ERCIM NEWS

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José Tribolet

João Fernandes

Founder Directors of INESC

(Photos: INESC)

EDITORIAL

INESC has its roots in the will of the R&D community in the Portuguese universities to build an R&D institution which has since become a national model as an interface between university and industry. After ten years of activity, INESC has branches in the major cities, near the most important engineering schools in computer sciences, electronics and telecommunications.

Nowadays, one of our main objectives is to put the flag of Portugal on the world map of information technology, both in scientific and in industrial terms.

By joining ERCIM, we have expressed our support to the idea of an effective European unity and the need for a strong development of the European potential. INESC now has about 200 partners in Europe, reaching from universities to industry.

We are contemplating the best way of mobilising this energy that emanates from mutual influence in order to make Europe move into action. The problem is, can we tap this source of energy for European success, or will the energy remain immobilised? Or worse yet, will this social energy work against the European mission?

At INESC, we believe there is a strong need for the creation of European excellence in terms of science, technology and management of these skills and its inter-relation with European socioeconomic activities. This objective is shared with all ERCIM members. From this point of view, it means spreading a new light on the R&D organisational culture.

As a step towards this objective, a "think tank" must be created, joining the Education, Industrial, Services and R&D sectors. In this context, the R&D sector must have a strong position, with one voice, and we believe that voice could be ERCIM's.

ERCIM is the first real European organisation in the R&D sector, as expressed in statutory terms based on legislation of the European community. ERCIM's members are major R&D organisations in their countries, but they represent not only their own but also their national scientific communities, providing ERCIM, not only with the skill to build a truly effective European R&D network, but with real influence and "roots" in each country.

In fact the necessity for setting out reliable interfaces and networks between the ERCIM members and R&D national centres make us think that this will probably be a prior condition for successful action at an EEC level.

A young organisation, composed of young researchers, such as INESC is, has a lot to improve on in respect to the more mature organisations like our partners at ERCIM . However, we believe that, if INESC can profit from the knowledge and substantial experience in order to face problems and the future, in the same way ERCIM can benefit from our energy and youth.

José Tribolet
João Lorenço Fernandes

SPECIAL :

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ITALY enters ERCIM

The Italian National Research Council is ERCIM's Sixth Partner

by Franco Denoth - Director, IEI-CNR

At the Directors' meeting in Paris on 17 June 1991, Italy became an official partner of ERCIM with the signing of the scientific cooperation agreement by the Italian National Research Council.

The National Research Council (CNR) is the most important institution in Italy for public research. It was founded in 1923 as an agency with the mandate to represent Italy in the International Research Council in Brussels and the first President was the famous mathematician Vito Volterra. Since 1989, it is dependent on the Ministry for Universities and Scientific and Technological Research (MURST).

The scientific, technological and operational units of CNR are structured into Institutes, Research Centres and Groups. The research activities and funding are coordinated by 15 National Advisory Committees. The permanent staff is currently about 6700 and the annual state funding is approximately 1,000 million US dollars.

The main institutional objectives of CNR are:
. the promotion and coordination of Italian scientific and technological research on a national and international level;
. the provision of scientific and technical consulting services for the government;
. the definition of standards in the scientific and technical sectors.

In order to fulfil these objectives, CNR finances and promotes research activities both directly in its own institutes and centres and also by means of contracts and contributions to external institutions, and finances large, nation-wide applied strategic research projects and the participation in important international scientific initiatives. In addition, CNR is responsible for training activities which include the granting of scholarships for post-graduate studies in Italy and abroad and the definition, in collaboration with the universities of postgraduate degree courses. It also organises a large number of conferences, courses, workshops, etc., annually, and publishes many articles, volumes, proceedings and journals of scientific and technological interest.

Informatics in Pisa

One of the largest concentrations of CNR institutes and centres, employing about 10% of the permanent CNR staff and covering a wide range of disciplines, is found in Pisa. At present, these institutes and centres are located in different buildings throughout the city which often makes communication and the coordination of scientific, technical and administrative activities problematic. However, in 1990, the foundation stone was laid for the construction of a new Area of Research which will become the site for all CNR research initiatives in Pisa. The Area should be ready in 1993 and should help considerably towards a streamlining of activities by permitting the centralisation of certain important services such as libraries, printing facilities, laboratories, etc. A model of the future 'Area of Research' is shown below.

The main CNR activity in the computer science field is conducted by three Institutes in Pisa:
. Istituto di Elaborazione della Informazione (IEI);
. Istituto CNUCE (CNUCE);
. Istituto di Linguistica Computazionale (ILC).

These Institutes thus represent the CNR partner in ERCIM. In addition, IEI will coordinate the participation of other CNR Institutes in Italy working in computer science and in applied mathematics.

The beginnings of activity and research in computer science in Pisa can be traced back to 1954 when, following a proposal of Enrico Fermi, it was decided to found the CSCE (Centre for Studies on Electronic Computing) with the objective of designing and constructing the first computer in Italy to be dedicated entirely to scientific activities. This decision was of great importance in helping to bring Italy into line with the rapid international scientific and technological developments in course at that moment.

By 1960 the CEP, the Pisan Electronic Computer, was operational. The studies which had been performed to design and develop the computer also stimulated the development of new skills and the preparation of scientists and technicians in this sector. In 1968, the CSCE became the "Istituto di Elaborazione della

A model of CNR's future 'Area of Research' in Pisa (Photo: CNR)

Informazione" (IEI) of CNR and was made responsible for conducting inter-disciplinary theoretical and applied research activities in the information processing sector. IEI also provides advanced services for hardware and software certification and image processing.

In 1964, CNUCE was founded as the National Computing Centre of the University of Pisa to become, in 1974, an Institute of CNR with the mandate of providing research and computing facilities and networking services for the Italian scientific community.

1978 saw the foundation of the "Istituto di Linguistica Computazionale" (ILC) as an independent CNR Institute. The primary objectives of the ILC are inter-disciplinary theoretical and applied research activities in the field of linguistic data processing.

This growth of expertise was to contribute significantly to the confirmation of the Department of Computer Science at the University of Pisa and in general the establishment of Pisa as the primary centre of research in this sector in Italy.

The current staffing and budgeting (salaries and site costs excluded) of these three Institutes is as follows:
IEI: 57 researchers, 45 technicians, 4 administrative staff; approximately 2.5 million U.S. dollars.
CNUCE: 50 researchers, 65 technicians, 4 administrative staff; approximately 9 million U.S. dollars.
ILC: 15 researchers, 8 technicians, 4 administrative staff; approximately 0.5 million US dollars.

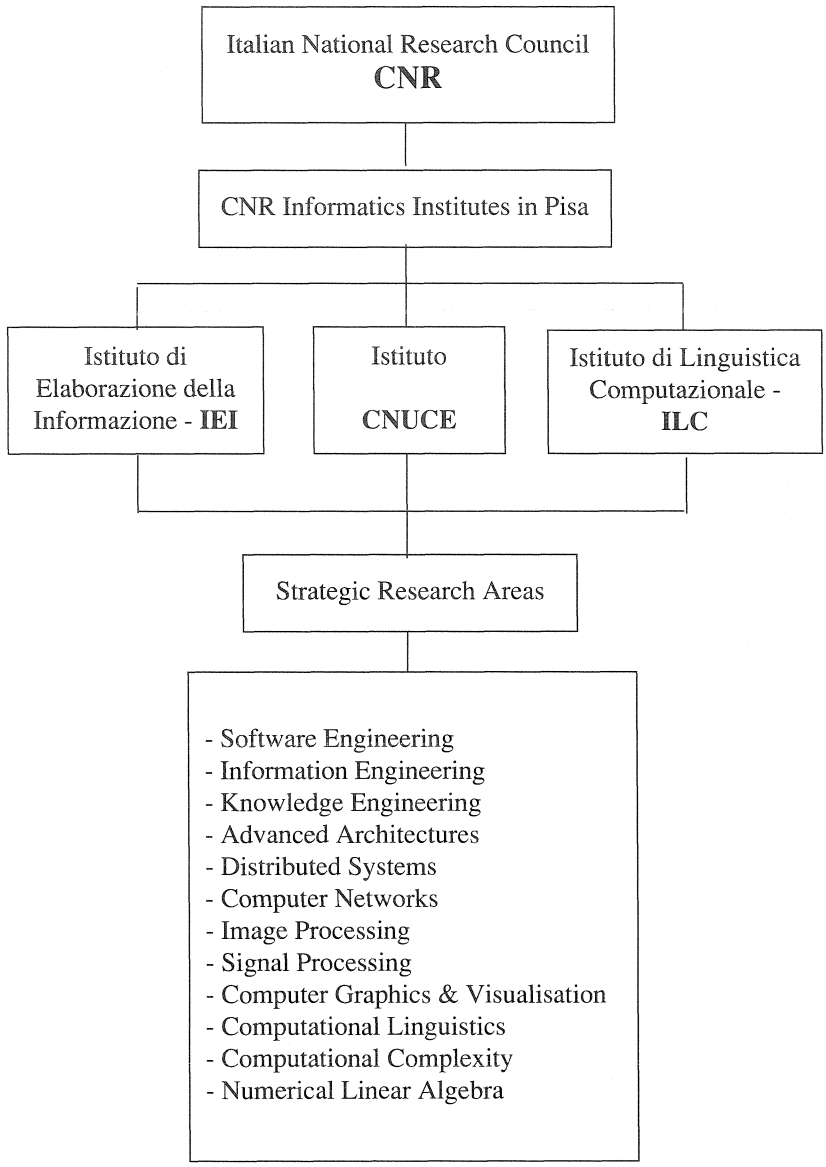
The CNR Informatics Institutes in Pisa participate in most of the major national research activities in the field and play a central part in the organisation and management of these activities. In particular, they have a key role in the organisation of the CNR Strategic Projects and the CNR "Finalised Project" for Information Systems and Parallel Computing. They also collaborate actively with a large number of public and private research institutions and with the Italian academic world including the University of Pisa, the Scuola Normale Superiore, and the Scuola Superiore di Studi Universitari e Perfezionamento S. Anna.

In order to promote know-how and technology transfer, the Institutes contributed to the creation and support of a Consortium: "Pisa Research Consortium" which has been set up by joint initiative of CNR and IRI (Institute for Industrial Reconstruction). The presence of the Informatics Institutes has also greatly contributed to the establishment in the Pisa area of a number of industrial R&D centres (Data Management, INTECS, OLIVETTI, PIAGGIO, SELENIA, S & M, TECSIEL).

The three Institutes are very much involved in international research activities and in particular in ESPRIT projects such as MULTOS, TODOS, FIDE, DELTA4, LOTOSPHERE, ACQUILEX, MULTILEX, IDEAL.

A scheme of the organisation of the CNR information technology activities in Pisa is shown above. More complete details of the different research activities of each of the Institutes are given in a booklet which can be obtained on request from Ms Manuela Mennucci, the ERCIM Secretary at IEI-CNR.

CNR is currently undergoing reorganisation and, in particular, with regard to Computer Science, the aim is to create a structure which will have the mandate of planning and organising research activity at a national level and the CNR participation in international projects and initiatives. This should render the research activity more efficient by grouping together all the CNR Institutes and centres working in this sector. The new structure should favour a freer transfer of scientific results to the industrial world and should also help to stimulate a greater integration of CNR basic and applied research activity in international projects, in particular those sponsored by the European Community. The participation in ERCIM is expected to help this process. ■



Organisation of the CNR activities in Pisa

Research and Technology Transfer

by Alain Michard - Manager, ERCIM

On June 17 th, ERCIM organised a Conference in Paris on the theme: "Research and Technology Transfer in Informatics for Europe". The objectives of the meeting were to present the ERCIM initiative to a large industrial public, and to discuss ERCIM's role in technology transfer in the future. Two hundred persons from all over Europe, representing public and industrial research organisations and governmental authorities, attended the meeting.

Professor Cor Baayen opened the proceedings by giving a description of ERCIM, insisting on its general and ambitious objectives: "In the IT field, a strong closely knit R&D community is a prerequisite for staying in the forefront of developments and taking part in the determination of standards. Such a community should be very diverse, with participation from computer manufacturers, software developers, researchers at universities and other institutions, and from users in companies, government and service industries." In the remainder of his talk he focused on the first attempt to build such a community: ERCIM...

Mr. Michel Carpentier, General Director at the European Commission, followed by evoking the relations that exist between basic research, applied (or pre-competitive) research and technological development in the framework of the innovation process. He explained that a linear model of the innovation process, going from fundamental research to the product, was not at all satisfactory. The innovation process could be better described by means of a " feed-back loop": "Science pushes technology and technology pulls science on the way to innovation. Applications which express the needs of the market and of the society, pull technologies. In the same time technologies enable new applications which are leading to new scientific and technological needs, and so on... This innovation process is not linear, and in the loop all links are mandatory." Through the R&D framework programme, the Commission has mainly contributed in strengthening two elements of this loop: pre-competitive research and basic research.

Mr. Eugenio Triana, General Secretary for Technology and Innovation at the Spanish Ministry of Industry, presented his views on "Technology Transfer in the Industrial Global Business". In his very documented presentation he explained that the globalisation strategy which characterise the large multinational companies first concerned manufacturing and marketing activities but that the last few years have seen some globalisation in the activities of R&T and of strategic decision. The consequence of the R&T globalisation is that companies are very often searching for collaborations with other companies, universities and public laboratories, as well as with governmental and international organisations on a worldwide basis. R&D programmes, both at national or at European levels, have proved to be useful instruments of this globalisation of pre-competitive R&D.

After the above presentations, a round-table gathering representatives of high-tech european industries and research organisations debated on three points:

- the potential interest of large international projects (e.g. Eureka) especially in the software domain,
- the particular difficulties encountered by young high-tech companies born and growing in Europe, and
- the conditions required which would allow European companies to develop their research, technical and industrial collaborations beyond ESPRIT-type programs.

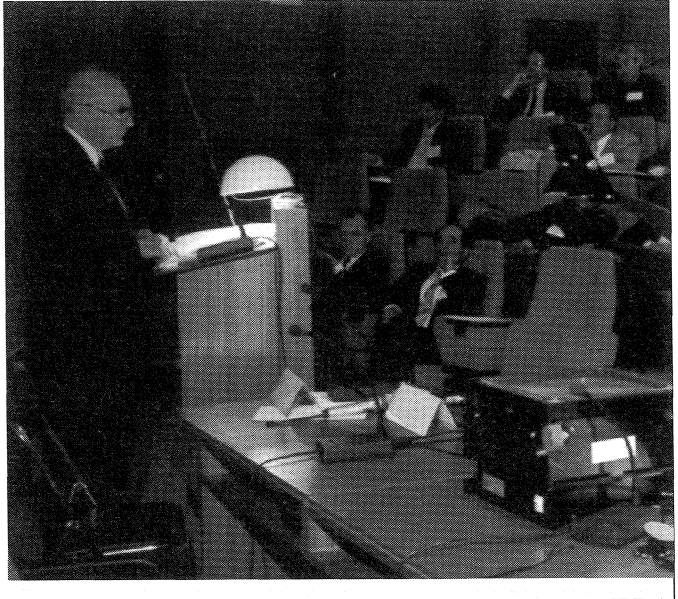
During these discussions, several speakers insisted on the fact that computer manufacturers, software houses, small high-tech companies and research organisations had the same interest in promoting the development of a healthy IT community in Europe and should more often collaborate to create new innovative products and of standards. Here again, ERCIM was seen as a promising instrument to facilitate collaborations between public research organisations and industry.

The French Minister of Research and Technology, Hubert Curien, concluded the meeting. He said that ERCIM was a good example of what should be done in Europe to strengthen the links in the scientific community, and that ERCIM's model should be followed in other domains than IT. He concluded by saying that ERCIM should play a major role in the future, not only in basic research, but also in technology transfer and in training of scientists.

The proceedings of this Conference with complete papers will be published by ERCIM in October 1991. ■

Michel Carpentier

Cor Baayen



Hubert Curien **(Photos: INRIA)**

The directors of the six current ERCIM member institutes at RAL (Photo: RAL)

ERCIM Meeting: RAL, May 2-3

Database Workshop

by John Kalmus - RAL

The participants agreed that the Database Workshop, hosted by RAL, had been most successful and thanked the Directors for giving us the opportunity to meet. There was a broad consensus on the way forward and directions for future research work.

Methods work on: Models, Languages and Theory (Object-Oriented, Deductive and Functional); Architectures (including Distributed and Parallel) and proof by demonstrations; System Development Methods and Tools

Applications work on: Scientific Databases; Multimedia and Hypertext

The sought after advances on methods and applications must be achieved against the important background requirement for Interoperability.

Attention was drawn to the disparity in the levels of effort currently available in the various ERCIM Institutes for Database Research (as opposed to Applications and User Support work) —- the participants felt that this pointed clearly to the need for concerted joint action by the ERCIM Database community to seek and obtain additional research funding (for instance, through the Esprit III initiative).

Several actions were proposed by the Workshop.

Firstly, Technical Workshops on "hot topics" will be organised at the ERCIM Institutes, involving:

- possible external speaker(s),
- a short report in ERCIM News, and
- keynote paper(s) / published proceedings.

The participants of the Database Workshop agreed to the following two Technical Workshops to start the series:

- Models, languages, theory - hosted by Martin Kersten at CWI in October 91;
- Application Solution - hosted by Keith Jeffery at RAL in May 92.

The other actions proposed by the Database Workshop participants were:

- ERCIM Fellowships by topic;
- Staff Exchange between ERCIM Institutions by topic;
- Political and financial support from ERCIM Management for Esprit III Bid Preparation.

The mechanism proposed was the setting up of a committee of representatives of the ERCIM DB Community, to act as a contact point for ERCIM management, using e-mail to maintain contact with the community.

ERCIM DB Community Representatives:

CWI: Martin Kersten, mk@cwi.nl
INRIA: Stephane Grumbach, grumbach@seti.inria.fr
GMD: Erich Neuhold, neuhold@darmstadt.gmd.de
RAL: Keith Jeffery, kgj@ib.rl.ac.uk
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■

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Numerical Algorithms Workshop

by Iain Duff - RAL

Since many of those attending the workshop had not previously met each other, either in the ERCIM context or elsewhere, a major purpose of this workshop was to introduce the participants to the work going on in the laboratories of ERCIM (present and future members) with a view to stimulating future cooperation in the area of numerical algorithms.

Overview presentations of numerical algorithm work at CWI, GMD, INRIA, RAL, CNR, and INESC were followed by more detailed talks on particular research projects. The topics included several in numerical linear algebra including direct and iterative methods for solving sparse equations, multigrid methods, domain decomposition, the eigenproblem for band matrices and for large sparse unsymmetric matrices, and a discussion of complexity issues in linear algebra. Many of the speakers stressed the exploitation or potential exploitation of parallelism within their algorithms. Target machines varied from those based on transputers to traditional multiprocessor vector supercomputers like the CRAY computers and the IBM 3090/VF.

The workshop participants decided to set up working groups on specific topics (for example, multigrid algorithms, parallel solution of odes/pdes, benchmarking) and to organise more specialized workshops at future ERCIM meetings to focus efforts for future collaboration —- hopefully such joint activities might EC attract funding from the Community either through support

for courses like LSSPC or for research through the basic research action programme, for example. The recommendations to ERCIM management included strong encouragement to support both political and technical progress towards better network access on a European scale and central support for exchange of researchers, extending the concept of the ERCIM Fellow to allow people already working at one laboratory to visit another for periods of from three months to a year. It was felt that the ERCIM Newsletter could be used to provide a useful forum for exchange of ideas perhaps by expanding its coverage in technical areas.

In general, our visitors remarked that they found the event interesting, informative, and stimulating. They liked the rural environment of the Laboratory and appreciated the hospitality offered during the Meeting. Copies of the final programme and of abstracts and transparencies of talks presented at the workshop are available from Linda Miles, Bldg R27, RAL (lmiles@ib.rl.ac.uk).

■

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Visualisation and Computer Graphics Workshop

by Julian Gallop - RAL

The presentations given by workshop participants fell into a number of areas

- Introductory: reports of the Eurographics Workshop on Visualisation in Delft (April 1991) and the UK Workshop on Visualisation at Cosener's, RAL (February 1991); introductory presentations from institutes, including CNR, INESC and NCC. As part of their introductory presentation INESC presented a computer animated film made for their recent 10th anniversary.
- A wide range of applications were described, including: engineering research including computational fluid dynamics and structural mechanics; analysis of the behaviour of graphics hardware; neutron scattering; inter-process communication structures; and oceanography.
- Techniques in visualisation, including: volume rendering, lighting, pin-screen emulation, physical models, video, multimedia, real-time 3D graphics hardware, modelling, and parallelism
- Environments for visualisation: inter-process communication, application builders and cognitive problems.
- The relationship between computer vision and image synthesis.

Several recommendations for future joint work of the institutes were made:

- The discussion in the workshop re-examined what scientific visualisation is actually for and how it really benefits the scientist. It was decided that collaborations between users and providers should be fostered and that the ERCIM institutes should share the findings and the resultant research topics.
- Many of the workshop participants had strong joint interests in computer graphics, even though the primary topic was visualisation. This is understandable given the overlap between the disciplines. Some participants are active on the ERCIM group working on future generations of computer graphics systems.The computer graphics requirements that arise from visualisation should be input to that group.
- Image synthesis and image analysis are both concerned with the relationship between images and computer-based models, but in opposite directions. The disciplines can be used to their mutual benefit, forming a bond between theory and experiment which has great potential. This needs to be explored jointly by ERCIM partners.
- To make progress with these activities, a small ERCIM working group on visualisation is to define specific areas of joint work and specific mechanisms of collaboration to further that joint work. All ERCIM institutes would be represented. Initially the costs for which ERCIM support is needed will be those incurred by the working group, which would be time and travel costs. When the mechanisms for further collaboration are defined, further proposals would be made.

■

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Next ERCIM Meeting: INESC, November 14-15

The next ERCIM Workshop will be held at Lisbon, 14th and 15th of November, organised by INESC. This workshop will be dedicated to three scientific areas:

- Distributed Systems
- User Interfaces and Multimedia Technology
- Decision Making: Methods and Applications

The Steering Committee and Directors Meetings will take place in parallel. Representatives of Greek and Norwegian research institutions aiming to become ERCIM partners will be invited to participate.

These workshops are conceived as an important instrument for promotion of mutual awareness of ongoing work and of the interests in each field, enabling the exchange of scientific and technological knowledge.

The main topics of the **Distributed Systems Workshop** are:

- Environments and tools for development of distributed applications;
- Large-scale distributed systems and cooperative work;
- Distributed fault-tolerant and real-time systems;
- Distributed operating systems.

At the **Multimedia Technology Workshop** the exchange of ideas and experiences will be concentrated on:

- Innovative user interfaces techniques;
- Multimedia interaction;
- Integration with existing user interfaces;
- Software architectures;
- Support for multiuser and multimedia interfaces;
- Architectural support for CSCW

applications;
- Tools and methodologies for constructions of interactive applications and systems;
- Object oriented techniques and automation tools;
- Multimedia information modelling and retrieval.

Finally, the **Decision Making Workshop** will discuss themes such as:

- Large scale optimisation;
- Multiple criteria decision making;
- Uncertainty in decision processes;
- Stochastic and fuzzy approaches;
- Interactive decision support methods;
- Engineering applications (eg. energy, communications, structural design, chemical processes).

Calls for participation and registration forms have already been distributed to the local coordinators at ERCIM institutes. Furthermore, members of research networks sponsored by the European Communities, including non-ERCIM research institutes, will participate for the first time in the workshops, in particular in the Research Network on Distributed Computing Systems and Architectures (DCSA), meaning an opening of this event to external institutes.

Workshop proceedings are being produced for distribution among the participants. ■

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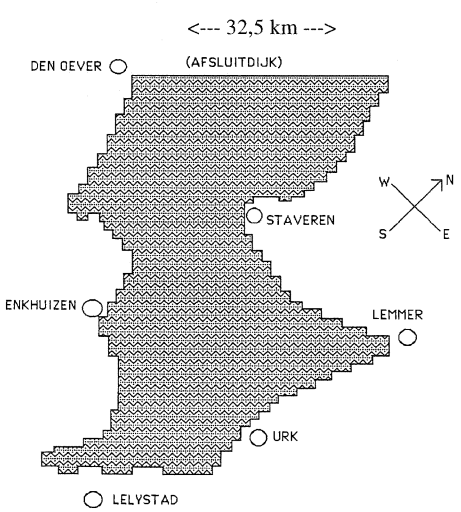
experiment on a non-rectangular domain

The IJsselmeer (largest lake in The Netherlands)

depth = 6.5 m. (5 layers of about 1.3 m.)
$\Delta x = \Delta y = 1$ km. (about 1100 grid points)



ERCIM Advanced 4-day Courses:

Large Scale Scientific Parallel Computing

by Herman te Riele - CWI

Modern super (vector-) computers, such as the Cray X-MP and Y-MP, the NEC SX-models and the Fujitsu VP's, play an important role in scientific research. These machines are of vital interest to scientists and engineers working in application areas like physics, chemistry, meteorology, oil exploration and computational fluid dynamics.

Multiple processor super-computers have recently made their appearance, together with parallel mini-supers like those of Convex, Alliant, Sequent and Encore. All these systems are based on shared memory data storage. Another important development is the concept of local memory systems, for example those consisting of transputer nodes, and hypercube-type systems. Finally, massively parallel machines, like the Connection Machine, are presently entering the market. Consequently, parallelism of numerical algorithms running on all these machines are becoming increasingly important.

The purpose of the ERCIM advanced courses on Large Scale Scientific Parallel Computing is to teach (prospective) researchers and engineers how to exploit modern parallel computing systems. Experience has learned that gaining know-how and experience in the field of vector and parallel computing can be a time-consuming activity. Participants can benefit from the insight, knowledge and experience of experts, having a relatively easy entrance to the field in this way.

The first version of this course was presented at CWI Amsterdam, November 20-23 1990 (with 17 participants), the second version at INRIA Rocquencourt, May 28-31 1991 (with 38 participants). A third version is to be hosted by the third founding ERCIM partner: GMD Bonn, December 10 - 13, 1991.

About half the number of participants comes from industry, the others are mainly from universities and government laboratories (including the ERCIM member institutes). The lecturers are either members of ERCIM laboratories, or guest experts, with the majority coming from the ERCIM member institute hosting the course.

At the end of each course, participants are requested to give their opinion about the course. In general, it appears that the course satisfies a fast growing need from industry, academia and government.

The courses are partly sponsored by the European COMETT programme (COMmunity action programme for Education and Training for Technology). ■

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CWI developed numerical models for parallel simulation of 3D water flows in a non-rectangular domain. These were applied to the IJsselmeer. Applications like this are treated at the ERCIM courses on Large-scale Scientific Parallel Computing.

E S P R I T
a major Community Programme

by Jean-Marie Cadiou - Director of ESPRIT, D.G. XIII

The major element of Community action in support of R&D in IT and electronics has been the ESPRIT programme.

In 1984, when the European Strategic Programme for Research and Development in Information Technologies was launched, it had the overall goal of helping the European information technology industry to build the technology base needed to become and remain competitive with the US and Japan in the 1990s. In addition to this primary objective, it aimed to promote European industrial cooperation in IT and to contribute to the development of internationally accepted standards.

Much has been achieved in pursuit of these objectives. The research programme has had, and continues to have, a very broad impact on a wide variety of participants, be it IT or users companies, universities and research centres, irrespective of their size. At the same time, the continued increase in R&D costs and the lowering of profit margins described earlier underline the need for increased cooperation.

Since 1984, a total investment of ECU 4.7 billion, equally shared between the Community and industry, has mobilised R&D resources. About 6000 researchers are now at work on ESPRIT projects. The programme has also played an important catalytic role in stimulating growth of R&D investment in European firms up to levels which are now close to that of US companies.

The central element of the ESPRIT mechanism is cooperation. Companies both large and small, universities and research institutes have achieved nearly 500 results through participating in ESPRIT. Together they have developed concepts, algorithms, tools, prototypes and standards, and, through further R&D outside of the programme itself, have brought a range of products and software packages to market and had key standards adopted by international bodies.

Furthermore, the Basic Research initiative, launched in 1989, rapidly gained momentum in 1990/91; nearly all research actions have now completed their first 18 months of activity, several results have been produced which have imminent industrial significance, and the proportion of actions with industrial participants has risen to over a quarter. The concept of Networks of Excellence has been put into reality (see next article), which encompasses not only technology transfer but also research coordination, human resources and the cohesion of the research and technology communities across Europe.

Although R&D initiatives such as ESPRIT have had excellent results, as reported above, this cannot be sufficient to overcome the state of crisis of the IT and electronics industry and to provide European industry with the means to compete in the global market.

The Community market has inherited a high degree of fragmentation and the limited scope of national markets has restricted the exploitation of economies of scale; Other elements such as the high cost of capital, the insufficient availability of skilled staff, or the lack of sufficient vertical integration in the European IT and electronics firms, strongly penalise European companies and make them more vulnerable than others to an adverse economic cycle, while they are engaged in a considerable restructuring effort.

Looking into the future, the overall industrial context and the necessity of higher investments in R&D, make such research cooperation mechanisms as ESPRIT more necessary now than ever.

The Council of Ministers gave its formal approval to the new phase on 8 July 1991, and the first general call for proposals has been launched very shortly afterwards.

The new phase of ESPRIT

The programme must adjust to a fast-changing scene by continuing to be a stimulus for cooperative R&D projects and by focusing on well-defined strategic objectives and technological priorities. Looking into the future, the overall industrial context and the necessity of higher investments in R&D make such a cooperation mechanism, if anything, more necessary now than ever. The new phase of ESPRIT is part of the third Framework Programme for Community R&D activities, which has been agreed for the period 1990-94. It foresees that out of ECU 5.7 billion earmarked for Community R&D, ECU 1.35 billion will be devoted to information technology. The new phase will consist of four technological areas plus Basic Research; a horizontal initiative in Open Microprocessor

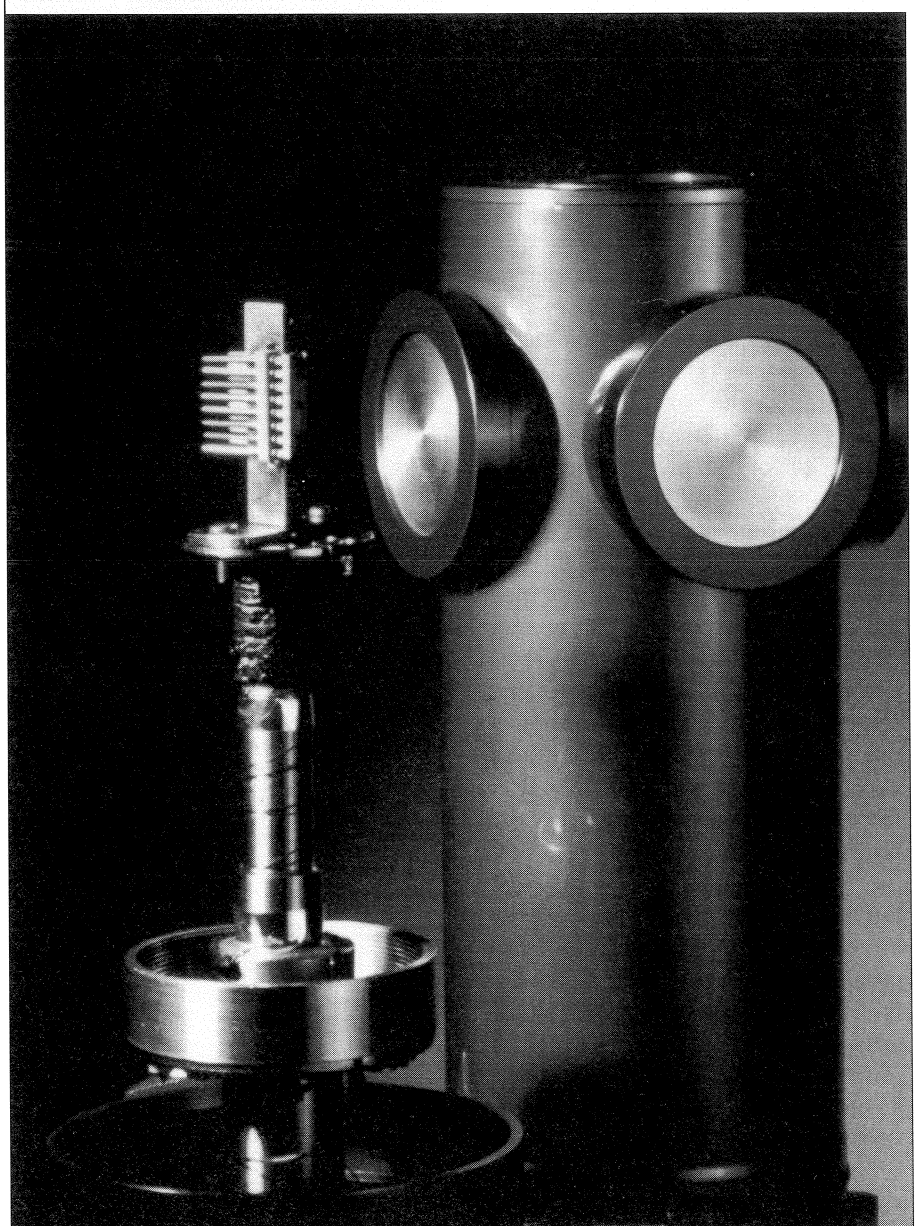
Systems; a set of supporting initiatives; and five large-scale targeted projects in line with the recent Commission's communication to the Council of Ministers[1].These areas and initiatives are outlined below.

Microelectronics

The key objectives are to strengthen the Community's ability to design and manufacture leading-edge ICs and to ensure their ready availability to a broad range of user companies. Particular attention will be paid to working in conjunction with JESSI, the Joint European Submicron Silicon Initiative, and to creating favourable conditions for the use of application-specific integrated circuits (ASICs) by SMEs.

Software Engineering and Information Processing Systems

The objectives in this area are to apply software-intensive systems design and engineering techniques to user needs; to develop information servers and their interfaces that are appropriate to different users' tasks and levels of expertise; and to develop advanced architectures and their applications. The R&D tasks will take into account the major technology transfer and awareness initiative, ESSI, one of the large scale targeted projects (see below).



A circuit consisting of transistors of dimensions smaller than 1 micron is shown mounted in a cryostat for measurements of the electrical characteristics and noise as a function of temperature. An important result of the NOISE Action (3017) is that the ageing of transistors is accelerated at low temperatures, thus providing new means for addressing problems of balance between performance enhancement and degradation. (Photo: B. Ciancia, LPCS, Grenoble)

Advanced Business and Home Systems - Peripherals

The work in this area aims to develop user-friendly support for cooperative working; promote the development and use of multimedia systems; demonstrate loosely coupled distributed systems; promote the introduction of information technology into the home; and develop selected peripheral technologies.

Computer-Integrated Manufacturing and Engineering

The main aim is to demonstrate how the manufacturing and engineering industries can benefit from the application and integration of IT in products and processes. Taking an integrative approach, in which social, economic, organisational and environmental factors will play a decisive role, the work will centre around the following themes: promoting the use of open systems; promoting the development of modular and compatible system components that lend themselves to an incremental approach and which SMEs can afford; and developing new generations of handling systems.

Basic Research

Basic Research will continue to have four key aims: to enhance the potential for future technological breakthroughs in IT; to benefit from the added value offered by cooperation at the European level; to contribute to the attainment of the programme's objectives from a position upstream of the market; and to reinforce interdisciplinary links. The results of any single Basic Research project are expected to feed through

into several projects and areas of technological R&D by providing the underlying knowledge and expertise needed to create future breakthroughs.

Open Microprocessor Systems Initiative

The goal of the Open Microprocessor Systems Initiative is to extend the concept of open systems and standards to the microprocessor systems environment by providing an open framework based on the macrocell approach and software portability. It will interact with and build on the results of all the technological areas of ESPRIT, as well as on standards and other relevant developments worldwide.

Large-Scale Targeted Projects

These will address the following domains:

- Microelectronics, to develop IC design and manufacturing technologies for both standard ICs and ASICs.
- Peripherals, in particular in high-resolution flat-panel display technology.
- Software, to increase productivity by concentrating on production methods and tools and their early transfer to users. This is an area where R&D must be accompanied by broad dissemination of results and training activities. The initiative is called ESSI (European Software and Systems Initiative).
- High-performance computing, to take advantage of the possibilities offered by progress in the field of parallel processing.
- CIM, to strengthen European manufacturing capabilities.

Conclusion

The past year and a half has been a very successful and exciting period for ESPRIT, with 150 new projects and exploratory actions launched, technological breakthrough and numerous tangible results emerging into the marketplace, and the build-up to the launch of the third phase of the programme. This new phase of ESPRIT represents an important element of the Commission's new policy for the electronics and IT industry, and maximum advantage should be taken from it.

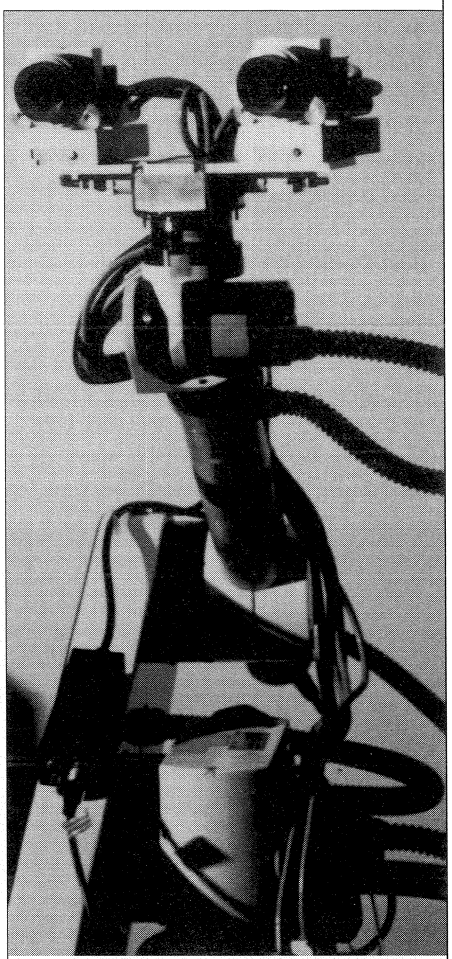
Since its inception in 1984, the programme has evolved in terms of both its technology focus point and the scope of its industrial interest. In the initial phase substantial emphasis was placed on strengthening the technology capabilities.In line with the new IT policy, the emphasis for this new phase of the programme must be further evolved.

Project proposals other than those for Basic Research must demonstrate how the development of improved technology capabilities will impact the market. Hence, particular attention should be given to the composition of the consortium, including the role that users can play, the ability of partners to secure clear levels of market place advantage, the organisation and management attributes necessary to achieve the overall project objectives.

The number of partners in a consortium should be kept to the minimum number necessary to achieve the goals of the project. The role and contribution that each partner is committed to make must be clearly identified. Excessive number of partners and a lack of clarity concerning roles will adversely affect the chances of achieving a successful project proposal.

On the global scale, the present situation of the industry calls for prompt action. Information technology is crucial to Europe's economy and prosperity and will remain so for as long as anyone can foresee. Public authorities and industrialists throughout the Community - both suppliers and users - must develop a sense of mutual responsibility and urgency about this issue. Our future certainly depends on it. ■

(1) The European Electronics and IT industry: State of Play, Issues at Stake and Proposals for Actions - SEC (91) - 565 final.



The VAP Action (3038) has developed a prototype of vision robot which is able to keep its focus of attention on moving scenes. It can recognise dynamic patterns, and can continuously coordinate the aiming and focussing of its "eyes" with its movements, employing advanced real-time computing and sensing. (Photo: J. Crowley, LIFIA, Grenoble)

Further information on the ESPRIT call for proposals can be obtained by contacting:

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B-1040 Bruxelles

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Closing date for reception of proposals by the Commission is October 14th 1991.

Networks of Excellence:
What are they ?

by George Metakides - Head of the Basic Research Division, ESPRIT, D.G. XIII

A network of excellence is a grouping of research teams with common long term technological goals coordinating their research as well as their training policies closely. For their common goals, the research teams that constitute the "nodes" of a network of excellence possess collectively:

- A critical mass of top level experts
- Skills in all disciplines which contribute to the attainment of the goals.
- A state-of-the-art infrastructure.

A network is in principle open to all organisations working towards the same goals wherever in Europe they may be situated. Typically, the nodes of a network define a strategy necessary for the achievement of its long term technological goals and devise a frame of reference in which fit the projects of the different members of the network.

The close linkage between the nodes of the network means that access to any node gives access to the resources of the whole network - know-how, special skills or material resources. This accessibility of the network from all geographical points has implications on:

- Industrial innovation / Technology Transfer
- Human Resources
- Cohesion

Whereas any one node may have considerable expertise in one aspect of an industrial problem the network combines the expertise of all its nodes. Thus, European industry, wherever it may be located, can have access to an entire network by accessing any one of its nodes.

Networks of Excellence is a new concept initiated by ESPRIT Basic Research of CEC/DGXIII which encompasses technology transfer, research coordination, human resources and the cohesion of the research and technology communities across Europe.

The collective strength of a network makes it a pole of attraction for young researchers, doctoral or post-doctoral, who may be able to spend part of their time in different nodes of a network collectively providing the interdisciplinary skills needed. The majority of researchers trained this way, through research itself, will find their future in industry, contributing to the skills industry needs so badly: those of systems engineers - people with a complete view of the area from concept to implementation.

The distributed nature of networks helps ensure that excellence is not drained away from regions of Europe which have not had the same tradition of technological development as others. These regions can have viable nodes of European networks, while having large "centres of excellence" would be unrealistic for them. Moreover, they give local industry the opportunity to access the most advanced research locally and the local research community access to a transnational industrial market.

Networks of excellence adopt concrete measures to achieve their objectives. They promote mobility of researchers, design curricula and interdisciplinary course material in the area of their expertise, act as clearing houses for research results but also promote personnel exchanges with industry so as to ensure continued training and technology transfer through people themselves.

What do Networks of Excellence imply for innovation and competitiveness?

The concept of Networks of Excellence looks at the long term of European research and innovation and is expected to have a profound and long lasting influence on the European research community and its role in industrial innovation and training. Assuming a broad acceptance of the concept, even beyond IT in which it is currently implemented, it has the following implications:

- Networks of Excellence allow the spreading of research and innovation throughout the community without the constraints that any "centre" of expertise must be all encompassing to have a technological impact. This promotes a balanced technological base for industrial activity in each region.

- This distribution and accessibility to technological expertise in all parts of Europe is of particular benefit to innovative SMEs. The benefit is dual: Access to knowledge needed to generate technology, and access to a market for the technology generated, through other nodes of the network. This promotes transnational European

partnerships and the evolution of global distribution networks, both enhancing the overall competitivity of European industry and SMEs in particular.

- The feasibility of having innovation centres distributed to all parts of Europe dictates the need, as well as offers the opportunity for the creation of local technology centres wherever human potential is found. The capacity of universities and research centres to attract high technology industries is thus enhanced.

- The principle that access to a single node gives access to the resources of a network as a whole is one that enhances temporary mobility of researchers who wish to work closely on an individual project, while at the same time making permanent migration unnecessary. This further contributes to the balance of economic activity and the ability to innovate throughout Europe.

- The complete chain of activity from the conception of ideas to their applications is integrated in a manner which respects the fundamental aspects of research while keeping its sights of it industrial, social and economic implications. Integration permits the most efficient use of scarce human resources.

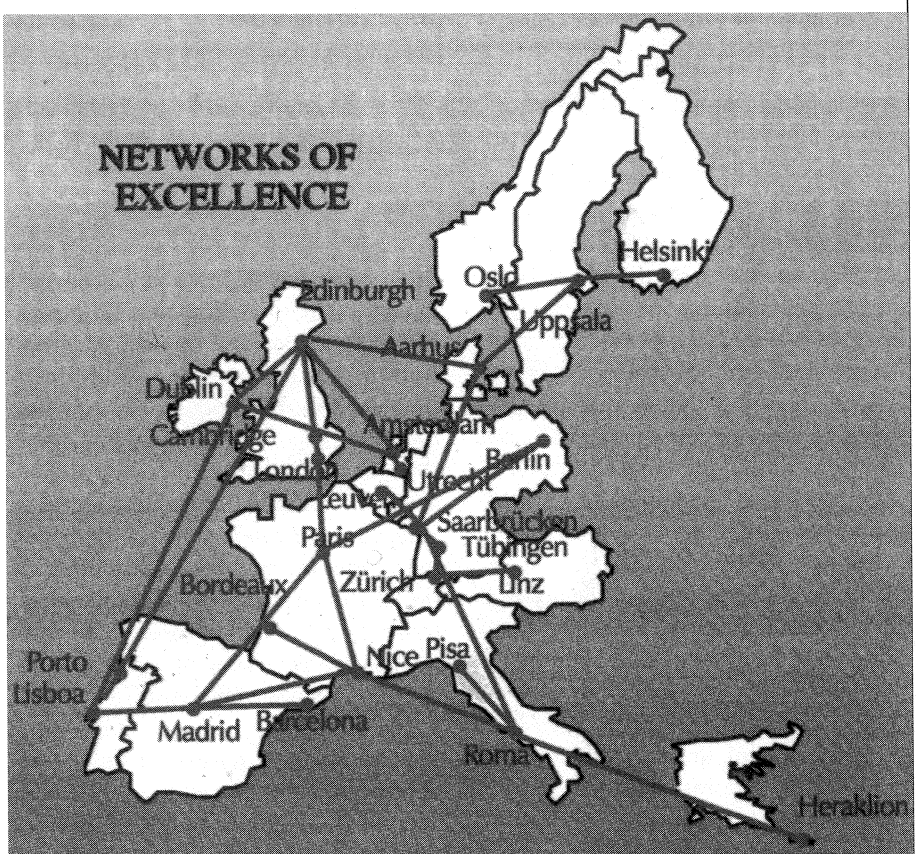
What is needed for the successful functioning of Networks of excellence?

There are three primary requirements:

- The willingness of the research community to coordinate their research and look to its long term implications. This will permit the research community to guide itself to effective social and economic ends without, at the same time, sacrificing long term benefits for small short term gains.

- The existence of a high performance telecommunications infrastructure to reinforce the ability of a network to behave as a single entity. Such an infrastructure should be able to permit more than exchange of messages, electronic mail etc. The telecommunications infrastructure should, in the first instance, be able to support distributed cooperative work.

- The facilitation of academic, industrial and venture capital links at the local level. The distribution of the ability to innovate must go hand-in-hand with creating the conditions through which innovation will be converted to wealth.



A typical structure of a network of excellence: the lines between the nodes indicate collaboration, exchanges or communication links. The network is open to all academic or industrial teams working towards common technological goals wherever they may be located

Three networks of excellence in the areas of "Computational Logic", "Language and Speech" and "Distributed Computer Systems Architectures" have already been launched in a first one-year pilot phase (see following reviews). It is expected that 1992 will see the beginning of networks with technological targets in different areas of information technology. ■

NETWORK OF EXCELLENCE

Language and Speech

by Ewan Klein

The aim of the Network in Language and Speech is to coordinate European research and postgraduate training activities which promote the integration of natural language (NL) and speech systems. At a theoretical level, research towards this goal forms part of the wider enterprise of constructing a comprehensive model of the "cognitive chain" which links speech to reasoning via NL. At a practical level, it will involve building systems that can both automatically understand speech and enable speech to be synthesised from abstract representations of meaning.

Although it is unlikely that constructing large-scale integrated speech and NL systems can be achieved within a decade, the Network is intended to accelerate progress towards this target. It will also help to reconcile the opposed methodological positions which are currently hindering fruitful interdisciplinary cooperation between the two research communities.

By building on structures and collaborative research projects already present at the national and European level, the Network will make use of the personal and intellectual ties that are vital for such a large-scale cooperative venture. Moreover, it will encourage technology transfer by increasing the level of interaction between academia and industry, and will promote activities that produce a variety of industrially relevant results during its life-time.

There are a number of reasons why it is appropriate to address these problems at a European, rather than a national, scale. First and foremost, the sheer complexity of the scientific problems involved mean that the widest available range of expertise should be drawn upon. Second, the Network will attempt to build an overarching framework within which existing and future research inititiatives can be oriented. Since some of the most important initiatives (e.g. ESPRIT, EUROTRA) are already being played on a European platform, it follows that the Network must be of a comparable scope. Third, the multilingual nature of Europe is an obvious impediment to the goal of establishing a common market and community while at the same time preserving national and cultural identities. But we can regard this impediment as a challenge to be addressed by the Network; indeed, responding creatively should allow Europe to seize a considerable opportunity, namely to establish a position of world-leadership in multilingual NL and speech proceeding systems.

The Network is currently developing initiatives in a number of areas, including the following:

- the organisation of an international workshop to assess the current state of the art in speech and language integration;

- the establishment of a European-wide PhD training network;

- a review of software tools and other reusable resources for speech and NL processing;

- the construction of information directories about relevant companies, software resources and academic expertise, in order to facilitate consultancy arrangements on a "mix and match" basis.

The Managing nodes of the Network are currently located in Amsterdam, Dublin, Edinburgh, Lisbon, Orsay, Pisa, Roskilde, Stuttgart and Utrecht. In addition, there are about 12 Associate nodes. However, the Network is rapidly evolving, and any group which feels that its research programme would contribute to the goals of the Network is encouraged to apply for membership. ■

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NETWORK OF EXCELLENCE

Distributed Computing Systems Architectures

by Nick Cook

The Research Network in Distributed Computing Systems Architectures brings together a number of internationally-ranked research groups, sited in various European university departments and research institutes, that are undertaking research into the problems of designing, and into the opportunities provided by, large scale distributed computing systems.

The particular research problems that the members expect their future work to concentrate on, and which many of their existing projects already directly address, relate to the provision of various pervasive system properties, such as:

- high dependability (including reliability, availability, safety and security),
- flexibility to changes in underlying hardware and to user requirements,
- guaranteed adherence to strict timing constraints, and
- transparent distributed resource sharing.

The Research Network will be a valuable means of coordinating and strengthening the research, the research training activities and the industrial linkages of the groups involved. It will provide a long term stable basis for research cooperation and integration, and a challenging Trans-European environment for research students.

The Executive Board of the Research Network, its governing body, held its first meeting in May at which committees for Research coordination, Research training, Industrial links and Infrastructure were formed. These committees have now been charged with producing workplans for their work area to begin to meet the objectives of the Research Network. In particular, as part of the work on Infrastructure, a questionnaire requesting information on present wide area computer networking facilities and short-term and long-term requirements has been distributed to the members of all three Research Networks.

Finally, one of the major benefits of the Research Network will be in what it facilitates rather than what it provides. In particular, the partners will be able to work together more effectively on collaborative projects of wider interest and relevance than simply the conduct of advanced research. Examples of the sort of projects envisaged are the publication and management of electronic newsletters, the joint production of a comprehensive set of training material on distributed systems, and the investigation of advanced facilities for wide-area multi-media and computer-supported co-operative working. The proposed Research Network will not directly fund all these activities itself, but it will provide the co-operative strength to ensure that such activities can be carried out in the most effective manner possible.

The initial members of the Research Network are: APM (Cambridge), Universities of Bologna and Pisa, BULL-IMAG (Gieres), University of Cambridge, Chorus (Saint Quentin en Yvelines), CTI (Patras), Trinity College Dublin, ETSIT (Madrid), GMD-FOKUS (Berlin), IEI-CNR (Pisa), INESC (Lisbon), INRIA/IRISA (Rocquencourt and Rennes), ITALTEL (Milan), University of Kaiserslautern, LAAS-CNRS (Toulouse), University of Newcastle upon Tyne, Twente University, Rijksuniversiteit Utrecht, Technical University of Vienna, and the Vrije Universiteit (Amsterdam). ■

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NETWORK OF EXCELLENCE

Computational Logic

by Luigia Aiello

COMPULOG NET is the Network of Excellence in Computational Logic supported by the ESPRIT Program of the European Community. It grows out of the ESPRIT Basic Research Action in Computational Logic.

Its scientific objective is to lay the foundations of an integrated software environment for building knowledge-rich applications, by extending the logic programming paradigm with enhancements from the areas of databases, artificial intelligence and logic.

The extension of logic programming has been chosen as the basis for the research activity of the network, both because of its sound logical foundations and because it has proved useful for applications in such diverse areas as programming, program specification, databases, knowledge representation and problem solving.

The main functions of the network are:
- coordinate research activities,
- allocate and coordinate research training fellowships,
- promote the exploitation of results by European industry.

Network and with other networks. It provides opportunities to upgrade the skills of established academic and industrial research workers. It facilitates the mobility needed both for the training activities and to integrate the results achieved by the different nodes in the network. It provides an infrastructure for the training of doctoral and postdoctoral researchers by providing them with opportunities to contribute to an integrated, well motivated and interdisciplinary research program. The network also facilitates technology transfer by providing easy access to the research results for both industries and other interested parties. The involvement of industry in the network helps to test research results and to promote the development of industrially relevant research.

The network is organised by scientific topics, with coordinating nodes having responsibility for each of them. Nodes in the network may be active in more than one topic. Presently, these topics are: Constraint logic programming, Knowledge bases, Knowledge representation and reasoning, Program development and Programming languages.

Constraint logic programming deals with extensions of the logic programming paradigm by means of algorithms and methods for constraint satisfaction.

The **Knowledge bases** topic deals with methods and techniques for building, querying, updating and checking the integrity of large deductive data bases.

The **Knowledge representation and reasoning** topic deals with the computer modelling of knowledge and mechanised reasoning procedures to use that knowledge for problem solving. It includes deduction, abduction, induction, temporal reasoning, metalevel reasoning and nonmonotonic reasoning.

Program development deals with methods and techniques for the automatic development of computer programs together with techniques for improving their efficiency. This topic includes also program verification, abstract interpretation and partial evaluation.

The **Programming languages** topic deals with the design of innovative programming languages and environments based on the logic programming paradigm. Semantics and implementation issues are included in this topic, in particular parallel and concurrent implementation techniques.

The network facilitates communication, mobility and technology transfer by means of regular scientific meetings, summer schools, access to electronic communication, dissemination of information about publications and coordination of training of graduate and postgraduate researchers.

The network consists of about fifty nodes all over Europe. ■

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C O D E S T

by Alain Michard [1] - Manager, ERCIM

Several ERCIM member laboratories have already obtained the necessary funding through the SCIENCE programme to support collaborative activities. Furthermore, several doctoral students are still preparing their PhD. in our organisations, with the support of SCIENCE grants. New proposals for twining operations are in the process of being evaluated. The future "Human Capital and Mobility" Programme which is likely to be launched at the beginning of 1992 should also provide ERCIM with good opportunities to develop its Fellowship Programme and its Staff Exchange Programme. For these reasons we thought it useful to give our readers a short description of CODEST, a key institution in the functioning of the Community S&T programmes.

The Committee for the European Development of Science and Technology (CODEST) was established in December 1982 with a view to assisting the Commission in the preparation and implementation of its scientific policy. CODEST was intended to provide a source of expert advice on current as well as prospective scientific and technical needs and opportunities.

The Committee is also responsible for the implementation of the SCIENCE (formerly STIMULATION) programme and is at the center of the referee network by which project proposals are evaluated. CODEST meets four times a year on a regular basis, and furthermore the Committee has been convened on several occasions for "extraordinary" meetings to discuss matters of particular importance such as Cooperation with the countries of eastern and central Europe, Japan, and the United States.

Troughout its eight years history, CODEST has been informed of all aspects of Community S&T activities through presentations and reports from the various EC programmes. It has been consulted on a range of policy issues including the setting-up of the SCIENCE programme, the assessment of the state of science in Europe, the evaluation of the STIMULATION and SCIENCE Programmes, advising on the selection of large-scale scientific facilities for Community support and the Stimulation Programme for the Economic Sciences. A series of high-level conferences has been held on the initiative of CODEST covering a wide-range of specialist subjects.

Made up of twenty four members from the twelve Community states, the Committee has been joined at its meetings by representatives of five EFTA countries (Austria, Finland, Norway, Sweden and Switzerland) since those countries became signatories to cooperation agreements on full participation in the SCIENCE programme in 1990. A feature of CODEST is that members are nominated on a personal basis by the Commission. Members are appointed for a period of four years (renewable once) and are chosen from "eminent persons of recognised standing in European scientific, technical and industrial circles". Membership of CODEST is purely honorary.

The first chairman of CODEST from 1983 to 1987 was Professor Umberto COLOMBO, long the President of ENEA in Italy and now chairman of the European Science Foundation. From 1987 onwards, CODEST has been chaired by Sir Peter SWINNERTON-DYER, outgoing Chief Executive of the British Universities Funding Council. Amongst the former members are Mr Hubert CURIEN, the French Minister of Research and Technology, Sir Geoffrey ALLEN, and the Nobel Prize winner Ilya PRIGOGINE. The Committee's second four-year term has now come to an end, and the new CODEST will meet in September.

The SCIENCE Programme which represents the main task of CODEST is due to finish at the end of 1992. Under the third Framework Programme, a decision on a new programme on "Human Capital and Mobility" has been taken and its seems likely that CODEST will have a major role to play in the scientific evaluation of the proposals.

[1] Partly printed from IRDAC News by courtesy of the Commission of European Communities.

CODEST Members (list available on July 30, 1991)

Prof. E. ALTHAUS, University of Karlsruhe - Germany

Prof. Thor A. BAK Royal Danish Academy of Sciences and Letters - Denmark

Prof. Augusto M.C.A. BARROSO, Universidade de Lisboa - Portugal

Prof. Alain BENSOUSSAN, Institut National de Recherche en Informatique et Automatique - France

Prof. J. BORGMAN, NWO - Netherlands

Prof. N. CABIBBO, Istituto Nazionale di Fisica Nucluare - Italy

Mr. J. P. CHANGEUX, Institut Pasteur - France

Prof. Dervilla DONNELLY, University College of Dublin - Ireland

Prof. Arturo FALASCHI, Centro Internazionale di Ingegneria Genetica - Italy

Prof. J.E. FENSTAD, Oslo University - Norway

Dr. M.W. GEERLINGS, AKZO - Netherlands

Dr. F.C. KAFATOS, Research Center of Crete - Greece

Prof. G. S. MOSCHYTZ, Institute für Signal und Informationsverabeitung - Switzerland

Mr. F. KOURILSKY, Centre National de la Recherche Scientifique - France

Mr Paul LEVAUX, Fond National de la Recherche Scientifique - Belgium

Prof. Doct. H. MARKL, Deutsche Forschungsgeme Inschaft - Germany

Sir William MITCHELL, Wadham College - United Kingdom

Prof. Y. NEUVO, Tampere University of Technology - Finland

Prof. Doct. F. PASCHKE, Technische Universitaet Wien - Austria

Prof. Pedro PASCUAL, Secretaria de Estado Universitades e Investigacion - Spain

Dr. Galo RAMIREZ, Universidad Autonoma de Madrid - Spain

Mr. C.H. REECE, Heath Ridge - United Kingdom

Dr. D.A. REES, Medical Research Council - United Kingdom

Prof. Carlo RIZZUTO, Universitario Nazionale di Fisica della Materia - Italy

Sir Petter SWINNERTON-DYER - United Kingdom

Prof. Doct. Max SYRBE, Fraunhoffer, Gesellschaft - Germany

Prof. VAN OVERSTRAETEN, IMEC V.Z.W. - Belgium

Prof. Dr. H. WALTHER, Max Planck Institut für Quantenoptik - Germany ■

Visualisation in ERCIM

by Julian Gallop - RAL

Visualisation in ERCIM is flourishing as illustrated by the articles in this issue, in which all the ERCIM institutes are represented.

Scientific visualisation is designed to assist the researcher who handles computer data and needs some way of comprehending the meaning in that data. The present widespread and increasing interest arises from

a need - complex phenomena can be modelled to increasing precision even on a workstation and increasingly voluminous experimental data can be gathered, outstripping the ability of a human to understand it, and

an opportunity - more powerful workstations, with increasing graphical and computational power.

In the articles in this issue can be seen general overviews of visualisation work; applications of visualisation; and the technical solution of specific visualisation problems.

The general overview articles each survey the work undertaken at a particular ERCIM institute in this field.

A number of articles from RAL focus on particular scientific applications. Elsewhere are mentioned a number of applications where close interaction between visualisation experts and scientists has taken place (Palamidese - CNR).

The overview article on visualisation at CWI (van Liere - CWI) presents a number of broad issues that need attention: good presentation, effective interaction and the use of distribution to obtain maximum benefit from available resources. Other articles describe the solution of specific technical problems. Two articles describe techniques for modelling: one studies methods of representing objects and motion (Jung and Neunreither - GMD); the other focusses on the physics of lighting and dynamics, which is necessary for simulation (Hegron - INRIA). For different applications, the data is sampled at a number of points in a volume and the rendering techniques are typically time consuming, requiring an architecture capable of running on serial and parallel architectures (Montani and Scopigno - CNR). In many situations, a user has to interact with a 3D visualisation application by manipulating a 2D input device. The data glove is an attempt to move away from these limitations (Prime - RAL). Other articles describe the use of wide area networks for multi-media (Gunther and Zimmer - GMD) and techniques for improving diagrams by applying a set of rules (Kansy - GMD).

Taken as a whole, the articles convey to me that visualisation is beginning to be used as a genuine tool, but there are still significant problems to solve. ■

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VISUALISATION AT INESC\LISBON

by Mario Gomes - INESC

The utilisation of visualisation techniques in Portugal is still quite unusual, both at university and industry. So, the main goal of our activity is, not only to do research, but also to motivate third parties to use this new technology.

Nowadays, there are two main R&D activities in this area at INESC\Lisbon: The parallelization of algorithms, and the implementation of new artistic forms of representation. Papers on both activities have been presented at Eurographic Workshops.

The parallelization research activity has two main goals:
To balance the execution of parallel algorithms on a distributed, transputer-based, graphic engine;
To implement an object-oriented graphic system.

Both the hardware and the software part of the system were developed at INESC. The communication with the graphic system is based on the creation, modification and destruction of graphic objects. The concept of a "graphic object", applied to a graphic system enables an automatic and intelligent update of the True Colour Screen and increases the communication semantics level.

The main goal of the Pin Screen project is to investigate the potential of a new computer animation paradigm, in image synthesis and in animation components areas. Pin Screen is an analogic technique invented by Alexandre Alexeieff and Claire Parker, between 1930 and 1935. Six films were produced by the inventors and only a few pin screens exist in the world. One of them is used by Jacques Drouin at the National Film Board of Canada, Montreal.

The informatics model is already implemented and was used to produce a poster of the 4th Conference of the Eurographics Portuguese Chapter.

To promote Scientific Visualisation, INESC is working in collaboration with several organisations in the utilisation of in-house software and a commercial animation system. These development activities have raised enormous interest, creating the demand for a specialised Multimedia Centre, now being planed with the support of state funds.

The main purpose of this Centre will be to increase the use of visualisation techniques by the Portuguese industry. Special links will be established with enterprises in the shoe-making and mould-making domains, as well as specialised university R&D centres. ■

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CNR Projects on Computer Graphics and Scientific Visualisation

by Giorgio Faconti - CNR

The National Research Council of Italy is funding a comprehensive set of projects with the aim of promoting cooperation between national research and industrial institutions in various fields of science and engineering. Computer Graphics and Scientific Visualisation play an important role within this set of projects as they are considered integrating and enabling technologies.

Research and development in the field is conducted by the major CNR Institutes involved with Computer Graphics and Visualisation in Genoa (Institute for Applied Mathematics), Milan (Institute for Industrial Automation), Pisa (CNUCE, IEI), and Rome (Institute for Automatic Computing) together with industrial partners, such as Alenia, Ansaldo, CadLab, IBM, ItalCAD, and Olivetti. All these projects are based on a five year programme covering the period 1989/1994. Major R&D projects included are the "Project on Robotics", the "Project on Information Systems and Parallel Computing", and the "Project on UIMS".

Robotics

The Project on Robotics has a budget of 67.8 thousand million Italian lire over five years. Its aim is to promote the development, prototyping and implementation of complete robot systems to be used in industrial applications. The project is developing a modular approach to robot system construction by defining sub-systems that can be variously interconnected to suit different application requirements. Adopting this approach should ensure that the project will satisfy the needs of a large community of producers and users working on different classes of robot systems. The work-plan for Computer Graphics includes the following work packages:

GAUSS: an integrated solid modelling system environment which is specialised for CIM applications;

MISS: a modeller for free form surfaces that permits the description of Bezier and B-spline surfaces;

ROBOSIM: a graphics system for the simulation of robot workcells in which positions that are unreachable for the robot, and interferences with workcell objects are detected during simulation of working phases.

Information Systems and Parallel Computing

The Project on Information Systems and Parallel Computing has a budget of 63.4 thousand million Italian lire over five years. It addresses three main goals: the development of tools for the programming of super-computing systems to solve highly complex problems and to promote technological transfer from the research community to industry; the integration of the state of the art of information technology with the more advanced AI techniques and in general with the more recent development in micro-processors and architectures; the development of new methodologies in software engineering, knowledge data bases and expert systems. Visualisation techniques and systems for a super-computing workstation environment are being studied together with the exploitation of the significance of visualisation to stimulate the growth of scientific knowledge. The goal of the work package is the definition of standard workstation functionalities to perform visual analysis of scientific phenomena, in connection with super-computing based simulations on a local and geographical network. Another major area of R&D concerns rendering algorithms and in particular volume rendering. A prototype system for volumetric visualisation for which parallel solutions have been investigated is being developed using a Transputer Network.

User Interface Management System

The Project on User Interface Management System received specific funding from the National Committee for Computer Science and Information Technology. UIMS is considered an orthogonal technology with respect to application areas and a special project has been set up to develop a prototype implementation. The aim of the project is to define an environment and to develop a set of tools for the automatic construction of user interfaces based on user oriented notations (i.e. direct graphics manipulation and visual languages). In particular, the development of the underlying User Interface System is based on the following topics: definition of a conceptual framework made up of logical modules; definition of user constituencies; definition of application areas; transparency (i.e. transparent programming of the interaction model and transparent generation of executable code); system portability; uniformity of the interaction style within an application; availability of different dialogue controls

After a three year period the results of these projects are now being evaluated. The next two years will be devoted to the final implementation of the most promising prototypes so far developed. ■

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Scientific Visualisation at CNR

by Patrizia Palamidese - CNR

In 1989 CNR started a project on Scientific Visualisation within the context of a wider research program on Parallel Computing for Scientific Applications. The Project is conducted by four working groups located at CNUCE CNR (Pisa), IAC CNR (Rome), the Department of Astronomy (University of Bologna), and the computing centre CINECA (Bologna).

Research on Visualisation has two complementary objectives: from the informatics viewpoint the aim is to develop new, application independent, visualisation techniques and systems for a supercomputer-workstation environment; from the science viewpoint to reveal the significant role of images in enhancing the knowledge of natural phenomena. This twofold goal implies a close interaction between visualisation experts and scientists who operate in computational and experimental areas of

geoscience, molecular studies, fluid dynamics, astrophysics.

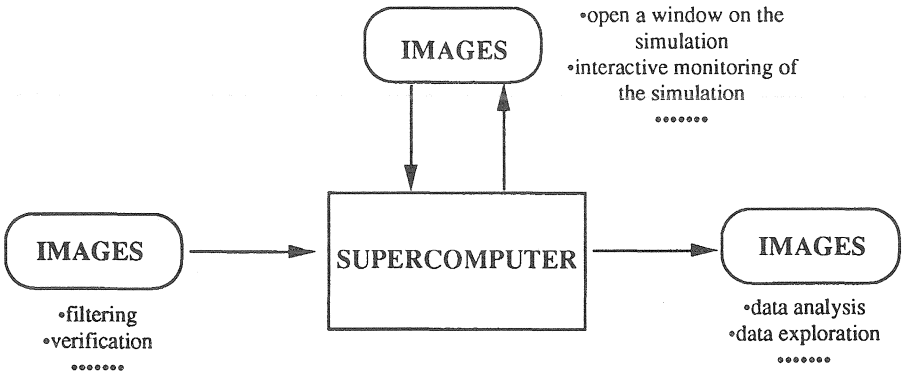
Visualisations of particular interest, static or time-dependent (animations), have been realised and constitute an exhaustive range of test cases for applications such as: study of transition phases and thermodynamics properties of anisotropic models, dynamics of a reticular vacancy in a silicon crystal, perturbed electronic density distribution of molecules, fluid dynamics simulations, wave propagation into isotopic and anisotropic means, simulation of vortices, galaxy formation.

The hardware/network architecture for the project includes a CRAY YMP located in Bologna and connected to the Italian Research Network (GARR) which has a transfer rate of two Mbit/s and reaches most university departments and CNR institutes throughout Italy. A satellite link between Bologna and Trento has also been used for experimentation into the remote monitoring of simulations.

The following prototypes have been defined and satisfy the image requirements which emerge from several phases of the computational activity (see figure):

REMOL, an interface for monitoring ab initio codes, such as MONSTERGAUSS and GAUSSIAN, which compute molecular properties and run in a distributed environment;

GALAXY, an interface for monitoring galaxy simulation;



Significant information is coded as static or dynamic images

VIDA, an API (A Programming Interface), an application independent tool to reconfigure distributed simulation-visualisation applications and steer the computation;

MUDI3, a visualiser for multidimensional datasets;

STICKTRACER, a visualiser that implements a voxel based technique;

LEOPARD, a language to describe animated visualisation of scalar fields.

The Scientific Visualisation project is now entering a new phase which includes experimentation with selected cases, and standardisation of functions aimed at generating and manipulating static and dynamic images on a workstation connected, by a high speed network, to a super-computer. ■

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Visualisation at RAL

by Julian Gallop - RAL

Rutherford Appleton Laboratory (RAL) is the largest of the establishments of the UK Science and Engineering Research Council. Its work on visualisation can best be understood by relation to its responsibilities in computing.

One of RAL's responsibilities is to operate a nationwide supercomputing service based on a Cray Y-MP system. The need for visualisation of application data on such a system is well understood. One of the facilities offered is a high quality, high performance video facility. The video facility is used not only for presentation material, but also for analysis, studying time-dependent effects.

The Laboratory runs a UK programme to promote the effective use of information technology in engineering research in the UK academic community. Visualisation, computer graphics and user interaction is (collectively) one of the major themes in this programme. As part of this, a community club for visualisation in engineering research has recently been instigated. It is hoped that this will bring together people with a common interest in this field and to guide future development and support. Visualisation in engineering shares the problems of sheer quantity with visualisation in other applications. Where it often differs is in the structure of the data, where irregular dispositions of data are common, particularly in finite element applications.

The Laboratory is involved with the advisory group on the use of computer graphics in the UK academic and research community (AGOCG). As part of this remit, it hosted in February 1991 a workshop on visualisation, its present state and the way forward in the UK academic and research community. Two works on visualisation resulted from this workshop, both being published by Springer-Verlag. One is an "Introductory Guide to Scientific Visualization" by Earnshaw and Wiseman (1991). The other is a larger book to which most of the experts contributed at the workshop and which was subsequently edited into an integrated work - "Scientific Visualization: Techniques and Applications", Brodlie et al (1991). The Workshop produced a number of recommendations designed to promote the effective use of visualisation solutions in the UK academic and research community.

Visualisation as a method is being tested in a number of situations in support of science carried out at RAL. Examples are presented in other articles in this issue. ■

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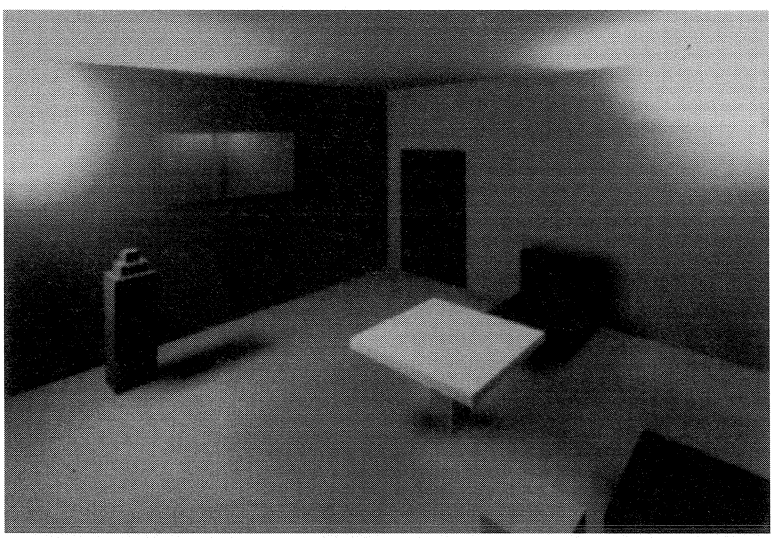
Physical Models for Realistic Image Synthesis

by Gerard Hegron - INRIA

The SIAMES project (INRIA Rennes) primarily involves the production of realistic image sequences. To provide the user with high level control tools, the integration of physical models for realistic image and motion generation is being investigated.

developed for the motion control of rigid or deformable articulated objects with open and closed chains. One of its main features is the automatic derivation of the motion equations, in symbolic form (DAG structure), from physical systems created interactively. Symbolic calculation provides friendly user interface for artists (graphically based interface) or scientists (symbolic equations), more numerical stability and system extensibility (object interaction, task modelling, etc.).
Real-time simulation of complex mechanisms is being studied. It involves symbolical motion equation simplification and natural parallelism exploiting the mechanism structure. This research is especially dedicated to a driving simulator.
The application of automatic control theory is under investigation for high level motion control of articulated bodies.



Synthesis image based on a physical lighting model: scene containing diffuse and specular materials (SIAMES project). (Photo: INRIA)

Physics-based lighting model

To attain realism, an accurate evaluation of global illumination effects is required. A physics-based lighting model is being implemented which includes:
- a physics-based reflection model,
- use of spectral distribution instead of RGB components,
- spectral reflectance and transmittance of materials as well as colour science,
- model not limited to perfectly specular materials,
- point discretization of the scene.

This model will be extended to handle transparency and participating media such as smoke, dust and flame. A parallel scheme will also be studied.

Animation and simulation

Based on a lagrangian formalism, an animation/simulation system has been

Applications

The introduction of physical models provide a large application spectrum from audio-visual to simulation (photo-simulation, driving simulator, vehicle simulation, etc.). In this research field our main partners are UPC of Barcelona, TDI, INRETS, Renault, PSA. ■

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Knowledge-Based Graphics Designer developed at GMD

by Klaus Kansy - GMD

Today's graphics packages give users an easy and comfortable access to graphics production. They do not, however, offer any assistance in aesthetic beautification or the choice of graphical means of expression. Within the GMD key project, Computer Assistance, a graphics designer is developed which tries to fill this gap.

The generator component of the graphics designer knows how to present given data by a diagram. It has domain knowledge about data types, types of comparison and classes of diagrams. With the help of a professional designer, rules are coded which govern the selection of graphical means to express a message contained in the data or given by the user.

The beautifier component deals with the fine calibration of a picture generated interactively. Where existing graphics systems just align graphical elements to a fixed grid, the beautifier analyses the graphics, aligns elements with respect to the structure, closes gaps between adjacent elements, spreads similar elements evenly across the available space, finds and corrects inconsistent use of stylistic elements, etc.

The graphics designer is based on an object-oriented graphics system, EPICT, and uses a system for non-monotonic reasoning, EXCEPT, both developed at GMD. ■

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THE COMPUTER GRAPHICS & CAD GROUP AT OPORTO

by Augusto Sousa - INESC

The Computer Graphics and CAD Group at Oporto started its activities in 1985, when INESC began its activities in the North of Portugal. Since then, the group has been concerned with Visualisation, amongst others, developing software and hardware.

The scientific objectives may be summarised as follows:
- Research in algorithms and special architectures for computer graphics and image processing;
- Research in intuitive man/machine interaction;
- Research in very realistic image synthesis;
- Development of tools for CAD systems integration (like industrial design tools for integration on shoe and textile industry CAD systems).

In the domain of Visualisation, our present projects include areas like visualisation hardware, interactive synthesis of realistic images, image processing and acquisition and visualisation of nuclear medical images.

In the area of visualisation hardware, several boards have been developed. One of them, for XT\AT bus, offers a monochromatic visualisation with a ultra high resolution (1700x2400, 200 dpi). This board, based on the TI TMS 34010 Graphics Processor, can visualise one A4 page, integrating text or manuscript, graphics and images, in real size. It locally makes the compression and expansion as defined by the T6 CCITT recommendation.

In the area of Interactive Synthesis of realistic images one of the important tasks is related to ray-tracing, one of the most qualified algorithms for 3D realistic image synthesis. Nevertheless, many improvements must be made so problems with the global illumination and time processing can be solved. Research in is also being done in the area of the image synthesis with increasing realism with a interactively controlled ray-tracing algorithm that is being developed. The implementation of modular and parallel architectures for ray-tracing, based on transputer technology is in progress.

In the area of intuitive design of 3D objects, the group is facing one of the main obstacles with the introduction of 3D CAD systems into industry, which are the poor man\machine interfaces, namely at the design phase. To solve this problem, we are trying to emulate the traditional designers work table, offering a friendly "Design Workstation" Using this tool, a designer will be able to sketch directly on the screen or to recover sketches that he made on paper.

In the area of Image Processing, research and development in the capture and classification of natural materials (like leather) are being done. From the results, modules to be included in particular CAD systems, will be implemented.

The acquisition and visualisation of nuclear medicine is an important need, nowadays. In this context, specialised hardware and software have been developed by this group. At present, one prototype composed of specialised PC boards is in use at a hospital.

Research and development on several of the above areas will continue. Nevertheless, new research areas, related to computer graphics and CAD systems are being added to the group activities. Examples of such areas are:
Multimedia: integration of multimedia information on CAD systems to support industrial design and geographic information systems, to improve the user interface.
Virtual reality: research and development of intuitive man\machine interaction tools.
Medical Teaching: research and development of models for interactive real-time simulation\multimedia medical teaching.

In parallel with the research and development activities, training has been an important task of the group. Industrial design based on computers, targeted to the traditional portuguese industry, is an area in which the group has enough know/how to provide technical support for the realisation of training courses. ■

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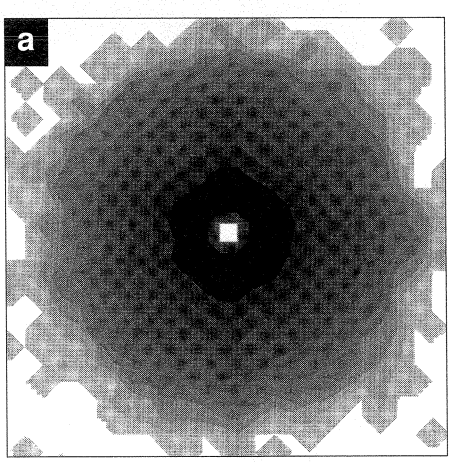
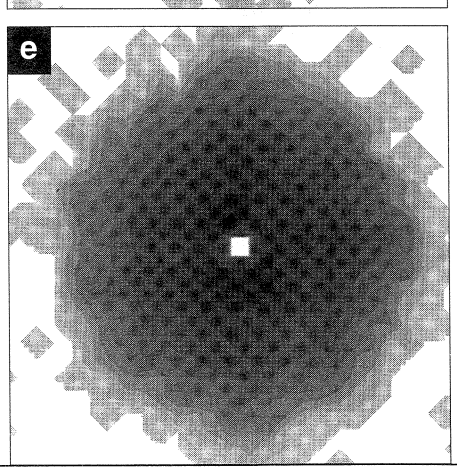
The Computing Group of the ISIS Instrumentation Division are responsible for all aspects of computing associated with the instruments, data acquisition, archival storage, and graphical display. Experiments are run by the users, scientists expert in materials science, but not necessarily in computing, so the display programs must be both "user friendly" and portable.

Visualisation is needed at all stages of the operations:

- during instrument calibration and checking
- during data collection to improve the quality
- to check correct data archival to the optical disc system
- during analysis





Visualisation Needs at ISIS

by Kate Crennell - RAL

ISIS, the pulsed neutron source at the Rutherford Appleton Laboratory, is used mainly for condensed matter research. Neutrons are a good probe for discovery of the atomic structure of materials because they are comparable in size to atoms and they have a magnetic moment so that they are affected by the electric charge distribution of the materials.

. for publication of results, where molecular graphics may be needed to show the material structures.

The figures illustrate a technique known as Couette shear flow. In this example the solution is contained between a stationary inner cylinder and a rotating outer cylinder. The speed of rotation of the outer cylinder then determines the applied shear gradient, G. The figures are two-dimensional because the horizontal and vertical axes correspond to the component of the scattering vector (the spectral variable - effectively an inverse length) parallel to and perpendicular to the direction of shear respectively. Figure (a) shows the system at rest. The scattering is isotropic. At low shear rates some structure is introduced - shown by the anisotropic nature of the scattering - but this is eventually broken down at very high shear rates, Figure (e). This puts an upper limit on the lifetime of the network. The positions of the intensity maxima in each direction provide estimates of the dimensions of the local structure.

These diagrams representing neutron counts have no natural colour, but the human eye is very good at seeing patterns in colour, so plotting them using `false colour' can often bring out interesting features. The colour mapping needed when data is being collected on the instrument may be different from those needed later during data analysis. To see detail in the peak at the same time as in the background can need data to be thresholded at lower and upper bounds and a non-linear mapping between neutron counts and colour. A series of such mappings is being developed.

Using Fortran on a mainframe will always be too slow to display data on the instruments as quickly as we would like, so transputer systems closer to the instrument will be investigated as both display and preliminary analysis tools. ■

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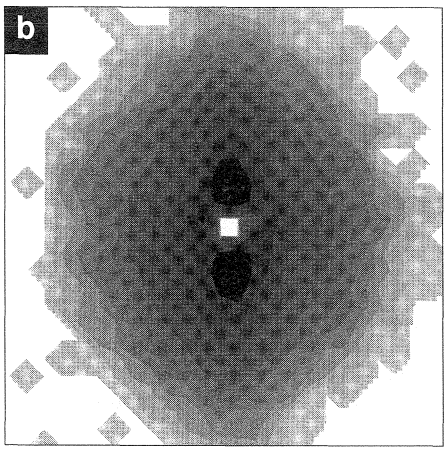

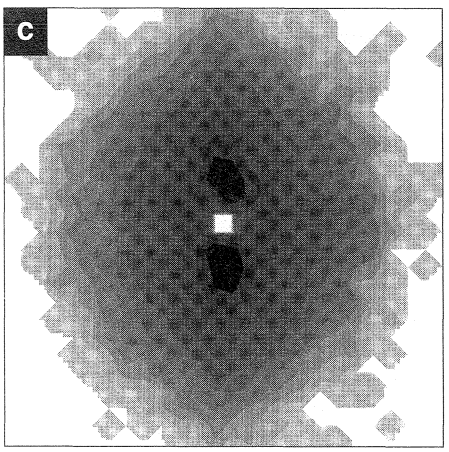

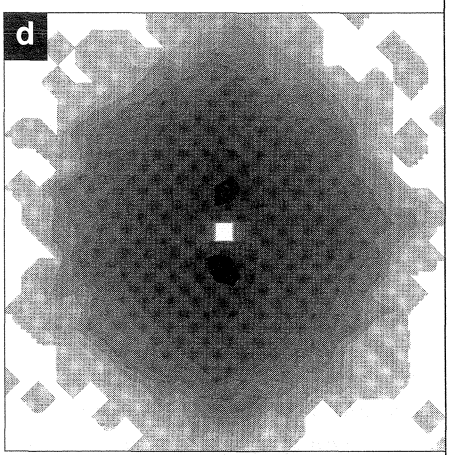

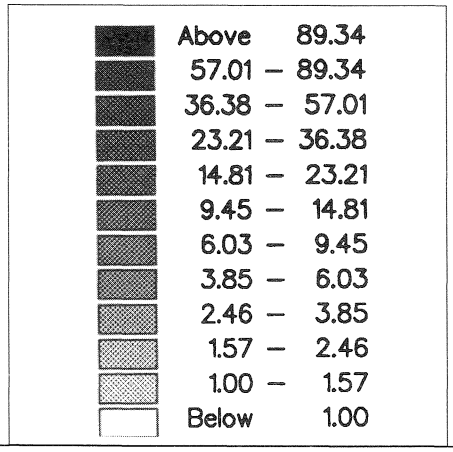

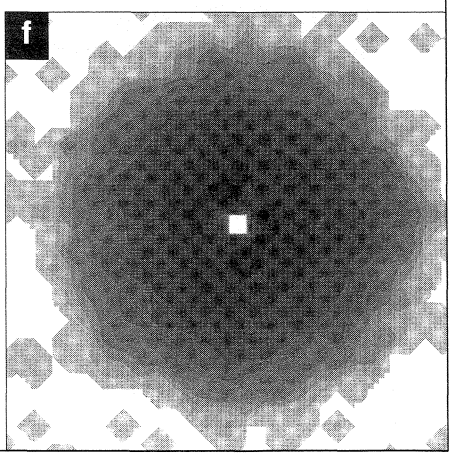

The figures show the small-angle neutron scattering from a diblock copolymer in a binary solvent system which is thought to promote the formation of a transient polymer network. Values of the applied shear gradient, G are:

(a) 0 s^{-1}; (b) 16 s^{-1}; (c) 1056 s^{-1};

(d) 3168 s^{-1}; (e) 4752 s^{-1}; (f) 10560 s^{-1}

Scientific Visualisation at CWI

by Robert van Liere - CWI

Scientific visualisation has recently become a field of study in most ERCIM institutes. Researchers have expressed interest for tools and techniques to visualise their research results. Furthermore, researchers are also becoming aware of the lack of support and deficiencies in current visualisation systems. It was recently decided at CWI to start research in fundamental problems arising in visualising large data sets and/or complex situations.

Simplifying somewhat, there are basically three areas in which one can research aspects of scientific visualisation.

Presentational issues

In this area we are concerned with basic techniques and algorithms that allow for a simple and concise presentation of data. For example, algorithms to determine contour levels or iso-levels of a variable in a data set, or algorithms to determine particle traces in a vector field.

Interactional issues

In this area we are concerned with basic techniques which allow the scientist to interact with the on-going simulation and/or data acquisition device. Proper interaction techniques will allow the scientist to probe the results of a simulation before the simulation has finished. In fact, some visualisation researchers advocate an environment in which a researcher is allowed to steer the computation of the simulation.

Distributional issues

It is clear that simulation steering requires powerful computational engines and a very high data bandwidth between these engines. Substantial research must still be done on how visualisation algorithms can be partitioned to achieve the maximum benefit from the available resources in the computing environment. The traditional computer visualisation environment consisted of a super-computer (which computes the simulation) and a powerful graphics workstation (which post-processes the simulation results). These environments will eventually be replaced with high bandwidth distributed environments. Although distributed computing environments are very popular, the visualisation software is currently not available to take advantage of these environments.

Perhaps the most important short term goal in the scientific arena is for truly usable, but still powerful and extensible, tool sets. While there is some progress, today's tool sets are not directly accessible to most of the scientific community. That is, these tool sets still require too much effort for the (usually not computer oriented) scientist. In the same manner in which everyone is able to operate a text editor these days, scientists should be able to use their visualisation tool sets.

■

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Multimedia Workstation for high-speed Networks

by Horst Günther & Wolfgang Zimmer - GMD

The BERKOM Projects Multimedia Display System (MMD) and BERKOM-FIRST Innovative Network Environment (B-FINE) are being undertaken at the Research Centre for Innovative Computer Systems and Technologies, a branch of GMD. A synergetic architecture design concept has been developed for future end-systems and constitutes a multimedia display system and a high-performance communication system. During the development phase a thorough investigation has been completed successfully to locate, reduce and avoid possible system bottlenecks and other problem areas.

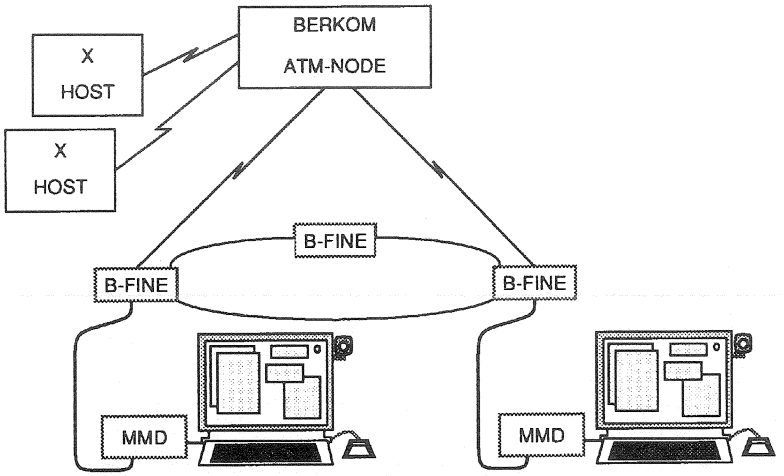
The Multimedia Display System has been developed as a platform for multimedia applications in a broadband networking environment. It can be used as a stand-alone multimedia terminal or integrated into a host system forming a multimedia workstation. All forms of visual communication, e.g. text, graphics, images and real-time video, are handled by the MMD in a uniform manner. The MMD is also designed to support a window-oriented user interface, which influences the hardware and software architecture.

With the support of the high performance B-FINE communication System, X applications on different hosts can exchange data (see figure) over BERKOM-ATM, ISDN or the FINE-RING (200 Mbit/s up to 1Gbit/s ring configuration), for which the modular high-speed protocol family, FINE-PF (OSI protocol levels 1-4) has been developed. The integration of other networking possibilities, such as FDDI or DQDB, is also being taken into consideration.

Basically, the MMD consists of two main modules, a display and a video module. The display module is made up of a graphics processor, a large display buffer and components needed to drive an analog monitor. The graphics processor is also well-suited to perform general purpose processing. This, and a large working memory (16 MByte), allows for complex system and graphic software to reside on the display module. The display buffer has a capacity of 2048 x 2048 pixels with a depth of 32 bits. This provides true colour capability plus an overlay space for each pixel. The output stage (DISPLAY D/A) is designed to drive analog monitors with a dot rate of up to 200 Mhz. Therefore all currently available high resolution monitors, as well as, HDTV displays can be connected to the MMD.

All resources of the display module (and the video module) can also be accessed from the host-interface bus, a VME BUS in the current implementation. To permit high speed access to the display buffer, primarily needed for real-time video integration, a special IMAGE-BUS has been developed. The IMAGE-BUS (IBUS) has a transfer rate of 128 MBytes/sec.

The video module performs all operations



Multi-media workstation in the BERKOM-ATM network

needed to integrate asynchronous real-time video into the MMD. It is designed to handle multiple video channels. Analog video signals (CCIR 601 compatible) can be digitized by a local video A/D-converter. A JPEG compatible compression/decompression unit, which can operate in full duplex, allows digital video to be received and transmitted with a manageable data rate. The resolution and frame rate for digital video channels is programmable. Therefore, the number of video channels that can be handled is only limited by the total bandwidth. For display purposes, all video channels must be synchronised. This task is performed by the SYNC-BUFFER. The IBUS-DMA transfers the video data to the display buffer synchronous to the display output. It also clips the video frames to arbitrary shapes. This has the advantage that invisible portions of video windows need not be transferred to the display buffer.

To make the potential processing power of the MMD available, various system and graphic software have been implemented. The system software is based on a message-passing operating system PEACE (Process execution and Communication Environment). Based on the MIT X Sample-Server, a multimedia X Server has been developed and implemented on the MMD. It uses a socket emulation, which transforms Unix socket calls to PEACE messages. The communication module is responsible for exchanging data between a host and MMD. ■

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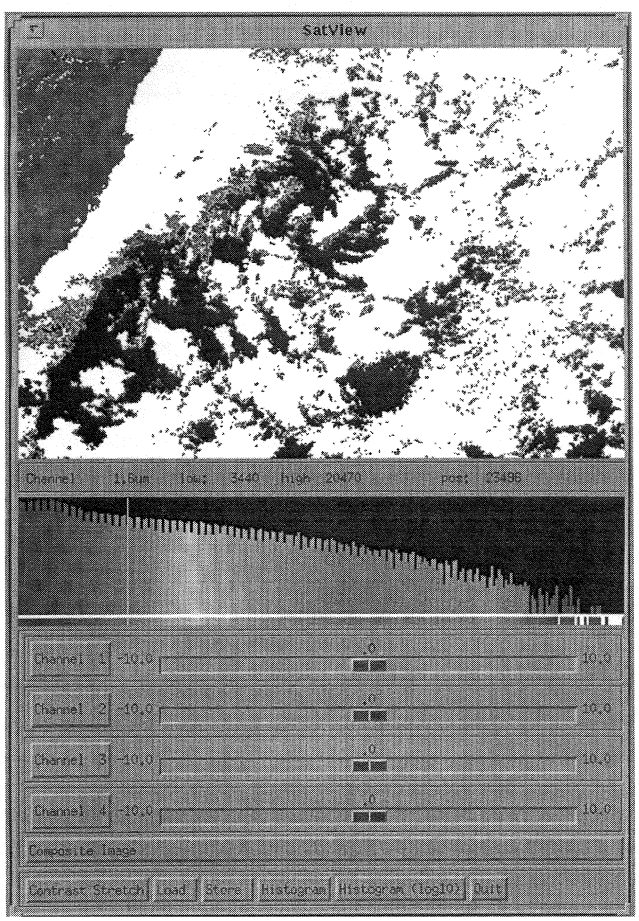

Screen layout of SatViews image builder

Interactive Calibration of a Satellite Data Processing System

by Brian Henderson - RAL

SATVIEW is an interactive visualisation system to allow the calibration of cloud clearing algorithms required in the production of Sea Surface Temperature (SST) images. This has been developed by RAL's Space and Informatics Departments.

The images will be produced by the ATSR (Along Track Scanning Radiometer) instrument which is one of the 5 instruments on the ESA Remote

Sensing Satellite (ERS-1) being launched from Kourou, French Guyana, in July 1991. RAL was part of a consortium which designed, built and tested the ATSR instrument.

RAL's Space division is providing a data processing system to produce products from the ATSR data. To provide good quality SST images clouds in the images must be identified and removed.Calibration of the cloud removal algorithms are fundamental to the quality of the SST images.

SATVIEW produces a display of ATSR images (currently using simulated data), calculates and displays the recognised cloud and allows the cloud parameters to be interactively changed. SATVIEW is produced using a workstation running X as its graphics system. The MOTIF widget system is used on top of X to build a flexible user interface. This interface includes sliders, buttons and menus to enable the user to alter the parameters used in the cloud clearing algorithms.

The current version of SATVIEW runs on an IBM RS/6000 Model 520 (30 MISP) and can calculate the cloud in just under 10 seconds. This is significantly better the the MicroVAX 3100 Model used for the complete data processing system which takes 90 seconds to calculate the cloud. SATVIEW provides a high level of inter-activity allowing the user to investigate the effects of each of the cloud parameters on the cloud generated by the cloud clearing algorithms.

The project is currently investigating the possibility of adding a parallel processing capability (based on Transputers) to the workstation. This could exploit the parallelism within the cloud algorithms to reduce the current calculation time to sub-second update rates. With this additional capability a full real-time interactive tool should be provided.

It is hoped that this visualisation system will assist in an improved determination of the cloud for the ATSR data. This should ensure that ATSR provides even better SST images than expected. ■

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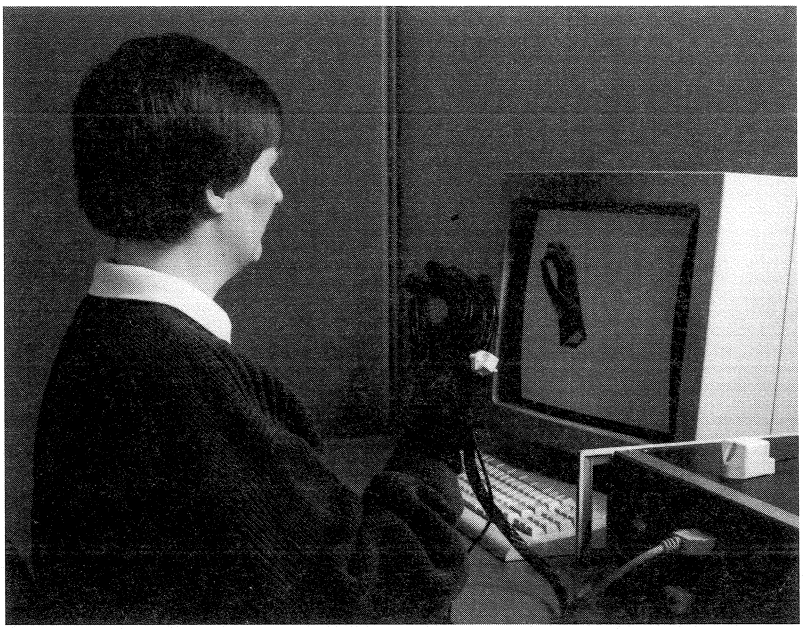
Novel 3-Dimensional Input Devices

by Martin Prime - RAL



The DataGlove registering a Gesture (Photo: RAL)

EuroWorkStation (EWS) is a recently completed ESPRIT project to design and build a high power graphics workstation system to rival the large US players in the market. It consists of a powerful general-purpose workstation and a number of specialised application-specific co-processor boards connected by a fast hardware bus. The communication between the software on each processor is handled by a distributed operating system, called CHORUS, developed at INRIA

The objective of this part of the project was to investigate a number of input devices for use in a rich interactive graphical environment for a variety of application tasks. From the work, guidelines were developed for the selection of suitable devices and associated interaction techniques. These vary according to the user's ability, experience, and the task.

The mouse is a current standard positioning device, but only provides 2-dimensional information for interaction with computers. The experimental work described in this report examines how a mouse can best be used in a 3-dimensional environment.

The Human Factors report describes and categorises the forms of information output as it relates to interaction. From this is developed a schema for comparing hardware input devices. A survey of existing and novel input devices was carried out. The schema explains why hand-tracking devices such as the DataGlove (TM) are useful for a more naturalistic and intuitive interaction with computers.

The DataGlove is a light-weight glove-shaped input device. The glove is made of lycra and is correspondingly light and elastic. It converts finger movement; hand position and orientation into computer-readable form in real time.

The DataGlove and mouse were compared experimentally, by getting subjects to carry out 3D tasks. The use of the DataGlove is not limited to a pure positional device, and it was further explored as a gesture input tool.

The results of an initial evaluation of a device called the Spaceball are presented. Finally the report discusses Virtual Reality and how the DataGlove could be used as a virtual tool. Copies of the Report are available from the author. ■

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Volumetric Visualisation

by Claudio Montani & Roberto Scopigno - CNR

The design and implementation of a volumetric visualisation system is financed by the CNR Special Project "Sistemi Informatici e Calcolo Parallelo". Researchers from CNUCE and IEI participate with an overall annual involvement of three man years. The system operates on sequential and parallel architectures.

Applications requiring data visualisation techniques exist in many wide-ranging fields of research including molecular modelling, medical imaging, mathematics, geo-sciences, astrophysics, computational fluid dynamics, and finite element analysis.

Typically, datasets are obtained in one of two ways. They may be acquired from a physical process or object using various sophisticated scanning techniques such as computed tomography or magnetic resonance imaging, or they can be produced as the result of a computer simulation of a complex physical process or mathematical system.

Volume visualisation provides the user with representation data structures and techniques that permit 3D grids of scalar data to be rendered in a more comprehensive manner rather than as tables or as a sequence of 2D images.

Two different approaches exist for rendering volumetric data: iso-surface generation and direct volume rendering. With the first approach, geometric information is extracted from the volumetric data set, represented in terms of polygonal patches, and displayed using traditional computer graphics rendering techniques. On the contrary, using the second approach, the data -set is directly visualised without a conversion process and with no loss of information.

A project on the design and implementation of a volumetric visualisation system based on the direct rendering of volumetric data and operating on several different hardware architectures is now in an advanced stage of development. The system uses a ray tracing approach in which, for each screen pixel, a primary ray is cast in the data -set lattice, searching for intersections with opaque or semi-transparent objects.

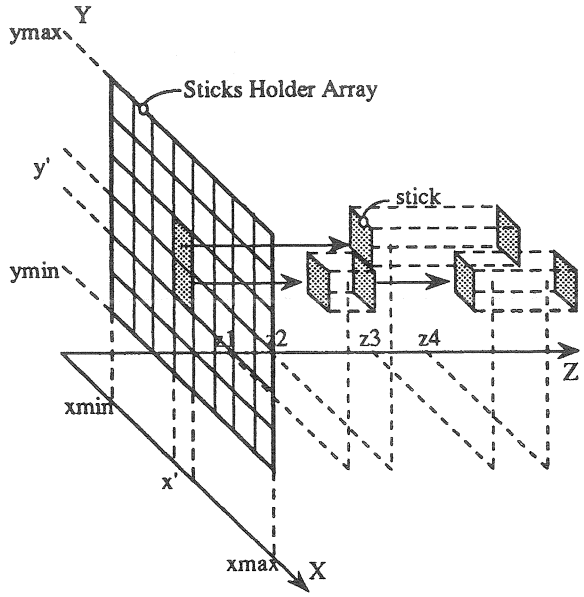

Figure 1: Internal representation scheme of the STICKTRACER system

The system (called STICKTRACER) has been developed to operate on sequential hardware architectures and is currently running on Apple Mac II and Sun SPARC Stations.

The main features of the system can be summarised as follows:

- use of an ad hoc internal representation scheme (see the STICK scheme in Figure 1) for the efficient management of classified volumetric models (models in which, after the user analysis of the input data, the data value range is reduced from the original range to a simpler one, e.g. the usual tissue-fat-bone classification common in medical imaging).

- use of the ray tracing technique for the visualisation process; each ray is discretized within the model space and the ray/object intersection is searched for by voxel inspection;

- ability to render shading and shadowing effects;

- ability to "see inside" the objects by means of transparency effects;

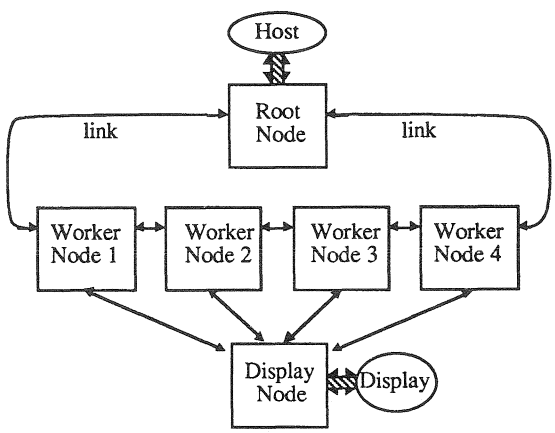

Figure 2: Transputer-based parallel architecture

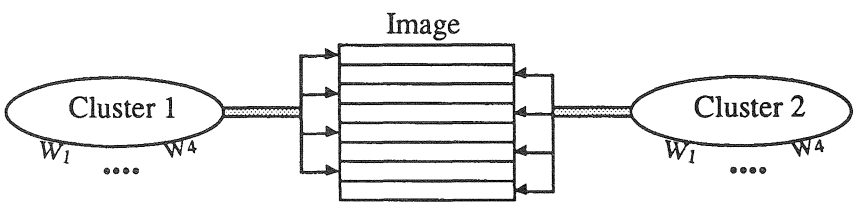

Figure 3: Exploiting image space parallelism on a NCUBE

- ability to interface input and output data with de facto standard products (NCSA Image or DataScope used for the classification of input models and Utah Rle for the storage and visualisation of the results).

A version of STICKTRACER operating on parallel hardware has also been developed. The target architecture consists of 5 ring connected INMOS T800 Transputers and of an INMOS B419 graphic processor (Figure 2).

The rendering process was parallelized by adopting a ray-dataflow approach; the STICK-represented data -set was partitioned by a set of parallel cutting planes and each partition assigned to a worker processor. Adjacent partitions are therefore assigned to worker processors which are topologically adjacent in the physical architecture.

The most interesting aspect of this solution is certainly the load balancing criterion. This is both simple and efficient. The root requests the execution of the ray tracing algorithm on a limited number of test rays. On the basis of the execution times of the workers, the root decides on a new distribution of the model among the workers. This distribution is carried out in parallel; each node simply acquires from (or sends to) its appropriate neighbour node the data to be moved.

The efficiency of the load balancing technique follows from the simplicity of the ring architecture. On the other hand, the partitioning the model into slices does not allow for high scalability of the system because the communication overheads surpass the computation times.

The porting of the Parallel STICKTRACER on a hypercube architecture (a dimension 7 hypercube NCUBE is now available in Pisa) is under investigation. The basic idea is to replicate the system as a number of clusters, each defined as a two dimensional hypercube with 4 nodes logically connected in a ring topology (Figure 3). The parallelism can thus be improved by dynamically assigning rows of pixels to each cluster, in this way distributing the work-load among the independent clusters. ■

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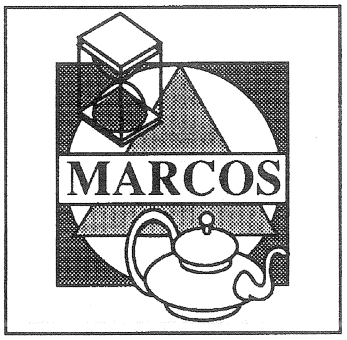

MARCOS

Animation of Complex Scenes

by
Thomas Jung and Stephan Neunreither - GMD

The MARCOS Project, which began in 1990, is a joint-venture of the GMD and the Technical University of Berlin. The goal of MARCOS (Modelling, Animation and Rendering of Complex Objects and Scenes) is to develop new solutions in the area of computer animation. The MARCOS System design phase is now completed, and the next objective is to build a prototype.

MARCOS can be divided in three primary areas of research: modelling, animation and rendering. The modelling process in MARCOS caters for the user's power of imagination. The modeller interface module is designed to be very visually oriented (WYSIWYG). For example, to deform an object, you put it on the anvil (available on the screen), hit it with the hammer (also on the screen) and repeat as needed.

Many different scenes of heterogenous objects can be relatively easily supported. The user does not need to choose the representation of an object or a scene to be modelled. Instead, the system selects the representation automatically according to the application. A representation can be converted by the system if necessary. A scene is represented as a set of various individual object representations. For example, the user can model the handle of a coffee cup as a 'sweep' and the body of the cup as a voluminous representation. The cup as a whole can be defined combining the two with CSG operations.

All objects are modelled physically. The FEM (Finite Element Method) will be used here. The conceptual tuning of FEM is a chief concern of MARCOS.

Because models must support their own animations, the animator module is designed to be closely coupled to the modeler module. A primary demand on the animator is to simulate the movements in a pseudo-physical environment. Here the issues of synchronisation, collision, etc. are perplexing. A further demand is to make the direction of scenes very user-friendly. This is difficult, because a desired motion may not be physically possible; therefore, the system must compromise. For example, what should happen if a ball is to be thrown through a window, but the window is closed?

To define a powerful and user-friendly interface for editing motions is a difficult problem. We have decided to design a language-based interface, which also encompasses the use of external graphical input devices, e.g. a mouse, for pointing positions, paths, etc. The language is a near-natural language, i.e. its domain is confined to terms of space and time.

In the areas of visualisation, there are two major demands placed on MARCOS. The first is the real-time rendering of scenes to support the user in modelling objects and motions. Here, rendering is considered to be a high-level process, whereby objects are displayed at a detail level that real-time visualisation allows.

The second demand is to produce a high-quality sequence of pictures, i.e. film. In this area ray tracing and radiosity is used based on a physically-based lighting model. This model uses wavelength curves instead of RGB values. We hope the first prototype will be available in the spring of 1992. ■

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Visualisation of the Magnetosphere for the Cluster Space Mission

by Malcolm Dunlop - Imperial College

Cluster is a scheduled joint ESA/NASA mission involving four satellites flying in formation in nearly similar, polar Earth orbits. It has a strong involvement from UK science teams, including RAL which will host part of a European network of data centres. Satellites sample the field on largely preset orbits, so that the visualisation problem is to view the orbital evolution in relation to various spatial models of the region sampled, perhaps in conjunction with particular analysis tasks, either of the model data, measured data, or of payload status.

Visualisation of three dimensional vector fields has always been a problem. The need to represent any time dependence in the vector field adds to this problem significantly if a computational representation is sought. In space physics applications both these features are relevant when viewing planetary (or solar) plasma and magnetic field information.

Time dependence arises in different ways: the Earth's own magnetic field is affected by variable external conditions (of solar origin) and the orientation of the Earth's magnetic dipole changes with the motion of the Earth in the solar system. Static models of the Earth's environment can ignore the variability in the external conditions altogether, at least over certain ranges of parameters. The remaining time dependence then becomes a question of coordinates. In the Earth's orbital plane, for instance, the dipole precesses with the Earth's spin about the geographic spin axis; which itself has a seasonally dependant orientation over the Earth's orbit.

The most common representation is to plot lines of force (or flow), but there is a need to show key structures and boundaries also and in particular how these evolve in time and with changing external conditions. A field line plot, is not easily updated in real time to simulate animation, is not suited to most solid modelling packages, but is much better for identifying key structure than surface representations. Key surface boundaries, or regions, may be difficult to define from the model data but are more suited to the production of rendered drawings. In general, a mixture of line and surface (solid) representations are sought, together with the abilities to update the drawing, real time, and perhaps sample the model data interactively. The problems stem from the duel needs to have standard scientific tools together with powerful visualisation tools.

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Start of ESPRIT-Project "HYTEA" at GMD-Darmstadt

by Manfred Thüring & Norbert Streitz - GMD

Work on a new project called HYTEA (HYperTExt Authoring) has started in January 1991 in the Integrated Publication and Information Systems Institute (IPSI) of GMD in Darmstadt. The HYTEA-project is part of the Office and Business Systems section of the ESPRIT-II programme. It will last until March 1993 and is funded with 2,2 million ECU's.

The members of the HYTEA consortium are Siemens AG (Munich), Epsilon Software (Athens), GMD-IPSI (Darmstadt), Olivetti (Pisa), Politecnico di Milano (Milano) and Systems & Management (Pisa). GMD-IPSI is associate partner to Siemens who is the main contractor of the project. Within GMD-IPSI, the project is carried out in the department WiBAS (Knowledge-based authoring and hypertext systems).

HYTEA aims at the implementation of tools to support the development of large and complex hypertext and hypermedia applications. These applications can be characterised by a number of distinct features:
- The information which has to be represented is large and complex.
- The development of the application requires a long lasting authoring effort and the application maintenance requires continuous updating.
- There is a clear-cut distinction between the authors of an application and its readers.

In order to provide efficient support for authors, it is necessary to know how such applications are created. Therefore, one of the main objectives in HYTEA is the development of a User Model which identifies the crucial features of hypertext authoring. The model is a major part of the contribution of GMD-IPSI to the HYTEA-Project. It draws on previous work in the WiBAS-department and characterises hypertext authoring as design problem solving which comprises two main activities, called authoring in the large and authoring in the small. Authoring in the large addresses the question of developing the overall structure (or schema) of an application while authoring in the small consists of creating the content (or schema instances) of an application. Both activities are highly interactive, consist of a multitude of more specific subprocesses and are subject to multiple constraints.

The user model of authoring will be the basis for two other objectives of the project, the Hypertext Design Model (HDM) and the tools which are developed in HYTEA. With HDM it is possible to specify potential schemata of applications as well as their objects. The tools will support authors in all phases of designing an application: specification, development, debugging maintenance, etc. Both, HDM and the authoring tools are strongly influenced by the User Model: HDM - because the model specifies the author's goal with respect to the intended features of the hyperdocument; the tools - because the model describes the main authoring activities and their interaction. This specification is the basis for the requirement analysis of the functionality of the tools and for the interface design.

A further goal of HYTEA is to develop a tool for translating HDM applications into conventional hypertext systems, like HyperCard or Toolbook.

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FIDE - Formally Integrated Data Environment

by Costantino Thanos - CNR

The FIDE Project is an ESPRIT Basic Research Action which aims at achieving a major advance in the technology necessary for the implementation of information systems for data intensive applications.

Information systems are currently supported by a set of loosely connected heterogeneous software components: database systems, programming languages, programming environments, etc.. Each one of these components was designed and built using a specific technology (database technology, programming language technology, etc.). This loose connection of components results in inefficient and unreliable systems. The inconsistencies between the components make programming much more difficult. This project proposes the ambitious task of building a new integrated technology to replace these several ill-fitting ones.

The success of FIDE could have a major impact on the construction of large scale data intensive systems. It should lead to the implementation of better systems to support CAD, CASE, Office Automation, CIM and AI applications. The project is carried out by a Consortium made up of GIP ALTAIR (France), IEI-CNR (Italy), University of Glasgow (U.K.), University of Hamburg (Germany), University of Paris-Sud (France), University of Pisa (Italy), and the University of St. Andrews (U.K.).

In the area of type systems and object stores, the first steps have been taken to isolate the kernel of a type system and an object store. Several directions of research are being currently considered. FIDE has already produced some integration tests such as the demonstration of the Galileo database programming language running with persistent data provided by the Napier 88 persistent data store.

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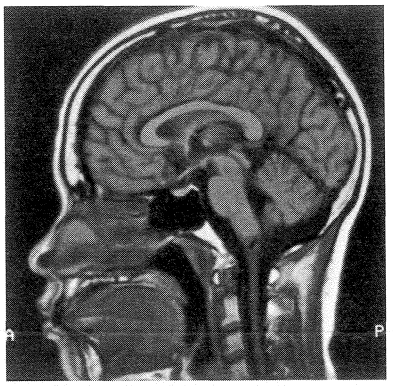
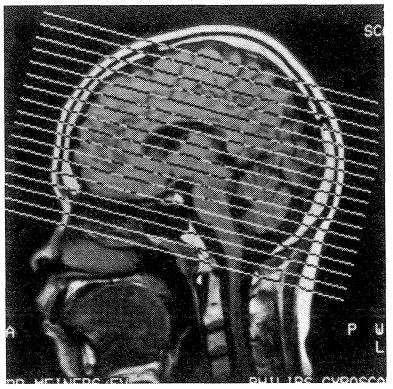
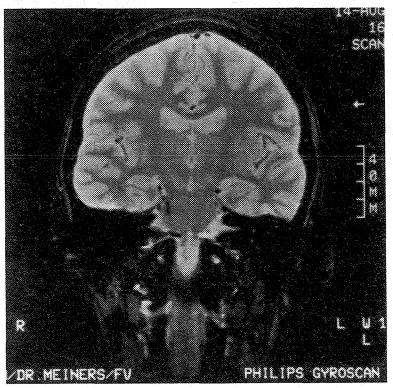


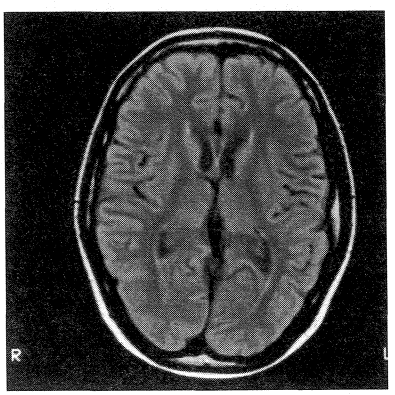
Sagittal Magnetic Resonance image of a skull.



As above. The orientation, separatioin and number of transversal slices to be made are indicated.



Coronal Magnetic Resonance image of the skull.



(Photos: SCVR, Utrecht)

Transversal magnetic resonance image of the brain. There is a clear distinction between the white and gray matter.

Bone is black due to absence of protons. Scanner: Philips Gyroscan T5.

Image reconstruction: improved performance by iterative methods

by Henk Nieland - CWI

Reconstruction of a two-dimensional image from its projections (line integrals) is described in discrete form by a system of algebraic equations. This system is usually large, sparse, inconsistent and ill-conditioned. Iterative solution methods for such a system may be a great deal more efficient than direct techniques, but performance is still too slow in practical situations on small and medium-size computers, for example in routine clinical applications.

In a project, concluded currently at the University of Utrecht, several aspects of improving the performance of iterative techniques for image reconstruction have been studied, including the effects of ordering the equations, other multi-level techniques, higher order discretisation, preconditioning and regularisation.

The project comes under one of the eight National Working Parties in Mathematics at Dutch universities, managed by the Foundation Mathematical Centre (SMC). CWI is the Foundation's research institute. At present the eight topics are: Numerical Mathematics, Stochastics, Operations Research & System Theory, Discrete Mathematics, Analysis, Algebra & Geometry, Logics and Foundations of Mathematics, and Mathematical Physics.

■

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A Support Environment for Formal Program Development

by Robert Gabriel - GMD

Data processing has developed into an indispensable aid in many fields of application. It is just as useful in the office as in the cockpit of a modern airliner. The civil aviation sector does, however, impose much greater demands on the computers and programs used. For faults in the hardware or software can have disastrous consequences here. One way of avoiding programming errors lies in the formal development of programs.

Formal development means constructing a program successively from the specification of what it is intended to do. When transforming a specification to a program, all steps must be formally proven in the mathematical sense. Dedicated specification languages, program development methods and program transformation techniques are being developed by computer scientists as a means of achieving this aim. The large number of languages and results provides a good theoretical basis for the move to formal program development. Many practical hurdles remain to be overcome, however. Computerized support for individual methods is often still inadequate, and, even at a theoretical level, the problem of combining different development techniques has only begun to be solved.

Against this background, GMD's Research Unit on Program Structures in Karlsruhe has participated in the development of a language, DEVA, which enables specifications, development methods, proofs and programs to be expressed in a uniform linguistic framework. Just as programming languages form the algorithmic framework for all types of software, DEVA provides a uniform, formal-logical linguistic framework for program development.

DEVA was developed in the framework of an ESPRIT project entitled ToolUse in close cooperation with the Université Catholique de Louvain (Belgium) and the Centre d'Etudes et de Recherche de Toulouse (France). With the support environment for DEVA, GMD's Research Unit for Program Structures at the University of Karlsruhe is making an important contribution to the success of this EC project and is supporting formal program development work. Developments are performed interactively with the computer and are checked by the system. This checking is to ensure that rules and laws are correctly applied. It is also possible to have some parts of development performed by the system.

The system is equipped with a graphic user interface for correct display of the formal development processes. This interface supports the graphic syntax of the DEVA language. As it was generated with the aid of G2F, a generator for graphic editors, it can be expanded with user-defined graphic notations, e.g. mathematical or formal-logical symbols. G2F is also an element in the DEFA environment. It allows for the definition of new notations and display of these through examples.

The system is a prototype. It was only developed to permit work with DEVA as means of identifying the strengths and weaknesses of current language development work. Small-scale developments and formalization studies have been performed for this purpose. The system would, however, require improvement in terms of efficiency and interactivity before it could be used for solving realistic problems. ■

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COMPUTATIONAL MATHEMATICS AT CNR, PISA

by Bruno Codenotti - CNR

The main research activities of the Computational Mathematics Group at IEI are focussed on numerical linear algebra and computational complexity. We are now working on parallel algorithms for several linear algebra computations, in particular for the solution of linear systems and related problems.

The approach we are currently following is to analyse parallel algorithms in abstract parallel models of computations, e.g. arithmetic circuits and PRAM. The main results so far concern the parallel complexity of matrix inversion and linear system solution on arithmetic circuits. We have developed a very fast parallel Monte Carlo algorithm for the solution of linear systems, and have also found an efficient PRAM implementation of this algorithm; we have thus been able to prove that matrix inversion belongs to the complexity class RNC[1].

We also are dealing with more concrete numerical linear algebra problems, such as incomplete factorization methods for Toeplitz matrices, algorithms for the solution of numerical problems arising in control theory, and algorithms for the solution of sparse linear systems. The approach followed in these studies is to try to develop efficient adaptive algorithms, whose good performance depend on the effort required to maintain, during computation, the properties of the structured input data (e.g. the Toeplitz structure).

One of the reasons for our interest in ERCIM depends on the interdisciplinary aspect of the research fields we are dealing with: they cannot be conventionally classified into computer science or applied mathematics. We feel that ERCIM will help European research institutions to build a bridge between computer science and different branches of applied mathematics. ■

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Engineering Information Directory (EID)

by John Kalmus & Kevin Lewis - RAL

The Engineering Information Directory (EID) is a database system facility being developed at RAL with the following three features.

Firstly, it will be accessible over JANET, assuming connection for dumb terminals.

Secondly, the database will contain:

- a directory of expertise at RAL (and later also expertise at UK Higher Educational Institutes, HEIs)
- a searchable copy of lists of Software approved by RAL (and later of assessment reports produced by RAL)
- a directory of courses, conferences, workshops, etc of interest to the UK Engineering Community
- pointers / convenient access to other data sources such as NISS, and the research programme information in GRANTDSS and EXIRPTS.

Finally, there will be an easy user interface so that novice and occasional users do not need tuition or a user guide.

The implementation of EID has involved several tasks, as follows.

A data analysis of the Software lists (originally in paper form) was performed, and a method devised for the automatic transfer of the data from Displaywriter (wordprocessor) form into database tables built using embedded SQL in an INGRES UNIX environment. Similar data analysis and table building was undertaken for the RAL expertise facility, with some of the data being regularly updated from the RAL Personnel / Accommodation database on the SERC central IBM machine. Using INGRES facilities, a standard menu-based screen interface was designed to incorporate both of these (and later other) applications, and was implemented using forms in INGRES 4GL.

The production configuration involves a Sparcstation 2 accessible over JANET to EID users, who are able to define their own terminal type to exploit normal INGRES functionality. This machine also enables EID to communicate with externally held databases, mentioned above, and acts as the client node running an INGRES front-end process. The INGRES server is another Sparcstation 2, closely coupled to this front-end.

This development work has been spearheaded by a team of 4 staff in the Data Engineering Group, under the leadership of Dr Keith Jeffery, Head of the Systems Engineering Division, together with input from members of other divisions of Informatics Department at RAL. The production platform, based on INGRES DBMS and the Sparcstation 2 server, has been accessible from the network since August. The INGRES relational DBMS is currently being integrated with STATUS free-text search DBMS, to provide a powerful search engine suitable for Engineering users.

Future applications of the EID include the provision of a "marriage broking" service between UK Industry and HEIs, putting together needs and available expertise with the aim of encouraging consultancy, collaboration or other forms of partnership. ■

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A Knowledge-Based System for the Water Supply Industry

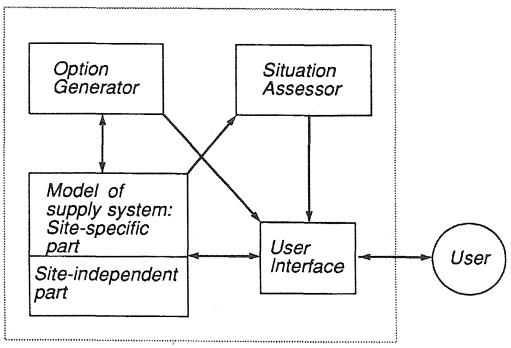
by Simon Lambert - RAL

The Knowledge Engineering Group at RAL is engaged in the development of an advanced Knowledge-Based System (KBS) for a consortium of UK water supply companies.

These companies have many operational practices and problems in common, and there are clear benefits to be had from KBS assistance in their day-to-day operations: for example, helping staff in taking decisions when those with the most experience are not available. The system that RAL is developing is intended to be of use to all the contributing companies, and the approach being taken has three phases:

- develop a first pilot system for one site;
- derive from it a site-independent "platform" representing knowledge which is general to the water industry;
- develop a second pilot based on the platform at another site, thereby demonstrating the benefits of the approach in reducing knowledge acquisition and development effort.

In the past, many KBS have been based on heuristic knowledge represented as rules, but more recently the idea of reasoning about a model of a system has become popular. The water industry system incorporates both these types: model-based reasoning about the behaviour of water supply networks, with representation of reservoirs, trunk mains, etc., and heuristic knowledge gained from experts, which allows the system to reason about, for instance, what to do in the case of abnormal incidents such as pump failures or burst mains. The KBS includes both analytical reasoning, to assess the developing situation modelled within it, and planning of actions to control the situation. The diagram illustrates the KBS architecture.



Architecture of the Knowledge-Based System

Prototype versions of the system have been well received by the water companies involved. The first pilot is about to be delivered to Southern Water plc, and work is soon expected to begin on development of the site-independent platform. ■

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Injecting Software Quality Principles and Practice into Italian Software Industry: *a difficult task?*

by Mario Fusani - IEI-CNR

Talking of quality has been a growing business for years. Expressions such as "total quality" or "quality of life" are escaping purely technical and industrial environments to appear in ordinary language or journalese. To most people such terms suggest excellence, perfectionism, sophistication, perhaps elitism.

The modern technologist knows better. The novel concept of "quality" merged with the naive notion of *normality* becomes not just a toy for the rich but a "must" for the survival of today's society. We must all, both as users and consumers, demand quality in goods and services: it is our right. And, surprisingly enough, today's technology can provide it; what was once just talk has become fact, at least for most technologies.

However, until recently, except for a very few enlightened laboratories, software technology has failed to satisfy quality requirements. This is unfortunate because software is "invading" our entire lifestyle; all those consumer goods which have become essential will have their (often small, but essential) software component. As the quality of a system, product or service is no greater than that of its poorest essential component, clearly it is not sufficient to ensure the performance of just the "hard" components. The software components must also be guaranteed.

The real difficulty is not to produce such software but to overcome the tremendous resistance most software producers oppose to adopting quality recommendations.

At IEI-CNR a programme has been defined for the "injection" of quality principles into Italian software houses. Injection is a suitable term as it stresses not only the reluctance of the patient to be treated but also the therapeutic effects of the treatment. This programme will exploit the considerable experience which we have acquired over the years in software engineering and in the provision of an independent software validation and verification service.

Steps are being taken to:
1) exploit legal constraints: this is not easy and can hardly be considered as a therapy;
2) educate the producers: this can be effective but is time consuming and unless the top executives are also "treated" the efforts may be waste of time;
3) educate the users: according to our experience so far, this seems to be the best course of action, and its effects can be immediate: if the user is made aware of his/her quality rights before signing a contract, then the producer is obliged to guarantee performance; the best solution may well be to incorporate well defined rules or recognised standards, e.g. ISO 9000-3, into the contract! ■

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RAL Wins £3M Parallel Computing Applications Centre Contract

by David Boyd - RAL

In partnership with Oxford University, RAL has won a £3M contract from the Department of Trade and Industry and the Science and Engineering Research Council under the UK Joint Information Technology Programme to set up a Centre for Parallel Computing Applications.

This Centre, to be known as Oxford Parallel, will work with a number of UK-based industrial companies to find cost-effective ways of using the latest parallel computing systems for practical industrial applications. Government funding for Oxford Parallel will progressively reduce over a 4 year period, during which time the Centre will need to become self-financing through contracts with industry. It is anticipated that over the first 4 years industrial contributions to joint projects with the Centre will approach £5M. Oxford Parallel is one of four centres to be set up under the Parallel Applications Programme. The others are at Edinburgh, London and Southampton.

An initial set of 12 collaborative projects has been defined to launch the activities of the Centre. A number of RAL staff with parallel computing and applications expertise will be involved working in close collaboration with staff at the Computing Laboratory in Oxford and with personnel from the industrial partners of Oxford Parallel. Initially, RAL's involvement will focus on parallel numerical algorithms, optimisation and computational fluid dynamics. To support the work of the Centre, state-of-the-art parallel computing systems will be located at Oxford and RAL for use on these projects. These will include systems based on the recently launched T9000 Transputer from Inmos which will become available early in 1992. ■

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O_2 Technology...

by Laure Reinhart - INRIA

After the creation of SIMULOG in 1984 and ILOG in 1987, INRIA has the major share in the capital of "O_2 Technology".

This company, stemming from the "ALTAIR" group, was created to exploit its results. ALTAIR, which was founded in 1987, will seize to exist end-September 1991. Its main activity was the design and development of the O_2 programming environment composed of an Object Oriented Data Base Management System and development environment.

INRIA will have a 51% share in the capital, with industrial partners and BULL and IN2-SIEMENS having a 13% share each. The chairman of O_2 Technology is Prof. Alain Bensoussan with Francois Bancilhon, former director of ALTAIR, as vice-chairman. ■

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STAPAC - *SmartCard Applications Revolutionise Everyday Life*

by Bruno Struif- GMD

More and more computers are now being used in the work place, computers themselves are increasingly being networked and distributed computer applications are supporting communication and cooperation between people, organisational units and companies. In the light of current developments in the field of information technology, such trends seem irreversible. In many cases, the level of computerisation in industry, commerce and administration is regarded as a key factor in the competitiveness of a national economy. In one of its main research themes, "Information-Technology Cooperation Support", GMD has set itself the objective of developing instruments for the technical support of cooperative tasks.

Reliability is one of the essential technical characteristics which a computer system must offer the user for "tele-cooperation" purposes. In the practical implementation of cooperation support systems, this requirement for reliability is primarily satisfied through the use of intelligent chipcards, also known as "smartcards".

These smartcards with integrated computer chips can be used as manipulation-proof, personal terminal equipment, e.g. for generating authenticated "electronic signatures", ensuring confidentiality by enciphering information, accessing operating and applications systems ("Open, Sesame!" function), or also as carriers for cooperation-related "personal files". They are thus a central element in systems engineering for reliable cooperation support.

The Gesellschaft für Automation und Organisation (GAO) and GMD are cooperating in a joint research project entitled STAPAC (SmarTcard Application PACkage) to develop a basic system for smartcard applications intended for personal computers. The smartcards for this basic system will be equipped with the newly developed and extremely high-performance smartcard chip operating system, STARCOS. The STARCOS smartcard based on the Hitachi H8/130 chip incorporates file organisation which takes account of the latest developments in standardisation (Working Draft ISO 7816-4). It includes a powerful set of chipcard commands which also makes it suitable for a broad range of applications extending beyond the field of tele-cooperation.

Development work is also being conducted on new card access units, called smartcard terminals, which are equipped with keypads, displays and security modules and can be connected to personal computers. The smartcard interface module STAMOD offers the applications programmer an interface which is suitable for accessing all smartcard functions. A further element in the basic system is the smartcard management control system, STAMAC, which can be used to define the sequence of commands relating to a smartcard application and also to personalise and manage smartcards. ■

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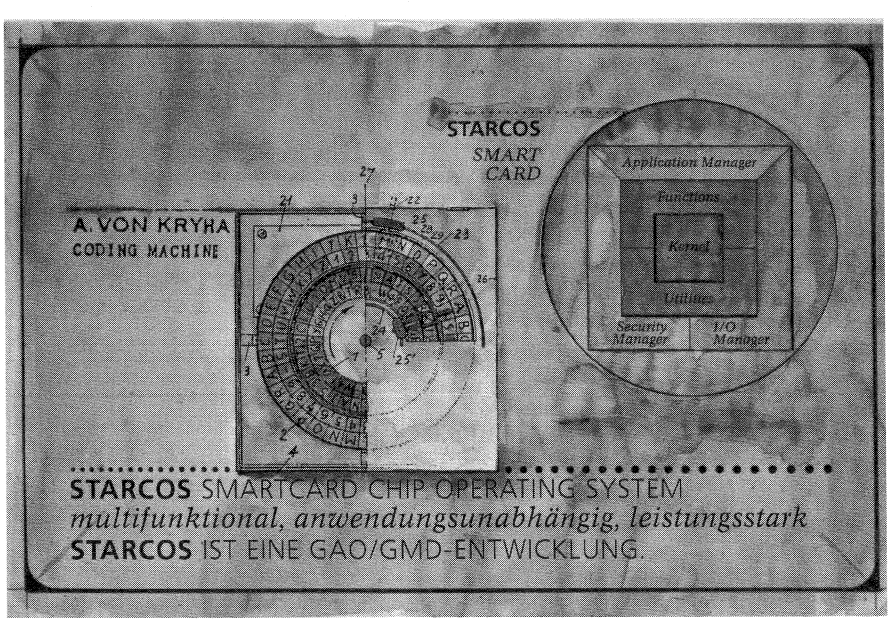

The STARCOS-SmartCard chip operating system

E U R E K A Software Factory

by Laure Reinhart - INRIA

The Eureka project, ESF, specialised in the design of software factory components, will continue in 1992 with the participation of INRIA. This project consists of sub-projects which produce components conforming to the ESF Standard Architecture and which are able to design Software Factories, adapted to specific environments: Management, Real Time systems, Telecommunications, etc.

The main partners are: SEMA GROUP, CAP GEMINI SOGETI, MATRA and INRIA in France; AEG, NIXDORF, SOFTLAB and the University of Dortmund in Germany; ICL in Great Britain; Norsk Data and SI in Norway; Telelogic in Sweden.

The project was launched in 1986 and will last 10 years. The results of the research and development teams are integrated into a common platform located in Berlin. The first products will appear late 1991. ■

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ESPRIT BRA PROJECT 3092

Predictable Dependable Computing Systems

2nd Open Workshop

Newcasle upon Tyne
28-30 May 1991

by Nick Cook - Administrative Coordinator, PDCS

The ESPRIT Basic Research Action PDCS (Predictably Dependable Computing Systems) is investigating how to make the process of designing and constructing adequately dependable computing systems much more predictable and cost-effective than it is at present. Particular attention is being paid to the problems of producing dependable distributed real-time systems in which the dependability is achieved by the incorporation of mechanisms for fault tolerance. Perhaps the single most important characteristic of the project is the stress being put on the necessity of taking a "systems engineering" approach. Thus an important goal of the project is to facilitate increased use of quantitative assessments of system dependability as a prerequisite to turning the construction of large computer-based systems into a true engineering discipline.

The ultimate long term objective of the work is to produce a design support environment which is well-populated with tools and ready-made system components and which fully supports the notion of predictably dependable design of large real-time fault-tolerant distributed systems. Given the emphasis on taking a "systems engineering" approach, the project aims at achieving significant, well-coordinated progress towards the following very challenging objectives:

(i) developing effective techniques for establishing realistic dependability requirements;
(ii) producing quantitative methods for measuring and predicting the dependability of complex software/hardware systems;
(iii) incorporating such methods more fully into the design process, making it much more controlled and capable of allowing design decisions to be based on meaningful analyses of risks and quantified likely benefits.

Each year the project organises an Open Workshop to present its research results, which are reviewed annually by independent reviewers. This year the workshop was held in Newcastle upon Tyne (28-30 May 1991) and brought together almost 100 people from both European and North American universities, research institutes and industry.
The workshop included technical sessions on: Dependability Requirements, Methods and Paradigms for Fault-Tolerant System Design, Real-Time Issues, Verification of Critical Software, Software Engineering Environments, Security, Dependability Evaluation and Assessment of Very High Dependability Software.

A series of demonstrations were also held on:

- statistical testing of software;
- SoRel, a tool for software reliability analysis and prediction;
- re-calibrating software reliability models;
- checking and interactive analysis of Z specifications;
- a secure terminal-host communication;
- relating dependability requirements to organisational structure;
- the MARDS design environment for real-time systems;
- the Paralex environment for parallel programming in distributed systems;
- programs for the real-time control of trains on a model railway, and for the automatic diagnosis of hardware faults;
- and a video of the MARS system, describing the system architecture and the design principles of MARS.

As with the workshop and review held at LAAS-CNRS (Toulouse) in May 1990, the results of the Action were well received. In fact, the reviewers once again considered that in significant areas of research the PDCS project determines the state of the art.

The PDCS partners are: City University (London), IEI-CNR (Pisa), Universitaet Karlsruhe, LAAS-CNRS (Toulouse), University of Newcastle upon Tyne, LRI-Universite Paris-Sud (Orsay), Technical University of Vienna and University of York.

The University of Newcastle upon Tyne is PDCS Coordinating Contractor. ■

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ESPRIT BRA PROJECT 3070

FIDE Course

Tropea
27-31 May 1991

by Costantino Thanos - CNR

The FIDE Course on Database Programming Languages and Persistent Systems was held in Tropea, Italy, 27 - 31 May 1991. The FIDE Course is a first output of an ESPRIT BRA project "Formally Integrated Data Environment - FIDE". The Course was aimed at researchers investigating object-oriented databases, database programming languages and persistent object systems, designers of advanced database applications and developers of advanced database tools and programming languages. The objective was to provide a better understanding of database and persistent programming languages, and related technologies.

During the Course, the fundamental properties of these technologies were presented, an analysis was made of the experience gained from the construction and use of several database programming languages and future directions in this area were discussed. Smaller special interest groups were formed to discuss specific research issues.

The Course was attended by about 50 participants and was directed by Professor M. Atkinson (University of Glasgow) and Dr C. Thanos (IEI-CNR). ■

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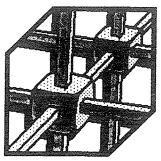

International IFIP Workshop on Open Distributed Processing

Berlin, October 8 - 11, 1991

by Jan de Meer - GMD

Open distributed processing will lead the way for data processing systems and telecommunication technologies in the nineties. At an "International Workshop on Open Distributed Processing (ODP)" to be held in Berlin from 8 to 11 October, 1991, by the International Federation for Information Processing (IFIP), the Geneva-based umbrella organisation for national federations, various experts will present the results of their latest work and discuss the possibilities for transforming research results into industrial products. Jan de Meer from the GMD Research Center for Open Communication Systems (FOKUS) is one of the chairpersons of the programme committee. The Technical University of Berlin and the Institut für Informatik und Rechnertechnik (IIR) share responsibility with FOKUS for the organisation of the event.

New integrative concepts are needed to master the challenges raised by distributed data processing applications. System openness must extend to communication, distributed systems must remain transparent and application portability must be maintained even when components are heterogeneous. Various international efforts to solve these problems have already been initiated, e.g. by the International Organisation for Standardisation ISO or the International Consultative Committee on Telegraphy and Telephony CCITT in Geneva.

New concepts and standards, based on the reference model for open distributed systems, will define the next generation of distributed systems. The concept of open distributed processing is not restricted to purely technical solutions. Instead, it offers a broad, comprehensive model based on five different abstractions. The five aspects of enterprise, information, computation, engineering and technology provide answers on how to build an ODP system. At the same time, the requirements and aims of the system in its working environment are covered, as is their practical implementation.

The work on ODP is also aimed at the definition of generic structures and functions of ODP systems. It provides basic modelling concepts and concepts for specification and architecture based on object-oriented paradigms using formal methods.

The International Workshop on Open Distributed Processing will provide an introduction to this specialist field. It is targeted both at R&D specialists and the users of open systems. ■

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Eurographics

Workshop on Formal Methods in Computer Graphics

Marina di Carrara
17-19 June 1991

by G.P. Faconti - CNR

For some time now, the Eurographics Association has been playing a key role in Europe in the establishment of a programme of technical activities on graphics by sponsoring international workshops on different aspects of computer graphics. Formal techniques for the specification, refinement and verification of systems are being developed in a number of research laboratories around the world and applications of those techniques are being made in computer graphics. The importance of the formal specification of computer graphics systems has become obvious as it provides clarification of concepts, discovers errors and omissions in informal specifications.

A workshop on Formal Specifications in Computer Graphics was held under the sponsorship of the Eurographics Association in Marina di Carrara, Italy, 17-19 June 1991. David Duce and Giorgio Faconti were co-chairmen of the Program Committee. The aim of the workshop was to review the state of the art in this area, to identify existing consensus amongst the approaches taken by different groups, and to identify the strengths and weaknesses of specific techniques and methods, and requirements for specification techniques for computer graphics.

The following major topics were discussed during the workshop: tool requirements for specification on graphics systems; comparison between methods/description techniques; specification of the ISO/IEC reference model for computer graphics systems; analytical, descriptive, predictive, prescriptive use of formal methods; what is eluding formalisation?; the role of time in formal methods; the role of approximation, probability, ...

It is hoped that the proceedings will be published in the Eurographics Seminars book series (Springer-Verlag). ■

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Workshop: New Standards for Computer Graphics

Amsterdam, October 1991

by Ivan Herman - CWI

The computer graphics market will probably exceed $50 billion before the end of 1993, showing a growth of nearly 70% in four years, the European share then exceeding one quarter. However, this market is currently strongly dominated by USA-based companies with Japanese ones coming up strongly in the more media-oriented parts of graphics. Europe cannot afford to loose or ignore such a huge market.

For the emerging new technologies and application areas, which cause this tremendous growth, a new software base is necessary which accommodates demands from special high performance hardware, dedicated application systems, distributed and parallel computing, scientific visualisation, object-oriented methods and multimedia, to name just a few. Moreover, this must be a standardised, well equipped software base. In turn, a successfully designed software base will influence the structure of future generation systems, including their hardware components. This

has happened, and is still happening, for instance through older systems and international standards such as GKS, PHIGS and the XWindows System.

Clearly a European standard proposal and implementation is the key to conquering a substantial share of the market presented above. Considerable experience is accumulated within ERCIM (all present ERCIM partners were key players in the development of GKS and PHIGS, the first generation graphics standards). The consortium is therefore particularly suited to produce this standard.

In view of this, an ongoing research activity started in December 1990 with participants of INRIA, RAL, GMD and CWI. Some additional experts, coming from the University of Manchester and the Fraunhofer Gesellschaft of Darmstadt, joined this group, which was finally enlarged by representatives of CNUCE, one of the three Pisa-based CNR institutes forming the Italian ERCIM member. Three workshops were held (December 1990 in Abingdon, March 1991 in Bonn and June 1991 in Paris) and a fourth one is planned in October 1991 in Amsterdam. By the end of the third Workshop a fairly clear idea concerning the new generation graphics standard has emerged from the discussions; a larger-scale ESPRIT proposal is now planned in cooperation with some other industrial partners (the latter being grouped into what is called the European Steering Committee on Computer Graphics).

At this stage a four-year R&D programme is envisaged. The first two years of the programme will be devoted to research issues and the entry of an initial draft standard document into ISO/IEC. The second phase will involve industry to a greater degree and will see the development of both prototype and production quality implementations. ■

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WORKSHOP ON BROADBAND COMMUNICATIONS

Estoril, Portugal 20-22 January 1992

CALL FOR PAPERS

SECOND ANNOUNCEMENT

The Workshop on Broadband Communications organized by **IFIP** Technical Comittee 6, is intended to provide an international forum for investigating the development of protocols, network architecture, access arrangements, traffic management and applications for broadband communications.

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Workshop: How Can Computer Networks and Operating Systems Support Digital Audio and Video Transmission?

Heidelberg
18-19 November 1991

by Radu Popescu-Zeletin - GMD

The trend towards powerful workstations and high-speed networks is producing a whole range of possible new applications. Digital audio and video transmission open up new dimensions in communication. The "Second International Workshop on Network and Operating System Support for Digital Audio and Video", to be held in Heidelberg on 18-19 November, 1991, will consider network and operating system support for continuous media communication.

The workshop is being organised by the IBM European Networking Center in Heidelberg and two specialist groups of the American Association for Computing Machinery, New York. The head of the GMD Research Center for Open Communication Systems, Prof. Dr. Radu Popescu-Zeletin, is co-chairman of the programme committee.

These new media differ from traditional media such as text and graphics in that they have relatively stringent bandwidth requirements. Today's data networks do not meet the requirements of broadband communication, and special operating systems are also necessary.

The Heidelberg Workshop is the second in a series started in November 1990 at the International Computer Science Institute and the University of California in Berkeley. Its aim is to bring together researchers in computer networks and operating systems so that they may work together to find new solutions for the application of broadband communication. ■

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ERCIM Workshops:

TOPICS:

- Distributed Systems
- User Interface and Multimedia Technology
- Decision Making: Methods and Applications

14-15 November 1991
INESC
Lisbon, Portugal

(see article on page 6)

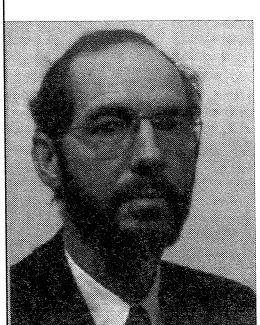
PEOPLE

GMD — **Prof. Dr. Carl Adam Petri**, Head of GMD's Institute for the Foundations of Information Technology, will retire from GMD on 31 July, 1991. After completing his studies of mathematics, he became departmental assistant at the Technical University of Hanover and then archive curator and research group leader at the Institute of Applied Mathematics of the University of Bonn. During that period, he established the largest university computer centre of the era. Prof. Petri has been a Head of Institute at GMD since its foundation in 1968 and has played a major role in the development of the agency. ■

Prof. Dr. Carl Adam Petri

(Photo: Münch, GMD)

CWI — **Dr.ir. Gerard van Oortmerssen** (46) has been appointed managing director of CWI. He succeeded Jan Nuis, who will retire at the end of the year, from the 1st of September. Van Oortmerssen received a Ph.D. from the Technical University of Delft in the field of naval architecture in 1976. He has worked for over twenty years at the National Maritime Research Institute (MARIN) in Wageningen, first as a researcher, and later as head of the Research & Development department. ■



Dr. ir. Gerard van Oortmerssen

(Photo: CWI)

ERCIM News

European Research Consortium for Informatics and Mathematics

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