

## FRONT PAGE



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### SPECIAL:

Financial Mathematics 7

## C O N T E N T S

Joint ERCIM Actions	2
The European Scene:	4
Special Theme: <b>Financial Mathematics</b>	7
Research and Development	23
Technology Transfer	34
Events	38
In Brief	39



ERCIM will  
celebrate its 10th  
anniversary with  
a two days event  
in Amsterdam,  
4-5 November  
1999. See  
announcement  
on page 3.

### Next Issue:

Special: 10 years ERCIM

The Slovak Research Consortium for Informatics and Mathematics (SRCIM) joined ERCIM in May 1998. It always takes time for a new partner to fully integrate into the co-operative work of the member institutes. The Familiarisation Day held during the recent ERCIM Board of Directors and ERCIM Executive Committee meetings in Bratislava will certainly help to speed up this process.

SRCIM aspires to both benefit from and contribute to the melting pot of information and experience embodied in ERCIM. Slovakia is amidst a difficult economical and social transformation. It will take a number of years before local industry becomes strong enough to look for challenges in the more distant future and to recognise the importance of research, development, and education. Some of the problems in the area of IT that Slovak society and industry are going to face in the future are in the meantime being recognised in many European countries and addressed by the ERCIM institutes. SRCIM intends to participate in looking for solutions to these problems and thus become ready to apply these solutions in the local context.

Historical circumstances inhibited advanced research in most applied areas of IT in Slovakia. Theoretical research, less dependent on hardware, managed to stay in touch with the current developments and the results achieved are recognised and appreciated by the international community. Strong theoretical research influenced the computer science education at leading universities. The educational paradigm 'through abstraction to flexibility', applied over many years, resulted in a strong base of IT professionals in Slovakia who are ready, many years after their graduation, to embrace the newest technologies and paradigms of software development. SRCIM member institutes are eager to find areas of common interest with other ERCIM member institutes. Their well-trained research and development teams are looking forward to contributing to and gaining experience from joint projects.

The challenges posed by our vision of the information society of the future transcend the borders and the solutions our community needs to find will require teams that transcend the borders too. It is vital that partners of varied expertise and societal background look for solutions that will indeed bring the benefits of IT to everyone. ERCIM has a large enough geographical coverage of Europe to find such partners and to form such teams. The member institutes of SRCIM have many years of experience in co-operation with countries in Central and Eastern Europe and are ready to share this experience.

The broad base of R&D, the geographical spread, and the multicultural outlook give ERCIM the potential of being one of the few organisations that can identify key issues and influence the strategy of European IT R&D. SRCIM welcomes the chance and the challenge to take part in this process. SRCIM is a junior partner in ERCIM, both in its size and in the duration of its membership. Having as members the key R&D institutions in IT in Slovakia and representing a base of well trained and flexible researchers, SRCIM has the ambition to contribute to finding solutions to the IT challenges on the ERCIM agenda.

**Branislav Rován**

## 5th ERCIM Environmental Modelling Group Workshop

by Jean-Paul Berroir

The fifth workshop of the ERCIM Environmental Modelling Group, dedicated to Information Systems for Environmental Modelling, was held on 3-4 June 1999. It was organized by INRIA and hosted in Palais des Congrès, Versailles, France and attracted some 20 participants from six countries. The workshop chairman was Isabelle Herlin from INRIA.

The lectures and discussions focused on information systems designed for environmental modelling. More specifically, several issues were addressed, all being crucial for the operational implementation of environmental models, such as systems for air quality monitoring, coastal zone management, hydrology, climate: these issues were system architecture, data collection on the Internet, data management, access to distributed geographic data sources, GIS applications over the Internet.

The workshop was divided into three sessions, the first one concerning applications of information systems to environment (air quality, risk management), the second being focused on systems themselves. A final session concerned ongoing European projects sharing the concern of designing systems for environmental modelling. Four projects have thus been presented, related to the European Telematics or Inco programs.

The workshop ended with a lecture by Achim Sydow, GMD, chairman of the working group, summarizing the IST/Telematics Environment Concertation Meeting. This was the opportunity to discuss ideas for future projects, to be formed within the working group. The DECAIR project, dedicated to the use of remote sensing data for air quality simulation, which has recently

started under the framework of the CEO program (Centre for Earth Observation), is a good example of the success of the collaboration between members of the working group. See <http://www-air.inria.fr/decair/> for information about this project.

Detailed information about the workshop program can be found at: <http://www-air.inria.fr/ercim>.

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## Ninth DELOS Workshop focuses on Distance Learning

by Pasquale Savino and Pavel Zezula

The 9th DELOS Workshop on Digital Libraries for Distance Learning was held in Brno, Czech Republic, 15-17 April 1999. The objective of the DELOS Working Group, part of the ERCIM Digital Library Initiative, is to promote research into the further development of digital library technologies. This year, Brno Technical University held its 100 year anniversary. It also recently became an associated partner of DELOS. The workshop was organized in celebration of these two events.

The workshop addressed two relatively new areas : Digital Libraries and Distance Learning. Access to education has become increasingly important for individuals who need to gain a competitive edge in the labour market through acquisition of specialized or new knowledge. This demand for new information, coupled with the ever increasing quantity of information available in digital form, has led to a change in traditional teaching methods.

Face to face teaching is gradually being replaced by distance education. In order to make this form of education both effective and efficient, advanced information and communication technologies must be exploited. Digital libraries of distributed complex multimedia data can serve as suitable repositories of continuously changing up-to-date information, which are indispensable for distance education.

The DELOS organizers cooperated with the Czech Association of Distance Learning Universities and the European Association of Distance Learning Universities in preparing the programme for the workshop.

The final programme contained contributions from nine countries. The invited talk, by John A.N. Lee, concentrated on distance learning experiences at the Department of Computer Science at Virginia Tech, USA. The remaining presentations can be divided in two categories. Papers in the first category concentrated on conceptual issues of distance learning, emphasizing the position of digital libraries in the global process of knowledge acquisition. Papers in the second category presented information about actual prototypes for distance learning or addressed some of the advance technology tools necessary to meet this aim. The workshop attendees also greatly appreciated the session dedicated to prototype demonstrations; six different prototypes were presented. The workshop inspired numerous, very lively discussions.

For more information on the Delos Working Group, see:

<http://www.iei.pi.cnr.it/DELOS/>  
The Proceedings of the Workshop have been published in the DELOS Workshop series and can be found at: <http://www.ercim.org/publication/ws-proceedings/DELOS9/>

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## A new Manager for ERCIM

During their recent meeting in Bratislava the ERCIM Board of Directors nominated Jean-Eric Pin the new Manager of ERCIM. Jean-Eric Pin is a 46 years old director of research at CNRS, and he currently heads a research team in the LIAFA (Laboratoire d'Informatique Algorithmique : Fondements et Applications) from University Paris 7. As a former director of the LIAFA, he is experienced in research management. He has also gathered knowledge in research transfer during the two years spent at the IT group Bull and with his activities as consultant for data compression for the French space agency CNES. He is well-versed in European programs such as ESPRIT and now IST. Pin first studied mathematics and then moved to computer science. In 1989, he received the IBM France



Scientific Prize in Computer Science for his work in automata theory.

*"I would like to thank ERCIM for the trust it puts in me. I am very enthusiastic about joining ERCIM and I hope to prove equal to this challenging new task. I am especially delighted to have to celebrate an anniversary so early after being nominated! It is not only an exciting festivity, but also a unique opportunity for our consortium to become an unavoidable entity at the European level. So, don't forget to tell your friends, your colleagues, and your industrial partners about that very special event that will take place in Amsterdam at the beginning of November. This anniversary is going to be a very rich event, both internally and externally, and I am sure that everybody is ready to help for its success!"*

Jean Eric Pin

## ERCIM 10th Anniversary Event

Amsterdam, 4-5 November 1999

ERCIM will celebrate its 10th anniversary with a two days event in the "Beurs van Berlage" in Amsterdam, 4-5 November 1999. The first day will be an internal event for ERCIM-member personnel only, while the second day is targeted towards Information and Communication Technology (ICT) users in European industry and leading people from the political community.

**ERCIM - a Virtual Laboratory for ICT Research in Europe, Amsterdam, Thursday 4 November 1999**

Under this slogan scientists of the ERCIM institutes will be given the opportunity to present their ideas on matters that are closely related to IT research. It is not research itself that will be targeted with these presentations but rather the issues that come up on a meta-level. To give some examples: A presentation will be given on the pros and cons of open source software development, on the state of the art in a number of ICT research areas, on new paradigms and prospects in particular fields, and so on. A full program will be available at the ERCIM website soon.

**ERCIM - Leveraging World Class R&D for Business and Society Amsterdam, Friday 5 November 1999**

The November 5 event is targeted towards the European industrial and political community. It aims at taking stock of information technology, its advancement and its applications in business and society. Presentations will be given by J.T. Bergqvist (BoD NOKIA), Gottfried Dutiné (Director of Alcatel/SEL Germany), Jacques Louis Lions (President of the French Academy of Sciences), Roger Needham (Director of Microsoft Research Europe), Gerard van Oortmerssen (President of ERCIM), and Alexander Rinnooy Kan (BoD ING Bank). Next to these presentations major achievements of the ERCIM institutes will be demonstrated throughout the day.



For more information see: <http://www.ercim.org/>

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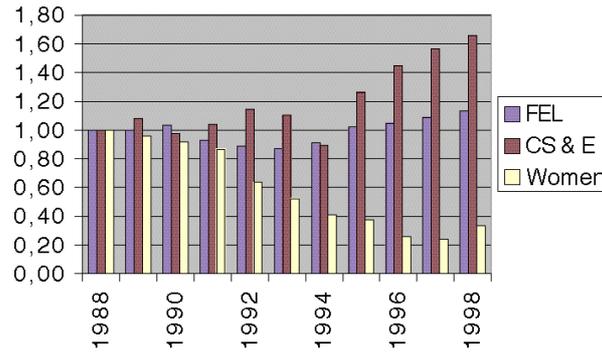
# IT Training in a Changing Society

by Josef Kolař

The process of changes in the countries of Central and Eastern Europe has removed barriers in their political, economical, and social life. In the Czech Republic, we experience the creation of a new environment in which both industrial companies and educational institutions are subject to conditions of an open market. This article presents some hypotheses concerning recent trends in student population at one of the faculties of the Czech Technical University in Prague.

The Department of Computer Science and Engineering (CS&E) at the Faculty of Electrical Engineering was the first offering a comprehensive university education in IT in the former Czechoslovakia. The study program has always been a balanced mixture of software- and hardware-oriented courses, so that the graduates were attractive to a relatively wide sector of the job market.

After the removal of the communist regime, the computer market opened to a massive import of technologies whose supply was strictly controlled before. Free import eliminated the need of technologically obsolete IT systems produced in the former COMECON countries, and caused a peak demand for IT personnel capable of a quick adoption to new technologies. Western companies started to build their local offices hiring mostly Czech personnel since they were cheaper and knew the local environment. Graduates from the Department of CS&E were some of the most successful in getting such jobs and in many cases they gradually reached the top positions in the Czech branches of many important companies (as eg IBM, Microsoft, Oracle, etc.). Apart from this, the continuous development in IT and telecommunications has been attracting young people to enroll for computer studies at the department.



Evaluation of the student population at the Faculty of Electrical Engineering (FEL), the number of students of the Department of Computer Science and Engineering (CS&E) and the number of women in the student population.

The figure shows how three indicators we consider interesting have been evolving in the last decade. They represent the overall student population of the faculty, the number of students of CS&E, and the number of women in the student population. The indicator values have been normalized in order to compare their trends (the actual starting values are 4037, 362, and 293, resp.). We see that after an initial stagnation, the population grows yet not that quickly as the numbers of CS&E students. The difference could have been even more remarkable if all students applying for the CS&E study program had been accepted, which is not possible due to limited space and personnel capacity of the department. While quite satisfactory for us, this situation reflects a serious drain-off effect to other study programs and departments both in student numbers and quality.

The critically decreasing number of women is something the university is not pleased with even though there is probably no chance for a technical university to achieve a close-to-balanced population with respect to sex. The decrease in women population is even more alarming if percentage is considered. The student population had 7.3% women in 1988, but only 1.6% in 1997. We tried to formulate possible hypothesis as to the reasons for this situation.

Girls do not like computers - The way children get the first exposure to IT is favoring boys. It is not only that most computer games are competition-oriented (fighting, war-games) but the technical aspects of the issue attract more boys than girls. More publicity is needed to stress the fact that there is enough space in IT applications for creativity, cooperation, and social communication,

both in usage and in design (as eg in WWW pages or human-computer interface), in which the female factor can be fully appreciated.

Girls do not like electrical engineering (EE) - Even accepting that technical disciplines (and specifically EE) are perhaps more male-attractive, how to explain the latest trend that has led from a modest 7.3% to an almost complete female extinction from the student body? Our hypothesis is that nowadays, there is a richer offering in the educational market so that most girls actually select study programs what they like more.

Another fact derived from indicators that are not depicted in the diagram is that the average time needed to graduate (if ever) has grown remarkably. Our hypothesis, whose verification would need more data, is that the reason is not the difficulty of the program but mostly the deliberate decision of the students. Since they do not pay any fees and have important advantages, they often stay studying while actually working for some company. The university thus offers a shelter for a smooth start into their professional life.

## Conclusions

There are many traditions and myths in university life that, surprisingly, quickly disappear when the society experiences a deep social transition. Although some of the changes are positive and some others are inevitable, we still have a chance to influence them provided that we find the real reasons.

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# A Successful Effort to Increase the Number of Female Students in Computer Science

by Truls Gjestland

**The Norwegian University for Science and Technology (NTNU) observed a steady decline in the number of female students in subjects related to computer science. In 1996 only 6 percent of the students in Computer Science were women. On the other hand female students with a degree in computer science were highly in demand, reflecting a general Norwegian trend to have a balanced workforce.**

## Why worry?

It is considered important that both men and women are among the well-qualified computer science and IT graduates that work in R&D projects that will color our future. Good qualifications in computer science is the gateway to interesting, well-paid careers. More females should be employed in this market. Both Norwegian industry and the public sector recognize that competent staff with IT skills are essential. When half the applicants to higher education are female, we should make use of the resources and scientific talents that women possess to educate well-qualified female computer science graduates.

## University initiative

In 1997 a special program was launched by NTNU to increase the number of young women in computer science. First of all a special extra quota was established reserved exclusively for female students. Someone would argue that having special quotas would lead to students with inferior qualifications. This has not been the case. In 1997 and 1998 a total of 36 and 37 women respectively were admitted on this special quota. At NTNU students are admitted to the various faculties

according to their grades from high school. Different faculties may have different qualification requirements. All of the 'quota girls' belong gradewise to the upper quarter of all the students at NTNU; definitely not a minor league team.

Information material especially designed for women were distributed to all the high schools in Norway, and all the women who expressed an interest in studying computer science at NTNU, were invited to participate in an all paid 'girls day' at the university. During this visit they would meet with students and faculty, and given all relevant information as a hands-on experience.

The results were promising. One of the problems earlier was that only 40% of the young women who were accepted actually started their studies at the



**A computer lab for female students is part of an initiative at NTNU to increase the number of young women in computer science.**

university. Now this percentage was increased to 80. At the semester start in 1996 only 6 out of 101 students in computer science were women. In 1997 the ratio was 50 out of a total of 171. In 1998 the efforts were further increased. In the fall 1998 the number of women starting to study computer science at NTNU had increased to 69 out of 230. The percentage of young women admitted for the fall semester 1999 is now 29.6 %. The experiment that started at NTNU has now been expanded to become a national initiative. Four universities are currently involved.

Measures directed at the upper secondary school was implemented in the summer 1998. The project engaged the services of a natural science teacher at this level. A common information campaign was launched by the four universities to get

more young women into computer science. This comprised a brochure, advertising, web-based information and a special postcard:

- 25 000 copies of the campaign brochure were distributed to universities and 380 upper secondary schools all over Norway. It was also sent to teachers in mathematics in the third year at secondary schools who participated in a special conference, Damer@Data (Females@Computing) at the University of Tromsø in March 1998.
- The campaign postcard was printed in 60 000 copies and distributed in cafes, discos and similar places where young students gather in most large towns in Norway. A further 10 000 were sent to universities. At NTNU, the Department of Computer and Information Science sent a personal postcard to all the young



Foto: Geir Otto Johansen

women in the upper secondary school in Norway who had taken the necessary subjects in mathematics and physics to be qualified for admission. Professor Reidar Conradi, head of the Department of Computer and Information Science wrote them and urged them to consider studying computing at NTNU.

- The project had double and single page ads in the press, especially in magazines for young people. There were also ads in the student newspapers at the four universities.
- The project also written about in the local and national media and specialized computer magazines.

It is not enough to have a high percentage of women at the beginning of their studies. You also have to make sure that they complete the courses. This was also part of the initiative.

NTNU does not have any computer classes exclusively for women. Certain actions, however, are specifically aimed at the female students. There is a computer lab for women with six designated assistants (female students at senior level), and there are two assistants whose prime task is to make sure that the new female students are having a good time! They arrange special courses, visits to computer businesses, social meetings with female industrial leaders, etc. In order to emphasize the role-model aspect, a female associate professor has also been engaged. Another important aspect has also been a series of lectures: Know your subject. In these lectures the relevance of the computer science subjects is discussed to give the students a broader perspective.

The project has received financial support from the Norwegian research council, and several large industrial firms in Norway act as sponsors. For further information see:

<http://www.ntnu.no/datajenter/engl.html>

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## Basic Research, Information Technologies, and their Perspectives in the Czech Academy

by Milan Mare

**Like in other countries in Central Europe, the research in the Academy of Sciences of the Czech Republic (formerly Czechoslovak Academy of Sciences), its management and the position of researchers after the early nintees display significant changes. Among the general and generally known conditions being valid in the**

**former regime, there existed additional problems connected specifically with the R&D in the informatics, information sciences and information technologies. Namely, the embargo on advanced technologies forced the researchers to ‘repeat’ the work already done in developing even simple elements of high electronic technology. Certain ignorance regarding the copyrights of software products led to the existence of their uncontrollable illegal ‘import’. General unconcern on the industrial production of advanced information technologies essentially limited the career possibilities of young gifted specialists outside the universities and basic research facilities, demand for them was rather limited. That all has changed almost overnight.**

However these changes are beneficent, from the general point of view, they bring qualitatively new problems to be solved by the managers of the research. The grant system of the financing of research projects led some researchers to a feeling of lower stability of their position.

Their ability and readiness to start risky research in quite new fields connected with the possibility of failure or, at least, with relatively long period of decrease of the publication outputs (with all the consequences for the success in the grant competition) becomes much lower. The ‘safety’ research in well-known areas seems to be more attractive. The mobility of researchers and research teams, as a natural reaction on the flexibility of supports, is rather difficult in a small country like the Czech Republic and this difficulty is even increased by the extremely limited possibilities to find adequate accommodation for researcher’s family. Last but far not least, the demand for information and computer specialists in the industry, business and banking has rapidly increased. The salaries offered by these new potential employers are much higher than those ones, which can be achieved in an academic institute or university. In the situation of young families this argument becomes very cogent.

Gifted postgraduate students frequently understand their study as an opportunity to increase their price on the labor market.

It is not wrong, generally, but it would be desirable to keep at least some (desirably the most gifted ones) in the institutes. All these new circumstances met the managements of the research institutes (also usually new) and confronted them with the problem to cope with the instability of research staff and guarantee its fluent regeneration. The way to manage this situation is both, simple in its general formulation and difficult in the practical realization. It is expectable that the labor market in the field of information science and technology will turn more saturated and that this can contribute to the equilibrium between the supply and demand for researchers in the institutes. But this expectation cannot be the starting point for the management of IT research in the next years.

First, it is necessary to built stable core of tribal researchers in the institute. This need not be very large, but it must be currently completed and its members have to be creative personalities being sure that the institute reckons with them. This core can be surrounded by a staff of researchers moving between institutes and applied research even with the risk of irreversibility of some moves or increasing their qualification. Such system cannot be effective without mobility of researchers - in the case of the Czech science also the international one in both directions - including the joint solution of research and grant projects. Also the narrow cooperation with universities and participation on the education is necessary for a sound life of the research institute of the considered type. Cooperation with industry and other consumers of applied results is effective only if it concerns original non-standard solutions of very specific problems. Academic institute cannot (and should not) compete with routine products of specialized firms. The achievement of such dynamic stability of the research system in Academic institutes is not solvable in short time and by simple tools, but it must be at the horizon of our endeavor if we want to manage the IT basic research on the level demanded by the contemporary world.

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# Financial Mathematics

by Denis Talay

**Financial markets play an important economical role as everybody knows. It is not well known (except by specialists) that the traders now use not only huge communication networks but also highly sophisticated mathematical models and scientific computation algorithms. Here are a few examples:**

The trading of options represents a large part of the financial activity. An option is a contract which gives the right to the buyer of the option to buy or sell a primary asset (for example, a stock or a bond) at a price and at a maturity date which are fixed at the time the contract is signed. This financial instrument can be seen as an insurance contract which protects the holder against undesirable changes of the primary asset price.

A natural and of practical importance question is: does there exist a theoretical price of any option within a coherent model for the economy? It is out of the scope of this short introduction to give a precise answer to such a difficult problem which, indeed, requires an entire book to be treated deeply (see Duffie '92). This introduction is limited to focusing on one element of the answer: owing to stochastic calculus and the notion of non arbitrage (one supposes that the market is such that, starting with a zero wealth, one cannot get a strictly positive future wealth with a positive probability), one can define rational prices for the options. Such a rational price is given as the initial amount of money invested in a financial portfolios which permits to exactly replicate the payoff of the option at its maturity date. The dynamic management of the portfolio is called the hedging strategy of the option.

It seems that the idea of modelling a financial asset price by a stochastic process is due to Bachelier (1900) who used Brownian motion to model a stock price, but the stochastic part of Financial Mathematics is actually born in 1973 with the celebrated Black and Scholes formula for European options and a paper by

Merton; decisive milestones then are papers by Harrison and Kreps (1979), Harrison and Pliska (1981) which provide a rigorous and very general conceptual framework to the option pricing problem, particularly owing to an intensive use of the stochastic integration theory. As a result, most of the traders in trading rooms are now using stochastic processes to model the primary assets and deduce theoretical optimal hedging strategies which help to take management decisions. The related questions are various and complex, such as: is it possible to identify stochastic models precisely, can one efficiently approximate the option prices (usually given as solutions of Partial Differential Equations or as expectations of functionals of processes) and the hedging strategies, can one evaluate the risks of severe losses corresponding to given financial positions or the risks induced by the numerous misspecifications of the models?

These questions are subjects of intensive current researches, both in academic and financial institutions. They require competences in Statistics, stochastic processes, Partial Differential Equations, numerical analysis, software engineering, and so forth. Of course, in the ERCIM institutes several research groups participate to the exponentially growing scientific activity raised by financial markets and insurance companies, and motivated by at least three factors:

- this economical sector is hiring an increasing number of good students
- it is rich enough to fund research
- it is a source of fascinating new open problems which are challenging science.

The selection of papers in this special theme gives a partial activity report of the ERCIM groups, preceded by an authorized opinion developed by Björn Palmgren, Chief Actuary and member of the Data Security project at SICS, on the needs for mathematical models in Finance. One can separate the papers in three groups which correspond to three essential concerns in trading rooms:

- how to identify models and parameters in the models: papers by Arno Siebes (CWI), Kacha Dzhaparidze and Peter Spreij (University of Amsterdam), József Hornyák and László Monostori (SZTAKI)

- how to price options or to evaluate financial risks: papers by Jiri Hoogland and Dimitri Neumann (CWI), László Gerencsér (SZTAKI), Michiel Bertsch (CNR), Gerhard Paaß (GMD), Valeria Skrivankova (SRCIM), Denis Talay (INRIA)
- efficient methods of numerical resolution and softwares: papers by David Sayers (NAG Ltd), Claude Martini (INRIA) and Antonino Zanette (University of Trieste), Mireille Bossy (INRIA), Arie van Deursen (CWI), László Monostori (SZTAKI). Several of these papers mention results obtained jointly by researchers working in different ERCIM institutes.

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## CONTENTS

The Need for Financial Models <i>by Björn Palmgren</i>	8
Mining Financial Time Series <i>by Arno Siebes</i>	9
Statistical Methods for Financial and other Dynamical Stochastic Models <i>by Kacha Dzhaparidze and Peter Spreij</i>	9
Genetic Programming for Feature Extraction in Financial Forecasting <i>by József Hornyák and László Monostori</i>	10
Taming Risks: Financial Models and Numerics <i>by Jiri Hoogland and Dimitri Neumann</i>	11
Stochastic Systems in Financial Mathematics – Research activities at SZTAKI <i>by László Gerencsér</i>	13
Understanding Mortgage-backed Securities <i>by Michiel Bertsch</i>	14
ShowRisk – Prediction of Credit Risk <i>by Gerhard Paaß</i>	15
Stochastic Methods in Finance: Evaluating Predictions <i>by Valeria Skrivankova</i>	16
Model Risk Analysis for Discount Bond Options <i>by Denis Talay</i>	17
Numerical Algorithms Group <i>by David Sayers</i>	17
Premia: An Option Pricing Project <i>by Claude Martini and Antonino Zanette</i>	19
Life Insurance Contract Simulations <i>by Mireille Bossy</i>	20
Using a Domain-Specific Language for Financial Engineering <i>by Arie van Deursen</i>	21
Subsymbolic and Hybrid Artificial Intelligence Techniques in Financial Engineering <i>by László Monostori</i>	22

# The Need for Financial Models

by Björn Palmgren

**Against a background in insurance and finance and with my present experience from supervision of the financial sector, I would like to give an overview and some reflections on the role of mathematics and statistics in finance. The emphasis will be on the need for models and a discussion of what may make models useful. There are other important areas, such as secure handling of information and related questions covered by the field of cryptography and protocols, which will be left out here.**

## Cash flows

One way to understand the need for financial models is to look at what the financial sector is dealing with. What we see is as customers are products and services offered by banks, securities firms and insurance companies. The financial institutions receive our deposits, savings and insurance premiums and offer management of investments, loans, insurance cover and pensions. With a more abstract description we could say that cash flows in and out are handled by these institutions. What is more important is that some of these cash flows may be uncertain at a given moment in time. Certain cash flows may be of size that cannot be predicted with certainty, such as the yield on bonds or equity. In particular, some future cash-flows may turn out to be nil or non-existent, due to the default of those who should provide this cash-flow, or due to that the conditions for payment will not be satisfied, eg in insurance when no damage covered by the insurance contract occurs.

## Uncertainty and stability

It is the duty of the financial institution to find a balance or at least an acceptable level of imbalance between the cash flows that it manages. This balance is a

condition for the fulfilment of liabilities to customers and the corresponding goal of stability of the financial sector motivates special legislation for the financial sector and a system of authorisation, monitoring and supervision. It is the uncertainty about this balance, subject to financial and operational risk, that is one of the motivations for an increasing interest in financial models of use for achieving this balance or stability. Talking of risk, it is worth mentioning the other side of the coin, opportunity. Opportunity is another good reason for trying to understand the financial processes using financial models, at least as a complement to everything else that is of value for success in the financial sector: information, knowledge and competence in the field.

Having identified uncertainty as a characteristic feature of financial activity, we turn next to aspects for managing it. Here it would seem reasonable to make some distinction between methods, tools and models, although they are quite intertwined. For the moment we will, however, make no particular efforts to keep these aspects apart. Instead we will look closer at the types of uncertainty or risk that may occur and put them into a wider context, in order to be able to say something non-trivial about the usefulness and need for financial models.

## Horizons

It is important to bear in mind that the practical use of models should be judged with reference to some decision situation or context. Such a context necessarily depends on some horizon or period within which decisions have to be made. This aspect of horizon has consequences for the choice of model for describing the uncertainty or risk. Many processes in industry have a need for reactions or decisions in real time or at least with a relatively short horizon for decisions or monitoring. Similar processes do occur in certain financial markets, such as different kind of trading activities. Most other financial activities work, however, with considerably longer horizons, ranging from days and weeks to months and years. With a longer horizon and less frequent data it may be problematic to use models that were designed to handle

continuous or highly frequent processes, mainly because the underlying reality will be too unstable or inhomogeneous to fit into such a model. This highlights another aspect of the use of models. Will they be used for predictions or will they rather be used for descriptions of experience or projections of assumptions made about the future? For processes in real time there is a need for models with predictive power for at least a very near future. There is a need for financial models in situations where there is little hope of safe prediction, for several reasons. The process modelled may be poorly understood or just intrinsically inhomogeneous. The process may be depending on unpredictable market behaviour or external events, resisting any attempt to find a truthful model.

For this reason it is important to realise that many if not most financial models cannot be used as sharp predictive instruments. There are, however, a number of other respectable uses of financial models. These include projections of assumptions made, assessment of possible uncertainty, risk or opportunity, including different kinds of sensitivity analysis and calculation of buffers or margins that may be needed to compensate for adverse developments, ie when things do not go your way. Such approaches are of importance for defining regulatory minimum capital requirements and for capital allocation and performance measurement.

## Some models and methods

With the background given I would finally like to mention some concrete approaches that seem to be fruitful for further research. A general reference that gives a critical overview of a part of this vast field is 'Risk Management and Analysis, Vol. 1' edited by Carol Alexander, Wiley 1998.

It is a general experience that a deep understanding of the phenomenon to be modelled is the best starting point. Models with elements of market behaviour satisfy this requirement to a certain extent. The assumption of no arbitrage has been fruitful for the area of stochastic financial calculus, including models for derivative instruments. These models are used in pricing and are put to the test there.

Still, actual behaviour may differ from theoretical assumption. In such fields as credit or counterparty risk there seems to be room for more analysis. First there is a need to link default risk to properties of the debtor. Much has been done in credit scoring where the law of large numbers seems to be working, but there are several areas where default is relatively scarce or comes in batches. There is a need to sort out risk determining factors and find more frequent proxies for default. Given sufficient and relevant data this is an area for statistical analysis, including cluster analysis and various kind of structure-finding methods. There are connections with non-life insurance, which faces similar problems for pricing insurance risk, but usually with more statistics available. The increasing capacity of computers makes certain methods or approaches more practical than before. One example is methods based on the Bayesian approach that can be combined with empirical data rather than subjective a priori information. Here we have eg credibility methods in insurance and the area of stochastic simulation for Bayesian inference, known as the Markov chain Monte Carlo approach.

Models describing inhomogeneous processes, especially rare or catastrophic events are of interest, although there are limits for what can be said in such cases. Information is scarce and it may take a very long time to evaluate whether decisions based on the models were correct. Extreme value theory can be explored further, but perhaps best within the framework of sensitivity testing rather than prediction.

When measuring the total exposure to risk of a financial entity, it is clear that models should reflect various kinds of dependencies. Such dependencies occur between consecutive periods of time and between various types of activities. Models incorporating dynamic control mechanisms can explain some of the dependencies over time. In a more descriptive approach, there seems to be further work to be done in finding and describing correlation between asset types and, in case of insurance, correlation between types of business. One area

where such interactions are studied is the area of asset liability models, where there is interaction between the two sides of the balance sheet. Future development and experience with such models can be expected.

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## Mining Financial Time Series

by Arno Siebes

**A lot of financial data is in the form of time-series data, eg, the tick data from stock markets. Interesting patterns mined from such data could be used for, eg, cleaning the data or spotting possible market opportunities.**

Mining time-series data is, however, not trivial. Simply seeing each individual time-series as a (large) record in a table pre-supposes that all series have the same length and sampling frequency. Moreover, straightforward application of standard mining algorithms to such tables means that one forgets the time structure in the series. To overcome these problems, one can work with a fixed set of characteristics that are derived from each individual time-series. These characteristics should be such that they preserve similarity of time-series. That is, time-series that are similar should have similar characteristics and vice versa. If such a set of characteristics can be found, the mining can be done on these characteristics rather than on the original time-series.

A confounding factor in defining such characteristics is that similarity of time-series is not a well-defined criterion. In the Dutch HPCN project IMPACT, in which CWI participates, we take similarity as being similar to the human eye, and we use wavelet analysis to

define and compute the characteristics. One of the attractive features of this approach is that different characterisations capture different aspects of similarity. For example, Hoelder exponents capture roughness at a pre-defined scale, whereas a Haar representation focuses on local slope.

Currently, experiments are underway with the Dutch ABN AMRO bank to filter errors from on-line tick-data. In the first stage, a Haar representation is used to identify spikes in the data. In the next stage, clustering on Hoelder exponents and/or Haar representations will be used to identify smaller scale errors.

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## Statistical Methods for Financial and other Dynamical Stochastic Models

by Kacha Dzhaparidze and Peter Spreij

**The high capacity of present day computers has enabled the use of complex stochastic models because data on the system under study can be obtained in huge amounts and analyzed by simulation techniques or other numerical methods. For instance, at the stock exchanges, time and price are recorded for every single trade. Mathematical finance is an example of a field with a vigorous development of new models. The development of statistical methods for stochastic process models, however, lags behind, with the result that far too often statistical methods have been applied that, although they can be relatively sophisticated, suffer from shortcomings**

**because they do not fully take into account and exploit the structure of the new models. Researchers at CWI aim at making a major contribution to the theory of statistical inference for stochastic processes.**

The research is carried out in close collaboration with many researchers in The Netherlands and elsewhere in Europe. The theoretical work uses the methods of modern probability theory including stochastic calculus. A more applied project objective is the statistical analysis and modelling of financial data such as stock prices, interest rates, exchange rates and prices of options and other derivative assets, and the development of more realistic models for these than those presently used in the financial industry. There are increasing demands (including new legislation) that banks and other financial institutions improve the management of their risk from holding positions in securities. This will require use of more realistic and sophisticated mathematical models as well as improved statistical procedures to evaluate prices of financial assets.

Mathematical finance is an example of a field where data analysis is, in practice, very often done by means of traditional discrete time models, whereas most of the models used for pricing derivative assets are continuous-time models. Continuous-time models have the additional advantage that they can be analysed by means of the powerful tools of stochastic calculus, so that results can often be obtained even for very complicated models. In many applications, however, one has to take into consideration that data are obtained at discrete time points, so inference methods for discretely observed continuous-time processes are to be applied. In recent years, statistical methods for discrete time observations from diffusion-type processes has started to attract attention and it appears that there are many challenging mathematical problems involved. A survey paper on this subject by Dzhaparidze, Spreij and Van Zanten will soon appear in *Statistica Neerlandica*.

Very often the complexity of the models in question prevents exact calculation of the statistical properties of the methods

developed. An example is calculation of the variances of estimators that are often used to choose the most efficient member of a family of estimators. Computer simulations are then a useful tool, but it is important to have a mathematical theory with which simulation results can be compared. Asymptotic statistical theory can play this role, being therefore an important research objective at CWI. In recent years Dzhaparidze and Spreij have published a number of papers on parameter estimation problems in a general context of semimartingales.

Asymptotic methods can also be used to approximate complex models by simpler ones for inferential purposes. Moreover, the theory of asymptotic equivalence of experiments will be used to simplify decision problems for complex stochastic models to those of Gaussian or Poisson models that approximate them in the deficiency distance. This method can also be used to the approximation of discrete-time models by continuous time-models. Certain rudimentary ideas and facts on the relationship between these models has been reported by Dzhaparidze in a series of three papers in *CWI Quarterly*. These papers gave rise to a textbook on options valuation which is recently completed and intended for publication at CWI.

The research described above will be further developed in close collaboration with research teams in, eg, Paris, Berlin, Copenhagen, Freiburg, Helsinki and Padova. Most of these teams have been involved in the HCM research programme 'Statistical Inference for Stochastic Processes'. Contacts between the members of these teams are currently maintained or reinforced at annual workshops, recently in Munzingen (Freiburg). The collaboration with E. Valkeila (Helsinki), in particular, proved to be quite fruitful. A number of joint papers on general parametric families of statistical experiments were published, and others are scheduled for this year. ■

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## Genetic Programming for Feature Extraction in Financial Forecasting

by József Hornyák  
and László Monostori

**Artificial neural networks (ANNs) received great attention in the past few years because they were able to solve several difficult problems with complex, irrelevant, noisy or partial information, and problems which were hardly manageable in other ways. The usual inputs of ANNs are the time-series themselves or their simple descendants, such as differences, moving averages or standard deviations. The applicability of genetic programming for feature extraction is investigated at the SZTAKI, as part of a PhD work.**

During the training phase ANNs try to learn associations between the inputs and the expected outputs. Although back propagation (BP) ANNs are appropriate for non-linear mapping, they cannot easily realise certain mathematical relationships. On the one hand, appropriate feature extraction techniques can simplify the mapping task, on the other hand, they can enhance the speed and effectiveness of learning. On the base of previous experience, the user usually defines a large number of features, and automatic feature selection methods (eg based on statistical measures) are applied to reduce the feature size. A different technique for feature creation is the genetic programming (GP) approach. Genetic programming provides a way to search the space of all possible functions composed of certain terminals and primitive functions to find a function that satisfies the initial conditions.

The measurement of goodness of individual features or feature sets plays

a significant role in all kinds of feature extraction techniques. Methods can be distinguished, whether the learning/classification/estimation phases are incorporated in the feature extraction method (filter and wrapper approaches).

In fact, most of the financial technical indicators (Average True Range, Chaikin

new features extracted by GP as well. Plain ANN models did not provide the necessary generalization power. The examined financial indicators showed interclass distance measure (ICDM) values better than those of raw data and enhanced the performance of ANN-based forecasting. By using GP much better inputs for ANNs could be created



**ANN-based forecasting of stock prices.**

Oscillator, Demand Index, Directional Movement Index, Relative Strength Index etc.) are features of time-series in a certain sense. Feature extraction can lead to similar indicators. An interesting question is, however, whether such an approach can create new, better indicators.

The techniques were demonstrated and compared on the problem of predicting the direction of changes in the next week's average of daily closes for S&P 500 Index. The fundamental data were the daily S&P 500 High, Low and Close Indices, Dow Jones Industrial Average, Dow Jones Transportation Average, Dow Jones 20 Bond Average, Dow Jones Utility Average and NYSE Total Volume from 1993 to 1996.

Three ANN-based forecasting models have been compared. The first one used ANNs trained by historical data and their simple descendants. The second one was trained by historical data and technical indicators, while the third model used

improving their learning and generalization abilities.

Nevertheless, further work on forecasting models is planned, for example:

- extension of functions and terminals for GP
- direct application of GP for the extraction of investment decisions
- committee forecasts where some different forecasting systems work for the same problem and these forecasts are merged.

This project is partially supported by the Scientific Research Fund OTKA, Hungary, Grant No. T023650.

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## Taming Risks: Financial Models and Numerics

by Jiri Hoogland  
and Dimitri Neumann

**The increasing complexity of the financial world and the speed at which markets respond to world-events requires both good models for the dynamics of the financial markets as well as proper means to use these models at the high speed required in present-day trading and risk-management. Research at CWI focuses on the development of models for high-frequency data and applications in option-pricing, and tools to allow fast evaluation of complex simulations required for option-pricing and risk-management.**

The modeling of equity price movements already started in 1900 with the work of Bachelier, who modeled asset prices as Brownian motion. The seminal papers by Merton, Black, and Scholes, in which they derived option prices on assets, modeled as geometric Brownian motions, spurred the enormous growth of the financial industry with a wide variety of (very) complex financial instruments, such as options and swaps. These derivatives can be used to fine-tune the balance between risk and profit in portfolios. Wrong use of them may lead to large losses. This is where risk-management comes in. It quantifies potentially hazardous positions in outstanding contracts over some time-horizon.

Option pricing requires complex mathematics. It is of utmost importance to try to simplify and clarify the fundamental concepts and mathematics required as this may eventually lead to simpler, less error-prone, and faster computations. We have derived a new formulation of the option-pricing theory of Merton, Black, and Scholes, which leads to simpler formulae and potentially better numerical algorithms.

Brownian motion is widely used to model asset-prices. High-frequency data clearly shows a deviation from Brownian motion, especially in the tails of the distributions. Large price-jumps occur in practice more often than in a Brownian motion world. Thus also big losses occur more frequently. It is therefore important

explore ways to partially hedge in incomplete markets.

A relatively new phenomenon in the financial market has been the introduction of credit risk derivatives. These are instruments which can be used to hedge against the risk of default of a

fast. The efficient evaluation of option prices, greeks, and portfolio risk-management is very important.

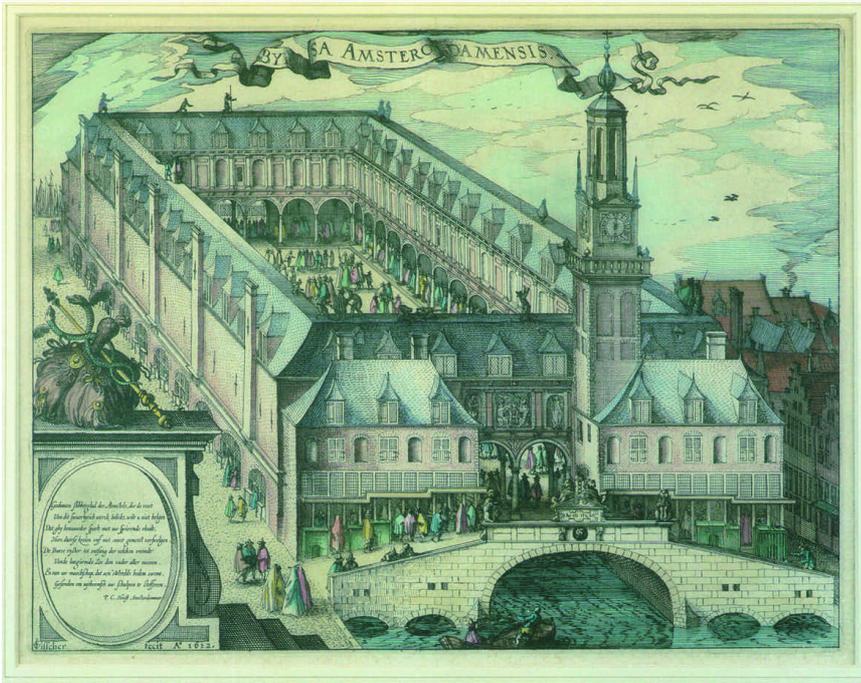
Many options depend on the prices of different assets. Often they allow the owner of the option to exercise the option at any moment up to the maturity of the (so-called) American-style option. The computation of prices of these options is very difficult. Analytically it seems to be impossible. Also numerically they are a tough nut to crack. For more than three underlying assets it becomes very hard to use tree or PDE methods. In that case Monte Carlo methods may provide a solution. The catch is that this is not done easily for American-style options. We are constructing methods which indirectly estimate American-style option prices on multiple assets using Monte Carlo techniques.

Monte Carlo methods are very versatile as their performance is independent of the number of underlying dynamic variables. They can be compared to gambling with dice in a casino many, many times, hence the name. Even if the number of assets becomes large, the amount of time required to compute the price stays approximately the same. Still the financial industry demands more speedy solutions, ie faster simulation methods. A potential candidate is the so-called Quasi-Monte Carlo method. The name stems from the fact that one gambles with hindsight (prepared dice), hence the 'Quasi'. It promises a much faster computation of the option-price. The problems one has to tackle are the generation of the required quasi-random variates (the dice) and the computation of the numerical error made. We try to find methods to devise optimal quasi-random number generators. Furthermore we look for simple rules-of-thumb which allow for the proper use of Quasi-Monte Carlo methods.

For more information see [http://dbs.cwi.nl:8080/cwwwi/owa/cwwwi/print\\_themes?ID=15](http://dbs.cwi.nl:8080/cwwwi/owa/cwwwi/print_themes?ID=15)

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Options were traded at the Beurs in Amsterdam (building by Hendrick de Keyser) already in the early 17th century.

to take this into account by more accurate modeling of the asset-price movements. This leads to power-laws, Levy-distributions, etc.

Apart from options on financial instruments like stocks, there exist options on physical objects. Examples are options to buy real estate, options to exploit an oil-well within a certain period of time, or options to buy electricity. Like ordinary options, these options should have a price. However, the writer of such an option (the one who receives the money) usually cannot hedge his risk sufficiently. The market is incomplete, in contrast with the assumptions in the Black-Scholes model. In order to attach a price to such an option, it is necessary to quantify the residual risk to the writer. Both parties can then negotiate how much money should be paid to compensate for this risk. We

debtor. It is obvious that this kind of risk requires a different modeling approach. The effect of default of a firm is a sudden jump in the value of the firm and its liabilities, and should be described by a jump process (for example, a Poisson-process). In practice, it is difficult to estimate the chance of default of some firm, given the information which is available. For larger firms, credit-worthiness is assessed by rating agencies like Standard and Poors. We are looking at methods to estimate and model the default risk of groups of smaller firms, using limited information.

The mathematics underlying financial derivatives has become quite formidable. Sometimes prices and related properties of options can be computed using analytical techniques, often one has to rely on numerical schemes to find approximations. This has to be done very

# Stochastic Systems in Financial Mathematics – Research activities at SZTAKI

by László Gerencsér

**Financial mathematics and mathematical methods in economy have attracted a lot of attention within academia in Hungary in recent years. The potentials of the new area has also been recognized at the SZTAKI: an inter-laboratory virtual research group has been established by the name ‘Financial Mathematics and Management’. The participating laboratories are: Laboratory of Applied Mathematics, Laboratory of Operations Research and Decision Systems and Laboratory of Engineering and Management Intelligence. The participants have committed themselves to carrying out research, among other things, in the area of option pricing, economic time series and portfolio analysis. This article gives a short overview of the activity of the Stochastic Systems Research Group, Laboratory of Applied Mathematics and the Laboratory of Operations Research and Decision Systems in the stochastic aspects of financial mathematics.**

Our activity in the area started with my discussions with Tomas Björk (Department of Finance, Stockholm School of Economics) and Andrea Gombani (CNR/LADSEB) in summer, 1996, while visiting Lorenzo Finesso in CNR/LADSEB. A prime theme for these discussions was financial mathematics that attracted many people working in stochastic analysis both in Europe and the USA last years. To try to use our specialized skills a formal procedure was initiated at the SZTAKI to get a project

in financial mathematics established. The initiative was accepted and the inter-laboratory virtual research group ‘Financial Mathematics and Management’ was established.

Our research efforts, in the stochastic aspects, are focused on market incompleteness due to uncertainties such as poor volatility estimates in modeling the stock-processes. Under too much modeling uncertainties the market is incomplete, and replicating a contingent claim requires a non-self-financing portfolio. We have analyzed the path-wise add-on cost and used it in formulating a stochastic programming problem which yields a performance index for any given price on which the seller and buyer agree. This approach has been motivated by my earlier research with Jorma Rissanen in the area of stochastic complexity on the interaction of statistical uncertainty and performance. The method is a result of my joint work with György Michaletzky, head of department at the Eötvös Loránd University (ELTE), Budapest, and a part-time researcher at the SZTAKI, an international authority on stochastic realization theory, and with Miklós Rásonyi, the youngest member of the Stochastic Systems Research Group. To get a data-driven procedure we also consider the analysis of financial data by using on-line statistical analysis, including adaptive prediction and change-detection. Zsuzsanna Vágó, member of Laboratory of Operations Research and Decision Systems, has obtained a János Bolyai research scholarship for three years to study these problems.

In addition to research, we have started an educational program. First, we had set up a one-semester course on derivative pricing. An adequate place for this course was the Department of Probability Theory and Statistics at the Eötvös Loránd University, headed by György Michaletzky.

A major thrust to our educational activity was a one-week thrilling minicourse, 14-20 September, 1998, held by Tomas Björk, with the title ‘Arbitrage pricing of derivative financial securities’. The

course attracted some 30 enthusiastic participants from industry and academia. Taking the advantage of this visit, we restructured our educational program and now we have a two-semester course, including more material on interest rate theory.

We are looking forward to having our next minicourse in financial mathematics to be held next September, with the title ‘Optimal Portfolios - Risk and Return Control’, given by Ralf Korn, Department of Mathematics, University of Kaiserslautern.

We have been in co-operation with Manfred Deistler, Technical University, Wien, in the area of time-series analysis, especially with respect to co-integration. A joint project with Youri Kabanov, Department of Mathematics at Université de Franche-Comté, Besancon, France, including problems of option pricing and hedging under transaction costs is just under way. We also see risk-sensitive control, an area that has been significantly enriched by Jan van Schuppen, CWI, as a potentially useful tool for portfolio design and an area for further cooperation. We are looking forward to developing a co-operative project with the group on research theme ‘Mathematics of Finance’, CWI, headed by Hans Schumacher.

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## Understanding Mortgage-backed Securities

by Michiel Bertsch

**A research project on the mathematical modeling of fixed income markets has recently begun at the CNR institute for applied mathematics in Rome (Istituto per le Applicazioni del Calcolo – IAC-CNR). The aim is to combine ‘real world problems’ with high quality research in mathematical finance, in order to obtain a better and more efficient understanding of the correct pricing of complicated fixed income products such as mortgage-backed securities. The project is intrinsically interdisciplinary, and uses techniques varying from the statistical analysis of financial data to the development of basic models and their numerical simulation.**

IAC has started a project on financial mathematics in collaboration with INA SIM S.P.A. (INA is a major insurance company in Italy). The aim of the project is both to study existing mathematical and statistical models for the correct pricing of fixed income financial products, and to develop new ones. In the early stage we focus on one hand on the analysis of the relevant statistical data and, on the other, on the study of existing advanced models in the academic literature. In a second stage, these two activities are intended to ‘meet’ in order to develop accurate models for the pricing of complicated financial products and their numerical implementation.

A particular example of such products are the so-called mortgage-backed securities (MBS’s). Roughly speaking, the US fixed income market is divided in three areas: treasury bills, corporate bonds and MBS’s, but nowadays the latter area is the bigger one. MBS’s are liquid and they are securitized for default risk. Their only disadvantage is the

prepayment risk, and it is exactly this point which makes MBS’s difficult to price and creates a challenge to financial modelers. Someone with a mortgage usually does not optimize the moment at which he exercises the prepayment option of the mortgage, and even pooling several mortgages together does not average out this effect. In the academic literature only very few advanced pricing models have been proposed; however, after more than 30 years of experience, the US market is a source of considerable data. This means that the necessary ingredients are present to improve the methods of quantitative analysis of MBS’s. In this context, we observe that quantitative analysis becomes a particularly powerful tool in the case of new emerging markets, in which even aggressive traders may lack the necessary experience to be as efficient as usual. In the future, in the new European context, MBS’s could very well form such an emerging market.

A closing remark regards the dramatic problem of the almost complete absence of good research in applied mathematics in Italian industry. The project on MBS’s is attracting first rate students and postdocs. Some of them will become academic researchers, but I am convinced that others will find a job in Italian financial institutes. Having researchers with a PhD degree in mathematics in strategic positions in private companies would be an important step towards further high-quality collaboration with Italian industry.

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## ShowRisk – Prediction of Credit Risk

by Gerhard Paaß

**The growing number of insolvencies as well as the intensified international competition calls for reliable procedures to evaluate the credit risk (risk of insolvency) of bank loans. GMD has developed a methodology that improves the current approaches in a decisive aspect: the explicit characterization of the predictive uncertainty for each new case. The resulting procedure does not only derive a single number as result, but also describes the uncertainty of this number.**

Credit Scoring procedures use a representative sample to estimate the credit risk, the probability that a borrower will not repay the credit. If all borrowers had the same features, the credit risk may be estimated. Therefore the uncertainty of the estimate is reduced if the number of sample elements grows. In the general case complex models (eg neural networks or classification trees) are required to capture the relation between the features of the borrowers and the credit risk. Most current procedures are not capable to estimate the uncertainty of the predicted credit risk.

### ■ Prediction with Plausible Models

We employ the Bayesian theory to generate a representative selection of models describing the uncertainty. For each model a prediction is performed which yields a distribution of plausible predictions. As each model represents another possible relation between inputs and outputs, all these possibilities are taken into account in the joint prediction.

A theoretical derivation shows that the average of these plausible predictions in general has a lower error than single ‘optimal’ predictions. This was confirmed by an empirical investigation: For a real data base of several thousand

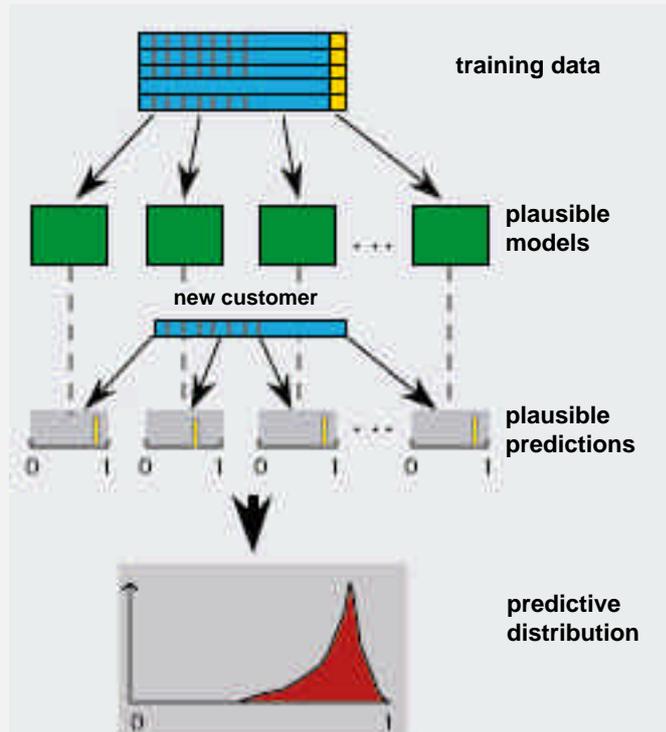


Figure 1: Steps of a prognosis.

enterprises with more than 70 balance sheet variables, the GMD procedure only rejected 35.5% of the 'good' loans, whereas other methods (neural networks, fuzzy pattern classification, etc.) rejected at least 40%.

**Expected Profit as Criterion**

The criterion for accepting a credit is a loss function specifying the gain or loss in case of solvency/insolvency. Using the predicted credit risk we may estimate the average or expected profit. According to statistical decision theory a credit application should be accepted if this

expected profit is positive. Depending on the credit conditions (interest rate, securities) this defines a decision threshold for the expected profit.

In figures 2 and 3 the decision threshold for a credit condition is depicted: If the predicted average credit risk is above the threshold, a loss is to be expected on average and the loan application should be rejected. Figure 2 shows a predictive distribution where the expected credit risk is low. The uncertainty about the credit risk is low, too, and the loan application could be accepted without further investigations. The expected

credit risk of the predictive distribution in figure 3 is close to the decision threshold.

The actual credit risk could be located in the favourable region the intermediate range or in the adverse region. The information in the training data are not sufficient to assign the credit risk to one of the regions. Obviously the data base contains too few similar cases for this prediction resulting in an uncertain prediction. Therefore in this case there is a large chance that additional information, especially a closer audit of the customer, yields a favorable credit risk.

**Application**

Under a contract the credit scoring procedure was adapted to the data of the German banking group Deutscher Sparkassen und Giroverband and is currently in a test phase. For each new application it is possible to modify the credit conditions (interest rate, securities) to find the conditions, where the credit on the average will yield a profit. For a prediction the computing times are about a second. Currently an explanation module is developed which will explain the customer and the bank officer in terms of plausible rules and concepts, why the procedure generated a specific prediction.

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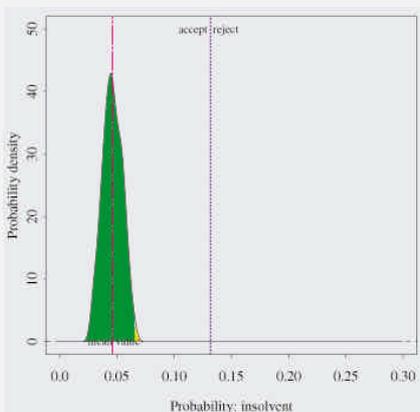


Figure 2: Distribution of credit risk with low expected credit risk and low uncertainty.

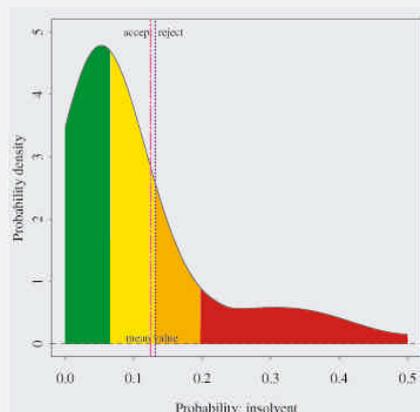


Figure 3: Distribution of credit risk with medium expected credit risk and high uncertainty.

# Stochastic Methods in Finance: Evaluating Predictions

by Valeria Skrivankova

**Stochastic methods in finance are mainly connected with risky financial operations, for example the security market trading. Relevant decisions are affected by a prediction of some quantity, but the adequate judgment on the future fulfilments of the expectation is often a difficult problem. Common methods of the evaluation of judgments are based on long term observations. The presented method of evaluation called Reflexive Evaluation Of Predictive Expertises (REOPE) is also applicable for the unrepeatable expertises.**

The financial market models are based on the premise that investors like return and dislike risk. So the financial management wants to maximize the return and minimize the risk. For this purpose it is necessary to have the best forecast of expected return and risk. The definition of risk used in a classical Markowitz 'Mean-Variance' Model for effective portfolio is a measure of the variability of return called the standard deviation of return. So the main task is to predict (estimate) the expected return and the standard deviation.

## What Forecasting can and cannot do?

One should not expect any forecasting theory or technique to predict the precise value at which a future price will settle tomorrow, or any given day, or what the exact high or low will be. A good forecasting method will on average have a small forecast error; that is, the difference between the forecast price and the actual market price will be small. Further, the forecast must be unbiased, which means that the errors should overshoot the actual price as often and by as much as they undershoot it.

## Measuring Talent by Common Methods

Talent can be differentiated from luck only by examining results averaged over many periods. Investors and management cannot afford to evaluate future performance and the reason for it merely on the basis of a one period forecast. They must consider such things as the expected contribution of a security analyst over time, how to estimate it and how to organize to make the most of it.

## Formulation of the Problem for REOPE

Consider the predicted quantity as a random variable  $X$  (eg portfolio return). Suppose that the quality of the judgement of  $X$  is evaluated according to the correspondence of the estimation with the consequently realized value of  $X$  only. Let  $t(X)$  be a relevant parameter of the distribution of  $X$  in sense of expert's opinion. The problem of the judgement evaluation is generally based on an evaluation function  $h = h(x, estim t)$ , where  $x$  is the realized value of  $X$  and  $estim t$  is the expert's estimation of  $t$ . The expert's criterion of optimality is fulfilled if he gives unbiased estimate of  $t$ . Suppose that  $estim t$  is fully determined by the expert's effort to optimize his criterion  $C$  which is connected with the evaluation  $h(X, estim t)$  of his work only. So we have to find the concrete evaluation function as a solution of certain equation. The expert's performance evaluation:

- optimizes the expert's criterion of utility  $C$  if he delivers an unbiased judgement
- reflects the correspondence between the single estimation of some parameter and the consequently realized value of the predicted quantity only
- motivates the expert to put a reasonable deal of his effort in the judgement.

## Mean Value Judgements

Let  $X$  be the followed random variable,  $E$  represents the mean value operator, the parameter  $t$  of the distribution of  $X$  is  $E(X)$ . The expert's criterion of optimality consists in the maximization of the mean value of his future evaluation here. We search for a function  $h$  so that

$E[h(X, E(X))]$  is the maximum of  $E[h(X, estim t)]$ . We can show that the function  $h$  given as  $a - b(estim t - x).(estim t - x)$ , where  $a, x$  are real numbers and  $b$  positive, fulfils our condition. Parameters  $a, b$  can be chosen by higher level management (management of expertises).

Common methods for the evaluation of judgements are based on statistical analysis of adequacy of past judgement. Ferguson (1975) uses simple regression methods which require long term observations. These models aren't suitable for the unrepeatable expertises. The presented method of evaluation is always applicable if the manager knows the expert's criterion  $C$  and the expert knows the evaluation function  $h$ . This method reflects the expert's success immediately so motivates him to the optimal performance in every judgement.

The given solution of the problem does not claim completeness. Probability distribution judgements and manager's utility optimization were published by Skrivanek (1996) and Skrivankova (1998). Statistical regulation of estimations and hypothesis testing of their convenience are studied.

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# Model Risk Analysis for Discount Bond Options

by Denis Talay

**Researchers of the Omega research group at INRIA Sophia Antipolis and of the University of Lausanne have started in 1998 a study on model risk for discount bond options. This research is funded by the Swiss Risklab institute. The aim of the project is to see how models risk affects the risk management of interest rate derivatives and how to manage this risk.**

RiskLab is a Swiss inter-university research institute, concentrating on precompetitive, applied research in the general area of (integrated) risk management for finance and insurance. The institute, founded in 1994, is presently co-sponsored by the ETHZ, the Crédit Suisse Group, the Swiss Reinsurance Company and UBS AG. Several research projects are being funded by Risklab. Among them, the project on model risk analysis for discount bond options proposed by researchers at the University of Lausanne (Rajna Gibson and François-Serge Lhabitant) and the Omega Research group at INRIA Sophia Antipolis (Mireille Bossy, Nathalie Pistre, Denis Talay, Zheng Ziyu).

Model risk is an important question for financial institutions. Indeed, trading, hedging and managing strategies for their books of options are derived from stochastic models proposed in the literature to describe the underlying assets evolutions. Of course these models are imperfect and, even if it were not, their parameters could not be estimated perfectly since, eg, market prices cannot be observed in continuous time. For discount bond options, additional mispecifications occur: for example, it seems difficult to discriminate models and to calibrate them from historical data

of the term structure. Thus a trader cannot make use of perfectly replicating strategies to hedge such options. The purpose of the study is to provide an analytical framework in which we formalize the model risk incurred by a financial institution which acts either as a market maker — posting bid and ask prices and replicating the instrument bought or sold — or as a trader who takes the market price as given and replicates the transaction until a terminal date (which does not necessarily extend until the maturity of his long or short position).

The first part of the study is to define the agent's profit and loss due to model risk, given that he uses an incorrect model for his replicating strategy, and to analytically (or numerically) analyse its distribution at any time. This allows us to quantify model risk for path independent as well as for path dependent derivatives. The main contributions of the study is to decompose the Profit and Loss (P&L) into three distinct terms: the first representing a pricing freedom degree arising at the strategy's inception (date 0), the second term representing the pricing error evaluated as of the current date  $t$  and the final term defining the cumulative replicating error which is shown to be essentially determined by the agent's erroneous 'gamma' multiplied by the squared deviation between the two forward rate volatilities curve segments' specifications. We furthermore derive the analytical properties of the P&L function for some simple forward rate volatilities specifications and finally conduct Monte Carlo simulations to illustrate and characterize the model error properties with respect to the moneyness, the time to maturity and the objective function chosen by the institution to evaluate the risk related to the wrong replicating model. A specific error analysis has been made for the numerical approximation of the quantiles of the P&L.

Aside from providing a fairly general yet conceptual framework for assessing model risk for interest rate sensitive claims, this approach has two interesting properties: first, it can be applied to a fairly large class of term structure models (all those nested in the Heath, Jarrow,

Morton general specification). Secondly, it shows that model risk does indeed encompass three well defined steps, that is, the identification of the factors, their specification and the estimation of the model's parameters. The elegance of the HJM term structure characterization is that those three steps can all be recast in terms of the specification and the estimation of the proper forward volatility curve function.

The second part of the study concerns the model risk management. We construct a strategy which minimizes the trader's losses universally with respect to all the possible stochastic dynamics of the term structure within a large class of models. This leads to complex stochastic game problems, hard to study theoretically and to solve numerically: this is in current progress.

Risklab: <http://www.risklab.ch/>

Omega Research team:

<http://www.inria.fr/Equipes/OMEGA-fra.html>

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## Numerical Algorithms Group

by David Sayers

**Numerical Algorithms Group Ltd (NAG<sup>TM</sup>), a not-for-profit software house, is the UK's leading producer and supplier of mathematical computer software for business, education and industry. A key focus and growth area is the complex world of finance. Here, according to NAG technical consultant David Sayers, the role that his company's technology could play in delivering competitive advantage is tantalisingly ripe for discovery.**

NAG was founded in an academic research environment. It was created in

1970 by numerical analysts co-ordinated from the University of Nottingham, moved to Oxford in 1973, then expanded to become an international group. Today NAG continues to be driven by a network of research professionals from around the world. Its successes to date have always depended on integrating this world effectively with that of the 'real' world as experienced by the end users of its technology. Nag is committed to secure future successes by adopting the same approach. For example, there is little point forging ahead with research to heighten accuracy, when customers have a more pressing need for speed of delivery. NAG has recently launched a proactive initiative to investigate the financial customer base in more detail, to direct its research network to deal more closely with the real life problems financial analysts have to solve today....and tomorrow.

NAG's numerical libraries are already used extensively in financial institutions around the world, here NAG is prized for the high quality, reliability and speed of its software, scope (in terms of the range of solutions available) and attentive level of technical support. The customer base is wide ranging, some users work on the smallest PC while others manage the most modern supercomputers; they use a variety of computing languages. A key requirement these institutions have in common is the need to use NAG routines to develop unique in-house trading and pricing strategies, something that is not possible with off-the-shelf complete packages.

For those with particularly complex financial challenges, NAG also offers a consultancy service. Recent work, for example, involved a sophisticated portfolio tracking program and the provision of a bespoke module for trading in global currency and bond markets.

The same NAG mathematical consultants are constantly considering general trends in the marketplace to direct software development.

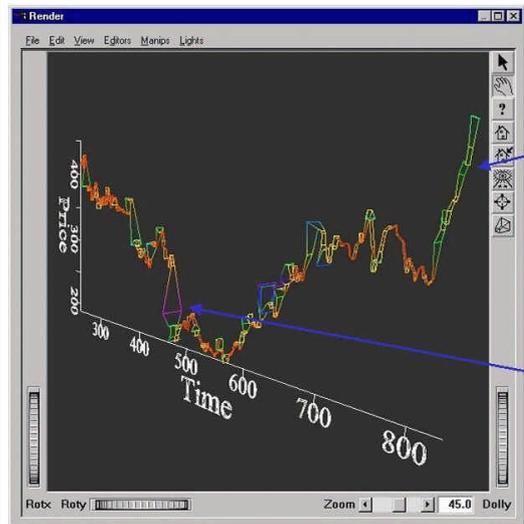
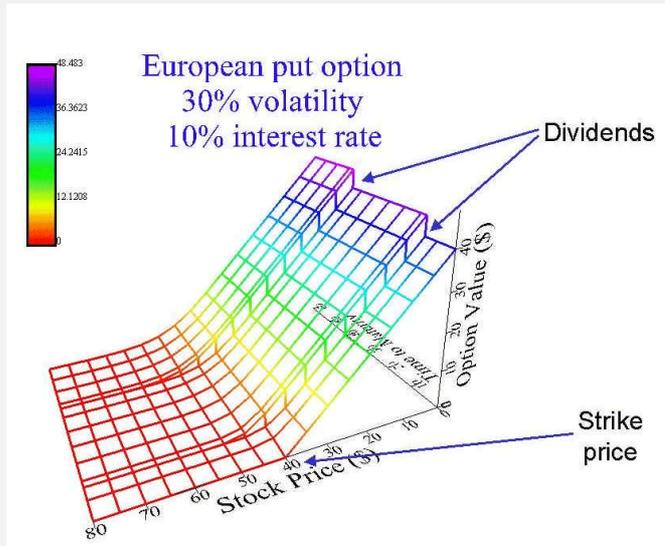
Key trends already identified include interest in the single European currency. NAG has already predicted a refinement

in investment strategies based on a much larger global portfolio of shares than at present in Europe. The indices will now cross the European spectrum of shares not just those quoted on the local exchanges. Problem sizes will be larger, leading to a greater demand for more powerful routines capable of solving larger problems. Here NAG's multi-processor libraries (SMP and Parallel libraries) are the ideal solution.

Another interesting development under scrutiny is the inclusion of transaction costs in portfolio modelling. This leads to the minimisation of numerically difficult discontinuous functions. Accordingly, major software systems will need to rely on NAG's expertise and quality to solve complex problems.

Derivatives are also becoming more complex – with simple option pricing

giving way to the more complicated problem of pricing exotic derivatives. Black-Scholes models are now starting to give way to more sophisticated models. As European markets change, so will the regulatory bodies and surrounding legislation. Dealers will need to know how their books stand at the end of the day, to meet both the regulatory requirements and the 'risk of exposure' requirements of their own managers. With NAG's flexible solvers, the adaptation to changing circumstances is made possible. NAG is also already anticipating new breeds of programmers graduating from universities. These people are moving away from the traditional library approach to problem solving. They will need either more sophisticated components or solution modules that interface to 'packages' or 'problem solving environments'. Users will have ever increasing amounts of data



NAG's visualisation package IRIS Explorer illustrates the type of visual analysis the financial community increasingly needs. Complex information is easily digested in a second and the ability to view data in different dimensions reveals pertinent relationships that could otherwise go overlooked.

to analyse and assess. This will require good visualisation capabilities and a system capable of performing meaningful and powerful statistical analysis of that data.

Looking ahead, NAG is committed to meeting financial analysts' need for speedier, accurate solutions by enhancing the numerical libraries that have already gained a considerable following in this community. The company will also deliver the security and flexibility these customers require. As architectures change, so the libraries will change to fully exploit new features and to embrace the increasing need for thread-safety. At the same time, NAG will enhance the libraries with newer and more powerful solvers, keeping pace with the rapid advances in numerical techniques. In addition, further work will focus on presenting NAG's numerical techniques in new ways, ensuring the power of this technology can be accessed by news types of user.

NAG also anticipates a surge in awareness of the competitive advantage of using visualisation packages, again a key area for the new types of user. NAG's own package, IRIS Explorer(tm) can be combined with the reliable engines of the company's libraries to form a bespoke computational and visualisation program. This is a vital development in the financial world where, for example, dealers are under pressure to absorb the results of a calculation at a glance. Numbers are not sufficient. NAG is set to develop more visualisation modules to meet the expected demand for increasingly more powerful tools in this area.

Further focus areas and challenges will doubtless emerge. NAG anticipates with relish that the rate of change and pace of software development will be phenomenal. For more information on NAG, see <http://www.nag.co.uk>.

■  
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## Premia: An Option Pricing Project

by **Claude Martini**  
and **Antonino Zanette**

**The main purpose of the Premia consortium is to provide routines for pricing financial derivative products together with scientific documentation. The Premia project is carried out at INRIA and CERMICS (Centre d'Enseignement et de Recherche en Mathématiques, Informatique et Calcul Scientifique).**

The Premia project focuses on the implementation of numerical analysis techniques to compute the quantities of interest rather than on the financial context. It is an attempt to keep track of the most recent advances in the field from a numerical point of view in a well-documented manner. The ultimate aim is to assist the R&D professional teams in their day-to-day duty. It may also be useful for academics who wish to perform tests on a new algorithm or pricing method without starting from scratch.

The Premia project is three-fold:

- the first component is a library designed to describe derivative products, models, pricing methods and which provides basic input/output functionalities. This library is written in C language and is object-oriented.
- The second component is the pricing routines themselves. Each routine is written in a separate .c file. The .c file contains the code of the routine; this part of the code is what matters for users who want to plug the routines of Premia in to another software.
- The third component is the scientific documentation system. It is created from hyperlinked PDF files which discuss either a pricing routine (every routine has its own PDF doc file) or a more general topic like Monte Carlo methods, lattice methods, etc. This web of PDF files also includes a PDF version of the whole C source code with

easy jumps from the source file to the documentation file.

The most valuable component of this project is the documentation which makes use of the scientific and numerical knowledge of our institutions. This documentation will complement in an important way books devoted to theoretical option pricing. The routines themselves come in second. We feel that on a given pricing issue some other professional R&D team will certainly have much better and competitive software or algorithm. Nevertheless on the average Premia should be of interest to them. Lastly the object-oriented software is only there to provide an easy way to test things. It was mainly designed for the use of the Premia team. Thus, Premia is more attractive than a plain library of C routines.

### Current State and Perspectives

We have already programmed and documented a fairly large set of routines computing the prices and the hedges of stock options. These routines use mainly explicit, lattice or finite difference methods. Current work deals with Monte-Carlo and quasi-Monte-carlo methods. We plan to start implementing algorithms for interest rate options in early 2000.

This project is funded by a group of financial institutions called the Premia consortium. Members of the consortium are Crédit Agricole Indosuez, Crédit Lyonnais, Caisse Centrale des Banques Populaires, Union Européenne du CIC, Caisse des Dépôts et Consignations. The funding members have access to the complete software with the source and the documentation. Other interested financial institutions are welcome to join the consortium.

A web site describing in more detail the aims of the project and the way to join the consortium is available at: <http://cermics.enpc.fr/~premia/>

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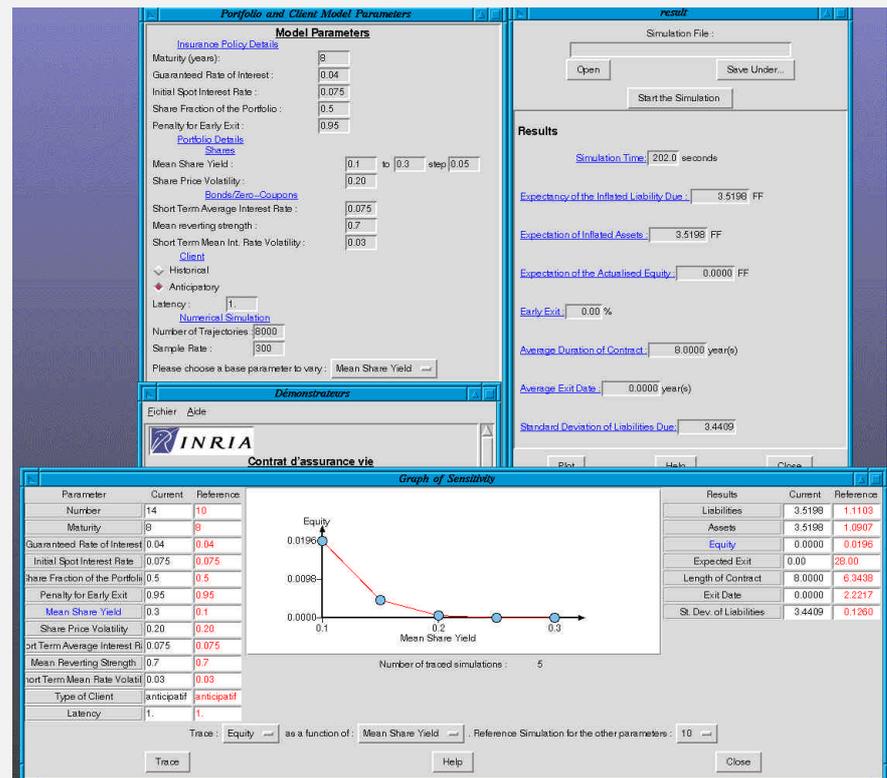
# Life Insurance Contract Simulations

by Mireille Bossy

A common feature of life insurance contracts is the early exit option which allows the policy holder to end the contract at any time before its maturity (with a penalty). Because of this option, usual methodologies fail to compute the value and the sensibility of the debt of the Insurance Company towards its customers. Moreover, it is now commonly admitted that an early exit option is a source of risk in a volatile interest rates environment. The OMEGA Research team at INRIA Sophia Antipolis studies risk management strategies for life insurance contracts which guarantee a minimal rate of return augmented by a participation to the financial benefits of the Company.

A preliminary work of OMEGA consisted in studying the dependency of the Insurance Company's debt value towards a given customer on various parameters such as the policy holder criterion of early exit and the financial parameters of the Company investment portfolio. Statistics of the value of the debt are obtained owing to a Monte Carlo method and simulations of the random evolution of the Company's financial portfolio, the interest rates and of the behaviour of a customer.

More precisely, the debt at the exit time  $t$  from the contract (with an initial value of 1), is modeled by  $D(t) = p(t)[\exp(rt) + \max(0, A(t) - \exp(rt))]$ . Here,  $r$  is the minimal rate of return guaranteed by the contract and  $\exp(rt)$  stands for the guaranteed minimal value of the contract at time  $t$ .  $A(t)$  is the value of the assets of the Company invested in a financial portfolio. A simplified model is  $A(t) = a S_t + b Z(t)$ , where  $S(t)$  (respectively  $Z(t)$ ) is the value of the stocks (respectively of the bonds) held by the Company;  $a$  and  $b$  denote the proportions of the investments in stocks and in bonds



LICS: a Life Insurance Contract Simulation software.

respectively. Finally, the function  $p(t)$  describes the penalty applied to the policy holder in the case of an anticipated exit of the contract. Two kinds of exit criterions are studied: the 'historical' customer chooses his exit time by computing mean rates of return on the basis of the past of the contract; the 'anticipative' customer applies a more complex rule which takes the conditional expected returns of the contract into account. In both cases, a latency parameter is introduced to represent the customer's rationality with respect to his exit criterion. (The simulation of a large number of independent paths of the processes  $S$  and  $Z$  permits to compute the different values of assets and liabilities in terms of the parameters of the market,  $a$ ,  $b$ , and the strategy followed by the policy holder.)

In our first simulations, the asset of the Company was extremely simplified:  $S(t)$  is the market price of a unique share (described by the Black and Scholes paradigm) and  $Z(t)$  is the market price of a unique zero-coupon bond (derived from the Vasicek model). Even in this framework, the computational cost is high and we take advantage of the Monte

Carlo procedure to propose a software (named LICS) which attempts to demonstrate the advantage of parallel computing in this field. This software was achieved within the FINANCE activity of the ProHPC TTN of HPCN.

The computational cost corresponding to more realistic models can become huge. Starting in March 99, the AMAZONE project is a part of the G.I.E. Dyade (BULL/INRIA). Its aim is to implement LICS on the NEC SX-4/16 Vector/Parallel Supercomputer. This version will include a large diversification of the financial portfolio (around thousand lines) and an aggregation of a large number of contracts mixing customers' behaviors.

In parallel to this the OMEGA team studies the problem of the optimal portfolio allocation in the context of simplified models for life insurance contract. For more information, see: <http://www-sop.inria.fr/omega/finance/demonst.html>, <http://www.dyade.fr>

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# Using a Domain-Specific Language for Financial Engineering

by Arie van Deursen

**In order to reduce the lead time to market for new types of financial products, it is crucial that a bank's financial and management information systems can be quickly adapted. The use of domain-specific languages has proved a valuable tool to achieve this required flexibility.**

Financial engineering deals, amongst others, with interest rate products. These products are typically used for inter-bank trade, or to finance company take-overs involving triple comma figures in multiple currencies. Crucial for such transactions are the protection against and the well-timed exploitation of risks coming with interest rate or currency exchange rate fluctuations.

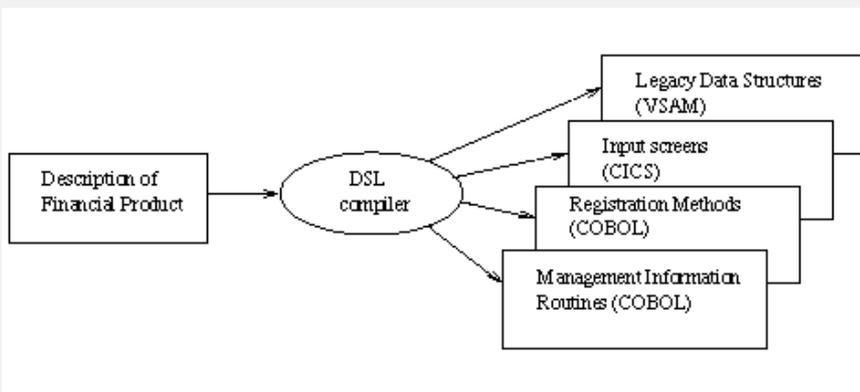
The simplest interest rate product is the loan: a fixed amount in a certain currency is borrowed for a fixed period at a given interest rate. More complicated products, such as the financial future, the forward rate agreement, or the capped floater, all aim at risk reallocation. Banks frequently invent new ways to achieve this, giving rise to more and more interest rate products. This, however, affects the

bank's automated systems, which perform contract administration and provide management information concerning the bank's on- and off-balance position, interest and exchange rate risks, etc.

To make the required modifications to these systems, bank MeesPierson and software house CAP Gemini decided to describe the essence of their interest rate products in a high-level language, and to generate the software automatically from these product descriptions. To that end, a small domain-specific language was designed, especially suited to describe so-called cash-flows following from products.

The use of this language is illustrated in the Figure. At the heart of the system is a compiler for the domain-specific language. Given a high-level product description, it is able to generate automatically data structures in VSAM format, data entry screens in CICS format, and COBOL routines for registering modifications in the product or for yielding management information.

The key enabler to the compiler is a COBOL library formalizing domain concepts such as cash flows, intervals, interest payment schemes, date manipulations, etc. The domain-specific language provides ways to combine these concepts into products, using a notation that is familiar to financial engineers. The language has been developed in collaboration with CWI, using the ASF+SDF Meta-Environment to construct a prototype tool suite.



Use of a language, designed to describe so-called cash-flows following from products.

The language has been included in Cap Gemini's Financial Product System FPS, which is in use at several Dutch financial institutions. Time to market has gone down from months to days, and IT cost reductions of up to 50% have been reported.

At the time of writing, CWI is involved in a major research project addressing the tooling, application, and methodology of domain-specific languages in general – a project that is carried out as part of the Dutch Telematics Institute, in collaboration with several Dutch businesses.

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## Subsymbolic and Hybrid Artificial Intelligence Techniques in Financial Engineering

by László Monostori

The major difficulties in financial engineering, the most computational intense subfield of finance, are as follows. The problems are usually multivariate, nonlinear, difficult to model. The information available is imprecise and incomplete, can have both numerical and linguistic forms. Chaotic features and changing environment can be mentioned as further barriers. Obviously, intelligent techniques, more exactly, techniques of artificial intelligence (AI) research, became conspicuous in different fields of finance and business. The range of applications is rapidly increasing and companies use intelligent systems even to automate parts of their core

**business. The fundamental goal of investigations started some years ago at the SZTAKI was to explore intelligent techniques, including intelligent hybrid systems and multistrategy learning applicable in different fields of finance and business.**

The potential users of intelligent techniques in finance and business are corporate finance, financial institutions, and professional investors. The applications can be grouped as follows: analysis of financial condition, business failure prediction, debt risk assessment, security market applications, financial forecasting, portfolio management, fraud detection and insurance, mining of financial and economic databases, other (eg macroeconomics) applications.

Intelligent hybrid systems are a very powerful class of computational methods that can provide solutions to problems that are not solvable by an individual intelligent technique alone. Perhaps, the most important class of hybrid systems is the integration of expert systems and neural networks. Several techniques have emerged over the past few years spreading from stand-alone models, through transformational, loosely and tightly coupled models to fully integrated expert system/neural network models. The integration of neural and fuzzy

techniques, which can be considered as a 'full integration', is an approach of high importance.

Software tools for technical and financial applications have been developed at the Research Group on Intelligent Manufacturing and Business Processes (IMBP) at the SZTAKI. The general-purpose neural network simulator (NEURECA) is to be mentioned first, which provides an integrated framework including feature definition and real-time computation; automatic feature selection; various learning algorithms, classification, estimation of unknown patterns; standardized (DDE) interfaces to other programs, etc. NEURECA was written in C++ using its object-oriented nature enabling to dynamically vary the network structure during learning and to implement different hybrid AI models:

- a hierarchically connected hybrid AI system, HYBEXP where neural networks work on the lower, subsymbolic level coupled with an expert system (ES) on the higher, symbolic level
- the neuro-fuzzy version of NEURECA, which is a symbiotic-type of hybrid AI system, uses a multistrategy learning approach combining self-organized clustering for initializing the membership functions (MBFs), competitive learning for selecting the

most important fuzzy rules, and back propagation (BP) learning for fine tuning the MBFs' parameters

- genetic algorithms supported rule selection within the neuro-fuzzy version of NEURECA.

The applicability of the developed techniques has been demonstrated through case studies:

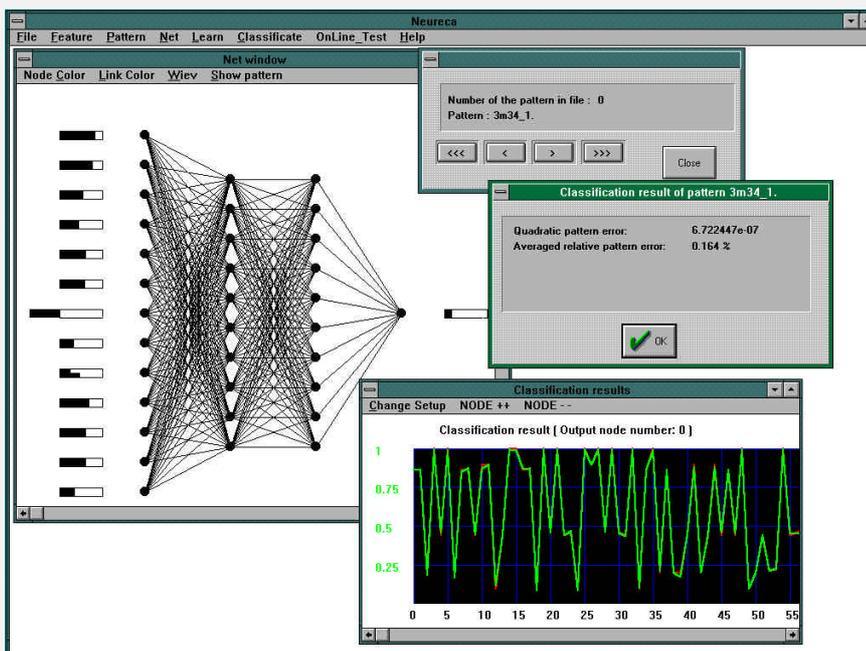
- ANN-based forecasting of stock prices
- bankruptcy prediction by ANN and neuro-fuzzy techniques
- stock analysis and trading with neuro-fuzzy techniques.

Promising results have been achieved illustrating the benefits of the hybrid AI approaches (eg comprehensive structures, some sort of explanation facility, higher convergence speed, etc.) over conventional methods or pure ANN or ES solutions.

Within SZTAKI, these and related activities in the field of financial engineering are coordinated by the inter-laboratory Research Group of Financial Mathematics and Management. Further impulses are expected from the ERCIM Working Group on Financial Mathematics. This project is partially supported by the Scientific Research Fund OTKA, Hungary, Grant No. T023650.

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The NEURECA ANN simulator.

# Micro Analytic Simulation Models for Political Planning

by Hermann Quinke

**The ever increasing complexity is a distinctive characteristic of tax and transfer laws. It is therefore impossible to evaluate proposed or enacted amendments without appropriate simulation models. GMD has a long standing tradition in developing such models and applying them in the context of the political decision making process. The project MIKMOD continues this tradition, because the demand for such models by the federal administration remains high and because their development poses interesting research problems.**

MIKMOD focuses on the development and application of microsimulation models for taxes and transfer programs and other types of models that proved useful for the analytical tasks of the administration. Microsimulation models are well suited for estimating the cost of law changes ie the change of total program cost or tax revenue. They are based on a projected representative sample of the relevant population segment, the micro data base. These models are also capable of estimating the distributive impact of the amendments.

For the German Federal Ministry for Education, Science, Research and Technology, we still maintain and update regularly the static micromodel BAFPLAN for the analysis of the federal training assistance act (BAföG). BAFPLAN is one of the few microsimulation models in Germany, which has been used in various versions on a regular basis for over fifteen years. We have built a comparable model for East Germany, because the income level and other socio-economic characteristics

in East and West Germany are and continue to be very divergent.

To keep the forecasting errors within reasonable bounds the database of BAFPLAN has to be replaced by a more timely sample of eligible students on a regular basis. Also the student forecasts, underlying the projection (ageing) of the sample, are regularly updated. Experience with BAFPLAN indicates, that these models are of course still prone to error, but that the forecasting errors are significantly smaller than those of the more intuitive methods formerly used.

The Federal Ministry for Families, the Elderly, Women and Youth has a special need for tools to analyse the economic conditions of the elderly. To satisfy these needs GMD developed AsA (Analysesystem Alterssicherung), a comprehensive model for simulating the formation of old-age income and its levying with social security contributions and taxes. It has been used extensively in the discussion about the radical change in the taxation of old-age income as well as for analysing the reform of the core pension insurance (Gesetzliche Rentenversicherung).

AsA consists of two components. One component comprises a classical static microanalytical simulation model in which specific variants of income-tax and social contributions are specified and the incomes of a representative sample of persons receiving old-age income are exposed to these variants. A common data base has been developed for the Federal Ministry for Families, the Elderly, Women and Youth and the Federal Ministry of Finance, derived from a survey by Infratest. The second component of AsA is a typical case model. It allows for analysing the generation of old-age income depending on individual biographies and the membership of an individual in one or more of the different systems providing old-age income. Due to the particular usage of AsA in the policy making process special emphasis has been put on the parametrization of the institutional specifics in order to speed up the analysis

of the economic effects of proposed legislative changes.

For the same ministry we developed APF, a decision support system for analysing direct and indirect transfers to families with dependent children. Like AsA it contains an elaborate typical case model, which is able to analyse the impact of direct and indirect taxation as well as the effect of all major transfers on the disposable income of families, seen as typical by the user. It also comprises a micromodel for estimating the cost of transfers to families with children. Because stringent data protection laws prohibit the access to a sample of tax returns for this ministry, the latest income and expenditure survey is used as the database. This survey had to be adjusted to key tables of the income tax statistic to reflect fully the income distribution of families. APF is the main analytical tool of the ministry in the ongoing discussion about public transfers to families.

The personal income model of the German Federal Ministry of Finance is based on a stratified sample of 123 thousand income tax returns, which was drawn and updated by MIKMOD. This model provides detailed analysis of changes in personal income tax. In order to estimate the distributive effects of decreasing income taxes and increasing indirect taxes, especially energy taxes, MIKMOD imputed the consumption pattern of all tax units in the sample by matching the income and expenditure survey and the sample of tax returns. ■

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# KALIF – Kernel Algorithms for Learning in Feature Spaces

by Bernhard Schölkopf

**Kernel Algorithms represent a novel means for nonlinear analysis of complex real-world data. By providing a mathematical foundation for previous algorithms such as Neural Nets, they support systematic and principled improvements of learning algorithms for pattern recognition, function estimation, and feature extraction.**

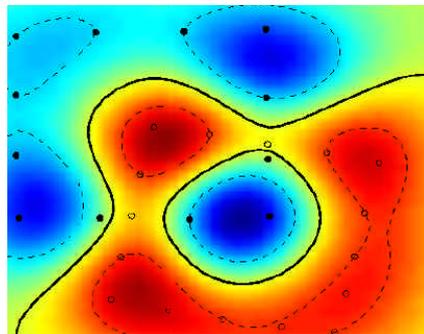
Learning algorithms are particularly useful in situations where an empirically observable dependency cannot be modelled explicitly, but ample empirical data are available. Examples thereof include pattern recognition problems ranging from pedestrian or traffic sign detection via internet text categorization to problems of financial time series analysis.

The KALIF project (Kernel Algorithms for Learning in Feature Spaces) develops and applies statistical methods for data analysis in nonlinear feature spaces. One can show that a certain class of kernel functions computes dot products in high-dimensional feature spaces nonlinearly related to input space. This way, a number of learning algorithms that can be cast in terms of dot products can implicitly be carried out in feature spaces – without the need for complex calculations in these high-dimensional spaces.

An example thereof are Support Vector methods for classification (see Figure) and regression. Moreover, we have recently generalized a standard algorithm for high-dimensional data analysis, the algorithm of statistical principal component analysis (PCA), to the nonlinear case. To this end, we carry out

standard linear PCA in the feature space, using kernels. The algorithm boils down to a matrix diagonalization. It can, for instance, be used for nonlinear feature extraction and dimensionality reduction.

It is precisely the close encounter of theory and practice that renders this recently emerging research area particularly appealing: using complexity concepts of statistical learning theory and methods of functional analysis, we can now theoretically analyze and further develop a number of successful heuristical methods of data analysis. This has already led to record results on



**By using a kernel to compute dot products, a Support Vector Classifier constructs a hyperplane in feature space, corresponding to a nonlinear decision rule in input space.**

several benchmark problems, such as the digit recognition database of the American National Institute of Standards and Technology (NIST).

Potentially more important, however, is the fact that the increased accuracy of these algorithms helps opening up new application fields, which previously had not been accessible to machine learning such as, for instance, very high-dimensional data sets.

More information at:  
<http://svm.first.gmd.de/kalif.html>

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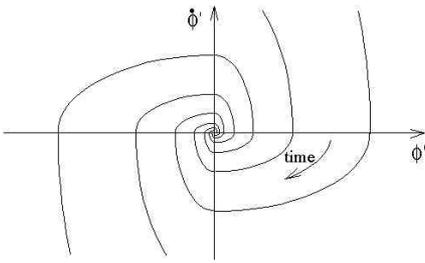
# Control Theory and Electro-elasticity: Realisation of an Active Damper

by Maurizio Brocato

**Interaction between mechanics and electronics is paramount in the design of sensors and actuators. At IEI-CNR, a system based on the electrorheologic properties of a colloidal suspension, capable of damping mechanical vibrations of small amplitude has been conceived and developed.**

Sensors and actuators are often developed using materials with particular electromechanical properties; their modelling as continua with microstructure differs from ordinary cases because of the possibility of controlling, at least in part, their microstructure. The design and optimisation of such devices utilises the mathematical theory of distributed controls. We deal with a problem of this type, but the case at issue differs from those prevalently analysed in the literature (mainly after the work of J. L. Lions) as some of the mechanical constitutive parameters may be altered, within limits, at will.

In a previous paper the author suggested an application of Pontryagin's Maximum Principle to find optimal control paths for such 'controllable' materials. The example of how mechanical waves can be damped, within given optimality requirements, in a body of which the elastic response can be controlled was given. The optimal path to be followed in order to minimise the kinetic energy in the shortest time, is of the type shown in Figure 1 on a deformation vs. rate of deformation plane: the body has to be as stiff as possible when its kinetic energy transforms into an elastic one, and as soft as possible under the opposite



**Figure 1: Optimal paths to damp elastic waves.**

circumstances. Energy is thus dissipated due to the discontinuities of the elastic behaviour in time.

To implement this control strategy and build an active device capable of damping vibrations, we need a fit actuator: a material with elastic modulus that can be controlled and modified sufficiently quickly to switch from its softest to its stiffest configuration four times during each period of the unwanted oscillation. Electrorheologic (ER) materials meet these requirements.

ER materials are colloidal suspensions of dielectric particles in a dielectric fluid, characterised by the Winslow effect. Applying an electric field, the suspension aggregates in columns orthogonal to the equipotential surfaces of the field. This phenomenon is primarily due to charges that accumulate at the interface between fluid and particles causing the latter to behave like dipoles. Thus, acting on the electric field, the microstructure of the mixture and therefore its gross mechanical properties can be modified. The mathematical model of such a sudden change of phase is particularly interesting and will be studied in the near future.

The particles' organisation in columns is reversible and ruled by a threshold of the electric field (a characteristic of the particular material employed, which, typically, ranges from 2 to 3 MV/m) above which it cannot be observed. The time needed for the organisation or its decomposition is in the order of 1 ms.

This effect is well known since Winslow's work in 1949. We focus on a particular aspect of it which, so far, has

been given little attention in applications: it gives the mixture – considered as a (perhaps composite) continuum – the typical behaviour of a Bingham body. When the suspension is organised in columns, applying a small mechanical force, the system reacts as a linear elastic solid, ie with a small displacement proportional to that force. This can be explained by the fact that the columns are neither destroyed nor rearranged during this process: they shear and bend as if they were very many small beams within the fluid matrix (of which the dynamic influence is probably negligible for such small displacements).

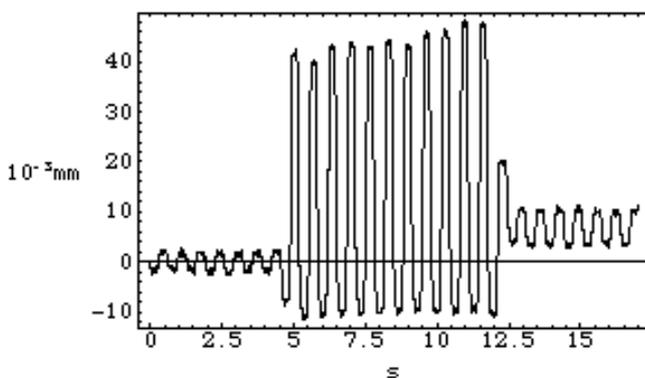
In our experimental set up, two conducting cylinders are free to move one into the other only along their common axis; both are in contact via a suspension of starch into silicon oil filling the thin space in between them, but otherwise electrically separate. When a relatively small motion occurs the sheared ER material reacts elastically, provided there is a sufficient difference of potential between the cylinders.

To realise the control algorithm, an LVDT (Linear Variable Differential Transformer) sensor captures the relative displacement of the cylinder and informs a computer of the current kinematic state. Once converted in terms of the phase variables of Figure 1, this information is sufficient to decide whether to switch on or off the electric field and thus drive the process along the desired path. The switch needed to interrupt about 2mA at 3kV in a few ms has been implemented using a beam triode.

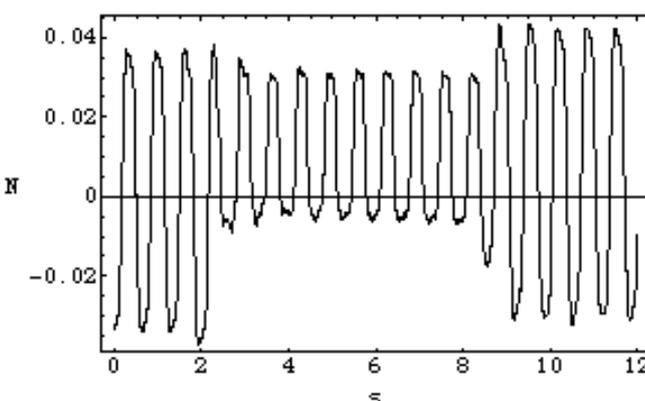
The plots in Figure 2 and Figure 3 show the effect on displacement and force of two opposite steps (on/off/on) of the electric field.

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**Figure 2: Displacement vs. time.**



**Figure 3: Force vs. time.**

# The GRAFIS Word Processor for People with Disabilities

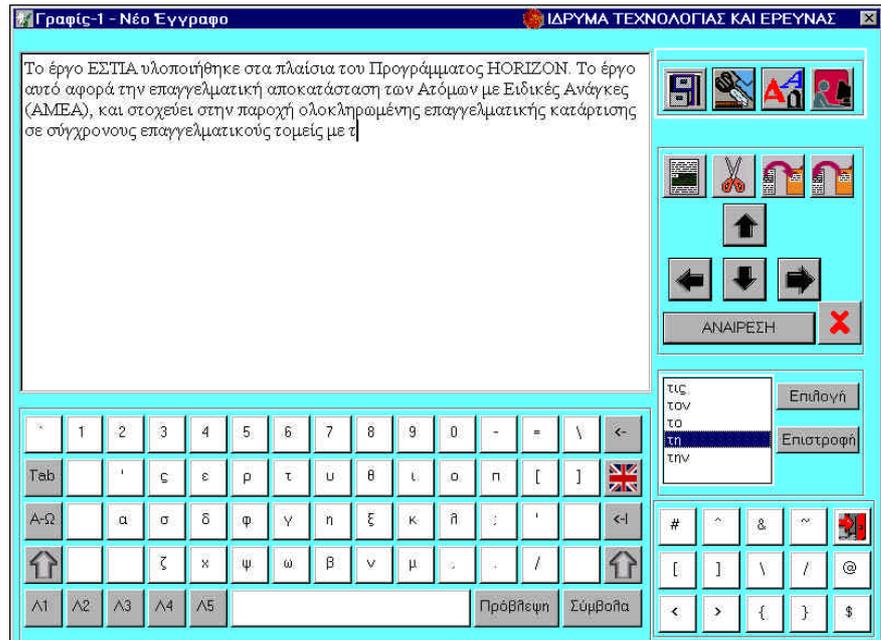
by Constantine Stephanidis

**GRAFIS is a word processor specifically developed for disabled people at ICS-FORTH in the framework of the HORIZON ESTIA Project. This project ran from January 1996 to June 1998 and focused on the vocational training of unemployed disabled people, through the use of information technologies.**

GRAFIS supports the typical word processing functionality, through a simple interface, accessible through conventional as well as alternative input-output devices. The basic characteristics of the interface are: (a) a clear separation between the 'text-input' and 'function' areas, and (b) elimination of overlapping objects on the screen through the grouping of functions in alternative function areas.

In addition to text input (in Greek and English), manipulation and formatting, GRAFIS features a simplified interface for storing, retrieving and otherwise managing document files. The user is supported by an extensive on-line help system which describes the interface and guides the user in the completion of common word processing tasks. GRAFIS also supports saving and loading documents in Rich-Text Format (RTF), thus allowing users to share and exchange documents with their able-bodied counterparts employing mainstream word processors.

GRAFIS supports a variety of input devices, including conventional and special keyboards, mouse, trackball, mouse emulators and binary switches. Interaction through switches is made possible through the use of interaction scanning techniques developed at ICS-FORTH. These techniques allow users that can operate only a single binary switch to make full use of the word processor.

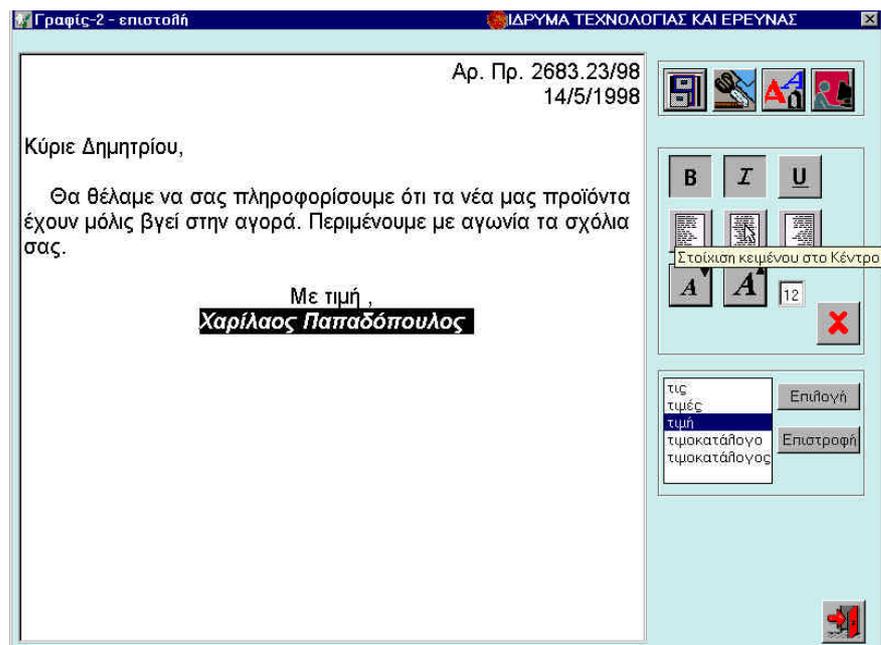


**Figure 1: An instance of the word processor GRAFIS-1 for users with motor impairment in their upper limbs.**

Text input for users employing binary switches is supported through virtual keyboards with alternative key arrangements, namely: (a) QWERTY, and (b) letter-frequency based (ie, keys are arranged based on the frequency of letters and digraphs in each of the supported languages). Rate enhancement is also achieved by means of a word prediction function, which performs context-based prediction of the possible next words in a text, or of the

continuation of the word currently being typed. Word prediction is based on a simple statistical technique applied to exemplary documents (eg, general-case business letters), prior to the use of GRAFIS, or documents that the user has edited, once a significant corpus of typical cases of such documents exists.

One of the primary design objectives of GRAFIS concerned the ease of customisation of the interface by both



**Figure 2: An instance of the word processor GRAFIS-2 for users with learning difficulties (without the optional virtual keyboard).**

facilitators and end users. Customisable characteristics include colour (background, virtual keyboards, etc.), dimension of characters in the virtual keyboard, activation / deactivation of acoustic feedback, and interaction scanning attributes (eg, speed).

GRAFIS addresses two main categories of disability, for which there exist separate versions of the word processor: GRAFIS-1 for users with motor impairment in upper limbs and GRAFIS-2 for users with learning difficulties. Both versions support the previously described functionality in its entirety, and have very similar interfaces, but differ in terms of the input techniques; the latter are provided on the basis of user characteristics and requirements. For instance, GRAFIS-1 supports virtual keyboards and scanning for access through mouse and binary switches, while GRAFIS-2 supports input through conventional keyboard and mouse, and offers the virtual keyboard optionally. Figure 1 depicts an instance of GRAFIS-1, and Figure 2 an instance of GRAFIS-2.

Both versions of the GRAFIS word processor have been tested and evaluated by end-users during the vocational training and pilot employment phases of the ESTIA project. Additionally, after the completion of the ESTIA project, GRAFIS was distributed to selected disability organisations and end users for further evaluation. The results of the various evaluation phases have shown that GRAFIS is easy to learn and use, and that its characteristics are appreciated, in particular by users with no previous experience in word processing.

Partners in the HORIZON ESTIA Project were: ICS-FORTH, University of Athens Department of Informatics, Idrima Kinonikis Ergasias, Panellinios Sindesmos Tiflon, Idrima Pammakaristos, Eteria Spastikon Voriou Ellados, Euroskills, INESC-Portugal. ■

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## Building Harmonised Semantic Lexicons

by Nicoletta Calzolari

**SIMPLE is a project sponsored by EC DG XIII in the framework of the Language Engineering programme. To our knowledge, this project represents the first attempt to develop wide-coverage semantic lexicons for a large number of languages (12), with a harmonised common model that encodes structured ‘semantic types’ and semantic (subcategorisation) frames. Even though SIMPLE is a lexicon building project, it also addresses challenging research issues and provides a framework for testing and evaluating the maturity of the current state-of-the-art in the realm of lexical semantics grounded on, and connected to, a syntactic foundation.**

Many theoretical approaches are currently tackling different aspects of semantics. However, such approaches have to be tested i) with wide-coverage implementations, and ii) with respect to their actual usefulness and usability in real-world systems both of mono- and multi-lingual nature. The SIMPLE project addresses point i) directly, while providing the necessary platform to allow application projects to address point ii).

SIMPLE is coherent with the strategic EC policy that aims at providing a core set of language resources for the EU languages and should be considered as a follow up to the PAROLE project (see <http://www.ilc.pi.cnr>); SIMPLE adds a semantic layer to a subset of the existing morphological and syntactic layers developed by PAROLE. The semantic lexicons (about 10,000 word meanings) are built in a harmonised way for the 12 PAROLE languages. These lexicons will be partially corpus-based, exploiting the harmonised and representative corpora built within PAROLE. In this way, the semantic encoding will respect actual

corpus distinctions. The lexicons are designed bearing in mind a future cross-language linking: they share and are built around the same core ontology and the same set of semantic templates. The ‘base concepts’ identified by EuroWordNet (about 800 senses at a high level in the taxonomy) are used as a common set of senses, so that a cross-language link for all the 12 languages is already provided automatically through their link to the EuroWordNet Interlingual Index (see: <http://www.let.uva.nl/~ewn/>).

### The Model

In the first stage of the project, the formal representation of the ‘conceptual core’ of the lexicons was specified, ie the basic structured set of ‘meaning-types’ (the SIMPLE ontology). This constitutes a common starting point on which to base the building of the language specific semantic lexicons. The development of 12 harmonised semantic lexicons requires strong mechanisms for guaranteeing uniformity and consistency. The multilingual aspect translates into the need to identify elements of the semantic vocabulary for structuring word meanings which are both language independent but also able to capture linguistically useful generalisations for different NLP tasks.

The SIMPLE model is based on the recommendations of the EAGLES Lexicon/Semantics Working Group (<http://www.ilc.pi.cnr.it/EAGLES96/rep2>) and on extensions of Generative Lexicon theory. An essential characteristic is its ability to capture the various dimensions of word meaning. The basic vocabulary relies on an extension of ‘qualia structure’ for structuring the semantic/conceptual types as a representational device for expressing the multi-dimensional aspect of word meaning. The model has a high degree of generality in that it provides the same mechanisms for generating broad-coverage and coherent concepts independently of their grammatical/semantic category (entities, events, qualities, etc.).

In order to combine the theoretical framework with the practical lexico-

graphic task of lexicon encoding, we have created a common 'library' of language independent template-types, which act as 'blueprints' for any given type - reflecting the conditions of well-formedness and providing constraints for lexical items belonging to that type. The relevance of this approach for building consistent resources is that types both provide the formal specifications and guide subsequent encoding, thus satisfying theoretical and practical methodological requirements.

The large number of languages covered by SIMPLE is reflected in the size of its Consortium: Università di Pisa (coordinator: A. Zampolli), Erli (now Lexiquist)-Paris, Institute for Language and Speech Processing-Athens, Institut d'Estudis Catalans, University of Birmingham, Univ. of Sheffield, Det Danske Sprog-og Litteraturselskab, Center for Sprogteknologi-Copenhagen, Språkdata-Göteborgs Universitet, University of Helsinki, Instituut voor Nederlandse Lexicologie-Leiden, Université de Liège BELTEXT, Centro de Linguística da Universidade de Lisboa, Instituto de Engenharia de Sistemas e Computadores-Lisboa, Fundacion Bosch Gimpera Universitat de Barcelona, Institut für Deutsche Sprache, Istituto di Linguistica Computazionale - CNR Pisa, University of Graz.

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## Live Teleteaching via the Internet

by **Konstantinos Fostiropoulos,**  
**Detlef Skaley, Hideyuki Inamura**  
**and Sepideh Chakaveh**

**The telecommunication sector for scientific use has developed parallel to the classical telephone system. However, in the last decade, this sector has undergone a change from one confined only to the relatively High Tech Sector of Sciences and Media, to one accessible and easily available to the general public. This change was brought about by the rapidly falling prices of telecommunication networks and equipment.**

Our planet is now covered by numerous networks with different transmission velocities – terrestrial by copper cable or fibre optical, via satellite or by directed radio transmission. The Internet has also changed because of this from catering primarily to the Scientific Community's need for data to addressing the multimedia needs of the general public – for education, work, consumer needs, entertainment and other personal matters. The high demand for these services has meant that growth opportunities in this industry are tremendous.

The changes mentioned above have affected the educational facet of the Internet. There is an enormous demand for high quality educational applications on the Internet in almost every subject. On the other hand, in spite of this high demand, there is no straightforward way to bring the teacher (service provider) and the student (customer) together for live lectures.

The various incompatible solutions which are implemented differ both in hardware and software. The small bandwidth, and the resulting slow connection, are the main reason why individual customers cannot receive these services easily at home. But Institutions such as companies and schools do have

the necessary connection speeds and can work and learn together.

One possible implementation of the tele education concept is in the form of the ISDN Video Conference System (standard H.320). This system has the capacity to support a variety of multimedia services using several bundled ISDN B-channels for the transmission of audio, video and documents.

Other implementations of this concept is via the Internet. There are a number of application specific teaching and learning tools developed by the lecturers themselves. However, the individual tools are difficult to extend to other applications.

In this paper, we present a solution that integrates both the ISDN (Integrated Services Digital Network) and IP techniques (Internet Protocol) on one platform in an uncomplicated manner. The result is an interactive distributed lecture that is also broadcast to the Internet.

### Education Demand

Since the physical and economical borders in Europe have opened, the educational institutions have been drawn into the whirlpool of the market, where they face competition from across the continent. For a student, the personality of a present teacher is no longer the only determining factor in choosing a school or university. The means employed to convey the teaching are also important. The student now has the opportunity to get a diploma from an internationally renowned educational institution without living there and consequently saving on cost of living at the very least. And he can choose the specific education for his needs because he has the entire world to choose from.

In former command economies in Eastern Europe, there is a strong interest to get economic know-how from the West. Since in order to orient oneself in the vast global market and establish private industry, one needs detailed knowledge of the market and its

structure. In this pilot project, we demonstrated that it is possible for people such as students, entrepreneurs, employees of companies and indeed the leaders themselves to take part in lectures of their choosing on the basis of IP and acquire the knowledge that they need.

Together with its partners, GMD succeeded in finding students in Bucharest and Sofia and in organising distributed lectures on a common platform with the content provider in Pennsylvania. The participants met in educational centres of the Faculty for Mathematics and Informatics (FMI),

University of Sofia, and the Institute for Mathematics (ICI), University of Bucharest. There they first listened to the live lecture from Pennsylvania. After that, there was the opportunity to have discussions between the three locations on questions arising from the lecture. The content of the lecture was delivered by CAPE, which is a consortium of more than 100 faculties in Pennsylvania on the following subjects:

- Venture Initiation
- Market Economies
- International Commerce
- Banking.

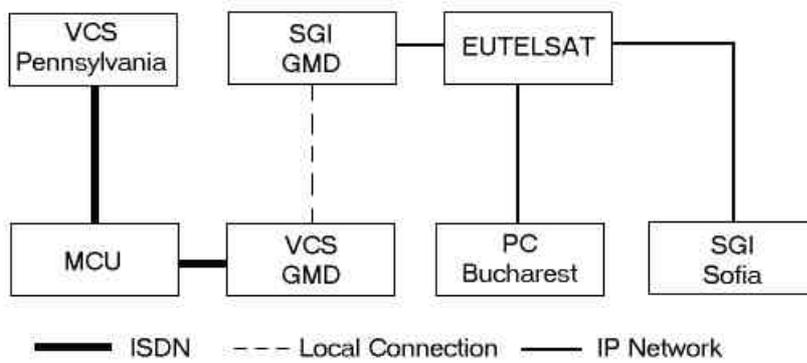
**Infrastructure**

For this course, the participants use a specially designed Intranet with access restricted by passwords. In order to minimise the effort in these three locations, the facilities at the three locations have to be used. However, these facilities are not compatible. The American side uses a commercial system for ISDN video conferencing of the standard H.320. With a similar system at GMD, a point to point connection to CAPE has been established via two ISDN B channels with 128 kb/s. In principle, the band width can be increased to 384 kb/s by bundling 6 channels. In addition, the number of participants can be increased by a multicast unit (MCU). The lecture notes can be accessed via the Internet from GMD's server.

The two Eastern European sides utilise IP networks but the connection speeds via terrestrial means are inadequate. Using GMD's MULTISERVE satellite communication network via EUTELSAT IIF3, it is possible to connect GMD, ICI in Bucharest and the Academy of Sciences in Sofia with 512 kb/s at this moment. In this pilot project, we transmit from GMD 128 kbit/s. On the back channels from the Eastern Europe sites 64 kb/s could be used.

In addition, there is a 128 kb/s connection via telephone modem from the Academy to the FMI in Sofia. These two multicast video conference systems (VCS) via ISDN and IP are linked together into one network in GMD. In order to make this link, the input and output signals of the ISDN VCS are transformed for the Intranet using an SGI O2 with Video Capture and Converter cards. For equalising the audio channels a mixer had to be used.

Software for the ISDN part of the network is fixed by the H.320 standard. The IP side had a variety of options from which to choose from. Most of these systems were not platform independent and in addition, a server would be needed for a multi-point conference. Therefore they were not adequate. The solution was to use the Mbone tools VIC v2.8uc13



**Figure 1: GMD's Teleteaching network including ISDN as well as IP video conference systems. Through this network students in Sofia and Bucharest met professors in Pennsylvania.**



**Figure 2: Discussion between participants of the distributed course via Satellite on questions arising from the lecture.**

(Video Conference) and RAT v3.0.34 (Robust Audio Tool). These run on most of the common operating systems and distribute the data streams directly by multicast routers. In GMD and FMI an SGI O2 is used as the terminal. On the Bucharest side, a multimedia Personal Computer is used. All terminals receive directly video and audio inputs and are connected to each other via the Intranet.

**Conclusions**

In this pilot project we performed four Teleteaching sessions of two hours each one per week. The participants in Pennsylvania dialed in by an ISDN VCS to GMD. The students in Sofia and Bucharest had interactive access to the lecture via Mbone VCS, chat and electronic mail. In addition the whole course was broadcast using RealPlayer on the Internet and the participants had access to the HTML lecture notes (Hypertext Markup Language) on GMD's server.

Because of the limited bandwidth we restricted the video transmission to five frames per second which is acceptable for Teleteaching purposes. The audio transmission was stable and its quality was sufficient for discussions.

Running this course we proved that a low cost, low bandwidth interactive distributed course can be implemented. Using full transmission capacities of the network the quality, as well as the cost, of the course will rise.

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# 3D City – Adaptive Capture and Visualization of Cityscapes

by Thomas Jung and Ines Ernst

**The project 3D City is concerned with the development of an innovative technique for visualizing cityscapes.**

The capture of existing cityscapes is normally an extremely time-consuming matter. It involves the three-dimensional surveying of objects and their provision with surface textures for the purposes of visualization. Generation of the models requires a great deal of subsequent reworking by hand. The large three-dimensional models can only be rendered in reasonable quality by using high-end graphics computers.

On the other hand, there are techniques that allow panoramic shots to be visualized interactively in photo-realistic

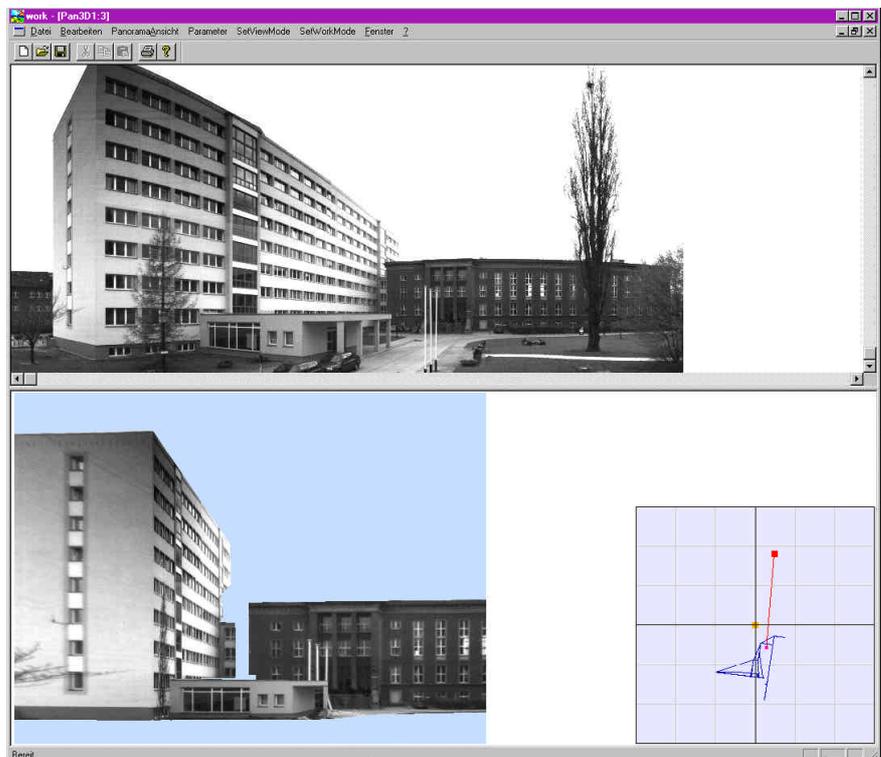
quality, eg QuicktimeVR. Here, however, the viewer cannot move freely, but only turn and alternate between different camera positions, as no depth information on the panoramic shots is available. Adding depth information to such shots should allow the viewer to move freely in cityscapes that have been captured photographically.

A new computer-graphics 2 1/2D rendering technique allows the generation of images for viewer positions from which no photograph was taken. On the basis of image and depth information, the rendering algorithm decides which object parts are visible from the current viewer position and renders them according to their appearance in the corresponding panoramas.

Using several panoramic shots, the depth values for individual pixels or image sections can be automatically reconstructed. Specialized tools allow depth information to be added semi-automatically for further image sections.

What emerges is a visualization environment with the following features:

- photo-realistic rendering quality: since the basic information is



Screen shot of 3D City system with (a) original panoramic shot (b) computer generated image parts (c) viewing position.

obtained from photographs, the image quality is comparable with that of multimedia environments such as QuicktimeVR

- free navigation in the parts of the scene that are rendered in the pictures taken; no fixed camera positions
- moderate computation time for rendering; it increases only slightly with the complexity of the scene
- use of modern 3D graphics cards, the techniques employed being based on 3D algorithms
- compatibility with 3D graphics: the technique can be used eg for rendering high-detail static components in VRML (Virtual Reality Modeling Language) scenes.

Possible application scenarios include:

- simple generation and updating of 3D city maps or 3D information systems
- helping architects by speeding up the job of drawing up tenders
- capturing the state of building and redevelopment areas
- supporting architectural presentations by enabling planned objects to be rendered in a natural, lifelike setting.

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## AVOCADO – The Virtual Environment Framework

by Henrik Tramberend, Frank Hasenbrink, Gerhard Eckel and Uli Lechner

**AVOCADO is a software framework designed to allow the rapid development of virtual environment applications for immersive and non-immersive display setups like the CAVE (CAVE Automatic Virtual Environment), CyberStage, Responsive Workbench and Teleport. It supports the programmer in all tasks involved with these types of applications.**

AVOCADO integrates a variety of different interface devices, is easily extensible and adaptable for new devices to be invented. It is highly interactive and responsive, supports a rapid prototyping style of application development, will enable the development of truly distributed applications, and is targeted at high-end Silicon Graphics workstations and aims to deliver the best performance these machines are capable of.

AVOCADO includes the following concepts:

- **Viewer:** All kinds of configurations of input and output devices can be assembled to viewers. A viewer builds up the interface between the user and the virtual world. Typical elements of a viewer are the visual, auditory and tactile displays as output devices and spatial trackers, audio or video sources as input devices. In a multi-user environment every user configures his own viewer.
- **Scripting:** All relevant parts of the system's Application Programming Interface are mapped to Scheme, an interpreted scripting language. This enables the user to specify and change scene content, viewer features and object behavior in a running system.
- **Streaming:** All objects know how to read and write their state to and from a

stream. This is the basic facility needed to implement object persistence and network distribution. Persistence together with streaming support for objects enable the user to write the complete state of the system to a disk file at any time. An initial system state can be read from a disk file as well.

- **Distribution:** All AVOCADO objects are distributable, and their state is shared by any number of participating viewers. Object creation, deletion and all changes at one site are immediately and transparently distributed to every participating viewer.
- **Extensions:** The System is extendible by subclassing existing C++ system classes. This concerns object classes as well as classes which encapsulate viewer features. Compiled extensions can be loaded into the system at runtime via Dynamically Shared Objects.
- **Interaction:** Viewers provide input/output services which can be mapped to objects in the scene. Objects can respond to events generated from input devices or other objects and can deliver events to output devices.
- **Visual Rendering:** The different displays all have their own rendering mechanism applied to the modeling hierarchy. Only the visual rendering has a direct access through the Performer pipeline. The auditory and the tactile rendering can be calculated on a second computer, connected to the 'master' by a fast network.

### Visual Data Processing

The visual data processing is organized in a pipeline and computed in parallel by Performer. This rendering pipeline consists of a set of optional units, for:

- a database connection
- a user application
- the visual culling of the scene
- the intersection of objects,
- the drawing of the scene.

After the modeling hierarchy is updated to its actual state in the application process it is passed on to the culling process which strips all invisible objects. It is important to support this technique by dividing large geometry into smaller,

cullable objects. The part of the scene left over after the culling is passed on to the drawing process where it is rendered to the screen with OpenGL. For configurations with more than one visual display system, the appropriate number of pipelines is used.

### Auditory Rendering

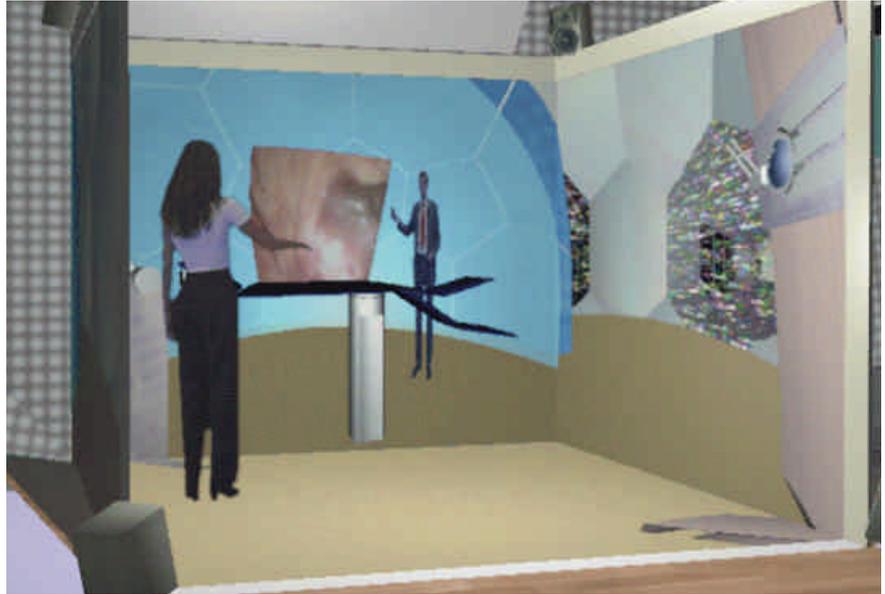
Rendering the auditory scene has to take into account the position of the observer's head in the virtual world and in the auditory display as well as the characteristics of the auditory display (ie the loudspeaker configuration). The auditory rendering process is a two stage process. In the first stage a source signal is synthesized and in the second stage it is spatialized. In the first stage only the sound model parameters are needed by the rendering process. In the second stage the signals driving the auditory display are computed as a function of the distance between observer and sound source, the radiation characteristics of the source and the signature of the acoustic environment.

With these signals the auditory display produces the illusion of a sound source emitted from a certain position in a certain acoustic environment shared by the observer and the source. The sound rendering is a dynamic process that takes into account movements of the observer in the display, movements in the virtual world, and movements of the sound source. If these movements are faster than about 30 km/h, the pitch changes due to Doppler shift are simulated as well.

### Tactile Rendering

The CyberStage display has a set of low-frequency emitters built into its floor. This allows vibrations to be generated, which can be felt through the feet and legs. There are two main areas of application of this display component. First, low frequency sound (which cannot be localized) can be emitted to complement the loudspeaker projection. Second, specially synthesized low frequency signals can be used to convey attributes such as roughness or surface texture.

The vibration display is handled like sound in the rendering process. Sound



**A remote participant being virtually present in a 3D virtual environment displayed in the CyberStage.**

models are used to generate the low-frequency signals. Sound synthesis techniques, generally referred to as granular synthesis, are very well suited to produce band-limited impulses that may represent surface features. Such features can be displayed through user interaction. For instance, a virtual pointing device can be used to slide or glide over a surface and produce vibrations. Additionally, higher-frequency sound can also be produced if necessary. Some of what can be felt usually through the skin of our fingers when sliding over an object is presented to our feet. This sensation can complement sound and vision dramatically.

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## Immersive Telepresence

by Vali Laloti, Frank Hasenbrink and Olaf Menkens

**The aim of Immersive Telepresence is to provide geographically dispersed groups of people the possibility to meet and work within projection-based Virtual Reality Systems as if face-to-face.**

In our approach participants not only meet as if face-to-face, but also share the same virtual space and perform common tasks, in order to reach a common goal. For this purpose live stereo-video and audio of remote participants is integrated into the virtual space of another participant, allowing a geographically separated group of people to collaborate while maintaining eye-contact, gaze awareness and body language.

Participants can use a wide range of Projective Virtual Reality Systems, such as CyberStage, Responsive Workbench, Cooperative Responsive Workbench and Teleport, resulting symmetric or asymmetric collaboration scenarios. The scientific approach includes stereo camera calibration, in order to obtain the camera parameters, which are then used

for integrating the stereo-video into the virtual space, while preserving the stereo-effect and perspective for the tracked viewer.

### Immersive Telepresence in Cyberstage

The first prototype of the environment was demonstrated in October 1997. A remote participant captured with a stereo camera was chroma-keyed into a 3D virtual space, being virtually present in a 3D virtual environment displayed in the CyberStage. For the first time ever a fully immersed 3D virtual teleconference was demonstrated based on virtual studio techniques of keying video images into computer generated scenes.

The imported image sequences had to pass several Silicon Graphics video options, delay units and chroma keys before taken as a dynamic texture into the AVOCADO Software Framework. AVOCADO handled the positioning and display of the remote participant within the virtual world of an operation theater. The remote participant gave instructions to CyberStage visitors on how to operate various devices and instruments of this virtual operation theater.

### Cyberstage and Immersive Telepresence

In integrating the live audio of the remote participant the spatial audio functionality of AVOCADO was used (see previous article). The live audio was attached as an audio source to the geometry representing the live stereo-video in the virtual world. Therefore, audio from the remote participant was spatialized, and was increasing in volume or fading away in direct response to moving nearer or further away from the video image of the remote participant in CyberStage. This greatly enhances the immersive telepresence effect.

### Immersive Telepresence at the Cooperative Responsive Workbench

The Cooperative Responsive Workbench extends the Responsive Workbench with a vertical screen, thus enlarging the viewing frustum and allowing remote collaboration and Immersive Telepresence.

On the vertical screen of the Cooperative Responsive Workbench a user could see and communicate in real-time with a person or team located at a different place, and at the same time view and manipulate 3D stereoscopic virtual objects (ie. the model of a car, seismic data for mining, medical data of a patient etc). Immersive telepresence can be used in a variety of application areas such as medical and geoscience applications. ■

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## BSCW sets Standard for Open Internet Cooperation

by Konrad Klöckner

**Even today, the platform-independent cooperation in geographically distributed projects is often a difficult problem. So far the Internet has provided support for this problem only to a limited extent. With the BSCW (Basic Support for Cooperative Work) system, GMD in Sankt Augustin has developed a World Wide Web-based platform for cooperation support which extends the possibilities of the World Wide Web considerably.**

The basic idea of the BSCW system is the autonomously managed Shared Workspace which the members of a working group install and use for the organization and coordination of their tasks. The members of the working group can upload documents from their local computer to the workspace as well as access documents in the workspace, eg for processing them.

In addition to the comfortable document management, there are a notification service providing information about current activities and a great number of functions and object types for more extensive support of cooperation. The user of the system only requires one of the usual browsers such as Netscape Navigator or Microsoft Internet Explorer.

BSCW is installed on some 300 servers both in the education area and in business around the world. For several years now, GMD has been operating a public server on which meanwhile more than 17,000 users have registered and manage common projects.

The version 3.3 of the system which has just been released is another step in the direction of open Internet cooperation. This version provides an object browser written in Java which enables a simple processing of files and documents in a similar way as the Windows file browser. For the support of information management, documents and World Wide Web links can now be annotated and rated individually, a median is calculated from the individual ratings and presented to the users.

The previous version was improved and extended in many respects, eg through improved e-mail integration, new locking mechanisms for distributed document processing, easier creation of large document archives and easier access rights management. Version 3.3 of the BSCW system thus fulfils a great number of requirements and requests from the large user group in the form of new and extended functionality. For further information visit our Web site at <http://bscw.gmd.de/> ■

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# European Software Institute and IEI-CNR to launch a Qualification Scheme for Software Process Assessors

by José Arias, Fabrizio Fabbrini, Mario Fusani, Vinicio Lami, Giuseppe Magnani

The SPICE project (Software Process Improvement and Capability dEtermination) began in 1993 to support the development of an ISO/IEC Standard for software process assessment and improvement. The project has been conducted within the context of ISO/IEC JTC1 SC7 WG10 by experts from all over the world. In 1988 it produced a Technical Report (ISO/IEC TR 15504), which includes a process reference model, an assessment model and assessment/improvement guidance. Experiments of SPICE models and guides, called Trials, have been under way since 1995, and hundreds of worldwide-assessment reports have now been collected. The results of the SPICE Trials are now supporting the current refining work for the final standard, expected by the end of 2001.

As assessment/improvement activities in the SPICE framework are going to have a large impact on the software community (suppliers, organized customers, end users), the need for qualified human resources to enact the Standard is becoming crucial. ISO/IEC TR15504 contains requirements and curricula criteria for Assessors but, as the Standard is approved, people must be ready to work with it.

The organizations involved in the SPICE project are well aware of this. Among them, non-profit public organizations such as the European Software Institute (ESI), Bilbao, Spain, and IEI of the National Research Council, Pisa, Italy, are combining efforts to set up a body capable of running a Qualification Scheme for SPICE Assessors.

The main objectives for defining the Qualification Scheme are the following:

- guarantee the consistency, repeatability and quality for SPICE based assessments
- design a qualification/registration programme with a common set of requirements to be fulfilled by all assessors
- establish a systematic improvement plan using a feedback system built into assessment methods, models and practices and disseminate that knowledge among the software community.

The overall programme is managed by a Qualification Body, an independent authority led by ESI, to corroborate the compatibility of models and methods, provide training courses for potential and existing assessors and support the operating activities and procedures with respect to registration.

Additional participation by other partners, such as the National Agencies for Quality (members of the European Organization for Quality) and other European non-profit organizations will be encouraged. Upon the completion of the Qualification Scheme, the ISO/IEC 15504 Standard for software process assessment will be endorsed, preserving integrity during the assessment activities by guaranteeing that those activities are performed by professionals with a high level of competence.

Thus, the Qualification Scheme does not just cover selection and training, but has been designed to ensure a high level of professionalism from assessors, to manage the assessors' activity database and to collect useful feedback in order to improve the Scheme itself, the SPICE assessments (including Trials) and all the assessments/improvements campaigns

performed within any existing framework (such as, for example, ISO 9000). ■

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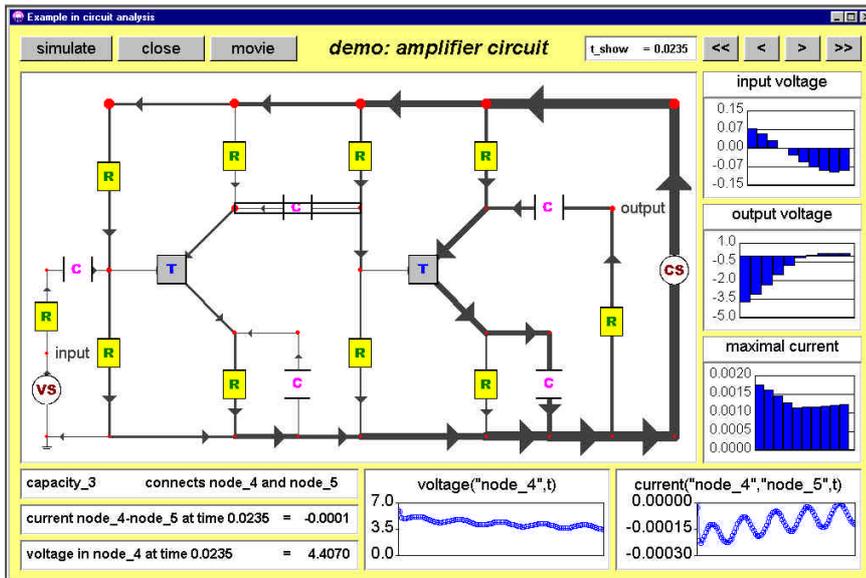
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# Solving Implicit Differential Equations within a Modeling Environment

by Jacques de Swart

Many industrial applications can be modeled by sets of Implicit Differential Equations (IDEs). In joint work at CWI and Paragon Decision Technology (PDT), sponsored by the Technology Foundation STW, it is shown how the integration of an IDE solver in an algebraic modeling system can help to overcome many of the difficulties that a user currently encounters in trying to solve such systems of IDEs.

In industrial design processes, testing designs is of major importance. Before products are manufactured based on some design, one wants to know how a product based on this design would behave under several circumstances. For this purpose, one models the product in terms of its design. By solving the model, one simulates the working of the product. This procedure is much cheaper than building and testing prototypes. Often the modeling of a product results in IDEs – equations in which derivatives of the unknowns with respect to one independent variable, typically time, appear implicitly. The modeling of time-dependent processes often results in



**Simulating the working of a transistor amplifier using AIMMS and PSIDE.**

IDEs. To solve IDEs, numerical methods are indispensable.

Examples of applications where simulation processes involve IDEs are testing the design of an electrical circuit, and the formulation of safety requirements for trains. Other areas include the modeling of turbulent flows in water tube systems, the description of demand-supply curves in liberalized markets, and the simulation of chemical reactions.

On the one hand, the complexity and size of the applications require a user friendly modeling environment, which speaks the language of the modeler, and offers the possibility to test and compare several scenarios and instances of the model data efficiently. Moreover, the modeler does not want to be involved in the often cumbersome interfacing with solvers. On the other hand, modern numerical techniques are required to solve ill-conditioned IDE systems of high dimension. How to meet these requirements is studied by integrating the novel IDE solver PSIDE, developed at CWI, in the advanced modeling environment AIMMS (Advanced Interactive Multi-dimensional Modeling System), which is a product of PDT.

If the time scales of the various solution components vary greatly, and if the rapidly changing components are

physically irrelevant, then we call a problem stiff. For example, if both high and low frequency signals are present in an electrical circuit, but the high-frequency signals are small in magnitude, then the modeling of such a circuit gives rise to a stiff system of IDEs. To solve such IDEs, an implicit method is required, which means that the numerical approximations are not directly available, but have to be computed from nonlinear systems. This computation requires the evaluation of Jacobians of the IDEs with respect to the unknowns. In AIMMS these Jacobians are available in analytical form.

If some solution components of an IDE are more sensitive to perturbations than others, then the IDE is said to be of higher index. In order to integrate IDEs numerically with variable stepsize, one usually estimates a local error, in which the index has to be taken into account. Existing IDE solvers do not have a facility to compute the index. An automatic index determination facility for PSIDE, which uses the analytical Jacobian available in AIMMS, is currently under development.

The IDE solver has to know not only the values of all variables at the start of the integration interval, but also their derivatives. Especially the latter are in practice often unknown to the modeler and have to be computed from an – often

nonlinear – system of algebraic equations. A powerful commercial nonlinear solver available in AIMMS is CONOPT. We used CONOPT successfully to compute the missing initial values. For higher index problems the problem of finding initial values is even more complicated, because the initial values have to satisfy differentiated equations as well. Based on the index determination facility and the capability of AIMMS to differentiate equations automatically, we are working on an automatic procedure for finding initial values for higher index problems.

One problem in the CWI Test Set is the Transistor Amplifier, whose circuit diagram is shown in the Figure. The task is to compute the behaviour of the voltages in the nodes and the currents in the wires over time. There are several symbolic equations, such as Kirchoff's Law, whereas for every type of electrical component there is an equation describing its working. These equations are independent of the specific electrical circuit. To simulate another circuit one only has to adapt model data. The application shown in the figure is clickable. One can play the movie of the circuit's working and select the wires and nodes of which one wants to see more information. As additional information, the maximum of the currents over all wires is displayed. The '<<', '<', '>' and '>>' buttons serve to step through the movie.

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# Multilevel Forecasting Improves Corporate Planning and Operations

by Ilkka Karanta

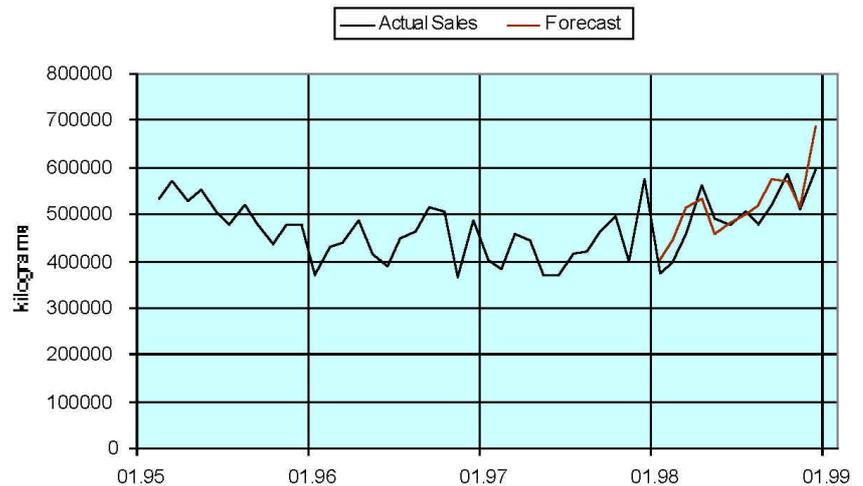
**Forecasting involves estimating future values for a process that is at least partially uncontrollable. Examples range from weather to election results and stock prices. An important subfield of forecasting is sales forecasting, where one tries to forecast the sales of products usually targeted to the consumer market. Although different actors in the supply chain - producers, wholesale companies and retail companies - all have ways of affecting the sales such as marketing and pricing, important uncertainty factors remain due to eg consumer behavior and the actions of competitors.**

Forecasts are needed on all levels of supply chain planning. At the operational level, logistical decisions such as inventory levels and transportation schedules and routes are affected by sales forecasts. At the tactical level, yearly budgeting decisions are affected by estimated sales for the next year. And at the strategic level, investment decisions are affected by estimates of regional demand for products.

A pervasive feature of sales forecasting problems is that they are needed for different hierarchies, and at different level in these hierarchies. For example, product-level forecasts are needed by marketing; product-group level forecasts are needed in budgeting; forecasts by region and product are needed in logistical decisions; and forecasts by customer and product are needed by customer-relations management staff. On the other hand, forecasts are needed for different time spans (a year, a quarter, or

a month) and for different sample rates (monthly, weekly or daily data). These forecasts should be consistent, and, in the best case, the models and data for each process should support the accuracy of forecasting in all the processes.

VTT Information Technology is doing research on automated modeling and hierarchical forecasting. In automated modeling, the emphasis is on selecting both an appropriate model class for a forecasting task (such as ARIMA, regression, exponential smoothing or neural networks) and an optimal model structure within that class. In hierarchical forecasting, the emphasis is in coordinating different models for different hierarchy levels so that forecasts are consistent and accuracy is improved.



**Forecast for the sales of a cheese brand.**

On the other hand, also new product forecasting, and the effects of new and ending products and customers on the items in hierarchies have been stresspoints of the research.

As a result, a forecasting system is under development where forecasts for different levels in hierarchies and different sample rates can be made. Some highlights of the system:

- multiple hierarchies are supported: the user can define for which nodes or levels the forecasts are needed in different hierarchies (eg product hierarchy, customer hierarchy, region

hierarchy), and the forecasts at different levels are consistent with each other

- formulation of statistical models is automatic; the end user doesn't need to know anything about statistical models
- several classes of statistical models are supported, and adding new classes is simple
- external software components are used in model parameter estimation and some other statistical calculations
- the system is platform-independent
- the system is object-oriented and written in Java.

The system has been installed to a large Finnish company in food manufacturing industry, and planning is under way to an implementation for a large Finnish

wholesales company. Future plans include utilization of data in the whole supply chain, and the incorporation of subjective assessment as part of the forecasting process. ■

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# Helping Company Founders: INRIA's Technological Outreach Strategy

by Bernard Larroutourou and Laurent Kott

**The founding of companies stemming from INRIA started in 1984. Over fifteen years, thirty-seven companies have been created by researchers, engineers or young PhDs coming from INRIA's research teams. Twenty-six of them are still in activity today under their own name and gather a total of over one thousand highly qualified jobs.**

INRIA's commitment to foster the creation of technology companies has been reinforced in the last two years. In addition to various incentives and encouragement, INRIA now supports company founders through post-doctoral fellowships and due to the incubator role played by its new subsidiary INRIA-Transfert. INRIA also played an essential role in setting up the I-Source-Gestion company that manages the first start-up fund in France consecrated to the sector of Information and Communication Science and Technology (ICST). This commitment led to very satisfying results in 1998 and the beginning of 1999. Seven technology companies stemming from INRIA were created in just twelve months: Gene-IT, Liquid Market, Novadis Services, Polyspace Technologies, Realviz, Saphir-Control and Trusted Logic. These companies intervene in such diverse fields as video digital special effects, software certification for smart cards, catalogue set up for electronic commerce and genome sequence processing, to name a few. The skills and technological basis for several of these companies come from highly theoretical research. Two years ago, it was not always evident that such

research had the potential required to enter the markets concerned today. Such company creations thus are very good examples of the breathtaking speed at which technological breakthroughs occur in ICST.

## INRIA-Transfert

INRIA-Transfert is a company with a capital of 13,2 Million Euros created in 1998 that is a 100% subsidiary of INRIA. Its purpose is twofold: to play a major role in the setting up of a start-up fund in ICST, and to provide the reference structure for the incubation of innovative company projects in software dominated information technology. On the start-up side, INRIA-Transfert is the reference stockholder in the newly established I-Source Gestion company (see below), but has no direct responsibility in the management of its start-up fund. Concerning incubation, the essential task is networking, that is to say setting up a network of professionals that INRIA-Transfert can call upon to detect, appraise and consolidate creation projects. The objective is to bring them to fruition in less than a year.

INRIA-Transfert is thus a structure that the project authors during the phase prior to the creation of the company itself. INRIA-Transfert provides help in the following steps:

- scientific appraisal of the project
- exchange of ideas to refine the project and narrow down the objectives
- search for financing
- market research
- verification that the final program proceeds as expected.

## I-Source Gestion

The goal of this company is to finance the seed phase of technology start-ups stemming from public or private research, operating in the ICT markets. The first financing tool is a venture capital mutual fund for an amount of 15,2 Million Euros and a duration of 10 years. Funds come from the public sector (like the main stockholder INRIA-Transfert and the Caisse des Dépôts et

Consignations) and private sector subscriptions (institutional investors, in particular the assurance company AXA, and venture capital companies).

I-Source Gestion develops a genuine 'co-business' approach with the project authors it selects. Starting from a draft of the product, team and business plan, I-Source Gestion works with them on the formalisation of their business strategy, on the definition of the first objectives and on the finalisation of the financing plan. The goal is to make sure that the start-up takes off successfully so that the start-up fund can disengage itself when strong growth phases are reached. An active follow-up of the start-up is made possible through a participation in the board of directors or the supervisory board. The planned average amount of I-Source Gestion intervention is on the order of 450,000 Euros in two instalments separated by 12 to 18 months. Project selection is extremely demanding on the marketing as well as technical level and I-Source Gestion does not hesitate to ask the advice of various experts, including INRIA scientists.

The first accomplished project that benefited from the help of I-Source Gestion financing is the Polyspace Technologies start-up, which specialises in the development and marketing of verification and validation environments for on-board real-time software. The company was founded at the initiative of Daniel Pilaud – formerly at Verilog – and Alain Deutsch, an INRIA-Rocquencourt researcher. Approximately twenty projects are currently under study. The objective of I-Source Gestion is to help starting up some eight technology companies per year over the next five years.

For more information, see:

- I-Source Gestion: <http://www.isourcegestion.fr/>
- Industrial relations at INRIA: <http://www.inria.fr/Partenariats/dev-rel-industrie-eng.html>

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## SPONSORED BY ERCIM

## Joint Summer School on Extending DataBase Technology (EDBT)

by Serge Abiteboul and Nourredine Mouaddib

The EDBT (Extending Data Base Technology) school took place at La Baule-les-Pins, France from 16 to 21 May 1999. The school, now a major and well-established event, was the fifth of a series of a European bi-yearly summer school in databases. Lectures were given by leading researchers of the international database community.

The school was attended by 61 participants. Together with the teachers and the organizers this lead to 75 persons. It should be noted that many teachers (as asked) attended most of the school. More than half were PhD students and among the others the wide majority were rather young researchers. The courses up to the last one were fully attended. It is our impression that the students enjoyed the school and learnt a lot. Indeed, the PhD students requested an extra session so they would have more time to discuss the future of the field.

### Programme

- Serge Abiteboul, INRIA: Electronic Commerce and Databases
- Georges Gardarin, Université de Versailles: Distributed Database Techniques: Architectures and Evolutions
- Gerti Kappel, University Johannes Kepler, Linz: UML at Work - Object-Oriented Software Development from Analysis to Implementation
- Mohamed Quafafou, Institut de Recherche en Informatique de Nantes: Knowledge Discovery
- Guido Moerkotte, University of Karlsruhe: Building Query Compilers
- C. Mohan, IBM, Almaden: Workflow Management in the Internet Age
- Vassilis Christophides, FORTH: System Infrastructure for Digital Libraries: A Survey and Outlook
- Michel Scholl, Centre National des Arts et Metiers, Paris: Spatio-temporal Databases

- Dennis Shasha, New York University: Time Series in Finance: the Array Database Approach
- Stefano Ceri, Politecnico di Milano: the Asilomar report and discussion on the new directions of the field; the students requested the addition of a session to discuss the future of the field. They lead the discussion during that session. They are planning an answer to the Asilomar report in a report tentatively called the La Baule Report.
- Four PhD students sessions of short presentations of their works.

For more details, see: <http://www-rocq.inria.fr/EDBT-school99>  
Students' presentations: <http://www-rocq.inria.fr/EDBT-school99/students.html>

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## FINAL CALL FOR PAPERS

## 5th ERCIM Workshop on User Interfaces for All

Dagstuhl, Germany,  
28 November - 1 December 1999

Extended deadline for submitting papers: 6 September 1999.

The 5th ERCIM Workshop on 'User Interfaces for All' is on theories, methodologies, techniques and tools which contribute to the development of User-Tailored Information Environments.

The vision of User Interfaces for All advocates the proactive realisation of the design for all principle in the field of Human-Computer Interaction, and involves the development of user interfaces to interactive applications and telematic services, which provide universal access and quality in use to potentially all users.

The invited speakers of this year's Workshop will be:

- Dr. Jon Gunderson, Coordinator of Assistive Communication and Information Technology, Division of Rehabilitation - Education Services,

University of Illinois at Urbana/Champaign, USA

- Dr. Hans-Heinrich Bothe, Associate Professor at Orebro University, Sweden.

For more information, see:

<http://zeus.gmd.de/5-UI4ALL-Workshop/call.html> or <http://www.ics.forth.gr/ercim-wg-ui4all/index.html>

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## CALL FOR PARTICIPATION

## Third European Conference on Research and Advanced Technology for Digital Libraries

Paris, 22-24 September 1999

After Pisa in 1997 and Heraklion in 1998, ECDL will take place in Paris at the prestigious location of the Bibliothèque Nationale de France. It is the third of a series of European conferences on research and technology for digital libraries, partially funded by the European TMR Programme. Its main objective is to bring together researchers from multiple disciplines to present their work on enabling technologies for digital libraries. The conference also provides an opportunity for scientists to develop a research community in Europe focusing on digital library development. More information, including conference programme, the list of accepted papers, demos, tutorials as well as a registration form is available on the conference web site at <http://www-rocq.inria.fr/EuroDL99/>

A special rate will be applied to registrations before 31 July 1999

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CLRC – **AlphaGalileo**, a new internet press centre, was formally launched by the UK's Minister for Science, Lord Sainsbury, at the British Association's Festival of Science at Cardiff University on 7th September. It was introduced in France on 7th October at the British Council, in the presence of Edouard Brezin, Chairman of the CNRS administrative council and Sir Michael Jay, British Ambassador to France. It is a project run by the British Association for the Advancement of Science and supported by the Office of Science and Technology and a number of Research Councils. The project manager, Peter Green, is now based at CLRC Rutherford Appleton Laboratory. Over the next 18 months, AlphaGalileo will develop into a multi-language service for communicating the best of European research to journalists world-wide. The web address is: <http://www.alphagalileo.org/>

CWI – **Piet Beertema**, one of the Internet's founding fathers, was knighted



on June 9 (Ridder in de Orde van de Nederlandse Leeuw) for his pioneering achievements in the development of the Internet in The Netherlands and in Europe. In

the eighties a predecessor of the Internet was developed at CWI, in close cooperation with research institutes elsewhere in Europe, which served the research community in Europe. Beertema played here a pivotal role, through close contacts with colleagues in the USA. Later on he founded and managed the Internet Domain Registration for The Netherlands, which became a working model for registries abroad. When in 1995 the growth of the Internet made clear that registration as well as handling other aspects could not any longer be a one-man business, the foundation Internet Domeinregistratie Nederland was created. When Beertema transferred his duties early 1997 to this foundation (in which he keeps playing an important role), almost 10.000 names were registered (now 77.000).

SZTAKI – **Paks nuclear power plant** becomes the first VVER 440 type plant modernizing its safety system by using the most recent methods in control theory and I&C technology. Siemens and SZTAKI contributed to the modernization and refurbishment of the complete reactor protection system (RPS) of the nuclear power plant Paks, Hungary over the past two years. By August, 1999 the refurbishment of the first unit is to be completed. While Siemens provided a state-of-the-art distributed multi-processor-based I&C system, the



**The nuclear power plant in Paks, Hungary.**

SZTAKI's team was entrusted with the complex task of the verification and validation (V&V) of the new system. The subject of V&V was the verification of hardware and software design both in activity and on document level. The verification of the testing methods provided by Siemens, moreover, the elaboration of the test cases independent from the supplier were also parts of the project.

SZTAKI – **A co-operation agreement** has been signed between SZTAKI and the Faculty of Information Technology, Péter Pázmány Catholic University, Budapest to establish an external Department on Information Techniques at the SZTAKI and to take part in a Science-Technology-Education Center organized at the Faculty with research laboratories and leading companies. Other external university departments at the SZTAKI are the Department of Decisions in Economy (Budapest University of Economic Sciences), the Department of Information Sciences (Eötvös Loránd University of Sciences, Budapest) and the Department of Integrated Production Information Systems (Technical University of

Budapest). Furthermore, SZTAKI and the Faculty of Transportation, Technical University of Budapest run a joint laboratory, the Dynamics and Control Systems Centre.

INRIA – **Claude Samson**, Research Director at INRIA Sophia Antipolis has been awarded the 1999 Michel Monpetit award from the French Academy of Sciences for his remarkable contributions to the mechanical and mathematical modeling of complex robots (in particular, mobile robots and walking robots), as well as the command and stabilization of such robots, which has been a source of difficulty in nonlinear mathematics.

INRIA – **Odile Lausecker** at INRIA's Multimedia Department of the Scientific Information and Communication Service received the Grand Prix of the Research Film Festival in the category 'Illustration of Research for Industry' (Nancy, March 1999). Her film 'Le Loria' is a guided tour of the Lorraine Research Laboratory in Computer Sciences and their applications. The institutional aspect of the presentation was deliberately downplayed. A young actress gave the audience a new perspective of Loria by introducing six research teams and their industrial partners. INRIA received the prize for the second consecutive year.

VTT – **Linus Torvalds**, creator of the operative system LINUX, guested a seminar aimed at young researchers and students on May 20, 1999 and

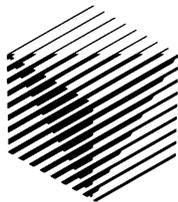


hosted by VTT together with Helsinki University of Helsinki. The highly interactive occasion covered subjects ranging from technological

questions to philosophic issues. The entity was held together by the three motivational stages: survival, communication and entertainment. Even technology and its development passes through these stages, which is important to keep in mind when developing innovations.

**European Research Consortium for Informatics and Mathematics**

**ERCIM**



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