3930.

22-24 **DIDAMATICA '92**. Campobasso, Italy
Contact: ISCS

30-May 1
23rd Annual Pittsburgh Conference on Modelling and Simulation. Pittsburgh, PA.
Contact: W.G. Vogt,348 Benedum Engineering Hall, Univ. of Pittsburgh, Pittsburgh, PA 15261.

FRANCOSIM Conference on discrete event modelling and simulation. France.
Contact: FRANCOSIM

May 1992

4-6 **ICOOMS 92, International Conference on Object-Oriented Manufacturing Systems**. Calgary, Canada.
Contact: D. Norrie, Div. of Manufacturing Engineering, Univ. of Calgary, 2500 University Drive N.W., Calgary, T2N 1N4, Alberta, Canada, Tel: 403-220 5787, Fax: 403-282 8406.

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

25-28 **IFAC Symposium "Information Control Problems in Manufacturing Technology"**. Toronto, Canada.
Contact: Dr. J. Scrimgeour, Advanced Manufacturing Technologies 6 Ind. Automation, Div. of EE National Research Council, Ottawa, Ont. K1A OR8, Canada.

June 1992

1-3 **ESM 92. European Simulation Multiconference**. York, U.K.
Contact: Philippe Geril, European Simulation Office, University of Ghent, Coupure Links 653, B - 9000 Ghent, Belgium. Tel/Fax: +32-91 23 49 41

10-12 **SIMS 92 Simulation Conference**. Lappeenranta, Finland.
Contact: M. Hänninen, Technical Research Center of Finland, P.O. Box 208 (Tekniikantie) 4), SF - 02151 Espoo, Finland. Tel:+358-0 4561, Fax:+358-0 456 5000.

22-24 **IMACS International Conference on Computer Methods for Partial Differential Equations**. New Brunswick, NJ.
Contact: Karen Hahn, Rutgers University, Department of Computer Science, New Brunswick, NJ 08903, USA, Fax: +1-(908) 932 5530

July 1992

1-3 **IFAC Symposium "Adaptive Control and Signal Processing"**. Grenoble, France.
Contact: L. Dugard, Lab dÁutomatique de Grenoble-ENSIEG, BP 46, F-38402 St. Martin d'Heres, France

8-10 **AIS'92. 3rd Annual Conference on Artificial Intelligence, Simulation & Planning in High Autonomy Systems**. Perth, Australia
Contact: Ms. Mary Simpson, School of Computing Science, Curtin University, P.O. Box U1987, Perth, WA 6001, Australia, Tel: +61-9-351 7298, Fax: +61-9-351 2819

14-17 **1992 International Systems Dynamics Conference**. Utrecht, The Netherlands.
Contact: Dr. J. Vennix, Utrecht Univ., Dept. of Social Sciences, Gamma-Informatics Unit, P.O. Box 80140, 3508 TC Utrecht, The Netherlands, Tel:+31-(0)30 534880, Fax: +31-(0)30 531619.

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

27-30 **1992 Summer Computer Simulation Conference**. Reno, Nevada.
Contact: B. O'Neill, SCS, P.O. Box 17900, San Diego, CA 92177. Tel.: +1-619-277 3888, Fax: +1-619-277 3930.

August 1992

18-20 **IFAC/IFORS/(IFIP)/(IIASA) Symposium "Modelling and Control of National Economies"**. Beijing, China
Contact: Prof. Jong-Ming Wu, Dept. of Computer Science and Techn., Beijing Information Technology Institute, Beijing, China

22-26 **IFAC/IFORS Symposium "Large Scale Systems: Theory and Applications"**. Beijing, China.
Contact: Prof. Bao Liu, Inst.of Systems Engineering, College of Engg., Tianjin University, Tianjin, China

23-25 **IFAC Workshop "Distributed Computer Control Systems" (CDDS 92)**. Beijing, China.
Contact: Prof. Bing Zhong Gong, POB 927, Beijing 10080, China

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

27 - September 2

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

September 1992

2-4 **International Conference on Control: Modelling, Computation, Information**. Manchester UK.
Contact: Dr.R.P. Jones, Department of Engineering, University of Warwick, Coventry CV4 7AL, U.K.

3-5 **IFAC Workshop "System Structure and Control"**. Prag, CSFR.
Contact: Dr.S. Kubik, Inst.of Inf. Theory and Automation, Pod vodarenskou vezi 4, CS-1182 Prague

IFAC Symposium "Low Cost Automation". Vienna, Austria.
Contact: Prof.W. Kopacek, c/o ÖPWZ, Rockhgasse 6, A-1014 Vienna, Austria

Conference on "Simulation and User Benefit" by ASIM working group "Simulation in der Fertigungstechnik". Aachen, Germany
Contact: Prof. A. Kuhn, Fraunhofer-Institut, IML, Emil-Figge-Straße 75, W - 4600 Dortmund 50, Tel: +49-(0)231 7549 130, Fax: +49-(0)231 7549 211.

29 - October 2
EUROSIM '92. EUROSIM Simulation Congress. Capri, Italy. Contact: Mrs. Antonella Di Chiara, Dept. of Civil Engineering, University of Rome "Tor Vergata", Via della Ricerca Scientifica, I - 00173 Roma, Italy, Tel: +39-6-72594575, Fax: +39-6-72594586, Telex: 622302 ROMCIV I

October 1992

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

November 1992

5-7 **SIMTECH 92: Simulation Technology Conference International 1992**. Houston, Texas.
Contact: Mary Lou Padgett, Auburn Univ., 1165 Owens Road, Auburn, AL 36830, Tel: +1-205-821 2472.

6-8 **ESS 92 European Simulation Symposium**. Dresden, Germany.
Contact: Philippe Geril, European Simulation Office, University of Ghent, Coupure Links 653, B - 9000 Ghent, Belgium. Tel/Fax: +32-91 23 49 41

December 1992

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

January 1993

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

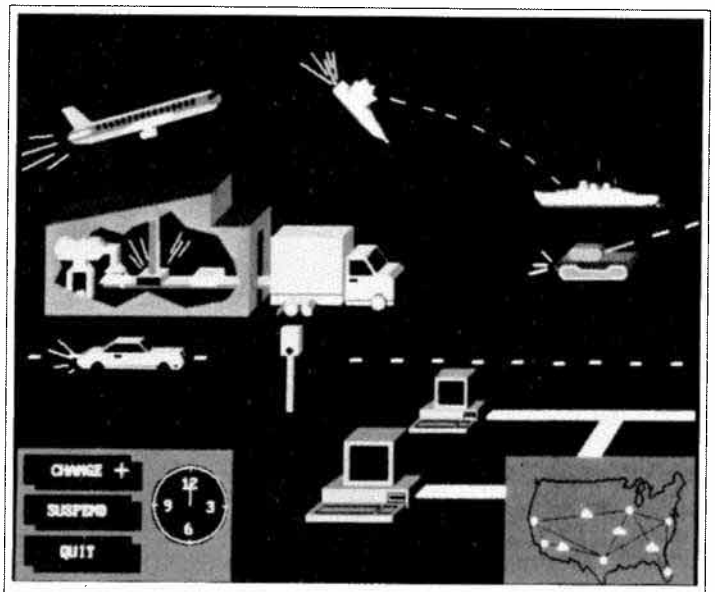
May 1993

5th Symposium on Modelling and Simulation of Systems, Olomouc, CSFR
Contact: CSSC

September 1993

28-30 **ASIM 93. 8th Symposium Simulationstechnik**. Berlin, Germany.
Contact: P. Schäfer, DAIMLER-BENZ AG, Forschungsinstitut, Alt Moabit 91 b , W - 1000 Berlin 21.

SIMULATION BREAKTHROUGH



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NEW OBJECT-ORIENTED LANGUAGE

```
FROM Animate IMPORT DynImageObj;
FROM GrpMod  IMPORT QueueObj;
TYPE
  PlatformObj = OBJECT(DynImageObj)
      OrbitPosition : REAL;
      OrbitVelocity : REAL;
      OrbitRadius   : REAL;
      Messages      : QueueObj;
      Quadrant      : INTEGER;
      TELL METHOD   SendTo(IN platform : PlatformObj);
      TELL METHOD   Receive From(IN platform : PlatformObj);
      ASK METHOD    ComputePosition;
  END OBJECT;
```

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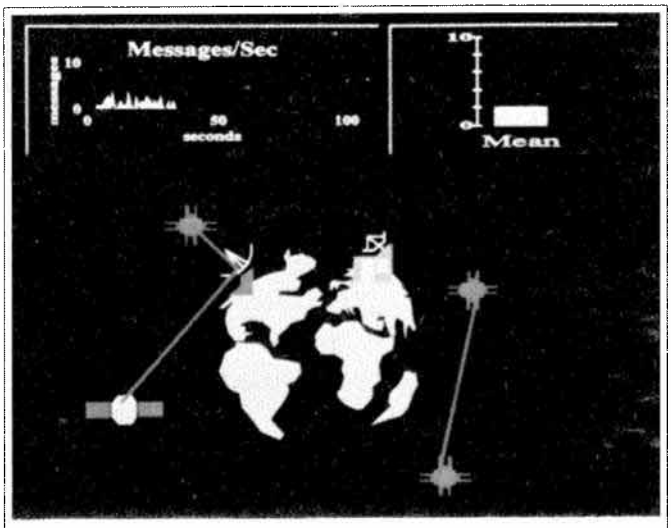

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