
EDITORIAL

ERCIM is Only Just Beginning

The editors of the ERCIM News (formerly CWI—GMD—INRIA Newsletter) are displaying considerable faith by inviting me to write an editorial for Issue No 5. The formal processes that make my Laboratory, the Rutherford Appleton Laboratory, the fourth member of the European Research Consortium for Informatics and Mathematics (ERCIM), have only just been concluded. It is a great tribute to the friendship shown to us by the three founder members that RAL's scientists and engineers are already beginning to behave like full members of "the club".

One of the most noticeable characteristics of ERCIM is its determination to look outside itself. A clear target for the

organisation is to raise the competence of Europe in the world Informatics and Mathematics scene. ERCIM's interests are not confined to those of GMD, CWI, INRIA and RAL, or even to Germany, The Netherlands, France and the United Kingdom. It is our desire to play a leading role in the framework of Europe as a whole.

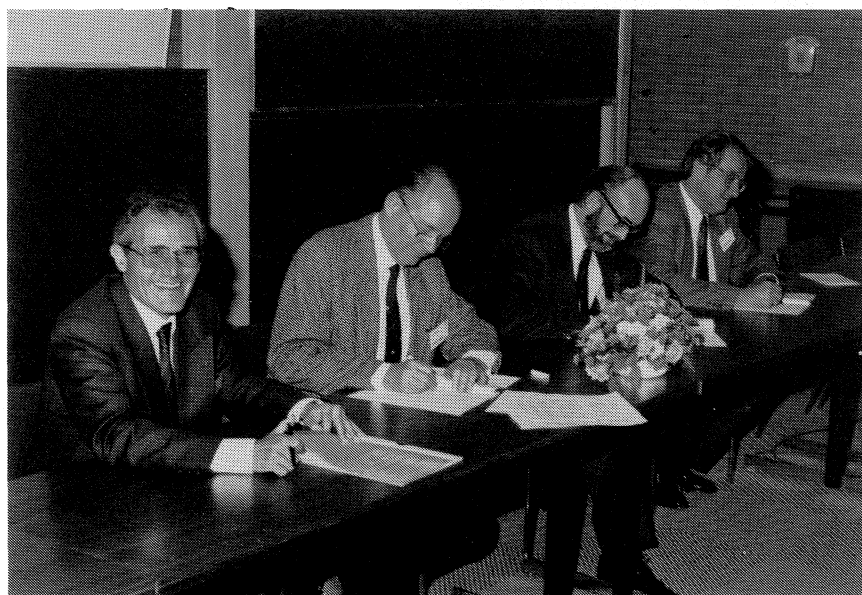
Perhaps the most exciting development since the July Issue of the Newsletter is in the Fellowship Programme. Three Fellows have now been appointed: Michal Haindl (at RAL from 1 October), Eric Rutten (at INRIA from 16 September) and Alexander Malyshev (at CWI from 1st of December) come from Czechoslovakia, France

and the USSR, respectively. This is an important step for ERCIM but only a first step. A principal objective of the Consortium is to open up the programmes and resources of its members to excellent mathematicians and information technologists and thereby to benefit both individual Fellows and the host institutes. ERCIM has ambitious plans for its Fellowship Programme and hopes, in close collaboration with the EC, quickly to increase the number of ERCIM Fellows appointed each year.

I was very impressed by my first exposure to an ERCIM meeting at Schloss Birlinghoven in April early this year. Clearly these joint workshops on themes of common interest are valuable events. They allow scientists from the member organisations to present their work to their peers but they are even more valuable than this. It is very important to encourage real collaborations at the working level between the ERCIM partners and the workshops can be seminal in setting up such collaborative groupings. The real strength and potential of ERCIM is in such collaborations and, in this context too, the ERCIM Fellows can play a very important role as, during their Fellowships, they move from institute to institute acting as a catalyst for collaboration.

ERCIM is only just beginning. I know that I speak for all the Directors in expressing a hope that other members will join us to enable the Consortium to play a full role in leading this vital area of science and technology in Europe.

Paul R Williams



ERCIM directors signing the documents of RAL-membership:
Prof. Alain Bensoussan (INRIA), Prof. Gerhard Seegmüller (GMD),
Dr. Paul Williams (RAL), Prof. Cor Baayen (CWI) - from left to right
Photo: Zwarst



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GMD-INRIA Newsletter* is published
under its new official name
ERCIM News.

COOPERATION

Expanding ERCIM Seeks Full-Scale European Participation

Ever since its inception in April 1988, ERCIM's intention has been to expand its membership within Europe. Thus, after a formal cooperation agreement between GMD, INRIA and CWI had been concluded in April 1989 during the ERCIM meeting at Schloss Birlinghoven (GMD's headquarters), the most recent meeting in Amsterdam (November 1990) has already seen the formal entry of RAL (United Kingdom). This meeting was also attended by observers from INESC (Instituto de Engenharia de Sistemas e Computadores, Portugal) and CNR (Consiglio Nazionale delle Ricerche, Italy).

First ERCIM Fellowships Awarded

ERCIM has awarded its first fellowships to three researchers: Michal Haindl (Czechoslovakia), Eric Rutten (France) and Alexander Malyshev (Soviet Union). They started their work this fall. Each of the fellows will spend three periods of half a year at three different ERCIM institutions. Thus they become well-informed about European research and contributes ERCIM to the mobility of researchers throughout Europe and their mental preparation for the European house of the 1990's.

Haindl is a specialist in computer vision, in particular applications of image analysis in remote sensing. His first ERCIM site is RAL, after which he will visit CWI and INRIA. Rutten wrote his Ph.D. thesis about the

application of temporal logic in telerobotics. He will use his fellowship for work in artificial intelligence, in particular knowledge representation, planning and man-machine communication. Rutten will stay at INRIA, GMD and CWI. Malyshev's speciality is numerical linear algebra. He will work on scientific computation and software for parallel systems at CWI, INRIA and GMD, respectively.

A second call for applications for four fellowships during 1991-1992 has recently been issued.

ERCIM Advanced Courses Started

The first course in the framework of ERCIM's advanced training programme was given at CWI in November. It was a four-day course on Large-scale scientific parallel computing, with twenty participants. In 1991, the course will be given in Bonn and Paris. The course receives support from the EC COMETT II programme.

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The Commission of the European Communities has just granted 50% funding (out of the COMETT II program) for the development of an "Advanced

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Course on Large Scale Scientific Parallel Computing", where GMD will be working together with scientists from CWI and INRIA.

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A short course on user interfaces, to be given by CWI, is envisaged for 1991. An application for support will be submitted to COMETT II. The course originates from RAL's large-scale educational COMETT I project on human-computer interaction.

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Similarly, in 1991 a COMETT II application will be submitted for a short course in computational fluid dynamics, to be developed by INRIA.

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ERCIM Meeting in Amsterdam — Reports on Workshops

The fifth ERCIM meeting took place at CWI in Amsterdam on the 8th and 9th of November 1990. Three workshops were organized on different themes. Here each of these workshops is briefly reported on.

Computer Algebra

A somewhat bold definition of Computer Algebra is: the common denominator of all exact-computational activities in mathematical and computer science research. This workshop reflected various aspects of these activities. The fifteen lectures could roughly be divided into the following five categories:

- Mathematical algorithms
- Underlying computer science (languages, interfaces, etc.)

- Expertise centres
- Package construction
- Future collaboration

In the mathematical session devoted to algorithms, recent breakthroughs in the solutions of polynomial equations and the determination of the dimension of Lie algebras of symmetries of differential equations, as well as computations in Lie algebras and Chow rings were touched upon. (Five talks)

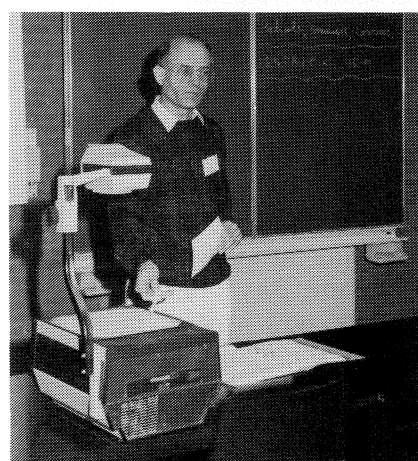
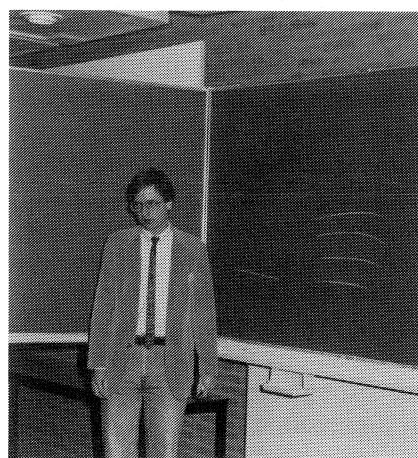
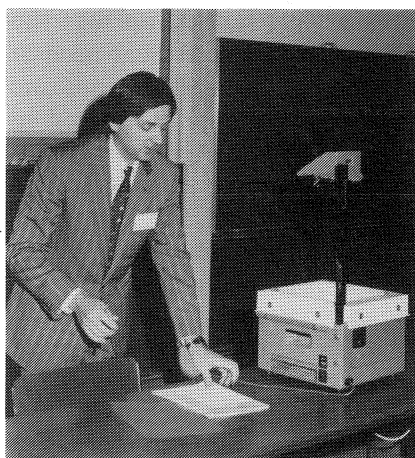
Regarding computer science aspects, the problem of typing in languages for symbolic computation received considerable attention. The language CAML was presented. (Two talks)

Both in The Netherlands and the United Kingdom, a centre of

expertise has been established. Representatives from these centres indicated the respective set ups and tasks. (Two talks)

The packages MACROFORT (to generate FORTRAN code in MAPLE), LiE (for Lie group theoretic computations), GEMMES (to generate numerical code from within MAPLE, especially for robotics etc.) and SISYPHE (a symbolic computation package in the make) were presented. (Four talks)

Regarding future collaboration, a few talks dealt with the practical problems of choosing interfaces amongst various (special and general purpose) computer algebra packages. (Two talks)



ERCIM-workshops at CWI
Photos: Zwarst

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Mathematical Aspects of Image Processing

Talks at this workshop represented eight research groups: INRIA Rocquencourt, INRIA Sophia Antipolis, INRIA Rennes, INRIA Nancy, RAL, CWI, Oxford University (represented by CWI visitor R. Middleton) and the Czechoslovak Academy of Sciences (represented by ERCIM fellow and RAL visitor M. Haindl).

A wide variety of image types and tasks was approached, including 3D imaging (reconstruction, image formation), time sequences (motion analysis, smoothing), multichannel remote sensing (classification, missing data) and general image analysis. Despite this diversity, there was a surprising degree of common interest among the researchers, and four strong themes emerged from our discussions.

- Stochastic methods

These are being studied very actively. Techniques like relaxation, stochastic annealing, and recursive estimation offer a powerful general toolkit for solving 'optimization' or 'information-extraction' tasks. The underlying theory, Markov random fields and Bayesian statistical inference, now plays an influential role in thinking about image processing problems.

- Geometrical analysis and modelling

This is both an important task for computer vision (edge

detection, object recognition, analysis of curvature, morphology) and an essential adjunct to other kinds of analysis (optical flow). This area exhibits a fascinating interaction between pure mathematics (differential geometry, algebraic geometry) and computer science.

- Combination of decisions from different levels

This was regarded by many speakers as an important goal because it is clear that many 'low-level' computer vision tasks (segmentation, edge detection, optical flow) cannot be correctly performed without information from higher levels (object recognition, connectivity, hierarchical shape analysis).

- Real world problems

An impressive feature of the talks at this workshop was the conviction that new ideas need to be tried out on 'real' images and their performance evaluated in terms of the 'real' problem. Examples included road traffic cameras (optical and infrared), medical tomography, robot vision and Landsat satellite images.

The workshop was a good exchange of research ideas and it was resolved to cement our research contacts by a more organised exchange of information, technical reports, addresses and research visits.

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High-Speed Networking

This workshop was organized around two central themes: first, to discuss the infrastructures available at each institution for conducting research that was based

on the availability of high-speed links, and second, to explore a number of areas that could benefit from an improved networking infrastructure among the ERCIM partners.

As a result, several talks were given on each institute's local- and wide-area networking activities, as well as a series of presentations that illustrated some of the research activities that made use of (or were influenced by) the presence of high-bandwidth communications facilities. The research presentations considered protocol development projects such as the development of Remote Procedure Call (RPC) protocols for use in distributed operating systems, the batching of remote functions so as to reduce the need for RPC activity, and issues surrounding the use of common local-area services in a wide-area network. Also aspects of multimedia projects that are underway at each of the ERCIM sites, were discussed.

The conclusions reached at the workshop indicated that while there is already a high degree of networking cooperation among some of the groups within ERCIM, there is still much to be done to improve the interconnections that should exist between all groups. This improved infrastructure is necessary to enable groups who now work separately to better communicate and share ideas.

An important aspect of a desired infrastructure is that it provides not only a high-bandwidth network among the ERCIM sites, but that it also provides a network with low delay characteristics, so that an environment can be presented to researchers that mimics their local networking environment. Without both of these characteristics, true interaction can not be expected to take place.

The workshop produced a number of consensus recommendations that the group felt would aid cooperation in the future:

- that an ERCIM interconnectivity project be established that would have as its goal the provision of an 34-Mbit network link among member sites as soon as external funding can be secured;
- that, given the needs of existing groups to increase communication and sharing of research results, an internally-funded 64kbit network be established as soon as possible;
- that focused attempts should be made to increase the cooperation on multimedia research, including having short-term ERCIM participation at the programme committee level for an upcoming conference on the subject in Amsterdam and having a longer-term coordination of multimedia research projects at each member's institute;
- that the ERCIM directorate should express concern to the representative European government agencies over the crisis state of pan-European research networking infrastructures, with the specific recommendation that more emphasis should be placed on mixed-protocol high-speed infrastructures (such as being done in the United States and elsewhere) and less emphasis on the development of protocols for low-speed networks (as is being done in Europe).

Each of the institutes agreed to appoint representatives to draft detailed plans for implementing these recommendations.

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IMAGE PROCESSING

Introduction to Image Processing

Once an arcane technology requiring specialised hardware and programming techniques, image processing is now a standard scientific tool, and part of the repertoire of any workstation computer. Images are collected by remote sensing satellites, video cameras, infrared and CCD sensing cameras, synthetic aperture radar, medical tomography (X-ray, NMR, positron emission), ultrasound, nondestructive testing probes, seismic reconstruction, digital interfaces to microscopic imaging (optical, electron, infrared), and even the humble home computer. Practical uses of image processing are myriad; for example,

- sensing:
observing the environment, for example, geographical and ecological surveys of the earth from satellites and aircraft; medical scanners;
- scientific data analysis:
recording experimental results such as microscopic images of minerals or biological tissues, astronomical images, ecological damage patterns, manufacturing faults on silicon chips; geographical information systems;
- vision:
interpreting and responding to sensed images, for example, robot vision in manufacturing; automated medical screening of blood and tissue samples; automatic document reading (cheques, postcodes, text, music);
- visualisation:
creating visual displays of numerical information (telephone network activity, particle accelerator data, soil surveys,

mathematical functions, engineering designs, simulations);

- visual archiving:
storage, indexing and retrieval of visual information, such as video archives, architectural drawings, art works;

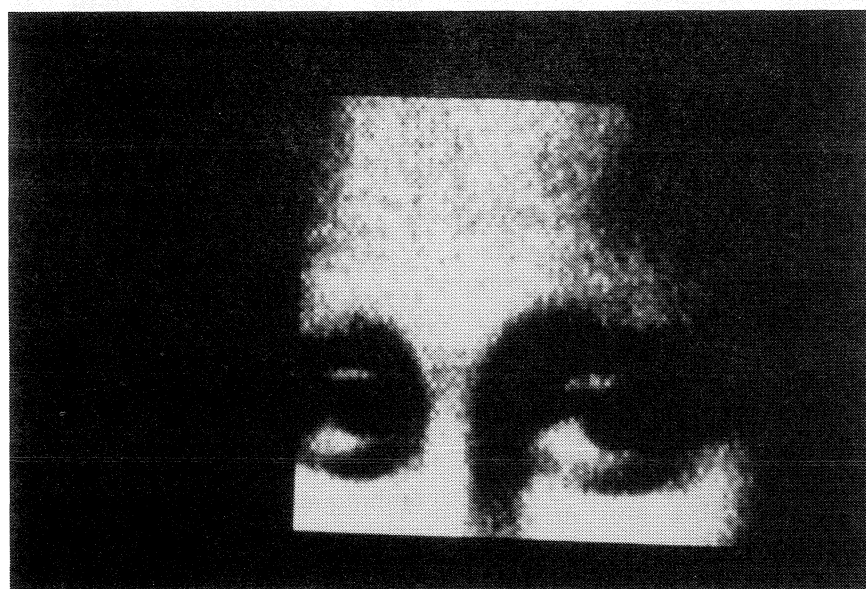
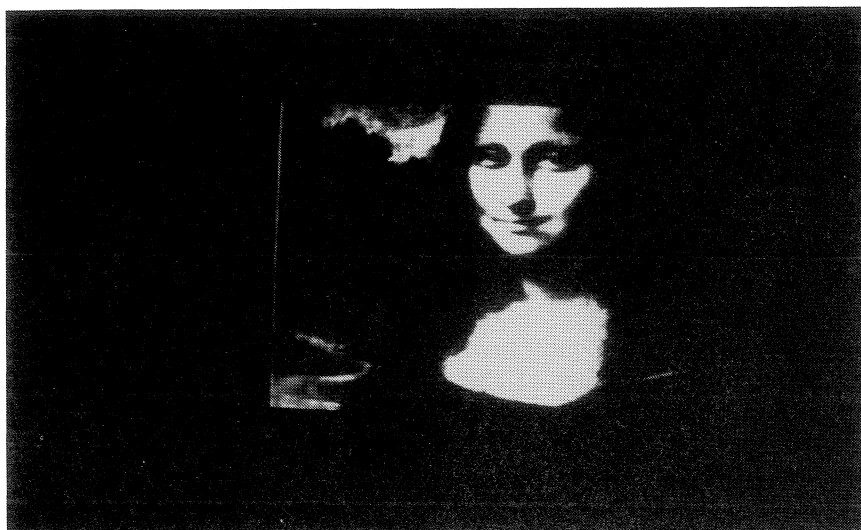
- visual communication:
interpersonal (electronic mail) communication including images; hypermedia; video conferencing; visual encyclopaedias and teaching texts (medical atlases).

Image processing is a huge and challenging field of application for computer science and mathematics, uniting many types of research activity:

- mathematical and statistical research on image processing;
- exploitation of image processing techniques in mathematics (visualisation, optimisation), statistics (spatial data analysis, interactive graphics) and computer science (graphics, multimedia computing, user interfaces);
- application of modern software techniques (user interfaces, program generation, graphics models, distributed systems) to image processing;
- adoption of image processing as a test application for current research.

A particular theme of current interest seems to be the fusion of image processing and graphics, not only in computing terms (algorithms, programming environments and user interfaces), but also in mathematics (mathematical morphology) and mathematical statistics (spatial statistics and image data analysis).

A particularly attractive feature of image processing research is that, while inherently interdisciplinary in nature, it presents the individual specialist with 'real' scientific problems in his or her own discipline. It



Processing 'the' smile: a 512 x 512 black and white video camera image of Da Vinci's La Gioconda, with detail (128 x 128) showing pixel composition
Photos: CWI

provides an excellent opportunity for the best kind of cooperation between researchers in different disciplines and different institutes.

The following articles give a representative survey, rather than exhaustive details, of research activity in image processing at our ERCIM institutes. The absence of GMD contributions does not by any means indicate a lack of interest, merely the current absence of defined projects in this field. It is our hope that this survey will encourage even more activity

in this very stimulating research area, both within ERCIM and outside.

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Vision by Associative Reasoning

RAL — RAL's main image analysis research interest is in connectionist approaches to low and intermediate level scene

interpretation. The programme of work commenced about five years ago in connection with a project concerned with understanding natural scenes; it is being continued as part of a second project which aims to develop novel neural network methods and apply them to aerial image interpretation.

The basic problem being studied is that of consistently labelling image entities using relaxation processing. Problems of this type are present at many levels in scene interpretation and include the extraction of consistent edge-maps, the semantic labelling of image regions and the interpretation of polyhedral scenes. One of the theoretical achievements of the research has been to formulate improved evidence combining strategies for handling uncertain or incomplete 2D image data. A concrete application of this theoretical framework has been the development of a highly robust evidence combining edge detector which is competitive in performance to Canny's popular algorithm.

So far the research has been aimed at handling single levels of scene interpretation. One of the topics to be investigated in connection with neural networks is how consistent labelling and evidence combination can take place within a conceptual hierarchy. A key idea in the single level work was the use of local constraint dictionaries to represent knowledge about the labelling application in hand. An important aspect of future work will be to consider how multi-level constraints can be represented.

Another key issue will be to investigate whether there are any symbiotic benefits to be gained from implementing the novel types of relaxation processing described above on a neural network. An

obvious candidate is to see if the difficult task of computing evidential weights can be handled using the adaptive capabilities of neural networks.

In October the group involved in this research was joined by Dr Michal Haindl who is one of the first three ERCIM fellows. He will be studying methods for multi-scale image interpretation using novel relaxation techniques.

Collaboration with other UK groups has been particularly important during this programme. Throughout the work there have been close contacts with Josef Kittler's internationally known group at the University of Surrey. Partners in the latest project also include British Aerospace, the Royal Signals and Radar Establishment and the University of York. The group is keen to explore the possibilities of extending its research programme in collaboration with other ERCIM laboratories.

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IPTACC — Image Processing Transputer Applications Community Club

RAL — IPTACC is one of three special interest groups set up by the RAL-based SERC / DTI Transputer Initiative. Its purpose is to assist those people using transputers for image processing and those who want to do so by enabling them to share experience, software, hardware, etc. Membership is free and open to anybody working on, or interested in, the application of transputers to information processing and currently there are some 160 members. Members' interests have been collected through a questionnaire and is being used to provide a directory of interests.

The membership meets once a year at an open meeting to elect an executive and to set objectives for the executive for the coming year. The executive has representatives from academia, industry and suppliers and it meets 3 times a year. Communication within IPTACC is through the Initiative's mailshot magazine and by email — a broadcast facility providing a bulletin board type service to all members.

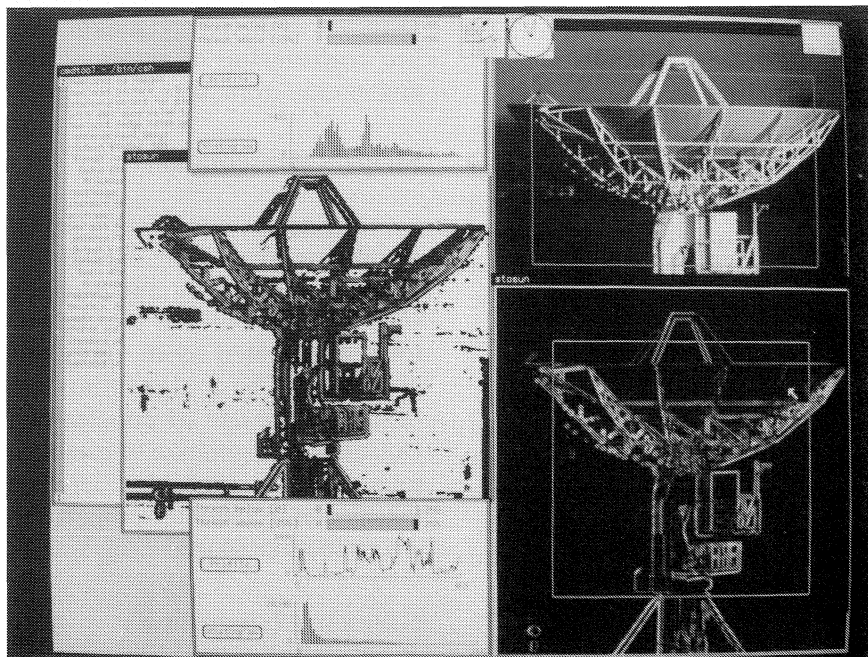
To date activities have included two day long seminars (free of charge to members), the compilation of hardware and software directories, the refereeing of papers in the information processing stream of the TA90 conference, and the running of a one day course on the use of transputers in information processing. Current activities include the enhancing of the software directory by gaining members' input on the usability of the packages, the creation of a

bibliography and the canvassing of members for ideas for a demonstrator project.

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Image Processing Algorithms Library (IPAL) to be Distributed by NAG Ltd

RAL — RAL has been collaborating with NAG Ltd, a UK company in Oxford, to produce a portable image processing library. This work, which was funded as part of the Alvey programme is now coming to completion. The library has two components since it was decided at an early stage that Fortran and C libraries should be produced. It has depended in part on contributions from other Alvey projects and is seen as a contribution towards the improvement of technical infrastructure for the benefit of future research and development



Results of using an edge enhancement routine from IPAL on an image of a satellite disk at RAL. The routine isolates those regions of the image where the light intensity varies most rapidly
Photo: RAL photoservices

activities. RAL was the academic partner in this collaboration and the library will be marketed by NAG Ltd.

The Fortran component is fairly conventional since it treats images as two-dimensional arrays of real numbers and the area to be processed as a rectangle. However the C library is much more flexible and so allows features in an image to be specified and extracted. Operations such as binary morphology fit naturally into the C library. Structures are used to specify the images and this extends to coding the boundaries of features as structures. The necessary low-level functions to create, delete and manipulate these structures are an important part of the library.

It is expected that both libraries will find industrial applications and undergo further development as it becomes clearer where this is needed.

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ROBOTVIS — Vision for Robotics

INRIA — The project ROBOTVIS is mainly concerned with mobile robotics, where perception is intended to build dynamically representations of the robot environment. Those representations are then used to emulate on the robot "intelligent" behaviour such as place and object identification, and planning of complex strategies in a variable environment. More specifically, the project is working on the following points:

Image Feature Extraction

A recursively implemented optimal edge detector has been developed that provides the gradient of the smoothed image

with a resolution (i.e. the amount of smoothing). Standard non-maximum suppression and hysteresis thresholding yields a gradient edge map. A set of algorithms is then used to extract the chains of connected edge pixels. Finally, by a polygonal approximation a set of line segments is created that approximates the original edge pixels.

These functions form the basic building block for a number of other functions devoted to the analysis of depth and motion and to the construction of a number of three-dimensional representations of the environment, such as :

- calibration
- token tracking
- spatio-temporal surfaces
- stereovision
- structure from motion
- motion from stereo

Integration of Stereo and Motion

There are many different ways of combining the information provided by stereo and motion. We are considering dynamic stereo and motion from 3D.

Shape Representation

The team developed a set of algorithms for making explicit the volume occupancy and surface information carried by the 3D tokens extracted by the previous processes. These algorithms are based on the use of constrained Delaunay triangulation to establish topological relationships between tokens and a visibility property to determine free space.

Geometric Integration

As the errors in the reconstructed 3D tokens are quite large, the notion of geometric uncertainty is built into the process of passive vision.

ROBOTVIS collaborates within the framework of ESPRIT P940 with MS2I, ITMI and NOESIS in France, ELSAG and the University of Genoa in Italy, and GEC and Cambridge University in England, on problems related to algorithms for dynamic vision and their hardware implementation. The boards which are now being built correspond to the following functions: edge detection, edge pixel linking, polygonal approximation, tricamera static stereo, and token tracker. Future boards will contain the functions of structure from motion, and motion from stereo. Possibly also some boards related to the shape representation and geometric integration function will be built, integrated into a coherent structure (the DMA machine) and interfaced on standard workstations.

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TEMIS — Processing, Exploitation and Modeling of Sequential Images

INRIA — The TEMIS laboratory is involved in several research activities: image sequence coding, motion detection, estimation and interpretation for dynamic scene analysis, dynamic and active vision for a mobile robot, scene interpretation, pattern recognition (especially handwriting character recognition), etc.

The recovery of visual motion from image sequences has motivated a number of investigations since the last decade. In our study the problem of simultaneous optic flow estimation and segmentation from image sequences is treated as a global estimation problem. The unknown quantities to be estimated are the 2D relative

velocity field and the local motion boundaries. These are modeled using a joint Markov Random Field enabling the smoothing of the velocity field and the preservation of motion boundaries. Several real world image sequences have been processed using this model. Accurate motion measurement near occlusion areas, as well as detection of motion boundaries with a surprisingly good quality have been obtained. Measurement on other motions, for instance moving edges, is currently being investigated.

Recently, there has been a great interest in multigrid algorithms based on a multiresolution representation of images. Such a representation can be obtained for example by sub-band decomposition with quadrature mirror filters or by pyramid transforms. Also wavelet theory has been used.

Another goal of this study is to design a multigrid motion estimation algorithm for an image sequence coding method using motion compensation.

Also a new approach to vision-based control in robotics has been developed, considering a vision system as a specific sensor dedicated to a task and included in a control servo-loop. In this framework of automatic control, stability and robustness questions arise.

The major aims of this study are the design of automatic reading methods of handwritten texts and the development of more user-friendly human-computer communication tools.

There is a fruitful collaboration with other public and private research centres such as CCETT (common television and telecommunications centre), IFREMER (national research institute of underwater

applications), CELAR (electronic centre of the army), CEA (nuclear energy agency), and CBI (Brittany image collaboration). Industrial partners comprise Thomson, Matra, Sagem, PSA and Renault.

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SIAMES — Image Synthesis, Animation, Modeling and Simulation

INRIA — The aim of SIAMES is the automatic control of 3D scene geometry, rendering and motion. To achieve this objective we investigate the integration of physical models, the use of declarative methods, and the application of automatic control theory. In the project, three aspects are considered:

Geometric Modeling of 3D Scenes

A declarative method is being developed for the creation of an architectural environment. The idea is to produce a sketch of a 3D scene by means of geometric constraints and properties. The environment is described from a user (occupant) point of view along paths (trajectories).

Realistic Image Synthesis

A global illumination model based on radiometric quantities and on a physical approach to ensure generality and consistency has been proposed. Two equivalent systems of equations can be stated depending on the used photometric quantity, namely light power and radiance. A method handling any kind of diffuse, specular or transparent objects is being implemented.

For the production of realistic image sequences by ray tracing, a prediction/correction method is

being studied taking into account temporal coherences not only in 3D space (moving objects) but also in the visibility data structures and in the image.

Parallel ray tracing algorithms have also been proposed and implemented on a distributed machine (an iPSC hypercube).

Animation

An extensible animation system has been implemented in which rigid and deformable multibody systems are animated from their geometric models and the specification of kinematic and dynamic constraints. The animation system offers the following features :

- a mechanical formalism based on the principle of virtual work;
- automatic derivation of the equations of motion in symbolic form;
- automatic motion control of physical objects;
- object collision detection and response;
- the ability to perform scientific simulation.

Applications range from audio-visual to simulation fields:

- integration of our animation system in the EXPLORE system of TDI (Thomson Digital Image - Paris);
- cooperation with the Architecture School of Brittany (Rennes) for the design of architectural environments;
- development of an interactive graphics system for tele-operation aid (in robotics) with CEA-UGRA (Paris);
- modeling of vehicle mechanics for a real-time driving simulator system with INRETS/Renault/PSA;
- simulation for human animation from image sequence analysis with Thomson-LER and the University of Rennes;
- participation in the BRITE project "Improvement of the firing

process of technical ceramics''
with Bertin & Co.

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EPIDAURE — Images, Automatized Diagnostic, Robotics

INRIA — New techniques produce internal images of the human body: magnetic resonance images (MRI), X-ray tomography (scanner), ultrasound echography, scintigraphy, etc. These images provide both morphological and functional information (usually 3D information obtained through image sequences). The diagnostic usually requires both their quantitative and qualitative 3D analysis. Then, the therapy often asks for a very precise medical gesture guided by the image analysis (tumor extraction, localized radiotherapy, repairing surgery).

The project's objective is to solve fundamental artificial vision and advanced robotics problems in order to build systems which assist the diagnostic from medical images and also the realization of medical gestures.

The research is currently focussing on the following topics :

- three-dimensionnal (3D) image segmentation
- complex 3D shape modelling
- motion and deformation analysis
- multimodality image comparison
- building of a computerized atlas of the human body
- planification and control of trajectories
- hardware integration

The main partners of the project are: CGR-GE, DEC, Fulmen Systems (London), Henri Dunant Hospital (Paris), INSERM,

Gustave Roussy Institute (Villejuif), MATRA, Siemens, Renault Automation, and Joseph Fourier University (Grenoble).

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SYNTIM — Image Synthesis and Analysis

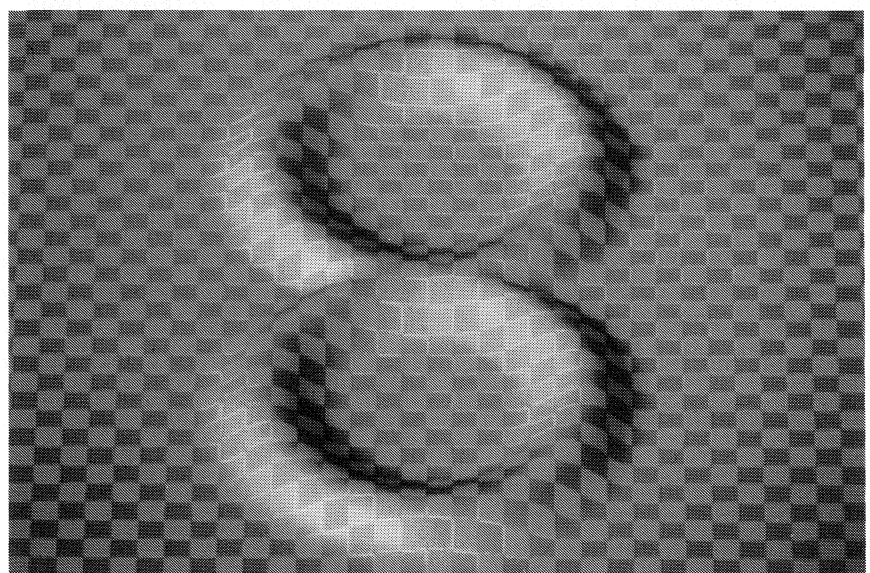
INRIA — The main objective of this project is to perform the vision task of a robot in a feedback loop instead of the usual open loop techniques. The idea is to produce a synthesizable scene model, construct from it a synthetic image and use the difference between the natural and the synthetic image to refine the vision technique (scene model).

On the analysis side of the loop, we are currently investigating possible cooperation between image segmentation and region matching. We recently solved the problem of 3D geometric interpretation which consists in finding correspondences between 3D facets obtained by the analysis, and 3D facets of an a priori given

world model. This interpretation infers a model-based image segmentation which allows further interpretation improvement and from which the photometric part of the scene model may be constructed. We are also well advanced in the design of a system able to automatically recognize major roads on panchromatic SPOT images by using Markov processes.

On the synthesis side we are currently improving the scene and animation modeller ACTION 3D, designed with SOGITEC. We are adding the possibility to interactively deform 3D objects, constructing hierarchical objects such as human bodies, and ray tracing all ACTION 3D objects. Within the animation part of ACTION 3D a new quaternion-based approach is used to enhance interactivity. We are finishing to implement a new ray tracing/radiosity algorithm.

Other important activities consist of modeling and animating a human face by integrating muscles and wrinkles in the model, and the study and comparison of various mapping techniques on general 3D objects (application to



Synthesis image created by ACTION 3D matching of texture on a given shape, project SYNTIM
Photo: INRIA

the design of shoes and clothes is underway).

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PASTIS — Scene Analysis and Treatment of Symbolic Vision

INRIA — This project mainly concerns image interpretation, i.e. the extraction of symbolic information. In the field of 3D vision an industrially operational system was created for producing numerical landscape models using stereoscopic scenes from the SPOT satellite, and a method was developed for the type of scenes used in robotics.

Furthermore, an expert system for complex form recognition was developed and is being marketed by ILOG, a subsidiary of INRIA, under the name of CLASSIC. The work centers on the automatic driving of a series of image interpretation processes and on the definition of a blackboard architecture for taking symbolic information into account. The

target applications here are hydrographic and road network detection using images from SPOT, and the detection of obstacles for road traffic.

Finally, a team of geologists from CNRS is working with the INRIA team to apply the methods studied in PASTIS to image interpretation relating to natural resources: expert system synthesis of geological data, geomorphological study, etc.

Most of the research presented above is the subject of various contracts with industry: Thomson Cimsa Sintra, CNES, CEA, the Eureka project Prometheus, etc., and the French Ministry of the Sea.

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NUAGES — Automatic Numerisation of the Geometry of Solids

INRIA — NUAGES is a software tool enabling the production of 3D models of

objects from flat cross-sections. From a set of polygonal sections, a 3D model is built in the form of a set of tetrahedrons which partition the interior of the object. This represents a new method in triangulation, based on the theory of solids and using the latest techniques in algorithmic geometry. Its main originality is its automatic processing of the case where the sections are made up of several regions — as is the case where the objects branch or contain holes.

The two main fields of application for NUAGES are electron microscopy and medical imagery. Satisfactory results have been obtained from data provided by a nuclear magnetic resonance tomograph. The complexity of the algorithm is virtually linear in relation to the number of input points and the computation time (on a SUN 3) is 0.07 secs/point.

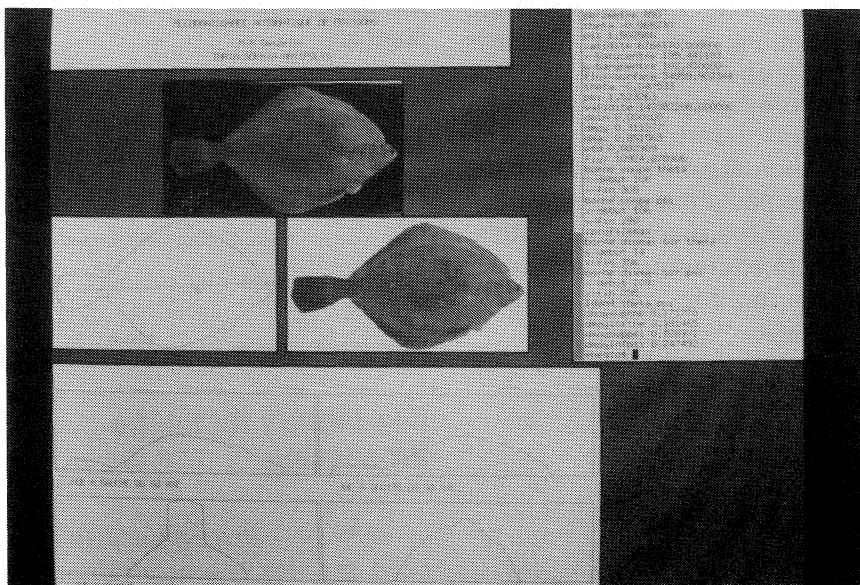
NUAGES is marketed by two specialized French companies: Digital Design and Noésis.

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Dynamic Cardiac Imaging by Magnetic Resonance

CWI — In collaboration with Philips Medical Systems, CWI researchers Jos Roerdink and Marcel Zwaan have studied reconstruction of dynamic images of the beating human heart, from magnetic resonance (MRI) data. Blurring and motion artefacts arise from nonuniform sampling effects associated with irregular heartbeats: but arrhythmia (persistent heart irregularity) is the medical problem that is of principal interest!

A mathematical model of the acquisition process was formulated to enable automatic compensation



Automatic recognition of fishes by CLASSIC, project PASTIS
Photo: INRIA

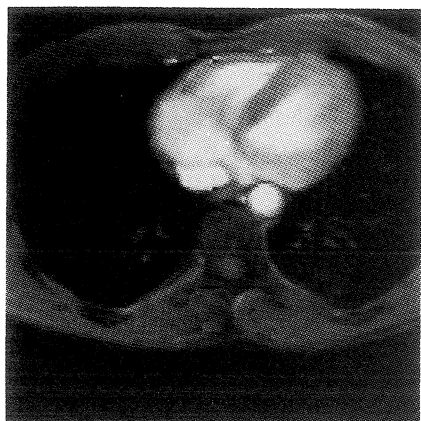


Image processing has numerous medical science applications and is an important source of information in the study of specific diseases, such as heartbeat irregularity (studied at CWI)

for this variability. Improved algorithms have been developed by formulating dynamic reconstruction as a moment problem. They have been successfully applied to the heart data and phantoms.

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Mathematical Morphology

CWI — An important development in image processing is 'mathematical morphology', which is both a mathematical theory and a source of practical image processing algorithms. Developed by J. Serra and G. Matheron at the Ecole des Mines de Paris, this is a geometrical approach to image analysis, which considers images as subsets in the image pixel space and manipulates them using set-based operators. These nonlinear transformations are pre-eminently suited to the analysis of geometrical structure in an image.

CWI researchers are very active in the current developments which are trying to extend the

power of morphological methods to deal with grey-scale images, hierarchical images and other images with graph-like structure. Henk Heijmans and Jos Roerdink (in cooperation with C. Ronse, Philips Research Laboratory, Brussels) have developed a general algebraic framework for morphological operators and are extending this to image spaces with non-commutative symmetry groups (applicable to images on a sphere). CWI (Henk Heijmans) has a collaborative research project with A. Toet (Institute for Perception, TNO) and F. Groen (University of Amsterdam) on morphological methods for hierarchical graph representations of images, sponsored by SION (the national foundation for research in computer science). This work has also attracted the involvement of L. Vincent (Harvard University). Recursive and iterative methods in morphology have been studied by Henk Heijmans in collaboration with J. Serra.

Since its inception, morphology has been closely related to stochastic ideas, particularly the theory of random sets ('stochastic geometry'). CWI researchers in probability and statistics (Adrian Baddeley and Marie-Colette van Lieshout) are collaborating with Henk Heijmans on stochastic models for morphological filters, and their relation to familiar image restoration algorithms such as the E-M (expectation-maximisation) algorithm and simulated annealing. Topics to be considered in the near future include colour image processing.

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Object Recognition in Images

CWI — The Bayesian approach to image analysis

developed by Besag (University of Durham) and Geman and Geman (Brown University, University of Massachusetts) has proved very successful in a range of problems such as segmentation, restoration and reconstruction. Their basic idea is to regard these tasks as statistical parameter estimation problems. The 'true image', which we would ideally like to recover from our noisy and blurred data, is taken as the statistical parameter of a probability model for the data; then prior information or conditions on the true image are incorporated as a Bayesian prior distribution on the parameter itself.

Researchers in mathematical statistics at CWI have been applying this approach to the problem of recognising objects in a grey-scale image. Possible applications are document reading and industrial robotics. Marie-Colette van Lieshout (supported by the Free University of Amsterdam) and Adrian Baddeley have studied the simplest case where all objects have the same shape or a small class of shapes. They have found that most of the standard object recognition techniques in the literature (Hough transform, morphological erosion, smoothing-and-template-matching) drop out as special cases of the Bayesian approach.

Current work is trying to adapt these techniques to the problem of reading printed sheets of music.

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C++ Library for Image Processing

CWI — In response to the need for flexible programming tools for writing low-level image processing operations for fundamental research, CWI

support staff member Adri Steenbeek has developed 'clip', a general C++ class and method structure for images. Standard image programming operations, such as looping through the pixel grid in various directions, addressing the neighbours of the current pixel, and testing for boundary cases, are written as in-line class methods. For example, a 100-line C program implementing the distance transform or a standard linear filter, reduces to about ten lines of 'clip'. A basic library of routines is provided, but 'clip' would normally be used as a programming interface to an existing C subroutine library.

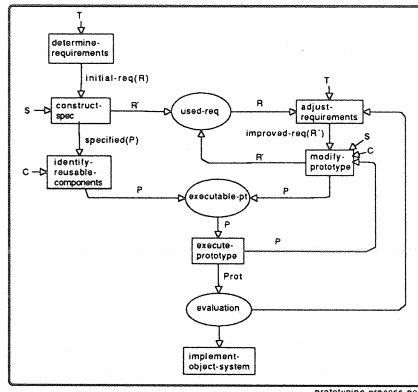
The package is still in development but will be generally released soon.

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RESEARCH ACTIVITIES

ProM: Software Process Modeling Environment

GMD — Recently, GMD started a new project, ProM, aiming at a prototype computational environment for constructing, simulating and reasoning about models of software engineering processes. This project was motivated by the growing consensus that a) alternatives to the traditional waterfall model must be developed, b) the development of suitable descriptive mechanisms and supporting environments may contribute effectively toward understanding, communicating, and systematically improving software processes, and c) automated software process environments are far from being applicable in practical applications.



```
% object type definitions
obj req-def is
  (descr: text; solution: prototype option).
obj psdl-prototype is
  (associated-req: req-def; spec: impl option).

% data type definitions
record spec is
  (inputs, outputs, states: type-decl list; ...).
record type-decl is
  (varname, type-name: id).

...

status predicates
  initial-req, used-req (req-def).
  specified, executable, tested (psdl-prototype).
  evaluation (protocol).

process actions
  determine-requirements (text).
  construct-spec (spec).
  identify-reusable-components (code).
...

vars R,R': req-def; D: text; P: psdl-prototype; S: spec; ...

rules
  initial-req (R):
    undefined (solution(R)).

  determine-requirements (D) (R):
    if inspected (D):
      where R is new.req-def with descr=D.

  construct-spec (S) (R,R',P):
    if satisfies (S,R):
      where P is new.prototype with associated-req=R, spec=S;
      R' is R and solution=P.
  ...

dynamics <prototyping-process-net>
```

Model of evolutionary software processes as supported by the PSDL prototyping method

Process models are declarative representations of software development activities and their causal or temporal relationships, of software objects, their interaction and evolution, and of other technical and organisational items affecting software development practice such as policies, laws, resources, or tools. An automated modelling environment could support planning, validation, consistency and performance analysis, monitoring and controlled change; it could also provide intelligent assistance to organise tasks and work contexts of individual software developers and support cooperative group work.

ProM is a joint research and development project between GMD, McGill University (Quebec), and Canadian industries to investigate and provide

solutions to key issues of software engineering process including

- methodologies for building and maintaining process models,
- formalisms for representing process models,
- prototype environments,
- experiments with process models and environments, and transfer of process modelling technology to industries.

Based on a detailed analysis of existing approaches, we plan to design a conceptual framework of software processes. This framework will include a behaviour-oriented model of development tasks and activities, an object-oriented model of software artefacts, and mechanisms to handle policies, guidelines and rules of thumb; it will also provide mechanisms to acquire and maintain knowledge about software engineering tools, such as their functionality, robustness, application constraints, or user experiences. Central research problems include

- the combination of capabilities to handle heuristics and experience-based knowledge with methods and techniques that deal adequately with the formalisable parts of software processes;
- modelling techniques and tools that support predictable and unpredictable dynamic changes as processes are performed;
- methods to instantiate and enact process models;
- presentation techniques;
- support of human communication and decision.

This framework will provide the basis for the design of a process modeling language and prototypes of supporting tools. The applicability of both language and prototype environment will then be explored at projects in cooperation with industrial partners.

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The SNAPAD System for Communication between Mainframes

GMD — The fact that mainframe computers have difficulty in communicating with each other is incomprehensible to laymen and home-computer users alike. After all, anyone with a home computer can buy software and an acoustic coupler and communicate quite easily with other home computers and computer-club units at radio stations and specialist journals. There are, however, a number of reasons why mainframes experience communication difficulties. First and foremost, mainframe communication has to satisfy much greater requirements:

- larger quantities of data have to be transmitted,
- no errors may be allowed to occur,
- the transmission procedure must be quicker,
- and if errors do occur, they must be corrected automatically.

All these requirements are so important that mainframe manufacturers have developed their own architectures to meet them. IBM developed Systems Network Architecture (SNA), Siemens developed TRANSDATA, and DEC developed DECNET. The situation today is similar to the situation with video recorders where a unit designed for a certain standard is unable to use a video tape of another standard. The same applies for mainframes: the telecommunication systems are incompatible.

A number of international institutions are looking to remedy this situation, in particular the International Standards Organisation (ISO) and the Comité Consultatif International Télégraphique et Téléphonique (CCITT). The most well-known result of the work conducted by

ISO is the 7-layer model for telecommunication purposes, while the CCITT has developed the X- and Y-series recommendations. All these efforts are directed at

- developing uniform terminology for telecommunications,
- giving telecommunications a logical structure and
- defining interfaces which allow different makes of systems to communicate with each other.

With the support of the Verein zur Förderung eines Deutschen Forschungsnetzes e.V. (DFN), GMD has developed a software which substantially enhances communication with mainframe computers. Since the time, back in 1985, when GMD first introduced this software for the IBM operating system MVS (/XA) under the name SNAPAD, this system has become an indispensable tool for many users in government institutions, banks, insurance companies and industry.

A factor which is of crucial importance for these users is that SNAPAD is able to utilise the existing terminal infrastructure. Additional computers, cables and post-office connections are superfluous. The very considerable capabilities of this software have been augmented more and more as a result of logical further development work. The Codework software house in Hennef is licensed to distribute SNAPAD.

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Toolbox Provides the Answer to Easier Compiler Construction

GMD — Generating compilers is a time-consuming and complex task. It is therefore worthwhile looking for methods to reduce this work input. The GMD is currently working on creating

compiler construction tools which, to a considerable extent, will enable programming-language compilers to be generated automatically. Scientists at the GMD Research Unit for Program Structures in Karlsruhe have now produced a toolbox which provides valuable support in virtually all phases of compiler construction work. This toolbox includes tools for generating lexical, syntactical and semantic analyses, for processing abstract syntax trees, for transforming attributed trees and for generating code generators.

In drafting the tools, particular emphasis was placed on their applicability in practice. The generated compilers are every match for manual programming in terms of quality and, in particular, efficiency. The tools run with the UNIX operating system and generate program modules in target languages C and Modula-2. The first realistic applications demonstrate the outstanding capabilities of these tools and show that they can be used for constructing compilers of high production quality.

Use of tools ensures significantly higher programming productivity and a marked increase in the reliability of the generated compilers. Instead of creating a whole program, the user simply has to generate a much shorter and less complex specification. The tools check the consistency of the specification and translate it into a program.

The compiler construction tools can be used to particular effect in the following applications:

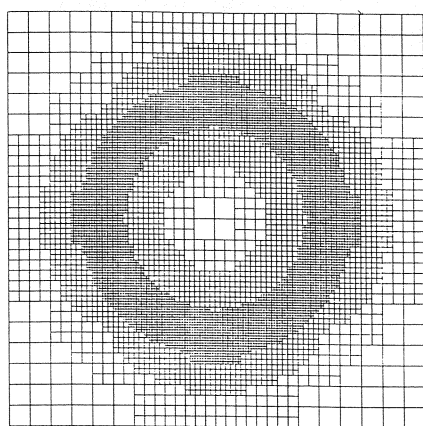
- Implementing extended languages;
- Constructing compilers for new programming languages;
- Implementing programming languages on new computers;

- Assessing the draft of new programming languages

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Adaptive Grid Methods

CWI — The CWI project 'Adaptive grid methods' deals with the numerical solution of time-dependent partial differential equations (PDEs). With these methods one computes numerical solutions on grids dynamically adapted to the solution at hand. The methods are meant for problems involving fine-scale structures that develop, propagate, decay, and/or disappear as the solution evolves. Examples include reaction zones in combustion processes, steep moving fronts in flow problems, etc. The numerical solution of these problems is difficult because the nature, location and duration of the fine-scale structures are usually not known in advance. Conventional numerical approaches that calculate solutions on a prescribed — typically uniform — grid, can readily fail to adequately resolve the fine-scale phenomena at reasonable computational costs. By a suitable adaptation of the grid, it is often



LUGR grid used in the computation of a circular wave front

possible to work with considerably less grid points and with a substantially higher degree of robustness and reliability.

With financial support from the Dutch Technology Foundation (STW), CWI started in 1987 a research project in this field. First, moving-grid methods for one-space dimensional problems (1D) were examined. These methods move the grid in a time-continuous way like in the classical Lagrangian approach. The well-known moving-finite-element (MFE) method belongs to this category. In cooperation with the Koninklijke/Shell Laboratory in Amsterdam, moving-grid software for systems of 1D time-dependent PDEs has been implemented in the existing, sophisticated Method of Lines package SPRINT (developed by Shell Research at Thornton and by the University of Leeds).

In 1989, research on methods for 2D problems has started. Attention focussed on the MFE method and on a newly developed class of so-called static-regridding methods based on the principle of local-uniform-grid-refinement (LUGR). Unlike a moving-grid method, a static-method adapts the grid only at discrete time levels. The static approach is more robust than the moving approach, in particular in multi-dimensions. So far, the research focussed on numerical analysis questions, like maintenance of stability and convergence when using LUGR.

With financial support from the Dutch National Institute of Public Health and Environmental Hygiene (RIVM), the research will be directed from January 1991 on to applying the various methods to specific flow problems arising in modelling ground water flows in porous media. This research will be carried out in close cooperation with hydrologists of the RIVM and focusses on the problem of final

disposal of hazardous waste in salt formations.

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INDUSTRIAL TRANSFER

Transputers at RAL

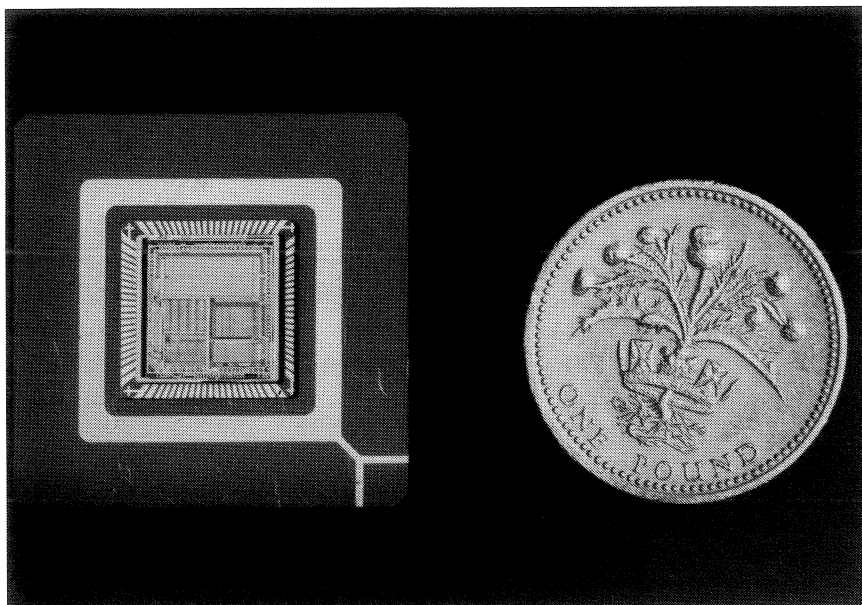
RAL — As part of the UK Transputer Initiative scheme to promote awareness of transputer technology, a transputer centre for the South East of England has been established at RAL. Indeed, the coordination team for the Initiative, jointly funded by the Science and Engineering Research Council SERC and the Department of Trade and Industry DTI, is based at the laboratory.

The transputer itself is widely used in experimental instrumentation, and for number-crunching at the laboratory. Clearly, RAL has a substantial involvement with the transputer.

The Initiative issues a monthly mailshot, full of conference information, product releases and technical papers. The Initiative organises conferences, exhibitions, workshops, community clubs for various application areas and administers a loan pool of transputer equipment for UK academic institutions.

The six regional centres, throughout the UK, run courses, provide both consultancy and technical support services, and make their on-site facilities available to both industry and academia.

The transputer is an innovative British microprocessor designed and built by Inmos (now part of SGS-Thomson). To form a parallel processing system of the



The photograph illustrates the comparative size of a T414 Transputer. To form a parallel processing system of the required power, the appropriate number of transputers have simply to be connected together

Photo: RAL photoservices

required power, the appropriate number of transputers have simply to be connected together. The barrier preventing the immediate uptake of this technology is software. Programming for this type of architecture is unfamiliar for those used to conventional serial machines because currently the software tools available are at an early stage. The aim of the Transputer Initiative (and much research) is to break down this barrier and introduce users to a new source of highly cost effective computing power.

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SIGNAL Compiler Transferred to TNI

INRIA — Since 1982, the project "Real Time Environment" conducted by Paul Le Guernic at IRISA, Rennes, has developed in cooperation with CNET (Centre National d'Etudes des Télécommunications) a synchro-

nous language called SIGNAL. This language is used for the design and implementation of real time algorithms onto multiprocessors.

In July 1990, a licence was signed between INRIA, CNET and the young company TNI (Brest) for industrialization and commercial transfer of SIGNAL. The French company Thomson is already interested to use SIGNAL in the domain of multitarget radar.

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ESTEREL Commercialized by ILOG

INRIA — In the framework of the cooperation between INRIA Sophia-Antipolis and the Ecole des Mines, a research team conducted by Gérard Berry and Gérard Boudol has developed the programming language ESTEREL. This language provides high level primitives for the programming of reactive systems. Such systems

receive signals from the environment and react synchronously by emitting other signals. ESTEREL programs compile and produce very efficient code. ESTEREL has been industrialized in the first stage by the French company CISI and is now transferred to ILOG, the INRIA subsidiary, for complementary development and commercialization.

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New Company PSIL Supports Strategic Decisions

INRIA — The two subsidiaries of INRIA, SIMULOG and ILOG, have created a new company called PSIL, specialized in supporting strategic military decisions. The dynamics of the decision systems for the different stages of a battle is modeled for information processing. This will help to evaluate under realistic conditions future tools for aiding strategic decisions. PSIL will also offer all kinds of services in the domain of numerical and symbolic simulation and control.

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New Manual for Information and Documentation

GMD — The long-awaited third edition of the standard work "Grundlagen der praktischen Information und Dokumentation" (Keystones of Practical Information and Documentation) from K.G. Saur Verlag has appeared in good time for this year's 42nd Frankfurt Book Fair. This manual - an introduction to the field of scientific and technical information - has been fully revised by the new publishing

team of Marianne Buder, Werner Rehfeld and Thomas Seeger and now comprises two volumes with a total of 1241 pages. The authors now also include Friedrich Mie, contributing an article on fact information systems, and Marlies Ockenfeld, who has written a section on classical information services. Like Werner Rehfeld, both these contributors are employed by the GMD Institute for Integrated Publication and Information Systems which deals with a wide spectrum of subjects from the field of scientific and technical information.

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Microcomputer Centre in Potsdam Opened in November

GMD — At the end of November one of the first manufacture independent information and training centres concerning Personal Computers and Workstations was opened in Potsdam, the capital of Brandenburg, one of the new states of Germany. This fast result has been achieved in a joint effort of a software company from Bonn, the IHKs (Chambers of Commerce) in Bonn and Potsdam, and the Microcomputer Centre of GMD, which has a lot of experience to contribute in this field. Potsdam has been chosen because of its town partnership with Bonn.

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GMD Exhibits at SYSTEC Fair

GMD — This year GMD went to Systec 90, the 3rd

International Trade Fair for Computer-Integrated Manufacturing, for the first time. The exhibition took place in Munich from October 22nd to 26th, 1990.

GMD presented:

- Development tools for ASICs (Application Specific Integrated Circuits); special chances for small and medium sized enterprises to get support for using these techniques
- The expert systems development tool BABYLON, which is being developed in cooperation with the software company VW-GEDAS
- the program of seminars, workshops and congresses, planned by GMD for 1991

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GMD-Programme of Events Published

GMD — The new catalog of events for 1991 is now available. It contains detailed information concerning the more than fifty seminars and courses held by GMD; about half of them are either new or have been fundamentally restructured. For the first time, workshops and scientific congresses organized by GMD have also been added, as well as additional events at the Microcomputer Centre of GMD near Birlinghoven.

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INTERNATIONAL RELATIONS

The International Computer Science Institute

GMD — The International Computer Science Institute (ICSI) is an independent, non-profit basic research institute located near the University of California campus in Berkeley, California. The ICSI was started in 1986 as a joint project of the Computer Science Division of the University of California, Berkeley (UCB) and GMD. German support of the Institute is now provided by a government-industry consortium. The "Schweizer Gesellschaft zur Förderung der Informatik und ihrer Anwendung" as well as Italy joined the sponsorship of ICSI in 1990. The Institute also receives support from a variety of U.S. sources.

Professor Jerome A. Feldman, of the Electrical Engineering and Computer Science Faculty in the College of Engineering at U.C. Berkeley, has assumed the position of Director. Professor Domenico Ferrari is Deputy Director of ICSI.

The core of ICSI's program is the intramural research effort. The International Computer Science Institute strives to maintain ongoing basic research projects of the highest standard in selected areas of computer science and engineering.

The particular areas of interest are chosen for their fundamental importance and their compatibility with the strengths of the Institute and U.C. Berkeley staff. The emphasis is on distributed and parallel computation with particular attention to massive parallelism. The four areas currently stressed are: complexity theory, realization of parallel

systems, applications to artificial intelligence and very large distributed systems.

In addition to its intramural research programs, ICSI maintains a number of other programs in support of international cooperation in advanced computer science and engineering. These include a post-doctoral program, exchange visits, summer jobs for graduate students and partial support of selected working conferences.

All of the ICSI programs place special attention on cooperation with sponsor nations. German support of the Institute is organized by a government-industry consortium. The "Verein zur Förderung der deutsch-amerikanischen Zusammenarbeit auf dem Gebiet der Informatik und ihrer Anwendungen e.V." (Association for the Promotion of German-American Cooperation in the Field of Computer Science and its Applications), was founded to bring together selected companies from different fields of industry which would also be potential applicants of the research results.

Through yearly membership fees, the Förderverein, together with the German Federal Minister of Research and Technology, each contribute about half of the funds for the research and development activities of ICSI.

On September 25, of this year, the Förderverein presented a "Review of ICSI Research Activities and Results" at the GMD, initiator and key member of this joint venture. It was the goal of this Review to make a larger number of employees of Förderverein member companies and other interested persons acquainted with ICSI research activities and to discuss these directly with scientists of the Institute.

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German-Canadian Cooperation Discussed at Workshop in Information Technology in Stuttgart

GMD — German-Canadian cooperation in science and technology should be significantly intensified and expanded. This was the proposal put forward by Canadian and German experts at the Canadian Economic Seminars held in Stuttgart from 16 - 18 October 1990. The "Workshop on Information Technology - Telecommunications and Artificial Intelligence" on 17 October was organised jointly by the Canadian Embassy and GMD.

The goal of the Canadian Economic Seminars was to demonstrate Canada's high standard of technical development, to develop business ties between Canada and the Federal Republic and to intensify German-Canadian cooperation in the field of research. "Marketplace" discussions with representatives of 50 Canadian enterprises gave German experts an opportunity to get to learn the Canadian guests at first hand. The Canadian visitors represented enterprises primarily from the fields of computer software, remote sensing, high tech, telecommunications and environmental engineering which are interested in cooperating with German undertakings.

The workshop for information technology served as a forum for sounding out the opportunities for closer collaboration in the light of new trends. During two seminars the participants were provided with first-hand information which enabled them to paint their own picture of the Canadian research and development market in such areas as information technology, telecommunications, artificial intelligence and robotics. A round-table discussion provided an opportunity to discuss technology

transfer projects. The areas here which appear to hold particular promise for joint R&D work were outlined in a podium discussion. The question of how existing instruments can be used to intensify cooperation and technology transfer in this sector was also examined.

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Scientific Relations with National Science Foundation

INRIA — INRIA and the National Science Foundation (NSF) signed an agreement in November 1987 to support the scientific collaboration between French and North-American research teams in the field of computer science. Ten different projects have been selected since 1988. The support of INRIA-NSF is aimed to cover international expenses like travels, seminars and invitations. Furthermore a high speed network connects INRIA and NSFNET. The costs are shared by both organizations.

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Cooperation Between CWI and Tata Institute of Fundamental Research

CWI — A cooperation agreement between the Tata Institute of Fundamental Research in Bombay, India, and CWI was concluded last June. The agreement covers the exchange of scientific information and publications, mutual visits of scholars, easier participation in each other's conferences, congresses, symposia, etc., exploration of possible joint research projects, and the

development and support of new directions in the field of the foundations of computer science. Until further notice the agreement is valid until December 31, 1992. During that time it provides the possibility for the exchange of 3 to 4 scientists for short visits up to one month. The possibility of participation is in principle open to all Dutch researchers in mathematics and computer science.

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Participation in New ESPRIT Projects

INRIA — INRIA will participate in 10 new ESPRIT II projects:

Project	Nr.	Coordinator	INRIA participant
REAKT	5146	Thomson-Sintra	Haton
COMPARE	5399	ACE	Jourdan
FASST	5212	Stollmann	Banatre
ROARS	5516	Thomson-Sintra ASM	Pierrel
GAZE	5390	SAGEM	Faugeras
HARNESS	5279	CAP Sesa Innovation	Shapiro
OSI95	5341	Bull SA	Huitema
AMICE	5288	CAP Sesa Belgium	Proth
COALA	5474	CAP Sesa Belgium	Proth
BECAUSE	5417	BERTIN	Dervieux

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RAL Delegation Visits CWI

CWI/RAL — A delegation of ERCIM's youngest member, the British Rutherford Appleton Laboratory (RAL), visited CWI on October 10 and 11. RAL was represented by Dr. Paul Williams (director), Prof. Bob Hopgood (head of the department of informatics), Dr. Brian Davies (head of the computing centre) and Prof. David Duce (researcher).

After general presentations of both institutions, CWI staff members presented a number of research projects to their British colleagues: formal specification methods, extensible programming methods, image analysis, computer algebra, radiosity, computer graphics hardware, parallel computing, computational aerodynamics, distributed systems and multimedia, Views, operations research, statistics, system theory, combinatorial optimization and algorithmics, and networking. The meeting, experienced by both sides as very informative, was concluded by a visit to SARA, the joint computing centre of both Amsterdam universities and CWI (twenty years ago originated from CWI as a separate institute), where Dr. Davies gave a presentation of RAL's computing centre.

SCIENCE Support for Combinatorial Optimization

CWI — In the framework of the European Commission's SCIENCE programme a grant has been allowed for three years to the project 'Algorithmic approaches to large and complex combinatorial optimization problems'. The programme's goal is to intensify scientific contacts by the exchange of researchers, the organization of workshops, etc. Participants in this project are: the universities of

Louvain, Augsburg, Grenoble (Université Joseph Fourier) and Valencia, CNR (Rome) and CWI.

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Chief Executives Meeting Between GMD and ICOT

GMD — The Executive Director of the Japanese Institute for New Generation Computer Technology (ICOT), Mr. Hiroichi Hiroshige, visited GMD on August 17, 1990, accompanied by ICOT's Department Director Takashi Kurozumi. GMD's Executive Board Chairman Prof. Gerhard Seegmüller welcomed the guests and outlined GMD's R&D guidelines.

During a Birlinghoven campus tour, the guests met with three GMD scientists who had recently worked as guest researchers with ICOT, and were briefed in detail on GMD's technology transfer and expert system group activities. This GMD-ICOT "summit meeting" underlines the well-established fruitful cooperation between both research centres. It will shortly be continued in Tokyo.

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Japanese Computer Industry Delegation Visits GMD

GMD — On September 29, 1990, GMD was honoured by the visit of a delegation of high-ranking executives of the leading Japanese computer companies NEC, Fujitsu, Hitachi, Toshiba, Mitsubishi and OKI, headed by the Japanese Parliament Advisor Tsuyoshi Yamaoka, and accompanied by representatives of industrial associations.

GMD Executive Board Member Friedrich Winkelhage outlined the present and planned R&D activities. The subsequent discussion centered on trends and perspectives of computer developments and applications.

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EVENTS

GMD Schloßtag 1990: Information and Communication Technology in Europe

GMD — Information technology and telecommunications will play a vital role in the Europe of tomorrow, not only as regards joint research efforts, but also in providing a key technical infrastructure for the Europe of the future. This statement was made by Prof. Jean Siotis, Departmental Head of Directorate General XIII of the Commission of the

European Communities in a lecture delivered at the GMD Schloßtag 1990 held in Sankt Augustin near Bonn on September, 24th. Prof. Siotis stressed that electronics in all its forms was in process of becoming the most important branch of industry in the world by the end of the century. In this context, information and communication technology is exerting a significant influence on the competitiveness of modern economies. This development had been impossible to predict in the initial years of the European Community, explained Prof. Siotis, but Europeans had risen to this challenge in the 1980s. Europeans have begun intensive collaboration in the field of high technology which extends beyond national boundaries and, over recent years, have directed their activities to achieving the goals of the European Single Market planned for 1993.

Europe's role in information and communication technology was also the subject of three further lectures delivered by the directors of the ERCIM partner establishments. Prof. Alain

Bensoussan, President of INRIA, discussed the significance for Europe of the research strategies pursued by the national information institutions. As an example of the research work, Prof. Cor Baayen, Scientific Director of CWI, discussed the importance of parallel processing in computer technology for European cooperation in the field of information technology. Prof. Gerhard Seegmüller, Chairman of the Board of GMD, looked at the improved opportunities for the future which could derive from European computer science research work.

With their some 2400 employees, 1800 of which are scientists, and a total annual budget of ECU 130 million, the four ERCIM partners represent a major source of research potential for Europe in the field of computer science and mathematics.

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TA90 — Engineering Applications of Transputers

RAL — The 2nd international conference on the engineering applications of transputers (TA90) was held in Southampton, 11-13 July, and was warmly received by both attendees and the Press. Sponsored by the SERC/DTI Transputer Initiative which is based at RAL, the conference was accompanied by the 2nd International Transputer Exhibition with over 40 companies being present. Events accompanying the conference included courses on using transputers and their use in image processing. With attendees coming from all over the world, including a Soviet delegation, and with supplier companies coming from as far away as Singapore, this was a truly international event.



Opening of the GMD-Schloßtag 1990 by Prof. Gerhard Seegmüller
Photo: Münch

The next conference in the series — TA91 — will be held in Glasgow, 28-30 August 1991, whilst the 4th will be part of a larger conference called PACTA 92 to be held in Barcelona, September 21-25 1992.

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Eurographics 90 at Montreux

RAL — Over 360 delegates from 27 countries attended the conference "Eurographics 90" at Montreux, 3-7 September 1990. Tutorial chairman Iván Herman (CWI) had prepared an excellent programme of tutorials in the form of one-day courses. The one on X/PEX programming was very well attended. Other topics included: superworkstation assessment, computer aided animation, image processing by the human visual system, 3D volume visualisation and parallel computing for graphics.

The technical programme was wide ranging, from hardware to basic algorithms. Visualisation and user interface design were prominent topics. The main interest in the standards area was PHIGS. A PHIGS toolkit was described by Hewitt et al from Manchester University. Erik Jansen (Delft University) won the best paper award for an efficient algorithm for constructing shadow volumes for objects defined with constructive solid geometry. Mike Wozny (USA) won second prize for 'Factoring a homogenous transformation for a more efficient graphics pipeline'. This paper provided an efficient solution to the display of curved surface primitives in PHIGS PLUS. Angella Scheller (GMD-Berlin)

gave a good presentation of DAPHNE. Edwin Blake (CWI) gave a state of the art report on advances in object oriented techniques for computer graphics. Dale Sutcliffe (RAL) described the ARGOSI ESPRIT project.

The next Eurographics conference will be held in Vienna from 2-6 September, 1991.

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VLDB90 — 16th International Conference on Very Large Databases

RAL — This conference took place in Brisbane, Australia, 13-16 August 1990. There were over 400 participants from 27 countries (about 230 from the host country), showing the truly international nature of this, the best conference in the advanced database field. The tutorials were: object oriented database systems (Won Kim), knowledge based databases (Kotagiri Ramamohanarao), PC-based database management systems (Dave Reiner), distributed and parallel database systems (Patrick Valduriez, INRIA), spatial databases (Hanan Samet), and federated heterogeneous databases (David Hsaio). The tutorials were good for people who were not in the front-line of academic research in the area; and encouraged delegates from industry.

The refereed papers covered the following areas of interest:

- object orientation — especially transaction control, concurrency and possible extensions of relational theory to encompass NF2 (NFNF, non-first normal form) relations;
- knowledge bases (KB) — especially constraint handling and fast

algorithms for handling transitive closure;

- distribution and parallelism — especially schema equivalencing and optimal partitioning, and with a move towards heterogeneous and federated systems;
- performance — especially in object orientation and KB systems, but still with interest in the provision of faster join algorithms for conventional relational systems;
- temporal issues — more work on temporal algebra(s), and especially links with the object orientation paradigm.

The panel session on object orientation, led by Reind van de Riet, contained a good discussion about whether the people working in the field of object orientation should develop a theory (as Codd did for relational databases) or implement systems. The general feeling was to implement systems to help understand object orientation, and that the theory would be developed at the moment of maturity.

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EASE 90 — First Annual Symposium and Exhibition on Engineering Applications: 'Is the Future Parallel?'

RAL — EASE, the Engineering Applications Support Environment has been the Science and Engineering Research Council (SERC) Engineering Board's policy for the provision of Information Technology support for its research community since 1988.

EASE 90 was the first annual symposium and exhibition held at UMIST in Manchester on 18-20 April 1990 and was organised by RAL's Informatics Department. Some 260 delegates attended.

The opening sessions, given by such speakers as David May (Inmos Ltd), John Douce (University of Warwick), Georgio Molinari (Genoa University) and Mike Brady (University of Oxford), gave a valuable overview of current directions in parallel processing, the future programme for EASE, and developments in parallel algorithms for vision and robotics. It was noted that, while hardware developments, including the transputer, appear to be progressing well, there is a need for additional effort on software development.

Several other speakers described the efforts of various Subject Committees to support engineering applications and many of the academics attending were surprised to hear John Loughhead (GEC research director and member of the Electro Mechanical Engineering Committee (EMEC)) when he indicated that there were not enough grant applications in the areas of plant analysis, simulation, design, control and monitoring.

The topics of the parallel sessions were: real time control, computational fluid dynamics, parallel languages, computer integrated manufacture, parallel libraries and tools, and benchmarking parallel architectures.

The tutorials covered the following subjects: the role of product data in engineering, exploiting the transputer, introduction to the X-Window system, data visualisation, and building engineering systems using AI techniques.

Alongside the conference, delegates had the opportunity of inspecting some of the latest developments in workstation technology with exhibits from 11 major suppliers which included

SUN, Inmos, AMT, Data General, Silicon Graphics, and Transtech.

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Workshop on Functional Analytic Methods for Structured Population Models

CWI — About 50 scientists, mainly from European countries, met in November near Utrecht, The Netherlands, for a one-week workshop on functional analytic methods for structured population models. Amongst others, the following topics were discussed:

- (general aspects of) model formulation
- numerical methods in functional analytic perspective
- linearization of non-linear problems
- open mathematical problems in the theory of evolution equations

The workshop is part of the Twinning Programme 'Evolutionary systems: deterministic and stochastic evolution equations, control theory and mathematical biology', sponsored by the SCIENCE programme of the European Commission.

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EASE 91 — Development Environments for Engineering Applications

RAL — EASE 91 is to be held at the University of Birmingham from 25-27 March 1991. The theme will be development environments for engineering applications. The provisional programme for this event includes tutorial sessions on

PHIGS+, quality assurance tools, EASE environment, developing KBS — methods and tools, X and toolkits for ordinary programmers. The keynote speakers will be C.B. Besant (Imperial College, University of London), J. Douce (chairman of computing facilities committee), M. Wozny (Rensselaer Polytechnic Institute, NY), J. Monniot (teaching company) and B.R. Martin (Head of Engineering Division, SERC).

Seminars will be held on: adding value to graphics standards, computing environments for the simulation of the environmental performance of buildings, environment, process and methods, standards work, and AI for engineers — project progress.

There will also be demonstrations of hardware and software by manufacturers.

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New Dutch National Supercomputer Facility

CWI — A new CRAY Y-MP4 supercomputer will be installed in December at SARA, the common computing centre of the two Amsterdam universities and CWI. CWI is one of SARA's founding fathers. The CRAY replaces the present CYBER 205 supercomputer, which served the Dutch 'number crunching community' for six years. The new supercomputer is purchased by the Netherlands organization for scientific research NWO. It will serve as a national research facility and will be managed by a separate foundation. As annual costs were estimated on some 15 million guilders, clearly no single university or research centre could afford such an investment.

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LICS91 — IEEE Symposium on Logic in Computer Science

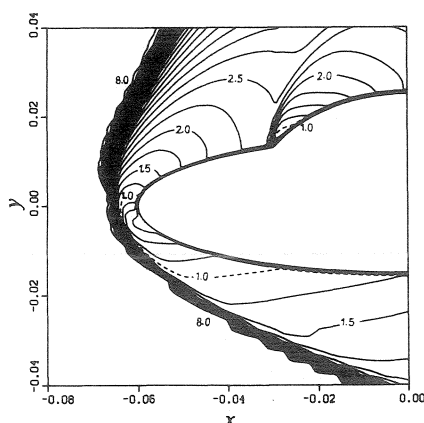
CWI/INRIA — The sixth annual IEEE symposium on logic in computer science will take place on July 15-19, 1991, in Amsterdam. The wide coverage of issues related to logic includes the algebraic, categorical and topological approaches. More specifically, suggested, but not exclusive, topics of interest include: abstract data types, automated deduction, concurrency, constructive mathematics, data base theory, finite model theory, knowledge representation, lambda and combinatory calculi, logical aspects of computational complexity, logics in artificial intelligence, logic programming, modal and temporal logics, program logic and semantics, rewrite rules, software specification, type systems, and verification.

Program chairman is Gilles Kahn (INRIA), conference co-chairmen are Roel de Vrijer (Free University Amsterdam) and Jan Willem Klop (CWI). General chairman is Albert R. Meyer (MIT). The program committee includes scientists from INRIA, GMD and CWI.

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HERMES Aerodynamics Meeting

CWI/INRIA — Some fifty European specialists in aerodynamic computations on aerospacecraft met at CWI in a two-day meeting in November. They are all involved in the development of the European space shuttle HERMES, a



Mach number distribution around a blunt forebody with canopy

cooperative effort of most member states of the European Space Agency ESA. The mathematical research in connection with HERMES is coordinated by the French aerospacecraft industry Avions Marcel Dassault - Bréguet Aviation. CWI participates in the project with its expertise in multigrid methods. INRIA is involved in turbulence modeling, compressible Navier-Stokes equations and Euler equations. These numerical solution methods can be applied quite effectively to the complicated aerodynamic models for computation of the so-called reentry flow (re-entry in the Earth's atmosphere is the most critical part of a space shuttle mission). The final design and the first construction phase of HERMES is envisaged for the first half of this decennium, and a manned mission before the end of the century.

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CONCUR Proceedings Appeared as LNCS 458

CWI — The first conference organized by the ESPRIT project CONCUR was held in Amsterdam at the end of August. With over

150 participants the conference was highly successful. In the meantime the proceedings have appeared at Springer Verlag in its series of Lecture Notes in Computer Science (nr. 458, editors J.C.M. Baeten and J.W. Klop).

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Third European Multigrid Conference with 150 Scientists from 19 Countries

GMD — The "Third European Conference on Multigrid Methods" held at the Gustav Stresemann Institute in Bonn from 1-4 October 1990 brought together more than 150 experts from 19 different countries. This international conference was arranged by GMD and was conducted under the direction of Prof. Ulrich Trottenberg, GMD and University of Cologne, and Prof. Wolfgang Hackbusch, University of Kiel.

Multigrid methods allow the "major" scientific and technical tasks of our era to be processed on computers - tasks such as climate research, meteorology, flow mechanics, elementary particle physics, protein engineering and many other sectors. Multigrid methods are able to reduce computing time - compared to conventional computation methods - by several orders of magnitude in many instances, and in some cases, by a factor of 1000, i.e. from days to minutes. It is now possible to resolve numerical tasks which were inconceivable in practice using classical methods.

Employing multigrid methods in the high-speed, parallel supercomputers which have already been developed represents a significant challenge. It was precisely this field, with its

promise of crucial breakthroughs in numerical simulation and scientific computation, which formed the pivot of interest at the Bonn conference.

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Summer School on "Petri Nets: System Design and Tools"

GMD — A summer school held at the University of Hildesheim from 2-5 August 1990 and attended by 54 participants from 30 different universities and other institutions set itself the goal of providing information on the use of Petri nets in designing systems. The event, entitled "Petri nets: system design and tools", covered a wide range of methods extending from theoretical to implemented tools. The summer school was promoted by GMD and the ESPRIT project DEMON (Design Methods Based on Nets) funded by the European Communities. It was organised by the University of Hildesheim, GMD and the Humboldt University in Berlin.

A series of main lectures dealt with the use of Petri nets for system design, and examined questions of specification and requirement, as well as programming and implementation. Implemented tools were introduced in a series of short lectures. Demonstrations of various tools on PCs and Workstations provided a practical outlook of the event.

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International Conference on Logistics of Information

GMD — From May 27 - 29, 1991 the German Society for

Information and Documentation (DGD - Deutsche Gesellschaft für Dokumentation) will hold its 6th International Conference in Garmisch-Partenkirchen, this time on the "Logistics of Information". The GMD Research Unit for the Economics of Information is coordinating the conference.

The logistics of information, in other words the optimisation of information availability and the runthrough time of information, is being increasingly recognised as a key competitive factor both in industry and the service sector. The conference will deal with basic conceptual issues from a managerial point of view, with application systems and networks, practical experience, case studies, perspectives for new services and aspects of electronic data interchange (EDI). The conference is directed at all groups in industry, services, administration, associations and research institutes who are concerned with the management and usage of information, with the development, provision or application of information services, systems and nets and with associated research matters.

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LIFE IN THE INSTITUTES

Starlink — Ten Years of Astronomical Data Analysis Facilities

RAL — Starlink is a project set up and funded by the Science and Engineering Research Council (SERC) to provide data analysis facilities for the UK astronomy research community. This year it is celebrating its 10th anniversary. It is managed by a central team at RAL and consists of about 100

networked VAX/VMS computers located at over 20 astronomy sites throughout the UK, serving about 1100 users. The VAX systems are used for the reduction and analysis of images, spectra and other data obtained from both groundbased and space observatories. As well as providing and operating computer hardware, Starlink coordinates the development of applications software, a large collection of which is distributed both within the UK and to collaborating institutions worldwide. The present budget is about two million pounds per year; there are 16 staff in the central management team at RAL, and about twice that number are employed at the university sites under contract.

Facilities such as large databases are provided, needed to meet the demands of current astronomical detectors and modern software. 2-D optical photon-counting detectors have increased in area by nearly 50 times since Starlink began, while software has become greedier (windows environments are a notorious example) and there is more of it (the application code alone now amounts to some two million lines).

As for the future, there are no obvious signs that Starlink's popularity is waning. To keep up with developments abroad, there will have to be an increase in the use and support of Unix, together with strenuous efforts to adapt the present software to run on multiple machine types. There is also interest in the provision of large-scale computing facilities at the larger nodes, and the next few years may well bring a rapid and in some respects unwelcome growth in hardware diversity compared with the VAX-only era. This will need careful management if the present excellent level of integration of the astronomical community, something Starlink

has done a great deal to bring about, is to be preserved.

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GMD Microcomputer Centre Welcomes its 10,000th Visitor

GMD — The GMD Microcomputer Centre has recently celebrated a memorable milestone. On 10th September 1990, this GMD computer advisory centre, set up in Hangelar in April 1986, welcomed its 10,000th visitor. Dr. Karlheinz Schunk, Head of the Institute for Technology Transfer, welcomed the unsuspecting visitor, Mr. Wolfgang Schramm, in the Microcomputer Centre in Sankt Augustin-Hangelar. Wolfgang Schramm is Head of the Department for Electronic Data Processing at the Kitz mechanical engineering company in Troisdorf-Bergheim. Mr. Schramm had come to the Microcomputer Centre to obtain information on the latest methods of networking personal computers. As a member of a medium-sized company, he is typical of the customers for which this GMD advisory centre was established.

The Microcomputer Centre - just one example of GMD's application-oriented activities - was set up by GMD to provide impartial advice on personal computers. The heart of the Centre is a permanent exhibition in which 16 German and international manufacturers present their latest personal computer systems and more than 100 software products. The primary objective of the Centre is to provide comprehensive information and free advice on selecting and utilising PC software solutions to small and medium-sized businesses, craftsmen, self-

employed persons, local authorities, schools and, of course, the public at large. The use of standard software - text processing, spreadsheet analysis, business graphics, databases and integrated packages - are at the forefront of this work. The Centre can be used for trying out a wide range of systems - from the MS-DOS single-user system to networked personal computers and UNIX multi-user systems.

The Centre can also offer a wide range of branch-specific applications which the visitor can try out himself, including solutions for doctors, librarians, documentors, roofers, craftsmen, freelancers, teachers/school administrators, clerks (wages, bookkeeping), secretaries etc.

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Lectures Professor Shiryayev

CWI — Professor A.N. Shiryayev (Steklov Mathematical Institute and Moscow State University) stayed for two months as a guest at CWI. He gave in September and October a series of lectures under the title 'Comparison and convergence of statistical experiments'. In particular he treated the new notion of lambda-convergence.

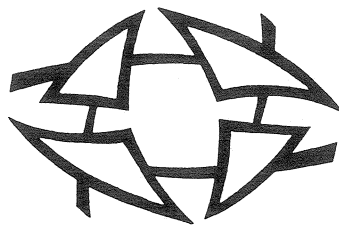
DIALOGUE — a New Project in Man-Machine Communication

INRIA — A new project conducted by Jean-Marie Pierrel has just been created at INRIA-Lorraine. DIALOGUE is a joint project with CRIN (Centre de Recherche en Informatique de Nancy), arisen from the former project SYCO managed by Jean-

Paul Haton. DIALOGUE will help to create a robust and reliable system of oral communication between man and machine by studying the mechanisms of vocal comprehension, language and dialog.

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PEOPLE



Dutch Graduate School in Systems and Control

RAL — **John P. Hulskamp**, senior lecturer at RMIT Victoria University of Technology, Melbourne, Australia and chairman of the Australian transputer and OCCAM user group, visited the UK Transputer Initiative (see article on Transputers at RAL) on a British Council travel grant. He had discussions on the working of the Transputer Initiative and on existing UK transputer-related courses (particularly on Parallel C), to help him in his decision to establish similar initiatives in Australia. While at RAL he gave a fascinating lecture which included a video of a sheep-shearing robot controlled by transputers!

INRIA — **Dr. Olivier Faugeras**, in charge of the project ROBOTVIS at INRIA Sophia-Antipolis, has been elected a senior member of IEEE (Institute of Electrical and Electronics Engineers, Inc.).

INRIA — **Dr. Gérard Berry**, in charge of the project MEIJE, carried out jointly by the Ecole des Mines and INRIA Sophia-Antipolis, received the prize "Michel Montpetit".

INRIA — **Dr. Albert Benveniste**, in charge of the project AUTOMATIQUE at INRIA Rennes, has received the "Médaille d'Argent du CNRS".

CWI — **Prof. Cor Baayen**, scientific director of CWI, celebrated in September the fact that he was appointed professor at the Free University of Amsterdam 25 years ago. A symposium was organized in his honour. Professor Baayen's specialties are topology and logic.

CWI — **Dr. Jan van Schuppen** has accepted a part-time appointment as professor at

the Dutch Graduate School in Systems and Control, administered at the University of Groningen. At present there are well over 100 of these graduate schools (about 50 receive government subsidy). The Graduate School of Systems and Control is an interuniversity cooperation. It provides regular graduate courses, colloquia and summer schools. Van Schuppen, staff member of CWI from 1978, remains leader of CWI's project on System and Control theory.

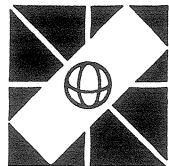
CWI/GMD — **Paul ten Hagen**, head of the department of Interactive Systems at CWI, and **Dr. Klaus Kansy** (GMD) have been elected to the Executive Committee of EUROGRAPHICS for a term of three years commencing at September 1990. **Profs. David Duce** and **Bob Hopgood** (RAL) and **Dr. Iván Herman** (CWI) are already members of this committee which reflects the strong position ERCIM-members play in the EUROGRAPHICS Association which combines some 1000 professionals working in computer graphics.

GMD — **Friedrich Winkelhage** has recently been appointed Administrative Director and Vice-Chairman of the Executive Board of Directors of GMD. Mr. Winkelhage previously was a Scientific and Technical Director of GMD.

GMD — **Dr. Karl A. Stroetmann**, senior research fellow at the GMD Research Unit for the Economics of Information

in Cologne, was elected by the General Assembly of the International Federation for Information and Documentation (FID) during its meeting on September 21 in Havana/Cuba, as councillor. He follows **Prof. Peter Canisius**, now President of the German UNESCO Commission. FID is an international non-governmental professional body for information science and documentation. It was founded in 1895 and has members in 90 countries. Its aim is to promote research in and development of information science and information management in all fields. The Council with national representatives from 18 countries is the central steering committee of the Federation.

GMD — **Dr. Thomas Hagemann** took up his duties at the GMD-Bureau Tokyo on September 1st, after his post as assistant to the directors of GMD at Birlinghoven. Before coming to GMD in 1988, he worked at the Fraunhofer Institute for Information and Data Processing in Karlsruhe. In Tokyo he will join the staff headed by **Dr. Ulrich Wattenberg**, an "Old Japan Hand" with more than 15 years of experience in Japan. Hagemann is replacing **Dr. Eckart Bierdömpel**, who will return to GMD-Birlinghoven in early 1991 after a three year stay in Tokyo. The GMD-Bureau, located in the German Cultural Center in Akasaka, Minato-ku, monitors the Japanese Informatics and Information Technology scene and serves as a liaison office for the German scientific community.



THIRD CONFERENCE ON HIGH SPEED NETWORKING

18-22 MARCH 1991

International
Congress Center
Berlin, Germany

Preliminary Program



The Conference

The 3rd Conference on High Speed Networking is dedicated to various aspects of a new engineering technology. The conference is a milestone for reviewing the state of the art at an international level and outlining future technical developments in high speed networking.

Berlin becoming the focus of Europe since the wall was opened in November 1989, will offer an exciting environment for further activities (festivals, exhibitions, entertainment).

Organization

The conference registration fee covers the admission to the technical sessions, one copy of the conference proceedings, refreshment and lunches. The fee also includes admission to a banquet held at "Museum für Verkehr und Technik". Tutorial registration covers the admission to the tutorial, tutorial text, refreshments and lunch. Rooms are blocked in different hotel categories. **Please make your hotel reservation as soon as possible**, because since the wall was opened Berlin has become a big tourist attraction.

For the final program and registration form please contact the conference secretariat:

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Tutorials (each full day) (18 - 19 March 1991)

Monday, March 18, 1991:

1. High Speed LAN / MAN / WAN Architectures
A. Danthine, Univ. Liège
2. Intelligent Networks
R. Kung, CNET

Tuesday, March 19, 1991:

3. High Speed Protocols
D. Dykeman, **M. Kalserswerth**, IBM Zurich
4. An Introduction to Multimedia Systems
W. D. Shepherd, **G. S. Blair**, **D. Hutchison**, Univ. of Lancaster

Conference Program (20 - 22 March 1991)

Wednesday, March 20, 1991:

- Session 1:** Opening Session
Invited Speaker: **P. Green**
(IBM Yorktown Heights)
- Session 2:** New Network Architectures
- Session 3:** FDDI
- Session 4:** Routing and Congestion Avoidance

Thursday, March 21, 1991:

- Session 5:** Light weight protocols
Invited Speaker: **G. Chesson** (PE I)
- Session 6:** Protocols in High Speed Environments
- Session 7:** High Speed Network and Multimedia
Invited Speaker: **A. Hopper**
(Olivetti Research Ltd.)
- Session 8:** Multimedia applications
- Session 9:** Panel: High Speed Network Integration

Friday, March 22, 1991:

- Session 10:** Broadband ISDN
Invited speaker: **M. de Prycker**
(ALCATEL-BELL)
- Session 11:** Getting connected to broadband
- 14.00-17.30 h: Visit at BERKOM (ATM/STM switches, multimedia applications, video-conferencing, joint-editing, etc.)

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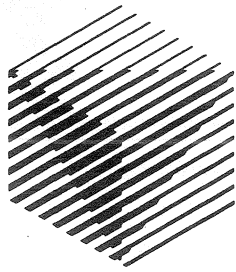
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1991-1992

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Research Themes

Software Technology
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Data Protection
Software for Parallel Systems
Image Analysis
Systems and Control Theory

Concurrency
Scientific Computation
Human Computer Interaction
VLSI Design
Symbolic Computation
High Speed Networking
Databases

Applications

- Before 1 May 1991
- Maximum age: 35
- PhD's only
- Open to Residents of European Countries
- Not open to (former) employees of ERCIM members

Information

For application forms and detailed information, contact:

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