



Fraunhofer Institut
Graphische
Datenverarbeitung

Annual Report

Achievements and Results

2002



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

Achievements and Results Annual Report 2002

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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In 2002, the economy as a whole and, in particular, the information and communication sector was still working its way through a recession trough. In the face of this economic situation, the Fraunhofer Institute for Computer Graphics IGD, in cooperation with its customers, decided to make a token gesture, not by joining in with the general complaining but by making an active contribution to overcoming the strained economic situation. Innovation wasn't prosecuted simply for its own sake but targeted and measuredly conceptual and structural priorities were set and implemented into existing know-how and associated structures, in order to achieve a maximum effect for the institute as well as for our customers. Once again, close cooperation with the different facilities of the INI-GraphicsNet proved to be particularly profitable.

Synergies arising from this cooperation were exemplary for the new GraphiTech group (Center for Advanced Computer Graphics Technologies), which was founded in 2002 in Trento, Italy. The key research areas of GraphiTech lie predominantly in the new technologies sector for digital media and streaming applications, content engineering, collaborative work on the further development of visual communication via Internet. These topics and the know-how of participating partners give the Fraunhofer IGD a chance to build on available competence and to provide companies with interesting offers, which can be more quickly developed with cooperation at European level.

The Fraunhofer Institute for Computer Graphics' international commitment is not an end in itself, it is based on constant control and evaluation. Consequently, of the cooperation projects with Brazil, India and Russia only the cooperation with India was stopped since the basis for this cooperation was no longer present (bridging personnel shortages in the German IT market). The projects in Brazil (in cooperation with the Fraunhofer IPA) and in Russia are still successful and will continue and be expanded in the future.

However, these evaluations do not just apply to external partnerships but also to branch offices. The ICPNM (International Certificate Program for New Media) was so successfully implemented by the Fraunhofer CRCG, the Rhode Island School of Design (RISD) and the TU Darmstadt in recent years that the joint decision was made to give this program a new structure. In order to continue to ensure expected positive developments in these activities, "imedia – The ICPNM Academy" was founded.

But changes have also been made within the Fraunhofer IGD. The growing importance of intelligent environments, i.e. context-sensitive user support by the computer, was taken into account in the extension of the "Interactive Multimedia Appliances" department in Darmstadt. Dr. Thomas Kirste was appointed as Head of the department. He ran the "Mobile Multimedia Technologies" department in Rostock for many years. The department in Ros-

tock was taken over by Gerald Bieber. The additional competences of the two groups resulted in a close cooperation already established in the first few weeks. The further development at the institute cannot only be seen in the founding of new departments. The "Virtual and Augmented Reality" department has masked the increasingly prominent topic of "Augmented Reality" and explicitly included this forward-looking topic into the department's name.

In order to take account of the growing importance of internal communication, the INI-Corporate Communication Center (INI-CCC) was established. Initial success came in the first year: in addition to the central coordination of various information services (and an associated increased range of service offers) and the introduction of new forms of communication services for faster and more effective information exchange in and between the departments, the INI-CCC also took responsibility for quality and knowledge management as well as the coordination of training, further education and advanced training for employees.

In addition to the activities already mentioned, in 2002 the Fraunhofer IGD laid the foundations for medium and long term thematic orientation. In preparation for the 6th EU Framework Program, the following topics were given center stage in the institute's internal discussions:

- How will Computer Graphics, interaction with computers and the visualization of information develop in the next 10 years?
- What expectations will these technologies fulfill in the next 10 years?
- What innovative opportunities will become available both in the application and technology sectors when IT, telecommunications and microelectronics are combined with Computer Graphics?

Considering trends, arising from these issues, does not only serve to strategically develop existing core competencies and market potential. The management of the Fraunhofer IGD has also presented these visions in various EU meetings, implemented for the content preparation and design of the 6th EU Framework Program. In this way, the Fraunhofer IGD makes its contribution to the design of research promotion in the EU.

The importance of developing visions can also be seen in industry where the first prototypes and innovative applications are being evaluated as part of industry and contract research projects. These include projects from the following fields:

- Human-Oriented Interaction and Visualization,
- Augmented Reality,
- Digital Storytelling,
- Intelligent Operation Assistants (Multimedia Appliances).

Through the constant development of these technologies, the Fraunhofer IGD has created the fundamentals for developing joint solutions with industry, which the economy needs to ensure stable development. The success of these strategies can be seen in the high numbers of repeat contracts from industry over the years, making the Fraunhofer Institute for Computer Graphics a strong partner in the field of applied research in developing forward-looking solutions required by customers.

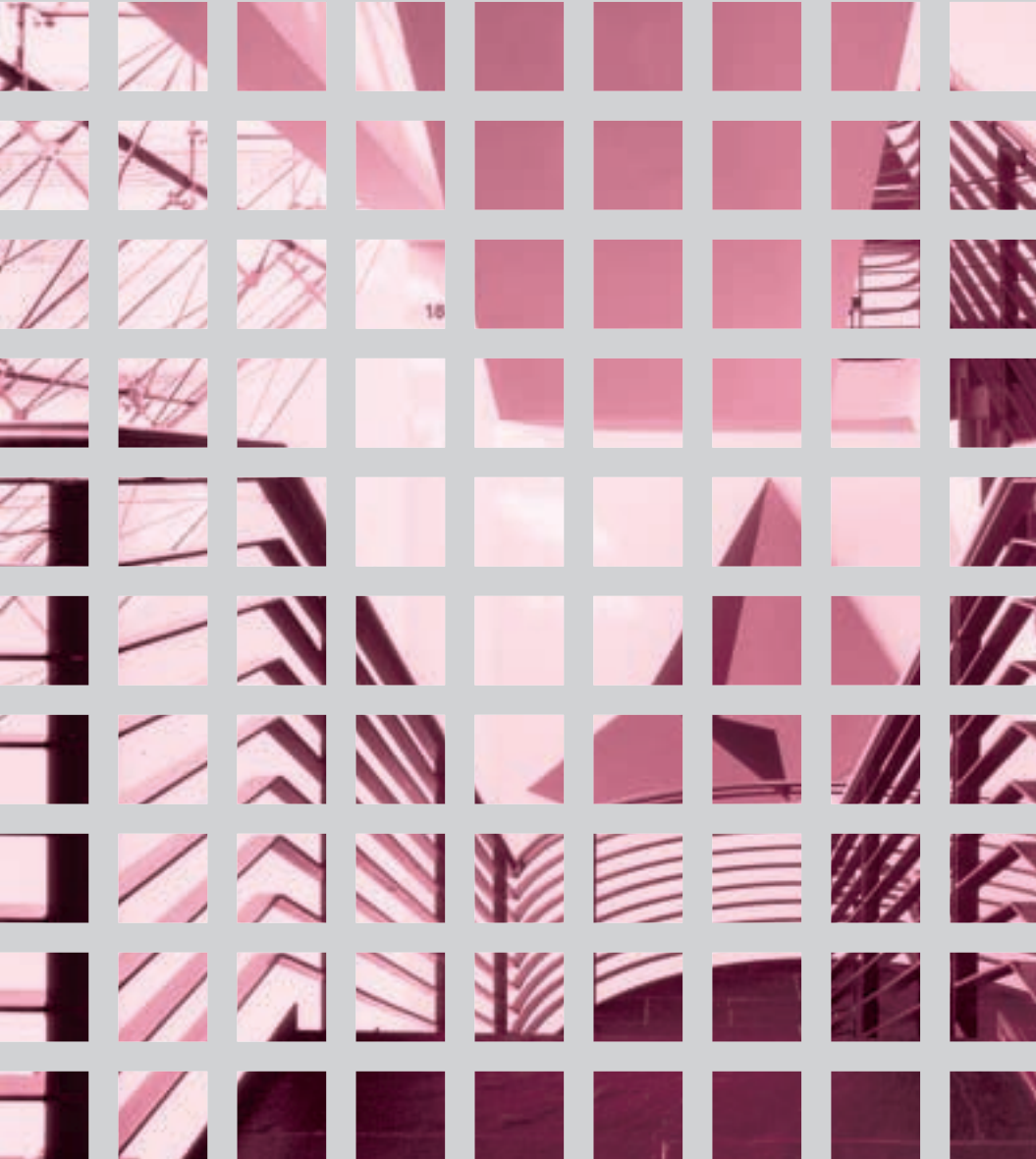


José L. Encarnação
Professor Dr.-Ing.
Dr. h.c. mult., Dr. E.h.,
Hon. Prof. mult.

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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 sea 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

- Agent Technology
- Animation
- Augmented Reality
- Avatars
- Computer Supported Cooperative Work (CSCW)
- Computer Vision
- Data Exchange
- Graphical Information Systems (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 Data Bases
- 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 has cooperated closely with the Technical University Darmstadt and the Computer Graphics Center ZGDV. In the following years, further institutes and external divisions have been established in Rostock, Frankfurt, Providence and Singapore.

All the 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 (hardware and software) and their adaptation to specific needs of customers. The institute contributes through its R&D-activities to establish the Computer Graphic in Germany as a technology, tool and development base and to endorse it with own products and techniques. The R&D-projects have a direct reference to current problems in industry, commerce, traffic and service.

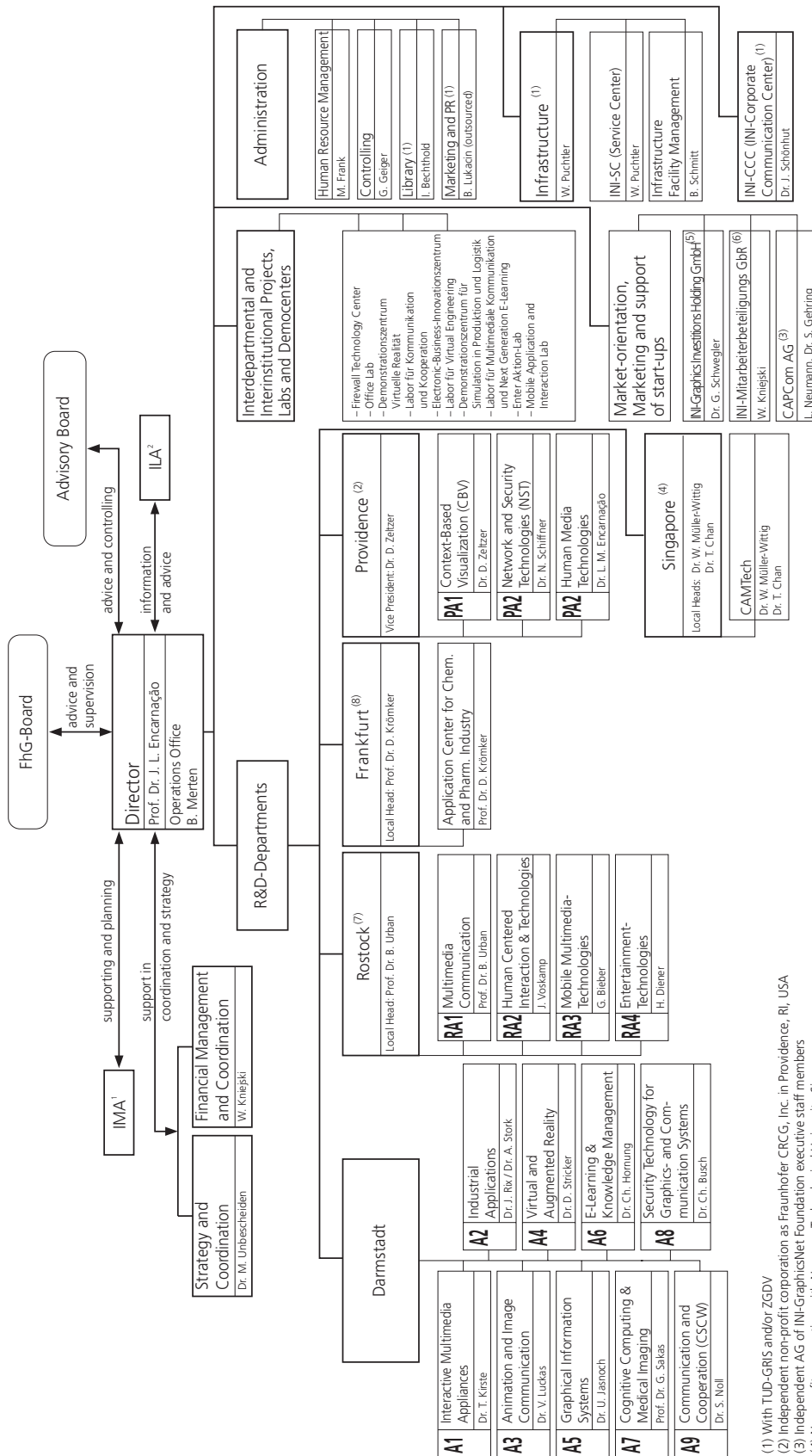
Since its foundation the Fraunhofer IGD has been managed by Professor Dr.-Ing. José Luis Encarnação, who is also director of the ZGDV and holds the chair for Interactive Graphics Systems.



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	Fraunhofer CRCG Providence	http://www.crcg.edu/
	CAMTech Singapore	http://camtech.ntu.edu.sg/
	INI-GraphicsNet	http://www.inigraphics.net/

Fraunhofer IGD-ORGANIZATION



1 Management Board of the Institute (Instituts Management Ausschuss)
 2 Steering Committee of the Institute (Instituts Lenkungs Ausschuss)

(1) With TUD-GRIS and/or ZGDV
 (2) Independent non-profit corporation as Fraunhofer CRCG, Inc. in Providence, RI, USA
 (3) Independent AG of INI-GraphicsNet Foundation executive staff members
 (4) Non-profit corporation with Nanyang Technological University, Singapore
 (5) Independent GmbH of INI-GraphicsNet Foundation, T-Venture, and executive staff members
 (6) Independent Partnership of executive staff members
 (7) Fraunhofer IGD division Rostock
 (8) Fraunhofer IGD division Frankfurt



INI-GraphicsNet

Together with other Computer Graphics organizations, the institutions of the Fraunhofer IGD in Darmstadt, Rostock, Frankfurt, Providence and Singapore are organized within an 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:

- Computer Graphics Center (ZGDV) in Darmstadt and Rostock,
- Forums associated with ZGDV
 - Forum for the Transfer of Information- and Communication-Technologies IKTT, Erbach,


- Forum for Information Services Mecklenburg-Vorpommern ISMV, Rostock,
- Information and Cooperation Forum for GeoData of ZGDV e.V. InGeoForum, Darmstadt,
- Multimedia Support Center Hessen mmsc, Darmstadt,
- CAST Forum Competence Center for Applied Security Technology, Darmstadt,
- INI-Graphics-Alumni Forum,
- Open SG – Open Source Scene-graph Forum,




Founding Members of the INI-GraphicsNet Foundation




Fraunhofer IGD
Institut Graphische Datenverarbeitung
Darmstadt, Rostock, Germany




Zentrum für Graphische Datenverarbeitung e.V.
Darmstadt, Rostock



Fraunhofer CRCG
Center for Research in Computer Graphics, Inc.
Providence, RI, USA




Centro de Computação Gráfica
Guimarães, Coimbra, Portugal




Centre Advanced Media Technology
Singapore


Members of the INI-GraphicsNet Foundation




VICOMTech, San Sebastian, Spain




INSTITUTE FOR NEUROSCIENCE TECHNOLOGY
NEMETech, Seoul, Korea



GraphiTech
GraphiTech, Trento – Rovereto, Italy



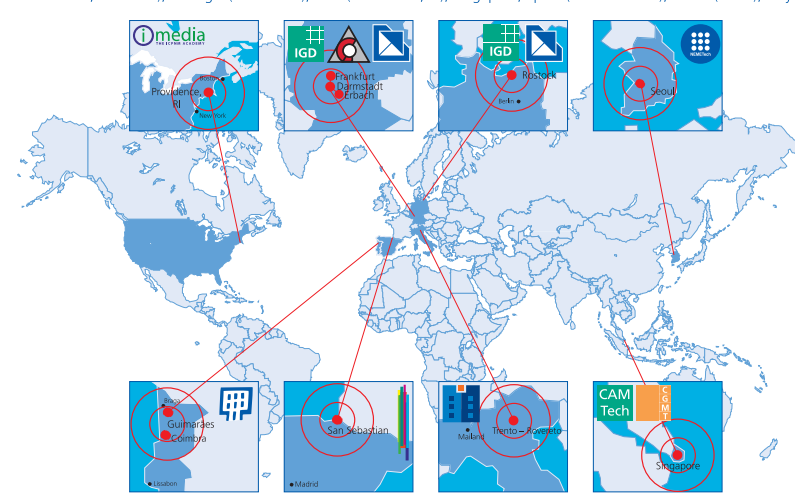
imedia
imedia, Providence, RI, USA




Centre Graphics & Media Technology
CGMT, Singapore

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 (Guimarães), USA (Providence, RI), Singapore, Spain (San Sebastian), Korea (Seoul), Italy (Trento)




University Partnerships




Technische Universität Darmstadt, Germany




Universidade do Minho, Guimarães, Portugal




Universität Rostock, Germany




Nanyang Technological University, Singapore




Johann Wolfgang Goethe-Universität, Frankfurt a.M., Germany




Ewha Womans University, Korea




Brown University, Providence, RI, USA



Università degli Studi di Trento, Trento, Italy












Rhode Island School of Design, Providence, RI, USA




Universidad del País Vasco Euskal Herriko Unibertsitatea The University of the Basque Country

Spin-offs of the INI-GraphicsNet













State of Hesse, Germany



T-Venture, Germany



State of Mecklenburg-Vorpommern, Germany

Locations of the INI-GraphicsNet.

- KOMM_MV – Centrum for Multimedia-Technology in Mecklenburg-Vorpommern,
- ProVR – User- and developer forum “VR-Technologies in Development, Construction, Production and Marketing”,
- KMD – Forum for Knowledge Media Design,
- Centro de Computação Gráfica, Guimaraes, Portugal,
- VICOMTech, San Sebastian, Spain,
- NEMETech, Seoul, South Korea,
- GraphiTech, Trento, Italy,
- Commercial spin-off companies.

- Ewha Womans University, Seoul, Korea,
- Universita degli Studi di Trento, Italy.

With more than 300 employees and 500 research assistants, and a budget of Euro 42 million, the INI-GraphicsNet today comprises one of the largest centers for Computer Graphics and graphical-interactive information and communication technology in the world.

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, we established several technology-oriented spin-off companies. With the support of external investors, as well as internal technology screening and incubation services, young scientists are now able to start their own companies to commercialize their technologies. It is intended that the institutes of the INI-GraphicsNet should benefit from the profit of their developed technologies, intellectual property rights and know-how through royalty payments.

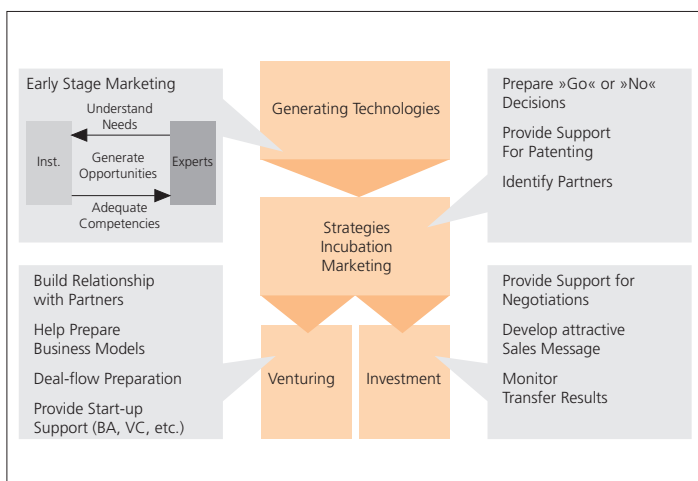
Cooperation agreements exist or collaboration is implemented with the following universities:

- TU Darmstadt,
- University of Rostock,
- Johann Wolfgang Goethe University Frankfurt,
- Universidade do Minho, Portugal,
- Brown University, Providence, RI, USA,
- Rhode Island School of Design (RISD), Providence, RI, USA,
- Nanyang Technological University (NTU), Singapore,
- The University of the Basque Country, San Sebastian, Spain,

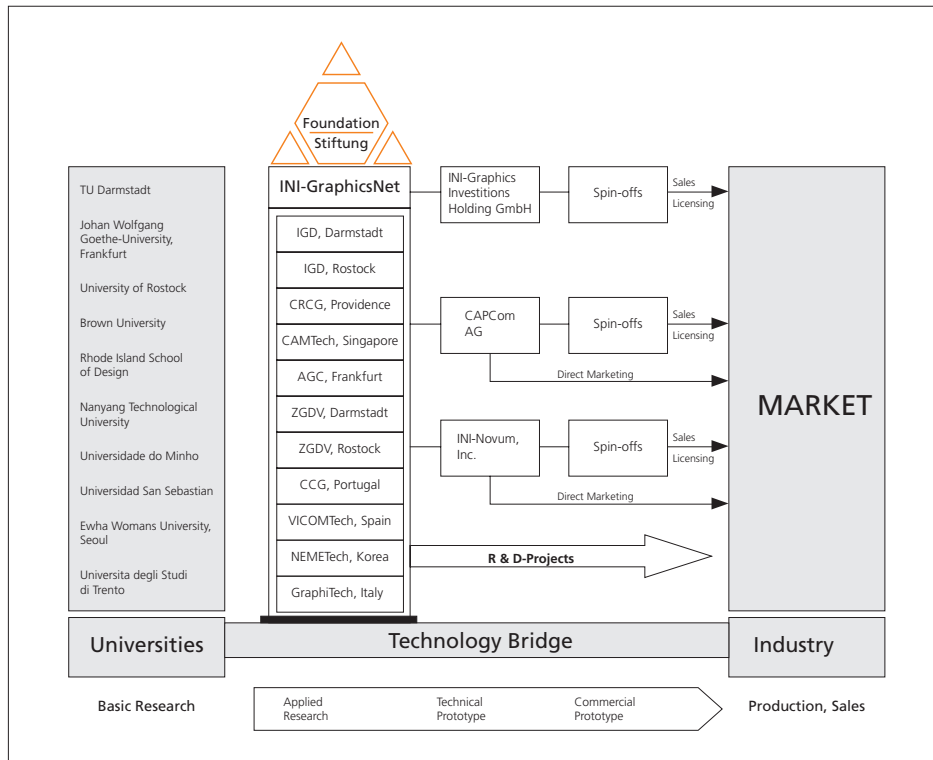
The INI-GraphicsNet Foundation was established and incorporated with legal standing under civil law on 17 September 1999. The purpose of the foundation is the advancement of scientific research and development in the field of Computer Graphics (information processing). The foundation pursues this purpose 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 foundation was established with assets of 190.000 Euro in cash. In the meantime the endowment grew to an amount of 1.200.000 Euro. From recurring funds, from external revenues and from revenues earned out of the foundation’s endowment, several successful projects for realizing the foundation’s purposes were carried out in 2002 with a total volume of nearly 1 million Euro. The foundation supported several strategic projects. Also, comprehensive projects for increasing software re-use inside the INI-GraphicsNet and for developing global quality management were initi-



Added Value as a Result of Integrated Process Management.



Transfer of technology.

- Development of a technology screening and incubation concept for structuring start-up companies. In this context the INI-GraphicsNet Foundation rented 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 synergistic fruits of work performed by INI-GraphicsNet member institutes. In cooperation with participating universities, the INI-GraphicsNet establishes the necessary links for the industrial and commercial use of research results.

ated. 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 assessing 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.

Support of Spin-off Activities

INI-Graphics Investitions Holding GmbH

The INI-Graphics Investitions Holding GmbH is a joint venture 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. The purpose is to support employees of the INI-GraphicsNet founding their own companies which aims to commercialize products developed inside the research institutions. For this purpose T-Venture provides about 5 million Euro as initial funding for the venturing of start-up businesses. Furthermore, T-Venture provides management support and other related consulting.

Shareholders of INI-Graphics Investitions Holding GmbH are T-Venture, the INI-GraphicsNet Foundation and a stock option company owned by employees of the INI-GraphicsNet. The INI-GraphicsNet Foundation especially supports the process of identifying marketable technologies within the INI-GraphicsNet, and provides all kinds of incubation services. The foundation therefore established a network of experts like start-up consultants, lawyers, tax advisors, marketing teams, seed-investors, and business universities such as the European Business School, to support the spin-off activities according to their needs and aims. At the end of the incubation process, accompanied by the INI-GraphicsNet Foundation, the potential founders of a new and innovative company are able to present a business plan to satisfy professional requirements.

This process is the link for successful cooperation between INI-GraphicsNet Foundation, young company founders and INI-GraphicsNet Investitions Holding GmbH that has been led by Dr. Georg Schwegler since August 2000.

The following companies have been successfully established:

Advance Training and Learning Corporation – ATLC

The Advance Training and Learning Corporation (ATLC) was created in November 2001 with the business headquarters in Glastonbury, USA. The company is a spin-off of the Fraunhofer CRCG in Providence, USA. The main function of the business is the use and advancement of the MTS technology. MTS (modular training system) is a modular state-of-the-art learning and training system that was developed in the Computer Graphics' Institute and transferred to the Fraunhofer CRCG. Additionally, the Fraunhofer CRCG further developed two advanced versions of MTS, called M5, and by using these technologies the enterprise causes positive modifications in the E-Learning and Knowledge Management fields.

CAPCom AG

CAPCom AG is the first spin-off from the INI-GraphicsNet. Established in 1996, the goal of the company is to provide the market-oriented distribution of research and development results from the INI-GraphicsNet institutes. CAPCom focuses on marketing and sales activities that specifically target the launching of previously dormant innovative developments. Hereby, CAPCom closes the gap between the existing prototype and the finished, market-driven product. The second business segment of CAPCom are customized solutions for companies that want to make profitable use of Internet and E-Business technology. Thereby, the close contact

with the INI-GraphicsNet guarantees sustainable state-of-the-art solutions for the needs of the customer.

Centre for Graphics and Media Technology – CGMT

The Centre for Graphics and Media Technology Ltd was established on the 14th of December 2001 and is registered with the Registrar of Companies and Businesses Singapore. CGMT is a non-profit research company with the founding members, Nanyang Technological University Ventures and the INI-GraphicsNet foundation. The centre focuses on the market in Singapore and the Asian region, with the aim of conducting applied research and development in the broad area of progressive media technology and applications. CGMT specializes in industry related contract research, studies & consultancy, and currently provides technological services in the area of broadcast media and Virtual Reality set-ups. The centre conducts studies in the identification of potential markets and the distribution of marketable technologies within the INI-GraphicsNet. CGMT works in close collaboration with the established Centre for Advanced Media Technology, CAMTech. These two centres complement each other in fulfilling their respective R&D objectives, and the cooperation is expected to increase the acquisition potential for both. This strong R&D alliance taps into the strengths of both centres, CAMTech which is closely linked to the university in academic research and CGMT with its focus on industry-related development projects.

Cybernarium Projektgesellschaft mbH

The Cybernarium Projektgesellschaft mbH was founded in January 2002 to offer events, exhibitions and services in the area of virtual learning and adventure worlds. The central point of the



seminal concept is "Learning as Adventure" for a broad public. Furthermore, the Cybernarium provides a platform for modern institutions and enterprises to present their research results and high-tech products using technologies of Virtual and Extended Reality. The Cybernarium Days 2002 in Darmstadt had more than 10.000 visitors in six days which already demonstrates how successful and instructive a public-efficient staging can be using state-of-the-art technology. For 2003, a tour of the exhibition across Germany is planned. The long-term goal is the establishment of a permanent base. With the support of the city of Darmstadt, an Edutainment-Center for more than 400.000 visitors per year is planned, which will present more than 60 interactive high-tech installations on more than 4.000 m². Under the trademark "Cybernarium", an attractive Edutainment offer is available to interested partners. Many different possibilities for participation and cooperation arise from renting of existing exhibits to sponsoring of exhibitions and use of the events as a communication platform up to individual development of public-efficient presentations and locations.

GIStec GmbH

GIStec GmbH was founded in April 2001. The starting point for the business idea was the present market situation for geo data. The enterprise, therefore, closes a market gap. It offers technical services supporting the transfer of geo data potential, created with software solutions, into innovative projects and solutions for final customers. Because the geographical information systems (GIS) and their productive application are changing intensively, the system requirements also change accordingly. The GIStec GmbH focuses on that area but it does not only offer the traditional system application for the geo base data col-

lection and administration, it also integrates its solutions in the value chain of geo referential information systems.

INI-Novum

INI-Novum, Inc. is a spin-off of the Fraunhofer Center for Research in Computer Graphics, Inc and located in Providence, Rhode Island, USA. In addition to managing a global licensing program of commercially valuable intellectual property, INI-Novum commercializes the patented technologies of its networked non-profit R&D institutions. The commercialization process includes the creation and support of the development of new commercial enterprises that utilize these technologies as the centerpiece of their business.

From the creation of a business plan for a new startup company through to its successful development INI-Novum provides seed capital, management and business development expertise, support in creating strategic business relationships, and a variety of business advisory services, including Board of Director participation, to accelerate the optimal company development.

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 that 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.

MediaSec Technologies

MediaSec Technologies LLC was established in 1996 in Providence, USA as a spin-off of the Fraunhofer IGD Darmstadt, Germany. MediaSec's patented and world leading watermarking technology was originally developed at the Fraunhofer Institutes between 1993 and 1997 by Dr. Eckhard Koch and Dr. Jian Zhao. MediaSec Technologies GmbH in Essen, Germany, was established in 1999 to focus on the European market. Cooperation with strategic partners and a multi million dollar investment by Deutsche Post Ventures resulted in an expansion of international business activities. MediaSec Technologies develops and markets products and solutions based on a combination of various security technologies protecting the integrity, the authenticity and the confidentiality of digital data and printed documents. MediaSec's mission is to be a customer-driven leader in digital watermarking solutions by inventing and providing security technology which solves current and future problems in the fields of document security and authentication, anti-counterfeiting, brand and copyright protection. MediaSec's watermarking technology was awarded prizes from the German Federal Ministry for Education, Science, Research and Technology and from the Fraunhofer-Gesellschaft. The technology enjoys high international recognition in the field of secure digital watermarking.

MediTEQ

MediTEQ provides portable teleradiology systems and access to Internet medical services and software that facilitate the transmission and sharing of medical images and vital signs, for remote triage, diagnosis and consultation by a qualified network of medical experts. MediTEQ technology provides the informatics equivalence of "being there", enabling remote "reach-in"

capabilities. MediTEQ products and services provide the following benefits to the users of this technology: lower medical costs, increased access and hospital outreach, increased quality of care, efficient use of resources and swift transfer of information.

Meticube – Sistemas de Informação, Comunicação e Multimedia, Lda.

Medicube was founded in December 2001 in Coimbra, Portugal, as a spin-off of the CCG in Portugal. The main goals of this young company are the conception and development of information and communication systems, multimedia systems and software, web design and graphical design. Additionally, Medicube provides several professional services such as consulting in the informatics field, commercialization, import and export of hardware and software, teaching and training, consulting on business management, marketing, market studies and services in the fields of information and communication.

OTLO VR Systeme GmbH

OTLO VR Systeme GmbH was created as the first spin-off of the Computer Graphics Center in Rostock, Germany. With the nationwide prize-winning business idea, the company provides presentation and visualization solutions of the Virtual Reality based in interlaced computer systems. These systems contain both hardware and software components and are characterized by an attractive price/performance ratio. The product targets range are the two main business fields: engineering / construction and marketing / selling. Various services, such as the production of three-dimensional presentation of materials, service and support, software development, technical care on fairs and exhibitions, consultation and training courses complete the product portfolio. The products of the OTLO VR Sys-

teme GmbH can be used in the construction and design models, in interactive training simulations and impressive three-dimensional product presentations.

Polygon Technology GmbH

Polygon Technology GmbH, created in September 2001, is the manufacturer of the complete systems for the three-dimensional digitalization of real objects and the production of true-to-form computer models from the input of a certain cloud of points. The target of the enterprise is the innovation of the optical three-dimensional measurement and the model reconstruction. The prototype QTSculptor is a base system. It measures real objects or form prototypes by three-dimensional sensors and reconstructs them by special procedures from several three-dimensional photographs. The software was developed at the Fraunhofer IGD and brought to fruition by the Polygon Technology GmbH. The operation of this system enables substantial assistance in the reconstruction of model forms. Polygon's products can be used in the three-dimensional model digitalization, the Reverse Engineering, the three-dimensional presentations on the Internet, for the documentation in the preservation of ancient monuments and in the Rapid Prototyping.

vrcom GmbH

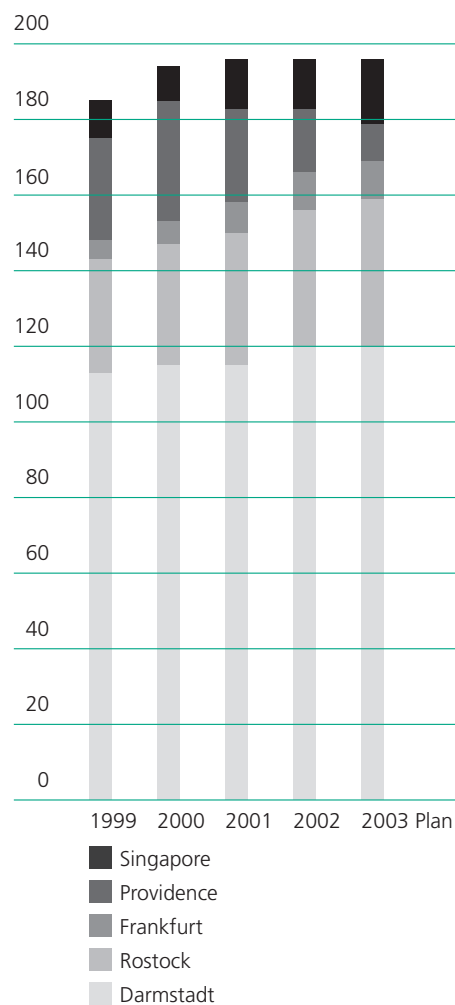
vrcom is the first spin-off to be created within the framework of the cooperation between T-Venture and the Fraunhofer-Institute for Computer Graphics IGD. The organization provides a broad spectrum of services such as interactive work with digital prototypes and their diverse visualization and processing options, which can be efficiently employed in industry. vrcom focuses on the marketing and development of their VR-system "Virtual Design", which was originally

developed at the Fraunhofer IGD and was introduced to the market by vrcom in 1999. The main areas of application are the different stages of the product development process, starting from design and modeling, then engineering and finally up to production.

The Institute in Numbers

In 2002, the personnel and financial development of the Fraunhofer IGD, its institute sections and offices, was characterized by a different development concerning the consolidated staff contingents and budgets. In total, 196 staff members were administered in Darmstadt, Rostock, Providence, Singapore and Frankfurt, resulting in a cost-effective quota of 175 staff years.

Out of these 196 staff members, 61% worked at the Fraunhofer IGD Darmstadt, 18% at the Fraunhofer IGD Rostock, 9% at the Fraunhofer CRCG Providence, 7% at the CAMTech Singapore, and 5% at the Fraunhofer AGC Frankfurt.

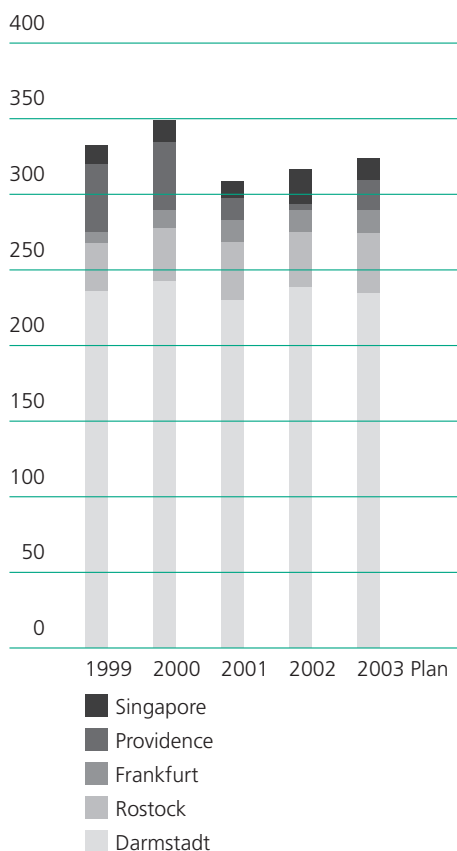


Development of staff contingents at the Fraunhofer IGD locations.

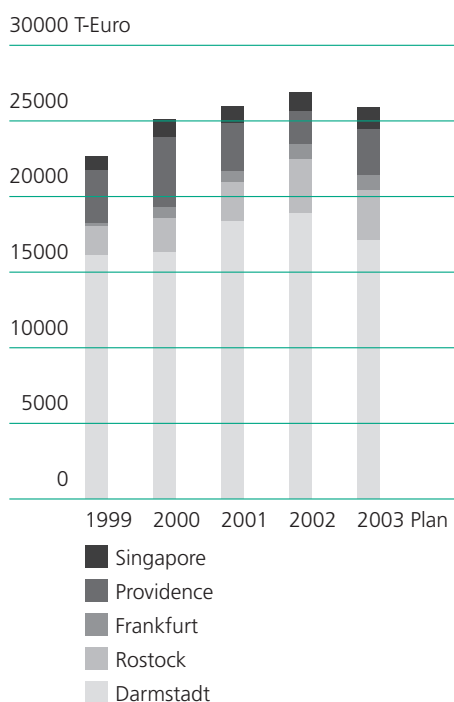
A total of 513 staff members, including the employment of external staff (research assistants, student assistants, guest researchers, and trainees) at the respective institutions, were employed in 2002.

The figures above show the continuous growth of the staff contingents over the past few years, as well as the expected development for 2003. Proceeding on the plans for the year 2003, the total contingent in this financial year will consolidate on the level of 521 staff members

In 2002, the sum of all total budgets was Euro 26.9 million. Of this, Euro 18.9 million (approx. 70%) went to the Fraunhofer IGD in Darmstadt, Euro 3.6 million (approx. 13%) to the Fraunhofer IGD in Rostock, Euro 2.2 million (approx. 8%) to the Fraunhofer CRCG in Providence, Euro 1.2 million (approx. 5%) to CAMTech in Singapore, and Euro 1.2 million (approx. 5%) to the Fraunhofer AGC in Frankfurt. According to plan, the budgets will increase to a total of Euro 25.9 million in the year 2003.



Development of external staff contingents at the Fraunhofer IGD locations.

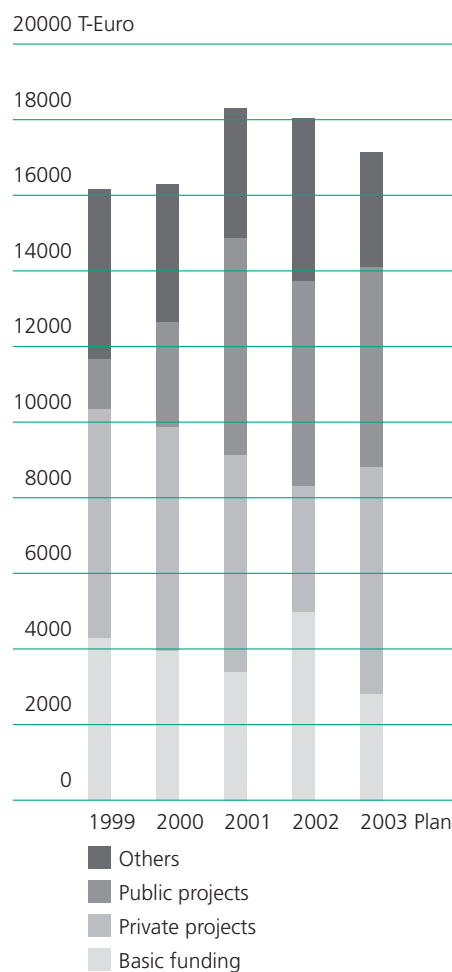


Budget development in the total budget at the Fraunhofer IGD locations.

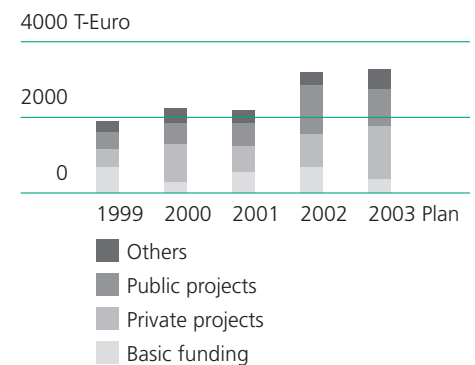


The operating budget of Fraunhofer IGD in Darmstadt is financed by 72% from external revenue and about 28% from basic funding of the Fraunhofer-Gesellschaft. The main part of external financing comes from national public projects with approximately 30% of the budget. The industrial revenue amounts to 18%, the revenue from EU projects amounts to approx. 24%. These shares are based on a sluggish economic situation on the one hand, but on the other hand the reputation for EU projects is continuously improving.

The development at the Fraunhofer IGD in Rostock shows a similar picture. Since its foundation in 1992, the budget has increased to Euro 3.6 million. The personnel situation determines the budgetary development here: in 2002, the share of the staff contingent in the operational budget was about 52%. After the first years with a mainly basic-funded organization, the share of financing from institutional support is now falling to a more usual level for a Fraunhofer-Institute. The Fraunhofer IGD in Rostock participates from direct public project funding. Above all, Mecklenburg-Vorpommern is an important customer. In addition, the constant share of industrial revenue also acts as an indicator for the established 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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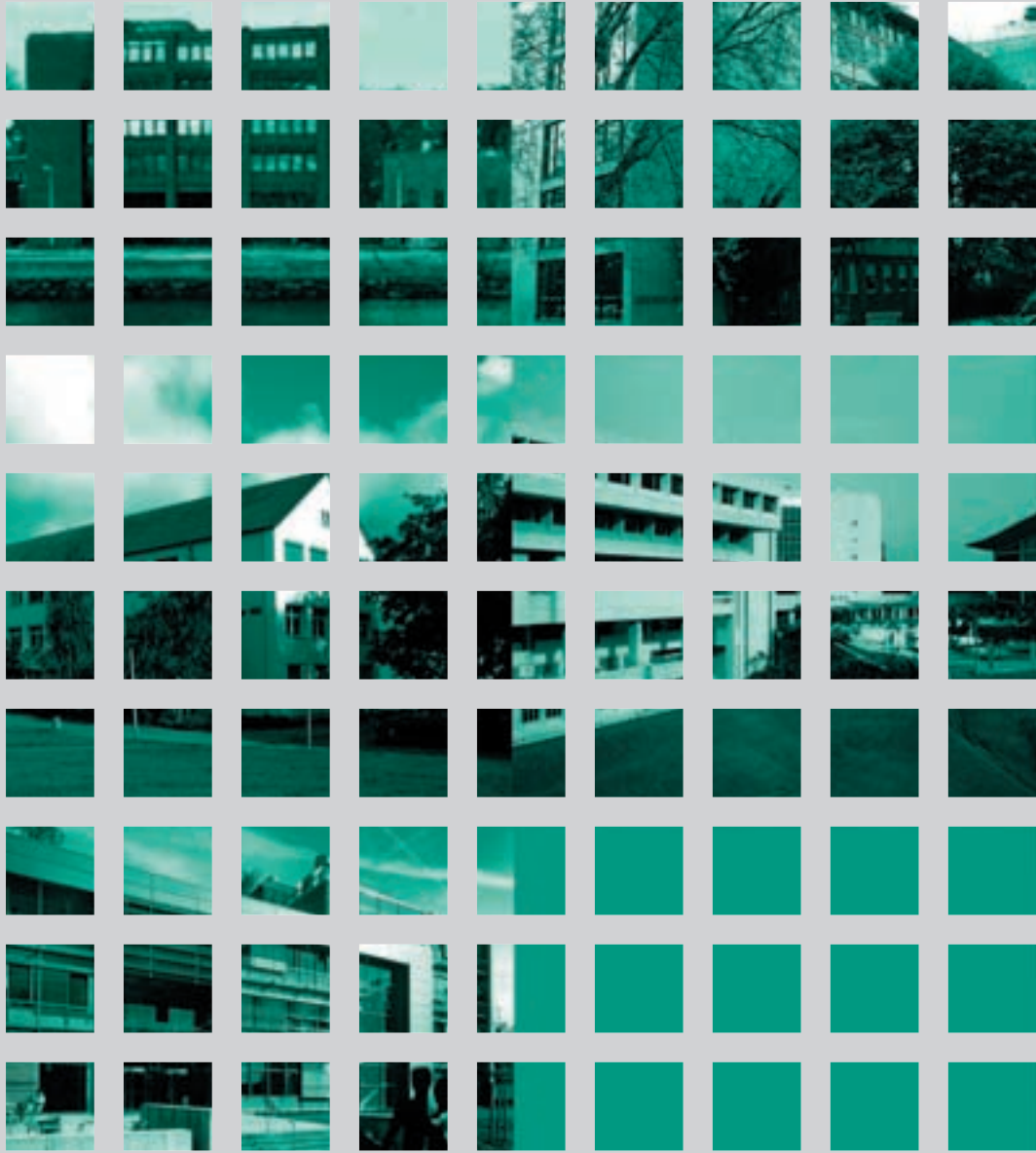
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- DivXNetworks, Inc
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- DLR Projektträger Informationstechnik
- DLR Projektträger Multimedia
- DS Technologie
- DSC, Dr. Staerk Computer Systeme GmbH, Langen
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- Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Stuttgart
- Fraunhofer Institute for Material and Beam Technology IWS, Dresden
- Fraunhofer Institute for Material Flow and Logistics IML, Dortmund
- Fraunhofer Institute for Media Communication IMK, Schloss Birlinghoven, Sankt Augustin
- Fraunhofer Institute for Microelectronic Circuits and Systems IMS, Dresden
- Fraunhofer Institute for Open Communication Systems FOKUS, Berlin
- Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg
- Fraunhofer Institute for Production Systems and Design Technology IPK, Stuttgart
- Fraunhofer Institute for Production Technology IPT, Aachen
- Fraunhofer Institute for Reliability and Microintegration IZM, Berlin
- Fraunhofer Institute for Secure Telecooperation SIT, Darmstadt
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- Frenz Cross Cultural Consulting GmbH
- Friderico Franciscum Gymnasium, Bad-Doberan
- FTB Forschungsinstitut Technologie-Behindertenhilfe der Evangelischen Stiftung Volmarstein, Wetter
- FZI Forschungszentrum Informatik
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- GI Stewa
- Giunti Multimedia, Minano/Italy
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- Peenewerft Wolgast
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- University of Greifswald
- University of Hamburg
- University of Hannover
- University of Konstanz
- University of Leipzig
- University of Mainz, Department of Ophthalmology
- University of Manchester
- University of Milan
- University of Porto
- University of Rhode Island
- University of Rostock
- University of Saarbrücken
- University of Southern California Institute for Creative Technologies
- University of Stuttgart
- University of Tübingen
- University of Weimar
- University of Würzburg, Department of Ophthalmology
- VICOMTech
- Video Vision
- Viewrope
- Volkstheater Rostock
- Volkswagen AG
- vrcom GmbH
- Weiterbildungsgesellschaft an der Universität Rostock e. V.
- Whu Hup Pte Ltd
- Wirtschaftsberatung Dr. Pieper und Partner
- Wirtschaftsministerium des Landes Mecklenburg-Vorpommern
- WZL
- ZdK-Zentralverband der KFZ-Industrie
- Zeiss
- Zenon SA, Athens, Greece
- ZENTEC Zentrum für Technologie, Existenzgründung und Cooperation GmbH, Grosswallstadt
- ZF, Friedrichshafen
- Zoo Rostock



Locations



The Fraunhofer Institute for Computer Graphics was formed in 1992 from the working group for computer graphics, established by the Fraunhofer Society in 1987 in Darmstadt. Since its founding it has worked closely with the TU Darmstadt and the Computer Graphics Center, founded in 1984. The personnel base and range of professional fields has been continuously expanded.

In addition to the extension of the Darmstadt location, a branch of the Fraunhofer Institute for Computer Graphics was set up in Rostock in 1992. The Fraunhofer Center for Research in Computer Graphics, Inc. CRCG, in Providence has made it possible for technical developments in the USA to be identified and transferred to European markets. The founding of the Center for Advanced Media Technology CAMTech in Singapore in 1998 got a foothold in Asia's markets of the future. The Fraunhofer Application Center for Computer Graphics in Chemistry and Pharmaceuticals in Frankfurt, opened in 1999, is committed to specific fields in this sector.

The above institutions work in synergy with one another and, consequently, allow a net to be cast around technology development, from basic research to applied research and application developments. The range of work carried out at the Fraunhofer Institute for Computer Graphics extends from basic

research specific to certain applications, such as algorithm and system concepts, to the creation of application and system prototypes (hardware and software) and their customization to meet customer demands.

The Fraunhofer Institute for Computer Graphics Darmstadt employs more than 100 full-time workers in nine departments, supported by around 250 scientific assistants. Over 8000m² of office and laboratory space is dedicated to processing research contracts.

The Fraunhofer Institute for Computer Graphics is divided according to fields, as follows:

- Interactive Multimedia Appliances, focusing on developing technologies for the establishment of coherently-acting appliance ensembles,
- Industrial Applications focusing on the field of virtual engineering: supporting virtual production processes,
- Animation and Image Communication, focusing on the fields of interactive 3D animation and visualization, object-oriented systems, data exchange and agent technologies,
- Virtual and Augmented Reality, focusing on the fields of scientific visualization, Virtual Reality and Augmented Reality,
- Graphic Information Systems, focusing on the fields of facility management and spatial information systems,
- E-Learning and Knowledge Management, focusing on the fields of system design, architecture design, development of components and consulting on application fields, such as multimedia learning and training, simulation and validation, information transfer and interactive telephony services,

- Cognitive Computing and Medical Imaging, focusing on the fields of visual computing, medical image processing and multimedia interfaces,
- Security technology for graphics and communication systems, focusing on the fields of security mechanism realization,
- Communication and Cooperation, focusing on the fields of multimedia communication and user interfaces for cooperation in divided environments as well as agent technologies.

With these new research departments, the Fraunhofer Institute for Computer Graphics is committed to the challenges arising from the use of computers privately, in industry, commerce, and in the transport and service sectors.

In all fields, the Fraunhofer Institute for Computer Graphics strives to focus on people as users and help them to simplify and make work with computers and with other people more efficient. The simple and intuitive use of new technologies is the core task of the Fraunhofer Institute for Computer Graphics, which is realized in the form of research and development projects within the individual departments.

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The Fraunhofer IGD Rostock was founded on 1 January 1992 as an external branch of the Fraunhofer IGD Darmstadt. It was one of 19 new institutions established in the new federal states as a result of the expansion of the activities of the Fraunhofer Society into the new federal states after Germany's reunification.

Today, the Fraunhofer IGD Rostock is a self-contained division of Fraunhofer IGD, and with 36 staff members, more than 45 part time students and a budget of 3.2 Million Euro, it is a full partner within the INI-GraphicsNet.

The competency of Fraunhofer IGD Rostock is represented by its four R&D Departments:

- *Multimedia Communication* with main focus on learning and training with new media, personalization of services, task delegation by agents, cooperative and interactive application in heterogeneous networks. For this the department develops concepts, technologies, services, and applications for Internet and Intranet, for open and adaptive learning and training environments, for personalized information systems, and for CSCW applications.
- *Human-Centered Interaction & Technologies* with main focus on innovative interaction techniques and modern visualization technologies including Virtual Reality, for design of application specific multimedia user interfaces by using Virtual Reality and different sensor types as well as user centered analyses and classification of sensor data.
- *Mobile Multimedia Technologies* with main focus on the development of solutions for personal digital assistance and interactive graphical and multimedia applications on the basis of mobile computers and wireless networks. The research emphases lay on the realization of situation controlled mobile assistance. This approach allows – based on flexible situation and task modeling and sensor systems – the individual and cognitive support of the user in his daily activities.
- *Entertainment Technologies* with main focus on innovative technologies for entertainment and edutainment systems and its application to engineering and educational applications. The department concentrates on game based interfaces to motivate users and intelligent systems for the development of adaptive and intelligent user interfaces (Perceptual User Interfaces, Affective Computing). This also includes the application of game based technologies for user guidance (Digital Storytelling).

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Based on the tried and true model of close cooperation between a Fraunhofer Institute and a school of higher learning, in this case, the Johann Wolfgang Goethe University at Frankfurt on the Main, another knot was formed in the INI-GraphicsNet in 1999.

For the first time in INI-GraphicsNet history, there is a clear branch orientation for a facility. The Application Center emphasises tailoring and specializing basic INI-GraphicsNet technologies to target branches. In addition, individual solutions and branch solutions are developed for our customers. Customers and partners of the Application Center have all the resources of the worldwide network at their disposal. This is a firm offer for a strategic partnership.

Fraunhofer AGC is currently focusing its activities on three work areas:

- E-Learning and E-Training: Applications in the Life Sciences,
- Visualization of chemical and biochemical processes, facilities and devices,
- Visualization in bioinformatics.

With new collaborators, Fraunhofer AGC activities in these three work areas could be expanded.

In addition to the "classic" visualization and virtual journeys through chemical production facilities, work area *Visual-*

ization and VR will encompass the visualization of chemical and biological processes; several project activities will include the development of laboratory equipment and process visualizations. This last area especially requires reliable 3D visualizations on the Internet. One initiative in particular, "Competence Center for Laboratory Diagnostics" is in the works.

The work area *Industrial Training* is supported by the targeted results of the EU project "ETOILE" (Environment for Team, Organizational, and Individual Training in Emergencies) in particular. ETOILE is a training system that implements several strategies for training improvement:

- Construction and presentation of a virtual world in which students interact,
- Use of intelligent agents that act as "computer players", assuming the roles of participants at emergency trainings,
- Enabling a distributed training over computer networks and the associated freedom for the trainees from not being confined to the site.

This work area is currently strongly supported and strengthened by a project started in April 2001 at the Goethe University. "K-MED" is a federal- and state-sponsored project in the program "New Media for Education" and targets an improvement of medical training in the areas of pre-clinical and theoretical-clinical studies. This includes the participation of all medical disciplines in Hessen, among others. The Fraunhofer AGC is working on and supporting the authoring process for top of the market 3D visualizations in particular. We are also contributing by developing various pilots (Rapid Prototypes). Several pharmaceutical concerns have expressed their interest in the results of this pro-

ject. New company contacts are being developed, especially in their specific research areas and – financially very meaningful – in "Science Marketing".

The third work area, *Visualization in Bioinformatics* is still under construction. Results from other work areas are currently benefiting this area's activities. A "backbone project" for this work area is in the application stage. Nevertheless, we already have initial acquisition successes, i.e., in the project DNA Chip with client Roche.

Further developments in core graphic technologies are also occurring in the strictly application-oriented work areas. These include:

- 3D Beanbox (as an integration base for results from all work areas),
- Virtual Glovebox, especially for the work area "Visualization and VR".

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The Fraunhofer Center for Research in Computer Graphics CRCG is a non-profit-making, applied research and development corporation located in Providence, Rhode Island. Fraunhofer CRCG has been developing compelling technology that takes advantage of advanced computing and communications for distributed enterprises, electronic commerce, telemedicine, publishing, scientific research, and education. Fraunhofer CRCG is organized into three departments: Context-Based Visualization, Human Media Technologies, and Secure Distributed Technologies.

The focus of the Context-Based Visualization department is to integrate knowledge about human decision making and the application domain into the visualization system intended to support that application. Initial work centers on visualization for achieving and maintaining situation-awareness of an ongoing operation. We call this emerging technology Decision-Centered Visualization, and an initial proof-of-concept prototype is being developed.

The department of Human Media Technologies focuses on unencumbered and natural human-computer interaction. The main research areas include multi-modal interaction, multi-sensory feedback, mixed-reality rendering, display technologies, and 3D graphics technologies for the Web. Application areas include planning and conceptual design, training, simulation and presentation in such diverse domains as medicine, cultural heritage, command and control, scientific data analysis, education, and entertainment.

The department of Secure Distributed Technology focuses on enabling and protecting the exchange of digital information. The main research areas include: copyright protection and security enforcement, secure wrappers for mobile agents, secure electronic commerce, adaptive security for audio over IP, immersive high quality communication, game engines for emergency management, entertainment and electronic commerce applications.

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In 1998 the Centre for Advanced Media Technology CAMTech was established as a joint research and development center of 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 representing the expansion of the International Network of Institutions for Computer Graphics (INI-GraphicsNet) into the fast growing markets of the Asia-Pacific region for the first time.

The center continues to demonstrate the reality of the high level of collaboration in education and technology that exists between Singapore and Germany. These efforts draw upon the strengths of both organizations in the fields of computer graphics and advanced media technology to build a center that meets the Asia-Pacific region's demands for R&D, technology, innovation and training in the fast growing and changing IT industry.

CAMTech's overall goal is to conduct research and development activities in the broad technology area of advanced media. The focus lies on the realization of applied R&D projects that are relevant to the immediate and future needs of Germany, Singapore and the Asian region. Close collaboration with the INI-GraphicsNet provides instant access to years of R&D effort and leading-edge technology. The center is contributing to the realization of Singapore's vision of becoming a world-class center of innovative technology with strong R&D capabilities.

The market for CAMTech's products and services include multinational corporations, local companies and SME's, government departments and agencies, statutory boards and their affiliated companies as well as educational and research institutions. CAMTech will primarily address the Singapore and Asian market and will work with INI-GraphicsNet on international projects.

Both directors of CAMTech are also involved in regular teaching activities at the NTU including supervising undergraduate and postgraduate research work projects. In addition, CAMTech facilitates the exchange of students between Germany and Singapore. Each year CAMTech hosts several students from Germany carrying out their Diploma thesis (equivalent to a Master's thesis) during their six-month stay in Singapore.

CAMTech's key competencies include the following areas:

- Multimedia in education and commerce,
- Geographical information systems,
- Scientific and medical visualization,
- Visual and haptic interaction,
- Virtual engineering,
- Virtual and augmented environments for medical applications,
- New media for cultural heritage.

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Also in 2002 the Fraunhofer IGD institutions processed numerous research and development projects. Many of these projects are handled in close cooperation with partners from industry, trade, business and science. The following sections introduce some selected projects, which are listed in the order of their application areas.



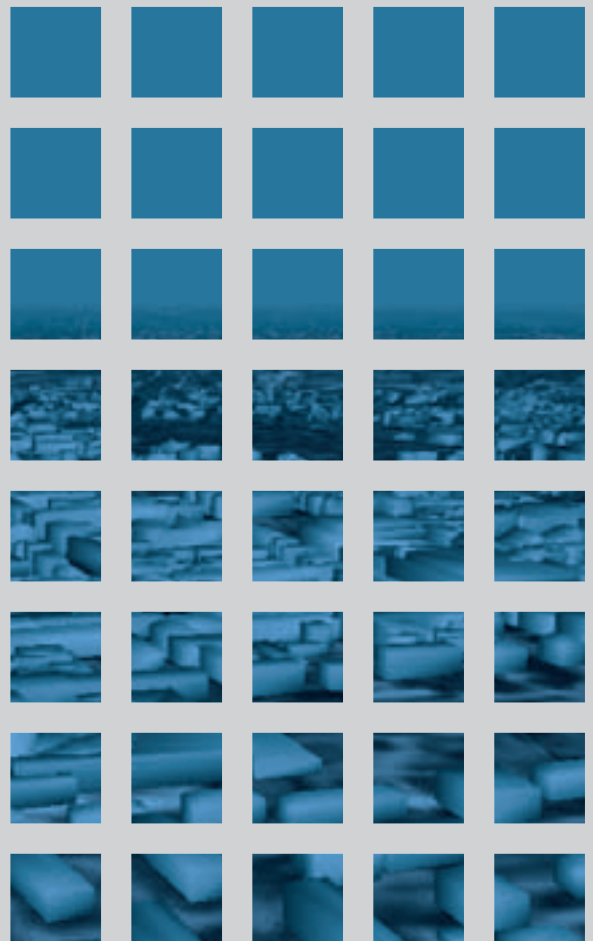
Applications

Mobile Computing

Mobile information systems allow a mobile user to record data or query stationary information services for background information on site, without interrupting the work process. Computer support and electronic information access can now be effortlessly embedded into work routines and other situations where the use of conventional hardware has been too expensive, too unwieldy, or simply impossible. By using mobile information systems, spatially distributed work tasks can now be handled faster, more reliably, and more cost effective.

Our concepts, systems, and applications can be used for processes such as:

- Maintenance of distributed installations (utilities, telephone and data networks, traffic networks),
- Field service and sales force automation,
- Mobile facility management,
- Medical/Clinical information systems,
- Maintenance of industrial plants and machinery,
- Environmental data acquisition and visualization,
- Advanced travel information systems,
- Mobile access to distributed multimedia information systems and online services,
- Personal information management systems, "mobile office".



e-ssist

The goal of the Fraunhofer-Innovation Initiative e-ssist (duration: 03/99-04/02) was the development of a technology platform for the mobile electronics of the future which included the following key points:

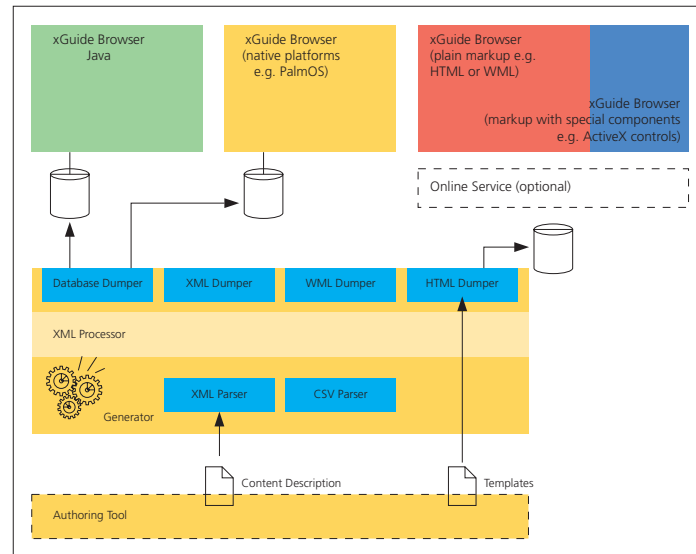
- Body area networks,
- Intelligent transponders (iTag),
- Low power concepts in circuitry,
- Flexible materials and foil for system integration (MCMFlex),
- Flexible application generator for situation aware mobile assistance systems (MapGen),

At the same time e-ssist on the Fraunhofer IGD Rostock further developed a row of concepts for mobile solutions in the field of Location and Situation based Services and implemented and integrated numerous solutions under the working name MapGen. Basically it concerns the following itemised aspects:

- 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 are required in the context of mobile location and



Fraunhofer-booth information system on CeBit 2002.



Architecture of xGuide-production system.

- 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,
- A generator, that generates a set of software-components for the target infrastructure from the application definition,
- An authoring tool for the graphical interactive production of an application definition.

The results of the itemised work packages were merged in a production system, which came into operation in 2002 as xGuide production system for the generation of numerous electronic event guides.

A broad presentation of the results of the whole project took place on CeBIT 2002. Specially for this purpose Fraunhofer IGD Rostock compiled a booth information system using the production system developed in the project. Furthermore the new technologies developed within the scope of the project were integrated to ensure a coherent final presentation.

In the final meeting of the heads of the institutes involved and the executive board of the Fraunhofer-Gesellschaft, the project was assessed positively and appreciation was expressed for its success.

URL: <http://www.e-ssist.fraunhofer.de>

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LoVEUS – Location Aware Visually Enhanced Ubiquitous Services

The EU funded project LoVEUS (IST-2000-30155) develops a mobile service that will provide personalized, tourist-oriented multimedia information enriched with relevant advertisement. The aim of LoVEUS is to create a new paradigm for promoting tourism, cultural heritage as well as commercial services successfully demonstrated in Athens, whereby the focus is set to the National Garden and its surroundings including part of the historical center (e.g. Temple of Zeus), but also part of the modern city with high-density areas.

The purpose of the project is to provide exciting information about the actual location of the user in order to guide him in terms of points of interest and to present visually enhanced



information about significant details. Thereby, the service provides active maps with city navigation, active panoramic views and visually enhanced content. Towards the end of the project pre-defined guided tours will also be offered in areas of important historical sites. The tours will provide multimedia based information to the currently visited historical objects.

The commercial content within the service is provided in the same manner. The advertisement presentation works with a combination of a push and a pull service. A balance between advertising and tourist information is

essential and will be also tested with real actors. Furthermore the project looks for a practicable business model.

The comprehensive service supports mobile phones, PDAs, and wearable computers that are enhanced with a GPS and a digital compass. Due to the shading of the GPS signals in high-density areas, service additionally uses positioning based on the telecommunication network. This position is calculated on the basis of the telecommunication antennas close to the user and the power of their signal onto the mobile device.

In order to implement the functionality of LoVEUS a Location Based Service (LBS) is combined with a multimedia managing system, so that a location server, a map server and a multimedia server work together in one system. The system can handle navigation and map requests as well as the multimedia content regarding freely defined spatial objects or areas. Based on a content filtering tool the content provided is adjusted to the user's interests, the network connection and the used mobile terminal.

To make the system completely independent of the applied area and the multimedia content available, an authoring tool is being developed for designing the provided representations and composing the multimedia guided tours as well as importation of these into the LoVEUS system.

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Selected three-dimensional reconstruction of the Temple of Zeus.



Active map with requested routing information and available representations to the Temple of Zeus.

Personal Interfaces-To-Go

PI-2-GO explores how several heterogeneous data visualization and exploration systems can be integrated into one collaborative workflow, where results gained on one system can be utilized using another system. Using affordable wireless mobile computing devices such as a PDA, we examine the possibilities of storing the collaboration and interaction data on a PDA, modifying it and transferring it to another system at a later time. This allows for time-decoupled communications, and the continuation of previous interaction sessions in different environments.

In the initial implementation, the following three data visualization systems have been used as PI-2-GO-enabled data exchange platforms:

MediDesk integrates hardware-accelerated, volume-rendering software with an interaction-rich and immersive VR

system. It is designed to enable several users to view and discuss medical data in stereoscopic projection.

TeleInViVo is a proprietary software platform for non-immersive, collaborative, medical volume visualization. Remote users can share views and coordinate control over a standard TCP/IP connection. The volumetric data can be visualized on standard desktop or laptop PCs through a fast and highly optimized software algorithm, or through OpenGL hardware-accelerated rendering.

The Virtual Showcase is a new multi-user AR display that allows virtual representations and real objects to share the same space, providing new ways of merging and exploring real and virtual content. It allows stereoscopic display for up to four head-tracked users, and supports volumetric rendering, as well as rendering of polygonal geometry.

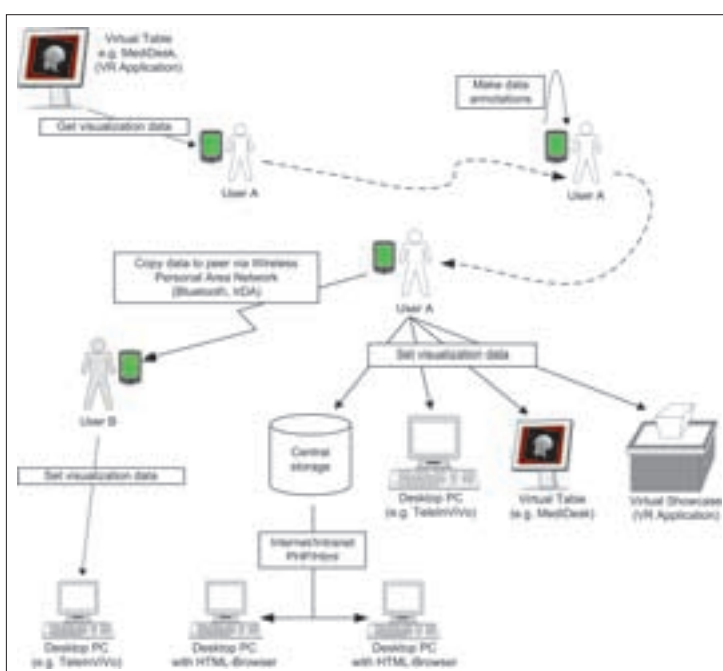


PDA with volume visualization screenshot from TeleInViVo.

A Compaq iPAQ 3870 PDA serves as our prototype hardware platform for the wireless mobile system. The PDA can be expanded with a WLAN (802.11b) card, or it can be used with its integrated Bluetooth capabilities. The prototype client software is written in Java and provides the connection to the visualization system, as well as a scrollable color image display of the visualization result. As a flexible communication protocol for exchanging data, the industry-standard SOAP is used.

Contact

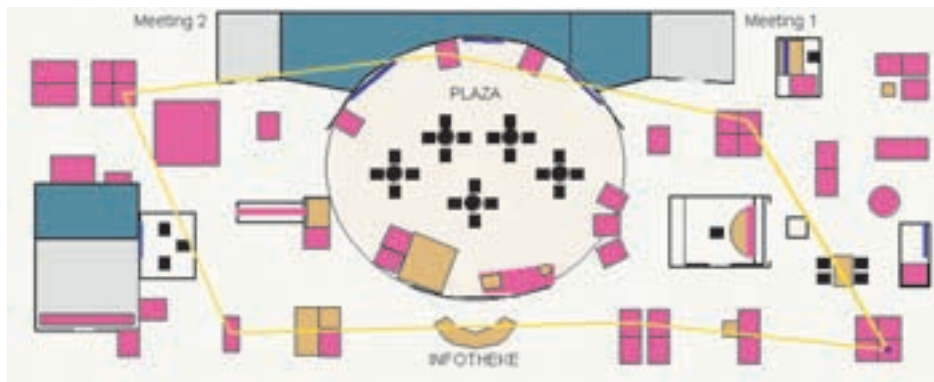
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Data exchange and interaction workflow.

SAiMotion

The goal of six partners in the joint research project Situation Awareness in Motion, promoted by the BMBF within the scope of "Life and Work in an Interconnected World" (SAiMotion; term: 04/01 to 12/03) is the development of situation-aware assistants, automatic proactive selection of information and context-sensitive presentation of the contents as well as interaction on ultraportable computers (personal digital assistants), SmartPhones and similar Multimedia devices. Fundamentally, a suitable system concept is necessary, which enables the determination of the individual needs of information on the basis of location, environment, user tasks and activities. This allows the development of a situation aware user assistant for interaction, information retrieval and – presentation. Substantial issues are the design of task models, situation analysis as well as a prototype conversion of software components for system evaluation.



A scheduled tour on the Fraunhofer CeBIT booth.

In 2002, a unified system architecture for a mobile, situation-aware assistant system was developed. It includes the fundamental structures for data representation and visualization (SAiMotion browser), data exchange (query generator) and personal task management.

Furthermore, Fraunhofer IGD Rostock has directed its research activities to problems related to scheduling of the user's personal agenda and to visualization of graphical data. For the personal agenda, a library of algorithms to optimize the activity schedule, differing in speed and quality, have been developed and implemented. For the visualisation of graphical data, a Graphics Engine for Mobile Devices (GEMoDe) has been developed. It uses vector graphics to allow seamless zooming and interactivity and is optimized for the needs of resource limited devices.

The developed components formed the integral part of the mobile component in the SAiMotion demonstration of a situation aware fair guide system at the CeBIT 2003.

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Map display with GEMoDe.



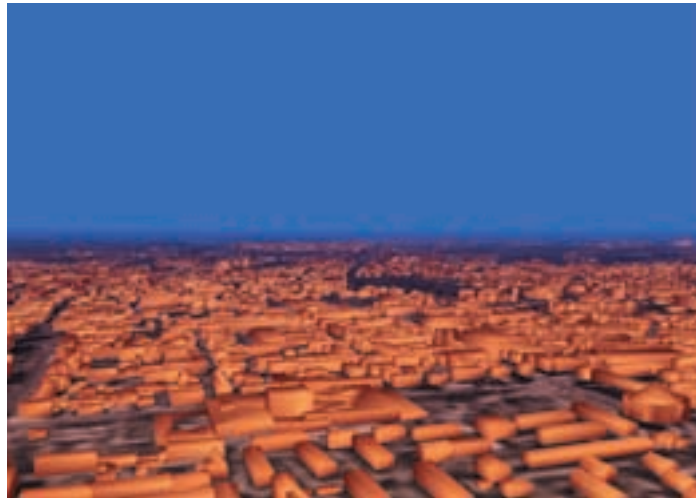
WAP for Graphical Objects

With the increasing capabilities of hardware for 3D graphics and network, 3D multi-user environments get more and more interesting for E-Business, entertainment and cooperative work. This addresses also small mobile devices such as laptop computers or PDAs.

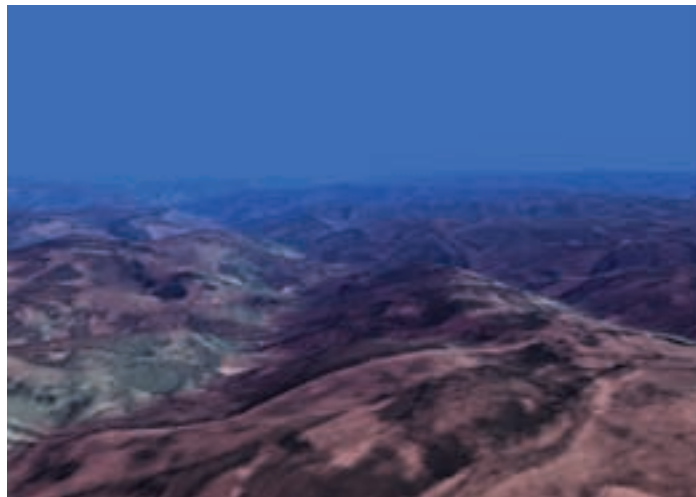
In the last few years the Fraunhofer IGD Darmstadt has developed a new client-server-architecture for the cooperative visualization of large, interactive, and dynamic 3D scenes, even on mobile devices. Large scenes contain structures with millions of objects and primitives. Dynamic scenes allow the free navigation of the observer in the scene as well as the transformation of the scene's objects. Interaction is not only the navigation of the user, but also the interaction between the user and the elements of the scene, and among the elements themselves.

In the architecture the spatial representation of a scene on server and client is provided by a dynamic space partitioning tree, which allows the fast computation of applications such as visibility culling, visualization, and collision detection. Since the tree offers parallel read and write operations, it is possible to visualize the scene, while objects are modified. A new developed algorithm computes the rearrangement of the tree, if necessary. If the scene's information exceeds the memory capacity of a system, then the information is cached in a backup system. The architecture is able to manage 264 objects.

In order to determine regions of the scene, which have to be transmitted or cached, the approach defines an area of interest of a client by several nested bounding boxes around the client's view frustum. Objects inside of the smallest box get the highest priority, while



The visualization of the complete German federal state Hessen was realized with the server's architecture and demonstrated at the Intergeo 2002.



The scene data consists of the governmental Digital Elevation Model DGM25 of Hessen, the official satellite images, and the 3D model of the city of Darmstadt.

objects outside of the largest box get the lowest priority. Since the determination of the area of interest for each client would be too expensive if applied in each visualization step, the approach provides a cascaded lazy algorithm. The clients are tested asynchronously to the visualization process; objects with higher priority are tested with a higher frequency. This is possible, because the amount of high priority objects is significantly smaller. The clients' areas of interest are evaluated by an I/O strategy for an efficient caching or transmitting of the data.

The current architecture allows the visualization of large, dynamic and interactive scenes. Single objects of a

scene can be transmitted progressively to remote, even mobile clients. Future work will concentrate on the transmission of complete 3D scenes and on the enhancement of interactivity. An important research field will consist of the cooperative visualization of 3D scenes even on palms and mobile telephones.

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xGuide / XyberScout Platform

Mobile information systems for the visitors of fairs, exhibitions, conferences, shopping malls, and similar events, aim to provide the user with a powerful means for organizing his visit and for navigation within the event's surroundings. Electronic guides provide all the needed information to the visitor of such an event: Where do I find what? What is going on when? How can I get there?

The Fraunhofer IGD Rostock has developed a series of such systems. Our experiences clearly show that the real challenge is to provide an efficient production environment to the organizer of an event. Also, we need user interface components and concepts on the mobile side that are easy to understand and simple to use and allow quick navigation through large amounts of data while at the same time occupying only minimal real estate on screen.

The Fraunhofer IGD Rostock built an integrated environment for the efficient creation of such mobile information systems – the XyberScout platform. XyberScout is based on a generator-browser concept. A service

provider – such as a fair or exhibition organizer – describes the properties of its specific service, its temporal and spatial topologies, the individual exhibits, search facilities, etc., using the XML-based “eGuide exchange format” (exf). A CSV format can be used for the data as well, which can easily be generated from existing databases. A web-based authoring tool helps to interactively create such a description. The generator translates the service description into platform specific data structures that can be viewed by the end-user with the help of the XyberScout browser (called xGuide). The system supports a multi-language user interface. We use the generator now on a regular basis and have stable support for PalmOS, HTML and PocketPC. In addition, online services based on WAP or i-mode could easily be provided.

The flexibility of the XyberScout platform allows fair and exhibition organizers to quickly create a tailored guide for an event, even if they are not familiar with programming mobile devices. Based on the XyberScout platform we constructed more than 15 mobile visitor information systems for fair grounds in Germany in 2002 (e. g. Berlin: HomeTech, InnoTrans; Munich: Systems, ISPO; Duesseldorf: MEDICA,



xGuide on a mobile device.

INHORGENTA), also for the booth of the Fraunhofer-Gesellschaft at the CeBIT'2002 and for the Eurographics'2002 conference.

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a)



b)



c)



TabMenu UI component: a) unselected b) selected c) submenu.

New Media for Cultural Heritage

Who has not 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 digitizing a great part of their stock. In this way digital artifacts and works of art will in the future 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", "Human-centered User Interface Design" and "Edutainment".



Augmented Reality Based On-Site Guide for Cultural Heritage

The ArcheoGuide system consists of a mobile multimedia information system that allows visitors of archaeological sites to understand history in a completely new way. A mobile unit provides visitors with multimedia information (images, text and sound) depending on their location on the site. In addition, through their data goggles they can contemplate virtual reconstructions of monuments appearing in their real surroundings. For example, visitors may look at a ruin while the computer generates the corresponding view of the virtual temple in its original beauty.

The hardware components of the system include a Site Information Server, the Mobile Units and a Wireless Local Area Network. With this infrastructure, it is possible to download information during the visit, for example, or to send images of the site by mail to other visitors or friends.

The mobile unit represents the central component of the system and consists essentially of a computer unit, a head mounted display with a camera, and a Global Positioning System (GPS) used as a navigation system. The HMD takes over the functionality of binoculars in which the virtual models of the monuments are displayed. At pre-defined so-called "AR stations", users



View of the Zeus Temple.

can wear the eyeglasses and contemplate the virtual monument in their real environment or a 3D animation of a sports competition.

In order to place the virtual objects into the real environment, the exact position and viewing direction of the visitor must be determined. For exact tracking, computer vision and image-matching methods have been applied on the basis of the live video provided by the camera attached to the user's HMD. The main advantage of this approach is that no markers or emitters have to be placed in the scene.

The first trials of the "ArcheoGuide mobile on-site guide" have been carried out at the site of the ancient Olympia in Greece. The tests have demonstrated the potential of "Augmented Reality" for tourism and the

digital cultural heritage market. The ArcheoGuide Consortium now aims at a commercial version of the system for the Olympic Games in 2004 in Athens.

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Tracking results.



GEIST

The GEIST research project is one of the projects of the contest of ideas for Virtual and Augmented Reality promoted by the Federal Ministry of Education and Research (BMBF). In cooperation with the Center for Computer Graphics (ZGDV) in Darmstadt and the European Media Laboratory (EML) in Heidelberg, Fraunhofer IGD has developed a mobile AR information system with Digital Storytelling which allows historical facts to be experienced within their context in an urban environment.

The aim is to get pupils more interested in history. Therefore we have developed a prototype realization of an educational game: The pupils are sent to find ghosts who appear at certain places in a town. Within this project it is the medieval centre of Heidelberg, which is not previously known to the pupils. This means that they move freely through the city. They are equipped with a laptop, a wearable display, and tracking sensors. The ghosts contact the pupils via headphones as soon as they enter one of the places. They appear in the wear-

able display in front of object reconstructions from the past and tell the pupils facts from the history of the place that played a certain role in the Thirty Years' War. The whole game forms a story, which is composed according to the particular pupil and the way he chooses. Whatever route is used, the game is exciting for everybody and always leads to a good end. The underlying StoryEngine is developed by ZGDV. EML is responsible for the database organization and the necessary intelligent access to the four databases. This access is not only used automatically by the game. By means of a PDA (Personal Digital Assistant), the pupils can also directly inquire not only facts but also reconstruction or fairytales and legends about the Thirty Years' War.

In the course of the game, the ghosts appear as avatars in front of the reconstruction of buildings of that time. The object reconstructions are georeferenced and therefore placed exactly where they stood in former times. For this exact corresponding position a reality tracking component must be developed which allows the exact identification of position and line of vision in the urban environment.

Although sensors like GPS (Global Positioning System) and an orientation tracker offer a first basis, they are, however, neither exact nor reliable enough. Therefore Fraunhofer IGD pursues a video-based approach in connection with a 3D model of the present environment. Pictures of the camera are compared with the data of the 3D model and in this way the position of the pupil identified. After the determination of the actual position and line of vision the reconstruction which the StoryEngine requires can be placed onto the display. So the building seems to be exactly at the place where it was during the Thirty Years' War.

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GEIST – Access to historical data and presentation in a learning game.

The Peranakans

With the advent of technological developments in Virtual Reality (VR) and the abundant content and need for the preservation and conservation for cultural heritage, there has been an explosion of Digital Heritage projects world-wide. Virtual Reality technology provides an important educational tool to recreate historical content in an immersive high-quality 3D environment where the user can enter and explore the virtual representation in real-time. It also provides intuitive interaction techniques for the user adding to the enhanced educational value of "learning-by-doing" experience they were never previously exposed to. Using this VR technology as the base, the Peranakans has been selected to represent the cultural history specific to Singapore and its region. A virtual scenario depicting the Peranakan history is currently being reconstructed in high-end 3D and the "story" behind the scenario is then presented to the visitor through a virtual Peranakan tour guide with additional interaction using the Chinese calligraphy brush.

So, why the Peranakans?

Singapore is a diverse city-country with many different ethnic groups living together side by side. It has a very rich culture that is a mixture of different



Peranakan Chamber.

ethnicities with its own unique identity. To better understand the Singaporean history, we cannot dismiss the impact of the Peranakans (which in Malay means "born here"), also known as the Straits-Chinese. A Peranakan man is called a Baba, while the ladies are known as Nyonya. The Peranakans are descendants of an early Chinese community that settled in the Malay archipelago at least since the 17th century. Peranakans evolved as a result of intermarriages between these early Chinese settlers and the indigenous Malay, since the Chinese women were not allowed to leave the country until the 19th century. This unique community developed distinct customs, cuisine and even their own language, as they blended Chinese and Malay ways of life to form a new and rich culture, which added another dimension to the Singaporean society. They played a key role in bringing Malaysia and Singapore to independence.

The Digital Heritage project undertaken by CAMTech will focus on the following aspects. The main focus of our project is the users/visitors that will visit our virtual cultural site. Therefore we put special attention and effort in the intuitive interaction techniques and the reconstruction of a realistic environment. Attractive realistic high-end 3D

models capable of optimal real-time rendering have been generated from Peranakan heritage objects such as furniture, ceramics, silverware, and embroidery. This will later be integrated into a Peranakan architectural setting. In addition, innovative user interaction techniques, where the visitor will be given the opportunity to explore and navigate the virtual environment due to their specific needs, are provided. A Peranakan Virtual Tour Guide will guide the visitor and provide more information about the Peranakan culture while the visitor will also be able to directly interact with the environment by using an actual Chinese calligraphy brush to paint directly in the virtual scene.

Digital heritage provides an exciting environment where a true combination of art and technology is showcased. The integration of such immersive 3D heritage environments in museum exhibitions is opening up new possibilities in bringing culture closer to the visitor.

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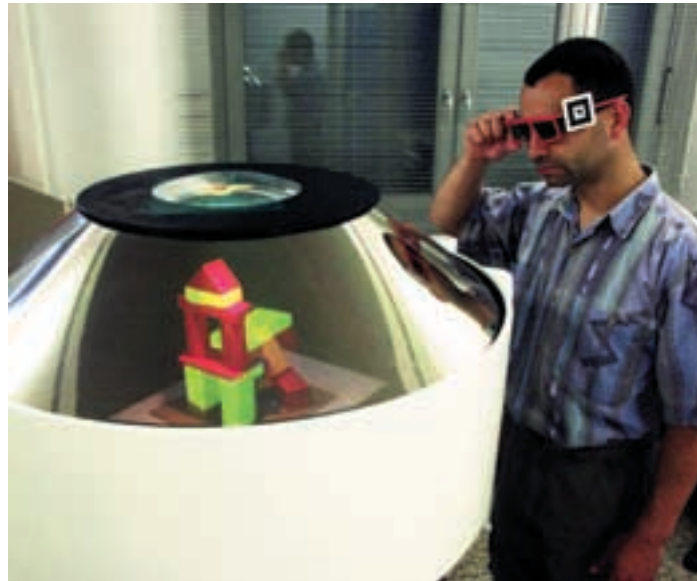
Interaction with the Calligraphy Brush.



Virtual Showcases – Presenting Hybrid Exhibits

Showcases are standard equipment in museums and other exhibition areas. They are used to present artefacts to the public and to make them available to a broad audience in combination with protecting them against environmental influences. Showcases normally are built from glass to give the visitor an optimal view of the exhibit.

With the implementation of the Virtual Showcase a new media will be established in museums, allowing the overlapping presentation of real exhibits with any kind of graphically presented information or the presentation of virtual exhibits respectively. Virtual Showcases are made from transparent material (e.g. glass or Perspex) covered with a half-transparent foil. The viewer can look into the exhibit through the half-transparent surface of the Virtual Showcase. At the same time computer generated graphics are presented to the viewer using the mirror component of the surface.



The Virtual Showcase "open view".

The European project "Virtual Showcases – Presenting hybrid Exhibits" deals with the technological realization of Virtual Showcases and will implement them into several museums. Partners in the project come from Austria, Portugal, Belgium, and Germany. The department "Human-Centered Interaction & Technologies" of the Fraunhofer IGD Rostock is co-ordinating the project.

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The main task of Fraunhofer IGD Rostock during the project, apart from the co-ordination of the whole project, lies in the development of the Virtual Showcase prototypes "open view". Regarding the other existing prototypes, the "Virtual Showcase open view" is distinguished by being transportable and having a projection plane out of the viewer's field of vision, which allows implementation at fairs and exhibitions. The user of the "Virtual Showcase open view" has a free 360 degree access to the showcase.



The Virtual Showcase "open view".

E*-Services

Usage of electronic media is of growing importance in the areas of education, work, business and public administration. E*-Services significantly contribute to this process.

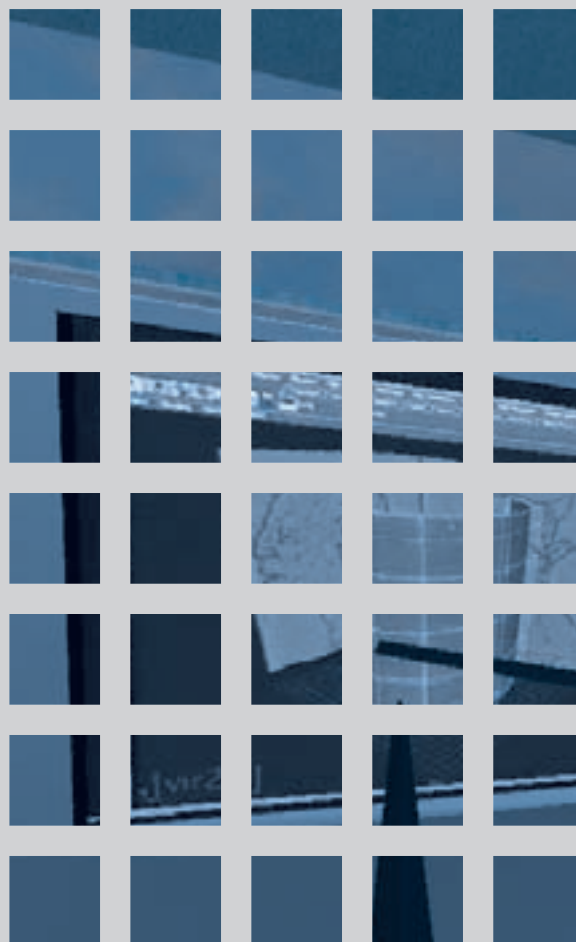
E-Learning applications, especially integrated course management systems like smartBLU or MTS, allow time- and location-independent learning, dynamic adaptation of course contents to the individual needs of the course attendee, as well as cooperative learning and tutoring in groups.

With the help of Content Management Systems (CMS) it will be possible to create multimedia and hyper-structured Internet presentations that are customer-oriented, to keep them consistent and to administrate them.

Electronic fairs and exhibitions allow people to be virtually present in actual remote exhibitions over the Internet. The tools developed by Fraunhofer IGD in the areas of Knowledge Management and Knowledge Asset Management allow the registration of processes and knowledge items, to make the knowledge of employees permanently usable for the whole company.

E-Government solutions permit the mobilization of public administration, electronic exchange of information and documents between departments as well as an improved contact between citizen and administration office. Thus, the citizen will be able to visit the administration office any time, to fill in forms on the PC and send them directly to the authorities, without having to consider the closing times.

For further information refer to the thematic brochures "Internet Life".



Citizens' Contact System (BKS) – an E-Government Solution for Mecklenburg-Vorpommern

BKS is a cooperative project within the multimedia initiative of Mecklenburg-Vorpommern designed for the development of an E-Government solution. The project partners are: Deutsche Telekom AG and T-Systems, Datenverarbeitungszentrum DVZ MV, Planet internet commerce GmbH, ZGDV, the University of Rostock and the Steinbeis Transferzentrum.

One of the tasks of the Fraunhofer IGD Rostock within the project is the development of concepts for intelligent forms which are based on a user profiling and their implementation for BKS services. Intelligent forms support automatic fill-in, sending and processing of forms based on an advanced user profiling. A subtask is the development of a form editor for the automatic generation of intelligent forms and of tools for automatic fill-in and processing of these forms. These concepts significantly simplify the operation of form based systems.

The following functionalities will be developed:

- Design and implementation of an advanced user profiling for the personalisation of services,
- Development of an form editor and of intelligent forms for the control of Internet based systems, providing functionality for management of forms including definition, administration, and connection to user profiles; assistance for fill-in of forms; connection to services; adaptation to the user and his individual needs; delegation of tasks; control of instructions,
- Application and evaluation of the solutions for E-Government practices.

BKS was activated in its first development stage in December 2002. In the first phase an information system was developed based on the content management system GAUSS, including a direction guide for public authorities and life situations as well as first services, e.g. for registration. In the second phase the solutions for a form editor and intelligent forms developed

by Fraunhofer IGD Rostock will be provided. The services developed by Fraunhofer IGD Rostock are part of a wide service area, which will finally include the connection of multifaceted procedures such as digital signature, codification and electronic payment. The project will be completed in November 2003.

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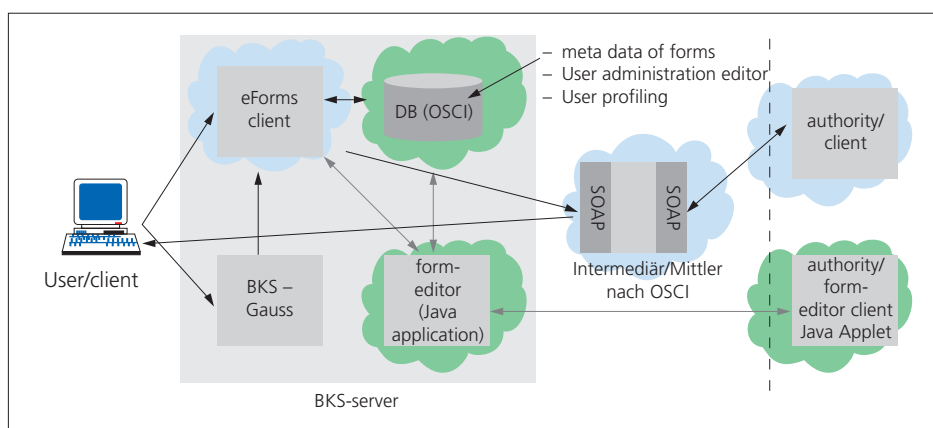
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System Architecture for form-based services.

E-Learning in Mecklenburg-Vorpommern

The Fraunhofer IGD Rostock has been carrying out research and development of technologies and applications for E-Learning and learning with new media since 1996. These activities cover the entire process of planning, creating, implementing and evaluating E-Learning content and services. The research and development activities at Fraunhofer IGD Rostock cover:

- the E-Learning process and its mapping on advisory systems and guidelines,
- didactic planning and creation of multimedia learning material,
- usage and application-oriented development of the Learning Management System smartBLU,
- personalization concepts (adaptation and user modeling),
- development and usage of portals within and beyond the E-Learning context, and
- the combination of E-Learning and Knowledge Management in technological development and application.

These activities focus on the theoretical as well as the practical aspects of E-Learning. Therefore, our projects emphasize application-oriented development in close cooperation with E-Learning content and service providers. Examples are "VOCAL – Netzbasierendes Lernen im Handwerk" and "Telelernen für Unternehmen in Mecklenburg-Vorpommern".

Within the project "VOCAL – Netzbasierendes Lernen im Handwerk" Fraunhofer IGD Rostock and several partners from the field of further education work on the introduction and evaluation of E-Learning courses for the trades. Fraunhofer IGD Rostock has developed a learning portal, which is used together with the Learning Management System smartBLU for orientation within an educational program and for providing and studying the multimedia learning content. The project partners developed trade-specific E-Learning content and evaluated it within the project. Fraunhofer IGD Rostock has evaluated and advanced smartBLU within this project as well as improved its competence and experience in the field of E-Learning. The project VOCAL is sponsored by the BMWA within the scope of LERNET.

The consortium of the project "Telelernen M-V" consists of educational providers and research institutes from Mecklenburg-Vorpommern. The project is targeted at employees from SMEs in Mecklenburg-Vorpommern and offers E-Learning courses for several topics, e.g. languages, information technologies, management, etc. Fraunhofer IGD Rostock in particular covers topics in the field of information technologies such as Java, Delphi, MS Office or CSCW. Furthermore, Fraunhofer IGD Rostock is implementing a learning portal that can be used to acquire information on E-Learning courses and how to book these courses. The project "Telelernen M-V" is sponsored by the state Mecklenburg-Vorpommern and the European Union.

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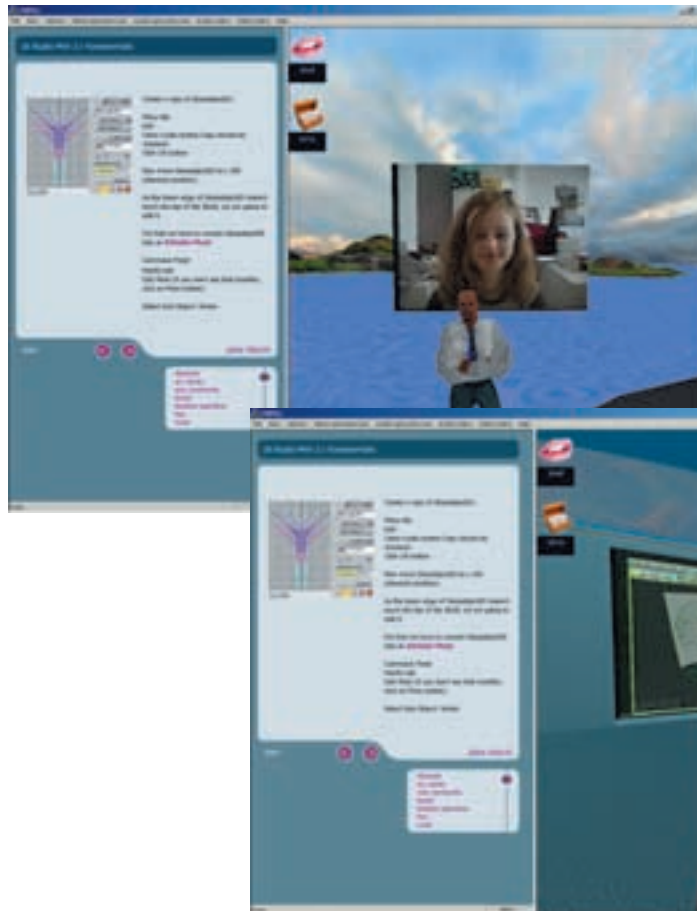
Learning with smartBLU.

Global-IT

Within the project as firm evidence of use, Global-IT stands for a virtual 3D university scenario that was developed together with GMD-FOKUS, Berlin. On the basis of a powerful service platform, users are able to learn and communicate simultaneously with each other in a distributed virtual 3D environment. The distributed virtual environment is accomplished by utilizing state-of-the-art 3D visualization techniques and thus provides a more realistic immersion into the distributed environment. The virtual university itself consists of several rooms that are at the course-participants' disposal for performing personal presentation of learning content.

A special conference room enables up to five learners to get in contact via audio-/video communication with colleagues or teachers at the same time. Live video textures projected onto the 3D projection walls of the virtual showrooms open up the possibility to show documentary videos about specific course themes.

Course and communication participants are represented by Avatars, three-dimensional modeled persons within the 3D environment. Avatars are human-looking placeholders for real human actors but within the 3D environment. High quality audio and video communication between participants increases the feeling of direct communication. To simplify the assignment of different audio streams to the corresponding emitters (e.g. video walls, Avatars), there is an aural rendering of sounds. To associate video streams with their emitters the streams are displayed by directly texturing specific video faces in the 3D environment.



Cooperative learning in a distributed virtual environment.

Learning content is presented as a combination of classic two-dimensional teaching aids with the possibilities of a three-dimensional user interface. By using specially modified internet content, it is possible to enrich 2D content with the advantages of three-dimensional visualization techniques. Amongst other things, this combination opens up visualizing two-dimensional content as a 3D model that can be manipulated, turned or even discussed. On the other hand the user may interact with the 3D model in three-dimensional space and therewith cause the invocation of specific two-dimensional context information.

Global-IT is a virtual three-dimensional university providing global learning over networks of spatially separated

companies or institute locations. The cutting edge technologies used are optimised IP-services for high quality audio and video transmission on the one hand, and learning content especially developed for the learning environment on the other.

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Knowledge Asset Management – Next Generation Knowledge Management

Content Management, Knowledge Management, Knowledge Asset Management – in the last few decades these terms have changed. Dealing with Knowledge Management is more than ever important for corporate and research organizations. It is increasingly recognized that the most important aspect in the area of knowledge management is the human being itself. At this point knowledge management has to begin. To make the knowledge of each person available to the company, it has to be collected, sorted and rated. For this purpose Fraunhofer IGD develops assessment tools. The interest is focused on the development of assessment tools that enables knowledge and knowledge items (smallest knowledge chips) to be assessed. On the other hand the Fraunhofer IGD is interested in the visualization of assessment outcomes and knowledge domains. The visualizations will be implemented with the help of standardized technologies such as Flash or Scalable Vector Graphics.

The project KAM.com deals with the development of a tool for the processing of online assessments in order to support the work of the consultants. This tool consists of an editor for questionnaires and an assessment module for the work with the questionnaires. The editor is useful for the creation of questionnaires in a fast and easy way. The project is accomplished together with several national partner institutions (zentec, Großwallstadt; FH Aschaffenburg; esi, Hof; IKV++, Berlin). It is funded by the Bavarian High-Tech-Offensive. In essence, the technical work focuses on two major aspects:



Visualized Rating Results (Screenshot).



2D Flash Topic Map Viewer.

- Generation, design and interactive manipulation of the result graphics,
- Development of an XML-based description language for questionnaires.

The generation and design of the visualization of the results will take place using SVG (Scalable Vector Graphics). By using this standard the graphics are designed to be manipulated, e. g. zooming or panning is possible.

The second research topic focuses on the development of an XML-based description language for questionnaires for all purposes: Questionnaire Modeling Markup Language (QMML). A first version of this language is implemented in the prototype. Furthermore, the development of an editor for the generation of these questionnaires is in focus.

The web-based search for information and knowledge is a complex task. In order to understand the content structure in web portals users have to



Knowledge Management Aspects.

understand the idea behind the organization of the content to enable efficient web application.

To support the concept-based acquisition of knowledge structures and navigation through complex information spaces, consisting of ensembles of associated knowledge items we developed a "2D Flash Topic Map Viewer" software application. The "2D Flash Topic Map Viewer" is applicable to different scenarios.

In the project Knowledge Management Portal (KM-Portal) a topic map for research topics of the Fraunhofer Institutes IGD and FIRST is visualized. In the project "Knowledge Asset Management, (KAM.sys)" the 2D visualization tool will be used for strategic business analysis and for description of knowledge assets in organizations.

Knowledge assets are defined as expertise or professional service, which are always connected to knowledge carriers, i.e. human beings. These relationships are visualized in a so-called "K-Asset-Map" and used to evaluate (balancing) knowledge as assets in an organization.

Arbitrary topic maps (usually developed for a specific domain) from different sources should be visualized and delivered through web browsers to distributed work places. For this purpose the topic map is supplied in the standardized exchange format XML Topic Maps (www.topicmaps.org).

For realization of the graphical user interface Macromedia Flash MX™ technology is used. This technology gives more opportunities in the design of graphical interfaces and especially in the design of human interactions with the software system. A further advantage of the Macromedia Flash technology is the high availability of the Flash Player plug in all usual browser versions. The Macromedia Flash technology is increasingly used in mobile devices. This will open new opportunities for innovative mobile services.

Main focus of future research will be user friendly navigation and representation of large knowledge maps. In the future we will work on the following themes.

- Graphic design of the visualization of associated topics,
- Guided drill-down functionalities (interactivity, zoom-in, zoom-out) in knowledge maps,
- Automatic opening of existing sheets of a knowledge unit, represented by a knot (circle) in the knowledge map, into a given depth,
- Editor for the production of XTM based knowledge maps.

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3D-Webscape

"3DWebscape" is a research project funded by the government of the state Mecklenburg-Vorpommern in the frame of the technology innovation funding program. The objective of the project is to develop an easy-to-use Content Management System (CMS).

With the help of the developed concept it will be possible to create multimedia and hyperstructured Internet presentations that are customer-oriented, to keep them consistent and to administrate them. "3DWebscape" will give Internet providers the possibility to create hypermedia, customer groups and customer oriented, adaptable websites that can be administrated by the information provider himself. It allows the creation of cross-media and intra-media websites and virtual landscapes in a consistent manner.

During the project a framework concept will be developed allowing the creation, management and administration of hypermedia, easy-to-use content management systems. Basic development tools such as a link structure editor, a page editor, a styles editor as well as several management utilities will be developed and integrated into the framework concept. They are the bases for an application-oriented authoring-front-end, which allows the information presentation and information management for different topics.

"3DWebscape" will be the basis for the realization of the "Virtuelle Museumslandschaft Mecklenburg-Vorpommern".

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WiBA-Net – Multimedia Learning Network for the Education in Civil Engineering and Architecture

The Project WiBA-Net was founded by the German Ministry of Education and Research within the research program "Neue Medien in der Bildung" (New media in education).

The Fraunhofer IGD Darmstadt has developed the learning network. Its application area is the education at universities in the field of architecture and civil engineering with the main focus on materials in civil engineering.

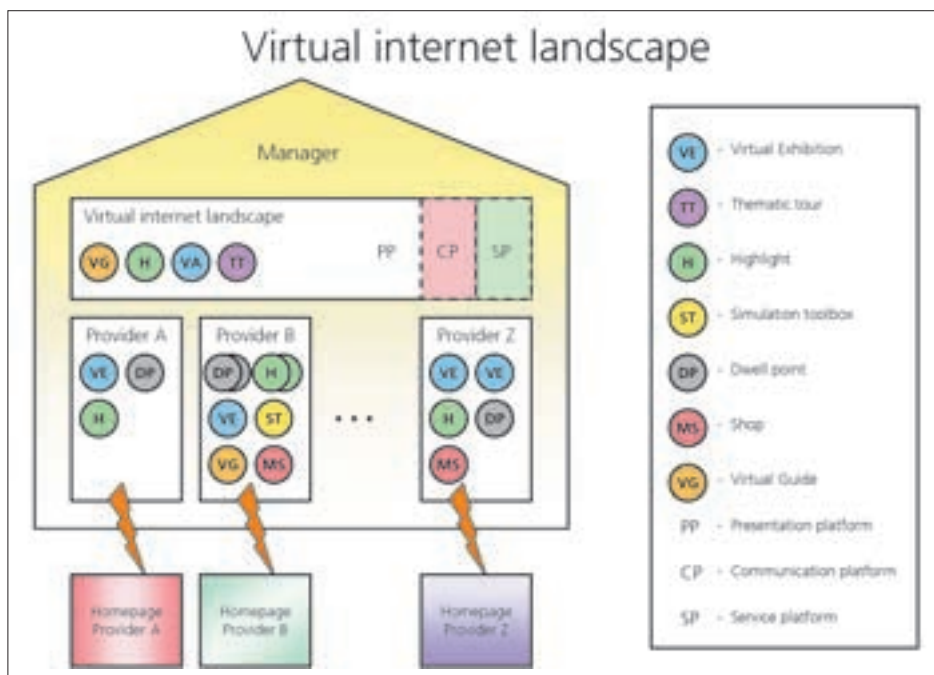
The Learning Management System WiBA-MTS was developed within the project. Its application area is the education at universities in the field of architecture and civil engineering with the main focus on materials in civil engineering. WiBA-MTS is based on the MTS Learning Management System that has been developed by Fraunhofer IGD and customized to the specific user requirements of the WiBA-NET project. It represents a combination of the general LMS on the one hand and application specific modules and user functionalities on the other hand.

One of the main goals of this project is to make the instructional content, which has been developed by the universities involved in the project, accessible to all students of the different universities.

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Realization concept of the application scenario "Virtuelle Museumslandschaft".

Fraunhofer Technology Search Portal

The Technology Search Portal of the Fraunhofer Society offers a central point of access for people interested in Fraunhofer technologies. The required data that the search for information is based on are primarily extracted from project information that exists on the institutes' web pages.

The search is based on a full-text index as well as a dynamically generated thesaurus that locates the relationship between each document and term. Other than the similarity between documents (project descriptions) and search query, weighting influences the search results, which institutes choose according to their priorities. The search system is based on a German language model, but will be extended to English.

Moreover, users can find proper names like that of project or persons according to their phonetic equivalents, which is useful when the correct spelling is unclear: so it is possible to find the project with the acronym "MQUBE" by the search query "MCUBE".

The search system is built on top of components of the system XperT ("experts per terms") developed by Fraunhofer IGD and was extended by an indexer for semi structural annotation of existing (web-based) data. Synchronization with the Fraunhofer LDAP directory reduces the effort to keep contact information up to date.



The Technology Search Portal of the Fraunhofer Society (Screenshot).

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eFairs – Web Solution for the Remote Presence in Exhibitions and Showhouses

Trade fairs and exhibitions are today probably the most effective medium for market communication. Hundreds of prestigious exhibitions and thousands of smaller specialized trade fairs take place every year around the world. However, attendance at these events is rendered prohibitive through associated negative constraints such as travel time and exorbitant costs for attending. The business of show-houses also has to deal with the same problems and is additionally affected by high operating costs. The eFairs project, which is partly funded by the European Commission's IST Programme, focuses on the need for an easy, readily available, customizable and cost effective service through which visitors can be virtually present in actual remote exhibitions or show-houses over the Internet. This solution employs state-of-the-art video technology and takes full advantage of new Internet performance capabilities and latest image processing techniques. eFairs enables users to access visual content in an interactive manner, thus

allowing them to obtain visual and descriptive information which before now was only provided through on-site presence.

Efforts for the creation of virtual fairs have so far concentrated on the development of a wholly virtual environment, which is effectively an enhanced catalogue. What differentiates eFairs from other virtual fairs is that it complements the actual live exhibition or show-house rather than replacing it, requiring a minimal customization effort for each installation. The eFairs project promotes an innovative environment for the interaction between exhibition organizers and show-house suppliers, with visitors and clients respectively, by integrating the communicative power of the Web with the potential of interactive video.

In the area of video interaction, the project aims to link the familiar electronic catalogue paradigm with the images transmitted by a web-camera. In particular, the user must be able to directly click on an object in the image and receive the appropriate information associated with this object which is stored in the electronic catalogue. For this purpose eFairs uses a static

environment where hyperlinks are manually predefined as well as an experimental dynamic approach where Content Based Image Retrieval (CBIR) technology, combined with edge detection and shape extraction methods, is used to dynamically identify objects in the video in order to link additional information with them.

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eFairs Video Viewer.

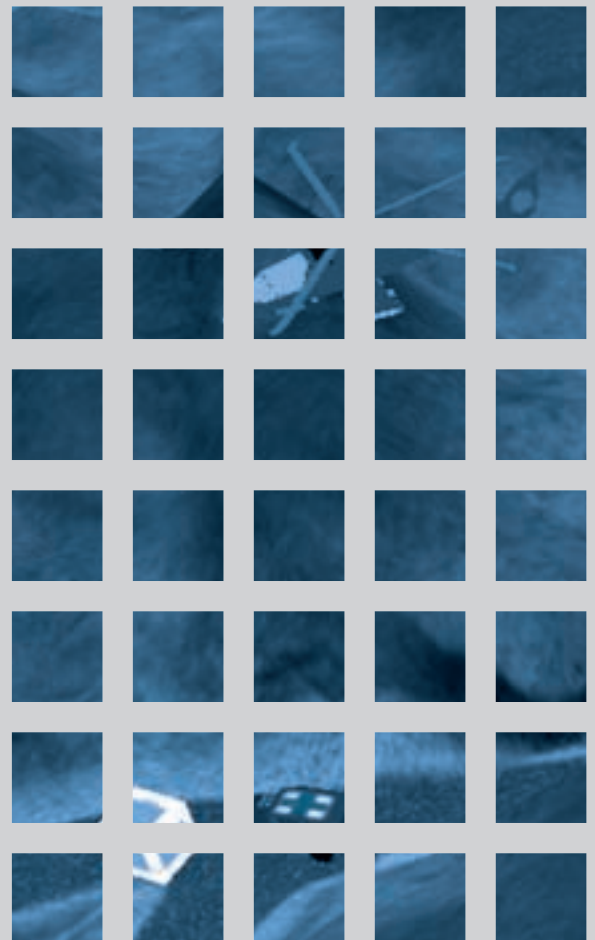
Innovative Handling- and Interaction Techniques

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 techniques, and 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 by hand.

These new applications place high demands on 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 adapting themselves to the user's routine. 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 involvement for remote participants. Using real or virtual avatars, remote and present users can now communicate and interact with each other.

For further information refer to the thematic brochures "Human-centered User Interface Design".

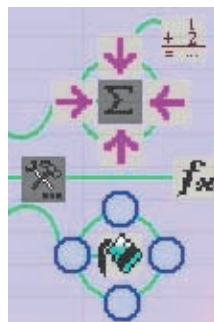
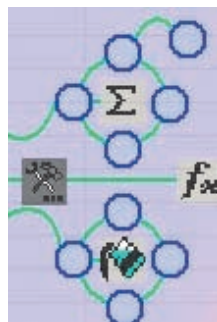


ContextControl

More functionality is always a good sales argument, but highly complex menu and dialog structures in standard applications like word processing or spreadsheets deter beginners and occasional users. Finally, they will switch to easier applications. To overcome these problems we need new structures and concepts for user interfaces to rearrange the functionality of applications.

Computer games are a good source for such new approaches, because they use new ideas like level systems or customizability to demonstrate their functionality. Within the project "Play the Application", we developed a new user interface for standard applications based on game concepts: ContextControl. This so-called Game Based Interface makes interaction with complex applications easier by motivating and supporting users.

We developed ContextControl to simplify the user interface by presenting just the necessary functions, to be adequate on task, self-explanatory,



Three states of the ContextControl starting with the basic level (left), the first sub menus (middle), and nearly all functional buttons open (right).

customizable and to support learning. ContextControl can be used in parallel to the usual context menu and is activated similarly. Our menu widget uses different sets of buttons. In the basic level, only a few menu items and functional buttons can be found. Clicking on menu items reveals more menu items and functional buttons around the selected menu only. The buttons of each set are arranged in special context groups to work on special tasks. Those groups are small and clearly arranged and can be changed very fast. We understand that simplicity and flexibility are basic game methods. The contrast of menu items to the background application can be set individually and allows the user to view the current working context and

to choose the suitable menu item at the same time. In addition, the background image of the ContextControl menu can provide additional information about the context of each button group.

The individual design and structure of functionality as well as integration of animation and active help elements makes ContextControl a suitable tool for education and training of complex software systems. With ContextControl, organizers of computer and software courses can build courses for software systems. Enterprises can train employees on-the-job by representing their own enterprise working processes with ContextControl. By restructuring the functionality of their own software, application handling is simplified and thus the motivation of employees is increased.

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ContextControl menu used with Microsoft Excel.



Decision-Centered Visualization – Time-Critical Situation Awareness and Decision Making

In time-critical domains, such as emergency management or military command and control, users are required to make decisions in highly stressful situations. Decision-Centered Visualization (DCV) is an adaptive, interactive visualization system under development at Fraunhofer CRCG that merges knowledge engineering and visualization technology. Decision and task models, and knowledge of the information environment of the application domain, are all tightly-coupled with the human-machine interface and the visualization architecture in order to produce timely, knowledge-based presentations. Our long-term objective is to provide automated, knowledge-based visualization components that enable decision-makers to quickly

achieve situation awareness during their tasks, and to make informed decisions under time pressure.

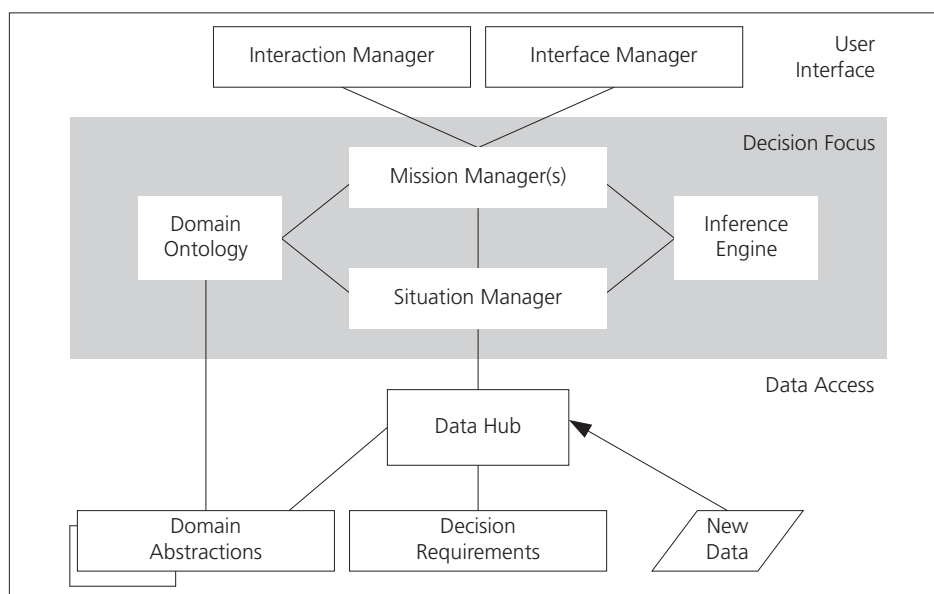
DCV embodies a distinct and unique view – DCV is not intended to replace human decision makers, to diagnose or plan, or to provide expert advice to human problem solvers. Instead, DCV is focused on real-time, context-sensitive, interactive visualization. As a visualization system, DCV uses domain, task and decision knowledge to assure that decision makers are presented with the right information at the right time. DCV embodies the argument that this can only be done by merging knowledge technologies with interactive visualization.

The DCV architecture is divided into three main parts: The Data Access module, the Decision Focus module, and the User Interface module. The Decision Focus module tracks and con-

trols information about the current situation and the tasks and decisions being worked. The Domain Ontology, Decision Requirements and Domain Abstractions modules are integrated with the Decision Focus module to show information relevant to a particular situation, task, and user in the DCV system.

The Domain Ontology specifies the objects, processes, and events within the domain of discourse. Domain Abstractions represent instances of these concepts and concept relationships in the current operation. For example, in the emergency management domain, the Domain Ontology might contain a generalization hierarchy that defines a medical evacuation helicopter as a kind of aerial transport with certain known variants and specific capabilities. The Domain Abstractions stores information on how many helicopters of this type are available in the current situation, their location, status and unique identifiers.

For any given decision or task, the Decision Requirements module represents a list of the critical information items needed to make a sound decision. In the infantry domain, for example, these information items might include the enemy's position, strengths and weaknesses, avenues of approach, location of obstacles, and key terrain properties they have and what the relations and causal connections are between them.



High-level architecture for Decision-Centered Visualization (DCV). The distinguishing feature of this technology is the incorporation of knowledge modules into the visualization system. These knowledge modules consist of Domain Ontology and Domain Abstractions, Decision Requirements all integrated with the Decision Focus context tracker.



DCV Prototype system.

domain information in a knowledge-based, interactive situation awareness presentation system.

While the initial DCV implementation has not been formally evaluated, a panel of domain experts for naval command and control applications has favorably assessed it. Future work on the DCV system will involve development of the knowledge representation structures, including the domain ontology and the corresponding knowledge base. We are also working on decoupling the user interface from the DCV system. This would allow the Interface Manager to guide several user interfaces or even several visualization systems in a network environment.

The Interface Manager guides the user interface. The Interface Manager is device-independent, and is not tied to a particular rendering engine, but instead, gives suggestions and commands to the visualization system based on an API. One of the advantages of this setup is that the Interface Manager and one or more visualization systems can be connected via network.

By using information about current tasks and decisions, the Decision Focus module aims at avoiding information overload by only displaying task-relevant information. While the Decision Focus module decides what needs to be displayed depending on the user's task and situation, the Interface Manager decides how the information will be displayed depending on the current interaction mode and the priority of the information. The Interface Manager maintains the current state of the DCV presentations and display devices, supervises the overall appearance of the presentations, and arbitrates and modulates additions, deletions, and modifications to the current presentation.

The DCV system is developed in C++ and currently runs on Windows NT/2000/XP. We make extensive use of platform independent libraries that allow for a relatively easy transition to other platforms. The domain abstractions and decision requirements are maintained in a relational database system. DCV uses CLIPS as its inference engine and Criterion's RenderWare for 3D visualization and maps.

A prototype DCV system for a dismounted infantry DCV application under development uses a combination of object-relational database technology and fuzzy-logic. The image below shows a view from this prototype DCV system. The current task is selected from a menu of tasks associated with the active mission, and a 3D view showing important elements of the current situation is presented. The significance of this work lies in the capability of DCV technology to enable decision-makers to make better decisions more quickly, and with fewer staff. Its uniqueness lies in the Decision-Centered Visualization architecture and prototype technology that Fraunhofer CRG brings to integrate

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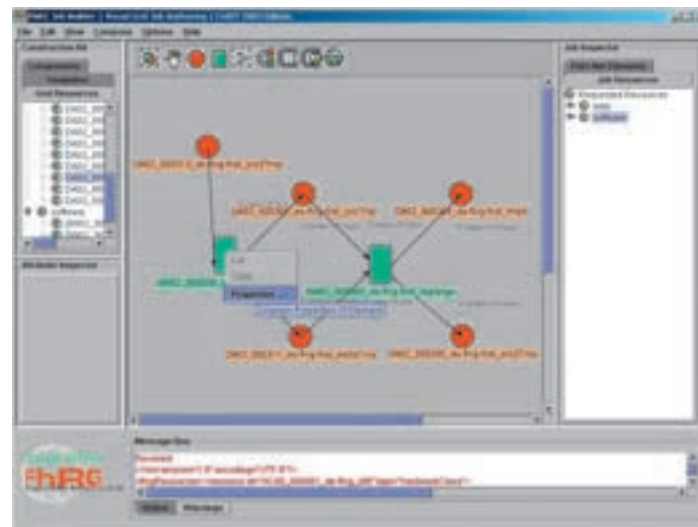


Fraunhofer Resource Grid I-Lab

Within this project the Fraunhofer Resource Grid (FhRG) has been established in cooperation with the other participating Fraunhofer institutes ITWM, FIRST, IAO and SIT. At the beginning all partners will benefit from the grid and later on a commercial usage for external customers will be provided.

Based upon this computing grid a so-called Internet Laboratory (I-Lab) is in development, which enables researchers and developers to use the infrastructure as a powerful "Problem Solving Environment" for their different tasks and problems.

A contribution to the topic of enhanced grid services for end users has been developed at the Fraunhofer IGD in the form of an application called Grid Job Builder. This software intends to be an approach to user-friendly and comfortable grid job editing, as far as it is possible in the world of distributed computing.



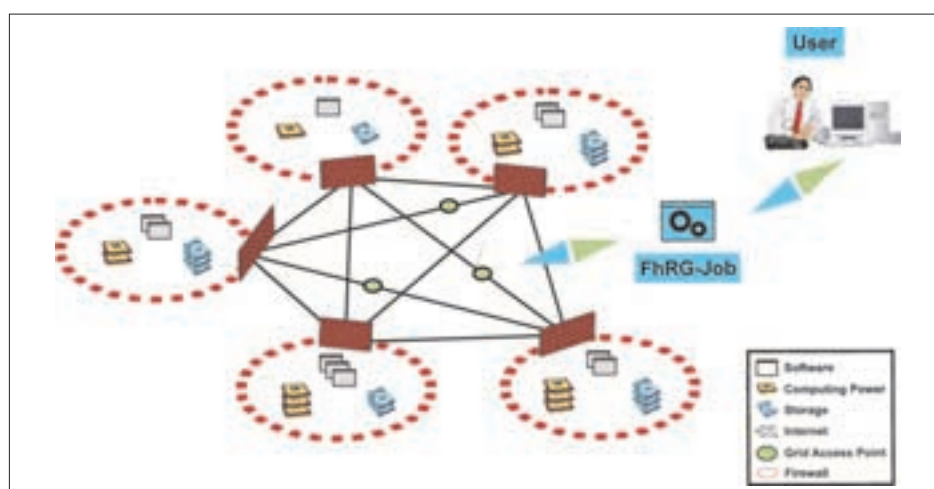
Screenshot of the Job-Builder User-Interface.

The definition of a grid job is carried out by using graphical elements which are known from Petri nets. Every element stands for a FhRG resource available to the user to use as a component in his job description. The workflow which will be initiated by executing the job description after a special process of analyzing can be defined by connecting a specific element with other elements.

The complex descriptions of grid resources as well as their dependencies are visualized by the more user-friendly graphical elements. The job

description resulting from the user's visual programming will be automatically generated by the software. Input and output of the application are written using a specific markup language developed within this project. The user doesn't need to learn this language and is able to focus on the description of his task and problem.

Commercial usage of the FhRG and the developed applications within I-Lab will be assured by focusing on platform independency of the different client software as well as defining and implementing a corresponding security infrastructure



Concept of the Fraunhofer Resource Grid.

I-Lab intends to provide easy access to the available resources of a computing grid to create distributed applications in a short period of time without reducing security aspects.

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INVISIP – Information Visualization for Site Planning

A basic problem in the site planning process is the search for actual and expressive data and their analysis. In particular spatial data are needed to analyze and realize planning objectives. Planners need spatial and context awareness to formulate evaluation criteria in the specific discipline (e.g. traffic and environmental aspects). INVISIP creates a framework to support all involved parties in the site planning process: municipal authorities and departments, planning offices, data suppliers and citizens. Information Visualization techniques are used to



improve search and analysis tasks, and to facilitate the decision-making process based on an existing metadata information system (MIS) for geographic data.

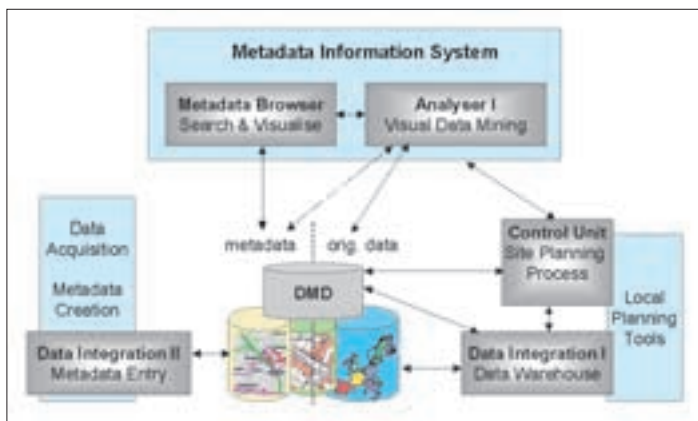
The essential component forms a Metadata Browser which provides methods and concepts for location and visualization of suitable data. New Information Visualization methods are developed, which are used to locate

appropriate geodata for the planning process and to enhance graphic-interactive access to data. In parallel an analysis instrument and a data integration component is developed. The analyzer will be realized as a domain-specific metadata application. Analogous to the Metadata Browser the data integration component is supported by a Web-based GIS and contains data warehouse functionality. The three components will be connected by appropriate interfaces and integrated into the INVISIP framework. Evaluation phases are not only used to check the (technical) functionality of the demonstrator and the prototype but also to check their usability.

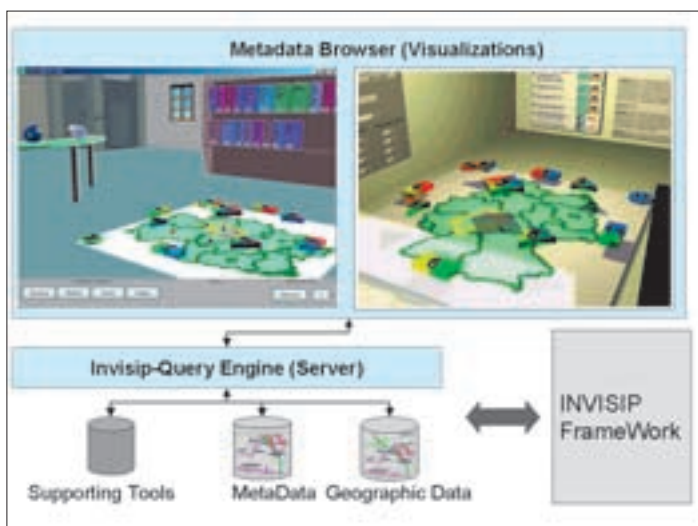
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Overall architecture.



Information visualization techniques.

Security Technologies

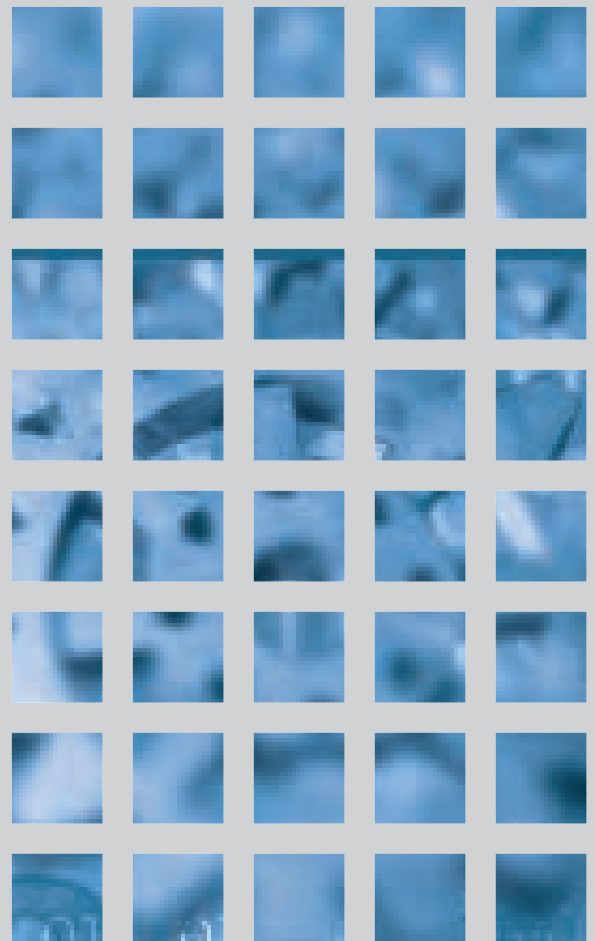
Security is preserving an important role in the Internet. Confidentiality of information and protection from unauthorized access to information, as well as data protection and protection of the intellectual property, have to be ensured so that the enormous potential of the Internet for industry and trade, service and utilization can be used 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.

Internet data security in the area of public service is of vital importance. The future citizen online-visit of his virtual city hall must guarantee personnel data protection, and verify the identity of the respective citizen. However the citizen's electronic document must first be legally verified.

E-Business has to ensure that the online-ordered products are paid by the client, that these 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 "Sicherheits-technologie" and "Internet Life".



A©WA

Easy-to-use peer-to-peer services are currently used to exchange data, which are locally stored on the systems of participating clients. This massive distribution potential for pirated copies already appears to severely curtail the market volume of physical CDs, particularly that of CD singles. Therefore new technologies are necessary to incorporate these desirable properties with the protection of intellectual property rights.

A©WA embeds a watermark into audio data to provide the means of protecting owners' and authors' intellectual property rights. A©WA is based on a statistical method and an underlying psychoacoustic model to embed a transparent and robust watermark into WAVE files.

A©WA is available as batch-oriented command-line version and library for the Windows platform. The software can be easily adjusted to the user's needs regarding the balance between robustness, perceptual observation and the size of the watermark. Fur-



thermore A©WA is implemented as a VST-PlugIn under Win98, Win2000. The PlugIn can be integrated in every sound-processing tool, which supports the VST-Interface from Steinberg.

To enable embedding in audio streams, A©WA exists as a hardware solution. The hardware solution uses the same framework as the software solution and is based on the ASIO-Interface from Steinberg. Of course this version of A©WA supports FileIO as well.

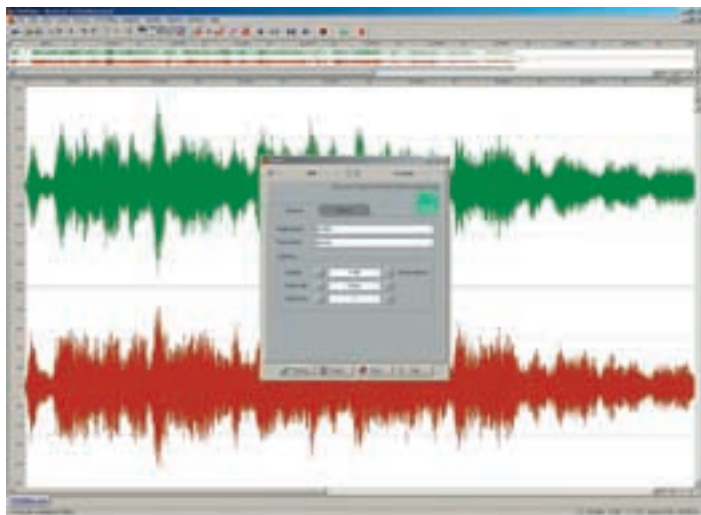
The benefits of the hardware-based solution are:

- Real-time watermarking,
- Different combinations of input and output types (streaming and/or FileIO),
- Any soundcard supporting the ASIO interface is ready to use in A©WA.

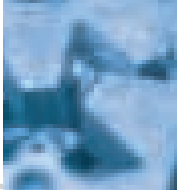
To find more information on our Digital Watermark Research and Development visit <http://syscop.igd.fraunhofer.de/audio>. The VST-PlugIn is available as a demo version at: <http://syscop.igd.fraunhofer.de/AcwaVSTPlugIn.htm>.

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The ACWA-VST PlugIn.



Anti-Tamper Software

Software is very expensive to develop but easy to steal, jeopardizing data and intellectual property. Worse still, hackers can break into and rewrite programs for malicious purposes. As a result, tamper-resistant software is urgently needed.

Anti-Tamper Software is a project funded by the U.S Air Force Research Laboratory at Wright-Patterson AFB in Dayton, Ohio. In this project, software will be protected, based on transformations of original binary code executables. The transformed binary software will be well-protected against an attacker's malicious intentions. This is a multi-year effort that will extend into 2004.

Nearly all current software protection approaches work on the source code level. However, programs protected this way may still be analyzed by hackers at the assembly code level. In fact, most computer criminals can successfully register a program without any payment solely by working with the binary code of an executable file. From this point of view, real software protection should be done at the binary code level, since good source code protection techniques may not apply well to binary code.

One also needs to protect the software execution environment – the operating system (OS) – because the interface between application software and the OS is a clear target for all software crackers.

Based on these observations, in this project, Fraunhofer CRCG anti-tamper protection works directly on the binary code level. In 2002, Fraunhofer CRCG worked with the Air Force Research Laboratory in Rome, New York, on the Mobile Code Security project, and, through that project, Fraunhofer CRCG developed the Information Armor™ mobile code protection framework, which includes complete obfuscation, encrypted execution and code watermarking. In the Anti-Tamper Software project, we will extend our approach for mobile code protection to protect software in a native operating system environment by developing a dynamic link library, static data, and program input/output protection techniques to meet the tamper resistance requirements in the Windows and Linux operating system environments.

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SeMoA – Secure Mobile Agents

Mobile Agents are software programs that can “jump” from one computer to another over the Internet and thereby can autonomously search for information or carry out other tasks. Thus not only computations can be allocated in distributed systems but also the program code that performs them. With the help of mobile agent technology, algorithms for filtering data can be transported directly to the source of those data and then only the results of this filtering need be sent over the network. Since mobile agents carry their program code with them, filtering can also take place in disconnected mode. In order to exploit such benefits, the utilized mobile agent solution has to be able to cope with a number of threats. This is why a sophisticated security model is needed for practical use.

SeMoA's security architecture can be compared to an onion: agents have to pass through an entire series of security layers before they are allowed into the runtime system and the first class of an agent is loaded into the server's JVM.

The first (outermost) layer is a transport layer security protocol like TLS or SSL. This layer provides mutual authentication, transparent encryption and integrity protection. The second layer consists of a pipeline of security filters. Each filter inspects and processes every incoming/outgoing agent, and accepts or rejects it. After an agent has successfully passed through all filters, SeMoA generates a so-called “sandbox” for the agent (layer three). Each agent is assigned its own thread group and its own class loader. All loaded classes are verified against a list of cryptographic hash values that the agent owner has signed together with



the agent, and must pass through a pipeline of filters for bytecode (layer four). Subsequently, agents are strictly separated from other agents in the server. The exchange of object references is restricted to the use of a so-called "global environment", whereas access is controlled through fine-grained security policies set up by the administrator.

In the meantime, SeMoA can be constituted as an operating system for mobile code with a security-centric design, which provides a variety of basic services to the application programmer: code migration, agent tracking, location-independent communication, remote administration, service discovery, interoperability between different agent systems, and monitor-

ing/auditing. Above and beyond these services some applications are available, which demonstrate content-based retrieval, location-based services, agent-based messaging, or the usability of SeMoA as a peer-to-peer system.

To contribute an infrastructure for the testing of services and applications in a real-world scenario to the SeMoA community, as well as to accelerate the transfer of technology, a network of public accessible SeMoA servers will be set up around the globe. Some institutions have already agreed to participate in the context of this so-called SeMoA-Net: these are Fraunhofer IGD Darmstadt; University of Jena; Fraunhofer CRCG Providence; NEMETech Seoul; CAMTech Singapore.

For further and more detailed information about the SeMoA architecture and SeMoA-Net we refer to our Website. The open source platform, which is implemented totally in Java, can be downloaded from this Website after acceptance of the license agreement.



An illustration of the "Agent Tracking and Location Service" (ATLAS): this service provides the location of tracked agents in the global infrastructure of SeMoA-Net.

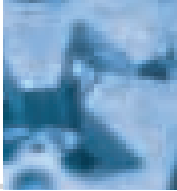
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Visualization of an agent's migration path on the globe (EARTH).



COSEDA – Comprehensive Security for Distributed Architectures

The COSEDA research program's goal is to provide an information assurance infrastructure for internetworked and heterogeneous systems. Such systems face a number of challenges. Some arise from the fact that the individual operating systems, middleware platforms, and applications are frequently limited in the security mechanisms they provide or inadequate when exposed to a large, potentially hostile, internetworked environment. Others arise from a lack of efficient enforcement mechanisms for security policies.

It is therefore necessary to be able to define and enforce sufficiently expressive policies, which can be enforced in operating systems, middleware platforms, and applications, even if these did not anticipate such mechanisms (e.g. as with commercially available operating systems and applications). At the same time policies must be defined in such a way that they can be enforced through technical means, yet be sufficiently abstract so as not to place an undue burden on the security administrators and managers defining the policy.

For an overall security policy to be technically enforceable, the ability to define an unambiguous syntactical and semantical model is critical. Moreover, for policies to be applied consistently across a distributed, heterogeneous system, a number of ontological and epistemological questions must be resolved to model the environment in which the policies are to be enforced correctly.

The core of the COSEDA program is a mathematical framework facilitating a number of advanced security mechanisms. The relevant aspects of the sys-



tems to be secured are captured in a formal mathematical model based on first order logic and derived from formal concept analysis. This provides a common basis for formulating the configuration, behavior, and operation of heterogeneous components such as operating systems, while an interpretation maps this formal model onto a specific instance of e.g. an operating system.

By employing the same mathematical model in formulating security policies, it thus becomes possible to describe permitted or required behavior within the abstract model once while the interpretation or translation into a given system occurs consistently and, more importantly, automatically. A security administrator can therefore be sure that a policy formulated once is always enforced consistently, even in a heterogeneous distributed system.

As part of the research program, policy-enforcing mechanisms are implemented based on the Microsoft Windows NT (2000/XP) family of operating systems as a reference platform. This demonstrates that the architecture can be implemented even in the case of a highly complex system to be instrumented with enforcement modules without requiring access to or modifications of source code of the operating system. Instead, arbitrary policies can be enforced without changing application programs or altering legitimate behavior of users; the security mechanisms are fully transparent to both.

The development process employs the use of formal methods particularly in design and specification to ensure that the security mechanisms provide adequate assurance.

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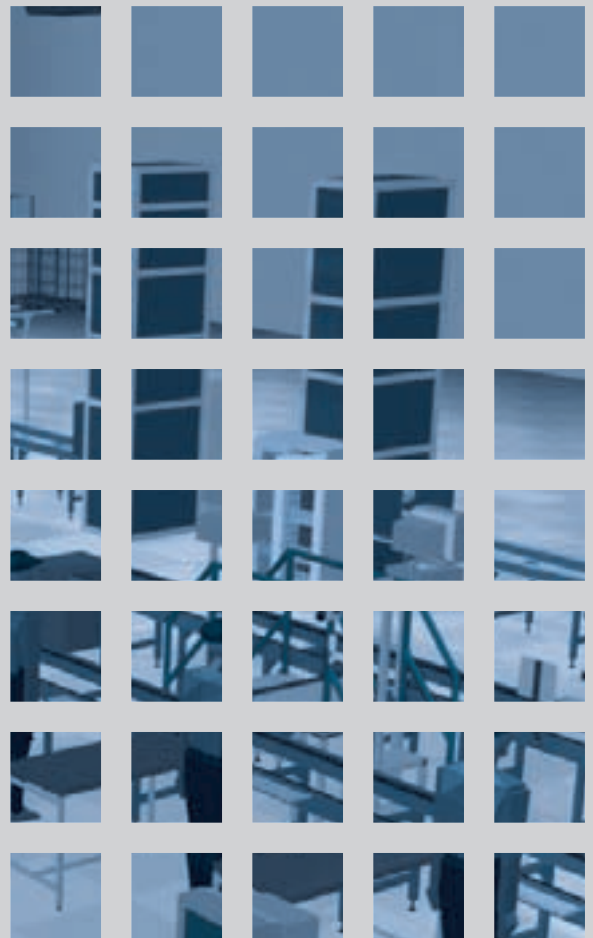
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Virtual Engineering

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, multi-media 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" und "Collaborative Visualisation".

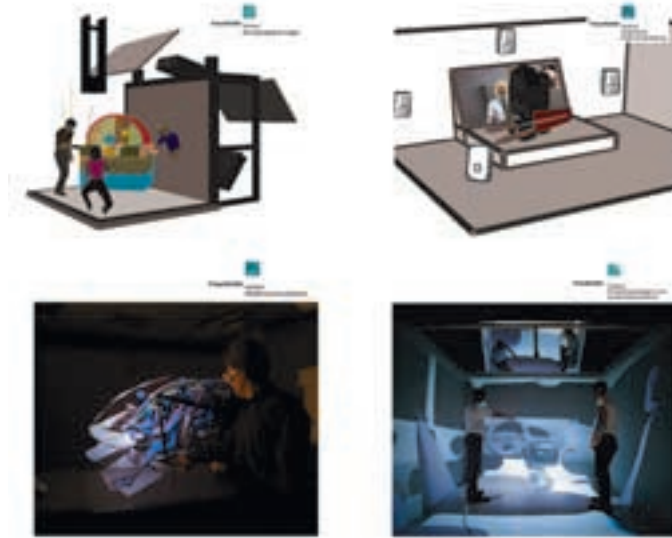
ProViT – Digital Product Development with Virtually Cooperating Teams using Optical Networks

Manufacturers of complex products in the investment industry are facing a market situation that demands increasing consideration of customer requests, such as shorter product development cycles, higher quality, and lower prices. In response, many companies are concentrating on their core business and are requesting additional services from external subcontractors, independent of their location. The use of digital product development tools in combination with novel information and communication technology enables place-independent integration of firms and serves as the basis for the creation of distributed development process chains.

The main aim of the cooperation project is to investigate:

- the extent to which product development can take place immersively with geographically distributed, globally operating, virtual teams (of up to 10 participants),
- which information and communication technical prerequisites are necessary, and
- what changes will occur in currently used work processes in the machine and construction industries.

Techniques and environments from the fields of Virtual Reality and telepresence are applied, extended with physically-based real-time simulation, and verified within design and construction scenarios from the aircraft, ship, and machine industries. Future industrial use of these prototypical, cooperative techniques requires both efficient audio and video streaming and real-time encoding of extremely voluminous and sensitive data (product



ProViT is running at all partner sites using different VR setups, ranging from CAVEs to L-Shaped Workbenches. All sites have Stereo-Support and feature spatial sound servers and setups to support for true immersive conferencing.

data and team communication). These data must be shared by all members of the virtual product development teams.

This research is trend setting as it is the first time that cooperative digital product development based on immersive telepresence will be attempted within traditional branches of industry. It can therefore be seen as a pilot for the globally operating German industry, and it represents a new opportunity for the institutes involved and for industries.

The distributed VR application features not only the interactive collaboration with 3D models, simulation of machines and industrial plants and the processing of 2D conference data, but also the communication interfaces necessary to implement a distributed collaborative conference. By application of robust state-of-the-art streaming technology and synchronous spatial representation of live audio/video streams an innovative platform for immersive group communication is

created. Thus immersive conferencing will be possible, featuring stereo video and spatial audio smoothly integrated into the VR engineering application.

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SketchAR – Collaborative Modeling and Visualization in Mixed Realities

During the last decade, product development processes have been greatly influenced by Virtual Reality. Many decisions, formerly made through evaluation of the physical model (physical mock-up – PMU), are nowadays made through evaluation of the virtual model. This procedure significantly reduces the time needed to reach decisions and therefore accelerates product development as well as development of product variants in the same amount of time as before.

SketchAR (our Augmented Reality Computer Aided Styling)-System is one of the first systems that not only supports three-dimensional modeling in space, but also in augmented realities. Furthermore, SketchAR allows for collaborative scenarios, for example multiple users working with a virtual model or locally on a physical mock-up. Visual data are constantly synchronized with the precise CAD representation of the product. The integration of a modeling kernel, modeling functionality and data export and import capabilities makes SketchAR different from traditional VR systems.

Our system features the capability to draw "polylines" or "curves", as well as 3D Objects using "sweeping" and "subtractive sweeping" techniques. Moreover we can interactively generate free-form surfaces based on "coons-patches", "skin-surfaces" and "net-surfaces". To update the user on each iteration of his surface or 3D Object modeling task, a simplified preview is generated, reflecting the current state of the result.

Annotations

To document changes in certain areas of a model and make them visible for participants of a design review session, our system includes annotations and direct 3D writing, which is similar to using a pen on a piece of paper.

Free form curves and surfaces

As well as 2D and 3D primitives, the system also supports the development of various free-form surfaces. For this purpose we support well-known modeling concepts, like "Coons"-Patches, "Net" and "Skin" surfaces. It is our goal to allow the user to directly sketch a free form surface in 3D space without prerequisites. Intuitive interaction is achieved through intelligent processing of input data, for example a "Coons"-Patch can be sketched in a single 3D movement.

Virtual 3D Taping

Taping is a widespread technique in car-design for the definition of two-dimensional characteristics lines in one-to-one views of the models. For this purpose a special duct tape is spread between the left and right hand. While the right hand remains above the surface and directs the orientation of the curve (tangent to a fixed point), the left hand sets the path of the curve by pressing the tape onto the surface.

We have translated this concept into a two-handed, three-dimensional input technique, that allows virtual taping on a physical mock-up.

Within the context of the European project "SmartSketches", our AR-CAS-System continues to progress. Our further efforts will focus on the integration of familiar interaction techniques, like drawing on working planes and the ability to edit curves and surfaces.

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Interactive generation of a free form surface in mixed realities.



Virtual Factory and Logistics

In collaboration with a Singaporean research institute and two industry partners, CAMTech is conducting a research project in order to improve the electronics assembly processes. Current approaches for analyzing such processes include the use of simulation systems. But the interpretation is very difficult and only suited for experts. 3D animations are intuitively more understandable than the raw data, and the user can easily verify assumptions and results of simulations. Results can be analyzed and easily presented to a wider audience of decision-makers.

The goal of this project is to visualize the behavior of an electronics assembly industry by simulating, visualizing the discrete events of the entire manufacturing processes, and observing the flow of materials, size of buffers and line balancing. The vivid representation allows direct recognition of relationships inside the simulation models. In addition, easy checking and validation of the accuracy of the model is provided.

To simulate the discrete events, a general-purpose simulation system has been employed. For modeling and visualization, CAMTech developed a new event visualization system. It analyzes the incoming simulation events and translates them into animation events, which trigger animation behaviors of 3D animation objects. These are provided by the system's library of reusable 3D elements and are laid out in the integrated Layout Editor. After the layout is finished, the animation objects have to be linked to the translation rules in order to receive animation events from the system's analyzer. The visualization system software is built on a component architecture and is highly customizable and extendable.



Virtual Factory.



Graphical User Interface.

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 the inbound, sub assembly, testing, packing, and outbound process. To carry out the visualization, a library of objects representing the equipment, inbound and outbound logistics processes has been generated. These objects are defined by 3D geometry and behavior. Each object (more than 100) was modeled in three levels of detail.

In general, this rapid 3D visualization of assembly processes based on simulation models has the potential to support decision management allowing the identification of bottlenecks to avoid costly errors.

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ViSiCADE – Cooperative Interactive Exploration of Simulation Results

Existing CAD/CAE systems for the analysis and optimisation of the digital model are crucial during the product development process. Metal forming, structural analysis and crash simulations are just a few of the many application areas in which Computer Aided Engineering (CAE) tools may be applied.

The figure shows the results of a stress analysis performed on a digital model as well as the visualisation of a flow field resulting from flow simulation around a turbine. The process of appropriately preparing a data model to yield an adequate result is time consuming and prone to error. Estimates in classical finite element analysis (FEA) point out that according to the problem approximately 90% of the workload is needed for modeling and results evaluation and only 10% for the execution of the simulation run. This does not take into account interactive modifications of the simulation. The development of new solutions for a flexible and contemporary analysis of digital models and prototypes is the

focus of our research efforts. The above efforts are included in an EU funded project called "ViSiCADE Virtual Environment for the Seamless Integration of CAD/CAE tasks into Virtual Reality".

The focus of our research does not only concentrate on optimization strategies for interactive simulations but also covers development efforts in the area of interactive cooperation. Here, we are aiming beyond a purely cooperative view (post processing) of different data formats (NASTRAN, FLUENT, SDRC). Different users should be able to interactively manipulate simulation runs, thereby covering the whole analysis process chain starting from data model preparation, setting and manipulation of boundary conditions via simulation to efficient post processing.

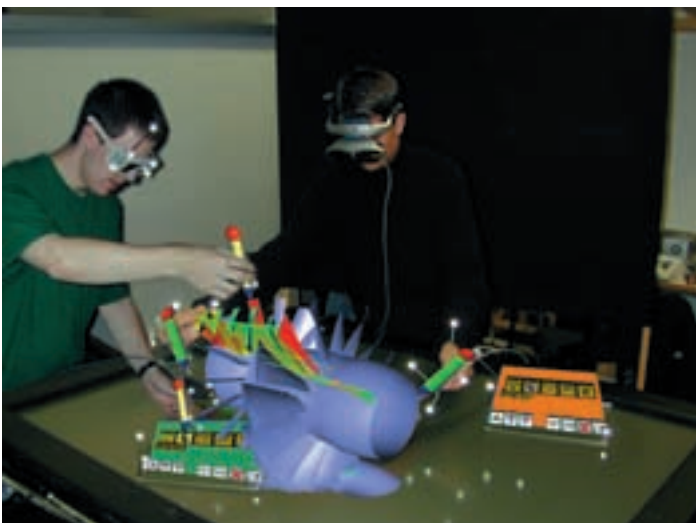
It is envisaged to realize fast and interactive access to digital information resulting from simulations in the area of CAE/CFD (Computational Fluid Dynamics). Hence, new mechanisms for the derivation of an appropriate CAE/CFD model suitable for the simulation will be developed in the modeling area. Innovative methods for the

recognition and removal of 'small' details in the CAD model which cause time-consuming mesh generation tasks, but have no impact on the results of a simulation run, are the focus of research efforts. Nowadays, it is not possible to analyze complex models that conform to industrial problems (>500.000 elements) in real-time. To allow interactive rates with the simulation run, new methods for the derivation of sub models have to be developed. The solvers used, which serve as the simulation engine, are based on new adaptive and hierarchical multi-grid methods. High performance computing facilities will provide the necessary computing power. Finally, new interaction methods with the digital model and new cooperative visualisation techniques are the focus of the VR developments.

Further development efforts aim to integrate simulation visualization with AR technology. With this development, different dynamic and static characteristics of a prototype can be identified through the overlay of the visualization on the physical prototype.

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Cooperative analysis of flow field around a turbine (CFD Simulation).

Mixed 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 expected to be 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" und "Edutainment".



Virtual Try-On

Virtual Try-On is a project in the context of the "Ideenwettbewerb des Bundesministeriums für Bildung und Forschung zur Virtuellen und Erweiterten Realität". There will be an implementation of VR-methods for virtual selection and try-on of clothes made to measure. The main objective is an accurate cloth simulation showing accurately the fitting behavior of the clothes in real-time. Hence simulation methods based on large material databases have to be implemented. The project includes the whole process from virtual try-on to the manufacturing of individualized clothes.

In the sub-project "Automatic Pre-positioning", which is under the control of the Fraunhofer IGD Darmstadt, the virtual patterns of a garment have to be placed automatically around the customer-individualized 3D body scan, so that the pieces can be virtually

"sewn" together directly on the body scan. This approach is necessary, because a simulation of the real dressing would be too expensive.

A physically based simulation realizes the virtual sewing process and the final fitting of the cloth onto the 3D body scan of the customer. Therefore the second research task at the Fraunhofer IGD is the development of an accurate textile simulation, which will be Java-based.

The project was launched on 1st March 2001. In that year the interfaces for the automatic pre-positioning and the textile simulation were specified and the implementation was begun. In 2002 the automatic pre-positioning as well as the textile simulation were extended for more complex garments. The algorithms developed at the Fraunhofer IGD are the first worldwide, which allow a completely automated dressing of 3D body scans.

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Automatic pre-positioning of a blouse worn over a skirt and the results of the subsequent textile simulation.

Two further results of our automated Virtual Try-On Application.



ARIS – Photometric Consistent Lighting Simulation and Representation

Lighting simulation methods will increase the realism of computer-generated scenes by computing shadows and inter-reflection. Efficient hierarchical radiosity with clustering is essential for handling large and complex scenes, while a reliable visibility classification algorithm will prevent typical artefacts such as missing shadows or floating objects.

However, for the everyday use of such visualization methods, e.g., for design and review, mere visual quality is insufficient. Physical reliability has to be ensured through photometrically and colorimetrically correct lighting simulation. Based on correct input data, such as light distribution, spectra and intensities of light sources, the whole simulation must be performed within a consistent colour space.

However, a correct simulation alone does not ensure correct visualization. Every output device has to be calibrated according to its distinct properties. The colour gamut must be determined, simulated values must be converted, gamma correction must be carried out and non-uniform brightness distribution must be eliminated. Only then can a reliable one-by-one visualization of the simulated data be guaranteed.

Computer vision methods enable the 3D scene reconstruction of geometry and textures. However, to realistically integrate virtual objects into these scenes, knowledge of the given lighting situation is essential. Reconstructing the response curve of the camera enables the reconstruction of photometric data for every pixel.

Light source properties are reconstructed using a light probe. A silver sphere is placed in the scene, reflecting the real world. Using an exposure series, a high dynamic range image containing photometric information can be created. Light source properties can then be reconstructed from the position and intensity of their reflections. Inverse radiosity simulation assists - up to a point - in the reconstruction of the material properties of objects.

A consistent input/simulation/representation pipeline on the one hand and a geometrically reconstructed scene with correct lighting values on the other, now enable the user to simulate virtual objects, such as furniture, using consistent lighting and to seamlessly integrate them into photographs of the real environment.

Within the ARIS European research project (Augmented Reality Image Synthesis), these methods are being developed with the goal of providing high-quality visualization for collaborative AR applications. Additionally, a mobile AR unit allows access to online product information for collaborative visualization using see-through displays - with limited lighting simulation due to the real-time requirements.

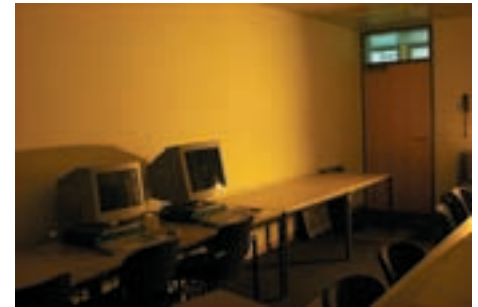
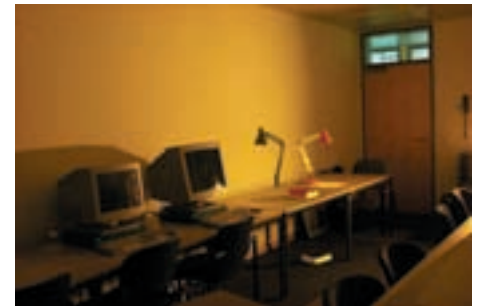


Image of a real scene.



The virtual lamp projects shadows on the wall and illuminates the real table.

In contrast to existing E-Commerce solutions, where products can mainly be listed in catalogues, E-(motion)-Commerce enables the presentation of products in the context of their future environment (e.g., new furniture for a living room, new light sources for an office, etc.).

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Context-Related Performance with Augmented Reality

The efficient transfer of information for the training of service technicians and/or the documentation of work processes, for example, has become increasingly difficult as products become more and more complex. This problem particularly affects sectors such as the automobile, aircraft and machine construction industries, and it requires improved diagnosis and maintenance tools.

Augmented Reality (AR) technology offers a decisive improvement in the presentation of information. Augmented reality supports context-related performance: computer-generated information for a maintenance task, for example, is presented step-by-step and displayed directly on the real object. This makes it possible to present a service technician with a complex maintenance workflow in a visual and immediately understandable form.

The whole AR browser can be regarded as a complete Virtual Reality (VR) system supplemented with special Augmented Reality capabilities encapsulated in an Internet plug-in. This means the AR browser can easily be



Application scenario.

integrated into the existing diagnostic tools and web infrastructures of a company. The Web-based approach allows any desired services and information systems to be connected to the AR system.

In order to correctly display the virtual information in the real scene, a computer vision-based tracking module has been developed and integrated in the AR browser. A camera mounted on a head mounted display or on a laptop detects well-defined markers placed in the scene and uses them to determine the current camera position and orientation.

The German economy has recognized the potential of Augmented Reality technology: 20 companies and research institutes have joined forces in the ARVIKA project and established the world's largest AR consortium. The goal of ARVIKA is to develop AR techniques for industrial applications, in particular for construction and maintenance tasks in the area of automobiles, airplanes, machines and plants. The project is funded by the German Federal Ministry for Education and Research (BMBF). The described mobile AR system has been developed in the framework of ARVIKA.

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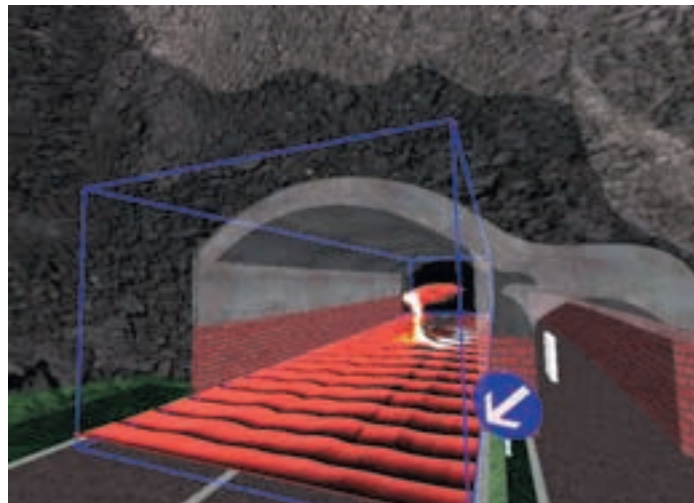


Marker-based tracking.

VIRTUALFIRES – Virtual Real Time Fire Emergency Simulator

VIRTUALFIRES is an EU project, which began on 1 November 2001, is funded by the European Commission. It involves eight partners from five European countries. The aim of the project is to develop a simulator that enables fire fighters to be trained in the efficient control of fires in a tunnel, using a computer generated virtual environment. The outcome of the project will provide a cheap and environmentally friendly alternative to real fire fighting exercises involving burning fuel in a disused tunnel. The resulting simulator can also be used to virtually test the fire safety of a tunnel and the influence of mitigating measures (ventilation, fire suppression etc.) on its fire safety level.

In the year 2002 the department "Animation and Image Communication" of the Fraunhofer IGD Darmstadt developed a visualization tool based on a common scenegraph (Coin3D, OpenSG) which can be easily extended. All visualization methods are rendered in parallel by a central scheduler in order to provide performance needed for interactive and therefore time-critical visualization of large data sets.



Scientific Visualization.

All standard methods for scientific visualization (iso surfaces, stream lines, volume rendering, etc.) have been implemented using recent algorithms and modern graphics hardware (ATI Radeon, NVIDIA GeForce).

For the development and implementation of the individual project work-packages several participants are responsible. For instance the institute of structural analysis / SITU-Research (Austria), the Christian-Doppler-Laboratory for Applied Computational Thermofluidynamics (Austria), the Fraunhofer IGD (Germany) and the Kungliga Tekniska Högskolan (Sweden) team up with the future user of the

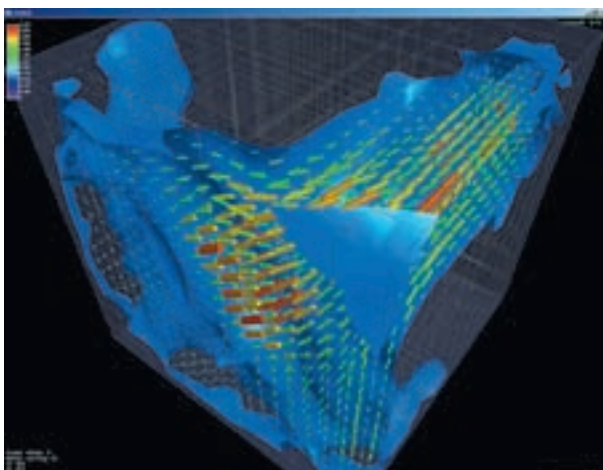
software to be developed: Groupe-ment Européen d'intérêt Economique Alpetunnel (France), Centre d'Etudes des Tunnel (France), Stadt Dortmund - StA 37 Feuerwehr (Germany) and European virtual Engineering - S.A. (Portugal).

The main project objectives are:

- Development of efficient numerical simulation codes for physically based computation of complex fire scenarios,
- Real time and high quality post visualization within a CAVE or HMD system,
- Comparative study of the impact of various fire fighting methods,
- Review of the simulation results and verification with real fire scenarios in order to ensure the quality of the computed results.

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Scientific Visualization. Realistic Visualization.

Medical Technology and Application

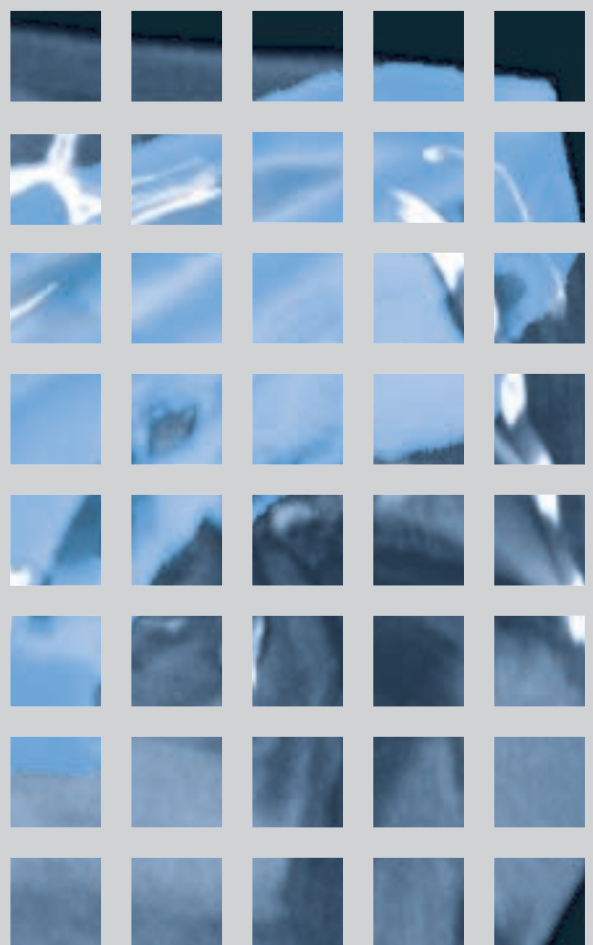
Today it is not possible to think about medicine without modern Information Technology. In particular, imaging methods such as X-rays, CT, MRI, Ultrasound, Angiography or Microscopy, play an important role. New methods such as IR Imaging or Laser Imaging become alternatives in special cases of application. 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 to work with data much more intuitively.

Exact 3D models make it possible to develop completely new applications in medicine. For instance, today planning operations and treatments are planned on a virtual body or organ. This 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 now be performed with great precision, which was unthinkable some years ago.

Computer networks connecting the medical facilities with each other 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 take place through 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.

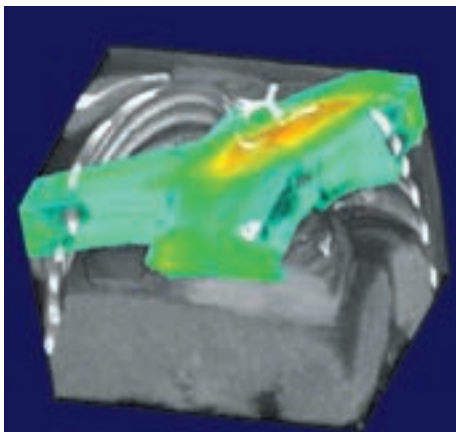
The Fraunhofer IGD has been developing innovative IT techniques in medicine since its foundation and surely will continue to develop this field actively in the future too.

For further information refer to the thematic brochures "Medical Technology and Application".

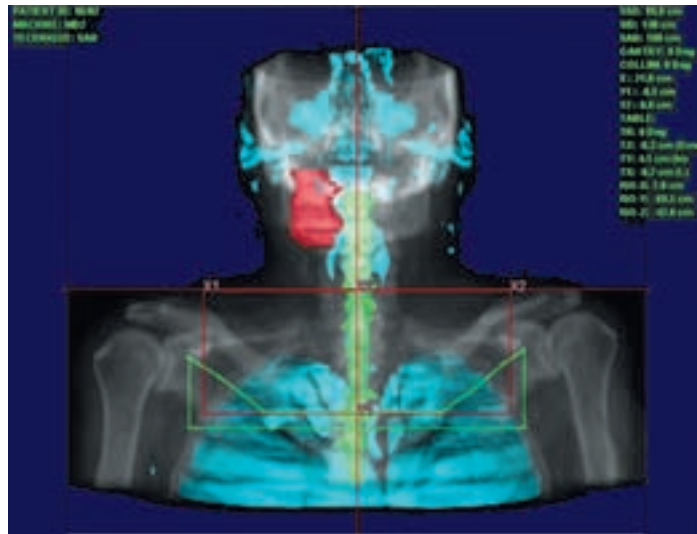


EXOMIO – 3D-Simulation for External Beam Irradiation

Simulators are medical modalities used in oncology clinics in order to simulate a patient's external beam irradiation. They have the geometry and they can perform the same mechanical movements as the treatment machine (linear accelerators), but they use low energy diagnostic X-rays instead of high-energy treatment rays. The simulator can produce a 2D-fluoroscopic image for verification and documentation purposes. The acquisition of a real simulator for a radiotherapy department is a great investment in terms of money, space and personal resources. The alternative to the real simulator can be the use of a 3D or virtual simulator. Virtual simulators are system-software that can perform the simulation process using the digital CT data of the patient, instead of the physical patient himself. The patient's dataset contains the external skin markers that are used to reproduce the patient treatment position through the different stages of their preparation and treatment.



Dose volumes over the tumor site and healthy patient anatomy.



Virtual Xray from patient's chest.

Exomio has been developed to support the simulation process and to improve the patient workflow in the clinical environment in terms of quality and speed. The system supports the following groups of technical features:

- High-end visualization techniques for the graphical simulation of every functionality of the real simulator including movements of mechanical components, light field projection and digital reconstructed radiograph (DRR),
- Verification tools: digital portal images can be processed and directly compared with DRRs in order to evaluate directly the patient treatment position. In addition, in order to evaluate the treatment planning results, the system allows the visualization of dose volumes over the tumor site and healthy patient anatomy,

- Digital data communication is performed using international standardized formats. DICOM-3 protocols are implemented for transferring medical volumes and DICOM-RT protocols are supported in order to communicate the radiotherapy objects produced during simulation.

The system has been successfully installed for the last two years and is in use in more than 50 oncology clinics in Europe.

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Names, Dates, Events



Events

Cybernarium Days 2002

From 23 to 28 January, the Fraunhofer Institute for Computer Graphics IGD showed fifteen unique exhibits of virtual and Augmented Reality (VR/AR) at the Cybernarium Days 2002 exhibition in the Darmstadt Centralstation. The event attracted more than 10,000 visitors from Germany in six days. They had the opportunity to actively experience the latest developments in fine arts, history, research and technology and playfully test the fascinating possibilities of the new media. The exhibition under the auspices of Peter Benz, Mayor of Darmstadt, gave them a taste of the envisaged unique edutainment center "Cybernarium" which will open in Darmstadt in 2004. About 80 exhibits will be shown there, and in the core the visitors will find a twelve meter high "Cyberdome", a type of cupola with 18 huge screens that will create unique virtual worlds using laser projections.



Visitors were fascinated by the tour through virtual space.



At the press conference.



Prof. J. L. Encarnação, Director of the Fraunhofer IGD, initiated the Cybernarium project.



Peter Benz, Mayor of Darmstadt.



Dr. Stefan Müller, Head of Department "Virtual and Augmented Reality" at Fraunhofer IGD.



Rolf Kruse, Director of the Cybernarium Projektgesellschaft.



Honorary Doctorate for Professor José Luis Encarnação

On 18 February 2002, the University of Minho (Universidade do Minho), Portugal, presented Prof. Dr.-Ing. J. L. Encarnação with an honorary doctorate (Honoris Causa). In honoring him this way, the University of Minho recognizes Professor Encarnação's outstanding achievements and life work in science and technology development, particularly in the area of computer graphics and information and communications systems. The ceremony was attended by several hundred guests from the areas of science, politics and culture, including the Portuguese Minister for Education and Culture, the Minister for Trade and Commerce and the Portuguese ambassador to Germany.



Prof. Licínio Chainho Pereira, Rector (Dean) of Universidade do Minho bestowes the honorary ring on Prof. José L. Encarnação.

Cooperation Agreement with the University of Caxias do Sul

On 2 April 2002, the University of Caxias do Sul (UCS), located in the state of Rio Grande do Sul, Brazil, and Fraunhofer IGD signed a cooperation agreement aimed at promoting and developing common scientific and cultural activities. Fraunhofer IGD, through the firm commitment of Prof. Encarnação to international cooperation, has a long-standing relationship to Brazilian universities and organizations. The current aim of the Fraunhofer-Gesellschaft, especially the IGD and IPA institutes, is to establish and strengthen applied research in Rio Grande do Sul with the goal to set up a Center of Excellence for Applied Research (CETA).



Representatives of UCS and Fraunhofer IGD signing the cooperation agreement. From left to right: Mr. Alois Schäfer, Ms. Luciana Stallivieri, Prof. Ruy Pauletti, Dr. Jürgen Schönhut, Mr. Luiz Santos, Mr. Rolando Vallejos.



Girls' Day 2002

In order to provide schoolgirls with an early glimpse at careers in technology and science, the second Germany-wide "Girls' Day" took place on 25 April 2002. The Fraunhofer Institute for Computer Graphics IGD in Rostock and Darmstadt took part in the initiative and offered young female students between the ages of 12 and 17 the opportunity to familiarize themselves with scientific careers in the field of Computer Graphics. The Fraunhofer IGD Rostock invited 35 girls to participate. They could participate in several seminars, for instance, build a toy robot using LEGO Mindstorms tools, produce a digital video clip about what was going on in the other seminars, create a building map using PDAs or learn about the Internet and the truth of information. In Darmstadt, a total of 45 girls from various regional schools along with some of the children of employees, took part in a day long trial training course, which included live presentations, activity groups and discussions with experts on career opportunities in research and science. At the end of the day, women working at the institute talked with the girls about problems and opportunities for women in technical professions.



Girls' Day activities at the Fraunhofer IGD Rostock.

Awarding of the Alwin Walther Medals

On 29 April 2002, the awarding of the Alwin Walther Medals took place in the Fraunhofer IGD Darmstadt building. This year's recipients of the Alwin Walther Medal were Prof. Dr. Dr. h.c. mult. Karl-Heinz Hoffman of Munich University of Technology, who is the founding director of the CAESAR Foundation in Bonn, and Prof. Dr. Hartmut Wedekind, an emeritus pro-

fessor of Friedrich Alexander University in Erlangen-Nuremberg. With the Alwin Walther Medals, which are endowed by the Center for Computer Graphics (ZGDV) and the Fraunhofer Institute for Computer Graphics IGD, Technische Universität Darmstadt honors outstanding achievements in the areas of mathematics and computer science.



Prof. Dr. Dr. h.c. mult. Karl-Heinz Hoffmann receives the Alwin Walther Medal.



Prof. em. Dr. Hartmut Wedekind receives the Alwin Walther Medal.



ICPNM Program started for the fifth time

In 2002, the Fraunhofer CRCG, Inc., in Providence started the International Certificate Program for New Media (ICPNM) for college graduates and professionals for the fifth time. Through this successful program, college graduates, who wish to develop, design and implement new media projects, can earn a certificate in new media. ICPNM is a joint program sponsored by the Fraunhofer CRCG, the Continuing Education Department of the Rhode Island School of Design, and Technische Universität Darmstadt in Germany. Participants study new media in areas such as Web design, digital multimedia, 3D modeling, animation and programming and scripting languages from both design and technological points of view.

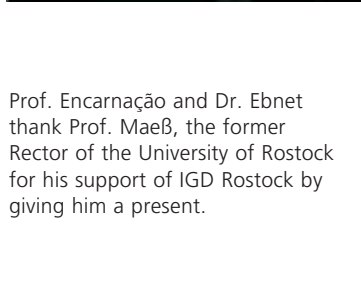
10th Anniversary of the Fraunhofer IGD Rostock

On 14 June 2002, the Fraunhofer IGD Rostock celebrated its tenth anniversary. Two hundred guests from politics, industry and research took part in the celebration. Welcoming speeches from the areas of business, science and politics acknowledged the ten years of successful development. Prof. Urban, the associate director of the Fraunhofer IGD Rostock, gave a short presentation reflecting on the development of the institute since its foundation in January 1992. Starting with only seven staff members, the Fraunhofer IGD Rostock now has 35 employees and around 45 students working part-time.

In the afternoon, a scientific program with three invitational talks took place, followed by a demo tour presenting actual research solutions from the Fraunhofer IGD Rostock and ZGDV Rostock. A gala party at night com-



Prof. Encarnação and Dr. Ebnet thank Prof. Wildenhain (from left to right) for his support of IGD Rostock by giving him a present.



Prof. Encarnação and Dr. Ebnet thank Prof. Maeß, the former Rector of the University of Rostock for his support of IGD Rostock by giving him a present.



Prof. Encarnação and Dr. Ebnet congratulate Prof. Urban on ten years of successful development of IGD Rostock.



Evening Event at Lokschuppen.



pleted the celebration of the tenth anniversary. Prof. Bertram Herzog gave a dinner speech reflecting on his impressions of Rostock from 1992

until today. During the evening event, treats for the eye and ear were presented by the employees of the Fraunhofer IGD Rostock.



CAST-Award for IT-Security

On 21 November 2002, the CAST-Award for IT-Security was presented for the second time in the building of the Fraunhofer IGD Darmstadt. Students or trainees from all institutions of higher education or on-the-job training positions, who completed their dissertations, research papers or other final works in the period from 1 January 2001 to 31 August 2002 were eligible to enter. From the numerous submissions the jury selected ten candidates, which introduced their contributions in a 20-minute presentation. Afterwards, the members of the CAST Forum voted on the allocation of places. A price money of totally 18.000 Euros has been awarded to the best three participants.



Winners of the award, left to right: Gerold Dieke (Darmstadt's head of government), Oliver Lobisch (third place), Gerrit Rothmaier (second place), Felix Madlener (first place), Christoph Busch (CAST-Forum), Markus Ruppert (CAST-Forum), Bernd Donabauer (CAST-Forum).



All candidates and management of the CAST-forum left to right: Oliver Lobisch, Nicolas Noffke, Moritz von Schwedler, Guillo Varvelli, Peter Ebinger, Gerrit Rothmaier, Amer Aijaz, Stefan Schwalm, Felix Madlener, Matthias Frisch, Markus Ruppert, Christoph Busch, Bernd Donabauer.

Computer Graphics Evening 2002

Outstanding performances in the area of Computer Graphics were honored by the INI-GraphcisNet in the context of the "4th Computer Graphics Night" which took place at the Fraunhofer Institute for Computer Graphics IGD in Darmstadt at the 5th of December 2002. Patent applications, as well as high-ranking research publications, dissertations and remarkable theses were awarded. The numerous guests at the festive event included representatives from the industry, the Fraunhofer-Gesellschaft and former employees of the INI-GraphcisNet. The computer scientist Dr.-Ing. Jürgen Stärk, former researcher of the Fraunhofer IGD, held this year's guest lecture.



Prof. Dr. Fellner presented the front-runners from amongst the 38 selected publications.



Mark Alexa und Johannes Behr received first place in the "Best Paper Award".



The audience shared in the joy of the prize-winners.

Prof. José L. Encarnação takes over as Chairman of ISTAG

In order to promote and support rapid development in the information and communications technology sector (ICT) in a targeted way, the European Commission is advised by the international board known as ISTAG (Information Society Technologies Programme Advisory Group). In November 2002, Prof. Dr. José L. Encarnação was appointed chairman of this high-profile research committee, which is comprised of prominent experts from industry, economics and science. Prof. Dr. José L. Encarnação is thus taking over one of the most important development and consulting positions for the Sixth European IST Programme (Information Society Technologies) of the EU.

Awards

Prof. Dr. G. Sakas receives International Brachytherapy Award.

Prof. Dr. Georgios Sakas from the Fraunhofer IGD Darmstadt received the Brachytherapy Award at the International Brachytherapy Conference in Santa Fe, USA (19-22 June 2002). The presentation of the prestigious specialist prize was in acknowledgement of the seminal research by the scientist and his team from. With the title "Navigation and Ultrasound Technologies", Professor Sakas gave his lecture in front of over 500 international experts and invited conference guests.

Virtual Showcase Application receives 2002 Laval Mayenne Technopole Award

A multi-disciplinary team of researchers from Fraunhofer CRCG, Brown University, Bauhaus University Weimar, and Technical University Vienna has been awarded the 2002 Laval Mayenne Technopole Award for its contribution "The Virtual Showcase and its Application to Paleontology". The Award Ceremony took place on 21 June 2002 and was part of the Fourth International Virtual Reality Conference in Laval, France. With the Virtual Showcase, they developed a new projection-based Augmented Reality Display that provides intuitive access to information in everyday environments. It has the same form factor as a real showcase, making it compatible with traditional displays, such as the ones that can be found in museums. Inside the Virtual Showcase, virtual representations and real artefacts share the same space, providing new ways of merging and exploring real and virtual content.

Fraunhofer IGD Department Receives 2002 Wolfgang Mueller Osten Award

This year's Wolfgang Mueller Osten Prize for the promotion of scientific research in surgery was jointly awarded to both Offenbach's City Clinic and the Fraunhofer IGD Group led by Professor Doctor Georgios Sakas. In the course of a joint research project, scientists and medical doctors cooperatively developed a navigation system of the future, which markedly improves intra-operative radiotherapy by making it possible to zero-in on a previously inoperable part of a malignant tumour and to irradiate it at exactly the right point. The award with a value of 5000 Euros was presented on 7 May 2002 at the Annual Congress of the German Surgical Society in Berlin.

Medical Technology Innovation Award 2002

Around 200,000 rear-end automobile collisions take place in Germany every year. Such collisions often cause a serious strain of the neck muscles known as whiplash. In order to determine the extent of whiplash injuries quickly and reliably, researchers at the Fraunhofer IGD Darmstadt, in cooperation with the Accident Surgery department of the University of Ulm, have developed a new procedure which will allow the intensity of the pain to be evaluated precisely with the help of electrically registered signals from the muscles. In recognition of this innovative procedure, Ulrich Bockholt and Alexander Bisler from the Fraunhofer IGD received this year's Medical Technology Innovation Award from the German Federal Ministry for Education and Research (BMBF) at the MEDICA 2002 trade fair on 20 November 2002.



Participation in Committees

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

- Advisory Board of GraphiTech, Trento, Italy
- Advisory council of "ARVIKA"
- Advisory council of "Internet-gesellschaft" – Feldafinger Kreis
- Advisory council of Telecom Business Academy (TBA)
- Board of Advisors: School of Creative Media, Hongkong
- Board of Directors of ICPNM Academy, Providence, RI, USA
- Board of directors of Innovationsagentur Mecklenburg-Vorpommern
- Board of Directors of NEMETech, Seoul, South Korea
- Board of directors of ProStep Verein
- Board of Directors of VICOMTech, San Sebastian, Spain
- Board of directors, board of trustees and advisory council of INI-GraphicsNet Foundation
- Board of trustees of Forschungszentrums Informatik (FZI) in Karlsruhe
- DIN NAM 430.4. – Transfer und Archivierung von Produktmodell-daten (TAP)
- Editorial Board Computer Aided Geometric Design (North Holland)
- Editorial Board Computers & Graphics (Pergamon Press) – since 1983 "Editor-in-Chief"
- Editorial Board INFORMATIK-F&E (Springer Verlag)
- Editorial Board Visual Computer (Springer Verlag)
- European Usability Forum
- Executive Board CAST Forum of the ZGDV
- Executive Board Forum for Information Services Mecklenburg-Vorpommern (ISMV) of the ZGDV

- Executive Board Information and Cooperation Forum for GeoData (InGeoForum) of the ZGDV
- Executive Board OpenSG Forum of the ZGDV
- Facharbeitskreis Informations- und Kommunikationstechnologien der Innovationsagentur Mecklenburg-Vorpommern
- Fachgutachter (Assessor) of DFG (Deutsche Forschungsgemeinschaft)
- German Informatics Society (GI), FA 4.1 – Graphische Datenverarbeitung and several partitions 4.1.1 - 4.1.6
- German Informatics Society (GI), FA 4.8
- German Informatics Society (GI), FB 4 – Informationstechnik und technische Nutzung der Informatik
- Interministerieller Ausschuss für Geoinformationswesen des Bundes
- ISTAG of the EU, Information Society Technologies Programme Advisory Group
- Jury Design-Preis Mecklenburg-Vorpommern
- Lenkungsausschuss Umweltdatenkatalog
- Multimedia-Beirat des Landes Mecklenburg-Vorpommern
- Münchener Kreis
- Nationaler Arbeitskreis IT-Sicherheitskriterien des BSI
- User- and developer forum "VRTechnologies in Development, Construction, Production and Marketing" – ProVR
- VDI Fachausschuss "Simulation und Visualisierung"
- Work group GIS of Facharbeitskreis IuK
- Membership in several national and international program committees for the organization of congresses, workshops and seminars on Computer Graphics topics
- Membership in various societies and associations

Fairs and Exhibitions

1. IuK-Tage Lingen
- CAT 2002, Stuttgart
- CeBIT 2002, Hannover
- ComNet Shenzhen 2002, Shenzhen, China
- Education quality forum, Dortmund
- EU-Partenariat 2002, Kuala Lumpur, Malaysia
- Euromold 2002, Frankfurt
- HMI 2002 - HANNOVER MESSE Industrie
- Intergeo 2002, Frankfurt
- Learntec 2002, Karlsruhe
- Medica 2002, Düsseldorf
- SMM2002 - Shipbuilding, Machinery and Marine Technology International Trade Fair, Hamburg
- SPIE 2002, San Jose, USA
- SuperComputing 2002, Baltimore, USA



Workshops

Public-Key-Infrastruktur
Darmstadt, 17 January 2002

Mobile Security
Darmstadt, 21 February 2002

International Workshop on 3D Digitization (3DD-2002)
Singapore, 25 February 2002

Internet sicher nutzen – Praxistag
Darmstadt, 21 March 2002

Sicherheit von Betriebssystemen
Darmstadt, 25 April 2002

UMTS & Interaktive Multimedia Systeme - Chancen und Herausforderungen
Darmstadt, 15 May 2002

Netzwerksicherheit
Darmstadt, 16 May 2002

BSI Symposium "Biometrie – Anwendungen und Datenschutz"
Darmstadt, 23 May 2002

Viren
Darmstadt, 13 June 2002

DSV-IS 2002 (9th International Workshop on the Design, Specification and Verification of Interactive Systems)
Rostock, 12 - 14 June 2002

BIOSIG-Workshop 2002: Biometrie und elektronische Signaturen
Darmstadt, 19 July 2002

IT-Sicherheitsengineering
Darmstadt, 15 August 2002

GI-STEWA "Workshop on Digital Watermarking and Digital Rights Management"
Darmstadt, 25 - 26 September 2002

IEEE & ACM International Symposium on Mixed and Augmented Reality 2002 (ISMAR)
Darmstadt, 30 September - 1 October 2002

SmartCard
Darmstadt, 17 October 2002

IT-Sicherheit und Medizin
Darmstadt, 18 October 2002

Wissen als Wertbestandteil unternehmerischen Vermögens
Hof, 21- 22 October 2002

Katastrophenmanagement und Innere Sicherheit
Darmstadt, 30 - 31 October 2002

Nachwuchstag: CAST-Förderpreis 2002
Darmstadt, 21 November 2002

Unternehmensübergreifende Kooperation
Darmstadt, 2 - 3 December 2002

International Conference for Web Delivering of Music Scores (WedelMusic 2002)
Darmstadt, 9 - 11 December 2002

Web-Security
Darmstadt, 12 December 2002

Publications

In 2002 the results of our research activities were published in numerous publications, theses and a total of ten successful dissertations. The work of the researchers reflects the broad research spectrum of the Fraunhofer IGD institutions, with topics ranging from novel IT-based environments to interactive applications in geographic information systems as well as new simulation methods for the modeling of 3D image data.

The presentations on internationally renowned conferences and congresses, for example ACM Multimedia 2002 in Juan-les-Pins, France, Advanced Simulation Technologies Conference 2002 in San Diego, DETC 2002 in Montreal, SIBGRAPI 2002 and SVR 2002 in Fortaleza, Brazil, CODATA 2002 and CARS 2002 in Paris, VRAI 2002 in Hangzhou, China, Wedelmusic 2002 in Darmstadt, MMVR 2002 in Newport Beach, USA, SPIE Security 2002 and SPIE VDA 2002 in San Jose, AACE Conference on E-Learning in Corporate, Government, Healthcare & Higher Education 2002 in Montreal, CAD 2002 in Dresden, DSV-IS 2002 in Rostock, ISMAR 2002 in Darmstadt, IV 2002 in London, ISE 2002 in San Diego, VSMM 2002 in Gyeongju, Korea, and ISA 2002 in Cancun, Mexico, placed emphasis on the large spectrum of the research activities of the institutions of the Fraunhofer IGD and illustrated the growing internationalization of the network. The best publications of all INI-GraphicsNet institutions have been collated in the "Selected Readings in Computer Graphics 2002".

On the occasion of the "4th Computer Graphics Night" in Darmstadt, three author teams of the INI-GraphicsNet were distinguished with the "Best Paper Award" for their excellent scien-

tific publications. An independent jury, headed by Professor Dieter Fellner, had to choose the best of a total of 38 pre-selected outstanding publications from the "Selected Readings in Computer Graphics 2001". Marc Alexa, Johannes Behr, Daniel Cohen-Or, Shachar Fleishman, David Levin and Claudio T. Silvia came first with their publication "Point Set Surface" – a novel approach to the transformation of 3D geometrical animation sequences. The INI-GraphicsNet honored the excellent article with 5.200 Euros. Oliver Bimber, Miguel Encarnação and Pedro Branco shared the second price and 2.600 Euro with their publication "The extended Virtual Table: An Optical Extension for Table-Like Projection Systems". The third price and 1.300 Euros were given to Marc Alexa, Wolfgang Müller and Marc Weber for the publication of their research results on the topic of "Visualizing Time-Series on Spirals".

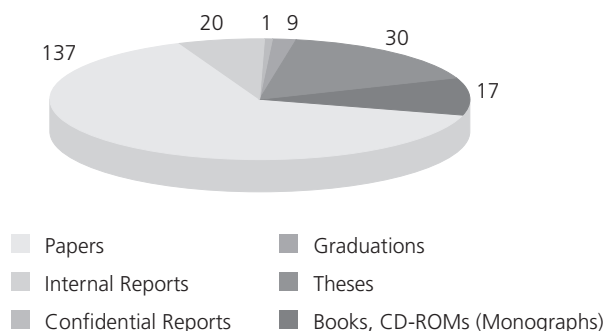
The INI-GraphicsNet further awarded prizes for outstanding study theses which emerged from within the institutions of the research network. The Best Thesis Awards were granted to three theses of equal rank: Jörg Treschau's draw up on the "Interactive parallel visualization of research data", the work of Anders Adamson "Ray Tracing of Point Set Surfaces" and Alain Pagani's work "Integration of vir-

tual objects into an image from a single view geometrical properties of images and panoramas".

With the "Patent Award", the INI-GraphicsNet for the third time honored employees who, in the context of their work, achieved exceptional results which lead to a patent or patent application in the field of Computer Graphics. Seven successful patents and patent applications from different application fields have been registered in 2002, for example, the Augmented Reality telescope or Virtual Graffiti – a system for the generation of large pictures on a projection screen.

The following section shows a selection of outstanding papers from the "Selected Readings in Computer Graphics 2002".

Publications of the Fraunhofer IGD institutions in 2002.





Selected Papers

Bimber, Oliver; Gatesby, Stephen M.; Witmer, Lawrence M.; Raskar, Ramesh; Encarnaçã, L. Miguel:

Merging Fossil Specimens with Computer-Generated Information.
In: IEEE Computer 35 (2002), 9, pp. 25-30

Blechschnitt, Eric; Strödecke, Christoph:
An Architecture to provide adaptive, synchronized and multimodal Human Computer Interaction.

In: Association for Computing Machinery (ACM): Multimedia Conference 2002. Proceedings: MM 2002. New York: ACM, 2002, pp. 287-290

Coors, Volker:

Resource-Adaptive Interactive 3D Maps.

In: Butz, Andreas (Ed.): International Symposium on Smart Graphics. Proceedings 2002. New York: ACM Press, 2002, pp. 140-144

Diener, Holger; Mainka, Mathias; Schumacher, Hagen:

Net-Fly and ContextControl: Two Examples of Game Based Interfaces.

In: Forbrig, Peter (Ed.) u. a.: PreProceedings of the 9th International Workshop on Design, Specification, and Verification: Bricks & Blocks: Towards Effective User Interface Patterns and Components. Rostock: Universität Rostock, Fachbereich Informatik, 2002, pp. 377-386

Dörner, Ralf; Ware, Colin:

Interactive Techniques for Exploring Data Using Behavioral Animation.

In: Knowledge Systems Institute: The Eighth International Conference on Distributed Multimedia Systems. Proceedings. Skokie: Knowledge Systems Institute, 2002, pp. 622-629

Dörner, Ralf; Grimm, Paul; Abawi, Daniel F.:

Synergies Between Interactive Training Simulations and Digital Storytelling: a Component-based Framework.

In: Computers & Graphics 26 (2002), 1, pp. 45-55

Fiorentino, Michele; Amicis, Raffaele de; Monno, Giuseppe; Stork, André:

Spacedesign: A Mixed Reality Workspace for Aesthetic Industrial Design.

In: Müller, Stefan (Ed.) u. a.; Institute of Electrical and Electronics Engineers (IEEE) u. a.: IEEE and ACM International Symposium on Mixed and Augmented Reality 2002. Proceedings. Los Alamitos, Calif.: IEEE Computer Society, 2002, pp. 86-94

Göbel, Stefan; Haist, Jörg; Reiterer, Harald; Müller, Frank:

INVISIP: Usage of Information Visualization Techniques to Access Geospatial Data Archives.

In: Hameurlain, Abdelkader (Ed.) u. a.: Database and Expert Systems Applications. Proceedings 2002. Berlin; Heidelberg: Springer, 2002, pp. 371-380 (Lecture Notes in Computer Science 2453).

Heider, Thomas; Kirste, Thomas:

Supporting Goal-Based Interaction with Dynamic Intelligent Environments.

In: Van Harmelen, Frank (Ed.); European Coordinating Committee on Artificial Intelligence (ECCAI) u. a.: European Conference on Artificial Intelligence. Proceedings 2002. Amsterdam; Berlin: IOS Press, 2002, pp. 596-600

Hergenröther, Elke; Bleile, Antonio; Middleton, Don; Trembilski, Andrzej:

The Abalone Interpolation – A Visual Interpolation Procedure for the Calculation of Cloud Movement.

In: Gonçalves, Luiz Marcos Garcia (Ed.) u. a.: XV Brazilian Symposium on Computer Graphics and Image Processing. Proceedings. Los Alamitos, Calif.: IEEE Computer Society, 2002, pp. 381-387

Jalali-Sohi, Mehrdad; Ebinger, Peter:
Towards Efficient PKIs for Restricted Mobile Devices.

In: Hamza, M.H. (Ed.); The International Association of Science and Technology for Development – IASTED: IASTED International Conference on Communications and Computer Networks 2002. Proceedings. Anaheim, Calgary, Zürich: ACTA Press, 2002, pp. 42-47

Karangelis, Grigorios; Zimeras, Stelios; Firlé, Evelyn; Wang, Min; Sakas, Georgios:

Volume Definition Tools for Medical Imaging Applications.

In: Niessen, Wiro J. (Ed.) u. a.: Medical Image Computing and Computer-Assisted Intervention – MICCAI 2001 Proceedings. 4th International Conference. Berlin, Heidelberg, New York: Springer Verlag, 2001, pp. 1295-1297 (Lecture Notes in Computer Science 2208).

Klein, Konrad; Malerczyk, Cornelius; Wiebesiek, Torsten; Wingbermühle, Jochen:

Creating a "Personalised, Immersive Sports TV Experience" via 3D Reconstruction of Moving Athletes.

In: Abramowicz, Witold (Ed.): Business Information Systems. Proceedings 2002. CD-ROM. 2002

Koch, Brigitte; Jasnoch, Uwe;
Stork, André:

WIDE – Semantic Web for Design and Engineering.

In: Smari, Waleed W. (Ed.) u. a.; The Society for Modeling and Simulation International: International Conference on Information Systems and Engineering 2002. Proceedings. San Diego: Simulation Councils, Inc., 2002, pp. 23-28

Kretschmer, Ursula:

Using Mobile Systems to Transmit Location Based Information.

In: Kalliany, R. (Ed.) u. a.; International Society of Photogrammetry and Remote Sensing and Spatial Information Sciences (ISPRS): Photogrammetric Computer Vision. Proceedings 2002. CD-ROM: Proceedings of the ISPRS Commission III Symposium. Graz, 2002

May, Thorsten; Schneider, Sascha;
Luckas, Volker:

Parallel Real Time Fluid Simulation and Animation with Fractal Optical Refinements.

In: Amborski, Krzysztof (Ed.) u. a.; Fachhochschule Darmstadt: 16th European Simulation Multiconference: Modelling and Simulation 2002: ESM 2002. Ghent: SCS-Europe, 2002, pp. 224-228

Müller-Wittig, Wolfgang K.; Mlynski, Gunter; Weinhold, Ivo; Bockholt, Uli;
Voss, Gerrit:

Nasal Airflow Diagnosis – Comparison of Experimental Studies and Computer Simulations.

In: Westwood, James D. (Ed.): Medicine Meets Virtual Reality 2002. Proceedings: Digital Upgrades: Applying Moore's Law to Health. Amsterdam: IOS Press; Ohmsha, 2002, pp. 311-317 (Studies in Health Technology and Informatics 85).

Niu, Xiamu; Schmucker, Martin;
Busch, Christoph:

Video Watermarking Resisting to Rotation, Scaling, and Translation.

In: Wong, Wah Ping (Ed.) u. a.; IS&T – The Society for Imaging Science and Technology u. a.: Security and Watermarking of Multimedia Contents IV. Washington: SPIE, 2002, pp. 512-519 (Proceedings of SPIE 4675).

Pinsdorf, Ulrich; Roth, Volker:

Mobile Agent Interoperability Patterns and Practice.

In: Ninth IEEE International Conference and Workshop on the Engineering of Computer-Based Systems. Proceedings. Los Alamitos, Calif.: IEEE Computer Society, 2002, pp. 238-244

Posada, Jorge; Larzabal, Alberto;
Stork, André:

Semantic-Based Parametric Control of CAD Model Conversion for Large Model Visualization in Virtual Reality.

In: Cruz-Neira, Carolina (Ed.) u. a.; Ecole Supérieure des Technologies Industrielles Avancées u. a.: Virtual Concept 2002. Proceedings. 2002, pp. 38-43

Preusche, Carsten; Hirzinger, G.;
Rettig, Alexander:

Assembly Verification in Digital Mock-Ups Using Force Feedback.

In: Ecole Nationale Supérieure d'Ingénieurs de Bourges: International Symposium on Measurement & Control in Robotics. Proceedings 2002. CD-ROM: Toward Advanced Robot Systems and Virtual Reality. Bourges, France, 2002

Schmalstieg, Dieter; Fuhrmann, Anton;
Szalavári, Zsolt; Hesina, Gerd;
Encarnação, L. Miguel; Gervautz, Michael; Purgathofer, Werner:

The Studierstube Augmented Reality Project.

In: Presence 11 (2002), 1, pp. 33-54

Schmucker, Martin:

Capacity Improvement of a Blind Symbolic Music Score Watermarking Technique.

In: Wong, Wah Ping (Ed.) u. a.; IS&T – The Society for Imaging Science and Technology u. a.: Security and Watermarking of Multimedia Contents IV. Washington: SPIE, 2002, pp. 206-213 (Proceedings of SPIE 4675).

Song, Meehae; Müller-Wittig, Wolfgang K.; Chan, Tony K.Y.:

Reconstructing Peranakan Identities through Digital Heritage.

In: International Society on Virtual Systems and MultiMedia: International Conference on Virtual Systems and MultiMedia. VSMM 2002. Proceedings. 2002

Trembilski, Andrzej; Brossler, Andreas:

Transparency for Polygon Based Cloud Rendering.

In: Association for Computing Machinery (ACM) u. a.: ACM Symposium on Applied Computing. Proceedings 2002. New York, 2002, pp. 785-790

Vlahakis, Vassilios; Ioannidis, Nikos;
Karigiannis, John; Tsotros, Manolis;
Gounaris, Michael; Stricker, Didier;
Gleue, Tim; Dähne, Patrick;
Almeida, Luis:

Archeoguide: An Augmented Reality Guide for Archaeological Sites.

In: IEEE Computer Graphics and Applications 22 (2002), 5, pp. 52-60

Volmer, Stephan:

Fast Approximate Nearest-Neighbour Queries in Metric Feature Spaces by Buoy Indexing.

In: Chang, Shi-Kuo (Ed.) u. a.: Recent Advances in Visual Information Systems. Berlin, Heidelberg, New York: Springer Verlag, 2002, pp. 36-49 (Lecture Notes in Computer Science 2314).



Voss, Gerrit; Behr, Johannes;
Reiners, Dirk; Roth, Marcus:

A Multi-thread Safe Foundation for Scene Graphs and its Extension to Clusters.

In: Bartz, Dirk (Ed.) u. a.; European Association for Computer Graphics (Eurographics): Fourth Eurographics Workshop on Parallel Graphics and Visualisation 2002. Proceedings: In cooperation with ACM Siggraph. New York: ACM Press, 2002, pp. 33-37

Wolthusen, Stephen:

Distributed Intrusion Detection for Policy- Controlled Heterogeneous Environments.

In: The National Security Agency u. a.: Third Annual IEEE SMC Information Assurance Workshop. Proceedings 2002. CD-ROM. West Point, New York, 2002, pp. 255-262

Wünstel, Michael; Schumann, Hagen:
Automatic 3D- Reconstruction of the Ocular Fundus from Stereo Images.

In: Lemke, Heinz U. (Ed.) u. a.: Computer Assisted Radiology and Surgery 2002. Proceedings. Berlin, Heidelberg, New York: Springer Verlag, 2002, pp. 456-460

Zhong, Yongmin; Müller-Wittig, Wolfgang K.; Ma, Weiyin:

A Model Representation for Solid Modelling in A Virtual Reality Environment.

In: Institute of Electrical and Electronics Engineers (IEEE): International Conference on Shape Modeling and Applications 2002. Proceedings. Los Alamitos: IEEE Computer Society Press, 2002, pp. 183-190

Graduations

Bimber, Oliver:

Interactive Rendering for Projection-Based Augmented Reality Displays.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação
Prof. Dr.-Ing. H. Fuchs, University of North Carolina
Graduation, TU Darmstadt, FB Informatik, FG GRIS, Oktober 2002

Chodura, Hartmut:

Räumliche audio-visuelle Integration und ihre Anwendungen.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação
Prof. Dr.-Ing. P. Astheimer, University of Abertay Dundee, England
Graduation, TU Darmstadt, FB Informatik, FG GRIS, July 2002

Fröhlich, Torsten:

Dynamisches Objektverhalten in Virtuellen Umgebungen.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação
Prof. Dr.-Ing. St. Müller, University Koblenz-Landau
Graduation, TU Darmstadt, FB Informatik, FG GRIS, September 2002

Graf, Frank:

Lernspezifische Sicherheitsmechanismen in Lernumgebungen mit modularem Lernmaterial.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação
Prof. Dr.-Ing. J. Paaso, University of Oulu, Finland
Graduation, TU Darmstadt, FB Informatik, FG GRIS, March 2002

Reiners, Dirk:

OpenSG: A Scene Graph System for Flexible and Efficient Realtime Rendering for Virtual and Augmented Reality.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação
Prof. Dr.-Ing. St. Müller, University Koblenz-Landau
Graduation, TU Darmstadt, FB Informatik, FG GRIS, June 2002

Stricker, Didier:

Computer Vision basierte Tracking- und Kalibrierungsverfahren für Augmented Reality.

Supervisors:

Prof. Dr.-Ing. J. L. Encarnação
Prof. Dr.-Ing. G. Klinker, TU Munich
Graduation, TU Darmstadt, FB Informatik, FG GRIS, November 2002

Theses

Aehnel, Mario:

Ein Benutzermodell für elektronische Lernumgebungen.

Supervisors: Hambach, S.; Urban, B.; Uhrmacher, A.

Diploma thesis, University of Rostock

Aehnel, Mario:

Eine adaptive und adaptierbare hypermediale Themenkarte für das Kursverwaltungssystem CMS-W3.

Supervisors: Hambach, S.; Urban, B.
Study thesis, University of Rostock

Audersch, Stefan:

Metadatenverwaltung für Multimedia-Content-Management mit OLAP-Funktionalität.

Supervisors: Flach, G.; Courvoisier, T.; Lubinski, A.; Heuer, A.; Urban, B.

Diploma thesis, University of Rostock

Bleile, Antonio:

Semantics Based Management and Visualization of Dynamic Atmospheric Data.

Supervisor: Hergenröther, E.
Diploma thesis, TU Darmstadt

Delépine, Ghislain:

Automatische Lokalisierung von Gesichtern in Videobildern.

Supervisor: Volmer, S.
Diploma thesis, TU Darmstadt

Drews, Michael:

Personalisierte Verwaltung und universeller Zugriff auf multimediale Dokument-Strukturen auf der Basis von MPEG-7.

Supervisors: Meyer, H.; Dobermann, M.; Flach, G.; Courvoisier, T.;

Heuer, A.; Urban, B.

Diploma thesis, University of Rostock

Ebert, Mirko:

Lernen mit Annotationen – Unterstützung des Lernprozesses in elektronischen Lernumgebungen durch Annotation von hypermedialen Arbeitsmaterialien.

Supervisors: Hambach, S.; Urban, B.; Schumann, H.

Diploma thesis, University of Rostock

El-Harti, Hicham:

Realisierung und Vergleich von Datenbankanbindungen für einen 3D-Geodatenserver.

Supervisor: Coors, V.
Diploma thesis, TU Darmstadt

Estades-Muntaner, Simon:

Shot Detection in Video Sequences.

Supervisor: Hahn, V.
Diploma thesis, UPC Barcelona

Feix, Axel:

Subdivision Surfaces für Modellierung und Virtuelle Realität.

Supervisor: Lutz, B.
Diploma thesis, TU Darmstadt

Gómez Zardáin, Jorge:

Automatic Registration of PET and CT resp. PET and MRT Volume Data.

Supervisor: Firlé, E.
Diploma thesis, TU Darmstadt

Grindel, Rolf:

Realisierung einer sicheren Mobilen Agenten Plattform auf einem PDA.

Supervisor: Pinsdorf, U.
Diploma thesis, FH Bingen

Groß, Jochen:

Entwicklung einer automatisierten Bewegungssteuerung für ein geographisch verteiltes audiovisuelles Telepräsenzsystem.

Supervisor: Krafzig, U.
Diploma thesis, FH Wiesbaden

Guthier, Thomas:

Visualisierung der Entwicklung der Sahara durch ein Virtual Reality Exponat für eine öffentliche Ausstellung.

Supervisor: Fröhlich, T.
Diploma thesis, FH Darmstadt

Hartmann, Steffen:

Konzeption und Evaluierung einer Visualisierungstechnik für mechanische Eigenschaften von biologischen Zellen.

Supervisors: Seiler, C.; Dörner, R.; Grimm, P.
Diploma thesis, University Frankfurt/M.

Hecking, Jan Peter:

Modes of communication in an Internet kiosk environment.

Supervisors: Cap, C.H.; Urban, B.
Diploma thesis, University of Rostock

Hirschbach, Henning:

Visualisierung und Übertragung medizinischer Daten über das Internet.

Supervisor: Sachpazidis, I.
Bachelor thesis, FH Darmstadt

Hohner, Bernd:

Parallelisiertes Volumen-Rendering mit 3D Texturen.

Supervisors: Schneider, S.; Luckas, V.
Diploma thesis, TU Darmstadt

Huang, Lidong:

Programme und Skript-Sprache für die Modellierung von Molekülen und die Behandlung ihrer Konformationen.

Supervisors: Seiler, C.; Breiner, T.
Diploma thesis, University Frankfurt/M.???



Johanns, Thorsten:
Übersichtskarten zur Verbesserung der Interaktion und Navigation in VR-Systemen.

Supervisors: Günther, N.; Schumann, H.; Urban, B.
Diploma thesis, University of Rostock

Kett, Jürgen:
Real-Time Special Effects – Neue Möglichkeiten durch benutzerprogrammierbare Grafik-Hardware.
Supervisors: Dörner, R.; Grimm, P.
Diploma thesis, University Frankfurt/M.

Kirchner, Bastian:
Evaluierung von Biosensoren zur Unterstützung einer Disposition persönlicher Aufgaben.
Supervisors: Bieber, G.; Urban, B.
Study thesis, University of Rostock

Klaaßen, Arne:
Visuelles Data Mining von Gesundheitsdaten.
Supervisors: Schumann, H.; Nocke, T.; Schulze-Wollgast, P.; Urban, B.
Diploma thesis, University of Rostock

Korten, Malte:
Entwurf, Konzeption und Realisierung eines Inhouse-Positionssystems auf der Basis mobiler Rechensysteme durch "Sensorfusion".
Supervisors: Eberl, H.W.; Bieber, G.; Urban, B.
Diploma thesis, Hochschule Mittweida (FH)

Kullmann, Daniel:
Intelligent Behavior Control and World Modelling for Virtual Humans in Virtual Environments.
Supervisor: Fröhlich, T.
Diploma thesis, TU Darmstadt

Lobisch, Oliver:
Verbesserung der Robustheit von Wasserzeichen in Audiodaten.

Supervisor: Arnold, M.
Diploma thesis, FH Darmstadt

Maier, Stefan Michael:
Automatische Erkennung von eingeblendetem Text in Videostreams.

Supervisor: Volmer, S.
Diploma thesis, TU Darmstadt

Milic, Stivens:
Sichere Kommunikation zwischen mobilen Agenten.

Supervisors: Pinsdorf, U.; Peters, J.
Diploma thesis, University Frankfurt/M.

Montan, Nils:
Sound Spatialization Server for Audio Augmented Environments.
Supervisors: Heinrich, G.; Karlsson, G.
Master thesis, Royal Institute of Technology Stockholm (KTH)

Oldenburg, Steffen:
Sicherheitskonzept für mobile Geräte.

Supervisors: Cap, C.H.; Urban, B.; Preuß, S.
Diploma thesis, University of Rostock

Paes, Thomas:
Navigations- und Interaktionstechniken.

Supervisor: Abawi, D. F.
Diploma thesis, University Frankfurt/M.

Pagani, Alain:
Integration virtueller Objekte in Bilder der realen Welt: Geometrische Analyse für Bild- und Panoramaansicht.

Supervisor: Stricker, D.
Diploma thesis, TU Darmstadt

Phatthanachuanchom, Somchai:
Connection between Panoramic Views and 2D-GIS.

Supervisors: Kretschmer, U.; Schulz, T.
Diploma thesis, FH Offenburg

Preuss, Andreas:
Einlesen eines Videostroms für die Bestimmung von Position und Blickrichtung.

Supervisor: Kretschmer, U.
Diploma thesis, FH Wiesbaden

Raab, Markus:
Der Produktionsprozess in der Spieleentwicklung und eine mögliche Optimierung durch den Einsatz von Design Pattern.

Supervisors: Dörner, R.; Grimm, P.
Diploma thesis, FH Hagenberg

Rama-Calvo, Antonio:
Shot Detection in Video Sequences using an Edge based Algorithm.
Supervisor: Hahn, V.
Diploma thesis, UPC Barcelona

Rasel, Thorsten:
Entwicklung von Methoden und Konzepten für den Aufbau einer 3D-Geodatenbibliothek.

Supervisor: Göbel, S.
Diploma thesis, TU Darmstadt

Repnak, Robert:
Darstellung von Netzwerken auf mobilen Handhelds.

Supervisors: Schumann, H.; Karstens, B.; Urban, B.
Diploma thesis, University of Rostock

Reuter, Andreas:
Koordinierte, verteilte Informationssuche auf Basis mobiler Agenten und Peer-to-Peer Technologie.

Supervisor: Pinsdorf, U.
Diploma thesis, FH Bingen

Reyes Garcia, Pedro:

Object Segmentation in Panoramic Video.

Supervisor: Hahn, V.

Diploma thesis, Universidad de Granada

Roessing, Jörg:

Partikelsystem für die Modellierung in der Paläontologie.

Supervisor: Hergenröther, E.

Diploma thesis, FH Darmstadt

Rubin, Anja:

Didaktische Modelle für das vernetzte Lernen mit Hypertext und Multimedia.

Supervisors: Hambach, S.; Sander, U.; Urban, B.

Diploma thesis, University of Rostock

Rust, Matthias:

Multimedia Content management für interaktive TV-Applikationen unter Einbeziehung des MPEG-7 Standards.

Supervisors: Flach, G.; Dobermann, M.; Heuer, A.; Urban, B.

Diploma thesis, University of Rostock

Sarrazin, Roland:

Kollisionserkennung und -behandlung zwischen stark deformierbaren und starren Körpern.

Supervisors: Fuhrmann, A.; Lucas, V.

Diploma thesis, TU Darmstadt

Schulze, Daniel:

Visualisierung Semantischer Constraints.

Supervisors: Grimm, P.; Dörner, R.;

Strippgen, S.

Diploma thesis, HTW Dresden

Schwalm, Stefan:

Entwicklung von Sicherheitsprotokollen und neue Mechanismen für ASP (Application Service Provider) für mobile Endgeräte.

Supervisor: Jalali-Sohi, M.

Diploma thesis, TU Darmstadt

Stahl, René:

Authoring Tools für Software-Agenten.

Supervisors: Herzig, C.; Urban, B.;

Cap, C.H.

Diploma thesis, University of Rostock

Sutiono, Heruwanli:

Erstellung einer Intelligent Tutoring Komponente innerhalb eines Modularen Training Systems.

Supervisor: Hellenschmidt, M.

Diploma thesis, FH Frankfurt/M.

Theisinger, Rolf:

Haptische 3D-Benutzungsoberfläche.

Supervisors: Seiler, C.; Baier, W.

Diploma thesis, University Frankfurt/M.

Treschau, Jörg:

Interaktive parallele Visualisierung wissenschaftlicher Daten.

Supervisors: Schneider, S.; Lucas, V.

Diploma thesis, TU Darmstadt

Unkelbach, Frank:

Ein modularer Ansatz zur Integration neuer Sensoren in ein Patientüberwachungssystem.

Supervisor: Sachpazidis, I.

Bachelor Arbeit, Fachhochschule Darmstadt

Vahl, Matthias:

Integration von Virtual Reality und CAD auf der Basis der CAD-Serviceschnittstelle.

Supervisors: von Lukas, U.; Urban, B.

Gutachter: Urban, B.; Schumann, H.

Diploma thesis, University of Rostock

Walburg, Jan:

Visualisierung in der Bioinformatik am Beispiel von Microarrays.

Supervisors: Grimm, P.; Seiler, C.

Diploma thesis, FH Heidelberg

Wöhl, Torsten:

Reengineering mit Software-Entwicklungs-Werkzeugen zur Erzeugung UML-konformer Dokumentationen.

Supervisor: Wünstel, M.

Bachelor thesis, FH Darmstadt

Yan, Hongning:

Data Hiding in Binärbildern.

Supervisor: Schmucker, M.

Master Thesis, FH Darmstadt

Zarcero Garcia-Risco, Maria del Carmen:

Computer-Based Methods for Matching and Comparison of Portal Image and Digitally Reconstructed Radiograph.

Supervisor: Karangelis, G.

Diploma thesis, TU Darmstadt



Patent Applications

Arnold, Michael; Lobisch, Oliver:
**Verfahren zur Auflösung der
Echtzeitanforderung bei digitalen
Audio-Watermarking Methoden.**

Bimber, Oliver; Encarnação, L. Miguel;
Stork, André:
**The extended Virtual Table: An
Optical Extension for Table-Like
Projection Systems.**

Bisler, Alexander; Bockholt, Uli:
**Ein Virtual Reality (VR) und Myo-
Feedback gestütztes System zur
Diagnose und Therapie von HWS-
Beschleunigungsverletzung.**

Coors, Volker:
**Ein Verfahren zur Kompression von
Dreiecksnetzen durch Prediction der
Topologie.**

Eschler, Peter:
**Virtual Graffiti – Ein System zur
Erzeugung großflächiger Bilder auf
einer projektionsgetriebenen Lein-
wand unter Verwendung eines
positions- und/oder orientierungs-
getrackten Eingabegeräts.**

Stricker, Didier:
Das Augmented Reality-Fernglas.

The Fraunhofer-Gesellschaft at a Glance





The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is the leading organization for institutes of applied research in Europe, 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 Länder ministries and governments, the organization undertakes future-oriented research projects which contribute to the development of innovations in spheres of major public concern and in key technologies. Typical research fields include communications, energy, microelectronics, manufacturing, transport and the environment.

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

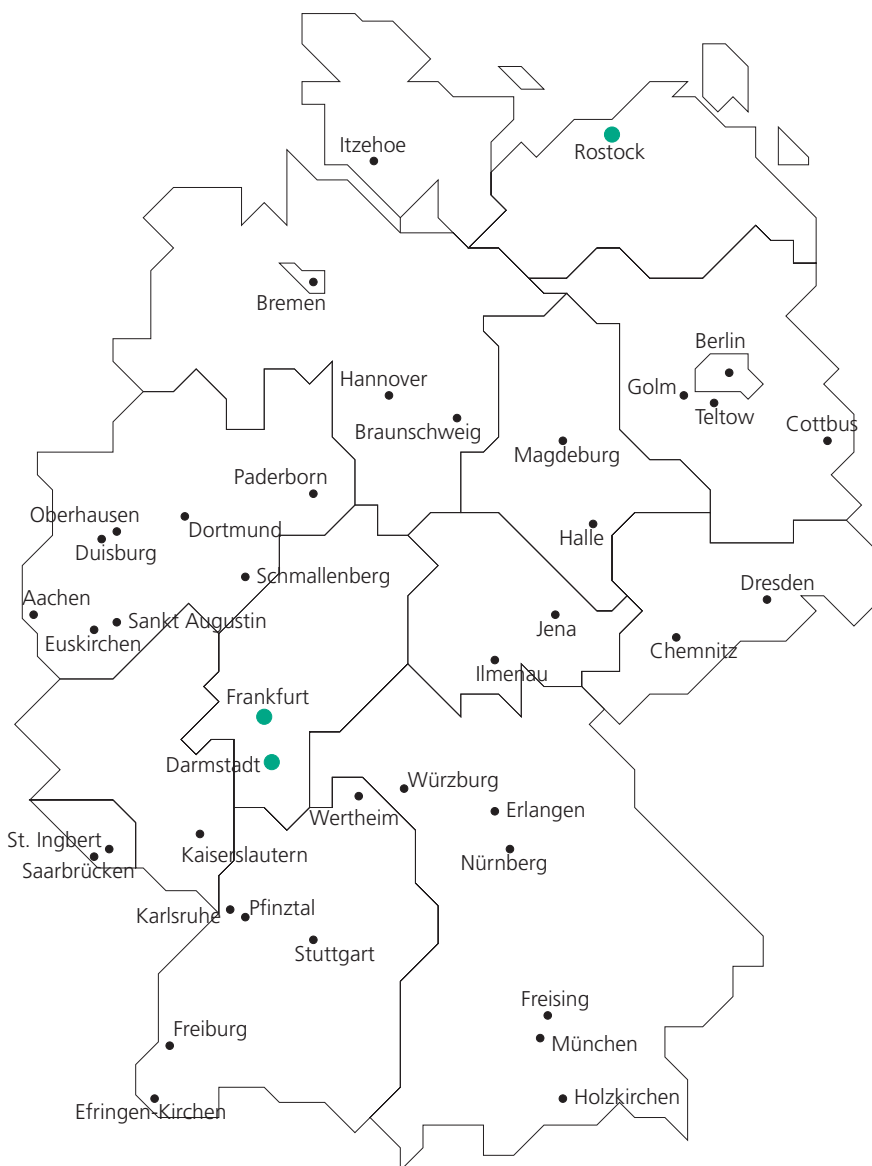
At present, the Fraunhofer-Gesellschaft maintains roughly 80 research units, including 57 Fraunhofer Institutes, at over 40 different locations in Germany. A staff of some 13,000, predominantly qualified scientists and engineers, work with an annual research budget of around one billion Euro. Of this sum, approximately 900

million Euro is generated through contract research. Roughly two thirds of the Fraunhofer-Gesellschafts contract research revenue is derived from contracts with industry and from publicly financed research projects. The remaining one third is contributed by the German federal and Länder governments, as a means of enabling the Institutes to pursue more fundamental research in areas that are likely to become relevant to industry and society in five or ten years, time.

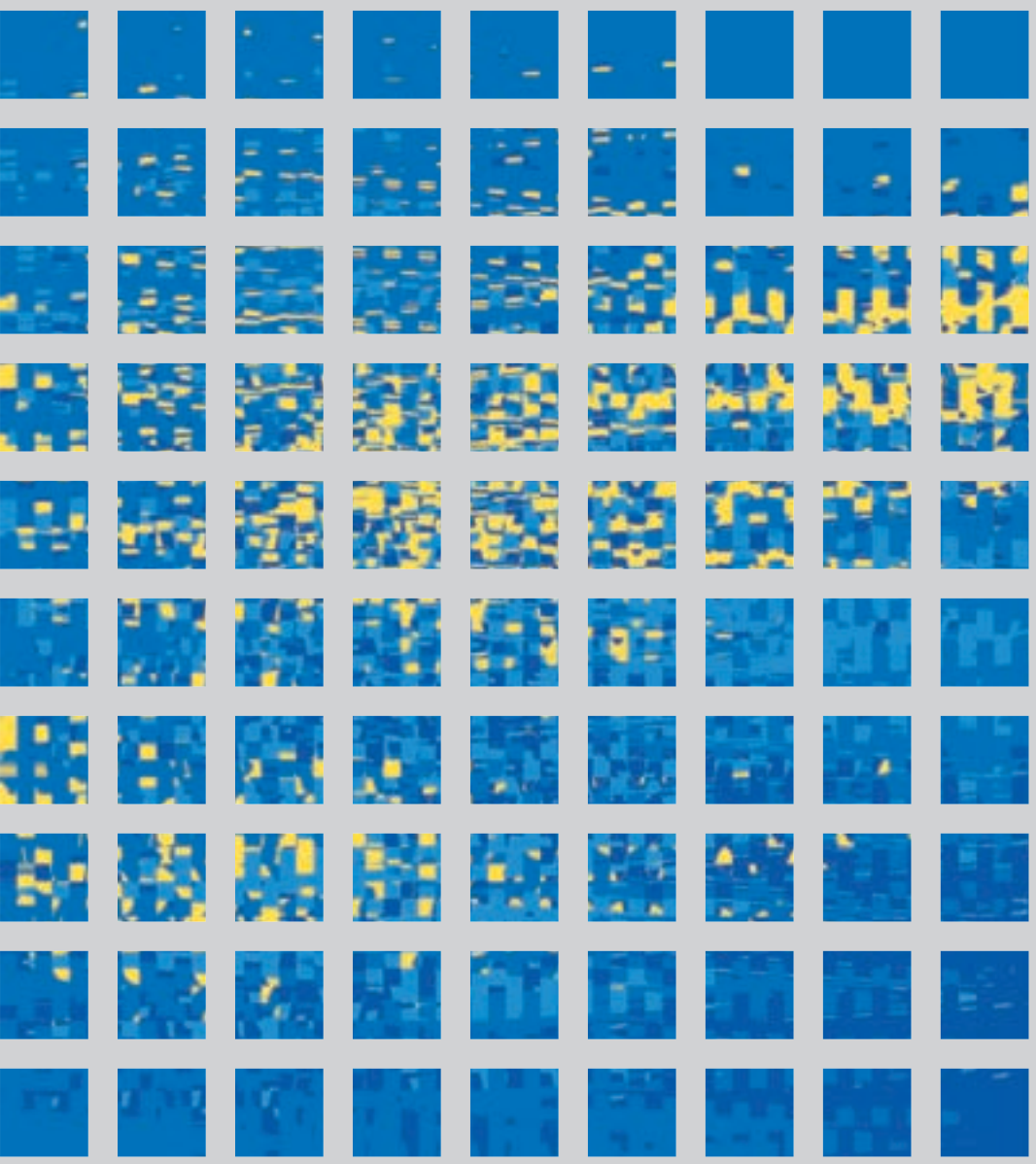
Fraunhofer scientists specialize in complex research tasks involving a broad spectrum of research fields. When required, several institutes pool their interdisciplinary expertise to develop system solutions.

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.



Fraunhofer IuK-Gruppe



Fraunhofer ICT Group

The Fraunhofer ICT Group consists of 15 institutes, employs a staff of over 2.000 and operates with an annual budget of over 200 Mio. Euro. This makes it the largest research alliance for information and communications technology in Europe and one of the largest in the world. The complementing main emphasis topics of the member institutes cover the full range of the added value chain in the communications and IT sectors.

“Living and Working in a Networked World” is the title of a joint program which the group has developed for application-orientated, theoretical, and preliminary research on behalf of the BMBF (Federal Ministry of Education and Research). Seven research programs are investigating the following core issues of IT and communications technology for the future: these include new technologies for the coming Internet generation and mobility support, new methods for knowledge management, IT security as well as new modes of communication in the man-machine dialogue. Computer simulation, visualisation and Virtual Reality will be integrated into digital development environments for industrial product development.

The Fraunhofer ICT Group makes its competence portfolio available to partners from industry and the public sector. Its range of services includes customised IT solutions, specialised technology consulting, and preliminary research for new products and services. Through their membership in international research programs, the member institutes are networked worldwide with business and research companies in the communications and IT sectors.

Supplementary focal points of the institutes comprehensively cover the added value chain in the ICT sector.

The core sectors are:

- Medicine,
- Transport,
- Product Development,
- Media, Entertainment,
- E-Government,
- Catastrophe Management,
- Financial Services.

The member institutes possess a high degree of innovation potential in the technological development of mobile networks and data transfer, IT security, software engineering, knowledge management and information logistics, E-Learning, ambient intelligence, electronic trade, virtual and simulated reality.

Contact

Apart from direct contact to the contacts in the Fraunhofer IGD, there is the possibility of finding the right partner through the offices of the Fraunhofer ICT group in Berlin Mitte as a “One-Stop Shop”.

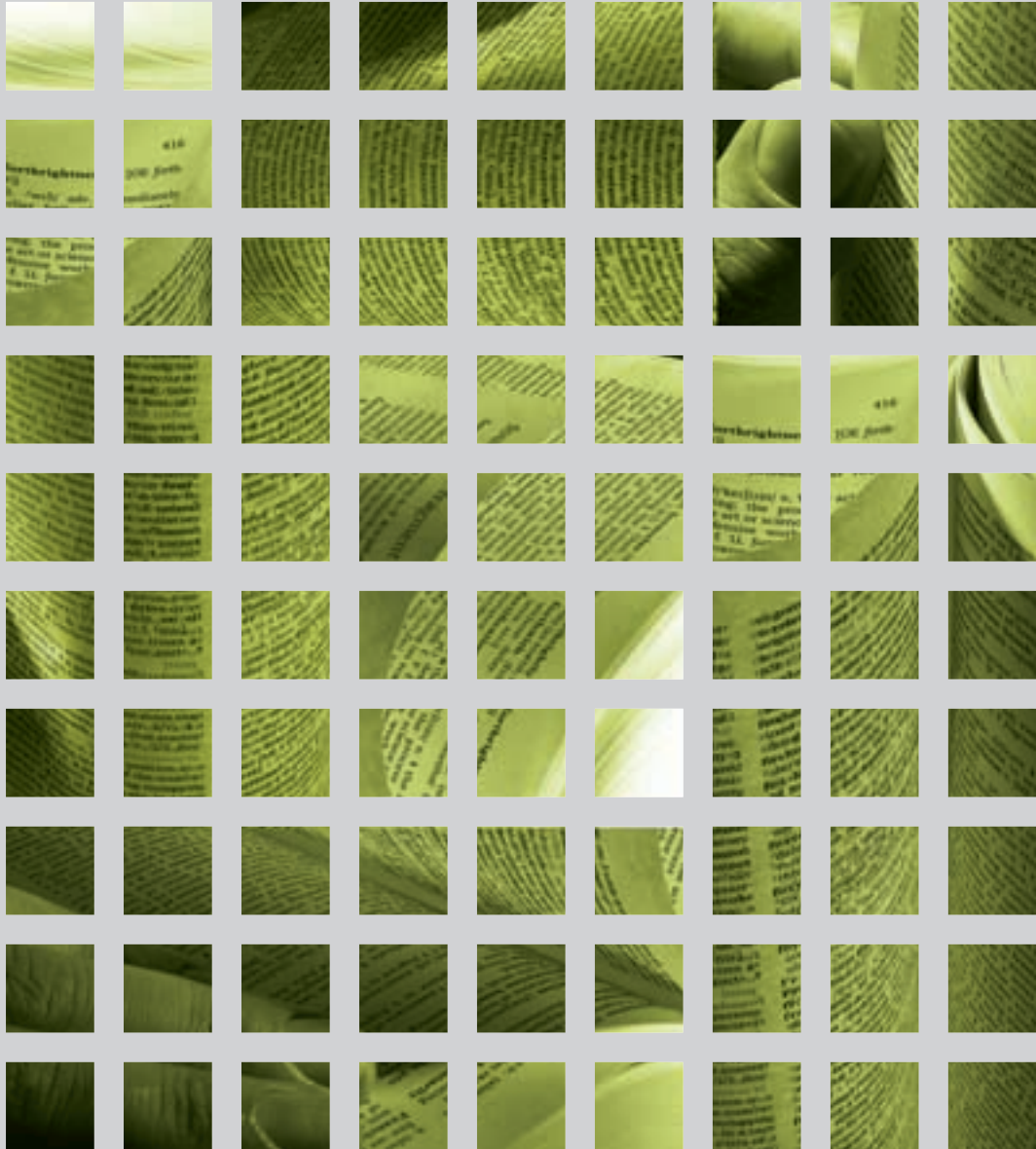
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Editorial Notes

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How to Find us in Darmstadt

From the Freeway (A5, A67)

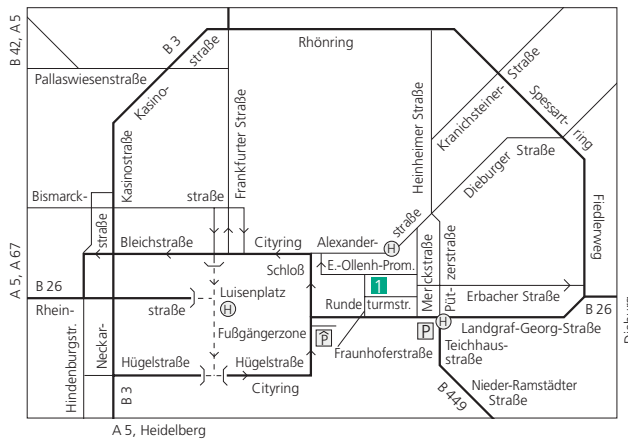
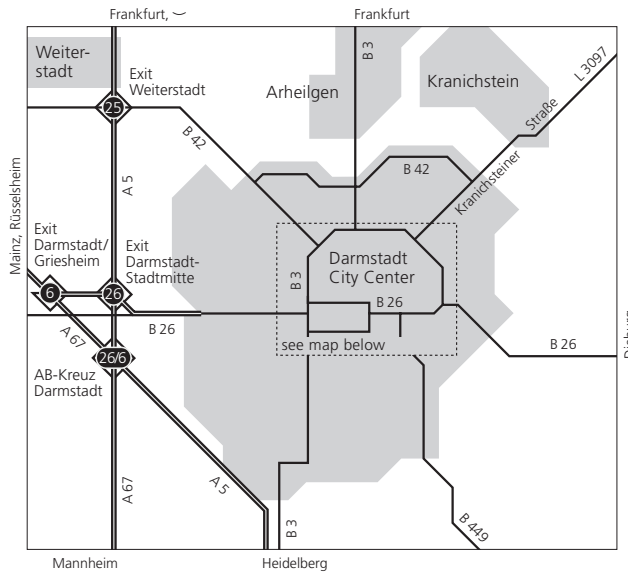
Freeway intersection (Autobahnkreuz) Darmstadt - freeway exit "Darmstadt/ Stadtmitte" (city): Follow "Rheinstrasse" through the city tunnel. At the end of the city tunnel, turn left and follow the "Cityring". At the first large crossing turn left into "Kirchstrasse". At the next large crossing, turn right into "Landgraf-Georg-Strasse". Shortly before the next traffic lights turn left into "Merckstrasse"; the next side street on the left is "Rundeturmstrasse". Following this street will lead you to Fraunhoferstrasse. Turn right to find the institute's entrance.

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 Fraunhoferstrasse. Follow this street and you will find the institute's entrance on your right.

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 catch either bus F (direction Oberwaldhaus), H (direction Kranichstein) or K (direction Parkstrasse) which will take you to "Alexanderstrasse/TH". Exit here and walk back along Alexanderstrasse a little, turn left and the Erich-Ollenhauer-



Location Darmstadt, Germany

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

Promenade will take you straight to our main entrance. Or from Luisenplatz take bus D (direction Ostbahnhof) and exit at "Teichhausstrasse". Walk back along the Landgraf-Georg-Strasse a little and take the second turning on the right (Fraunhoferstrasse). Follow this street. You will find the institute's entrance on the right hand.

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 first turning on the left (Fraunhoferstrasse). Follow this street. You will find the institute's entrance on the right hand.



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 Freeway (A20)

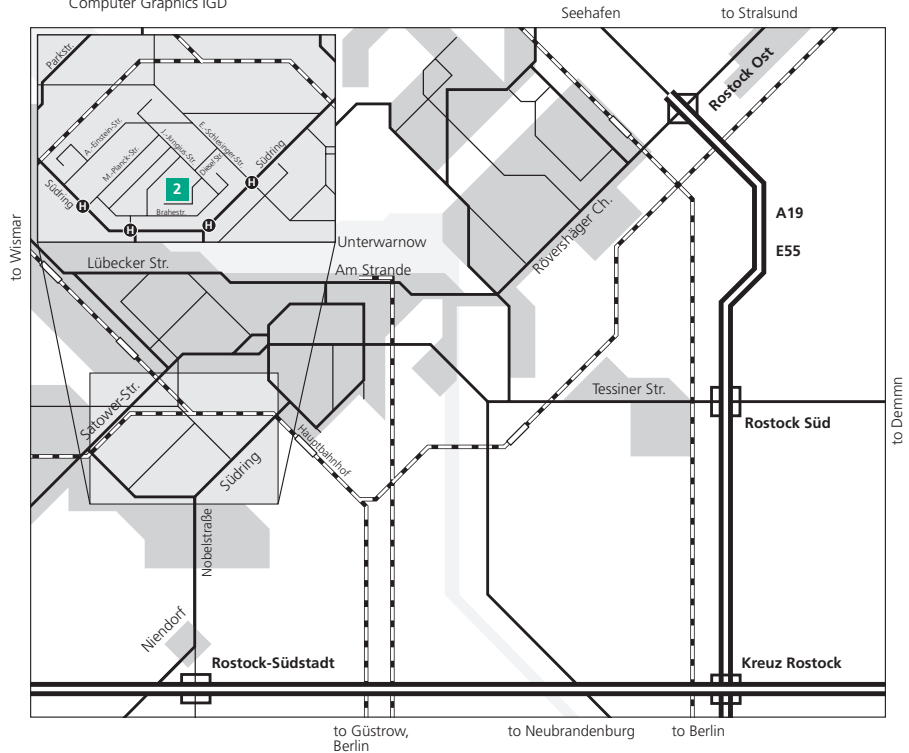
Exit the E22 (A20) at "Rostock-Südstadt" and follow the signs to Niendorf. On the country road L132, follow the signs to Rostock. Follow the Nobelstrasse to the "Südring". Turn right towards the center of Rostock ("Rostock-Zentrum"). Turn right at the first crossing and follow "Erich-Schlesinger-Strasse". 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.

Location Rostock, Germany

2 Fraunhofer Institute for Computer Graphics IGD



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 taxi to Rostock.

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

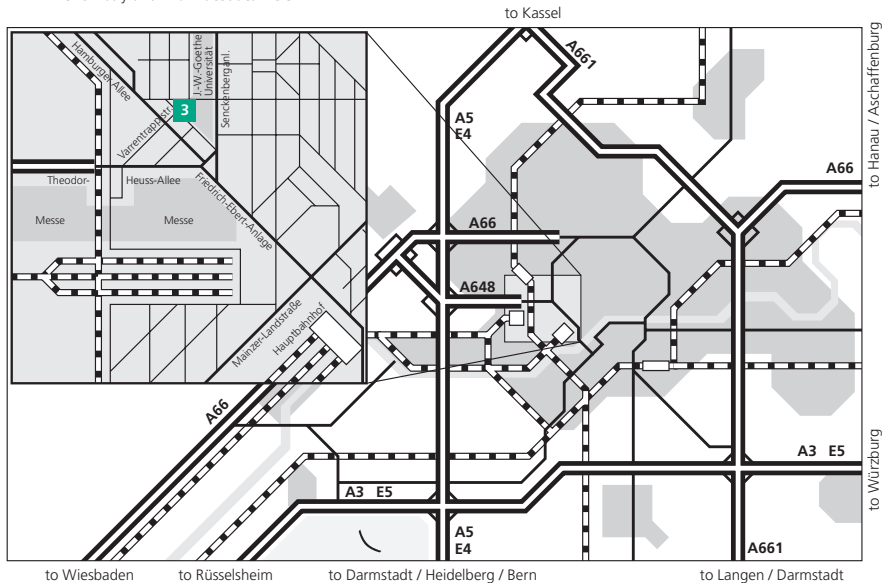
Go to the tram station in front of the main railway station. Either take the #16 (direction Ginnheim) or #19 (direction Westbahnhof) tram. Exit at "Varrentrappstrasse" (4th stop). The Fraunhofer AGC is located on the right hand side of the street (house no. 40-42).

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 Pharmaceutics AGC





How to Find us in Providence

By Car from the North or South

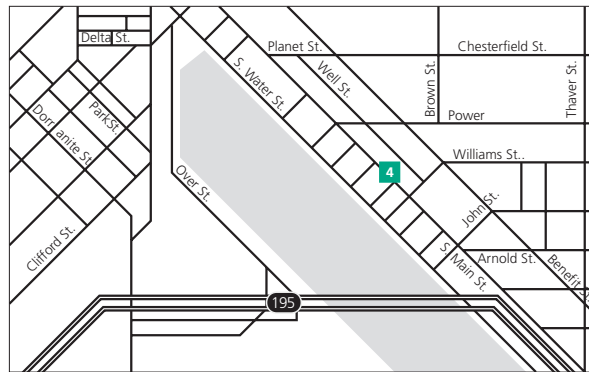
Most people travelling to Providence take Interstate 95. Regardless of whether you are starting from I-95 North or South, get off at Exit 20 onto I-195 East. (Northbound travelers will note the absence of an exit 19 and should take exit 20, one mile after exit 18.) From I-195 East, get off at Exit 1 (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 Technical University (NTU), Jurong. The NTU is situated in the south-western part, approximately 25 km from Singapore city center.

By Bus

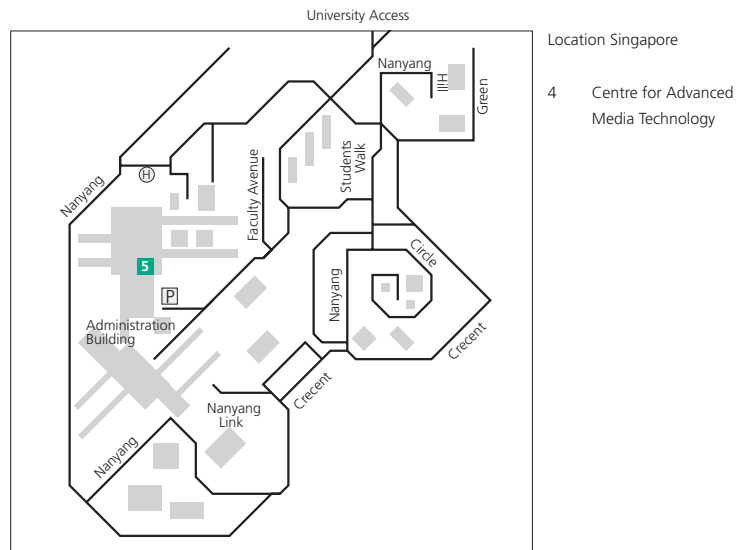
Take Bus 199 at Boon Lay Bus Interchange. Exit at the 3rd bus stop from the NTU entrance. Walk briskly for 5 minutes through Canteen A & across Carpark A (Keep to the right of Carpark A). Take Lift NS1-1 to the 5th floor. Use the intercom to request entry to CAMTech.

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.



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Germany

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according boxes and send or fax a
copy of this page to our Darmstadt
address. More information is also
provided on our Website.
<http://www.igd.fraunhofer.de>.

Areas of Interest

- Interactive Multimedia Appliances
- Industrial Applications
- Animation and Image
Communication
- Virtual and Augmented Reality
- Graphic Information Systems
- E-Learning & Knowledge
Management
- Cognitive Computing & Medical
Imaging
- Security Technology in Graphics
and Communication Systems
- Communication and Cooperation
(CSCW)
- Multimedia Communication
- Human Centered Interaction &
Technologies
- Mobile Multimedia Technologies
- Entertainment Technologies
- Context-Based Visualization
- Secure Distributed Technologies
- Human Media Technologies
- Applications Center for Computer
Graphics in Chemistry and
Pharmaceutics AGC

Periodica and Brochures

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- Virtual Reality Augmented Reality
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- Medical Technology and
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- Visualization and IT Concepts in
Chemistry and the Life Sciences
- IT-based Teaching and Training
- Tourism and Traffic
- Virtual Engineering
- Printing and Publishing
- Internet Life
- Edutainment
- Collaborative Visualisation
- Human-centered User Interface
Design
- further Information

Return Address

Last Name, First Name

Company

Position

Department

Address

ZIP Code/City

Telephone

Fax

E-Mail

Date/Signature

