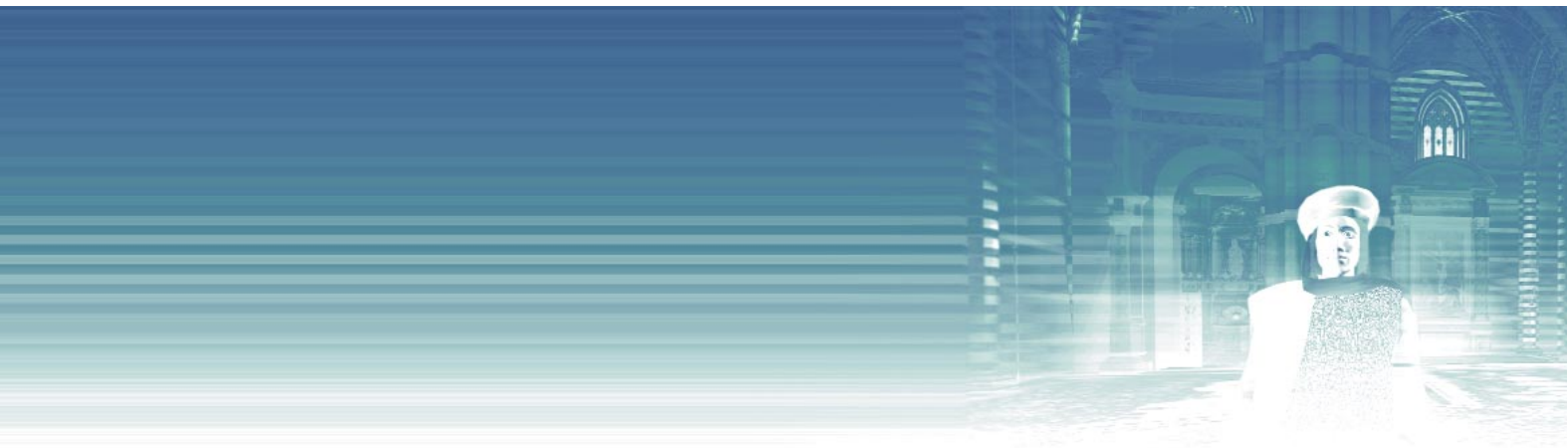




Fraunhofer Institut
Graphische
Datenverarbeitung



2000

Annual Report

Achievements and Results



Fraunhofer Institute for Computer
Graphics IGD is member of
the INI-GraphicsNet

Achievements and Results Annual Report 2000

Fraunhofer Institute for Computer Graphics IGD

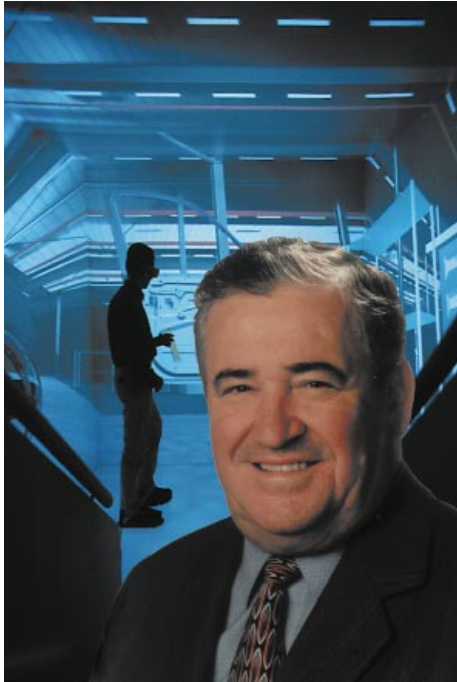


»IGD the Fraunhofer Institute for technologies and applications of visualization, interaction and communication in the field of information and communication technology«

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The development of the Fraunhofer Institute for Computer Graphics IGD was characterized by an ongoing positive trend in 2000. This year, this development was once again based on cooperation with the various institutions of INI-GraphicsNet – a cooperation which enabled the Fraunhofer IGD to react extremely quickly and flexibly to market requirements, namely by conducting an increasing number of projects by means of both national and international cooperation. This enables project teams to be made up in such a manner that customers have optimal benefit.

It is not only the successfully-conducted joint research activities of the branches of the Fraunhofer IGD which reflect this cooperation. Last year these branches further extended their significance in the INI-GraphicsNet, and they are increasingly contributing towards the budget as a whole.

These positive contributions meant that the INI-GraphicsNet – with locations in Darmstadt and Rostock (Germany), Providence (USA), Coimbra (Portugal) and Singapore – was able to further extend its international lead in the field of applied research on subjects concerning Computer Graphics. In 2000, more than 300 members of staff were employed by the network. Together with more than 450 research assistants, a budget amounting to more than Euro 36 million was generated.

Another factor contributing towards this success is the INI-SC (International Network of Institutions – Service Center), which supports the infrastructure of the individual INI-GraphicsNet locations and promotes communications between the various locations. The significance of the tasks performed by this department continued to grow last year. The functionality of the networks (the »central nervous system« of an institute which operates globally),

continues to gain in significance in view of the ever-increasing networked implementation of projects.

The close cooperation between the Fraunhofer IGD and local universities, the Technische Universität Darmstadt, the University of Rostock, the Johann Wolfgang Goethe University in Frankfurt, the Nanyang Technological University in Singapore, Brown University and the Rhode Island School of Design in Providence, is another factor which contributed towards the success achieved during the past year.

The link between the Fraunhofer IGD and the universities ensures a permanently high degree of potential for basic research, the required technological up-front tasks and an effective transfer of technology in the world of economics by means of applied R&D.

In 2000, nine PhDs were obtained and more than 40 theses were supported at the Fraunhofer IGD alone.

Close cooperation with universities in the USA is also reflected in the qualification of graduates in the fields of information science and design. The ICPNM Program, within the framework of which the fields of information technology, the media, design, marketing and management are addressed, recorded an unchanged high demand in 2000.

The ongoing development of the Fraunhofer IGD is also reflected in new appointments to leading positions. Dr. Volker Luckas took over the position of Department Head of the »Animation and Image Communication« department from Prof. Reinhard Klein, who was offered a chair at the University of Bonn. In the Rostock branch of the Institute, Jörg Voskamp was appointed new Head of the »Visualization and Interaction Techniques« department.

He replaces Dr. Erhard Berndt, who, due to the growth of the location, has become more involved in the administrative side and has assumed a coordinating function there. Furthermore, a fourth department was established in Rostock. Holger Diener assumed the post of Head of the new »Entertainment Technologies« department, which focuses on the development of innovative technologies for edutainment and entertainment systems, as well as their application in production and education. In Singapore, too, there was a change in staff in 2000. Dr. Wolfgang Müller-Wittig was appointed new Director of CAMTech, replacing Dr. Wolfgang Felger, who had most successfully headed this branch in the previous three years.

This smooth transition in management structure is also due to further education measures for the staff. These further education measures are constantly being reinforced and employees are, among other things, given a basic knowledge of economics and marketing, so that, besides their special qualifications, they are also skilled in these increasingly vital fields. The success of this strategy is, however, not only reflected among management, but also in the Fraunhofer IGD spin-off activities. By means of employee promotion, additional spin-offs could be envisaged or actually implemented. In this respect MediTEQ, among others, deserves mention. The company was hived off from the Fraunhofer CRCG. Among ideas for a spin-off currently in the planning stage are Xyberscout, Reverse Prototyping, Depot and GIStec.

The Fraunhofer IGD is also playing a major role in the projects promoted by the German Ministry of Education and Research (BMBF). In the VR/AR concept competition run last year, the Fraunhofer IGD was able to give proof of its leading position in the field of research by means of several successful illustrations of ideas. A new type of information system is being developed in the GEIST project, with elements of Digital Storytelling being linked to GIS and Augmented Reality (AR), in order to enable tourists to directly experience history. In MEDARPA, an intuitive medical AR tool is being developed to support doctors while they are providing treatment. They are able to have the necessary patient data (for example, CT or MR data) within view, so that they are directly transposed onto the patient. Among other areas, the fields of biopsies and brachytherapy are being examined as possible areas of application for this particular type of technology. In Virtual-Try-On a complete 3D simulation and visualization of diverse articles of clothing are transposed onto a virtual figure. The special feature here is the fact that this figure is a »virtual twin« of the user, drawn up by means of a 3D scan. Under the OpenSG Plus project, several of the most significant Computer Graphics groups in Germany will integrate their latest developments into the OpenSG System. This means that, by means of the OpenSG Forum supported Open-Source Initiative of the Fraunhofer IGD, they receive widespread support in the field of research in Germany.





By means of these research projects, and others as well, the Fraunhofer IGD creates a Foundation for itself, in order to be in a position to develop innovative ideas in the future too – ideas which are the basis of being able to react quickly and flexibly to changing requirements in the economy. This approach, as well as strategic cooperation with universities, is another measure undertaken by the Fraunhofer IGD in order to continue its targeted development. This means that in the future too, it will continue to be a strong partner in the field of applied research, and will be able to provide its customers with optimal support in the face of upcoming challenges.

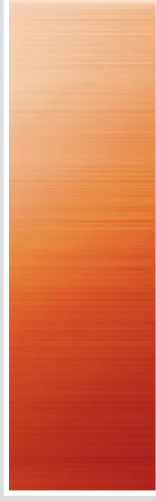


Prof. Dr.-Ing. Dr. h.c. Dr. E.h.

José L. Encarnação

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The Institute in Profile



Computer Graphics

is the technology with which pictures – in the general sense (synthetic graphics as well as greyscale and color images) – are generated or acquired, managed, displayed, and processed in an application-oriented manner by means of computers, and with which pictures are also correlated with non-graphical application data. The term »Computer Graphics« also implies the computer-aided integration and handling of these pictures synchronized with other data types; e.g., audio, text, and video (multimedia systems), and the advanced dialogue techniques associated with these data types.

Our Aims

These days it is impossible to imagine industry, trade, and the traffic and service sectors without computers. The PC's triumphal procession has not stopped at the private sector either. Today, everyone can access the World Wide Web – modern information society's global data pool – with just a computer and a tele-communications connection. But these new opportunities are also accompanied by massive usage problems caused by the continually growing capacity of computers and the explosion in the size of available data: How do I use complex software packages? How can I use computers and networks for tele-cooperation and further education? How do I find a specific item of information in this ocean of data? The Fraunhofer Institute for Computer Graphics IGD aims to help its customers in industry and business to find a solution to these everyday questions. In addition, we have now been involved in »traditional« areas, such as document imaging, CAx, animation, visualization, information systems, image processing and new technologies, such as virtual reality, augmented reality, mobile computing and digital security technologies for several years.

The rapid development of technology brings about changes in the areas of information and communication. Hardware components are getting smaller, cheaper and more efficient. New technologies and innovative applications for taking advantage of these opportunities need to be developed. The Fraunhofer Institute for Computer Graphics does exactly this within the context of industrial and contract research. Prototypes and innovative applications currently being developed in new areas include:

- Human Media Technology
- Augmented Reality
- Digital Storytelling
- Integrated, Interactive (Inter) Net Broadcasting
- Multimedia Workplaces
- Interactive Information Appliances

The Fraunhofer IGD strives to place the individual as user at the focal-point of all these areas and help simplify the task of working with computers and other individuals using computers. The simple and intuitive use of new technologies represents a key task at the Fraunhofer IGD, with individual departments approaching this task through various research and development projects.

Core Competencies and Application Areas

Core Competencies

- Agent Technology
- Animation
- Augmented Reality
- Avatars
- Computer Supported Cooperative Work (CSCW)
- Computer Vision
- Data Exchange
- Graphical Information System (GIS)
- Graphical User Interface
- Human Computer Interaction (HCI)
- Imaging
- Image Processing
- Internet, Intranet
- IT based Learning and Training
- Knowledge Management
- Mobile Computing
- Modeling
- Multi/Hyper Media
- Multimedia Databases
- Networking, Tele-communication
- Neuronal Nets and Evolutionary Algorithms
- OO-Framework and Compound Document Architecture
- Perceptual Computing
- Printing & Publishing
- Product Data Technology (PDT)
- Radiosity & Raytracing
- Secure Image Communication
- Security Technology
- Simulation
- Tele-work, Tele-cooperation, Tele-learning
- Video Computing
- Visual Computing
- Virtual Engineering
- Virtual Reality
- Visualization

Application Areas

- Automotive industry
- Architecture, interior decoration, design
- Banking and insurance business
- Biotechnology
- Air and space travel systems
- Chemical and pharmaceutical industry
- Cultural heritage
- E-Business
- Education and training
- Entertainment
- Facility management
- Marketing and advertising
- Mechanical engineering
- Medicine and medical technologies
- Microelectronics
- Mobile information systems
- Online services and new media
- Pollution control
- Print machines
- Public administration
- Publishing trade
- Ship construction
- Social and public health, support of elderly and disabled persons
- Software industry
- Tele-communications, networking and service providers
- Telematics
- Tele-work Technologies
- TV Stations
- Tourism
- Transport and Traffic

Short Portrait

The Fraunhofer Institute for Computer Graphics IGD was formed in 1992 from the Workgroup for Computer Graphics Darmstadt AGD, which was founded by the Fraunhofer-Gesellschaft in 1987. Since its Foundation the Fraunhofer IGD cooperates closely with the Technische Universität Darmstadt and the Computer Graphics Center (ZGDV), which was founded in 1984. The number of employees has increased and the expertise spectrum upgraded continuously. Besides the expansion of the institute in Darmstadt with now more than 100 employees in nine departments this has been achieved by:

- Opening of an external division in Rostock (IGD-R) in 1992,
- Foundation of the Fraunhofer Center for Research in Computer Graphics CRCG in Providence, USA in 1993,
- Foundation of the Centre for Advanced Media Technology CAMTech in Singapore in 1998,
- Foundation of the Fraunhofer Applications Center for Computer Graphics in Chemistry and Pharmaceuticals Industry AGC Frankfurt in 1999.

Through the Fraunhofer CRCG it is possible to recognize promptly new technical trends and developments in the USA and to transfer them to the European market. CAMTech ensures the representation on the important markets in Asia.

All these institutions of the Fraunhofer IGD are partners in an international network of institutions for Computer Graphics – the INI-GraphicsNet. They collaborate closely and cover the complete spectrum from basic research,



applied research and application development, up to the production and marketing of products.

The spectrum of the work conducted by the Fraunhofer IGD involves application specific basic research (i.e. algorithmic and system concepts) as well as realization of prototypes of applications and systems (hard- and software) and their adaptation to specific needs of customers. The institute contributes through its R&D-activities to establish the Computer Graphics in Germany as a technology, tool and development base and to emboss it with own products and techniques. The R&D-projects have a direct reference to current problems in industry, commerce, traffic and service.

Since its Foundation the Fraunhofer IGD has been managed by Prof. Dr.-Ing. Dr. h.c. Dr. E.h. José Luis Encarnação, who is also director of the ZGDV and holds the chair for Interactive Graphics Systems Group at the Technische Universität Darmstadt. The Fraunhofer IGD is structured as follows:

Fraunhofer Institute for Computer Graphics Darmstadt IGD with the departments:

- Integrated Publishing and eBusiness Solutions
- Industrial Applications
- Animation and Image Communication
- Visualization and Virtual Reality
- Graphic Information Systems
- E-Learning & Knowledge Management
- Cognitive Computing & Medical Imaging
- Security Technology for Graphics and Communication Systems
- Communication and Cooperation

Fraunhofer Institute for Computer Graphics, Division Rostock, IGD-R with the departments

- Multimedia Communications
- Visualization and Interaction Techniques
- Mobile Multimedia Technologies
- Entertainment Technologies

Fraunhofer Applications Center for Computer Graphics in Chemistry and Pharmaceutics Industry AGC Frankfurt am Main

Fraunhofer Center for Research in Computer Graphics, Inc. CRCG Providence/RI with the departments

- Global Visualization Services
- Collaborative Global Environments
- Digital Security Technology

Centre for Advanced Media Technology CAMTech, Singapore

INI-GraphicsNet

Together with other Computer Graphics organizations, the institutions of the Fraunhofer IGD in Darmstadt, Rostock, Frankfurt, Providence and Singapore are organized within the International Network of Institutions for advanced education, training and R&D in Computer Graphics technology, systems and applications: the INI-GraphicsNet.

Based on the technical and scientific synergy and the advantage of a global presence, the INI-GraphicsNet is a key player in the area of Computer Graphics, and information and communication technology. The Fraunhofer IGD itself plays a leading and integrating role within the network.

As well as the institutions of Fraunhofer IGD, the following institutions form the INI-GraphicsNet:

- The Computer Graphics Center (ZGDV) in Darmstadt and Rostock
- Forums associated with ZGDV
 - The Forum for the Transfer of Information- and Communication-Technologies IKTT, Erbach
 - The Forum for Information Services Mecklenburg-Vorpommern ISMV, Rostock
 - The Information and Cooperation Forum for GeoData of ZGDV e.V. InGeoForum, Darmstadt
 - The Multimedia Support Center Hessen mmsc, Darmstadt
 - The CAST Forum Competence Center for Applied Security Technology, Darmstadt
 - The INI-Graphics-Alumni Forum
- Centro de Computação Gráfica, Coimbra, Portugal

- Commercial spin-offs
 - CAPCom Technologie Beratung Entwicklung und Vertrieb AG
 - MedCom Gesellschaft für medizinische Bildverarbeitung mbH
 - MediaSec Technologies LLC
 - VRCom Gesellschaft für immersive Visualisierungslösungen mbH
 - INI-Graphics Investitions Holding GmbH

Cooperation agreements exist with the following institutions:

- Technische Universität Darmstadt, Germany
- University of Rostock, Germany
- Johann Wolfgang Goethe University Frankfurt, Germany

- Universidade do Minho, Portugal
- Brown University, Providence, RI, USA
- Rhode Island School of Design (RISD), Providence, RI, USA
- Nanyang Technological University (NTU), Singapore










With more than 300 employees and 460 research assistants, and a budget of more than DM 70 million, the INI-GraphicsNet today comprises one of the largest centers for Computer Graphics and graphical-interactive information and communication technology in the world.


On 17 June 1999 the Fraunhofer Institute for Computer Graphics IGD and the Computer Graphics Center (ZGDV)

signed a Contract of Basic Cooperation (Grundlagenvereinbarung) with T-Telematik Venture Holding GmbH (T-Venture), a 100 percent subsidiary of the Deutsche Telekom AG. The contract constitutes the promotion of spin-off activities in order to commercialize new products and systems developed by the institutions organized in the INI-GraphicsNet.

The INI-GraphicsNet institutes very efficiently transfer applied research into innovation for the benefit of the industry. To increase our contribution to innovation of products and services, the framework for applicable research and realization of the results has to be extended. This is to support the formation of young, technology-oriented,


Forums of ZGDV

-  Forum für Informations- und Kommunikationstechnologietransfer des ZGDV e.V.
-  Forum für Informations-Services in Mecklenburg-Vorpommern des ZGDV e.V.
-  InGeoForum Informations- und Kooperationsforum für Geodäten des ZGDV e.V.
-  Multimedia Support Center Hessen Forum des ZGDV e.V.
-  Competence Center for Applied Security Technology Forum des ZGDV e.V.
-  INI-Graphics-Alumni Forum des ZGDV e.V.
-  OpenSG Forum Forum des ZGDV e.V.
-  Kompetenzzentrum für Multimedia-Technologien des Landes Mecklenburg-Vorpommern Forum des ZGDV e.V.
-  Anwender- und Entwicklerforum für VR-Technologien in der Entwicklung, Konstruktion, Fertigung und im Marketing - ProVR Forum des ZGDV e.V.



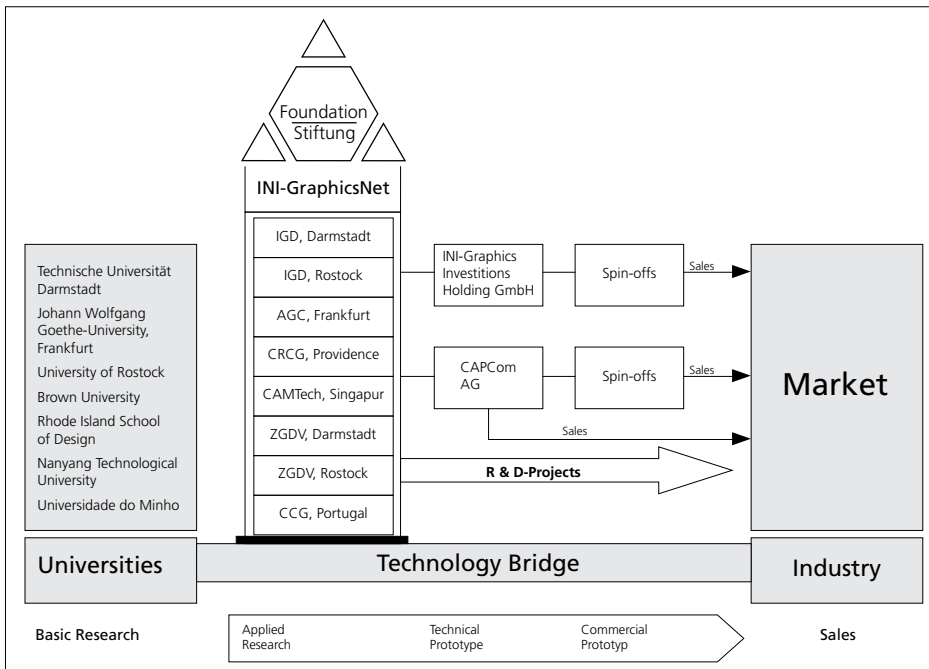
INI-GraphicsNet

INI-GraphicsNet



The International Network of Institutions
 for advanced education, training and R&D in Computer Graphics technology, systems and applications
 Germany (Darmstadt, Rostock, Frankfurt), Portugal (Coimbra), USA (Providence, RI), Singapore

Locations of the INI-GraphicsNet



Transfer of technology

expanding spin-off businesses based on new marketable products and services. With the support of external investors, young scientists will be able to start their own businesses to realize the marketing of their developed technologies. This is in direct commercial accompaniment of the activities of the INI-GraphicsNet institutes. It is also the intention that the institutes of the INI-GraphicsNet should benefit from the profit of their developed technologies, intellectual property rights and know-how.

On 17 September 1999, the INI-GraphicsNet Foundation was established and incorporated with legal standing under civil law. The purpose of the Foundation is the advancement of scientific research and development in the field of Computer Graphics (information processing). The Foundation pursues this purpose by supporting research and development institutions in the area of Computer Graphics with grants earmarked exclusively for the implementation of charitable projects. This means that resources of the Foundation are used for

- Projects of INI-GraphicsNet member institutes,
- Stability against changes in leadership and political changes,
- Continuity: harmonic development of mutual functions,
- Synergy: use of international expense and market structures in order to support the institutions,
- Consolidation: continuous dialogs for further synergy development,
- Observation of general tasks, obtaining funds e.g. for marketing and promotion, supporting software re-use in INI-GraphicsNet members,
- Increasing the innovational effect while using the same resources.

The INI-GraphicsNet Foundation is also important from a social and economic viewpoint. Because of the large number and size of individual institutes in the INI-GraphicsNet Foundation, profiled images of all activity fields are crucial, which results in a substantial contribution being made to support initiatives for innovation and employment.

The Foundation was established with assets of 374.000 DM in cash. ZGDV, Fraunhofer-Gesellschaft and Prof. Encarnação each transferred their two percent shares in the CAPCom AG to the Foundation at the end of 2000. For ongoing financing, every member of the Foundation pays one percent of its annual budget. These funds are used for increasing Foundation's assets as well as for directly carrying out the Foundation's tasks.

From these recurring funds and revenues from the Foundation's assets, several successful projects for realizing the Foundation's purposes were carried out in the last part of 1999 and in 2000. Among other things the Foundation supported the project »One-stop Shopping« and a study for an evaluation of existing document management systems. Also, comprehensive projects for increasing software re-use inside the INI-GraphicsNet and for developing global quality management were initiated. International student exchange was supported by financing a »Researcher Fellowship« at Fraunhofer CRCG and by the granting of two scholarships for taking part in the International Certificate Program for New Media. This program offers students a special qualification by combining Web design, layout and computing courses.

To promote and support the Foundation of spin-offs in the institutes of the INI-GraphicsNet, the INI-GraphicsNet Foundation formulated an extensive set of measures, i.e.:

- Realization of a qualification program, in which employees of the INI-GraphicsNet participate free of charge. They acquire basic knowledge on questions of tendering of accounts and cost computing. Potential future employers are intensively trained in creating and judging business plans and concepts.
- Creation of a network of partners, which consists of Foundation advisers, marketing agencies, market research companies and universities, which have a scientific knowledge on the subject of problems of business Foundation and -management.
- Development of an incubation concept for structuring start-up companies. In this context the INI-GraphicsNet Foundation rented some premises near the House of Computer Graphics in Darmstadt and offered them to young companies at a low price.

The activities of the INI-GraphicsNet Foundation are very important for increasing innovation and developing new markets and possibilities for acquiring financial support. The INI-GraphicsNet Foundation serves as a framework for promoting the synergetic fruits of work performed by INI-GraphicsNet member institutes. In cooperation with participating universities, the INI-GraphicsNet establishes the necessary links for the industrial use of research results. In future, the complementary role of transferring technologies will be placed increasingly in the hands of spin-off companies.



Support of Spin-offs

INI-Graphics Investitions Holding GmbH

The INI-Graphics Investitions Holding GmbH is a joint enterprise of the INI-GraphicsNet and the T-Telematik Venture Holding GmbH (T-Venture) which supports start-up businesses that are based on technologies developed in the INI-GraphicsNet regarding management, financial support and consulting. It manages a fund for the financial outfitting of start-up businesses.

The contract agrees to support spin-offs by employees of the INI-GraphicsNet founded with the goal to commercialize products developed inside the research institutions. For this purpose T-Venture provides, together with a financing consortium, 10 million DM as initial capital to finance the framework for the new business.

T-Venture further supports the cooperation by providing venture capital and management know-how for founding start-up companies while the institutions organized in the INI-GraphicsNet have the scientific know-how. By founding autonomous companies by scientific employees, a useful private industrial supply of the research institutes and their development of technologies and concepts should be

established. The INI-GraphicsNet Foundation and INI-Graphics Investitions Holding GmbH were established to support the founding of new companies.

While the Foundation is coordinating the work of the institutes involved, INI-Graphics Investitions Holding GmbH finances and supports the founding of the new companies and commercialization of technologies, know-how and patent matters of the institutes organized in INI-GraphicsNet. Partners of INI-Graphics Investitions Holding GmbH are T-Venture, INI-GraphicsNet Foundation and an employee share company. This company was founded by leading employees of the institutes organized in the INI-GraphicsNet as a German Gesellschaft bürgerlichen Rechts (INI-GbR).

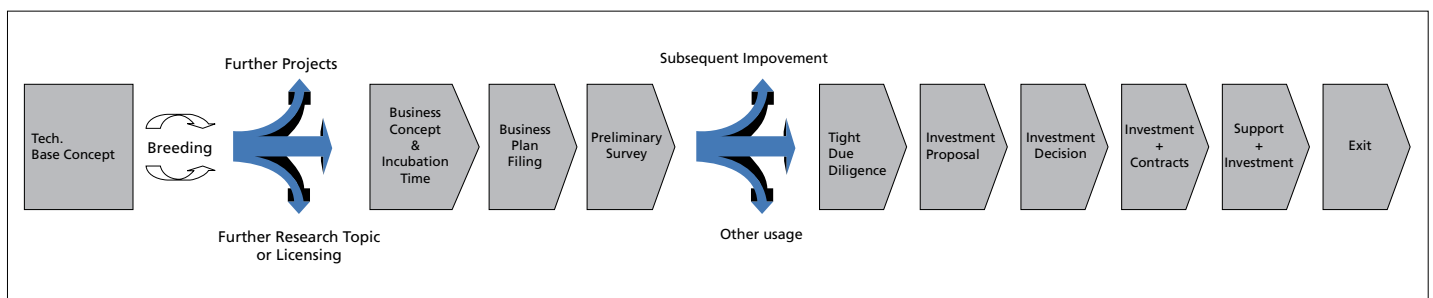
INI-GraphicsNet Foundation places great emphasis on accompanying spin-offs from the moment of conception. Most founders need help while configuring their new business, for instance because they have no one with business qualifications on their management team. INI-GraphicsNet Foundation provides support in cooperation with INI-Graphics Investitions Holding GmbH.

To enter into a contract with INI-Graphics Investitions Holding GmbH or any other reputable venture capitalist, the innovative company founders must present a business plan to satisfy professional requirements. For the first contact the presentation of a two-page preliminary Executive Summary Plan should be sufficient. The final business plan of approximately 100 pages is submitted later, outlining future concepts and technologies, marketing ideas, as well as risks and any unforeseen problems. At INI-Graphics Investitions Holding GmbH the process of this information is shown in the following picture.

This process is the basis for a decision to be made for or against participating in the company. It provides the links for successful cooperation between INI-GraphicsNet Foundation, young company founders and INI-GraphicsNet Investitions Holding GmbH led by Dr. Georg Schwegler since August 2000.

CAPCom AG

CAPCom Technologie Beratung Entwicklung und Vertrieb AG was the first INI-GraphicsNet spin-off. Founded on 1 July 1996, the corporation exists to support the market-related distribution of research and development achievements at INI-GraphicsNet institutes. CAPCom's activities focus on marketing, distribution, system integration, consulting, and holdings.



From a technological base concept to a successful exit

Marketing and distribution activities specifically target the launching of previously dormant innovative developments into the market. In the fields of system integration, CAPCom creates highly integrated, user-oriented turnkey solutions. In addition, the company provides qualified consulting and training for its innovative software products, thus providing partners and consumers with a transparent interface to their services and requirements.

**MediaSec Technologies LLC
Providence and
MediaSec GmbH Essen**

Founded in 1996, MediaSec specializes in data security issues in the multimedia sector. Its patented watermarking technology is aimed at emerging markets in enterprise content security and privacy, document authentication and integrity and E-Commerce. This innovative technology can be easily integrated or connected to other products, such as E-Commerce servers, DVD devices and digital cameras. The company's latest product, »MediaSign«, allows access authorization to be appended to documents (similar to signatures on cheques) via digital watermark encryption. The SpiderCop system has also been developed as a response to the large demand for copyright and document security on the Internet. This allows copyright violations and the correct finalising of sales contracts to be reconstructed at a later date.

MedCom GmbH

MedCom was founded in October 1997 to provide professional support to Fraunhofer IGD activities in Darmstadt in the field of medical software. MedCom's goal has been to develop »InViVo« Software to the point of commercial viability. InViVo comprises a general platform for processing medical imaging modalities such as those which result from tomographic data (CT, MR). Another project EU-TeleInViVo comprises a portable, telemedical, 3D ultrasound workstation, which allows the simple recording of 3D ultrasound data. Recorded 3D datasets can then be transferred to, for example, outlying experts for teleconsultation via the Internet.

vrcom GmbH

vrcom is the first spin-off to be realized within the framework of the cooperation between T-Venture and the Fraunhofer Institute for Computer Graphics IGD. The organization provides a broad spectrum of services such as interactive work with digital prototypes and their diverse visualization options, which can be efficiently employed in industry. vrcom sells state-of-the-art technology which has already progressed from the research to the production stage. vrcom focuses on the marketing and development of their VR-system »Virtual Design«, which was originally developed at the Fraunhofer IGD. The main area of application of this system is the creation of digital prototypes as used, for example, in the automobile industry or in virtual factory planning.

MediTEQ Inc. Providence, RI, USA

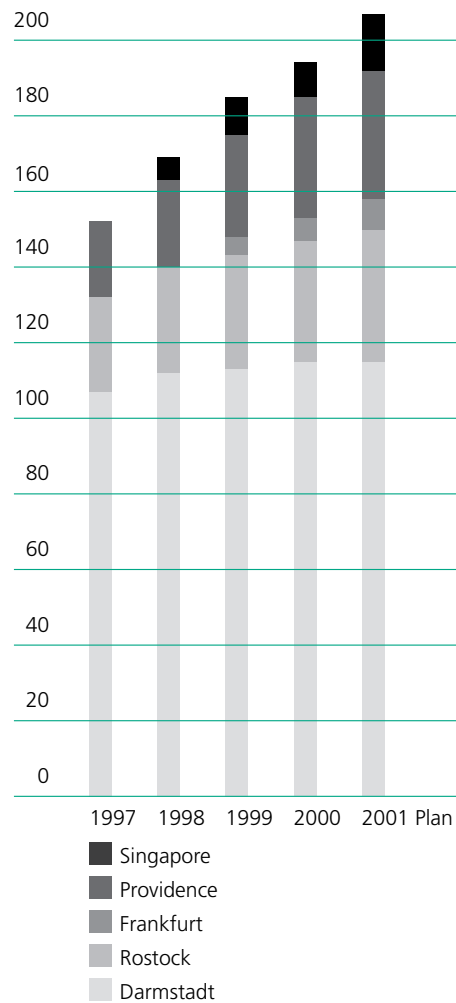
Founded in January 2000, MediTEQ is a telemedicine company whose mission is to capture, structure, and network medical multimedia for the enhancement of diagnostic medicine. MediTEQ's initial product offering includes a portable 3D ultrasound system that will play a major role in ambulatory care, ambulance services, home healthcare, disaster relief, emergency medical departments, and rural clinics, and a standalone medical imaging system with collaborative and remote 3D image access and novel visualization and navigation capabilities.



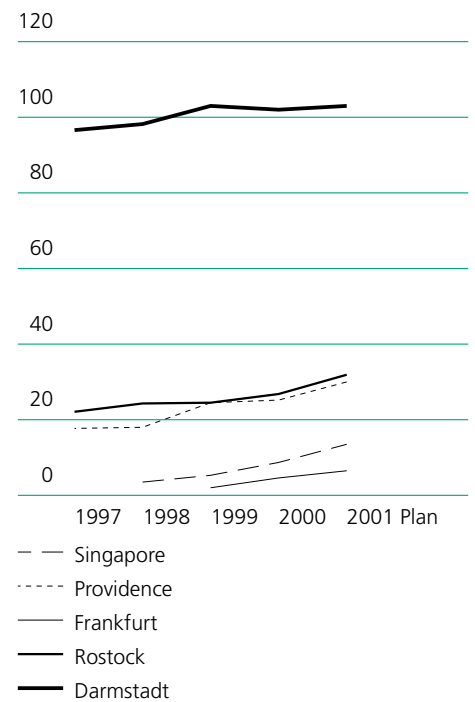
The Institute in Numbers

Also in 2000, the personnel and financial development of the Fraunhofer IGD, its institute sections and offices was characterized by growing staff contingents and increasing budgets. In total, 194 staff members were administered in Darmstadt, Rostock, Providence, Singapore and Frankfurt, resulting in a cost-effective quota of 185 staff years.

Out of these 194 staff members, 59% work at the Fraunhofer IGD Darmstadt, 16% at the Fraunhofer IGD Rostock, 16% at the Fraunhofer CRCG Providence, 5% at the CAMTech Singapore, and 3% at the Fraunhofer AGC Frankfurt.



Development of staff contingents at the Fraunhofer IGD locations

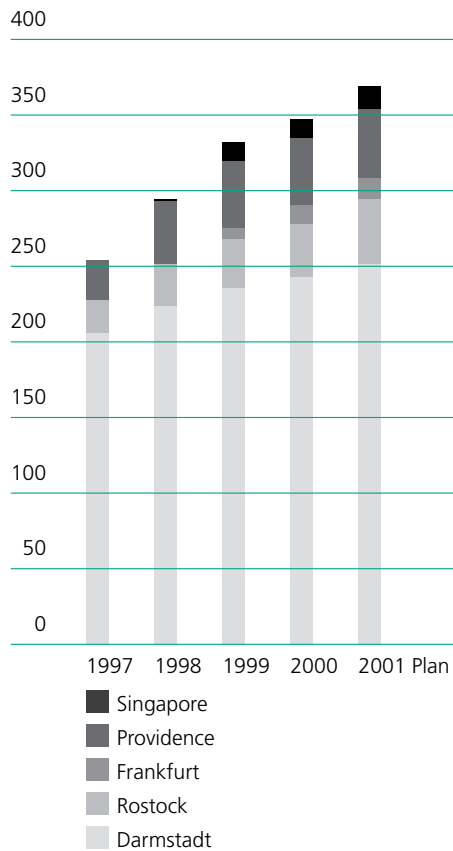


Development of cost-effective capacity

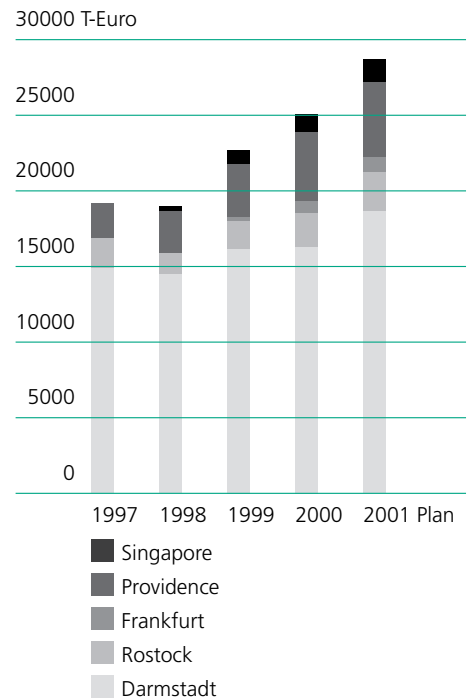
Including the employment of external staff (research assistants, student assistants, guest researchers, and trainees) at the respective institutions, a total of 543 staff members were employed in 2000.

The figures show the continuous growth of the staff contingents over the last years, as well as the expected growth for 2001. Proceeding on the plans for the year 2001, the total contingent in this financial year will grow by another 6% to a total of 576 staff members.

In 2000, the sum of all operational budgets totaled Euro 25 million. Of that, Euro 16.3 million (ca. 65%) went to the Fraunhofer IGD in Darmstadt, Euro 2.2 million (ca. 9%) to the Fraunhofer IGD in Rostock, Euro 4.6 million (ca. 18%) to the Fraunhofer CRCG in Providence, Euro 1.1 million (ca. 5%) to the CAMTech in Singapore, and Euro 0.8 million (ca. 3%) to the Fraunhofer AGC in Frankfurt. According to plan, the budgets will increase to a total of Euro 28.7 million in the year 2001.



Development of external staff contingents at the Fraunhofer IGD locations

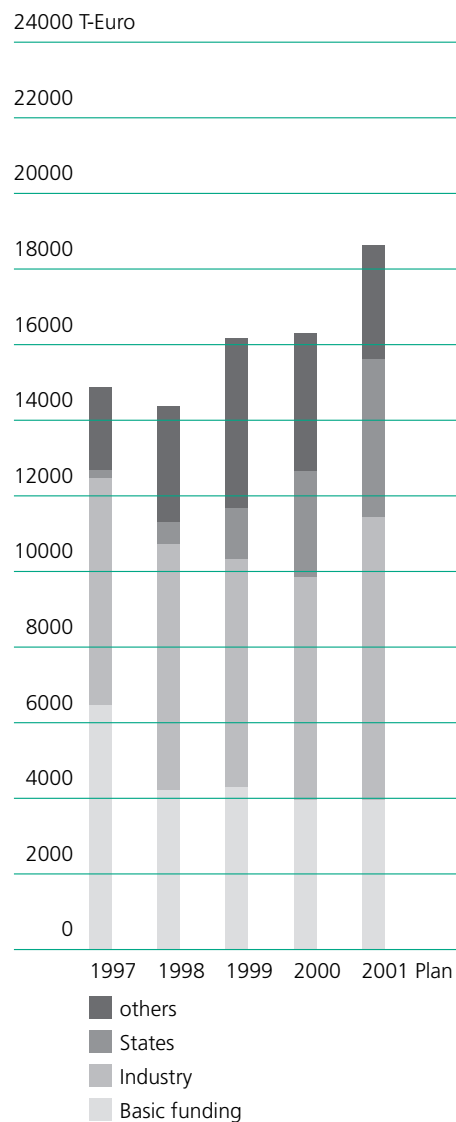


Budget development in the total budget at the Fraunhofer IGD locations

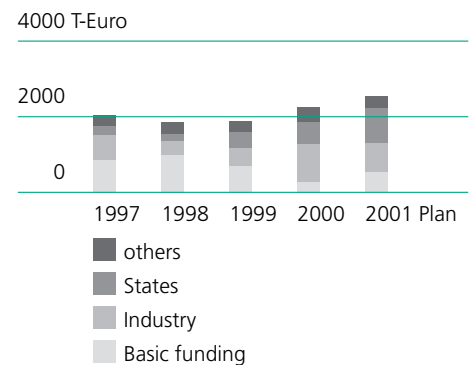


The Fraunhofer IGD in Darmstadt is financed at 53% from external revenue, 22% from institutionally funded strategic projects, and about 24% from basic funding of the Fraunhofer-Gesellschaft. The lion's share of external financing comes from industry with approximately 36% of the total budget. In addition, the profits from public projects have a great impact on financing. The main reason lies in a stronger involvement in BMBF-Lead-projects such as MAP, EMBASSI and ARVIKA. Because of the participation in the public financed GMD merger projects, a further increase is expected. Considering the time development of the financial structure, it shows that the increasing staff contingents are mainly a result of the increasing economic success of the institute.

Equally positive developments can be seen in Rostock. Since the Foundation in 1992, the budget has increased to Euro 2.2 million. Growth in personnel volumes also determines budgetary development here: in 2000, the share of the staff contingent in the operational budget was about 55%. After the first years with a mainly basic-funded organization, the share of financing from institutional support is now declining. Instead, the Fraunhofer IGD in Rostock participates in direct public project funding. Above all, Mecklenburg-Vorpommern is an important customer. In addition, the increasing share of industrial revenue also acts as an indicator for the economic relevance of the R&D activities here.



Financing structure of the Fraunhofer IGD Darmstadt



Financing structure of the Fraunhofer IGD Rostock

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Darmstadt, Germany



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The department »Integrated Publishing and eBusiness Solutions« aims at the integration of two essential areas of modern communication: Database Publishing and Electronic Business. We strive for solutions that allow the fully automated ordering, production, distribution, and billing of printed and electronic documents, including online documents, through networks, especially the Internet. In our understanding, not competition but mutual enrichment is the most important aspect of the relationship between the different media.

Additionally, we survey the actual process of print production. Due to the development of several data formats and applications, we have had a considerable share in the worldwide endeavors for standardization and implementation of Computer Integrated Manufacturing (CIM) for the Graphic Arts industry.

Other main areas of our work include computer based training and digital holography.

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The aim of the department is to support Virtual Engineering through modern Information and communication technology. The coordination, communication and cooperation of the people, products and processes involved in the product development process is the key for realizing Virtual Engineering. Main components are integration, tele-cooperation, and digital prototypes (DMUs) using high quality visualization and virtual reality techniques.

Research and development topics are:

- Innovative 3D interaction and modeling techniques in styling and design,
- New visualization techniques in Computer Aided Engineering (CAE),
- Support of tele-cooperation for distributed users and systems,
- Integration of CAx, VR and simulation through product data technology/PDM/STEP.

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Projects

- ARCADE
- ARCHE
- Architecture Visualization
- CAE/CFD-Visualization
- CAx/VR-Integration
- Cooperative Engineering
- DMU-Cabeling
- iViP – virtual testbed
- MASP
- MiroWalk
- COWORK
- OrgTech
- SmartSolids – towards parametric data exchange using STEP
- TeZeD – Teleservice Zentrum Design
- India Co-operation Large Model Viewing (LMV)
- JOST
- TransFIT
- Application research Brazil



Projects

- CASUS System
- neonCAD – Computer based design of neon luminous advertising
- Object centered navigation in virtual worlds
- OfficePlus
- ProLite 2.1
- Simplification of CAD data
- Real-time CFD visualization
- Index simulation of Head-Up Display Systems (HUD)

The main expertise of the department lies in the areas

- Intelligent User Interfaces and Multimedia
- 3D Web design and 3D Web applications
- Animation and simulation as well as in
- Visualization and Rendering.

In the area of Intelligent User Interfaces and Multimedia Animation we focus on the development of a useful »virtual secretary«. With the strong support of multimedia technology and mobile agents this system will assist the user on every days tasks in the office. Non-wimp interaction techniques and visual programming are the main topics to improve human computer interaction.

New releases of 3D catalogues are used in many application areas in the Internet. We are working on intuitive user interfaces and authoring tools to allow fast and efficient creation of 3D Web content and 3D E Commerce applications, even for novices.

In the area of animation and simulation we are focusing on object oriented frameworks and system components for 2D and 3D animation. Among the behavioral description of animation elements we support physically based modeling for realistic animation in new areas, like fluid dynamics and cloth craping Services include consulting, design and production of applications.

In the area of Visualization and Rendering we have great expertise in real-time rendering techniques using different APIs (OpenGL, Direct3D, Java3D), volume visualization techniques as well as in global illumination.

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Within the framework of applied research projects, the »Visualization and Virtual Reality« department provides technology competency and innovative solutions in the fields of:

- Scientific Visualization
- Virtual Reality
- Augmented Reality

This comprises the development of special software solutions, the integration of innovative hardware and software technologies, the prototypical realization of solutions for new application areas and consulting and concept support for innovative visualization solutions.

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Projects

- AIT-DMU-VI
- Archeoguide
- ARVIKA
- Augmented Man
- Cathedral of Siena
- CUMULI
- DMU-FS
- FEK
- iViP force-feedback-system
- JavaMAP
- LAHYSTOTRAIN
- Light simulation BMW
- RoMed
- SEF-Study Augmented Reality
- SpEnvCoat
- Urolotrainer
- Video »Hochschule Bremen«
- Virtual Articulator
- Visualization of restoration objects of the Wismut GmbH
- VISUAL-Server
- VW-Study shadows



Graphic Information Systems are computer systems integrating databases with interactive components for recording, visualizing, processing and analyzing data. These systems include, e.g. Geographic Information Systems (GIS), Facility Management Systems (FMS), or Network Documentation Systems (NDS).

Key working areas of the department are:

- GIS
- Web based Information Systems
- Geo-Information Management
- Location based Services

Within these areas, the work covers research aspects as well as services relevant to users and system suppliers, e.g.

- The development of problem solutions based on requirement analyses,
- The conception and development of WWW-GIS, as well as, Wearable-GIS solutions in different application areas,
- Data structuring and data integration,
- Analysis of existing technologies and commercial systems and

- The implementation of special solutions and/or the extension of commercial software systems.

Future developments in the field of Graphic Information Systems comprise distributed solutions for Internet/Intranet applications, information management, metadata handling and access to multimedia data stocks. Furthermore a technology transfer to further application areas such as environmental management and traffic management is due to play a major role in the future.

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Projects

- Analysis DTAG-Fachschale
- Bodeninformationssystem
- CommonGIS
- Development of a Multidata Manager
- Habitat analysis
- Immobilienatlas
- InGeo InformationCenter
- Integration of external data in Deep Map
- KogiPlan
- Metadata adaption for the Terramap server
- Stiftskirche
- Synergies in Entertainment and Production
- Wearable GIS – GEIST



The department »e-Learning & Knowledge Management« focuses on concepts, development, and implementation of e-Learning systems, the modeling and visualization of knowledge domains and the development of intelligent assistance systems. Moreover, the department runs the e-Qualification, Training and Qualification (e-LTQ) Lab, offering authoring seminars and individual consultancy in courseware development.

E-Learning

The basis is the ubiquitous access to knowledge modules, which can be shared and processed by virtual teams. The focus of the works is on the design and implementation of e-Learning systems.

e-LTQ Lab

The goal of the e-LTQ Lab is the development of generic templates and patterns for reuse in multimedia courseware development as well as the offering of authoring seminars and individual consultation in setting up and running e-Learning systems.

Knowledge Management/Knowledge Domains

This field comprises the conceptualization, modeling and implementation of knowledge domains. The work concentrates on the implementation of scenarios for the integration of knowledge utilization in teaching and training as well as in network based, knowledge based working.

Another focus of work is the development of Web based visualization components for the role-specific presentation of knowledge networks.

Intelligent Assistance

The methods of Intelligent Assistance support the user in diverse training and application situations. Based on expert systems, experience databases and agent technology, a framework will be developed which integrates different methods of assistance and supports situation-driven assistance in Web based environments.

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Projects

- CORONET
- EMBASSI
- e-Qualification Framework (e-QF)
- FhG/GMD-Knowledge Management Portal
- Fraunhofer Knowledge Network (FKN)
- INI-OSS
- Knowledge Management in the INI-GraphicsNet (INI-KM)
- Medi@Train
- Modular Training System for SGD (sgd-MTS)
- Multimedia-Werkstatt (MMW)
- Realit@ain



The department holds expertise in three different areas of scientific focus: visual computing, medical imaging, and content based image retrieval.

Visual Computing includes topics such as image processing, image segmentation and Computer vision & 3D imaging. The focus here is to create 3D models of existing objects of any size. Depending on the application, we employ either closerange photogrammetry or active sensors. Application areas include:

- architectural applications, building and terrain modeling
- CAD, reverse engineering
- »Virtual cloning« of pieces of art, museum objects, archaeological sites etc.
- creating environments for Virtual and Augmented Reality applications
- automatic reconstruction of dental inlays and crowns

In the area »*Medical Imaging*« we employ several basic technologies to support processing of medical images:

- Classical imaging of 2D & 3D medical data (volume rendering, CT, MR, PET, SPECT, nuclear medicine)
- Laser Confocal microscopy
- 3D ultrasound
- Cardiology (angiography, 3D, 4D, 5D echocardiography)
- Cancer treatment (brachytherapy, external beams, virtual simulators, medical training simulators)
- Telemedicine

Content based Image retrieval (CBIR) is enabling the indexing and search of pictorial (images) or multimedia (video) information stored in unstructured databases or the Web by analyzing the content of the information, thus not requiring manual indexing.

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Projects

- 3D Product Models
- CAMERA
- Cipress-2000
- COBWEB
- EMBASSI
- ENREVI
- GlauCAD
- LIVE@WEB.COM
- Med-SANARE
- MITTUG
- New Roentgen
- NewCOS
- PISTE
- RF-Processor
- TeleInViVo
- Virtual Simulation



The department »Security Technology in Graphics and Communication Systems« is working on the realization of security services (confidentiality, integrity, digital signature etc.) and their integration in information and communication systems.

Of special interest is the development of security mechanisms and protocols adapted to the particularities of multimedia communication and cooperation, including access control for multimedia broadcasting systems (Pay-TV, Video-on-demand, etc), copyright protection and management for multimedia data, usage of voice and face recognition for authentication, security mechanisms for multimedia, and security in electronic commerce. Current research areas include:

- Security mechanism
- Access control
- Trusted third parties
- Electronic marketing and electronic commerce
- Secure mobile agents
- Copyright protection
- Digital watermarks for multimedia data (image, video, audio, geometry)
- Biometric authentication

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Projects

- BONA FIDE – BrOket based Network Architecture for Fail-safe IPR Clearance of Digital ContEnt
- CERTIMARK – CERTification of WaterMARKing Techniques
- CIPRESS – Cryptographic Intellectual Property Rights Enforcement SyStem
- EBIZ – Electronic Business Innovationszentrum
- EMBASSI – electronic multimedia serving and service assistance
- FILIGRANE – FlexIbLe IPR for Software AGent ReliANcE
- FTC – Firewall Technology Center
- GeoMark
- MAP – Multimedia Workplace of the Future
- Online-Ticket
- SeMoA – Secure Mobile Agents
- WEDELMUSIC – Web DELivering of MUSIC Scores
- CERTIMARK
- Copyright protection VRML
- HLVA Study



Projects

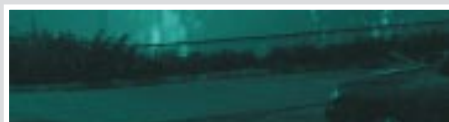
- CIPRESS – Cryptographic Intellectual Property Rights Protection SyStem
- CVE – Cooperative Virtual Environment for T-Nova
- eduPort
- Electronic Business Innovationszentrum
- Global IT based Qualifying
- Net_Quality
- OrgTech
- Roxy – Internet Live
- VMR FutureLab
- Visual Programming Environment for MAP

The department »Communication and Cooperation« provides solutions in the area of computer supported cooperative work (CSCW), groupware and communication in digital networks. Key issues are multimedia communication and user interfaces for cooperative work in distributed environments as well as agent technology.

CSCW supports and enhances the collaboration between people by improving their ability to share information with the help of computer technology. It allows communication between individuals independently of location and time. Our developments in this area improve the information flow between teams or groups and make it more flexible and efficient.

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The main objectives of research of the department »Multimedia Communication« are Internet technologies and their application.

Research and development include conception, implementation, and application of methods and tools to support the exchange of multimedia information and the multimedia communication and cooperation in global networks.

Applications focus on Open Learning Environments in the Internet and on personalized services and delegation concepts based on agent technologies.

Current research areas include:

- Multimedia information systems in the Internet
- Management systems for IT based learning and training
- Open and adaptive learning and training environments
- Integration and personalization of services and information by agents
- Cooperative applications (T.120, CORBA)

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Projects

- BABS: Business Around the Baltic Sea
- Business-MV: Agent based Services for B2B and B2C
- CMS-W3: Course Management System for WWW
- Fraunhofer Knowledge and Learning Network
- IKTUS: Internationalization of an Auction System
- Investor Portal: Internet Portal for Investors in Mecklenburg-Vorpommern
- MIS-Browser: Multiple Image Stack Browser
- MUBIS-Toolbox: Multimedia Editors for Digital Media Broadcast
- MMLK: Multimedia Concept for Mecklenburg-Vorpommern
- MV-Info: Information System of Mecklenburg-Vorpommern
- OfficePlus: Field Trial of the Multimedia Workplace of the Future
- QTOP: Qualification Project
- TeCoMed: Tele Consultation System about the Health Situation in Mecklenburg-Vorpommern
- Tele Courses for IT based Further Education
- T-Nova – Qualification



Projects

- 2D Gelelectrophoresis
- Dunhuang-EXPO
- EVRES
- Gesture based interaction
- IT-DICOM-Manager
- PDM-Backbone
- T-Nova – Qualification
- Telebuddy
- Networked Metadata-InfoSys
- VIRTUOS – Virtual Reality and Multimedia for SMEs
- xVR-proposal sketch
- your-guide.de-proposal sketch
- Zauberflöte – Online

Strategic goal of the department »Visualization and Interaction Techniques« is an independent development of technology in the fields of visualization, innovative interaction techniques and imaging. Procedures and products can be used in a broad area of application: shipbuilding, culture, architecture and town planning, education and training, administration and work with disabled and handicapped people, among others.

The department operates a special lab in order to support the application dependent development of innovative interaction techniques.

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The research works of the department include:

- Innovative interaction techniques research on the creation of application-conform user interfaces by using virtual reality interaction techniques
- Creation of virtual worlds (modeling, simulation, visualization, animation)
- Investigation into facilitating biological signals for communication
- Special solutions in imaging concentrate on 3D reconstruction
- Establishment and utilization of image data structures and image data bases



Projects

- eGuide – Electronic Exhibition Guide
- EMBASSI – Electronic Multimedia Operating and Service Assistance
- e-sist- Electronic Assistance
- MAP – Multimedia Workspace of the Future
- MOIN – Mobile System for Inventory
- MoVi – Mobile Visualization
- Telebuddy

The goal of the department »Mobile Multimedia Technologies« is the development of personal digital assistants and interactive multimedia applications utilizing mobile computing hardware and wireless networks. Main focus is the development of intelligent, situation-controlled assisting conceptions for the seamless integration of computing support in individual daily business.

The research activities concentrate on the fields of

- Development of intelligent personal assisting systems,
- Development of innovative user interfaces and operating concepts for mobile information systems,
- Offerings of solution concepts for mobile multimedia middleware,
- Sensor technology for navigation and orientation,
- Technologies and applications for intelligent appliances.

Applications are realized among others in the following fields:

- Location management systems for fairs, museums and exhibitions,
- mobile medical/clinical information systems,
- mobile facility management,
- field service, maintenance and installation,
- staff information management,
- workflow management and staff coordination.

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Projects

- SEF-Strategic Project: Presentation and data management: Multiple usage of leading-edge technologies in industry and entertainment
- 2D Gelelectrophoresis
- Optimization of gel matching and protein quantification in 2D gel electrophoresis image data

The department focuses on the development of innovative technologies for entertainment and edutainment systems as well as their transfer to applications of production or learning.

The department's main topics include

- Game based Interfaces
- Media Asset Management
- Intelligent Systems

The field »Game based Interfaces« covers development and transfer of game based concepts for the use of everyday work applications. Additionally it involves the design of system architectures and basic systems for learning and gaming environments.

The subject »Media Asset Management« concentrates on synergetic technologies for the production and entertainment industry. Concepts and solutions are developed for multiple use in different application areas based on experience and skills of both industries.

The topic »Intelligent Systems« deals with the support of users during their daily work. The usage of expert systems or neural networks in intuitive authoring tools and computer generated characters makes it possible to delegate routine tasks or complex inquiries to virtual assistants and agents.

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Fraunhofer Applications Center

for Computer Graphics in Chemistry and Pharmaceuticals AGC
Frankfurt, Germany



Projects

- 3D Beanbox
- ETOILE
- Process- and System Visualization
- Virtual Glove Box

A new knot in the INI-GraphicsNet has been constructed according to the proven model of close cooperation between a Fraunhofer institution and a university, in this case, the Johann Wolfgang Goethe-University, Frankfurt am Main.

For the first time in the INI-GraphicsNet history there is a clear orientation to a specific branch. A focus of the applications center is to adapt and specialize INI-GraphicsNet base technologies by providing individual solutions or branch solutions to our customers. Customers and Partners will have all the resources of the worldwide network available. The new Fraunhofer Applications Center offers the chemical and pharmaceutical industry a strategic partnership for the new millennium.

The Fraunhofer AGC is focussing its activities in three areas:

- E-Learning and Training: Applications in the Life Sciences
- Visualization of chemical and biochemical processes, plants and devices
- Visualization in Bio Informatics

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Fraunhofer Center

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Global Visualization Services

»Global Visualization Services« is engaged in scientific visualization with major emphasis on medical imaging modalities and informatics. Our research interests include the acquisition, display, interaction, and analysis of data and the process of information refinement whereby lower order primitives (i.e., raw data) are transformed into high-level semantic primitives (i.e., symbols).

While the major activity has been in the area of tele-medicine, significant efforts have also been made in non-medical applications, such as image data mining, non-destructive evaluation and underwater acoustics.

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Collaborative Global Environments

The »Collaborative Global Environments« focus area is dedicated to the development of networked software platforms that permit several users to jointly observe, interact with, share information, and manipulate representations of the real world to solve difficult or complex problems. While these collaborative environments vary widely in the application areas that they target, there are also a number of research problems related to the user interface, inter-process communication, and aspects of the system and network architecture that they have in common. Fraunhofer CRCG's program is focused on identifying and solving these common problems and applying those solutions to the various specific applications.

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Digital Security Technologies

»Digital Security Technologies« focuses on the research and development of innovative security technologies that enforce data confidentiality, integrity, authentication, and non-repudiation. Our main research areas include the development of mechanisms and protocols to secure mobile code for trusted use on the Internet, development of frameworks and tools for trust management in electronic commerce transactions, and development of watermarking methods for copyright protection and rights management after the secure delivery of digital media.

– *Mobile Code Security*

Our patent-pending Java bytecode obfuscation and watermarking technologies provide effective techniques for protecting mobile code from various threats, as well as protecting host computers from malicious mobile agents.

– *Trusted Electronic Commerce*

Our mobile agent based approach provides electronic transactions with strong security and new models of Internet commerce.



– *Copyright Protection and Security
Policy Enforcement*

We have developed intelligent and robust watermark technologies, and the Fraunhofer CRCG mobile agents can be used for effective content tracking, and the enforcement of copyright and security policies.

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Projects

- Web Portal Development
- TRANSFIT
- Java Trust
- Mobile Code Security
- Sensorspace Awareness
- Perivision
- Decision-Centered Visualization
- Platinum 2000
- M5 Distance Learning
- Virtual Table 2000
- MediDesk
- ALVIN



CAMTech

Fraunhofer Centre for Advanced Media Technology
Singapore



CAMTech is the joint research and development center established by the Fraunhofer Institute for Computer Graphics IGD, Darmstadt, Germany and Nanyang Technological University (NTU), Singapore. Currently, the center is located on the campus of NTU and is hosted by the School of Applied Science.

Close collaboration with the International Network of Institutions for Computer Graphics (INI-GraphicsNet) will provide instant access to years of R&D effort and leading edge technology. The center contributes to the realization of Singapore's vision of becoming a world-class hub of innovative technology with strong R&D capabilities.

CAMTech is established to conduct research and development activities in the broad technology area of advanced media. The focus is on applied R&D projects that are relevant to the immediate and future needs of Singapore and the Asian region. CAMTech's competency includes the following areas:

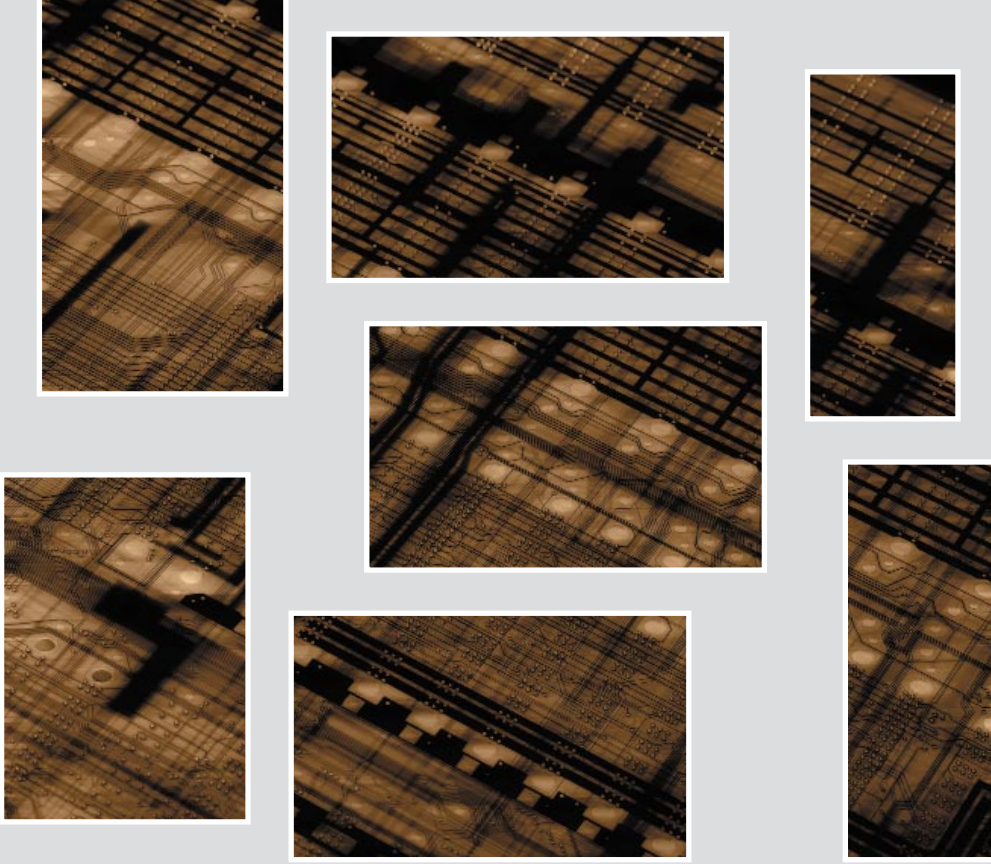
- IT in education,
- virtual prototyping,
- virtual and augmented reality,
- digital publishing,
- 3D visualization & interaction,
- animation,
- visual computing,
- multimedia,
- CSCW,
- document management & database applications, and
- digital media security.

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Projects

- Electronic Document Management for the Office of the Future
- MM Office Environment
- Unified Terrain Modeling
- Video Authoring Toolset
- Virtual Engineering
- Virtual Factory & Logistics
- Virtual Product Design & Development
- Visualization of Financial Data
- Visualization of Head and Neck Tumors



Technical Infrastructure



International Network of Institutions-Service Center

The INI-SC is a global organization jointly founded by Fraunhofer IGD, Technische Universität Darmstadt GRIS and the ZGDV. Its main purpose is to provide services such as network management, file services and management of client workstations at the locations Darmstadt, Rostock, Frankfurt, Coimbra, Providence and Singapore.

Network

In the second half of 2000 the extension of the network was in progress at Darmstadt. The concept used proved to be simply expandable and so the new components could be easily integrated. The existing network was extended by two floor distributors.

In the area of WAN the change of DFN to UUNET/Worldcom occurred at the turn of the year. In December 2000 the implementation of the 34 MBit connection should have taken place. However, this was impossible due to problems of supply by Deutsche Telekom AG. Together with MANDA network (Metropolitan Area Network Darmstadt) three providers will be available,

so that the failure of an ISP can be counterbalanced. As well as UUNET/Worldcom there are also Level3 and KPNQwest.

The INI-SC Rostock installed a new WWW proxy and cache server. At the end of the year the whole HTTP traffic will be routed over it by the multi-layer switching function of the Cisco catalyst switches, to increase the efficiency of the Internet connections. The target is to separate the traffic. Also, additional reliability has been created by the provision of another 2 MBit Internet connection via an alternative Internet service provider.

As well as the above concepts, the application of a hardware based firewall solution offers still more security. This solution, which is provided with automatic fail-safe, has been operating in Darmstadt since the end of 2000 and will also be implemented at Rostock and Frankfurt next year.

Server (UNIX)

For library retrieval, a Web front-end was provided by the INI-SC. The necessary disk space extensions were established in Rostock by a new SUN server with a hardware raid and a link to the gigabit

backbone. Thus, additional disk space could be provided to the developers. This technology was preferred to a SAN (Storage Area Network) solution, since the data accesses take place in the network via numerous computers, which are not centrally located.

In Frankfurt, the construction of the server infrastructure has been concluded. All central services are controlled by SUN Unix computers.

Personal computers (Windows)

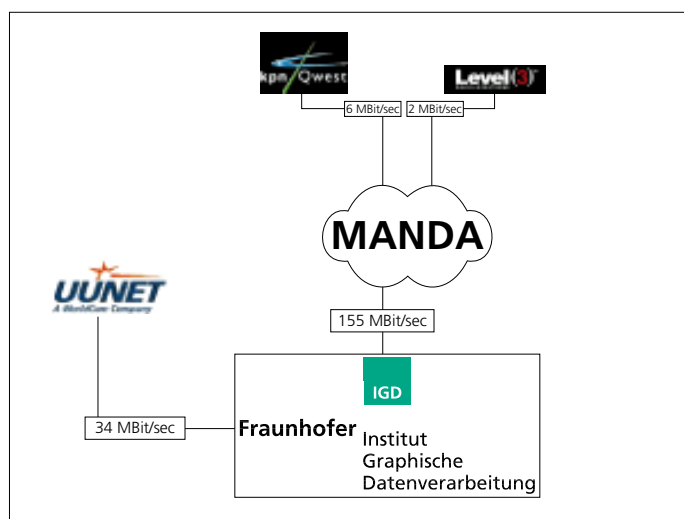
The construction of two Microsoft clusters began towards the end of 2000. In one domain ASP applications are evaluated concerning integration and functionality, in the other the introduction of the Active Directory Concept is analyzed and prepared. Thus, the path to a successful conclusion in 2001 is established.

Miscellaneous

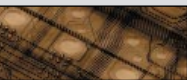
The seminar rooms in Rostock were newly furnished and mostly re-equipped with new PC technology. The reliability in the whole building has been increased by installing a central uninterruptible power supply (UPS). This became necessary because of the unstable power supply situation in Rostock.

Perspective

In the future, a close examination of the existing safety precautions will take place. This ranges from the fire protection and admission controls up to measures of the encoding of sensitive data. Due to the installation of new equipment in the building, which was completed this year, the computer infrastructure is now up-to-date. It must now maintain this high standard in the future.



WAN connection Darmstadt



INI-GraphicsNet Library

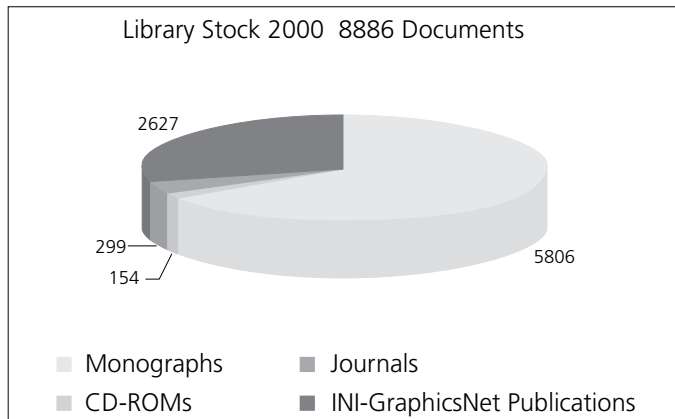
The INI-GraphicsNet Library is a joint service of Fraunhofer IGD, ZGDV and Technische Universität Darmstadt, GRIS. Its main purposes are to provide an appropriate information infrastructure, and to document all scientific publications and reports produced in the INI-GraphicsNet.

New Library Automation System

The new library automation system STAR, installed in 1999, supports document indexing as well as loan organization in a user-friendly way, and facilitates the library catalogue use for all library users. The library database is connected to the Internet, and the web-opac is accessible all over the INI-GraphicsNet Intranet. Using this interface, library users can display their user account and reserve media lent by other users.

In 2000, the library contributed to the system's further optimization by defining requirements and getting proposals accepted at STAR user meetings.

Library Stock 2000: Statistics



New Website

Since January 2000, the new library website is available in the Intranet. As it is supposed to be used by all INI-GraphicsNet members, the library developed it as a comprehensive information tool containing communication components.

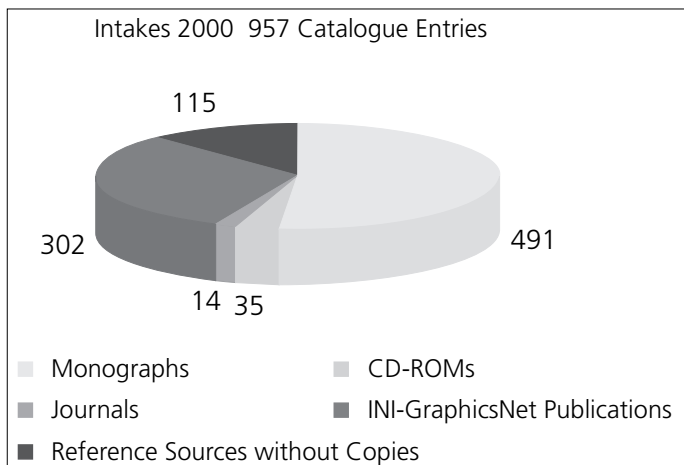
All pages are available in German and English. Therefore, employees at external divisions and non German-speaking guests can easily access the information provided.

Reorganization

In 2000, the library started a reorganization of its collections and the loan organization. The aim is to present the media collections in a clear and user-friendly way, as well as to organize charging and return of media more efficiently.

Every medium is being provided with a location mark to facilitate its retrieval on the bookshelf. A barcode label on every loan medium makes charging fast and easy.

As every book has to be handled, the library takes the opportunity to adapt the present classified shelving system to the updated ACM Classification System. With regard to its shelf location, every book is being checked, and classified to the proper section if necessary. At the end of 2000, the library had processed 1900 books in this way.



Intakes and Catalogue Entries 2000: Statistics



Furthermore, the library has transferred about 1200 books of rather historic interest to the archives. They remain recorded in the catalogue, and are available if needed.

Information service

In 2000, users borrowed 1354 media from the library. For staff members, the library ordered 113 articles and books from other libraries, and downloaded about 100 articles from digital libraries. Furthermore, the librarian performed several extensive thematic searches in databases for staff members.

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 (Intranet)

Technology Labs and Competence Centers

Darmstadt

- 3D Communication Competence Center
- Agentsheets Demo and Support Center Europe
- Communication and Cooperation Lab
- Lab for e-Learning, Qualification and Training (e-LTQ Lab)
- Demonstration, Consulting, Training Center for Multimedia Communication (MMK-Lab)
- Distributed Lab for Publishing
- E-Business Innovations Center (EBIZ)
- Firewall Technology Center (FTC)
- KADENZ – Competence and Application Development Center for Multimedia-Content-Production
- Lab for Innovative Interaction Techniques
- Lab for Mobile Applications and Interaction
- Lab for Multi-modal Communication
- Lab for Pre-Press and New Media
- Microsoft Lab
- Mobility Lab
- Office Plus Lab
- On-Demand Center
- Perceptive Computing Lab
- Showroom
- Technology and Application Center GIS/FM
- Virtual Engineering Lab
- Visual-Computing Lab
- VR Technology Lab
- Windows NT Development and Solution Center – NT Dev'n'Sol

Rostock

- Lab for Innovative Interaction Technologies
- Mobile Application and Interaction Lab
- Multimedia Communication Lab

Providence

- Fraunhofer CRCG Technology Incubator

Applications





Electronic Business

Electronic Business describes business relationships via digital electronic media between

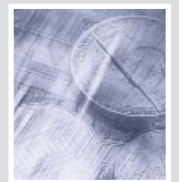
- enterprises and consumers (business-to-consumer, B2C),
- business partners (business-to-business, B2B),
- enterprises and public authorities (business-to-public authorities, B2A),
- consumers (user-to-user).

Its most important features are:

- the support of integrating cross-business procedures and
- the connection between existing and the creation of new added value chains.

Respective partners in the E-Business are: enterprises, consumers, public authorities.

Technically, E-Business is based on standards and systems of information and communication technology. This includes WWW technologies and standards, Electronic Data Interchange (EDI), GroupWare, document management, workflow management, security technologies, protection of intellectual property, payment and clearing systems, Smartcards, etc. Depending on the individual application, they can be realized either in the Internet or in Intra- or Extranets specifically designed for this purpose.



For further information refer to the thematic brochures »Electronic Commerce«

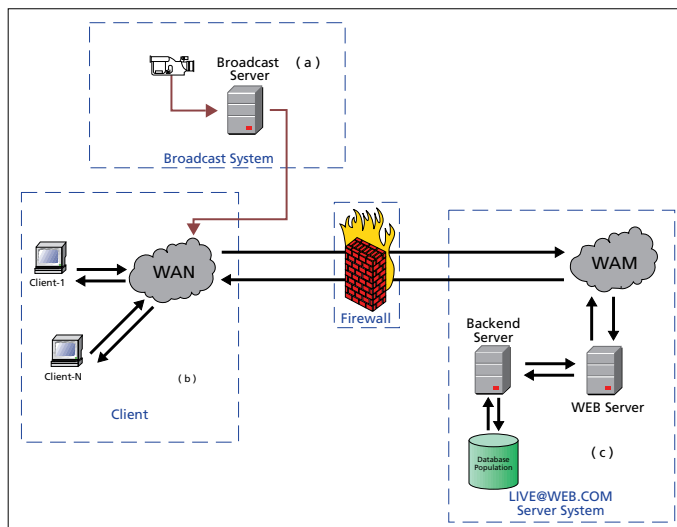


LIVE@WEB.COM

LIVE@WEB.COM allows consumers to perform on-line purchase by directly and real-time interacting with the running videos. Consumers can perform their searches and selections of products by clicking on brand names, product samples, etc. while they appear in the running video. Once selections are made, purchases can then be finalized on-line by, e.g., comparing side-by-side products, getting more information on the selected products, ordering and paying, using traditional E-Commerce techniques. LIVE@WEB.COM combines state-of-the-art technologies for interactive TV over the Web and advances in the area of image processing to create an innovative E-Commerce platform, allowing:

- Companies to promote brands and products using live TV programs broadcast over the Web. Videos can range from live transmission of, e.g., sport events (in which products and brands are advertised through, for instance, posters around a tennis court, brands on the T-shirts of soccer players, etc.), to films (where products and brands may appear in some shot), to fashion shows, to TV advertising spots.

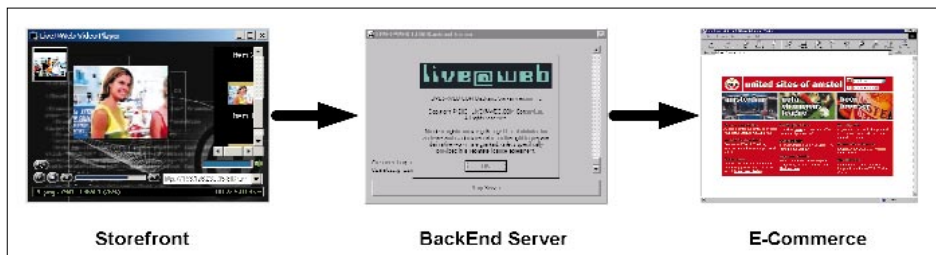
The components of the LIVE@WEB.COM system



- Consumers to perform on-line purchase by directly and real-time interacting with live TV programs broadcast over the Web. Consumers can perform selection of products and searches for information by clicking on images while they appear on the screen during program broadcasting. The system will understand the consumer's selection by comparing images extracted from the live TV programs with sample images of advertised products stored in the product database.

From a technical point of view, in order to get the above, major advances in the techniques to capture and analyze moving images are necessary. LIVE@WEB.COM is composed by three modules:

- E-Commerce Storefront enables the user/customer to interact with broadcast TV programs over the Internet, to select frames in the video and to store them for further examination, to match the relevant Web pages.
- Product Database is a database which includes images related to those products which are sold via LIVE@WEB.COM, and a URL to link to typical traditional E-Commerce systems.
- Matching Engine is the core of the system and the main task is to match images selected by the user/customer with images in the database and finally to return a relevant URL of an E-Commerce site to the customer. In order to match the images, advanced image processing techniques like histogram, wavelet, coherence, and correlogram are used.



User interface



LIVE@WEB.COM could be applied to many applications such as:

- Search through a very large database for similar videos to a sample video («query video»).
- Search a video database formulating queries using a picture painted by the user.
- Object recognition in the database: identify videos containing an object, e.g. Coca-Cola can, Pepsi can, or Adidas logo.

During the year 2000 the consortium of LIVE@WEB.COM developed a full functional system. The end-user is able to watch a video from a broadcast server in real time using the Storefront. In addition modules for add, remove and modify videos in the database have been developed. The Backend Server, which includes the Matching Engine, has already been completed and our aim is to develop sophisticated methods for matching videos.

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OnlineTicket

The conventional ways to acquire an eligibility voucher like a ticket for a cultural event are well known. Equally known are the unpleasant circumstances connected with the acquisition. Tickets ordered in advance must be collected early. If you want to buy a ticket at the box-office or the ticket-office you must queue.

For quite a time now, some organizers are presenting information about their events on the Internet. The client can get some information about current theatre performances or films. The transfer of the voucher, however, is still performed in the way described above.

The project OnlineTicket aims at using the Internet for the complete transaction. The client chooses and pays for the ticket electronically in interaction with the ticket server of the organizer. The ticket is then transmitted electronically and then makes a printout on ordinary paper to the customer's desktop printer. So the customer gets up

to date information about the event and receives the ticket instantly. The event information and the ticket-selling transaction are completed in one step. There is no more need to arrive early for collecting tickets ordered in advance or for queuing up at a ticket-office, because every customer has his own ticket office at home, his Web browser.

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Ticket purchase online



TeZeD Teleservice Zentrum Design

The project TeZeD was funded by the European ADAPT-initiative. The goal of this project was to develop an Internet based information and knowledge management system as a prototype to support industrial designers and engineers in their acquisition of information and knowledge.

Features of TeZeD are:

- Fast acquisition of important project-relevant information and knowledge,
- Knowledge acquisition during the product-development process,
- Goal-oriented search for suitable partners, customers and suppliers,
- Medium for cooperation and communication,
- Platform for offering information and services.

This Internet service that provides access to information especially adapted to the needs of designers and engineers was realized as a demonstrator.

The technological components comprise:

- The conception of the system architecture,
- The implementation of a user interface that can be accessed via the Internet,
- The realization of user-specific navigation possibilities,
- The creation of an interface to a database that was designed for the project,
- The design of an information structure and the implementation of the database as a prototype,
- The conception of Internet agents to enable user-specific queries,
- The development of security concepts.

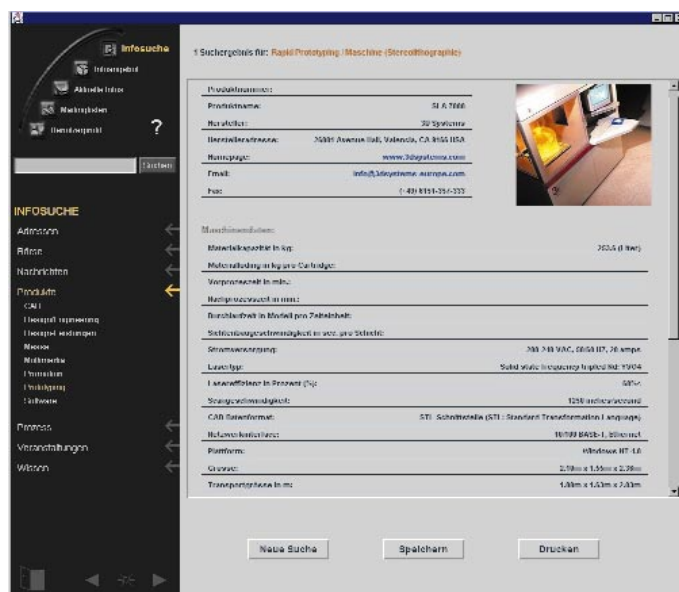
Another focus in TeZeD was the development of the TeZeD-contents. Knowledge bases, giving relevant information about design and engineering, were developed and made accessible.

The information and knowledge requirements for the design and engineering branch were analyzed. The results served as a basis for the constitution of an expert group from several design companies, rapid prototyping and model-making suppliers, design institutions and engineering associations. The object was to estimate the market potential, the acceptance and the willingness for cooperation of target group representatives as well as the economical capacity of the planned system. The systematical usage of the Internet as a source of information and its transformation into a structured network for designers and engineers is a focal point of the TeZeD concept. The participants of the expert group see this approach in a very positive way. The German engineering association »VDI« for example pointed out that the project enables a strengthening of cooperation between design and engineering. Future plans include fur-

ther technological development by using Internet, database and agent technology as well as specific but widespread knowledge from the design and engineering area to realize a prototype as a basis for the commercialization of the system.

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User interface of TeZeD with a retrieval result: A stereo lithographic machine from the category rapid prototyping products



WEDELMUSIC – WEB DELivering of MUSIC

WEDELMUSIC is an innovative idea to allow the distribution of interactive music via Internet totally respecting the publisher rights and protecting them against copyright violation. WEDELMUSIC enables publishers and consumers (theatres, orchestras, music schools, libraries, music shops, musicians) to manage interactive music in various ways. It supports preparing performances, studying music, analyzing music, learning instruments, distributing music at low cost, etc. The same music objects will be available for traditional media and Braille. These innovative features are possible thanks to the definition and implementation of:

- a unified XML based format for modeling music including audio, symbolic, image, documentformat, etc.,
- reliable mechanisms for protecting music in symbolic, image and audio formats,
- a full set of tools for building, converting, storing, distributing music on the Internet.

Business Model

The business model of WEDELMUSIC includes different parties reflecting different roles during the distribution and interaction of the music objects:

- WEDELMUSIC Server database: A server database for collecting music in WEDEL format which is located in the plant of the publisher or second-level publisher.
- Local Distributor: The Local Distributor plays the role of client towards the WEDELMUSIC Server(s), and the role of local Server on the music consumer site.

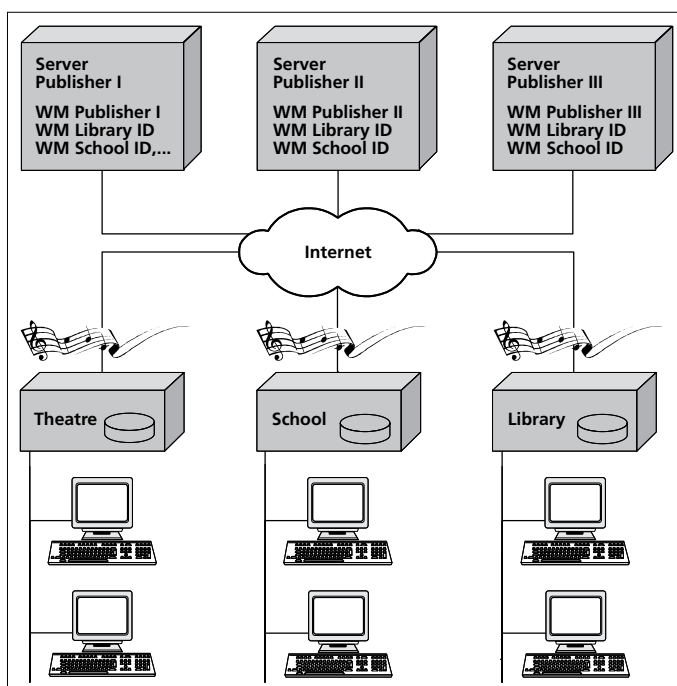
- Music editor/Music viewer and listener: Applications running on the client machines at the Local Distributor site to interact with the music in a variety of ways.

Protection Model

The available mechanisms for protecting digital objects are under continuous restructuring. Security in the context of the WEDELMUSIC project consists of two principle components. Encryption and decryption as the active component prevents the unauthorized access to the delivered data. Watermarking in turn acts as a passive component, intended to evaluate the misuse of data. Encryption, watermarking and decryption are basic security operations.

Securing the transmission of music via Cryptography

Typically, security mechanisms such as symmetric or asymmetric encryption techniques have been in use: RSA, DES, triple DES, etc., also according to cryptography regulations and laws which are defined at the European and national levels. In WEDELMUSIC project customizations for protecting images of music sheets, audio files, and music in symbolic formats will be defined. This will set up a specific solution to guarantee the protection for a number of years comparable to the duration of rights for music publishers in both symbolic and audio formats.



WedelMusic Business Model



Watermarking for IPR protection

The watermarks embedded in WEDEL-MUSIC serve different purposes:

- copyright watermarks, identifying the publisher by embedding a publisher ID code (WM Publisher I, II, III) and
- fingerprint watermarks, identifying the client by embedding a local distributor ID code (WM Library ID, WM School ID etc.).

After the specification phase during the first six months the second half of the year was mainly devoted to the research of watermarking techniques of audio files and images of music scores.

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Security Technologies

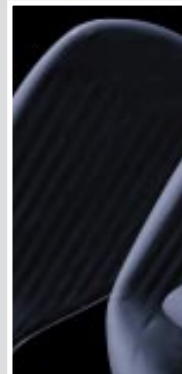
Security is preserving an important role in the Internet. Confidentiality of information and protection from unauthorized access to information as well as data protection and protection of the intellectual property have to be ensured to use the enormous potential of the Internet for industry and trade, service and utilization optimally. Unauthorized individuals or organizations should not be able to gain access to confidential data, and misuse of confidential information should be provable in case it cannot be prevented.



Of vital importance is Internet data security in the area of public service. The future citizen's online-visit of his virtual city hall has to guarantee personnel data protection, has to verify the identity of the respective citizen and the citizen's presented electronic document has to obtain legal significance.

E-Business has to ensure that the online-ordered products are paid by the client, that the paid products can only be received by the legitimate client, that the salesman does not apply a user's profile without the client's agreement, and that the protection of property and utilization rights is respected. New technologies like the agent technology open new possibilities of electronic commerce, but they also include security risks.

The ongoing digitizing of conventional media such as images, sound, and video data enables new marketing and sales channels such as the Internet. However, security problems arise especially with regard to property and utilization rights.



For further information refer to the thematic brochures »Security Technology«



CIPRESS – Cryptographic Intellectual Property Rights Enforcement SyStem

Spectacular hacker attacks directed at organizations like Microsoft, research laboratories or the Pentagon, make the headlines again and again. However, not only these well-published attacks involving viruses or Trojan horses from the Internet are dangerous, internal sources of security problems including careless or malicious employees represent a significant source of security problems, e.g. by using non-licensed software, by infiltrating viruses, misusing network access rights or stealing information or complete storage modules. Therefore an overall security concept

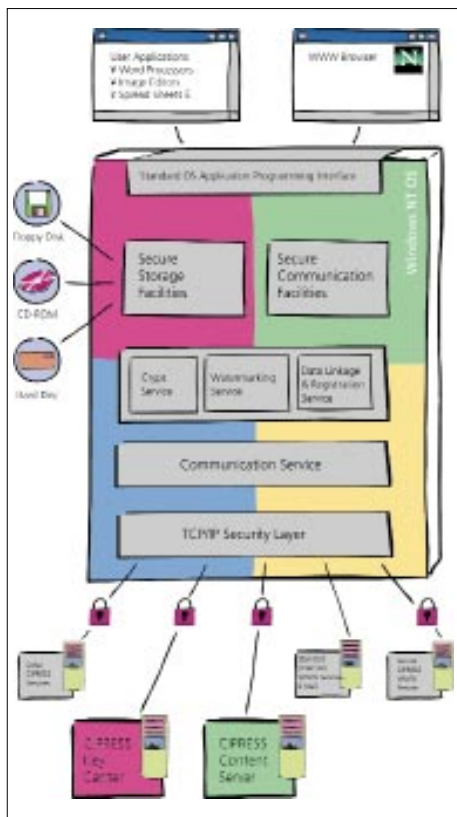
preventing the misuse of sensitive information and the violation of copy-rights – internally and externally – is required.

Flexible access and use control in a high-security environment is offered by the so-called »ReEncryption™ System«, known under the project name »CIPRESS«. This security system has been presented at the CeBIT 2001 computer fair. »CIPRESS« (Cryptographic Intellectual Property Rights Enforcement SyStem) has been developed by Fraunhofer IGD researchers on behalf of Mitsubishi Corporation, Tokyo which will offer the ReEncryption™ product commercially after CeBIT 2001. The system enforces mandatory encryption at all times while presenting a normal view of operations to users. Furthermore, security administrators can trace and control the use of data. Even illegal analog copies of digital data can be identified and the perpetrator can be prosecuted. Even theft of complete storage devices or computers does not endanger the security of sensitive data contained therein. This high security level is achieved by combining two advanced technologies: The ReEncryption™ method patented by Mitsubishi Corporation and the Digital Watermarks patented by Fraunhofer IGD are directly embedded into the operating system and can therefore provide overall security for all applications available on the operating system. The version of the system released at CeBIT 2001 supports Microsoft Windows NT 4.0. During 2000, a version supporting Microsoft Windows 2000 was created along with a number of improvements for cross-platform usability, most notably an XML/SOAP based communication mechanism for all communication between CIPRESS nodes.

User identification and authentication is handled by extending the regular operating system mechanisms for this, at the same time permitting the chaining of advanced authentication mechanisms as may be found in heterogeneous environments. All network traffic is controlled and can be encrypted transparently without users and application programs noticing. The same is true for all operations relating to file systems.

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The architecture of the CIPRESS system

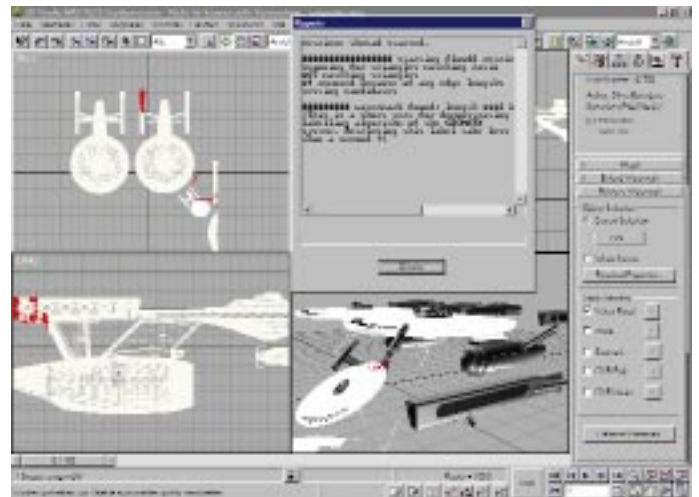


Geomark

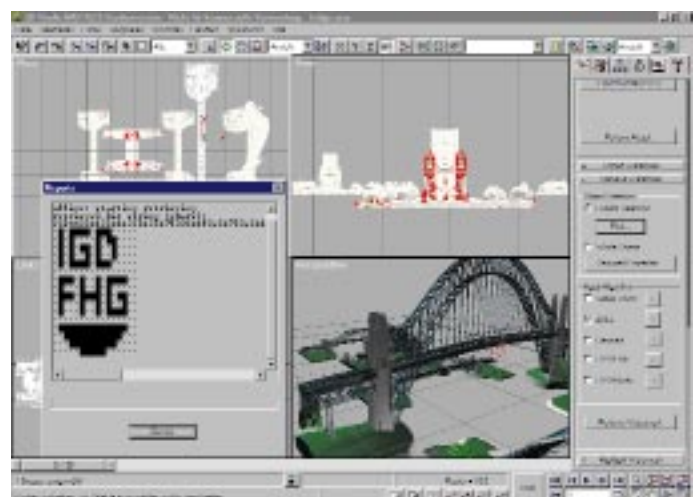
The Geomark-system provides watermarking-technology for the general applications labeling and copyright-protection of 3D models and virtual scenes in the fields of modeling, animation- and visualization. Labeling enables the embedding of additional model- and scene related information, e.g. links to related textures or render-specific information. Further applications are the embedding of version- and history-related information to support the workflow in collaborative environments, supporting automated indexing of 3D content through embedding of (symbolic) categorization information and integrity checks. In the field of copyright protection watermarks enable the following applications:

- Transmission of license information to users,
- Authentication of content,
- Tracing of copies (fingerprinting),
- Proving copyright-/ownership-claims.

Retrieval of a label with watermark-carriers (vertices) highlighted in red



Retrieval of a watermark (bitmap) from an affine transformed polygonal model





The Geomark-system is implemented as a 3D Studio MAX plugin and provides the following functionality:

- Labeling and integrity-checks of polygonal models through public readable fragile watermarks,
- Local secret and public readable watermarks for polygonal and NURBS based models with robustness against affine transformations,
- Secret watermarks robust against more complex transformations, e.g. polygonal simplification or freeform-deformation.

All algorithms are blind, which means the original model is not required in the extraction process of a watermark, and can be applied to general manifolds.

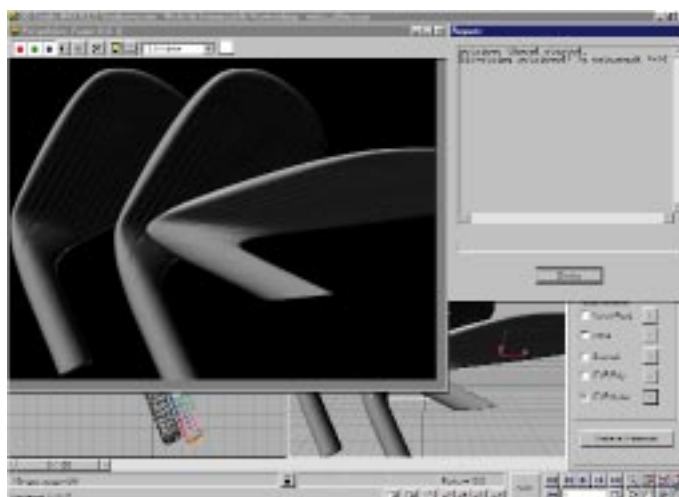
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Retrieval of a robust watermark from complex transformed models (heads from left to right: original, watermarked copy, polygon simplification, free-form deformation, fragment)



Retrieval of a watermark from an affine transformed NURBS model





Mobile Code Security

Mobile code that migrates from host to host on a computer network has advantages over the traditional client-server distributed computing model. However, mobile code may also cause severe security problems that threaten both mobile code and host computers. At Fraunhofer CRCG, as a novel solution to these security problems, our patent-pending mobile code obfuscation and watermarking technologies provide effective techniques for protecting both mobile code and host computers against various threats.

Complete Obfuscation and Code Watermarking Technologies

Code obfuscation is a technology to hide or remove symbolic information in mobile code so that a software developer's source code can be protected even if a program is decompiled. Our complete obfuscation technology can further manipulate Java system classes, which traditional obfuscation approaches cannot touch. Complete obfuscation can also greatly reduce the size of a program.

Code watermarking is a technology to embed a secure and invisible label in mobile code. Our Java bytecode watermarking techniques can embed a sensitive, »fragile watermark« into Java software and this feature can be used for authentication by easily detecting modifications of the original Java bytecode.

Benefits and Applications

Our mobile code security technologies have the following three remarkable benefits on intellectual property, network bandwidth and transaction authentication:

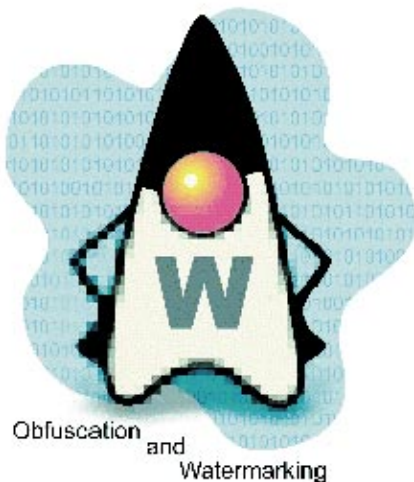
- We protect intellectual properties by hiding meaningful symbolic names. Now it is much harder for a competitor to find trade secrets in a Java software.
- By significantly reducing the size of Java programs, our technologies greatly save network bandwidth for telecomm operators and bankers.
- We support secure B2B applications using our end-to-end authentication technology. This is the security beyond secure network transmissions.

Besides these features and benefits, the cost of our technologies is very low and our technologies have excellent scalability because it is easy to integrate them with standard Internet security technologies, such as PKI and SSL.

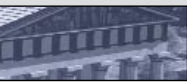
For business applications, we have identified mobile Internet, B2B applications and developer community as our initial targets, and started the commercialization process by seeking investors.

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Obfuscate and watermark a Java program



Printing & Publishing

In recent years, the new electronic media- above all the Internet – have turned out to be new challenges for the publishing industry. There is an increasing desire of customers to present their publications on paper, on CD-ROM, and on the World Wide Web in parallel. This has led to media service providers who not only produce documents for just one but also for a variety of media. The goal is to convert data – once recorded and processed – for various media with the least possible effort. This concept is known as »Cross Media Publishing«.

Technical achievements of the past include CTP (Computer-to-Plate) and digital printing. CTP has been the last building block for the complete digitization of the pre-press workflow from text and image recording through plate making. Digital printing goes one step further, carrying digitization beyond pre-press; in combination with database systems, entirely new possibilities of extensive personalization and customization of print products are created. Another trend in the Graphic Arts industry is to adopt Computer Integrated Manufacturing (CIM) for Print; i.e. to digitally connect all machines and work-stations in pre-press, press, post-press, delivery, and administration to one big network.

By means of databases and Markup Languages like SGML and XML, data can be stored and structured according to their content and dynamically compiled to up-to-date documents and customized electronic or paper publications as required. Conversely, database publishing systems enable the users of the Internet and other on-line systems to efficiently search for, retrieve, and compile very specific information.

Not competition and even rivalry but mutual enrichment is the most important aspect of the relationship between the print media and the electronic media. Our goal is to build a bridge between those media by offering solutions that combine their specific advantages.



For further information refer to the thematic brochures »Printing and Publishing«



eManual

The project »eManual« realized ideas, concepts and prototypes in the area of technical documentation. Our focus was the improvement of understandability of product documentation for end users by applying a product specific preparation of the information material. The starting point for this project was the insight that today's operating instructions are overloaded with information by the many product options and variants, which in turn makes finding the right information increasingly difficult. Methods of cross-media publishing (CMP) and document individualization are applied to generate automatically and »just-in-time« a product or user specific operating instruction for multiple output media from a common data pool.

A multi-lingual, individualized cross-media publishing system was implemented; as a demonstration of the functionality we published a part of an original operating instruction of a large automobile corporation, which was individualized to a single customer for diverse media. Potential output media are print (FrameMaker/PDF), Internet (HTML) and CD-ROM (Director). Language versions can be selected from German, English or Chinese. The CMP system is realized in a way that further applications and output media can easily be added through layout descriptions and plug-ins.

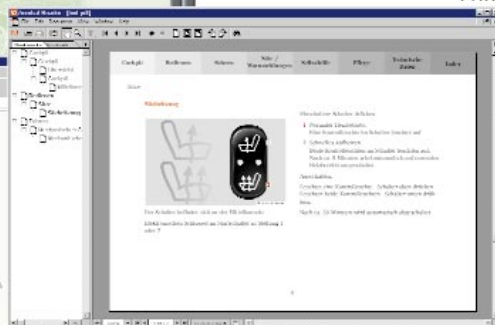
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CD/DVD-ROM



Print



Internet

Media specific versions of an instruction manual

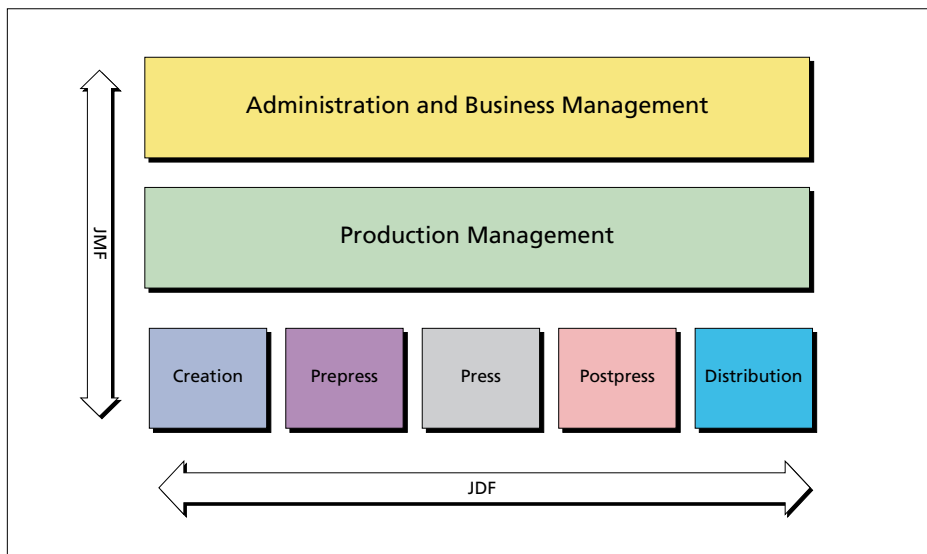


Job Definition Format

The department »Integrated Publishing and eBusiness Solutions« of the Fraunhofer IGD Darmstadt has achieved world-wide recognition in the area of automation of print production (CIM for Print) through its activities for the CIP3/CIP4 Consortium (currently more than 40 industry members, cf. www.cip4.org). The CIP3 Print Production Format (PPF), specified by the department already today has reached the status of a standard for print production to achieve high quality presetting of presses and postpress equipment.

Building on that situation four members (Adobe, Agfa, Heidelberg, MAN Roland) of the CIP3 Consortium have initiated the development of the Job Definition Formats (JDF). JDF was specified by these four companies together with our department, and it forms a significant extension of the concepts of PPF. The goal of the specification of this format, based on XML, was a continuation of the efforts to automate all processes contributing to print production.

This does not only mean calculation of preset values of specific equipment, but also the possibility to link those values to Management Information Systems (MIS) using the Job Messaging Format (JMF). JDF will also cover the whole area of workflow, so that not only the areas of print and postpress are involved, but also processes in prepress (creation, technical prepress) as well as distribution. JDF also offers extensions in the areas of press and postpress. The diagram shows how the different components will be linked in the future using this technology.



JDF in the Workflow

JDF as well as PPF will be freely available to everybody. After the aforementioned four companies have handed over the document to CIP3/4, version 1.0 of the JDF document will be published shortly. As a consequence JDF compatible products are expected to surface at the market.

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web2press

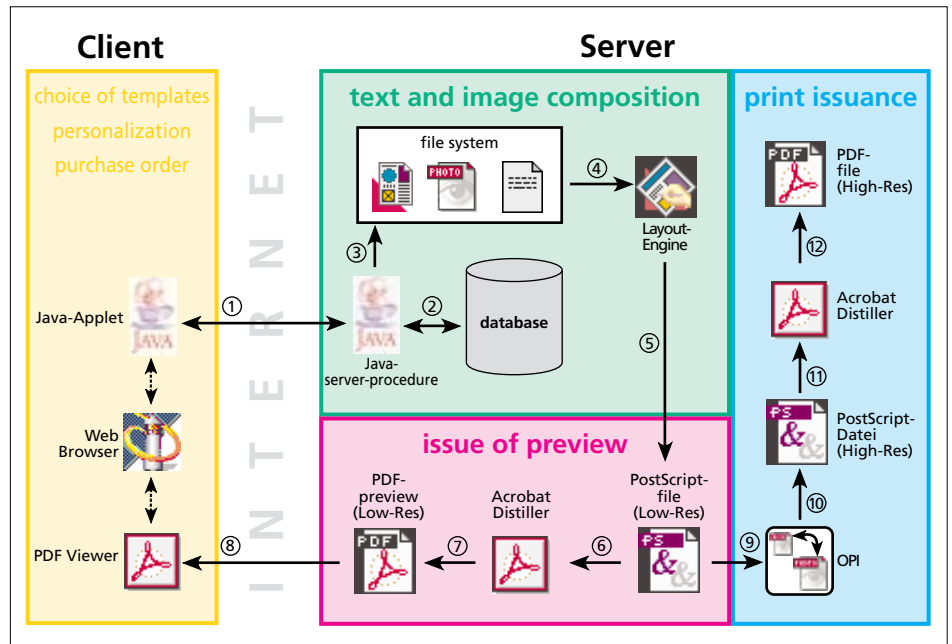


web2press, the Internet based E-Commerce system for individualizing, ordering and production of high quality printed products has been refined continually.

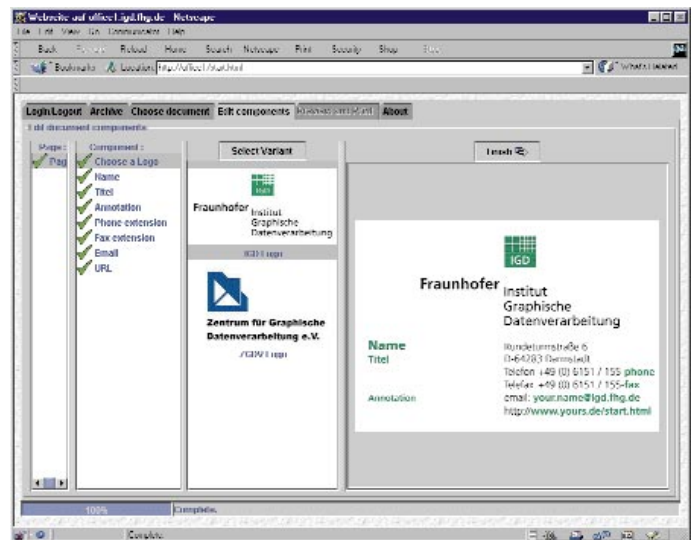
web2press allows users without know-how in print production to generate production quality files that can be processed by digital or conventional printing systems. In this process, company-specific design guidelines (corporate design) are enforced. web2press can be utilized via a user-friendly interface, that can be presented through a standard Web browser. The system can achieve an enormous reduction of production time in pre-press by reuse of information, without sacrificing quality.

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web2press: system architecture



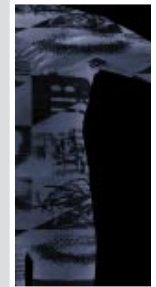
Selection of image components in web2press



Virtual and Augmented Reality

A growing complexity of data sets, process interactions and digital information environments requires new technologies in the field of data visualization and man-machine-communication. Virtual reality (VR) stands for this type of technology. The user is immersed in a computer-generated 3D data world and is able to interact with data and processes intuitively and efficiently with the help of new interaction mechanisms.

While VR technologies have established themselves for a variety of industrial applications, »Augmented Reality« describes a technological development whose breakthrough is to be expected very soon, as it shows enormous potential for practical use. The user observes a real environment through a semi-transparent display (e.g. data glasses) which augments reality with virtual representation.



For further information refer to the thematic brochures »Virtual Reality Augmented Reality«



ARVIKA – Augmented Reality for design, production and service

ARVIKA, sponsored by the German Ministry of Education and Research (BMBF) and supervised by the DLR (German Aerospace Center), uses Augmented Reality (AR) technologies to research and create a user-oriented and system-driven support of operation procedures. It focuses on the development, production, and service of complex technical products and systems. Augmented Reality technologies improve your working environment by merging real objects with computer-generated virtual objects to allow for detailed engineering and processing instructions.

The project ideas are realized in various application areas of German industry, such as automobile manufacture and aircraft construction, mechanical engineering and system development. Particularly mid-sized enterprises can use these technologies to improve and facilitate analysis and maintenance operations to become more efficient and flexible in the global business competition.

The main application-related topics of ARVIKA aim to verify Augmented Reality in the development, production and service cycles of the products being used. This also includes the service of the machines and systems required for the production environment. The scheduled project concentrates on the following areas: development (automobile and aircraft), production (automobile manufacture and aircraft construction), service (system techniques, in this case power stations and the tools and machines required for the production). This covers the major application areas of AR, avoids duplicate developments, and enables a profound, application-oriented verification of this novel technique. The project phases go along with user-centered system design that is based on scientific methods.

All applications in this research are based on AR base technologies supporting both the high-end/power applications in the development process and the low-end activity of the skilled worker using belt-worn equipment in the real production and service environment. This is realized by an open platform that allows for different performance grades and especially for true wearability. This project is geared

to support market requirements in production, manufacturing, and service-oriented information and communication technologies to be used by skilled workers, technicians and engineers. The whole project will comprise of four years (7/1999 - 6/2003) and is divided into two parts. For each part of the project, prototypes will be provided.

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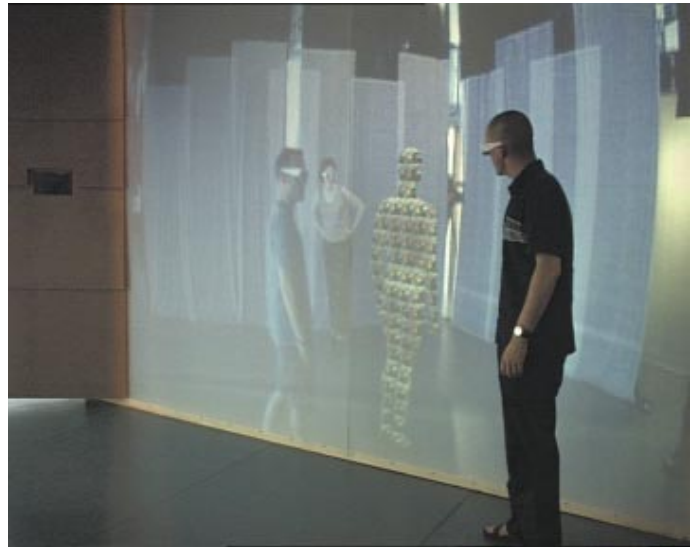
Image based tracking with markers (e.g. service)



Augmented Man

»Augmented Man« presents a vision of a new media technology, blending real and virtual world and has been developed in the context of an artistic exhibition. The audience enters the installation room of about 6x6 meters that contains a big projection screen of 4x3 meters on one side. Two stereo cameras close to the projection screen record the scene at eye level. A third camera at the ceiling analyses the position of the visitors from above. The images of the stereo cameras are projected in a stereoscopic view. The visitor sees himself like in a 3D mirror but with a new virtual person – the »Augmented Man« – walking at his side.

The installation of
»Augmented Man«

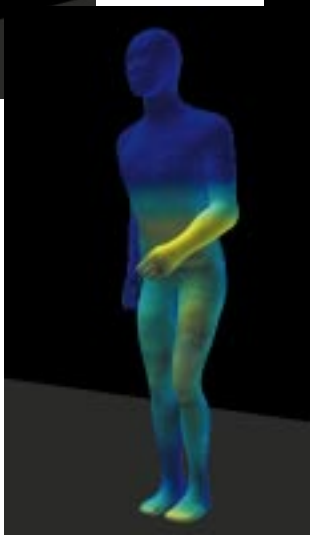
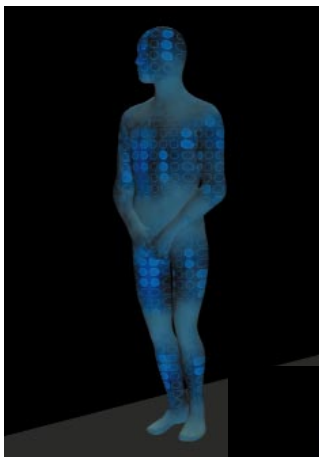


The »Augmented Man« reacts to the real people on the video screen by possessing a repertoire of predefined behaviors. He tries to find a path through the room, avoiding collisions with visitors and walls. Textures are selected at random intervals, postures are activated when the »Augmented Man« has approached a visitor. Thus, the visitor meets a virtual man, who seems to have emotions and who tries to get in contact by talking and asking questions.

The »Augmented Man« has been implemented in cooperation with the Institute of Media Design and Media Technology at the University of Applied Sciences Wiesbaden and has been presented at the exhibition »Gutenberg 2000« in Mainz.

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Postures of
»Augmented Man«



Cx/VR Integration

Tools to support DMU and Virtual Prototyping processes

In 2000 the realization of tools to improve the integration of VR-systems into the product development processes/chains was one of the core activities of the department »Industrial Applications«. These activities aim at more effective Digital Mock-Up (DMU) and Virtual Prototyping (VP) processes. Today, their productive and beneficial use is hampered by a time-consuming transition from CAD or simulation (CAE) data stored in product data management systems (PDM) to VR data/systems. To ease the transition from CAD to VR data and to improve the integration of VR into the product development process several complementary projects were carried out in 2000.

»Digital Mock-Up Visualization in product conception and down-stream processes« (DMU-VI) was a European project finished in August 2000. The developments within DMU-VI improved the seamless integration of software

components along the digital product development and optimized the product development process through innovative DMU tools. The department »Industrial Applications« developed a CAD server as a link between the engineering environment (CAD/CAE/PDM) and VR which serves as an immersive visualization tool for a design review of complex product models. Within the project »Integrated VR interface« (IVR) in cooperation with vrcom GmbH the CAD server was further developed to a commercial off the shelf product (VDDP – Virtual Design Data Preparation). Core of VDDP is a graphical interactive editor to prepare part and assembly models for VR. The editor allows to import parametric 3D CAD models and to tessellate as well as to optimize them regarding the required rendering precision and performance. Furthermore, models can be corrected in a semi-automatic manner, e.g. wrongly oriented faces can be flipped, multiply defined faces can be deleted, etc. An important component of VDDP is a converter that allows the importation of CAD models from CATIA. The CAD system, CATIA, is heavily used in the automotive and aerospace industry.

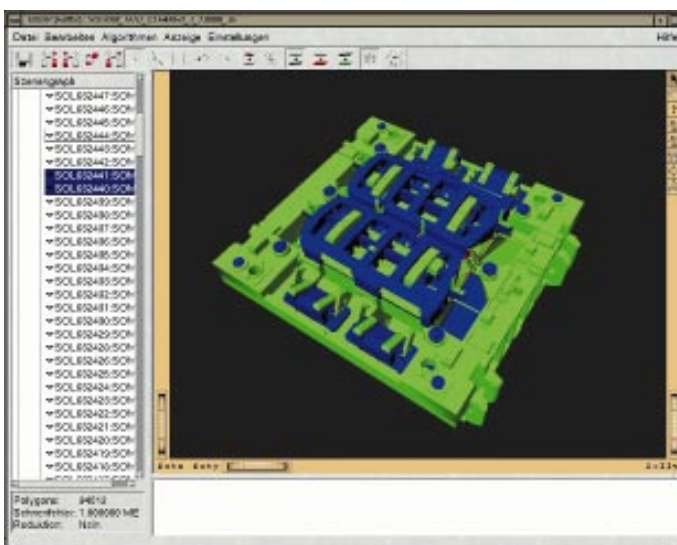
Additionally a CORBA based interface to a PDM system was introduced. The online PDM connection allows the user to navigate product structures and to select parts and assemblies for conversion. For BMW the PDM interface was mapped to the PDM system in use (PRISMA). VDDP's unique features expedited the tasks needed to generate digital prototypes – even without specific VR knowledge on the user's side. In some cases it reduced the data preparation phase from days to a few hours.

Another project that is tightly linked to Cax/VR integration is DKM-STEP/VR, which was carried out for Volkswagen AG (VW). Starting from an analysis of the creation process of virtual prototypes of a car body and interior, the requirements for a completely STEP based (Standard for Exchange of Product data – ISO 10303) process have been analyzed. On that basis a concept was framed that supports and improves especially the integration of the VR system. It is intended that an extension to VDDP will be a follow-up activity for 2001.

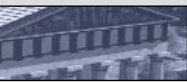
The integration topic will be extended towards CAE/FEM and innovative approaches for visualizing simulation results from stress analysis and thermo dynamics in the future.

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VDDP – part editor to change the orientation of faces



ENREVI

ENREVI (Enhanced Reality for the Video) an IST project, aims at the development of new techniques for the mixing of broadcasting video streams with artificial, virtual objects in real time. Developments carried out by several partners are concentrated on improvement of chroma keying technologies, improvement of speed and quality of rendering systems using low-cost platforms and also on improvement of algorithms for tracking of camera movements in unconstrained environments using a hybrid approach. The development of the tracking system is carried out at Fraunhofer IGD.

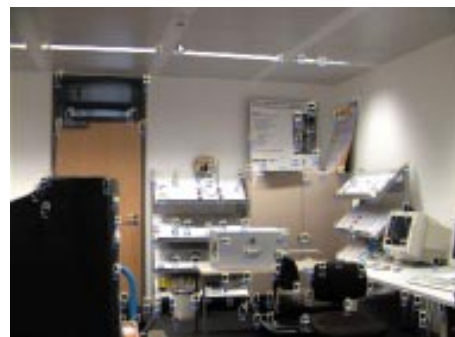
The system to be developed will be based on a hybrid approach. It will combine a vision component consisting of a stereo system and an inertial 3 DOF Tracker from Intersense (IS300 pro).

In the first step of the operation the complete system is calibrated. The vision component is calibrated using a combination of pattern based and self-calibration techniques. The inertial tracker is then calibrated to the vision system using rotation measurements from the vision and the inertial tracker. The vision system uses automatically selected, tracked and replaced natural features for rotation measurements. During tracking, the drift of the inertial tracker will be compensated by using measurements from the vision system. Position tracking is performed by calculating the 3D coordinates of the tracked image features.

The tracking system is especially designed to work on standard low cost systems like off-the-shelf PCs. A highly optimized, scalable approach has been chosen to allow real time performance on different types of computers. Parallel architectures are also supported.

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Sample of a sequence of point features tracked and reselected in real time



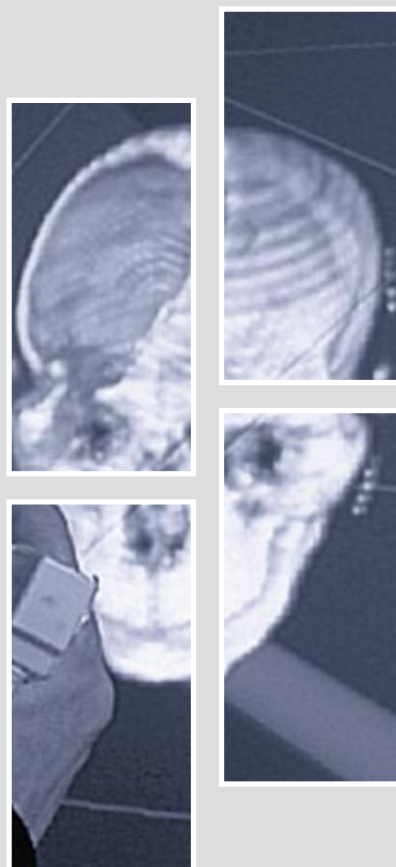
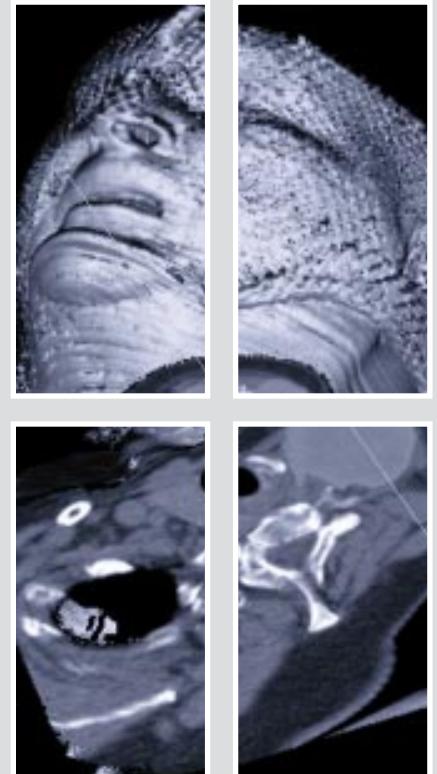
Medical Technology and Application

Today it is not possible to think about medicine without modern Information Technology. Especially imaging methods such as X-rays, CT, MRI, ultrasound, Angiography or Microscopy, play an important role. New methods like IR Imaging or Laser Imaging become alternatives in special cases of application. All imaging methods become meaningful only in connection with powerful image processing methods. In this field we can see a trend from simple 2D applications into very exact 3D images and models. Therefore it becomes possible for medics working with data much more intuitively.

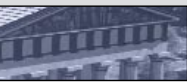
Exact 3D models make it possible to develop completely new applications in medicine. For instance, today optimize operations and treatments are planned on a virtual body or organ. That makes it possible to optimize the procedures for doctor and patient. Additionally we can test and train complex situations or unexpected incidents intensively by using simulations and VR environments. For navigation and control during the operation the support by imaging methods together with simulations, VR environments and robotics, are increasing. For instance, in neuro-surgery the operation can be performed very accurately, which was unthinkable some years ago.

Computer networks connecting the medical facilities make it possible to develop completely new working procedures. Specialists from all over the world can be consulted just by being connected to a virtual conference network. Watching and observing operations or treatments can be made over special network connections. Surely in future it will be possible to perform medical operations without a surgeon being present, who could be connected by a network instead.

The Fraunhofer IGD is developing innovative IT techniques in medicine since it was founded and surely will continue to develop this field actively in the future too.



For further information refer to the thematic brochures »Medical Technology and Application«



MediDesk – Interactive Volume Exploration on a Virtual Table for Medical Diagnosis and Treatment Planning

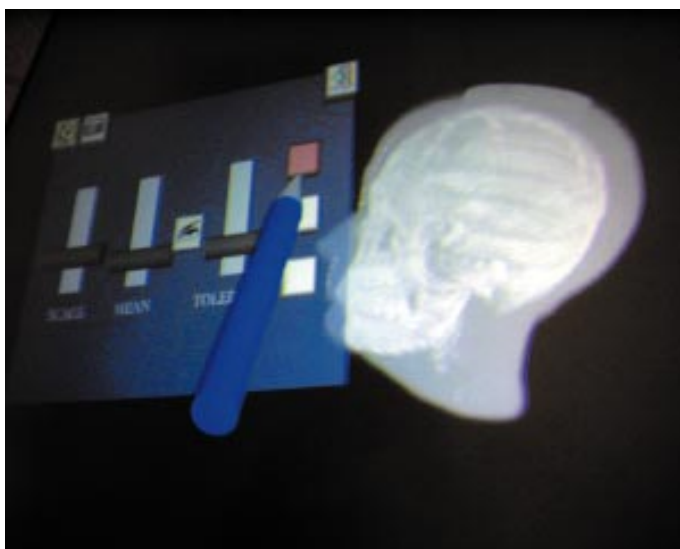
Volume data is becoming increasingly important in the scientific and medical fields because of the growing use of MRI, CT and ultrasound imaging techniques. Volume data are usually very large and difficult to handle, but need to be analyzed in an efficient way. It is

therefore important to think about easier and more natural ways to interact with volume data.

Collaboration between Vienna Technical University and the Rostock branch of the Fraunhofer Institute for Computer Graphics IGD resulted in the development of an interactive tool which enables complex bulk data to be analyzed and processed intuitively in three-dimensional space. In medical diagnosis and the analysis of multi-

dimensional, scientific data records it, is important for such data to be evaluated swiftly and inexpensively. The so-called MediDesk system is a combination of an interaction-rich VR system (Study-Desk) and a volume-rendering system (SGI's OpenGL Volumizer), and is designed to enable several users to view and discuss the data in stereoscopic projection. The virtual reality interactive techniques which have been developed enable users to process the parameters of data records directly.

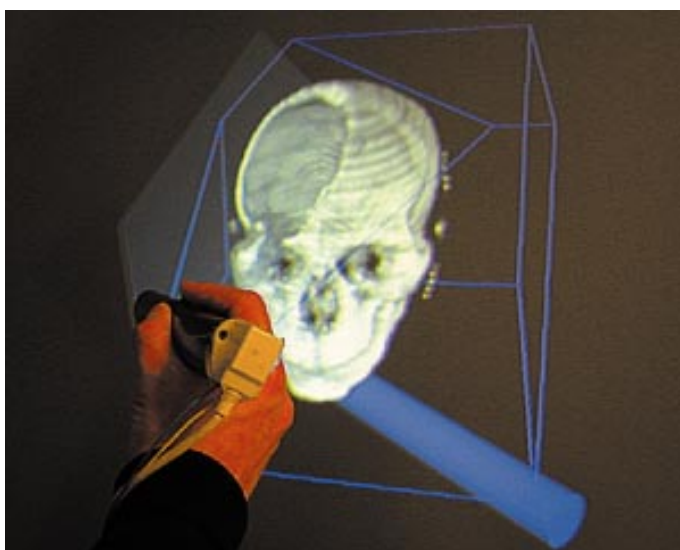
Using the look-up table to control the opacity of the volume



The Fraunhofer CRCG's solution comprises a powerful interaction system for exploring volume data that allows the user to drag, scale, or cut the volume in a very natural way using two-handed interaction. It also gives users the ability to extract arbitrary slices out of the volume data and provides methods for posting («freezing») and unposting («unfreezing») cutting planes into different displays.

Future work will focus on analyzing the application behavior with large-scale data visualizations on high-end graphics engines and studying the interaction improvements achieved by integrating speech command input and force feedback.

Interactive, two-handed definition of arbitrary cutting plane in 3D space



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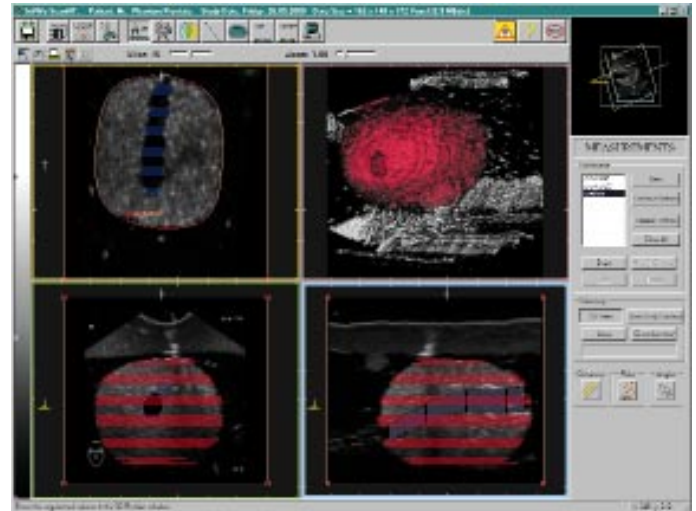


MITTUG – Minimal Invasive Therapy for Tumors 3D Ultrasound guided

The traditional treatment for cancer is surgery. A modern and very rapidly growing alternative is radiation treatment. At present, brachytherapy radiation treatment, i.e. a technique where the radioactive sources are inserted in the patient's body, is conducted by two principal methods:

- Either by implanting radioactive seeds of low activity (LDR) and leaving them in the tumor forever,
- Or by a short-duration treatment using a computer-driven single high-activity radioactive source (HDR) and catheters or needles inserted temporarily into the tissue.

Segmentation of the Prostate-Phantom



The aim of this project is to create a dual-usage brachytherapy system employing seeds or catheters using 3D ultrasound images rather than CT scans in order to overcome the shortcomings of present treatment conditions. In the first step we are concentrating on the treatment of prostate cancer.

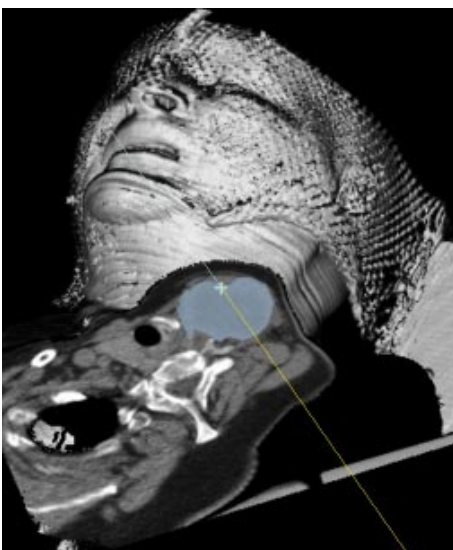
Herewith the following components of the systems were developed at the Fraunhofer IGD during the last year:

- Patient modeling system based mainly on 3D ultrasound (U/S) rather than on CT scans: In this connection we developed a semi-automatic segmentation tool based on active contours to segment the patients prostate (as the planing target volume) in 3D ultrasound images. Due to the pure contrast and the speckle of the ultrasound images we used different preprocessing algorithms to emphasis the edges while rejecting a noisy background. We then used the resulting image to segment the prostate.
- Active Immobilization Algorithm: A new active immobilization was designed to compensate the movement and change of orientation of

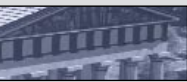
the patient tissues which will guarantee the relative position and orientation between the patient tissues and treatment tools such as needles, catheter etc. Algorithms for the accurate and precise registration between the tissues and tools were developed.

During the further process we will concentrate on the development of the following items:

- Free hand navigation: Our purpose is to develop a navigation system for catheters; i.e. a navigation system based on the 3D data set(s) and tracking the location of the needle by trackers. This system is based on magnetic tracker information which will give doctors, for the first time, the possibility of seeing the result of their action in real time and will enable them to position implants accurately in the positions defined by the pre-planning. This will increase the effectiveness of the treatment and enable accurate records to be kept.
- Algorithms for CT & U/S using the anatomical structures of prostate, urethra and bladder: The aim is to develop algorithms for automatic



Visualization of the needle-navigation



fusion between two sets of patient data from the two imaging modalities CT and U/S. In several cases where a CT device is available, and depending on the anatomic region (e.g. head & neck), a combination of the information provided by CT and U/S images offers advantages in recognizing the borders of the lesion and delineating the region of treatment. For these applications the CT and U/S scans have to be registered and fusion in a multi-modal dataset. This 3D ultrasound and CT Registration can become a stand-alone tool with application possibilities in other medical areas such as cardiology.

RoMed – Robots and Manipulators for Medical Application

In a cooperation project of several Fraunhofer Institutes an exemplary application of robot-aided spine surgery is being developed. The system consists of a robotic component and planning software. The surgeon selects the appropriate implant types and positions the implant into a model of the spine derived from the patient's CT scans. According to the specification done with this planning software the robot is driven. The benefit of robot-aided surgery should be higher precision and a better surgical outcome.



Xray simulation after screw placement

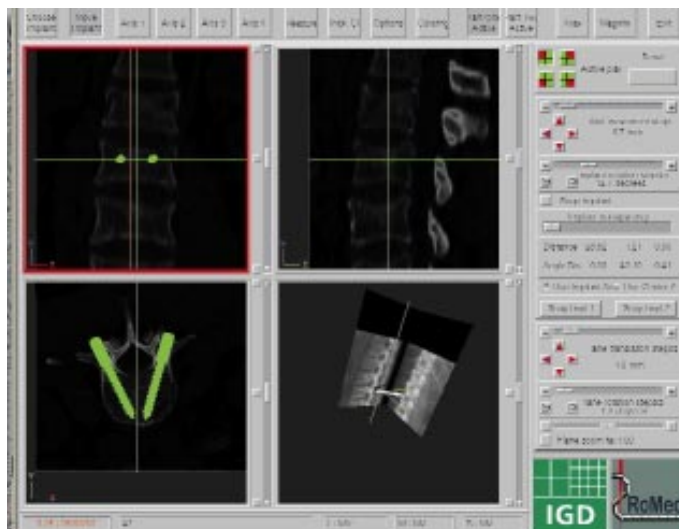
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The use of Virtual Reality and Medical Imaging techniques can support the surgeon in pre-operative planning. Before performing a surgical procedure on a real patient, the surgeon is able to practice on a virtual patient to simulate the intervention. In this manner, the safest and most effective surgical approach may be selected requiring less time in the operating room. Furthermore, a decrease in the rate of complications is expected. Even indi-

vidual implants can be created based on the patient-specific tomography data.

To further support the pre-operative planning process a finite element framework is used to simulate the patient specific bio-mechanics. Given the finite element models derived from the patient's CT/MRI scans, new diagnostic possibilities are offered to the surgeon, for example the load sharing in the patient's spine can be examined.



Planning system user interface



Ideally this framework will also be used to simulate the bio-mechanical situation after the pedicle screws are placed, allowing an approximate prediction of the expected outcome.

In addition, Augmented Reality technique is evaluated to give the surgeon inter-operative support. Registration of the patient is very important for the Augmented Reality application.

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TeleInViVo – 3D Ultrasound Telemedical Workstation

TeleInViVo is a transportable telemedicine workstation for application worldwide which can be used in isolated areas such as islands, rural and crisis situation areas. It integrates a portable PC with telecommunication capabilities and a light, robust, portable 3D ultrasound station in a custom-made device. The system has low price and weight, is easily transportable and is non-radiating. It is therefore an excellent example of how modern medical imaging, combined with advanced telecommunications, can provide better health care and diagnosis, improve patient handling, reduce health service costs and save lives effectively everywhere in the world.

With TeleInViVo a physician collects 3D ultrasound data of a patient. By means of the built-in flexible telecommunication channel (phone line, ISDN, Internet, GSM, satellite) these 3D data are transferred to a remote expert, who can be virtually everywhere in the world. After data transmission both parties are linked online over the telecommunication channel performing »virtual echography« on the 3D data replicated in each site and viewing identical images on their screens in real-time and practically without time-lag, even through narrow-band telecommunication channels. The system has been tested with hundreds of patients in three continents.



The TeleInViVo device

Medical care can be provided through this system almost anywhere at any-time. The physicians and Health Care organizations will be able to guarantee high quality care, without patient transportation over long distances.

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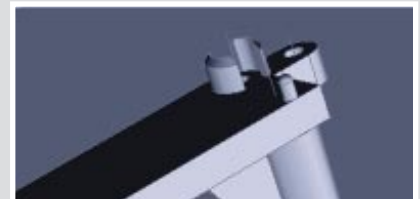


Virtual Engineering

Manufacturing industry is an important factor of our modern economy. Companies are in permanent competition for improved quality products for ever-lower prices. Innovative information technologies become more and more a key factor for companies to face the growing competition.

Virtual engineering offers several different approaches, like immersive visualization of products and processes, the use of virtual reality environments for digitally assisted prototyping, the visual simulation of assembling processes, multimedia product catalogues, and cooperation platforms for distributed engineering. Very soon it will be possible to develop a product purely digitally in a virtual environment, as successful pilot projects demonstrate. Currently, the tools for virtual engineering are being improved and refined, and platforms for cooperative and distributed work are being developed.

Based on the innovative interaction techniques, the Fraunhofer IGD developed new tools, which open unique opportunities for product development and engineering. Other fields of activity with important results were visualization of processes and professional training of employees. Some of the current projects are presented in the following section.



For further information refer to the thematic brochures »Virtual Engineering«

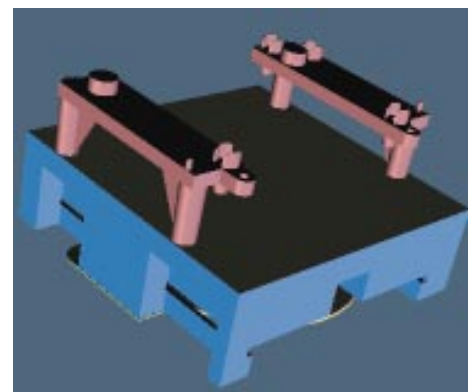
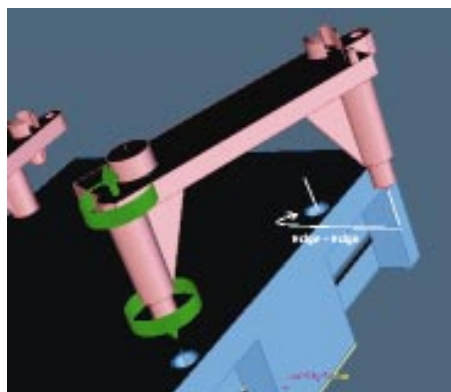
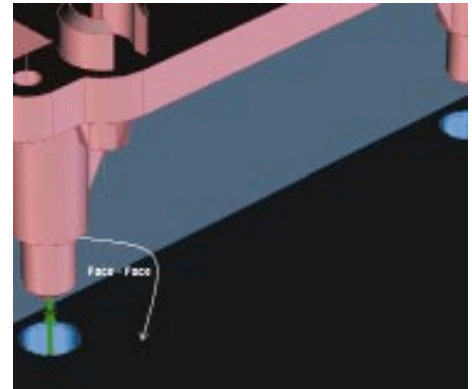
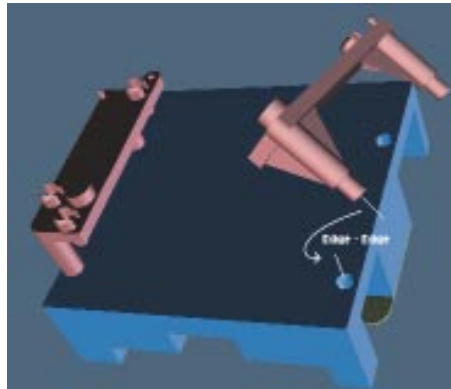


Cooperative Engineering

In the past years the product development process has developed from a more sequential process to an increasingly parallel process which requires a higher degree of cooperation, communication and coordination. In 2000 the department for »Industrial Applications« carried out different projects and developments on various topics in the field of cooperative engineering.

Within the strategic cooperation with CoCreate Software GmbH a solution for assembling CAD part models to assembly models in an intuitive and intelligent way was developed; patent pending for Germany and the U.S. The models can stem from different CAD systems and can be assembled in the distributed engineering environment OneSpace by simply assigning topological entities meaningful to the designer. In each step the system checks whether the assembly can be performed while maintaining the already existing constraints introduced by preceding assembly steps. If not, the system prompts a message to the user which tells him exactly where the inconsistency comes from. Parts of an assembly model can be dragged interactively to show possible assembly problems to a partner in a conference session. For 2001 it is planned to work in the direction of streaming and geometry compression.

With ARCADE we go a step beyond what is available to the market today, e.g. CoCreates OneSpace, in cooperative modeling. ARCADE offers the possibility to simultaneously model and design in a spatially distributed virtual design space. The direct-manipulative actions of the dispersed users are visualized in real-time to all participants. In 2000 the prototype was extended towards heterogeneous environments.



Assembly sequence in CoCreates OneSpace with the realized approach

MASP is a conferencing system for Wearable Computers. Wearable Computers are completely independent from any wiring (power as well as communication network). They are so small that they can be worn on the body allowing real tasks to be performed with both hands. Wearable Computers have very specific requirements to the user-friendliness of applications which also have to consider the instabilities of wireless networks. The conferencing system MASP fulfils these requirements.

The projects CoWork and OrgTech had a different focus: here the main topic was the development of end-user applications. The European project CoWork mainly dealt with tele-cooperation support for SMEs working

asynchronously. For this end, the department developed a communication tool based on STEP. Within the project OrgTech synchronous forms of tele-cooperation between SMEs were analyzed, introduced and evaluated. To solve the specific problems of online-communication between SMEs, software components have been adapted.

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EVRES – The Use of VR Technologies to Achieve Better Efficiency in Shipbuilding

The aim of the EVRES project was to show the general feasibility of new ways of working which makes it possible to achieve better efficiency concerning the interaction between human and computer with the help of VR technologies as a key technology in shipbuilding.

During the EVRES project the examination of the processing chain, beginning with the offer phase via construction outsourcing up to the construction of subsystems of a ship, concentrated on the value intensive and technologically challenging machinery space of a ship. Primarily we concentrated on the development of robust and inexpensive hardware and the adaptation of software. Having in mind a wide field of use of the necessary hardware, we focused on PC technique. We developed a system which is based on standard components for computer- and projection technique and which makes possible the immersive visualization of three dimensional construction data on PCs as well as on a huge screen. The latter projection on the screen is more interesting for the user, especially if there

are several people who wish to have a meeting on design issues and talk about the actual state of the virtual model.

In cooperation with the Swedish company TRIBON-Solutions AB, Malmö, we developed several interfaces to the TRIBON system. Hence, the participating industry partners can use the VR presentation directly in their ship-construction systems.

EVRES, as a pilot project, is supported by the German Ministry of Education and Research (BMBF).

The following partners participated in the project:

- Aker MTV Werft GmbH
- Meerestechnik Engineering GmbH
- Schneller System Technik GmbH
- Fraunhofer IGD Rostock
- ZGDV Rostock

Contact

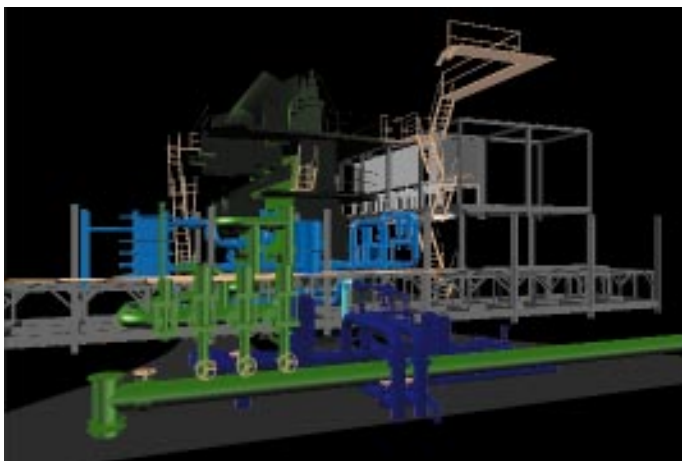
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Virtual Factory and Logistics

Funded by the Singapore National Science and Technology Board (NSTB), CAMTech is collaborating with a Singaporean research institute and two industry partners with the objective of improving electronics assembly processes. The goal of this project is to visualize the behavior of an electronics assembly industry by simulating and visualizing the discrete events of the entire manufacturing processes, and by observing the flow of materials, size of buffers, and line balancing. It is required to have:

- A system for modeling virtual prototypes, verifying the existing manufacturing processes by animating the behavior, and to make improvements of the necessary processes to avoid costly errors.
- Information from existing real manufacturing systems and use it to model, analyze, test, evaluate, and simulate the main electronics assembly process. The criteria to compare can be minimal processing time and overall cost for various cases.

The traditional scenario – from the customer placing an order for a product to delivery – goes through various phases including manufacturing the product. Several major electronics manufacturing stages can be addressed: fabrication, assembly, testing, and packing. Each of these stages account for setup, process, failure, and waiting periods. A delay in one process will



Part model of a machine room (without shipcover)



accumulate and increase future delays. To simulate the discrete events a general-purpose simulation system has been employed, and for modeling and visualization the CASUS system has been used. In this work, the prototype interface between simulation trace file and CASUS animation scripts has been implemented. The animation script created using this interface is converted into a scene file and finally visualized. These discrete-event simulation software systems are adopting an object-oriented approach for performing effective simulation.

The focus of this work is to provide an automatic pipeline starting with the conversion of simulation trace files into animation scripts and ending with the visualization of the simulation. Moreover, the complex assembly process has to be considered divided in inbound, sub assembly, testing, packing, and outbound process. Based on the simulation and visualization results the refinement of existing processes like minimal process time, reduced waiting time or buffer size can be made. Currently, the animation of 3D objects is working along with static objects from a layout file. This uses a simulation trace file containing a single assembly line with plates moving on the top. Future work will focus on the realization of complex manufacturing processes.

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Semi-immersive presentation of virtual factory



Virtual assembly lines





IT Based Learning and Training

Education and further education are of increasing importance in today's society. In contrast to yesteryear, today's employees have to update their knowledge and keep learning throughout their whole working life. However, employees are so involved in the work process that extensive qualification measures are difficult to put into practice. Hence it is necessary to tailor the classes to the individual needs of every single attendee. This concerns time and location, as well as the content of the courses.

One approach is using modern IT-technologies. These applications allow time- and location independent learning, but usually it is not possible to tailor the content of lessons or for the tutor to monitor the learning process.

Another approach is the provision of integrated course management systems. These allow a dynamic adaptation of the content of the course to the individual needs of the course attendee (student tracking), as well as individual tests and integrated solutions for cooperative learning and tutoring in groups. Two of the few existing products in this field are the modular training system MTS from the Fraunhofer IGD Darmstadt and the CMS-W3 course management system from the Fraunhofer IGD Rostock.



For further information refer to the thematic brochures »IT-based Teaching & Training«



e-Qualification Framework

The FhG/GMD collaboration project e-Qualification Framework (e-QF) aims at the harmonization of the e-Learning activities in Fraunhofer-Gesellschaft and GMD. The goal is to develop a uniform e-Learning methodology, infrastructure and portal. The e-QF partners are the Fraunhofer institutes IGD, IAO, IESE and IIS as well as the GMD-institutes FIT, IPSI and SIT. The project will last for 24 months, running from 1 November 2000 until 31 October 2002. The first prototype is planned for October 2001.

The technical work in e-QF comprises the development of a uniform e-Learning methodology, the implementation of an e-Learning platform, the development of uniform templates and patterns for e-QF courseware, as well as the implementation of a qualification network. e-QF concentrates on technical development and forms the basis for the content projects FKN and Medi@Train, which run in parallel. It is planned that the content projects use and evaluate the results provided by e-QF.

The Fraunhofer IGD is responsible for the coordination of the project. Furthermore, in the workpackage »Methodology«, a knowledge domain model, in the workpackage »Infrastructure« an intelligent help system, and in the workpackage »Templates«, templates and patterns for navigation and interactive tests will be developed.

The work in the area knowledge domain model concentrates on the development of a methodology for structuring the FhG/GMD knowledge used in e-QF. Knowledge domains are a concept that allows knowledge to be structured according to different aspects and to define different forms of relations between the knowledge elements. This enables, for example, the branch-specific structuring of knowledge or to correlate added-value components like online consulting or presence seminars to a knowledge topic. The technical basis of the knowledge domains to be developed is the ISO-standard »Topic Maps«. Topic Maps are based on XML and allow a provider-neutral definition of knowledge structures. The work of the Fraunhofer IGD concentrates on the development of knowledge domains for different branches and the development of different forms of visualizations for knowledge domains. The management of the knowledge domains will be based on commercial topic map systems.

In the workpackage »infrastructure«, Fraunhofer IGD develops an intelligent assistance- and help system. In the first phase of the project, will be developed. i-FAQ, an intelligent FAQ-system. Based on traditional FAQ-systems, i-FAQ offers the learner the possibility to introduce feedback (e.g. by annotations). Moreover, group- and topic-related FAQs will be supported. The system will be complemented by an FAQ-agent, which customizes FAQs according to user preferences (like history or registration information).

In the workpackage Templates and Patterns, Fraunhofer IGD develops navigation patterns and templates for interactive tests. Uniform navigation patterns provide the learner a common look and feel across the different courseware offers of FhG/GMD. The goal is the development of different templates according to the different needs of learners (beginners, experts). This work is closely related to the didactic model to be developed in e-QF. In the area of interactive tests, templates for different forms of knowledge checking (multiple choice tests, construction of test ensembles, search for solutions in images) will be developed. The transfer of the test results to the e-Learning system will be based on established e-Learning standards (ADL-SCORM, IMS). The separation and independence of courseware and platform protects the investment in courseware development.

The work described will be integrated in a first prototype in October 2001.

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Fraunhofer Knowledge Network FKN

The MAVO project Fraunhofer Knowledge Network (FKN) aims at the development of the business sector education and training of the Fraunhofer-Gesellschaft. In 1999, the FKN-consortium carried out a state of the art analysis on the activities in this sector in different Fraunhofer institutes. The main project FKN, planned for a period of 30 months, has been running since 1 July 2000.

In the first phase of the project (1 July 2000 - 30 June 2001) four demonstrators will be developed. The Fraunhofer IGD is responsible for horizontal activities in the area of technology infrastructures and cooperates with the Fraunhofer IAO in horizontal activities in the area of didactics. These activities form a link to the project e-Qualification Framework, which runs in parallel. The Fraunhofer IGD will offer seminars for courseware authors in order to provide a uniform layout of the FKN courseware to be developed. The Fraunhofer IGD is involved in the demonstrator provided by the Fraunhofer IESE (UML for managers). This demonstrator will be developed based on the e-Learning system MTS-2000.

In the second phase of FKN (1 July 2001 - 31 December 2002), the Fraunhofer Knowledge Network will be installed and the FKN-courseware will be provided via a FhG-wide e-Learning portal. The Fraunhofer IGD will be responsible for the link to e-Qualification Framework and continue to develop the prototype UML for managers later on. Moreover, the Fraunhofer IGD will develop the demonstrator »virtual media house«.

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A Web based Distributive Simulator for the ALVIN Deep Submersible Vehicle

The Woods Hole Oceanographic Institution (WHOI) research submersible »ALVIN« is used for civilian scientific research at extreme ocean depth for oceanographic research. The duration of underwater missions can last from six up to nine hours. The key element that determines the length of a dive is efficient energy budgeting in order to get the most out of the two batteries' overall capacity. Energy consumption is mainly determined by the use of outside lights, propulsion tasks and use of experimental devices. Since the ALVIN submersible is completely reserved for years into the future, and inherits a unique technical design, mission training until now had to be achieved »on the job.« In 2000, Fraunhofer CRCG developed the ALVIN Web based distributive simulator that will allow scientists to plan and rehearse their dives in an efficient way in the future. WHOI experience shows that through the familiarization and training of new scientists, an increase of up to 40 minutes bottom time will result, which can lead to a significant decrease of overall mission costs.



Cockpit view of the ALVIN simulator
Web-interface



Meters-panel displaying crucial variables of the
simulation



Tasklists in the ALVIN simulator interface

The simulator

In addition to full mission planning for WHOI scientists, the ALVIN simulator was intended to provide applicability as a public relations tool so that users at home would be able to find out about WHOI research. For that reason a broad range of requirements had to be achieved:

- Photo realistic interface,
- 3D look and interaction,
- Full electrical and logical evaluation of experimental and navigational operations,
- Visual feedback for ongoing processes,
- Analog and digital rendering of crucial variables,
- In-depth scientific applicability,
- Distributive operational collaboration,
- Web delivery with state of the art performance,
- Fun interaction opportunities for public use,
- Visual appeal for marketing reasons.

Web delivered simulation and collaboration

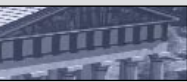
Most of today's simulators are limited in terms of local and time-wise availability to the user. In contrast, we built the ALVIN simulator as a slim interface that can be delivered ubiquitously via the Internet and be launched in a standard browser like Internet Explorer 5 or Netscape 4.7. Scientists as well as public users are allowed to collaborate in teams of up to three persons – just like in the real ALVIN cockpit where a team consists of one pilot and two scientists. Every member's actions of a joined session will influence the virtual dive and will be reflected on all the team-members systems.

Future considerations

Due to its extendibility, the ALVIN simulator can accommodate future adaptations to design changes of the submarine. Application testing has proven that scientists consider it a very helpful tool for mission planning, particularly since online accessibility makes it easy to use it anytime in most regular working environments. The ALVIN simulator is one of the first Web based simulation tools for ocean scientists, and we expect that future need for Web based training simulations will increase significantly.

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ETOILE – Environment for Team, Organizational and Individual Learning in Emergencies

The trainings of emergency scenarios have often focussed on operational issues while communicative, decision-making and team aspects are more or less neglected. The reason is not because communication is unimportant (on the contrary, avoiding misunderstandings and having the correct information policy is vital) but dedicated training methods and tools are missing. In addition, agreeing on a common training date is difficult because many of the people involved may belong to different companies, institutions and authorities. Obstacles for communication and management training of emergency situations also involve high costs associated with the training, disruption of the regular operation and potentially dangerous usage of expensive equipment and machinery. To improve this situation and raise the frequency and quality of the training we propose to jointly apply the following solution strategies:

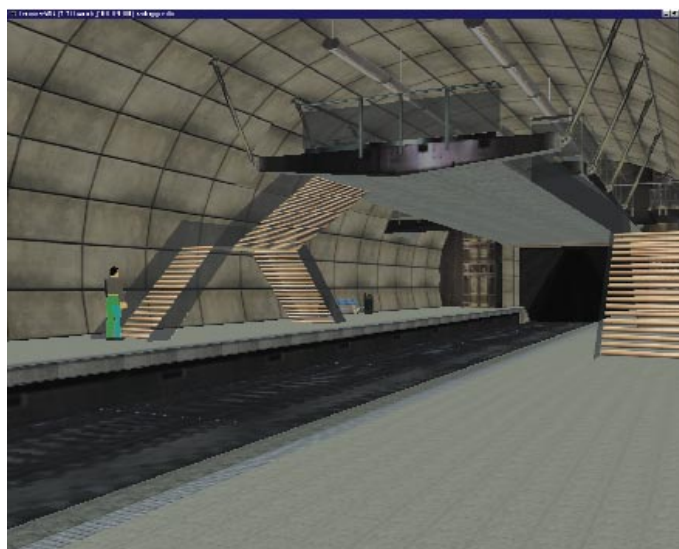
- Using intelligent agents who assume the roles of participants in a training scenario,
- Enabling a distributed training via computer networks where trainees do not necessarily meet at the same location,
- Using virtual environments,
- Raising frequency and quality of training for individuals, teams as well as organizations,
- Supporting the construction, acquisition and development of shared mental models.

As a major goal of ETOILE is to reduce costs, a set of tools is provided that is designated for authors of the end user domain. The tools allow a cost efficient construction of training scenarios at a

Control room with agent and human training participant



Virtual Subway station of the Metro training scenario



high quality level. This is especially true for the virtual reality and the agents included in a training scenario. With the ETOILE tools two training scenarios were made by the end user project partners. One scenario deals with an incident in a nuclear power plant, the second scenario concerns a fire in a Metro tunnel. Experts in the field of pedagogy and psychology have evaluated the training and it was possible to successfully feed back their findings in the tool and training scenario development.

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Modular Training System MTS-2000

The Modular Training System MTS-2000 has been under development since the beginning of 2000 in close cooperation with the Studiengemeinschaft Darmstadt (SGD), one of the biggest correspondence schools in Germany. The goal of this project is the conceptualization and implementation of an Internet based e-Learning system, implementing the special processes of a correspondence school. MTS-2000 has the following highlights: e-Learning curricula, support of different roles, integration of learning, communication and information as well as the support of learning hierarchies and context sensitivity.

MTS-2000 supports two forms of curricula structures: organizational structure and topic structure. The e-Learning offers are organized in courses. A course is a self-standing learning unit which is correlated with a degree/certificate. A course consists of several learning materials or learning material groups (which can be tested separately and ease the structuring of large and

complex courses). A learning material itself consists of a content and an optional test. Additionally, learning material can be categorized according to topics. This allows a grouping of learning material across courses.

A unique feature of MTS-2000 is the support of individualized courses. A learner can, based on his learning history and success, skip parts of a course he has already approved or buy valued added components in order to improve his learning settings. This concept allows for a highly individualized and optimized setup of e-curricula.

MTS-2000 supports different e-Learning roles by individualized GUIs: administrators, topic tutors, curriculum tutors, curriculum managers and learners. All these roles are supported by individualized GUIs with special functionality.

MTS-2000 supports e-Learning hierarchies. The MTS-system can be integrated in a publicly available e-Learning portal, providing general functions. By logging on to the MTS-system, the user reaches the MTS-layer. This layer provides an overview of all booked

courses as well as communication capabilities with an MTS tutor and general learning groups. By selecting a course, the learner enters the course layer. This layer presents the internal structure of a course, consisting of learning material and learning material groups, as well as communication facilities with a course tutor and course-related learning groups. The information provided concentrates on news and FAQs about the selected course. By selecting a learning material, the learner enters the material layer. This layer provides a description of the material (like online, download, offline, test available) as well as access to a topic tutor and material-specific information. This concept delivers the learner an optimized, context-sensitive learning environment. The learner always has the necessary information to hand.

MTS-2000 has been developed in close cooperation with Studiengemeinschaft Darmstadt (SGD). SGD uses a commercial version of the system under the trademark waveLearn.

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The waveLearn user interface



Visualization and Concepts in Chemistry and Life Sciences

One problem of increasing importance in chemistry and life sciences is the rapidly growing amount of data needed for research and production purposes. In recent years, techniques for simulation, process control and imaging has very quickly developed with the result that increasingly more data have been produced. This data »explosion« leads to completely new or drastically refined opportunities for applications on the one hand, but also to the need for innovative procedures to analyze and classify those data and to interact with them for acquiring new and better results.

Due to the fast development of computer hardware it is now possible to simulate and visualize, even in virtual reality, very exact models, which was not even dreamed of a few years ago. Novel interaction techniques allow a totally new way to work with the acquired data.

Fraunhofer IGD has dealt with chemistry- and life sciences related problems for several years. New concepts for the visualizing and electronic publishing of data were developed. Another field of intensive scientific activity is interactive 3D visualization of simulations in virtual reality environments. By using new technologies impressive results were subsequently achieved. But of course Fraunhofer IGD also works in improving conventional image processing algorithms.

Well-used slogans such as »New Media«, »Visualization« or »Knowledge Management« are not just buzzwords, but are a reality at the Fraunhofer IGD.



For further information refer to the thematic brochures »Visualization and IT Concepts in Chemistry and the Life Sciences«



2D Gelelectrophoresis

Image Processing

2D gelelectrophoresis is a standard method for the analysis of the proteins of living organisms and human beings. The two-dimensional method allows the separation of different proteins, according to their polarity (horizontal diffusion) and their molecular weight (vertical diffusion) on a polyacrylamide gel substrate. By application of different staining methods the separated proteins visually appear in the form of a spot pattern, which allows the measurement of characteristic features, like isotropy, size, and density for quantitative analysis.

The efficient use of proteom analysis strongly depends on the development of automatic image processing procedures for spot-identification and quantification. In order to master this challenge, the Computer Graphics Center Darmstadt, together with the Fraunhofer IGD Rostock, developed a procedure for automatic identification and quantification of protein spots from 2D electrophoresis gels on behalf of Aventis Research & Technologies.

After protein diffusion and staining, the gels are scanned by means of a special flat bed scanner. In the subsequent automatic image analysis stage, the images are LP-filtered, background and protein regions are segmented and saturated regions identified. The final quantification and modeling of the protein spots leads to parametric representations of each spot. Besides a

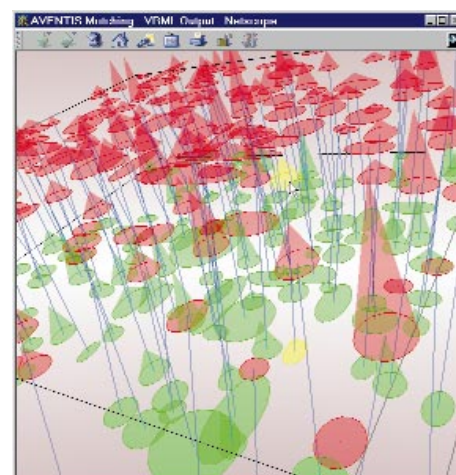
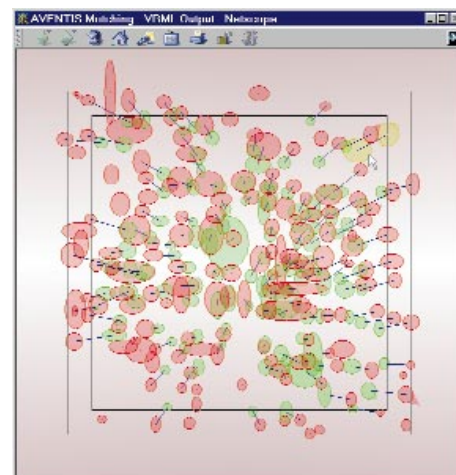
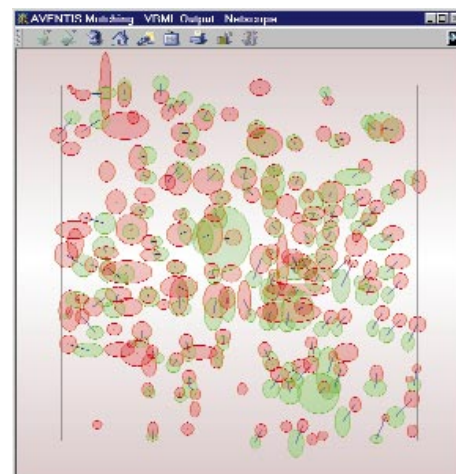
compressed, quantitative description of the image content, they also provide a more suitable means for following studies such as spot matching between any number of similar gels.

This year's advancements include the handling of exceptional cases in the segmentation and modeling stage. Amongst others, the advancements cover the modeling of drop-shaped spots as well as saturated spots. Sporadic occurrences of twin models resulting from image defects are predicted using image segmentation features. This allows their elimination before the modeling.

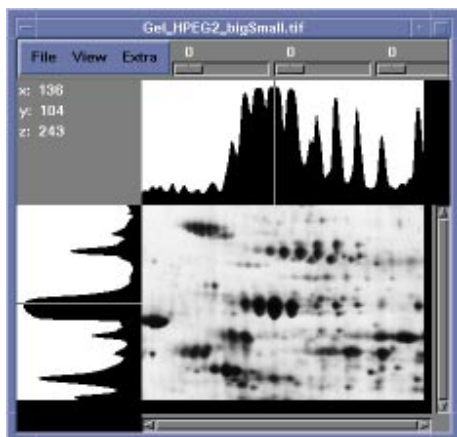
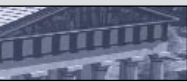
Matching

Multiple repetitions of electrophoresis experiments allow the minimization of common gel defects (e.g. dust particles or gel deformations). The resulting gels show big structural similarity. A similarity based automatic matching makes it possible to give reliable statistical statements about the distribution and measurements of proteins.

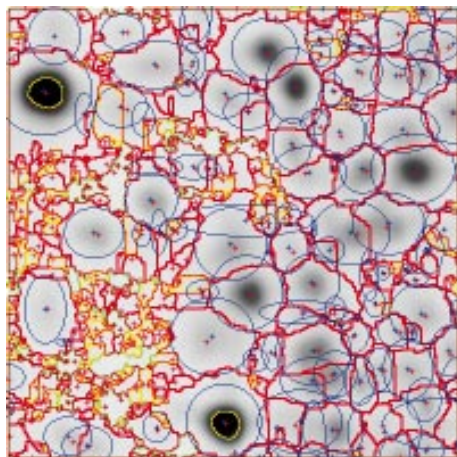
In order to support an automatic matching, the Fraunhofer IGD Rostock developed matching methods, which allow the simultaneous matching of more than two gels. The result is a single representation of the complete test series.



3D visualization for the matching of two gels (parallel view, perspective view, detail view with yellow highlighted spot pair)



View of the testbed during the inspection of a gel



Result of the modeling step with saturation- and collision-handling

Starting from the gel models provided by the image processing module, the matching correlates corresponding spots from different gels by means of a flexible cost function. In certain scenarios, however, a structural similarity between two spot-patterns cannot be assumed. One form of mycoses, for instance, leads to a resistance whereas another form is still sensitive to a therapeutic drug. In order to determine these differences a comparison of the mycotic structures is necessary. This requires the identification of a determined partial pattern. A study concerning the evaluation of methods matching arbitrary partial patterns was conducted. Its result showed the ability of the studied method to also match incomplete patterns.

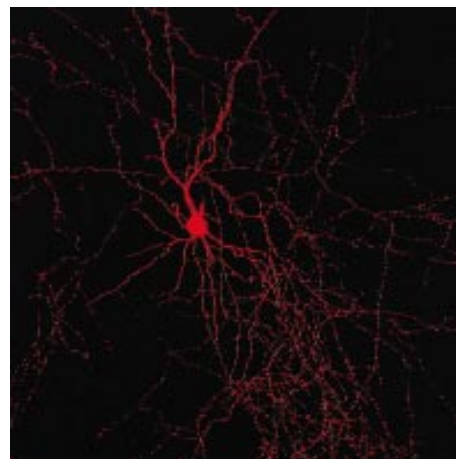
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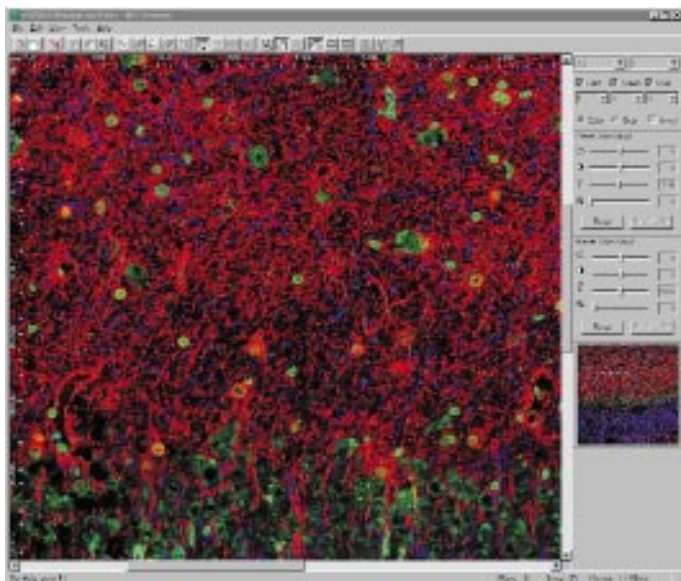
Multiple Image Stack Browser

In the last few years the progress made by neuro scientific science has been tremendous. The development of new, productive microscopy hardware is one of the main reasons for this. Confocal laser scanning microscopes are able to scan stacks of layers into a microscopic preparation without cutting it into slides. This means we can view real image volumes. New color techniques allow the marking of interesting substances. It is even possible, using several markers simultaneously, to detect them by different lasers and assign them to different channels of the image.

Most recently the scientists were especially interested in investigating intracellular features by looking at the interaction between different cells of the population at the same time. For that they need an overview over the whole large scanning volume and a very high resolution of the details at the same time. But dependent on their construction, microscopes can either



Maximum Intensity Projection of a single neuron (64 Planes of 3072 by 4096 Pixels)



Screenshot of the MIS Browser

scan large areas with small resolution or small areas with high resolution at a time.

For solving this contradiction the Multiple Image Stack Acquisition (MISA) was developed at the Leibniz Institute for Neuro Biology Magdeburg. By this technique the microscope is connected with a motorized stage. Therefore it is possible to scan large regions with high resolutions by dividing the whole volume into several image stacks which are scanned one after the other. This results in many single images belonging to the scanning volume. The single image stacks can be scanned overlapped for aligning the whole volume exactly. In order to use the scanning volume all the single images of the multiple image stacks (MIS) have to assemble to one large single image stack (SIS).

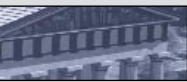
For assembling and post processing the SIS the Multiple Image Stack Browser (MIS Browser) was developed. This is a program running under Windows, which performs the assembly and post processing of the image data. Users of the application can browse through the whole image volume almost without time lag. The browser handles post processing of different image parameters up to adjusting the individual color curves. It is possible to measure distances inside the image volume. Any part of the volume can be exported into different file formats, for instance for using it in a foreign 3D visualizing tool.

The largest problem while implementing the browser was dealing with very large data amounts. Today we are using scans with a size of about 2 GB. We expect even larger scans in the near future. To show these data as fast as possible we use several caching and mapping strategies.

In future the MIS Browser will be extended into a base platform for working with large microscope data. For users requests we will develop several plug-in interfaces for different fields of use. Although a plug-in interface for alignment algorithms already exists we are developing interfaces for working on the real image data. In addition we are working on a generic module for steering different microscopes and motorized stages from the browser. This will result in one solution that the user can use for image acquisition and image processing.

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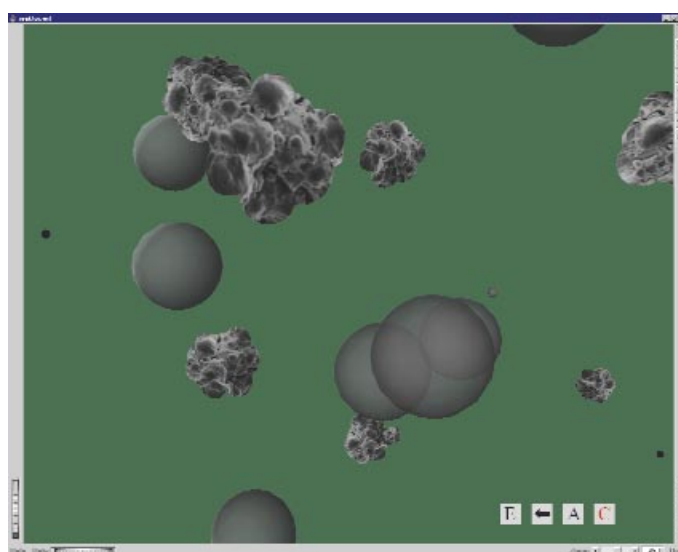
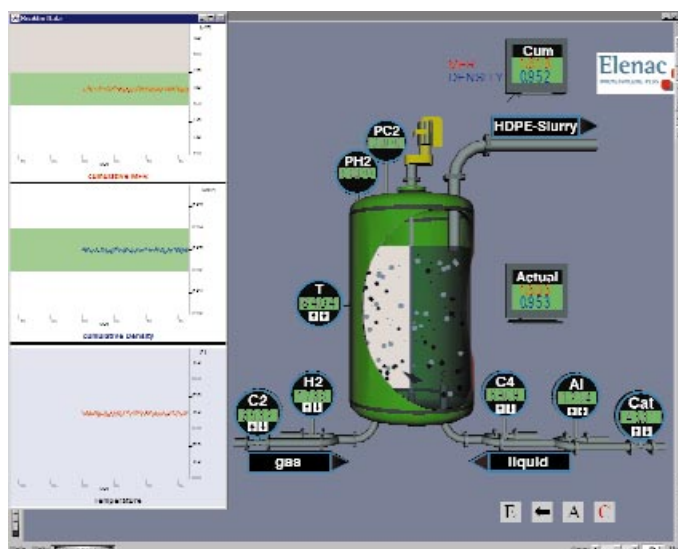
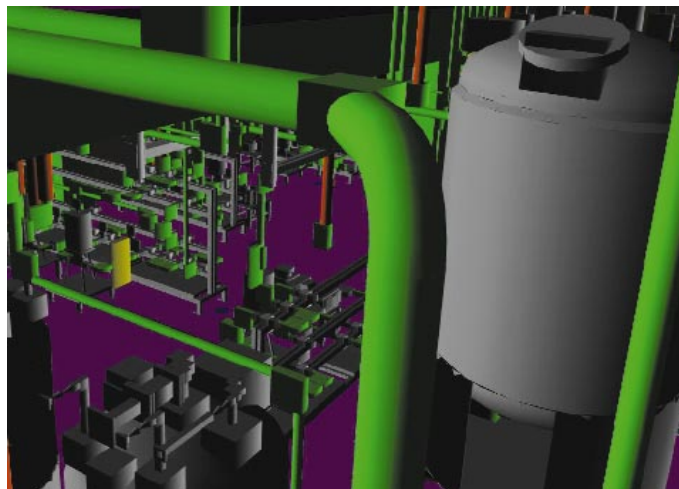
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Process- and Plant Visualization

Computer Graphics is a key technology for rapid product development especially in chemistry and life sciences. Visualization of information and correlations is one of the major topics. The project of the Fraunhofer AGC »Glass reactor«, which is conducted by order of the companies Elenac and Axiva, comprises the visualization of the polymerization process for high-density polyethylene. The data for the visualization are calculated using a simulator. The experiences of Elenac with the production process combined with the know-how of Axiva in the area of process optimization and simulation, allowed the construction of a simulation model, which can also be utilized directly in the production process for monitoring and regulation tasks.

During an exhibition visitors with no previous knowledge were supposed to be able to use the simulation model. So a visualization had to be found, which allows easy operation of the model without prior instructions. The result is a computer-generated, interactive operable, three-dimensional model of the reactor. The output, either on a common computer screen, a laptop or a »Virtual Table«, shows an interactive model of a synthesis reactor in three stages. The first stage, the closed reactor, represents the link to the real world. The user recognizes the familiar reactor, without special explanations being necessary. When the reactor is open in the second stage, new insights in the functioning of the reactor are revealed, which are usually invisible in reality. This impression is further increased by a dive into the microscopic view of the polymer particles in the core of the reactor in the third stage. There the most important reacting substances can be observed, i.e. the visibly growing polymer particles,



Three stages of the »Glass reactor« (closed, open, microscopic view)



and also the gaseous substances, which are part of the reaction, as well as catalyst particles.

There are numerous application areas for plant visualization. In the preliminary stages of planning a first impression of the new plant can be gained. During the planning, the acceptance of services rendered, for instance the acceptance of the piping, can take place in a virtual showroom with the planning engineers and the customer. Even before completion of the plant future operators can be trained, and during the operation of the plant the virtual model can be used as an advertising medium for the plant. The Fraunhofer AGC developed, in cooperation with the Fraunhofer IGD Darmstadt, techniques to visualize complex plants directly from the planning process. Key issues were techniques on the reduction of the extraordinary high complexity of industrial plants to enable the realization of interactive solutions. Together with Axiva a general agreement on plant visualization has been reached. Virtual acceptance of services is now a fixed part of plant planning.

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Virtual Glove Box

A glove box is an apparatus used in chemistry or biology to work on targets in a closed atmosphere, without contaminating the substances or endangering the user. A glove box usually consists of a transparent hull in which the experiments can be performed. The user can reach into the box through gloves that are attached to the inside of the box. The gloves can be reached through corresponding holes in the box.

Since glove boxes are well known in our domain of interest, the glove box is used as an interaction metaphor for visualization applications. The Virtual Glove Box consists of a stereoscopic display using passive stereo technology (i.e. a two projector system with polarized lenses which continuously display images for each eye; the user views the scene through matching polarized glasses) and two CyberGrasp haptic exoskeleton displays for the hands. The user can reach through holes into a box, wearing the exoskeletons while the visual display shows the virtual hands and the virtual objects (atoms, molecules etc.).



The mechanical force-feedback exoskeleton CyberGrasp by Virtual Technologies, Inc.

There are several use-case-scenarios for the Virtual Glove Box. Our first focus is on the virtual manipulation of chemical reactions on the molecular and atomic level. In this case we will be able to demonstrate the benefit of a new over conventional devices used in chemistry or biology. The second focus will be the manipulation of virtual »real life« laboratory objects. In this case the aspect of teaching and training is important.

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Usage of a conventional glove box



New Media for Cultural Heritage

Who has not (yet) heard the slogans of our modern information society like Internet, multimedia, hypermedia, telecommunication, virtual reality. New technologies are indeed gaining ground in our living, working, and leisure habits.

This also applies to the management of cultural assets. Museums and galleries, curators and artists, they all – with increasing success – make use of digital technologies for collecting, preserving, exploring, and conveying art and human culture.

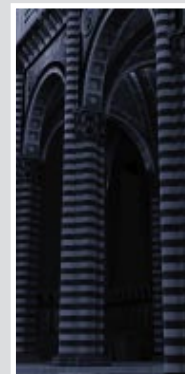
Museums present themselves on the Internet. Invitations are given to visit virtual museums. By means of a simple mouse-click the »cyberspace« museum visitor can get a multimedia visualization of special historical, art, archaeological, or engineering issues composed of video and sound documents, images, and text. In a »Memorandum of Understanding« some European museums have engaged in digitalizing a great part of their stock. In this way digital artifacts and works of art will become accessible to everybody.

Digital technologies are also used for a virtual reconstruction of architectural monuments. They can also effectively support the simulation of historical work techniques and the scientific work of art historians, archaeologists, historians, or restorers.

So the new media technologies open up entirely new application scenarios. Important challenges are:

- Passing-on of knowledge,
- Global access to cultural heritage,
- Permanent preservation of cultural assets,
- Efficiency of cultural research.

Furthermore, multimedia presentations are an excellent instrument for marketing purposes or acquisition of sponsors.



For further information refer to the thematic brochures »New Media for Cultural Heritage«



ARCHEOGUIDE – Augmented Reality Based Cultural Heritage On-site GUIDE

ARCHEOGUIDE (Augmented Reality based Cultural Heritage On-site GUIDE) is the acronym of a project pursued by a consortium of European organizations: Intracom S.A. (Greece), Fraunhofer IGD Darmstadt (Germany), the Computer Graphics Center (Germany), the Centro de Computação Gráfica (Portugal), A&C 2000 (Italy), Post Reality (Greece) and the Hellenic Ministry of Culture (Greece). Funded by the EU IST framework (IST-1999-11306), the consortium aims to design and develop a system that will fundamentally change the way visitors view and learn about a cultural heritage site. In particular, we are in the process of designing a system that will give the visitors a feeling of how the site was in the past.

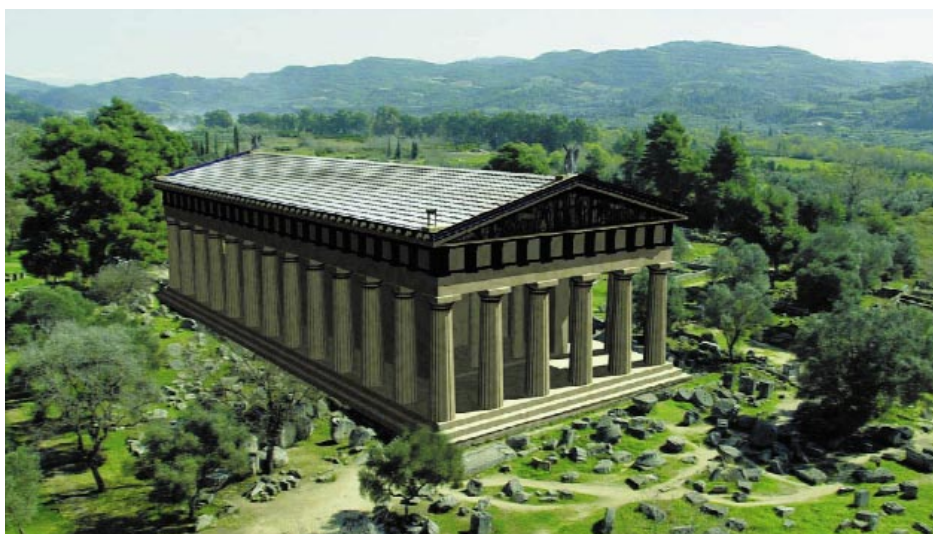
As a first trial site, we have selected ancient Olympia in Greece, the famous

birthplace of the Olympic games. The project's consortium envisions a multi-user distributed computing system that will operate as follows: visitors, upon arrival on the site, will be given a Mobile Unit (MU), i.e. a wearable computer including a see-through Head Mounted Display (HMD) equipped with a camera and speaker and a very lightweight portable computer with sufficient hard disk space, processing power and wireless connectivity to the system server. The visitor will provide a user profile indicating their interests and background, and they will be invited to choose a tour from a set of pre-defined tours. The system will then guide them through the site, acting as a personal intelligent aid giving them audio-visual information suitable for them according to their profiles. Whenever and wherever appropriate, the system will render images of 3D models of the monuments of the site and display them to the user's HMD. Correct object registration and occlusion handling of course requires having adequate position and orientation

tracking systems and a detailed model of the site's static environment. This will be obtained by accurate photogrammetric techniques and through the use of accurate site maps. Through intelligent adaptive system behavior, we plan to tailor the visitor's tour to closely match their interests.

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Augmented View of the temple of Zeus



City-historic Information System

In the year 2001 Germany celebrates the Romanesque year. For this celebration the Aschaffenburg Stiftsmuseum starts an exhibition that focuses on the various remains of the Romanesque period in the town. The interest centers on the collegiate church St. Peter and Alexander, one of the oldest Romanesque churches in Germany. The collegiate church was probably erected during the Foundation of the collegiate St. Peter and Alexander in Aschaffenburg circa 957 AD. Over the centuries, many more or less important building projects changed the appearance of the church according to the architectural style of the particular epoch. The church as a whole was never destroyed. Therefore many of these changes still exist and the variety of the components has become characteristic of the church.

The church will be virtually reconstructed in the three main epochs of its evolution: Romanesque, Gothic and Baroque. The aim of the church's reconstruction in different epochs is to create an access to its history and to visualize the development of the architectural styles. The tourist on site will be able to see the virtual reconstruction in the museum. Another way to acquire information is through the Internet.

Publishing the models via the WWW helps to achieve broad public access to the results. Hopefully this work will encourage people to visit the church and enhance their visit by providing them with extra knowledge of the significance of the site.

A common problem of historical buildings is the lack of documentation. Rarely is a complete set of plans available; often none at all. If the building does not exist anymore, drawings or

Reconstruction of the collegiate church St. Peter and Alexander, Aschaffenburg



paintings may help to reconstruct the plans. Often, only a comparison with similar buildings of the particular epoch is possible. A complete set of plans of the collegiate buildings of the church of St. Peter and Alexander was available. For the church itself, plans of the ground floor, some sections and facades – but only of the 18th century – and photographs helped to complete the plans of the present state. In order to reconstruct the model of the church in the Gothic epoch many parts were copied from drawings, but the model of the

Romanesque epoch could only be reconstructed in accordance with the architectural style of the epoch.

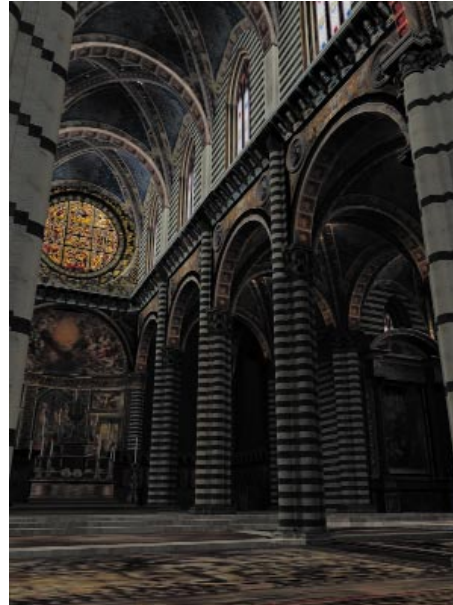
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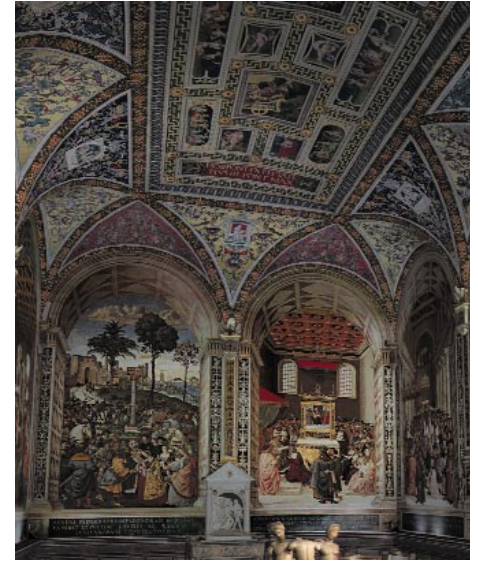


VR-Presentation of the Cathedral of Siena at EXPO 2000

Funded by German Ministry of Education and Research (BMBF), Fraunhofer IGD developed a computer graphics model of the Cathedral of Siena, including all interior parts and the famous library of Piccolomini. In addition, a lighting simulation had been performed to improve image quality. This 3D model was integrated in a newly developed VR environment in order to prototype new concepts for the integration of historical, architectural, and cultural data related to a



A view of the cathedral with a radiosity simulation, rendered in real-time



Liberia Piccolomini



The virtual avatar »Luigi«

cultural heritage site, into an immersive Virtual Reality environment. Stereoscopic projection and 3D sound had been used for the presentation of the new system.

In comparison to computer-animated movies, the digital cathedral of Siena enables the visitor to interact with the 3D model. An ancient book (realized through a touch-screen) serves as an input device, displaying a 2D map of the cathedral and providing easy-to-use navigation paradigms and information access. In addition, a 3D avatar »Luigi« – a virtual tourist guide – assists the visitor by explaining the history of the cathedral and supporting the orientation through the virtual building.

The VR system has been shown at EXPO 2000 in the theme park »basic needs«.

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The Interface



Innovative Handling- and Interaction Techniques

An increasing part of our daily life is influenced by modern information technology. Whilst the use of computers was restricted to classical areas such as accountancy or text processing in the past, completely new application areas have now emerged. Mobile information systems allow data entry and -analysis independently of stationary technique, high-speed networks allow mobile access to large amounts of data and the Internet. The use of modern sensor- and simulation techniques generates immense quantities of data, which are almost impossible to handle.

These new applications ask too much of the classical interfaces between man and machine. Completely new concepts of interaction with innovative applications are required to enable their efficient usage. Digital personal assistants can help the user by adjusting themselves to his habits. Equipped with facilities for geographic positioning, the assistant is able to provide useful information and help for a specific situation; thereby effectively supporting the user in his work without distracting him with secondary tasks. An application area for these assistants are electronic visitor information systems, which can significantly ease the orientation in an unknown environment.

New communication technologies allow data transmission and influence to real situations almost everywhere. Real scenes can be combined with virtual worlds to increase the immersivity for remote participants. Using real or virtual avatars, remote and present users can now communicate and interact with each other.





eGuide

eGuide is a new mobile visitor information system, basing on PDA hand-held devices. The system has been used by more than 40.000 users on trade shows, conventions or exhibitions, (e.g. CeBIT 2000, EXPO 2000, Systems 2000, DRUPA 2000, MEDICA 2000, SAP-Congress »mySAP.com« in Paris, SAP-Congress »SAPHIRE« in Las Vegas, McKinsey-Tage in Nizza, Palm-Source Europe 2001 in Amsterdam). This has resulted in the eGuide system being the most successful information system on the European market.

The eGuide combines textural and graphical information such as objects, products, product groups, exhibitors, speakers or lectures and supports the navigation by graphical interaction and sights. The user can create and select personalized tours. In addition the eGuide provides situation aware information to the user. Special infrared-beacons (IrDA-Beacon®, research prod-

Downloading station at the CeBIT



uct by the Fraunhofer IGD) can give the spatial information of objects or exhibits to the eGuide system. Through this the user can check which session is going on behind the closed doors of the convention or the location of the user's present position and which exhibit is in front. The application can be provided by the Internet or at data-stations locally at the conference or trade show. The user can download the application via infrared without any need of configuration.



eGuide overview map

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EMBASSI – Electronic Multimedia Serving and Service Assistance

The Challenge

The networking of audio/video electronics progresses inexorably; entertainment electronics, home computers and Internet merge in the near future into a common platform for Multimedia and Infotainment. Thus the question urgently arises: how can the difficult-to-understand variety and functionality of these future platforms be made accessible to the user? How can these systems be used efficiently, intuitively and playfully? What is necessary, so that such infrastructures correspond to the non-standard needs and desires of the user?

Targeting

The target of the master project EMBASSI – »electronic multimedia serving and service assistance« – is the development of a global assistance concept, which supports the user with assistance during the operation of everyday life technology. EMBASSI does not direct thereby at a purely punctual solution from control problems. Rather from the outset the center of attention is the statement that the user must interact with a dynamically interconnected system of individual components, in

order to hit his desires. The basis is thereby a user-centered beginning. Instead of asking how the user could best control the functions of a system, e.g. his domestic Infotainment infrastructure, EMBASSI first asks for the requirements and goals of the user. On this basis EMBASSI supplies procedures to assist the user to express his requirements and which allow the system to fulfil these requirements. The user does not have to say: »switch the television on around quarter past eight and select channel 7«, if he actually means: »I would like to see the news«.

Technological Background

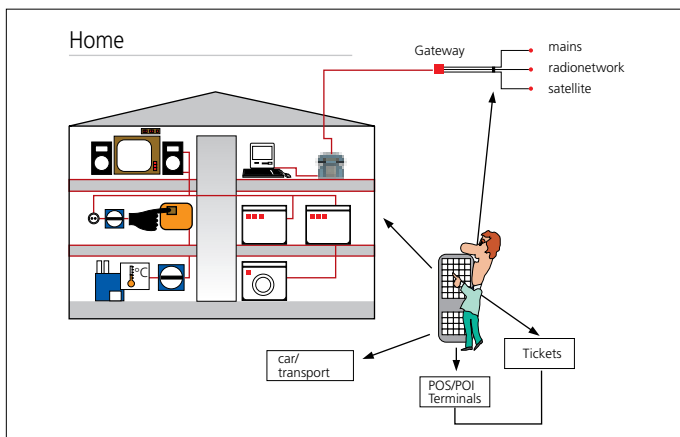
Regarding the available broad technological fundamentals, the inclusion of existing standards and models plays an important role for EMBASSI. Thus in the area of the private household the HAVI-protocol forms an important platform for the current work; in the area of motor vehicles this is MOST. Basically for communication between system components TCP/IP is used, on which knowledge based modules use KQML. As the common content language for all communication between EMBASSI components XML is used. For the definitions of the relevant ontologies in EMBASSI the description logic is used (ALCF). For the dynamic declara-

tion of the operators offered in an EMBASSI system of the individual components Action-Description-Language (ADL) is used, on whose base planning processes take place.

Planning Component

The function of the used planning assistant is to develop independently strategies for the fulfillment of user goals with the help of the available technical infrastructure and the operators offered by this infrastructure. The special feature of the planning assistant is situated in the fact that its concept enables the dynamic adding of new components. If a new component is integrated into the infrastructure, the additional functions offered by this component can be used directly for planning.

Assistants have the function to develop a »program« (xprog) based on the operations supported by the available devices aimed to fulfill the user's goal by its execution. In order to be able to plan thereby on complex infrastructures, a co-ordination algorithm is necessary, which coordinates the distributed execution of the »program«. So that each component does not have to support this co-ordination individually, which would make also resource management difficult an X-Scheduler was conceived and implemented, which can take over the scheduling of all X-components in the system.



The EMBASSI Environment

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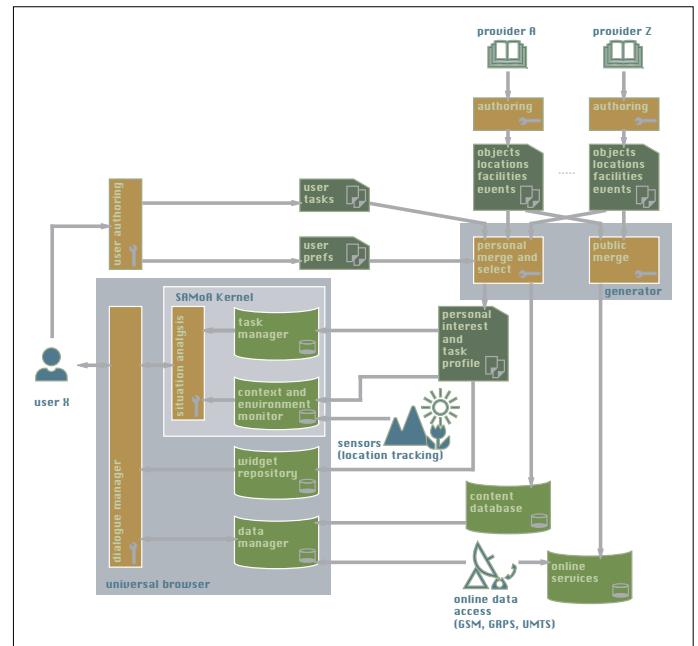
e-ssist

The goal of the Fraunhofer Innovations Initiative e-ssist is the development of a technology platform for the mobile electronics of the future aiming for the following key points:

- Body area networks
- Intelligent transponders (iTag)
- Low power concepts in circuitry
- Flexible materials and foil for system integration (MCMFlex)
- Flexible application generator for situation aware mobile assistance systems (MapGen)

In e-ssist we proceed those technologies and integrate it in a framework with attractive and forward-looking functionality. E-ssist will be handled jointly from the Fraunhofer Institutes IGD, IIS, IMS and IZM. The Fraunhofer IGD Rostock is concentrated in the period from October 2000 to December 2001 particularly to the application generator (MapGen). It is a matter of the following one-in-one aspects:

e-ssist Architecture



- Development of a generic application framework («universal browser») as the basis for the appropriation of a specific application in a mobile infrastructure,
- A toolkit, a suite of software-plugins for the interaction with typical data structures, that may be required in the context of mobile location and situation aware applications (e.g. map and topology management),
- An application definition language to define a specific application on the basis of functions of the generic framework,
- An authoring tool for graphical interactive production of an application definition.



Mobile Shopping Scout: Routing

**e-ssist shopping**

In cooperation with the institutes concerned in e-ssist an »electronic shopping list« has been developed as a functional demonstrator for the »e-ssist«-consortium. eShop – a mobile shopping scout – is a system, which extends the classic model of pen and notepad. Among the simplest extensions additional functionality is enabled by the dedication of mobile micro computer:

- non-standard settings for the shopping list (conceivably a learning shopping list),
- automatic generation of the shopping list or automatic home replenishment,
- help for orientation in the shopping environment,
- actual information on products, e.g. advertisements.

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Multimedia Workplace of the Future

The target of the leading project »Multimedia Workplace of the Future« (MAP) is to relieve the computer user from time-consuming routine activities by innovative agent and assistance concepts. Increased productivity as well as a larger action radius of the user will be obtained by special consideration of the mobile activities and by the integration of mobile terminals. Such activities for example are integrated administration of messages such as letters, faxes, email, telephone, automatic reaction to standard inquiries, provision of information and, in particular, administration and pursuit of task and time schedules. A mobile MAP workstation relieves the user of such work and completes it independently, without influencing control of the user. Thus the computer does not provide only common direct-manipulative tools. MAP permits the user to automate his activities individually and to delegate tasks to his electronic assistant.

MAP is promoted by the Federal Ministry for Economics and Technology (BMWi). As a leading project it demonstrates how to achieve more efficiency and mobility of labor in the age of M-Commerce. The implementation of the project's vision »pocket-sized office« is mainly focused on security, man-machine interaction and agents as well as mobile assistance.

MAP includes nine enterprises of economy as well as six institutions of trade union and science, in which are involved several departments of the Fraunhofer IGD. Project coordinator is the ALCATEL SEL AG.

Within the scope of MAP the task of the AR3 department of the Fraunhofer IGD is focused on the development of a personal task management assistant on the base of mobile devices and sensor based perception of the environment, supporting the user in the administration of his personal daily activities – especially with regard to increasing the importance of fast, flexible reaction to unplanned events. The A9 department is developing a visual programming environment. It determines the program logic or the behavior of the base agents by means of graphic methods and components (metaphors) which enable the user to control the agents behavior by condition/action rules (i.e. too CA-Rules or »if-then«-rules). The A8 department is involved particularly in the subproject »safety technologies« and, among others, is charged with the development of a secure mobile agent infrastructure. Based on previous work in the current project, SeMoA special safety architectures for agent servers are developed, as well as scalable mechanisms for a transparent communication of mobile agents among themselves, and cryptographic logs for the protection of agents.

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Telebuddy

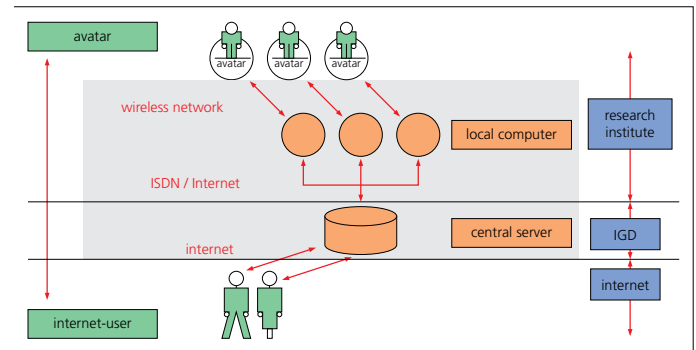
Telebuddy is the result of a BMBF-funded project shared jointly between the Fraunhofer IGD Rostock and the ZGDV Darmstadt. The aim of this project is to develop a »physical avatar« to give Internet users a physical presence in remote locations. An avatar is a »surrogate« – body which lends it's sensors and actuators to the Internet user.

For the first time the avatar was used to present German research institutes at the »Global Dialogue« event during the EXPO 2000. Here, the avatar was embedded in a virtual research scene. The user then could discover the whole spectrum of research in Germany and visit labs of some institutions live through the Telebuddy. This project also demonstrated a new dimension of multimedia presence and active participation through new inter-



Telebuddy on the EXPO2000

Major compounds



action and control concepts, use of wireless multimedia technologies and the Internet.

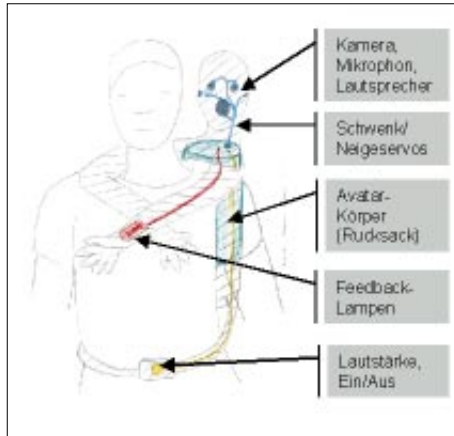
Other successful presentations of the Telebuddy were the BMBF/DLR Open Day in Berlin and in the »Kindercampus« event of ZDF television.

The system is available permanently giving a regular, efficient and attractive presentation of German research and its results in the Internet. Beside using it for interactive demonstrations and exhibitions, it can also be used for cultural events, games, or educational purposes. A model for further use of the service will be developed in this project as well as strategies for the step from a prototype to a commercial product.

The realization of the Telebuddy system comprises work in the three major fields of

- the avatar (Telebuddy),
- the stationary computer as a link between the avatar and the central system,
- the central server as access point to the Telebuddy system with its navigation and retrieval elements.

The prototype of the avatar looks like a crossbreed of a teddy bear and a muppet puppet, but inside it is full of high-tech components. The puppet is in permanent radio contact with the server, allowing the Internet user to access its communicational parts. In one eye the Telebuddy has a camera delivering a video stream, the other eye accommodates an infrared (IR-) sensor to identify its current location from IR-beacons (IrDA-Beacon® transmitter). The user can also chat with other participants and even talk to the outside world through Telebuddy's computer generated voice.



Broadcast and sensor technology

The integration of trend concepts like Internet chat, mobile Webcam, and electronic toy connects previously sovereign fields of telepresence, mobility and human-machine communication to anthropomorphic avatars. This new way of interaction and communication will give interesting insights into group processes.

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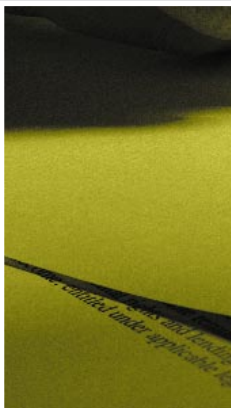
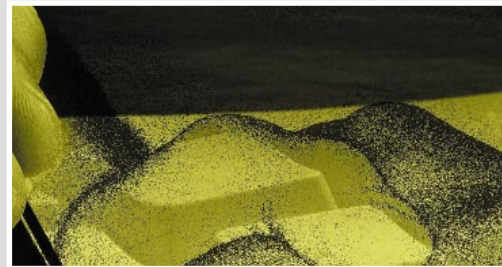
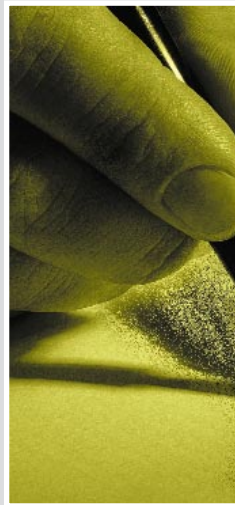
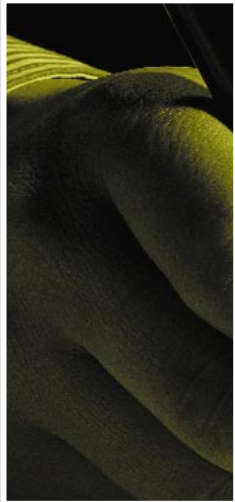
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Names, Dates, Events



Events

Forum Founded for a Cross-platform Development of a Standard for 3D Graphics Applications

The Open Source Scenegraph (OpenSG) forum was founded in Darmstadt on 28 January 2000. Initiated by researchers of the Fraunhofer Institute for Computer Graphics IGD, leading German industrial companies of various branches joined this forum. They aim to create a cross-platform standard for 3D graphics applications focusing on applications in the field of virtual reality. The realization will base on the Open Source model to secure long-term availability and sustainability of the result. The OpenSG forum will coordinate this project.

User Day »Computer Graphics in Chemistry and Pharmacy«

On 23 February 2000 the user day »Computer Graphics in Chemistry and Pharmacy« took place at Fraunhofer IGD in Darmstadt, organized by the newly founded Fraunhofer AGC and supported by Silicon Graphics (Munich). On this occasion visualization and simulation methods were demonstrated, which permit a significant improvement of quality and efficiency both of the complicated planning and production processes in the chemical and pharmaceutical industry, and the training of the staff.

Communicating Via Pictures – 25 Years GRIS

On 16 November 2000 the department Interactive Graphics Systems Group (GRIS) at Technische Universität Darmstadt celebrated its 25th anniversary which was attended by high-ranking representatives from politics and science. From small beginnings, Darmstadt is now a world-class player in the area of Computer Graphics. The focus of teaching and research activities of GRIS – until 1978 called Graphic Data Processing – was from the start to establish Computer Graphics as communication interface between human and machine. With only three assistants the founder of GRIS, computer science Professor Encarnaç o, started

Best Paper Award

On 16 November 2000 the award for the best publications from the INI-GraphicsNet took place in Darmstadt. This year the jury voted for the contributions »Texturing 3D Models of Real World Objects from Multiple Unregistered Photographic Views« by Peter J. Neugebauer and Konrad Klein, »Using Transparent Props for Interaction with the Virtual Table« by Dieter Schmalstieg, L. Miguel Encarnaç o and Zsolt Szalav ari, as well as »Reducing Memory Requirements for Interactive Radiosity Using Movement Prediction« by Frank Sch offel and Andreas Pomi.



Prof. Jos  L. Encarnaç o welcomes the guests at the Jubilee Celebration 25 Years GRIS



Numerous guests from home and abroad attended the Festival of Sciences



to transfer the digital world into pictures and aimed to establish Computer Graphics as a discipline in Germany and Europe. Meanwhile Computer Graphics developed to a key technology, which changed almost all areas of life and which is the impelling force for the innovations of the future.

Dr. Stefan Noll presents an overview of the E-Business Innovation Center



Opening of the E-Business Innovation Center at the Fraunhofer IGD (E-BIZ)

On 16 November 2000, the offices of the E-BIZ (E-Business Innovation Center) opened at the Fraunhofer IGD in Darmstadt. The official opening was accompanied by an E-Business symposium on the topic of »Technological Aspects, Applications and Trends«. At the symposium, experts from the areas of research and economics gave an overview of the activities of E-BIZ, examined security aspects, and reported on their experiences with electronic commerce technologies. Finally Professor Encarnaç o, head of the Fraunhofer IGD, addressed the audience about »Information Portals – Innovation by Knowledge Access«.



Award of the Design Prize Mecklenburg-Vorpommern

On 20 October 2000 the Design Prize of the State of Mecklenburg-Vorpommern was awarded for the sixth time by the Minister of Economics Professor Dr. Rolf Eggert, at the Fraunhofer IGD Rostock. From a total of 81 submitted works, 17 exhibits for the Design Prize and five exhibits for the Design Promotion Prize were chosen.

The prize-winners Prof. Dr.-Ing Robert Piloty and Prof. Dr. Willi Jäger discussing with Dr. Hans-Peter Kohlhammer, winner of the Alwin-Walther medal 1997



Award of the Alwin-Walther-Medals

Alwin-Walther-Medals were awarded at the Fraunhofer IGD in Darmstadt on 17 June 2000 on the occasion of an academic ceremony of the Computer Science and Mathematics Departments of Technische Universität Darmstadt. This year the medals were awarded to Prof. Dr. Dr. h.c. mult. Willi Jäger of Heidelberg University and Prof. Dr. Eng. Robert Piloty of Technische Universität Darmstadt. With the Alwin-Walther-Medals, founded by Computer Graphics Center and Fraunhofer IGD, the Technische Universität Darmstadt honors outstanding achievements in the fields of Mathematics and Computer Science. The Alwin-Walther-Medals were awarded in 2000 for the second time since 1997. They are a memorial to Professor Dr. Dr. h.c. Alwin Walther, a pioneer of the development of electronic calculating machines.



Prof. Dr. Johann-Dietrich Wörner, Prof. Dr. Jost Bernhard Walther and Prof. Klaus Keimel at the event

Prof. José L. Encarnação welcomes the guests at the Alwin-Walther award



Above:
Prof. Dr.-Ing Robert Piloty receives the Alwin-Walther medal



Right:
Prof. Dr. Willi Jäger receives the Alwin-Walther medal



Prof. Georgios Sakas during the Award Ceremony

TeleInViVo wins IST-Prize 2001

The three winners of the highest European technology prize »Großer Preis für ein Europa der Informationstechnologie 2001«, also known as the »Oscar of Information Technology«, include the telemedicine project »TeleInViVo«. Initiated by the Fraunhofer IGD, an interdisciplinary research group developed a transportable telemedical workstation that allows for medical teleconsultations. Integrated into the workstation, which fits into a light aluminum suitcase, is a 3D ultrasound unit with a PC, which can exchange data via any telecommunication channels. A doctor can use the equipment to scan a patient's data – ultrasound or radiology – and relay it to an expert thousands of miles away. Both doctors can then view the three-dimensional visual data and discuss a diagnosis and possible treatment methods online. The integrated wavelet data compression allows a loss-free compression of the data. So the patient information can be transmitted quickly and easily via Internet, ISDN, or even analog modem or satellite. Results, pictures, and specific expert knowledge are thus quickly available to the doctor in attendance or the medical assistant. This can save lives.

Meanwhile, the usefulness of the system has been impressively confirmed by hundreds of successful teleconsultations.

The Fraunhofer IGD Darmstadt realized the TeleInViVo project in cooperation with Computer Graphics Center (ZDGV) Darmstadt and the Centro de Computação Gráfica (CCG) in Coimbra, Portugal. Further consortial partners are: UNESCO, DSC Dr. Stärk Computer GmbH, PIE Medical, CATAI, Hospitais da Universidade de Coimbra and Hospital de Ponta Delgada.

Hessian Culture Prize awarded to Prof. José L. Encarnação

Professor José L. Encarnação, head of the INI-GraphicsNet, was awarded the Culture Prize 2000 of the State of Hesse for his outstanding successes in the area of Computer Graphics. The awards ceremony took place on 12 November 2000 in the Mathildenhöhe exhibition hall in Darmstadt, Germany. The Hessian Prime Minister Roland Koch took the laudation. The Prime Minister attested Prof. Encarnação a visionary feeling for the future. In his talk »Deception or Reality« Prof. Encarnação presented among others the virtual cathedral of Siena. Prof. Encarnação plans to introduce the digital key technologies of the new millennium to all interested people. His vision is a so-called »Cyberarium«, which will hopefully be developed in the Rhine-Main-area and is intended to playfully present culture to the people using modern information technology.



The Hessian Prime Minister Roland Koch presents Prof. José L. Encarnação the »Culture Prize 2000 of the State of Hesse«



INI-GraphicsNet produces Award-Winners in the Virtual and Augmented Reality Competition

To encourage the development of new simulation technologies, the German Ministry of Education and Research (BMBF) initiated a project proposal competition for virtual and augmented reality. In the first round of selections in July 2000, the German Ministry of Education and Research (BMBF) awarded 25 of the 173 draft project proposals that had been submitted. Institutions of the INI-GraphicsNet research network are substantially involved in eight of these proposals, and the Fraunhofer IGD or the Computer Graphics Center (ZGDV) are consortium leaders for six of the selected project proposals. This result shows the capabilities and incredible range of the INI-GraphicsNet in the areas of virtual and augmented reality.

High-Tech for Cancer Treatment

Researchers from the Fraunhofer IGD are among the winners of the »Innovation competition for the promotion of medical technology«. Along with eleven other prize-winners, they were honored by the Federal Ministry of Education and Research on the occasion of the MEDICA congress on 24 November 2000. An international jury honored their innovative research method jointly followed by researchers of the Institute and the Dr.-Horst-Schmidt hospital in Wiesbaden, Germany. The aim is to »upgrade« the established white light endoscopy by a new image processing software to allow a novel analysis and information processing of the endoscopic picture. If successful, diagnosis and therapy of bladder cancer could be considerably improved. Within less than two years, a prototype will deliver revealing tumor pictures for doctors.

Participation in Committees

Fraunhofer IGD employees participate in the following national and international committees, often in leading roles:

- Anwender- und Entwicklerforum »VR Technologien in der Entwicklung, Konstruktion, Fertigung und im Marketing« – ProVR
- Arbeitsgruppe 4 im VDI-Fachausschuss Simulation und Visualisierung
- Arbeitsgruppe GIS des Facharbeitskreises IuK
- Association for Computer Machinery (ACM)
- Advisory Council INI-GraphicsNet Foundation
- German Ministry of Education and Research (BMBF) Board of Advisors »EXIST – Existenzgründer an Hochschulen«
- CIP4 Advisory Board
- Deutsche Vertretung im IFIP TC5 (Computers in Industry)
- DIN NABAU Metadaten
- DIN NAM 430.4. – Transfer und Archivierung von Produktmodell-daten (TAP)
- Editorial Board »Computers & Graphics« (Pergamon Press) – seit 1983 »Editor-in-Chief«
- Editorial Board Computer Aided Geometric Design (North Holland)
- Editorial Board INFORMATIK-F&E (Springer Verlag)
- Editorial Board Visual Computer (Springer Verlag)
- EUROGRAPHICS Association
- Expertenkreis »Hochschulentwicklung durch neue Medien« der Bildungsinitiative der Bertelsmann-Stiftung
- Facharbeitskreis Informations- und Kommunikationstechnologien der Innovationsagentur Mecklenburg-Vorpommern



- Fachgutachter der DFG (Deutsche Forschungsgemeinschaft)
- Fraunhofer Vision
- Geschäftsführung CAST Forum im ZGDV e.V.
- Geschäftsführung des Forums für Informations-Services Mecklenburg-Vorpommern des ZGDV – ISMV
- Geschäftsführung Informations- und Kommunikationsforum für Geodaten des ZGDV
- Geschäftsführung OpenSG Forum im ZGDV
- Gesellschaft für Informatik, IFIP-Beirat
- GI-Fachausschuß 4.1 Graphische Datenverarbeitung und verschiedene Untergliederungen 4.1.1 – 4.1.6
- GI-Fachausschuß 4.8 Peripherie und Kommunikation
- GI-Fachbereich 4 Informationstechnik und technische Nutzung der Informatik
- GI-Fachgruppe 2.5.1 Datenbanksysteme
- Interministerieller Ausschuss für Geoinformationswesen des Bundes
- Board of Trustees INI-GraphicsNet Foundation
- Kuratorium des Forschungszentrums Informatik (FZI) in Karlsruhe
- Lenkungsausschuss Umweltdatenkatalog
- Lenkungskreis GI-Fachausschuß 4.9 Publikationssysteme
- Lenkungskreis GI-Fachgruppe 4.9.2 Multimedia
- Multimedia-Beirat des Landes Mecklenburg-Vorpommern
- Münchener Kreis
- Nationaler Arbeitskreis IT-Sicherheitskriterien des BSI
- Programmbeirat, 7. Deutscher IT-Sicherheitskongress, Bonn-Bad Godesberg
- Senior Editor, Presence Teleoperators & Vertical Environments
- Stellvertretender Vorsitz im IFIP WG 5.10 (Computer Graphics)
- Stiftung Deutsch-Amerikanisches Akademisches Konzil (German-American Academic Council Foundation), DAAK/GAAC
- VDI Arbeitskreis Simulation und Visualisierung
- Board of Directors INI-GraphicsNet Foundation
- Board of Directors Innovationsagentur Mecklenburg-Vorpommern
- Board of Directors ProStep Verein
- Membership in several national and international program committees for the organization of congresses, workshops and seminars on Computer Graphics topics
- Membership in several boards.

Workshops

Die digitale Signatur – der »Schlüssel« gegen Dokumentenfälschung, Darmstadt, 14 January 2000

Symposium »Zukunft der Biometrie«, Darmstadt, 14 January 2000

Workshop »Public-Key-Infrastrukturen«, Darmstadt, 28 January 2000

BioIS Technikfolgen-Abschätzungssymposium, Darmstadt, 9 February 2000

Firewall-Workshop, Darmstadt, 17 March 2000

Workshop »Zahlungssysteme und sichere E-Commerce Anwendungen«, Darmstadt, 27 April 2000

Workshop »Web-Security«, Darmstadt, 29 June 2000

Workshop »Advanced 3D Visualization Technologies for Industrial Applications«, Singapore, 15 August 2000

Workshop »Telemedicine – Present and Future«, EXPO Hannover, 6 September 2000

Workshop »IT-Sicherheits-Engineering«, Darmstadt, 22 September 2000

Workshop »SmartCards – Technik und Anwendung«, Darmstadt, 20 October 2000

Workshop IMC 2000 »Intelligent Interactive Assistance and Mobile Computing«, Rostock, 9-10 November 2000

Workshop »Kryptographie mit Elliptischen Kurven«, Darmstadt, 16 November 2000

E-Business Symposium zum Thema
»Technologische Aspekte,
Anwendungen und Trends«,
Darmstadt, 16 November 2000

Workshop »3D Stadtmodelle«,
Darmstadt, 17 November 2000

Workshop »Lighting Simulation in
Virtual Environments«,
Darmstadt, 17 November 2000

Workshop »Data Hiding«,
Darmstadt, 24 November 2000

Best Practice Seminar »Elektronische
Kataloge«,
Darmstadt, 4 December 2000

Fairs and Exhibitions

Also in 2000 the results of the Fraunhofer IGD research activities could be seen at numerous fairs and exhibitions. In addition to other events, we were present at the following occasions:

Achema
Frankfurt, 22-27 May 2000

Analytica und Analytica Symposium
Munich, 11-14 April 2000

Ausstellung »Village Gutenberg«
Mainz, 14-15 May 2000

CeBIT 2000
Hannover, 24 February - 1 March
2000

drupa
Düsseldorf, 18-31 May 2000

EUROMOLD 2000
Frankfurt, 29 November - 2 December
2000

EXPO 2000
Hannover, 1 June - 31 October 2000

Hannover Industriemesse 2000
Hannover, 20-25 March 2000

IBM Partnercamp
May 2000

ispo
Munich, 6-9 August 2000

Medica
Düsseldorf, 22-24 November 2000

Medientage
Munich, 6-8 November 2000

Photokina
Cologne, 20-25 September 2000

Promotiontour Schiff M-V
April-May 2000

SAP mySAP.com
Paris, April 2000

SAP SAPHIRE
Berlin, June 2000

SAP TechEd
Hamburg, April 2000

SAP
Las Vegas, June 2000

Systems 2000
Munich, 6-10 November 2000



Visitors

In 2000, again, we were glad to welcome to our institutes numerous guests from the fields of science, commerce, industry and politics. The following is a selection of some of our guests:

Guests from the Fields of Science and Research:

Manuel Cendoya, Parque Tecnológico de San Sebastian, Spain

Professor H.K. Chang, President of City University Hong Kong

Lino Fernandes and Delgado Domingos, IST

Professor Marcelo Gattass, Catholic University of Rio de Janeiro, Brazil

Professor Mario Rui Gomes, INESC, Instituto de Engenharia de Sistemas, Portugal

Dr. Paul ten Hagen, CWI, Netherlands

ITG-Fachausschuss

Dr. Se Ho Kang, President of UNITEL

Professor Kim, Korea, EWHA

Professor H.S. Lee of EWHA

Sergej Lesovoy, Institute for Informatics, University of St. Petersburg

Stephen Oliver, Microsoft Research, University Relations Group, Cambridge

Professor Picot, University of München

Professor Reiser, GMD St. Augustin

Dr. Mohamad Salleh Ismail, Technology Park, Malaysia

Professor Skiera, University of Frankfurt

Jürgen Stauder, Thomson multimedia R&D France

Jim Thomas, Battelle Pacific Northwest National Laboratory, Richland, USA

Participants of the national contest »Jugend forscht« 2000

Professor Vöge, BMW Munich

Guests from the Field of Politics:

David R. Wilkinson, European Commission Ispra, Italy

Neil Edwards, State Government of Victoria

Schulz, CDU

Siebel, SPD Darmstadt

Guests from the Fields of Commerce and Industry:

Ahle, Siemens Business Services EBS, Paderborn

Janos Avramopoulos, Intrasoft, Greece

Professor Barth, Dresdner Bank Frankfurt am Main

Basile Dimitriou and Gikas, Intrasoft, Greece

Dick Bultermann, Oratrix BV

Luise Büchner, Lions Club Darmstadt

Delegation of managers of the food industry

Erb, Krischer, Arbeitskreis IT der IG Metall, Kommunikationsforum

Jaffe and Bendiek, Fa. Early Bird

Jaksholt, Norwegian National Insurance Administration

Jost Stollmann, create-it

Hövel, CMC Cologne

Kotthaus, Wenz and Körner, Commerzbank

Kramer, Commerzbank, Frankfurt am Main

Makita, Mitsubishi – Germany

Meurer, Bertelsmann

Mr. Okuma, Mitsubishi – Tokio

Saito, Mitsubishi-Management

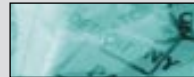
Sasaki, President Mitsubishi Corporation, Tokyo

Dr. Schwegler, T-Venture

Wilfried Straub, Director Deutscher Fussballbund



Scientific Publications



Lectures and Seminars

Benölken, P.:

Projekt Systementwicklung – 3D Java für verteiltes Viewing.

Seminar, University of Applied Sciences
Darmstadt, SS 2000

Bimber, O.:

Computer Graphics Aspects.

University of Rostock, Department of
Computer Science, January/February
2000

Bimber, O.:

Image based Rendering.

International Certificate Program for
New Media (ICPNM), Providence, USA,
March 2000

Encarnaçao, J. L.; Gerfelder, N.;
Neumann, L.:

Mobile Multimediale Kommunikation.
Seminar, Technische Universität
Darmstadt, WS 1999/2000, SS 2000,
WS 2000/2001

Encarnaçao, J. L.; Göbel, S.:

Informationssysteme für Geodaten im WWW.

Seminar, Technische Universität
Darmstadt, WS 1999/2000,
WS 2000/2001

Encarnaçao, J. L.; Hornung, C.:

E-Knowledge System für Lernen, Training und Wissensmanagement.

Practical, Technische Universität
Darmstadt, SS 2000

Encarnaçao, J. L.; Klein, R.; Lindner, R.;
Müller, W.:

Graphische Datenverarbeitung I.

Lecture+Tutorial, Technische Universität
Darmstadt, WS 1999/2000,
WS 2000/2001

Encarnaçao, J. L.; Klein, R.; Lindner, R.;
Müller, W.:

Graphische Datenverarbeitung II.

Lecture+Tutorial, Technische Universität
Darmstadt, SS 2000

Encarnaçao, J. L.; Klein, R.; Lindner, R.;
Müller, W.:

Graphische Datenverarbeitung III.

Lecture+Tutorial, Technische Universität
Darmstadt, WS 1999/2000,
WS 2000/2001

Encarnaçao, J. L.; Lindner, R.:

Programmierung eines graphischen Systems.

Practical, Technische Universität
Darmstadt, WS 1999/2000, SS 2000,
WS 2000/2001

Encarnaçao, J. L.; Lindner, R.:

Themen zu Graphisch-Interaktiven Systemen.

Seminar, Technische Universität
Darmstadt, WS 1999/2000, SS 2000,
WS 2000/2001

Encarnaçao, J. L.; Müller, W.;
Spierling, U.:

High Definition Multimedia (Agenten und Avatars).

Seminar, Technische Universität
Darmstadt, WS 1999/2000, SS 2000,
WS 2000/2001

Encarnaçao, J. L.; Schöffel, F.;
Kresse, W.:

Radiosity und Ray-Tracing.

Seminar, Technische Universität
Darmstadt, WS 1999/2000, SS 2000,
WS 2000/2001

Encarnaçao, J. L.; Schönhut, J.:

Grundlagen der Informatik II.

Lecture, Technische Universität
Darmstadt, SS 2000

Jasnoch, U.:

Graphische Datenverarbeitung.

University of Heidelberg, 2000

Jasnoch, U.:

Graphische Informationssysteme.

Lecture, Technische Universität
Darmstadt, WS 1999/2000,
WS 2000/2001

Jasnoch, U.:

Offene, verteilte Informations- umgebungen.

University of Applied Sciences
Aschaffenburg, 2000

Krömker, D.:

Animation und Multimedia.

Goethe-University, Frankfurt a. M.,
WS 2000/2001

Krömker, D.:

Animation und Visualisierung.

Goethe-University, Frankfurt a. M.,
WS 1999/2000

Krömker, D.:

Computergraphik mit VRML und JAVA 3D.

Goethe-University, Frankfurt a. M.,
WS 1999/2000, WS 2000/2001

Krömker, D.:

Ergänzungen zur Graphischen Datenverarbeitung.

Goethe-University, Frankfurt a. M.,
SS 2000

Krömker, D.:

Graphische Datenverarbeitung.

Goethe-University, Frankfurt a. M.,
SS 2000

Krömker, D.:
Informationsvisualisierung und Scientific Visualization.
 Goethe-University, Frankfurt a. M.,
 SS 2000

Krömker, D.:
Multimedia und 3D Animation.
 Goethe-University, Frankfurt a. M.,
 WS 1999/2000

Krömker, D.:
Visualisierung.
 Goethe-University, Frankfurt a. M.,
 WS 2000/2001

Müller, S.:
Augmented Reality.
 Seminar, Technische Universität
 Darmstadt, WS 2000/2001

Müller, S.:
Visualisierung und Virtuelle Realität.
 Lecture, Technische Universität
 Darmstadt, SS 2000

Sakas, G.:
Bildverarbeitung.
 Lecture, Technische Universität
 Darmstadt, SS 2000

Schönhut, J.:
Color in Display and Printing.
 International Certificate Program for
 New Media (ICPNM), Providence, USA,
 18.-20. January 2000

Urban, B.:
**Aspekte der Computer Graphik:
 IT based Learning and Training.**
 Lecture, University of Rostock,
 Department of Computer Science,
 WS 1999/2000

Urban, B.:
**Encoding and Compression
 Techniques for Multimedia
 Communication.**
 Lecture, International Certificate
 Program for New Media (ICPNM),
 Providence, USA, 08.-12. December
 2000

Urban, B.:
Multimediale Kommunikation.
 Lecture, University of Rostock,
 Department of Computer Science,
 WS 1999/2000, WS 2000/2001

Urban, B.; Hambach, S.; Sander, U.;
 Malo, S.:
Didaktik für Neue Medien.
 Interdisciplinary Seminar, University
 of Rostock, Department of Computer
 Science and Department of Educational
 Sciences, WS 2000/2001

Graduations

Bauer, Klaus M.:
**Automatische Generierung multi-
 medialer Präsentationen für Elec-
 tronic-Commerce-Anwendungen.**
 Supervisors:
 Prof. Dr.-Ing. J. L. Encarnação, Technische
 Universität Darmstadt
 Prof. Dr. P. Mertens, Universität
 Erlangen
 Prof. Dr. H. J. Hoffmann, Technische
 Universität Darmstadt
 Graduation, Technische Universität
 Darmstadt, Department of Computer
 Science, FG GRIS, 14 April 2000

Cai, Wenli:
**Interactive Volume Visualization in
 the Context of Virtual Radiotherapy
 Treatment Planning.**
 Supervisors:
 Prof. Dr.-Ing. J. L. Encarnação,
 Technische Universität Darmstadt
 Prof. Jiaoying Shi, Zhejiang University
 Prof. Dr.-Ing. G. Sakas, Technical
 University of Athens
 Technische Universität Darmstadt,
 Department of Computer Science,
 FG GRIS, 19 May 2000

Luckas, Volker:
**Elementbasierte, effiziente und
 schnelle Generierung von 3D Visual-
 isierungen und 3D Animationen.**
 Supervisors:
 Prof. Dr.-Ing. J. L. Encarnação,
 Technische Universität Darmstadt
 Prof. Dr. A. Kuhn, University of
 Dortmund
 Graduation, Technische Universität
 Darmstadt, Department of Computer
 Science, FG GRIS, 23 February 2000



Lux, Miriam:

Ein offenes Rahmensystem zur Wissenskristallisierung ökonomischer Daten.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Prof. Dr. Chr. Schlueter-Langdon,
University of Southern California
Graduation, Technische Universität
Darmstadt, FG GRIS, 27 October 2000

Müller, Wolfgang:

Effektiver Einsatz grundlegender Darstellungsprimitive zur Informationsvisualisierung.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Prof. H. Schumann, University of
Rostock
Graduation, Technische Universität
Darmstadt, Department of Computer
Science, FG GRIS, 1999

Müller-Wittig, Wolfgang:

Kopplung von Objektverhalten anatomischer Strukturen mit haptischen Displays und dazugehörige Interaktionsmöglichkeiten.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Prof. Dr.med. M. Börner, BG Unfall-
klinik Frankfurt
Graduation, Technische Universität
Darmstadt, Department of Computer
Science, FG GRIS, 8 December 2000

Neugebauer, Peter:

3D Digitalisierung und Rekonstruktion realer Objekte unter Berücksichtigung der Sensorgeometrie.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Prof. Dr. G. Sakas, TU Athens
Prof. Dr. C.-E. Liedtke, University of
Hannover
Graduation, Technische Universität
Darmstadt, Department of Computer
Science, FG GRIS, 24 November 2000

Schiffner, Norbert:

Entwurf eines multimedialen 3D Konferenzsystems für geographisch verteilte Arbeitsgruppen.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Prof. Dr. Alexander Schill, University
of Dresden
Graduation, Technische Universität
Darmstadt, Department of Computer
Science, FG GRIS, 30 June 2000

Stork, Andre:

Effiziente 3D Interaktions- und Visualisierungstechniken für benutzer-zentrierte Modellierungssysteme.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Prof. Dr.-Ing. F.-L. Krause, TU Berlin
Graduation, Technische Universität
Darmstadt, Department of Computer
Science, FG GRIS, 29 September 2000

Zachmann, Gabriel:

Virtual Reality in Assembly Simulation- Collision Detection, Simulation Algorithms, and Interaction Techniques.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação,
Technische Universität Darmstadt
Dr. C. Cruz-Neira, IOWA State
University, USA
Graduation, Technische Universität
Darmstadt, Department of Computer
Science, FG GRIS, 10 July 2000

Theses

Abawi, Daniel F.:

Visuelle Meta-Komponenten.

Supervisors: Dörner, R.; Grimm, P.
Study thesis, Technische Universität Darmstadt

Bach, Holger:

CAD-Datenaustausch und -Visualisierung im Internet: Evaluierung und Vergleich unter Berücksichtigung von ISO 10303 (STEP).

Supervisors: Brunetti, G.; Elcacho, C.
Study thesis, Technische Universität Darmstadt

Barreiros Morais, Angel:

Investigation of Hybrid Tracking Basics in the Context of Augmented Reality.

Supervisor: Stricker, D.
Diploma thesis, Technische Universität Darmstadt

Beinhauer, Wolfgang:

Concept and Development of an On-line Information Repository.

Supervisor: Felger, W.
Diploma thesis, University of Singapore

Bieniek, Markus:

Aufbau und Kalibrierung eines hybriden Tracking Systems.

Supervisor: Schumann, H.
Diploma thesis, University of Applied Sciences Darmstadt

Bork, Markus:

Konzeption und Realisierung der Integration einer komponentenbasierten virtuellen Umgebung in ein Trainingssystem.

Supervisors: Grimm, P.; Dörner, R.
Diploma thesis, Technische Universität Darmstadt

Brossler, Andreas:

Visualisierungstechniken zur Darstellung von 3D Wolken für Anwendungen in Augmented Video.

Supervisor: Trembilski, A.
Diploma thesis, University of Applied Sciences Darmstadt

Daum, Henning:

Methoden zur Erkennung von Manipulationen an graphischen Zugangsberechtigungsanzeigen.

Supervisor: Busch, C.
Diploma thesis, Technische Universität Darmstadt

Dingel, Thomas:

Authoring von interaktiven Verhaltenskomponenten für 3D Modelle im WWW.

Supervisor: Elcacho, C.
Diploma thesis, University of Applied Sciences Darmstadt

Duran Sanchez, Miguel Angel:

Design and Implementation of a Library of Functions for Hybrid Volume Rendering Using OpenGL.

Supervisor: Walter, S.
Diploma thesis, Technische Universität Darmstadt

Ehnes, Jochen:

Immersive Sketching as a Tool for the Evaluation of CAD Data – A new Approach to the Design Process.

Supervisors: Unbescheiden, M.; Felger, W.
Diploma thesis, Technische Universität Darmstadt

Eichenauer, Peter:

Modellerstellung und Programmierung eines Avatars in 3D.

Supervisor: Fröhlich, T.
Diploma thesis, University of Applied Sciences Darmstadt

Euler, Magnus:

Analyse von Alternativen für eine integrierte Produktentwicklungsumgebung.

Supervisors: Anderl, R.; Rix, J.
Study thesis, Technische Universität Darmstadt

Flick, Andreas:

Optimierung und Vergleich verschiedener inkrementeller und hierarchischer Kollisionsalgorithmen.

Supervisor: Zachmann, G.
Diploma thesis, Technische Universität Darmstadt

Frotscher, Thilo:

Entwicklung von Methoden und Konzepten für den Einsatz von skalierbaren und erweiterbaren Middleware-Technologien für verteilte Geo-Metadaten-Informationssysteme im WWW.

Supervisor: Göbel, S.
Diploma thesis, Technische Universität Darmstadt

Grune, Christian:

Lernen in Computernetzen: Analyse didaktischer Konzepte für IT-basierte multimediale Lernumgebungen.

Supervisors: Nieke, W.; Sander, U.; Hambach, S.
Diploma thesis, University of Rostock

Hess, Uwe:

Visualisierung der Relationen innerhalb wirtschaftlicher Daten.

Supervisor: Lux, M.
Diploma thesis, University of Applied Sciences Darmstadt



Hinz, Oliver:

Konzeption und Realisierung der Integration von realen Kommunikationsendgeräten in virtuelle Umgebungen.

Supervisors: Dörner, R.; Grimm, P.
Diploma thesis, Technische Universität Darmstadt

Hou, Ping:

Mobile Computing und Mobile Agenten.

Supervisors: Schirmer, J.; Roth, V.
Diploma thesis, Technische Universität Darmstadt

Huang, Zongwei:

Simultanes Einbetten mehrerer Wasserzeichen in Audiodaten.

Supervisor: Arnold, M.
Study thesis, Technische Universität Darmstadt

Huber, Matthias:

Merkmalsbasierte Erkennung von Videosequenzen in einem kontinuierlichen Datenstrom einer digitalen Videoquelle.

Supervisor: Volmer, S.
Diploma thesis, Technische Universität Darmstadt

Huch, Tassilo:

Videobasiertes mobiles Tracking-system in einer urbanen Umgebung unter Nutzung eines 3D Stadtmodells.

Supervisors: Coors, V.; Kretschmer, U.
Diploma thesis, Technische Universität Darmstadt

Koglin, Ilona:

Konzeption eines Seminars zum Thema PDF.

Supervisors: Heuer, J.; Daun, S.; Krieger, K.-O.
Diploma thesis, University of Applied Sciences Leipzig

Krafzig, Urs:

Telepresence by Spatial Audio-Visual Output.

Supervisor: Chodura, H.
Diploma thesis, Technische Universität Darmstadt

Leukel, Oliver:

Web based Artifact Exchange.

Supervisors: Noll, S.; Repenning, A.
Diploma thesis, Technische Universität Darmstadt

Mussel, Jan:

Integration psychoakustischer Modelle in Wasserzeichenverfahren.

Supervisor: Arnold, M.
Diploma thesis, University of Applied Sciences Bingen

Neidhardt, Jennifer:

»Grafische Datenformate« – Ausarbeitung eines Schulungskonzeptes.

Supervisor: Koch, R.
Diploma thesis, University of Applied Sciences Berlin

Peters, Jan:

Namensdienste für Mobile Agenten Systeme.

Supervisor: Roth, V.
Diploma thesis, Technische Universität Darmstadt

Pfeiffer, Nina:

3D Animation von 2D Bauplänen.

Supervisor: Luckas, V.
Diploma thesis, University of Applied Sciences Darmstadt

Pinsdorf, Ulrich:

Entwicklung eines Dialogsystems zur multimodalen Interaktion zwischen Mensch und Agenten unter besonderer Berücksichtigung der natürlichen Sprache.

Supervisor: Jalali-Sohi, M.
Diploma thesis, University of Applied Sciences Bingen

Plößer, Michael:

Haptische Simulation minimal invasiver Eingriffe zur Integration in einen VR-basierten Trainings-simulator.

Supervisor: Müller, W.
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Schulmeyer, Sven:

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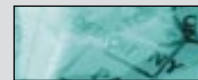
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Vom Kursverwaltungssystem zur offenen Lernumgebung.
 10. Arbeitstreffen »Intelligente Lehr- und Lernsysteme«, Hamburg, 1-2 December 2000
- Hein, O.:
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 12. GI-Workshop »Grundlagen von Datenbanken«, Pl n, 16 June 2000
- Hein, O.:
Aufbau eines verteilten Metadaten-informationssystems mit XML.
 4. Darmst dter XML Kongress – XML und Datenbanken, Darmstadt, 6 December 2000

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Agentenbasierte Moderations- und Hilfsdienste für die Kooperationsplattform Business-MV.

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Controlling Networked Multimedia Appliances Within an Open Environment – a Plan Based Approach.

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Technologische Rahmenbedingungen & Entwicklungsperspektiven für GIS im Internet.

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Jasnoch, U.:

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CommonGIS: The Data Characterization Language.

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An Internet Based Information Service to Support the Product Development Process in Design Offices.

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EU-TeleInViVo: An Integrated Portable Telemedicine Workstation Featuring Acquisition, Processing and Transmission over Low-bandwidth Lines of 3D Ultrasound Volume Images.

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Invited Junear Lecturer, 4th IEEE EMBS International Summer School on Biomedical Imaging, Ile de Berder, Bretagne, Frankreich, 17-24 June 2000

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An Autocalibration Tool for the Photometric and Colorimetric Consistency of IPTs.

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Neue Technologien für Kommunikations- und Teamtraining im Sicherheitsmanagement.

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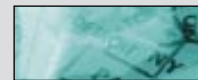
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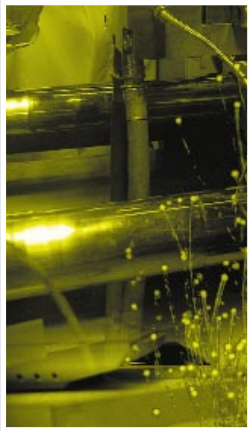
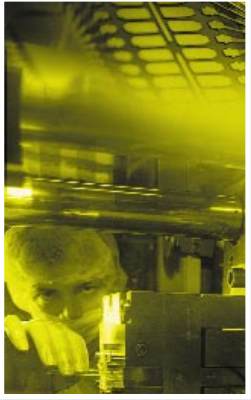


- Krömker, D.:
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- Linnert, C.:
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- Lutz, B.:
Viruelles Geschichtenerzählen – Der Dom von Siena.
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- Lux, M.:
The Iceberg Metaphor to Support the Knowledge Crystallization Cycle.
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- Lux, M.:
PROSECO – A Framework Architecture to Provide Services for Economic Data.
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- Lux, M.:
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- Müller, W.:
Computer Assisted Preoperative Planning System for Total Knee Replacement.
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Planning System for Computer Assisted Total Knee Replacement.
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The Virtual Reality Arthroscopy Training Simulator.
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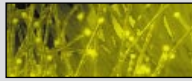
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- Seiler, C.:
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A Flexible Framework for the Knowledge based Generation of Multimedia Presentations.
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- Urban, B.:
Das Kursverwaltungssystem CMS-W3.
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- Urban, B.:
Multimedia und Bildung.
Facharbeitskreis IuK, Rostock, 5 July 2000
- Urban, B.:
Konzepte und Lösungen für adaptive rechnerbasierte Ausbildung und Training.
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- Urban, B.:
Internetdienste im Landesinformationssystem MV-Info.
Stammtisch Unternehmerverband Rostock und Umgebung, Rostock, 12 April 2000
- Urban, B.:
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- Urban, B.:
Education on Demand – the Way to the Flexible Education.
Workshop »Structures of Learning – Shaping the Transition«, European Regional Information Society Association and Technology Foundation of Schleswig-Holstein, Lübeck, 3-4 July 2000
- Urban, B.:
TeCoMed: Telekonsultationssystem zur aktuellen Gesundheitssituation in MV.
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- Urban, B.; Brozio, L.:
Der Multimediastandort Mecklenburg-Vorpommern.
Gründungsveranstaltung Forum KOMM-MV des ZGDV e.V., Rostock, 14 June 2000
- Urban, B.; Haßinger, S.:
Nutzen und Potentiale des Einsatzes neuer IuK-Technologien für Unternehmen in MV.
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- Voskamp, J.:
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- Voskamp, J.:
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Learning and Training Technologies.
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- Voss, G.:
Lahystotrain: Intelligent training system for Laparoscopy and Hysteroscopy.
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- Walter, S.:
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- Wohlfahrter, W.; Encarnaçao, L. M.; Schmalstieg, D.:
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The Fraunhofer-Gesellschaft at a Glance



The Fraunhofer-Gesellschaft at a Glance

The Fraunhofer-Gesellschaft is the leading organization for institutes of applied research in Germany, undertaking contract research on behalf of industry, the service sector and the government. Commissioned by customers in industry, it provides rapid, economical and immediately applicable solutions to technical and organizational problems.

Within the framework of the European Union's technology programs, the Fraunhofer-Gesellschaft is actively involved in industrial consortiums which seek technical solutions to improve the competitiveness of European industry. The Fraunhofer-Gesellschaft also assumes a major role in strategic research. Commissioned and funded by Federal and States ministries and governments, the organization undertakes future-oriented research projects that contribute to the development of innovations in key technologies and spheres of major public concern, such as energy, transport and the environment.

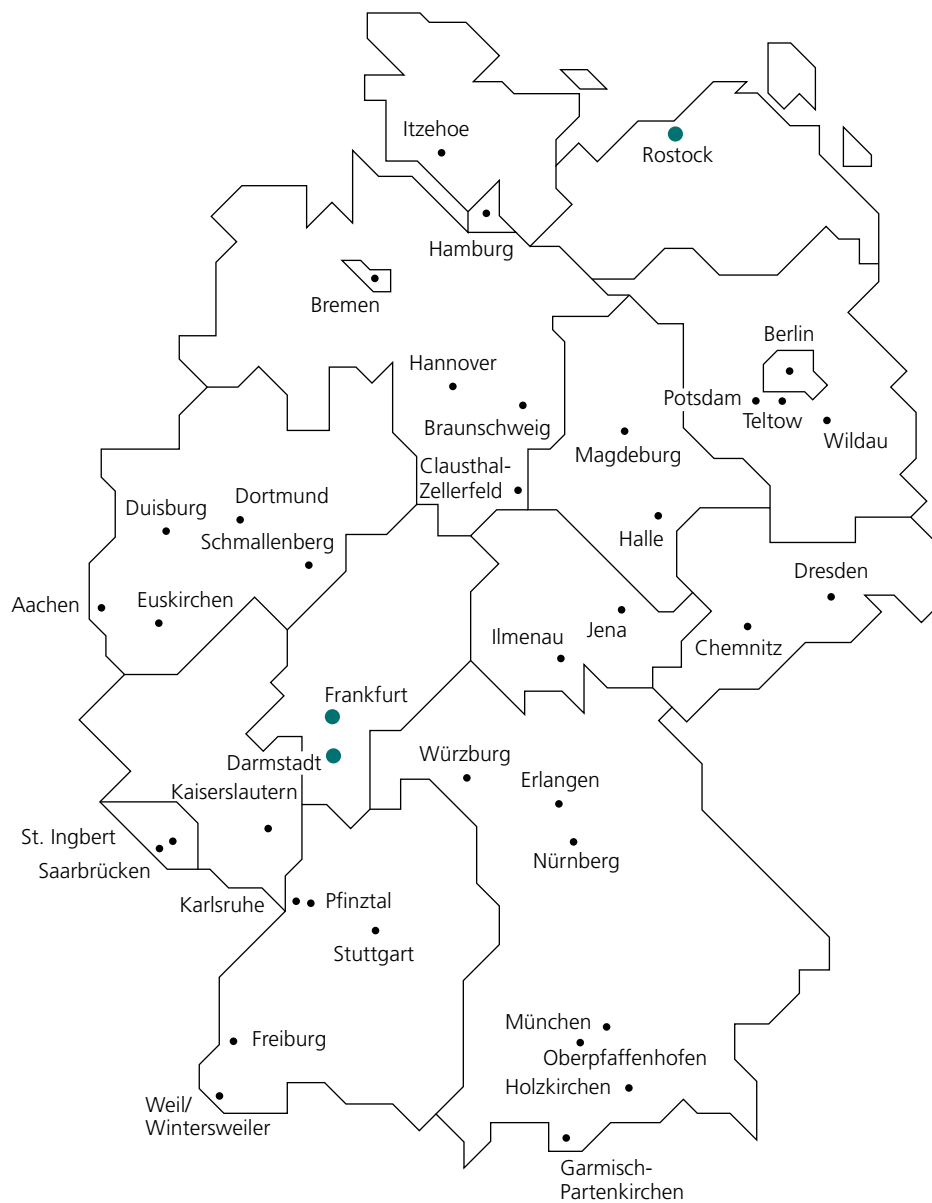
The global alignment of industry and research has made international collaboration imperative. Furthermore, affiliated Fraunhofer institutes in Europe, in the USA and Asia ensure contact with the most important current and future economic markets.

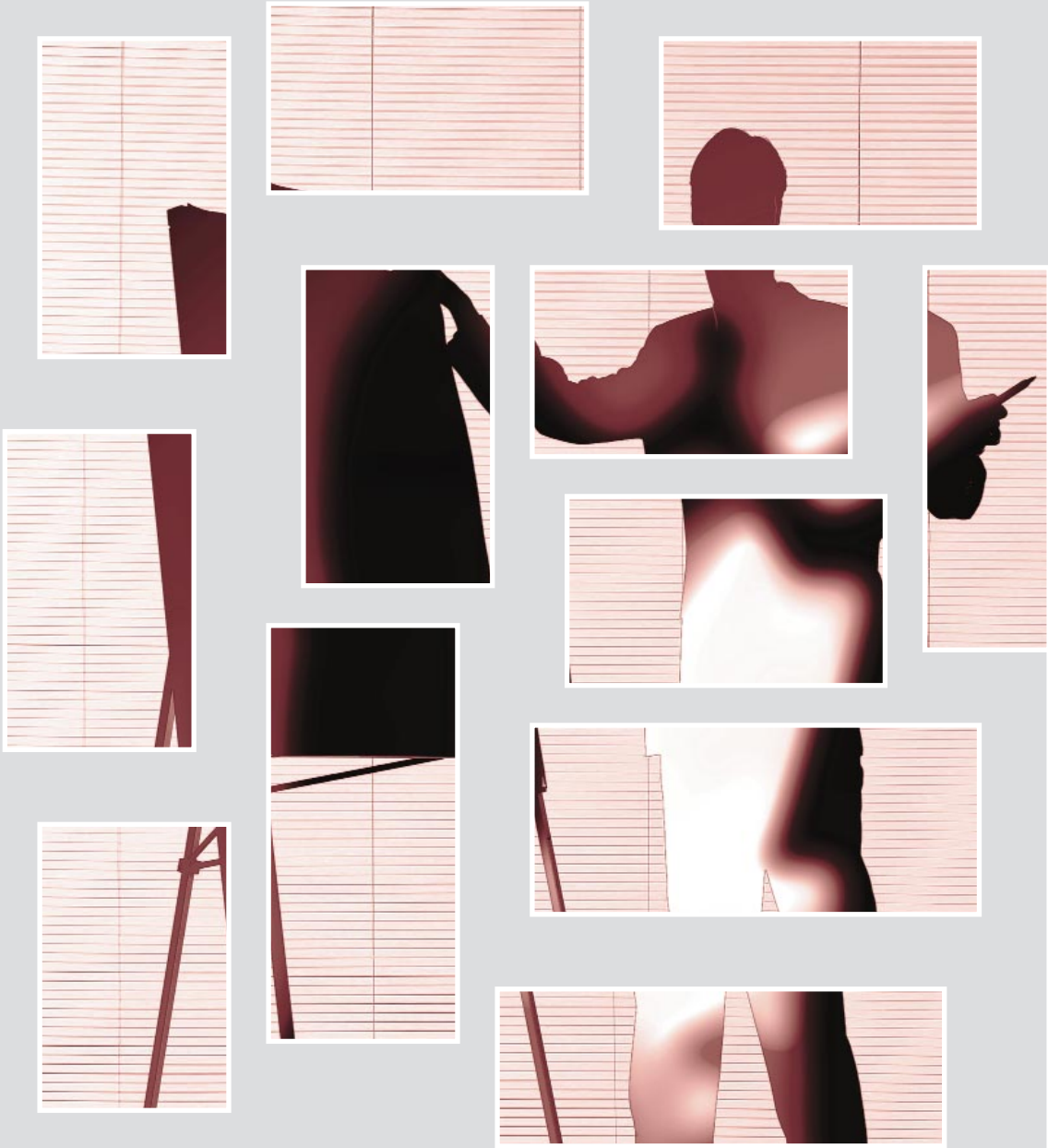
At present, the organization maintains 48 research establishments at locations throughout Germany. A staff of some 9,600, the majority of whom are qualified scientists and engineers, generate the annual research volume of around 760 million. Of this amount, 650 million is derived from contract research. Approximately two thirds of the Fraunhofer-Gesellschaft's contract revenue is generated through research contracts funded by industry and publicly-financed research projects.

Fraunhofer scientists specialize in complex research tasks involving a broad spectrum of research fields. When required, several institutes pool their interdisciplinary expertise to develop system solutions.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognized non-profit organization. Its members include well-known companies and private patrons who contribute to the promotion of its application-oriented policy.

The organization takes its name from Joseph von Fraunhofer (1787-1826), the successful Munich researcher, inventor and entrepreneur.





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Editorial

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How to Find us in Darmstadt

On Foot

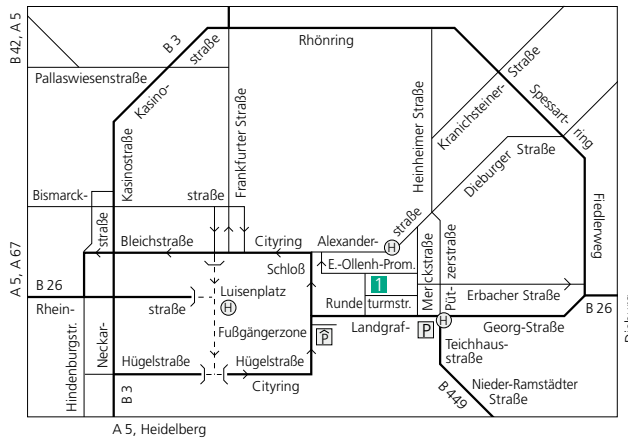
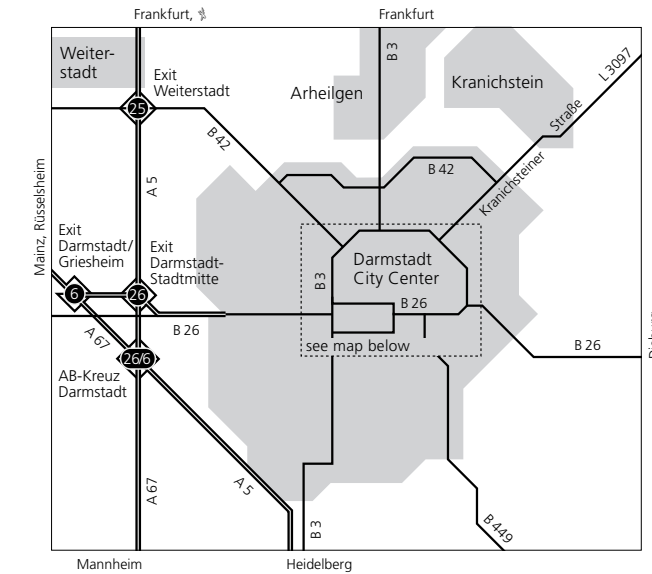
From »Luisenplatz«, follow the pedestrian zone (Rheinstrasse) past Ernst-Ludwig-Square with its statue and past the castle. At the end of the pedestrian zone follow »Landgraf-Georg-Strasse«, and take the second turning on the left. Follow this street. The next street on the right hand is »Rundeturmstrasse«, where you will find our institute.

From the Freeway (A5, A67)

Freeway intersection (Autobahnkreuz) Darmstadt – freeway exit »Darmstadt /Stadtmitte« (city): Follow »Rheinstrasse« through the city tunnel. At the end of the city tunnel, turn left and follow the »Cityring«. At the first large crossing turn left into »Kirchstrasse«. At the next large crossing, turn right into »Landgraf-Georg-Strasse«. Shortly before the next traffic lights turn left into »Merckstrasse«; the next side street on the left is »Rundeturmstrasse«.

From the Central Station

Take Bus F (direction »Oberwaldhaus«) to »Alexanderstrasse/TU« and exit here. Going back along »Merckstrasse« a little turn right in »Erich-Ollenhauer-Promenade«, which will lead you straight to our main entrance. Or take Bus D (direction »Ostbahnhof«) to »Teichhausstrasse«. and exit here. Going back along »Landgraf-Georg-Strasse« a little, turn right at the second turning. The next street on the right »Rundeturmstrasse«.



Location Darmstadt, Germany

- 1 Fraunhofer Institute for Computer Graphics IGD
- Undercover Parking in the Justus-Liebig-Haus
- Parking at the »Altes Finanzamt«

From the Airport (Frankfurt)

The Airline provides a bus transfer every (half an) hour from bus stop #14 at Frankfurt airport to Darmstadt/ Luisenplatz. From here you can either walk (see »On Foot« above) or catch a bus (see »From the Central Station« above):

How to Find us in Rostock

From the Freeway (A19)

Exit the E55 (A19) freeway at »Rostock Ost« or »Rostock Süd« and follow the signs to »Zentrum/Hauptbahnhof (main station)«. At the main station, turn right and follow »Goethe-Strasse«. Turn left at the next crossing (Goethe-Platz) and follow the »Südring«. Turn right at the first crossing and follow »Erich-Schlesinger-Strasse«. At the first crossroads turn left into »Rudolf-Diesel-Strasse«. The »Rostocker Innovations- und Gründerzentrum (RIGZ)« is located at the end of this street. Our institute is located at the rear of the RIGZ – please follow the signs.

From the Main Station

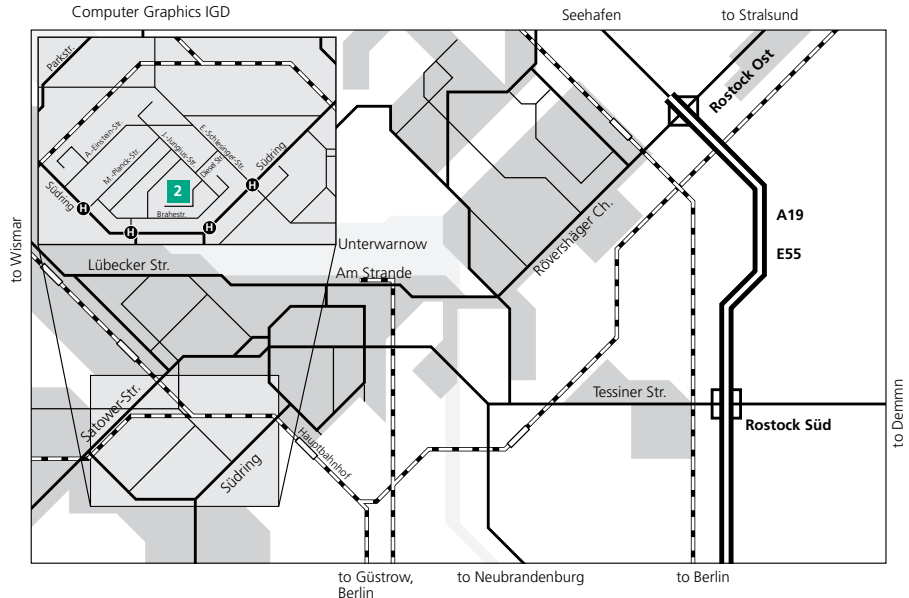
Take the #23 bus (direction Mensa). Exit the bus at »Erich-Schlesinger-Strasse« (2 stops). Follow »Erich-Schlesinger-Strasse«, and turn left at the first crossroads (»Rudolf-Diesel-Strasse«). The »Rostocker Innovations- und Gründerzentrum (RIGZ)« is located at the end of this street. Our institute is located at the rear of the RIGZ – please follow the signs.

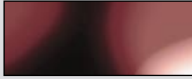
From the Airport

There are flights to Berlin or Hamburg. From here you can either take a train, rent a car or take a shuttle service to Rostock. There are also direct flights from Berlin, Hamburg, Bremen, Dortmund and some other German cities to Rostock-Laage airport available. From the airport, take a train or a taxi to Rostock.

Location Rostock, Germany

2 Fraunhofer Institute for
Computer Graphics IGD





How to Find us in Frankfurt

From the Freeway

No matter which direction you travel from, always take the A5 freeway and exit at »Autobahnkreuz West«. Then follow the sign for »Stadtmitte/Messe« (City Center/Exhibition Center). You are now on the »Theodor-Heuss-Allee«. Carry on until you reach the »Ludwig Erhard Anlage« roundabout. Take the exit leading onto »Hamburger Allee« and then the second right into »Varrentrappstrasse«. The Fraunhofer AGC is located on the right of the street (house no. 40-42).

From the Main Station

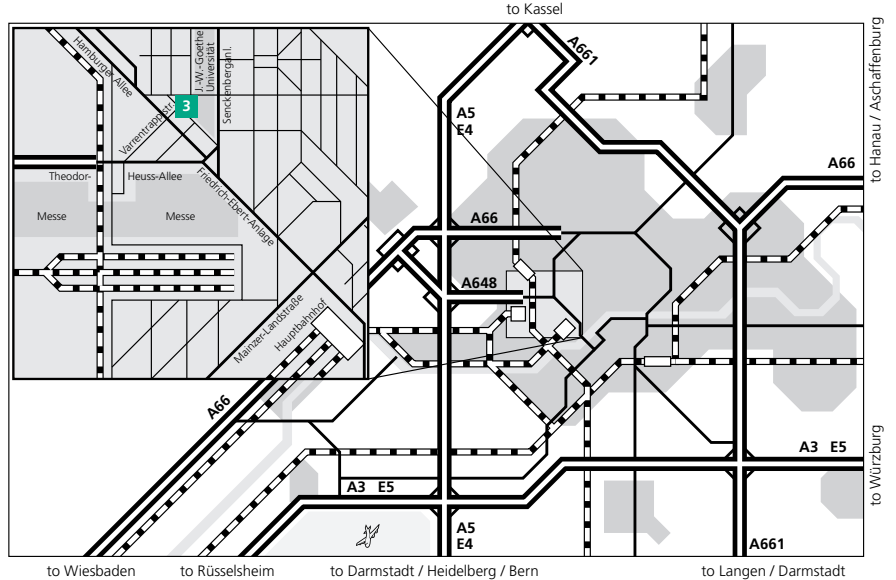
Go to the tram station in front of the main railway station. Either take the #16 (direction Ginnheim) or #19 (direction Westbahnhof) tram. Exit at »Varrentrappstrasse« (4th stop). The Fraunhofer AGC is located on the right hand side of the street (house no. 40-42).

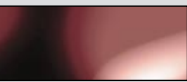
From the Airport

Go to the regional railway station on the lower level of the airport. Take the train to the main station (Frankfurt Hauptbahnhof, e.g. S-Bahn S8 for Hanau Hauptbahnhof) then follow the tram instructions.

Location Frankfurt am Main, Germany

3 Fraunhofer Applications Center for Computer Graphics
in Chemistry and Pharmaceuticals AGC





How to Find us in Providence

By Car from the North or South

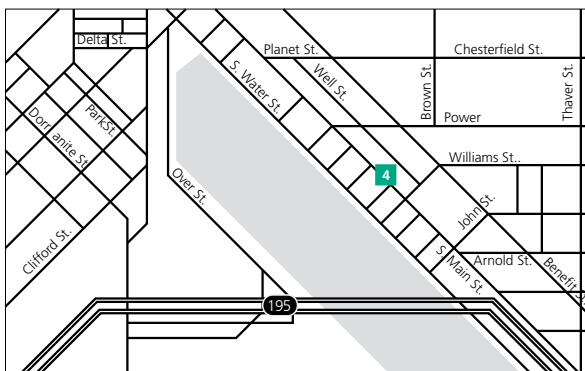
Most people travelling to Providence take Interstate 95. Regardless of whether you are starting from I-95 North or South, get off at Exit 20 onto I-195 East. (Northbound travelers will note the absence of an exit 19 and should take exit 20, one mile after exit 18.) From I-195 East, get off at Exit 1 (downtown exit). Follow the ramp and road along the river and take the first right (go over bridge) onto Crawford Street. This becomes S. Water Street. Follow S. Water Street along the river, keeping left as the road forks, to Williams Street. Go left at Williams Street; then left onto So. Main Street.

By Car from the East

Take Interstate 195 West. Get off at Exit 2 (S. Main St). 321 is in the second block on your left. You can park on S. Main Street (2 hour meters) in front of the building. You can also park in the paid parking lot at the rear of the building on S. Water Street.

By Train or Bus

Amtrak runs almost all of its northeast corridor trains through Providence on their way to Boston or New York City. Bonanza and other bus companies run regular buses to Kennedy Plaza in downtown Providence. From Boston, there are also »T« commuter trains running to Providence and South Attleboro. If you are arriving here by train or bus, simply take a taxi and ask the cab driver to take you to 321 S. Main Street. We are on the second floor.

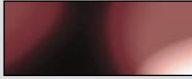


Location Providence, USA

- 4 Fraunhofer Center for Research in Computer Graphics CRCG

By Plane

Providence (officially, T.F. Green) Airport is located off exit 13 on Interstate 95. If you are traveling by airplane, you can ask a cab to take you to 321 S. Main Street. The fare is about \$25-30. We are on the second floor. If you are driving from the airport, simply follow the instructions above under »By Car from the North or South.« Alternatively, the Airport Van shuttle leaves the airport every hour on the hour. For \$9.00 (cash only) it will take you to the RISD (Rhode Island School of Design), just a few blocks from our office.



How to Find us in Singapore

Our offices are located on the campus of the Nanyang Technological University (NTU), Jurong. The NTU is situated in the south-western part, approximately 25 km from Singapore city center.

By Bus

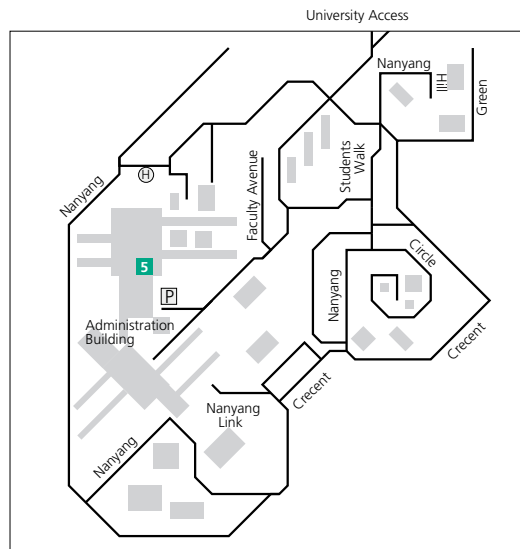
Take Bus 199 at Boon Lay Bus Interchange. Exit at the 3rd bus stop from the NTU entrance. Walk briskly for 5 minutes through Canteen A & across Carpark A (Keep to the right of Carpark A). Take Lift NS1-1 to the 5th floor. Use the intercom to request entry to CAMTech.

By Taxi

The taxi fare from the airport is about 15-20 Singapore Dollars. The ride takes about 30 minutes. Ask the taxi driver to stop at the Administration Building. Walk towards Carpark A (Keep to the left). Take Lift NS1-1 to 5th floor. Use the intercom to request entry to CAMTech.

By Car

Car owners, please park at Carpark A and take Lift NS1-1. Use the intercom to request entry to CAMTech.



Location Singapore

4 Centre for Advanced Media Technology

Fraunhofer Institute for
Computer Graphics IGD
Corporate Communications
Rundeturmstrasse 6

64283 Darmstadt
Germany

For further information, please tick the
according boxes and send or fax a
copy of this page to our Darmstadt
address. More information is also pro-
vided on our Website.
<http://www.igd.fhg.de>.

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- Visualization and Virtual Reality
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- E-Learning & Knowledge Management
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- Communication and Cooperation (CSCW)
- Multimedia Communication
- Visualization and Interaction Techniques
- Mobile Multimedia Technologies
- Entertainment Technologies
- Global Visualization Services
- Global Work Environments
- Digital Security Technology
- Applications Center for Computer Graphics in Chemistry and Pharmaceutics AGC

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Return Address

Last Name, First Name

Company

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