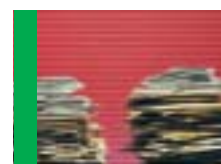
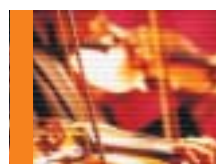
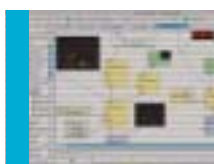
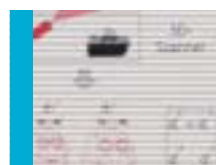
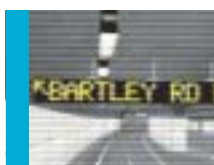
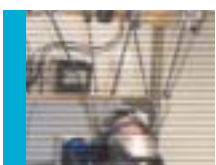
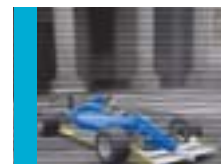
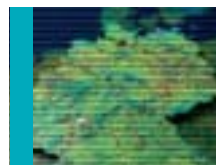




Fraunhofer Institut
Graphische
Datenverarbeitung

Achievements and Results Annual Report 2005



Achievements and Results

Annual Report 2005

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

Fraunhofer Institute for Computer
Graphics IGD is certified according to
DIN ISO 9001:2000





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



Dr.-Ing. Matthias Unbescheiden

A year of significant enhancements and changes has passed. These have not only affected the Fraunhofer IGD but also the surroundings of the institute which, of course, influence its development. Thus, the conceptual orientation, for instance, cannot be pushed independently of external developments. Vice versa, however, the IGD sets trends that decisively mould the changes in its own environment.

Just how closely the components are interwoven will also become clear from our short retrospective.

Technical Progress of the Fraunhofer IGD

Standstill is regression. Frequently cited, sometimes even strained, this statement is the driving force for the staff of research institutions. When scientific staff is concerned, the idea can be realized fairly easily in a Fraunhofer Institute that is a »geyser« for young scientists. Short-term contracts ensure a continuous change of employees accompanied by the amendment of the know-how of the departments with new ideas. In this scenario the person of the head of department is essential to guarantee the continuity within the department and an optimal service to the customers over time. After a time of changes during the last years the IGD has entered a more stable phase. Only one more head of department had to be substituted. Christoph Busch (head of the department of »Security Technology in Graphics and Communication Systems«) has accepted the appointment to the FH Darmstadt. Because of the relevance of the department for the institute the arrangement of the succession became a matter of particular importance. Alexander Nouak could be recruited as head of department. He covers the thematic background and brings along the necessary management capabilities as well. Additionally, a cooperation has been agreed

upon with Christoph Busch who will continue to accompany the standardization activities for the next years. This combination of expertise will be the basis for the further success of the department.

The Topics

The thematic re-orientation has been pushed in parallel to the staff changes. We have set up a laboratory for the upcoming topic of »Visual Analytics«. It will serve as a basis for further research in this area. Besides new fields, the existing competences have been strengthened again. The »EnterAction« laboratory in Rostock has been extended by the »Game Industry Technologies Labor« using strategic investment funds. Upgrading the core competence in the area of games the IGD boosts its leading role in this field within the Fraunhofer ICT group as well as the Fraunhofer Gesellschaft as a whole. It promotes the topic »Edutainment / Digital Games«, especially in the context of »Serious Games« meaning »gamelike« tools und interfaces for logistic field applications, planning, simulation and the like.

The successful positioning of the Fraunhofer IGD in seminal thematic key areas is shown again by the involvement in the elaboration of the »Fraunhofer Innovation Topics«. Whereas we significantly contribute to the topic of »Human Computer Interaction« under the leadership of the IAO, the IGD leads the moulding of the topic »Intelligent Products and Environments« together with the IIS and will as well push this area for the FhG in the future.

Commercialization

The research efforts of a Fraunhofer Institute, however, are only half the story. On the other hand it is equally

important to present the achieved results to the public and to bring them to the market.

The marketing has been built strategically on three main pillars. The participation in the relevant fairs and congresses is taken for granted. Secondly we have extended the series of portrayals of the eight business segments of the Fraunhofer IGD by several topic oriented brochures. The third measure is the continued event series of »Science meets Business«. Besides the internationally observed »GameDays« we have gained success organizing other events such as »Mobile Applications and Location-based Services« and »Visual Analytics - Opportunity for the Financial Sector«.

Many conversations with the industry accompanying these marketing activities focus on the question of protection of the results by patents. In order to assure the rights and marketing possibilities for the IGD, the application for patents is being promoted by the patents appointee. The application for nine patents in the last year proves the success of this measure.

In addition to the measures of the institute itself, key account negotiations have been started within the activities of the ICT Group for an amended exploitation of the potential of strategic co-operations with industry partners.

Quality of work

Above all considerations of new topics and marketing and the like, the customer always is our focus and with him the notion to ensure the high quality he expects from a Fraunhofer Institute and even to enhance it. For this purpose, we took some efforts to establish a comprehensive quality management for our institute last year. In doing so, we could build on the preparatory work and experiences of the department of »Industrial Applications«, certified according to DIN ISO 9001:2000 for several years.

What we achieved is a harmonization and in the long run simplification of internal processes accompanied by the assurance and enhancement of the quality of our research and development results. At the same time we wanted to document and visualize our quality management efforts to the public.

In December 2005, the audit by DQS GmbH, Deutsche Gesellschaft zur Zertifizierung von Managementsystemen, finally lead to the certificate according to DIN ISO 9000:2001.

The last year brought lots of developments and activities worth to be mentioned which can only be shortly scribed here. Nevertheless, our last thoughts are with the employees and the staff of the IGD who only make all this possible with their high personal engagement and who suffered a severe loss at the end of the year. Suddenly and unexpectedly Jürgen Schönhut, highly recognized by his colleagues, died. Jürgen Schönhut has accompanied and formed the setup of the IGD from the very beginning. Beside his profound knowledge, especially his human qualities and social qualification made Jürgen Schönhut extremely valuable for the IGD. All colleagues and we both will always keep Jürgen Schönhut in good remembrance.



José L. Encarnação

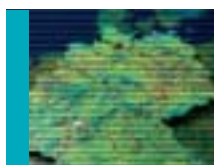
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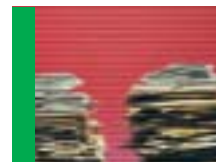
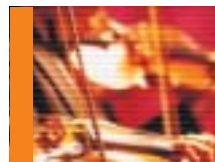
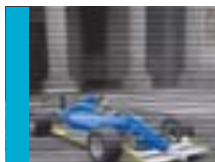
Dr.-Ing. Matthias Unbescheiden

Deputy Director

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The Institute in Profile



Computer Graphics

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

The fusion of computers, broadband telecommunication, and entertainment opens up a variety of new applications and services – in industry and business as well as in education, the arts, culture, leisure time, and in science. The basis for this innovative change of society is the continuously developing networking of the world. The digital future is coming into existence together with trendsetting technologies such as computer-supported visualization of data, information, and knowledge, with human-centered communication and interaction in intelligent IT environments, as well as with visual, multi-media based, and multimodal communication.

But despite all dynamics in the area of information and communication technologies, there is a real danger of a digital division of society into »I-literates« and »others«. One of the most important tasks in terms of a productive and balanced community is to enable also disadvantaged groups and minorities to participate in the digital future on an equal footing. Neither in the application of software systems nor in the utilization of hardware may the »digital divide« become reality.

The users of modern systems therefore increasingly expect qualified support in their »everyday computer life«. Computers and network infrastructures are going to be usable in a ubiquitous and human-centered (intuitive) way. They are going to be at the user's disposal in any desired location at any time - at home, when traveling, or in the office. At the same time, this increasing mobility requires new possibilities to request information and knowledge via the most diverse media. Tomorrow's IT world therefore also includes a new multimodal form of multimedia.

Within this context, society is currently part of a powerful economic restructuring and adaptation process and we are facing a major change as this unstoppable change requires innovations on all levels. Methods, technologies, and systems are necessary to transform the modern requirements into market-driven, usable products. Parallel test and analysis environments as well as their underlying infrastructures are necessary to guarantee this process. Only that way it is possible to develop applications and services that satisfy the requirements of the modern information and knowledge society while delivering a reasonable price/performance/benefit ratio. Tests and evaluation of their operability and usefulness have to be possible at a very early stage, i.e. already in the development phase (user participation).

In the digital world of tomorrow, new interfaces and forms of human/machine interaction or communication will come into existence that unite the manifold expectations with regard to these products and the various needs of their user groups. In this process, the computer has to be oriented towards the needs of the human, and not vice versa. Not only disadvantaged groups and minorities will be included that way, but the cornerstone for the central main idea will also be laid. IT is the new infrastructure and basic provisioning of a modern, human-centered society.

1. Computer Graphics is one of the most important components for this development towards a modern information and knowledge society.
We take part in the development of the IT future.
2. The IGD provides advanced technology for success on the market. This applied research in the area of Computer Graphics supports the innovation process of businesses as well as the development of society.
We do market-oriented research.
3. The IGD provides significant support for the strategic development of industry and economy with applied research, in particular for small and medium-sized businesses (service centers).
We offer services for all requirements, ranging from large-scale projects to standard products, and from industrial applications to private usage.
4. The IGD belongs, with regard to creativity and research performance, Europe- and world-wide to the leading institutions. The Fraunhofer IGD belongs to the »best in class«.
We do not need to fear our competitors.
5. The digital division of society shall be prevented by every means. The IGD research shall contribute to this process.
We develop systems that can be used by everyone.
6. As the employees of the IGD have excellent qualifications, projects and assignments can be carried out on schedule and in a reliable, professional, and technically accurate way.
We work in a motivated and customer oriented fashion.

7. Excellent research, development, and further education performance only result from contented and motivated employees as well as from a cooperative and trustful atmosphere.
We build on our employees' motivation and contentment.

These thoughts are incorporated in the guidelines that shall support all the employees of the Fraunhofer Institute for Computer Graphics IGD in their daily work.

Quality Management

Research in the Fraunhofer IGD is always oriented along the goals of the institute, the guidelines of Fraunhofer-Gesellschaft, as well as internal quality rules which are to guarantee a constant quality of our work, even growing whenever possible. Last year, all these guidelines have been harmonized and integrated in the »Qualitätsmanagement-Handbuch IGD«. We intensified our efforts to establish a comprehensive quality management for our institute. In doing so, we could build on the preparatory work and experiences of the department of »Industrial Applications«, certified according to DIN ISO 9001:2000 for several years.

What we achieved is a harmonization and in the long run simplification of internal processes accompanied by the assurance and enhancement of the quality of our research and development results. At the same time we wanted to document and visualize our quality management efforts to the public.

In December 2005, the audit by DQS GmbH, Deutsche Gesellschaft zur Zertifizierung von Managementsystemen, eventually lead to the certificate according to DIN ISO 9000:2001. It rates the »Implementation and maintenance of a quality management system for the execution of application oriented research and development projects and customer specific adaptations« at the Fraunhofer IGD.



The Fraunhofer Institut für Computer Graphics IGD is certified according to DIN ISO 9001:2000 by DQS GmbH, Deutsche Gesellschaft zur Zertifizierung von Managementsystemen.



Core Competencies

- 3D Interaction and Visualization
- Agent Technologies
- Animation
- Ambient Intelligence
- Augmented Reality
- Computer Supported Cooperative Work (CSCW)
- Geometric Modeling / CAD Model
- Graphical Information Systems (GIS)
- GUI / Interaction Technology
- Image Analysis, Image Quality
- Internet & Intranet Solutions
- I*net-based Learning and Training
- Medical Data / Image Processing
- Mobile Computing Technology
- Modeling and 3D Reconstruction
- Multimedia and Hypermedia
- Multimedia User Interfaces
- Perceptual Computing
- Product Data Management
- Radiosity & Raytracing
- Rendering
- Scientific Visualization
- Secure Image Communication
- Semantic Modeling
- System Integration
- Networking / Telecommunications
- Ubiquitous Computing / Pervasive Computing
- Usability and Utility Engineering Technologies & Methods
- Virtual Prototyping
- Virtual Reality
- Visualization & Simulation
- Visual Analytics
- Visual Computing

Application Areas

- eApplications
- eServices
- eBusiness
- IT for Medical Applications
- IT Security and IT for the security in our society
- Visualization and Interaction in traffic engineering and traffic telematics
- Ambient Intelligence
- Games and Edutainment
- Usability and Utility Engineering
- Software for the product and production development

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 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.

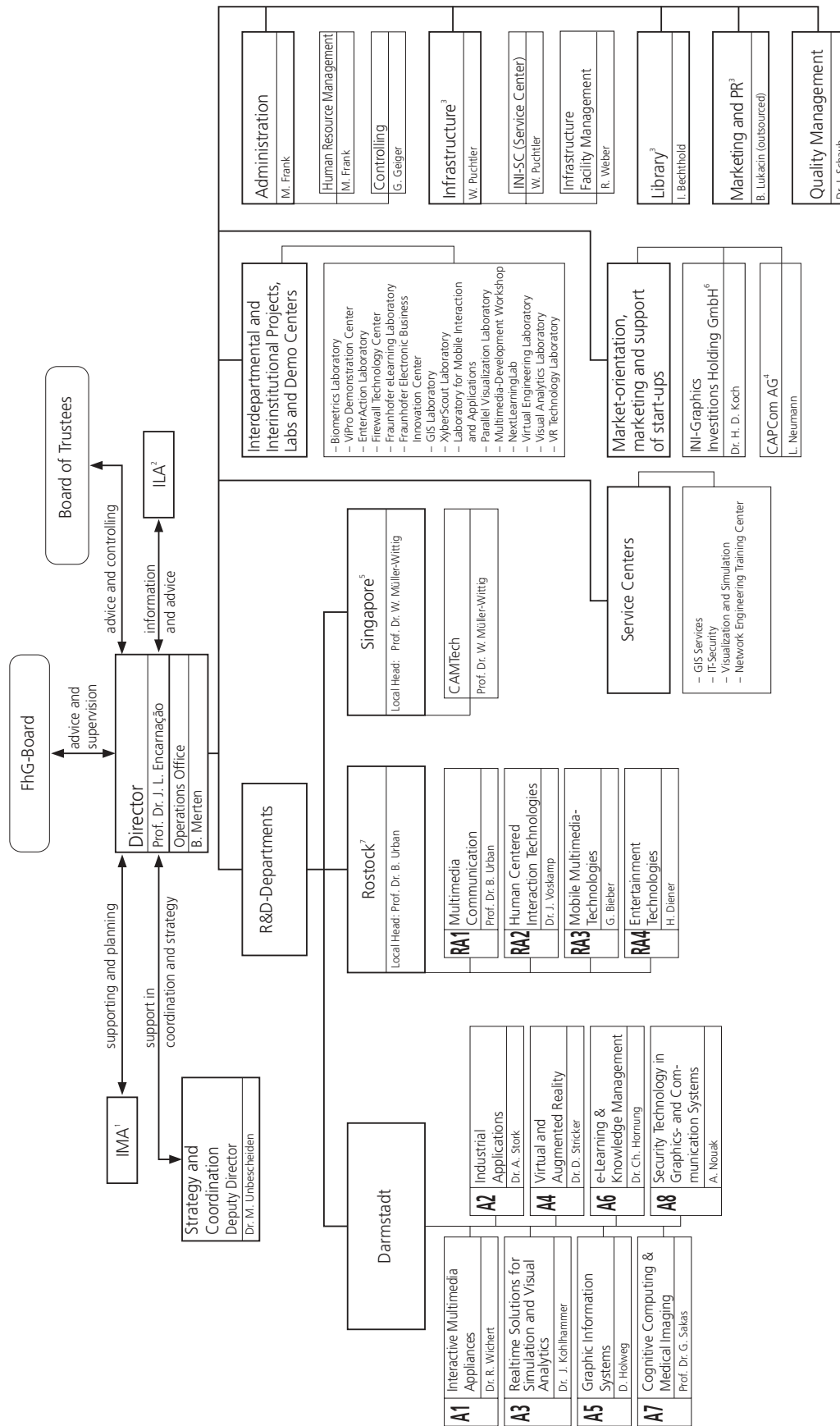
The spectrum of the work conducted by the Fraunhofer IGD involves application specific basic research (i.e. algorithmic and system concepts) as well as realization of prototypes of applications and systems (hardware and software) and their adaptation to specific needs of customers. The institute contributes through its R&D activities to establish Computer Graphics 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 L. Encarnação, who is also director of the ZGDV and holds the chair for Interactive Graphics Systems.

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IGD-ORGANIZATION



¹ Management Board of the Institute (Instituts Management Ausschuss)

² Steering Committee of the Institute (Instituts Lenkungs Ausschuss)

³ With TUD-GRIS and/or ZGDV

⁴ Independent AG of INI-GraphicsNet Foundation executive staff members

⁵ Non-profit corporation with Nanyang Technological University, Singapore

⁶ Independent GmbH of INI-GraphicsNet Foundation, T-Venture and executive staff members

⁷ IGD division Rostock

as of: February 2006

The Institute in Numbers

The personnel and financial development of the Fraunhofer IGD, its institute section in Rostock and its office in Singapore have further stabilized concerning the staff contingents and budgets. In total, 145 staff members were administered in Darmstadt, Rostock and Singapore, resulting in a cost-effective quota of 122 staff years.

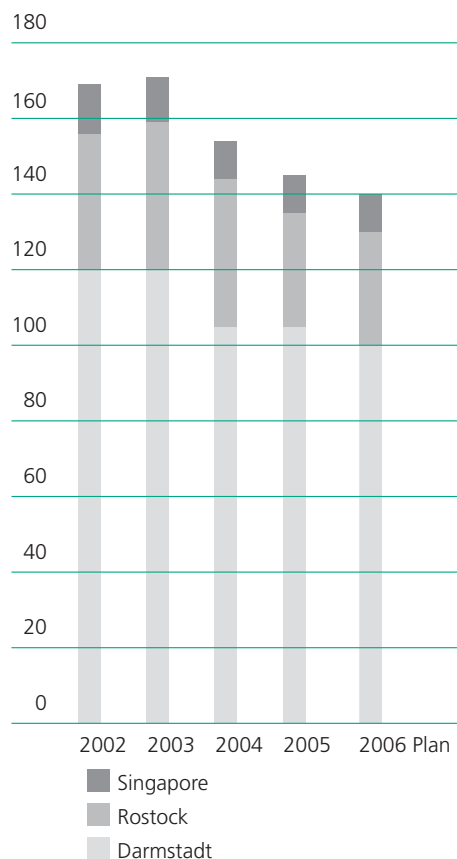
This performance of 122 staff years was rendered 68 per cent at IGD Darmstadt, 24 per cent at IGD Rostock and 8 per cent at Camtech, Singapore.

The charts below show the cost-effective capacity of the last year as well the planning for 2006.

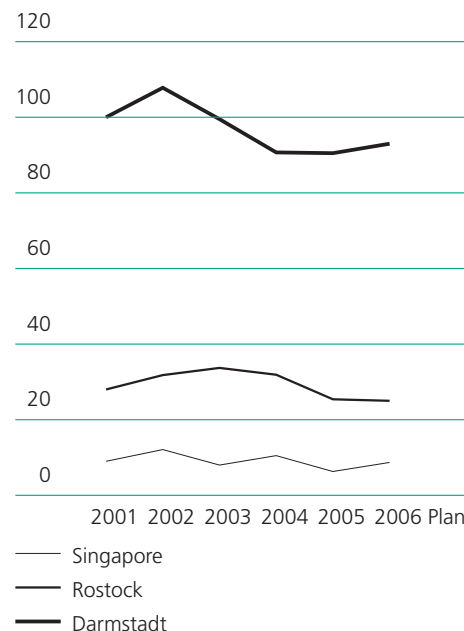
Including the employment of part-time staff (research assistants, student assistants, guest researchers, and trainees)

at the respective institutions, a total of 358 staff members were employed in 2005.

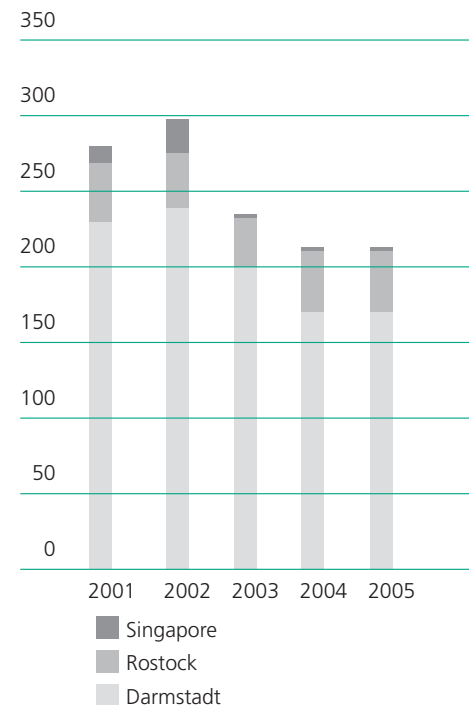
In 2005 the sum of the operating budgets amounts to 16.5 million euros. Out of that sum, about 77 per cent resulted from IGD Darmstadt, 17 per cent from IGD in Rostock and about 6 per cent from Camtech in Singapore. According to plan, the sum of the budgets in 2006 with 16.9 million euros should follow the stabilized economic basic condition.



Development of staff contingents at the Fraunhofer IGD locations.



Development of cost-effective capacity.



Development of part-time staff contingents at the Fraunhofer IGD locations.

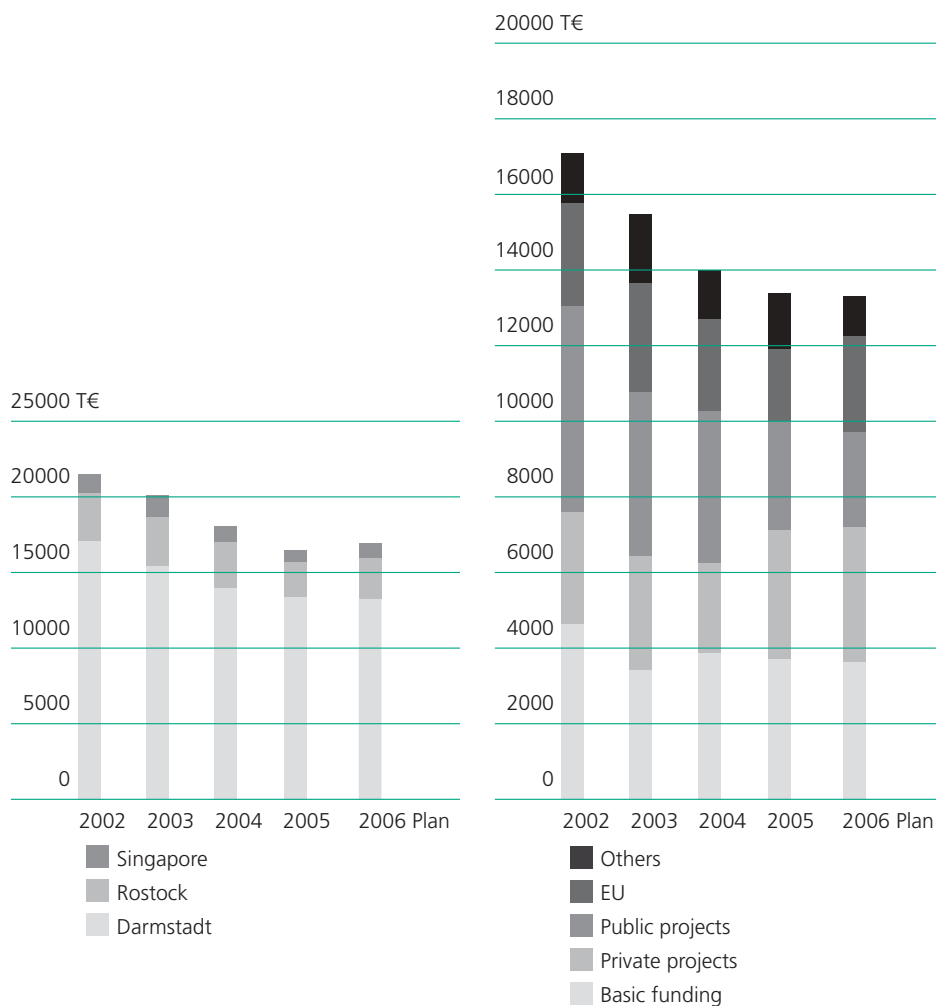


The budget of Fraunhofer IGD Darmstadt is financed 72 per cent by external revenue and 28 per cent by from basic funding of the Fraunhofer-Gesellschaft. The main part of external financing comes from national public projects with approximately 28 per cent of the budget. The industrial revenues amount to about 26 per cent last year, the revenues from EC-projects add up to approximately 14 per cent. These relations reflect a growing

increase in the industrial sector on one hand, the continuing high participation in EC-projects on the other hand.

The development at IGD-Rostock reflects the difficult economic situation in Mecklenburg-Vorpommern. The operating budget reduces compared to 2004 to 2.3 million euros caused by the reduced personnel. The share of the staff contingent in the budget of 2005 amounts to about 61 per cent. On the financial side, the share of

basic funding in the budget totals about 18 per cent. The share of public revenues remains at 42 per cent. The share of industrial revenues could increase to about 28 per cent. The revenues coming from EC-projects remain at 4 per cent.



Total budget development at the Fraunhofer IGD locations.

Financing structure of the Fraunhofer IGD Darmstadt.

Financing structure of the Fraunhofer IGD Rostock.

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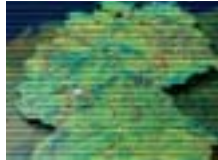
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The Fraunhofer-Gesellschaft at a Glance



The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprises and of wide benefit to society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration. The organization also accepts commissions and funding from German federal and *Länder* ministries and government departments to participate in future-oriented research projects with the aim of finding innovative solutions to issues concerning the industrial economy and society in general.

By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. Through their work, they aim to promote the successful economic development of our industrial society, with particular regard for social welfare and environmental compatibility.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, in other scientific domains, in industry and in society.

At present, the Fraunhofer-Gesellschaft maintains some 80 research units, including 58 Fraunhofer Institutes, at different locations in Germany. The majority of the

roughly 12,500 staff are qualified scientists and engineers, who work with an annual research budget of over 1 billion euros. Of this sum, more than 900 million euros is generated through contract research. Roughly two thirds of the Fraunhofer-Gesellschaft's 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, partly 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.

Affiliated research centers and representative offices in Europe, the USA and Asia provide contact with the regions of greatest importance to present and future scientific progress and economic development.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognized non-profit organization. Its members include well-known companies and private patrons who help to shape the Fraunhofer-Gesellschaft's research policy and strategic development.

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

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Fraunhofer ICT Group



Fraunhofer ICT Group

Shaping the Digital Change

The mobile office in the middle of a sand dune, a relaxed chat while driving the car, or a shopping spree from the comfort of your bathtub - the habits of our daily lives and work are changing at such breath-taking speed. On the one hand, information and communication technologies are the main cause of these dramatic changes, but at the same time, they are also indispensable tools for bringing society and commerce into line with ever-changing conditions. To remain internationally competitive, companies have to keep up with the latest technological breakthroughs. And this is precisely where the Fraunhofer Information and Communication Technology Group (ICT) comes into its own: it picks up important trends, which are then converted into marketable products and services in the form of mission-oriented research.

Combining Strengths, Using Synergies

As Europe's largest combined research unit for information and communication technology (ICT), the Fraunhofer ICT Group is the starting point for clients from industry and the media who are looking for the right contacts. The strengths of our 17 member institutes are combined and marketed jointly. This networking makes well-aimed, integrated solutions possible from application-oriented research for each specific area of industry: tailor-made IT solutions, expert advice on technology, and prospective research for new products and services. Regular business summits bring the right partners from industry and research round the table.

One Common Strategy

The ICT Group develops strategies and visions for medium-term research projects. Member institutes are supported in technology transfer and the marketing of research. As a result of international research programmes, our institutes have links with companies and scientific institutions throughout the world.

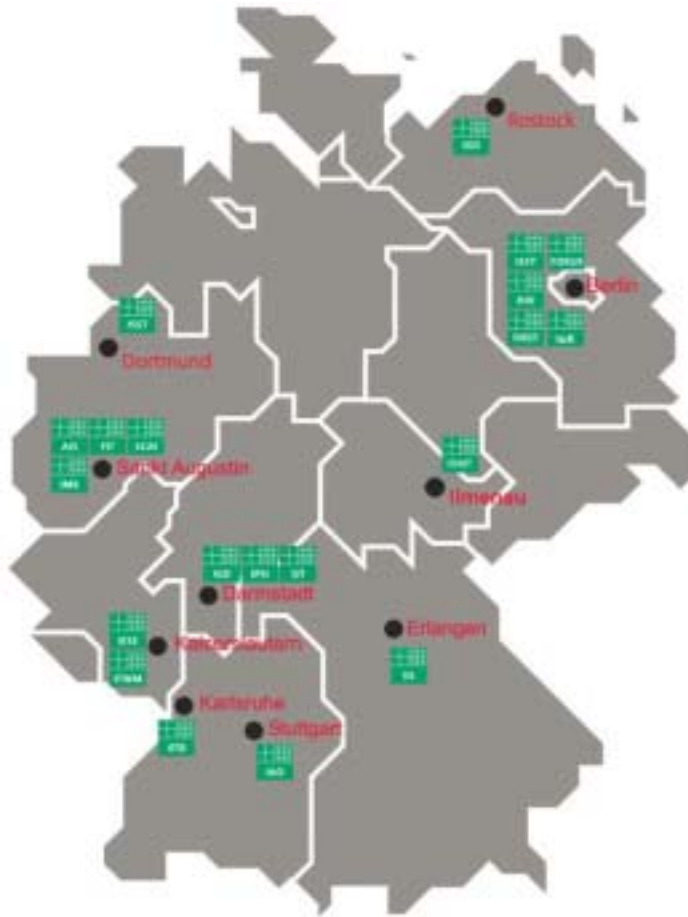
Broad Spectrum of Technologies

Employing a total of nearly 3,000 people at its 17 institutes and with an annual budget of approximately 176 million euros, the ICT Group is Europe's largest research association. The technologies in its ten business areas thus also cover the whole value chain:

- eBusiness
- eGovernment
- Medicine and Life Sciences
- Traffic, Transport, and Mobility
- Production
- Digital Media
- Security
- Culture and Entertainment
- Software
- Communication Systems and Interdisciplinary Applications

Comprehensive Media Portal

Press releases and announcements from the 17 member institutes can be found in our Media Portal. The material can be looked up by either category or full-text search. Graphical material can be found in our large archive.



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INI-GraphicsNet





INI-GraphicsNet Stiftung

Only six years after its establishment, the INI-GraphicsNet Stiftung represents an important institution for the promotion of synergistic work in the field of Computer Graphics and has already consolidated its role as a framework in promoting the synergy of tasks among INI-GraphicsNet member institutes. In 1999, upon establishment the Stiftung's endowment amounted to approximately €190,000. In the meantime, this has substantially increased over the years and currently exceeds €2 million.

These were the growing reasons which have led to the realization of a new and independent office building for the Stiftung. Construction for the 4-storey office building at Rundeturmstrasse in Darmstadt began in summer 2004. This was followed by the »Richtfest« in June 2005, and finally in April 2006, the Stiftung was able to move into its new home.

This has effectively resulted in the increasing importance of the Stiftung's spin-off support activities. With the dynamic development and expansion of the services it provides, the Stiftung has been able to effectively meet the growing global demands of the INI-GraphicsNet.

The INI-GraphicsNet Stiftung has grown rapidly and its supporting programs have helped to realize a great number of current project ideas. The funding activities carried out by the INI-GraphicsNet Stiftung foster syner-

gies within the Network and the outside as a representative for Computer Graphics, encouraging the consideration and development of new competences, the opening of new markets, as well as the further development of junior scientists through the scholarships granted. With these activities, the Stiftung supports the aims of its network members, particularly regarding innovation and new research topics, to the commercialization of results on the market, simultaneously using and strengthening synergies within the network.

The year 2005 was one of the most successful in the history of the INI-GraphicsNet Stiftung. The achievement of planned objectives has contributed to the increasing national and international renown of the Stiftung. Cooperation with the Patent agency in Mecklenburg-Vorpommern and network partners in the EXIST transfer project »GruenderFLAIR« funded by



Top: »Richtfest« celebrations held in June 2005

Left: Construction of the INI-GraphicsNet Stiftung Building

the German Ministry of Science was completed successfully before the project due date.

These activities are carried out continuously with concerted actions which support the establishment of Hi-Tech Start-ups directly out of universities and research institutes in Mecklenburg-Vorpommern. The INI-GraphicsNet Stiftung has contributed towards the »Wissenschaftsstiftung MV Mecklenburg-Vorpommern GmbH« founded in September 2005, provided essential support towards the success of the »Baltic Forum for Innovation and Entrepreneurship« in April 2005, and held managing responsibility for the idea contest »Computer Graphics 2005« in Rostock.

In Greece and Cyprus, cooperation efforts for supporting the establishment of young enterprises continued together with local incubators and departments of different ministries. Furthermore, the INI-GraphicsNet Stiftung maintains its support for several projects at the University of Porto which involves all departments of the university with the introduction of its self-developed »Integrated Commercialisation Process« in Portugal.

All these activities within the Spin-Off support program have led to sustainable successes in the establishment of young, technology-oriented enterprises, both nationally as well as internationally. In 2005, among the many companies founded, the Spanish company Vilaumedia was established with the focus to strengthen future licensing activities of the INI-Graphics-Net Stiftung especially for the Spanish and Portuguese market.

In Germany, in cooperation with the INI-Novation GmbH, the INI-Graphics-Net Stiftung has become an accredited coach in the High-Tech Gründer-



Organization of the contest »Ideas in Computer Graphics 2005« in Rostock



Signing the contract on cooperation with the Finnish commercialization network Hermia Business Development, Tampere, Finland.

fonds. In addition, the INI-GraphicsNet Stiftung successfully accompanied the ordering of funded projects within the EXIST-SEED program, and takes care of its coaching activities and the entrepreneurial qualification.

The INI-GraphicsNet Stiftung was able to follow general globalization trends in all funding areas through the work it carries out. In the eGOIA project (Electronic Government Information and Access) funded by the EU, the INI-GraphicsNet Stiftung still provides support regarding economic questions concerning the dissemination and exploitation of the project results. In 2005, cooperation contracts were closed with the internationally active private equity investor Entre International situated in London, and the Finnish commercialization network of Hermia Business Development, Tampere, Finland. The purpose of these agreements focuses on the internationalization of commercialization activities.

Special attention will be dedicated to these developments through the course of this year, and the importance of the Stiftung will continue to mount steadily. In this respect, we will also be engaged in the successful realization of future tasks within the INI-GraphicsNet.

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Fraunhofer Institute for
Computer Graphics IGD,
Darmstadt





Fraunhofer Institute for Computer Graphics IGD Darmstadt

The Fraunhofer Institute for Computer Graphics IGD was formed in 1992 from the Workgroup for Computer Graphics Darmstadt AGD, which was founded by the Fraunhofer-Gesellschaft in 1987. Since its foundation the Fraunhofer IGD cooperates closely with the Technische Universität Darmstadt and the Computer Graphics Center (ZGDV), which was founded in 1984. The number of employees has increased and the expertise spectrum continuously expanded.

Besides the expansion of the institute in Darmstadt, a new external division was opened in 1992. The founding of the Centre for Advanced Media Technology CAMTech in Singapore ensures the representation on the important markets in Asia.

All these institutions of the Fraunhofer IGD collaborate closely and cover the complete spectrum from basic research, applied research and application development, up to the production and marketing of products. The spectrum of the work conducted by the Fraunhofer IGD involves application specific basic research (i.e. algorithmic and system concepts) as well as realization of prototypes of applications and systems (hard- and software) and their adaptation to the specific needs of customers.

The Fraunhofer IGD Darmstadt employs more than 100 members of staff in eight areas of operation, who are supported by approx. 250 research fellows. More than 8000 sqm of offices and labs can be used to process the research tasks.

The Fraunhofer IGD Darmstadt is structured as follows:

- *Interactive Multimedia Appliances* focusing on developing technologies for the establishment of coherently-acting appliance ensembles,
- *Industrial Applications* with main focus on the realization of the Virtual Engineering concept,
- *Realtime Solutions for Simulation and Visual Analytics* with main focus on simulation and rendering in real-time, adaptive 3D data transmission and visualization and interactive visualization of large amounts of multi-dimensional data,
- *Visualization and Virtual Reality* with main focus on Scientific Visualization, Virtual Reality, and Augmented Reality,
- *Graphical Information Systems* with main focus on Facility Management and spatial information systems,
- *eLearning and Knowledge Management* with main focus on system design, system architectures, development of components and consulting in the application areas multimedia learning and training, simulation and validation, information brokering and interactive teleservices,
- *Cognitive Computing and Medical Imaging* with main focus on Visual Computing, Medical Imaging, and Multimedia Interfaces,
- *Security Technology for Graphics and Communication Systems* with main focus on the realization of security services.

With these eight research departments the Fraunhofer Institute for Computer Graphics is committed to the challenges arising from the use of computers privately, in industry, commerce, in 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 single departments.

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Fraunhofer Institute for
Computer Graphics IGD,
Rostock





Fraunhofer Institute for Computer Graphics IGD Rostock

On January 1, 1992 the Fraunhofer Institute for Computer Graphics Rostock was founded as an external branch of the Fraunhofer IGD Darmstadt. It was one of 19 new institutions established in the Eastern German Länder as a result of the expansion of the activities of the Fraunhofer-Gesellschaft after Germany's reunification. Today, the Fraunhofer IGD Rostock is a self-contained division of Fraunhofer IGD, with 31 staff members, more than 45 part time students and a budget of 2.3 million euros.

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

- *Multimedia Communication* with the two groups »eLearning Technologies and Applications« and »Intelligent Personalized Services«. The eLearning group focuses on innovative learning environments (LMS, Portals, Advisory System, Topic Maps), process models for eLearning, modularization of eLearning content, personalization and user modelling as well as production lines for educational content. The group »Intelligent Personalized Services« focuses on Internet

based services, profiling and personalization, agents and assistance as well as intelligent form services.

- *Human Centered Interaction Technologies* with main focus on modern interaction technologies including innovative interaction techniques for design of application specific multimodal user interfaces by using for example Virtual Reality interaction technologies and biosensors for optimization of the communication between human user and computer, user tracking and user behaviour analysis.
- *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 emphasis lays on the realization of situation controlled mobile assistance and mobile Ambient Intelligence. This approach allows – based on flexible situation and task modelling 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 and to support users for learning and working as well as 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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Prof. Dr.-Ing. Bodo Urban

Centre for Advanced Media Technology
CAMTech, Singapore





Centre for Advanced Media Technology CAMTech, Singapore

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 markets and will work with INI-GraphicsNet on international projects.

The director of CAMTech is 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 competency 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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Customers and Cooperation Partners



Customers and Cooperation Partners (a selection)

- sem engineering methods ag
- [rmh] New Media GmbH
- 3D Computergraphik
- 3Dims GmbH
- 3N Mobile GmbH
- A.C.T. Kern GmbH & Co. KG
- ABB Corporate Research
- ACIT GmbH
- acp – advanced clean production, Information Technology AG
- AD Solutions srl, Turin
- Adam Opel AG
- Advanced Realtime Tracking GmbH
- Aesculap AG & Co. KG
- AICM Agentur für Internet Communication und Medien
- Airbus Deutschland GmbH
- Alcatel SEL
- Alessi spa, Italy
- ALFAMICRO, Sistemas de Computadores, Lda., Portugal
- Allianz Versicherungs-AG
- Altair Engineering GmbH
- Anglo-Chinese School Singapore
- ANOVA Multimedia Studios GmbH
- Arbeitsgemeinschaft industrieller Forschungsvereinigungen »Otto von Guericke« e.V.
- Arca, Italy
- ARCADIS ASAL Ingenieure GmbH
- AR-Tracking GmbH
- ask
- Assyst – Gesellschaft für Automatisierung, Software und Systeme mbH
- assyst bullmer GmbH
- ATB – Advanced Technologies in Business Ltd, Great Britain
- Athens Technology Center S.A., Greece
- Audi AG
- AutoForm Engineering GmbH, Switzerland
- BARCO
- BarskiDesign
- BBC
- Bekleidungsphysiologisches Institut Hohenstein e.V.
- Bertrandt AG
- Berufsbildungs- und Technologiezentrum des Handwerks Lingen
- Berufsbildungszentrum Iserlohn der Kreishandwerkerschaft Märkischer Kreis
- BITKOM – Bundesverband Informationsswirtschaft, Telekommunikation und neue Medien
- B-K Medical, Danmark
- BKA – Bundeskriminalamt
- BMW AG, München
- Bosch Sortotec
- Bouresly Medical Services Co., Kuwait
- BSI – Bundesamt für Sicherheit in der Informationstechnik
- Bundesanstalt für Arbeitsschutz + Arbeitsmedizin
- Bundesforschungsanstalt für Fischerei, Institut für Ostseefischerei
- Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie (BMBF)
- Bundesministerium für Wirtschaft und Arbeit (BMWA)
- Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
- Bundesministeriums für Wirtschaft und Technologie (BMW)
- CADFEM GmbH
- CADpartner GmbH, Schwerin
- Canamet Inc., Canada
- CAPAROL Farben Lacke Bautenschutz GmbH & Co. Vertriebs KG
- CAPCom AG
- Carl Schenck AG
- Carl Zeiss AG
- CAS Software AG
- CAST e.V. – Competence Center for Applied Security Technology
- Castello di Belgioioso, Italy
- CBT+L, Herrsching
- Cefriel, Italy
- Centre National de la Recherche Scientifique, France
- Centro de Computação Gráfica (CCG), Coimbra, Portugal
- CERN – European Organization for Nuclear Research
- CETA RS, Brasil
- CeWe Color Holding AG
- Channel News Asia, Singapore
- Charamel GmbH
- Christie Digital Systems Singapore
- CIM Technologiezentrum, Wismar
- CIP4 – International Cooperation for the Integration of Processes in Prepress, Press and Postpress
- CiS GmbH
- CoCreate Software GmbH & Co. KG
- Cognitec Systems GmbH
- ComLogic Frankfurt Systems GmbH
- Comverse, Israel
- Conante Advanced Interface Solutions GmbH
- Consiglio Nazionale delle Ricerche (CNR), IMATI Italy
- COWI Consulting Engineers and Planners AS, Danmark
- Cross Czech, Prag
- Cryptolog International SAS, France
- Cryptovision
- CS Systèmes d'Information, France
- CSTB, France
- Cyprus State Fairs Authority, Cyprus
- DAI Labor, Berlin
- DaimlerChrysler AG
- Danet GmbH
- Daresbury Laboratory CLRC, Great Britain
- Darmstädter Echo, Verlag und Druckerei GmbH
- DeguDent GmbH
- Delphi Automotive Systems Deutschland GmbH
- Desenvolvimento, Lisbon, Portugal
- DESY – Deutsches Elektronen-Synchrotron
- Deutsche Bahn AG
- Deutsche Börse Systems AG
- Deutsche Forschungsgemeinschaft (DFG)
- Deutsche Messe AG, Mainz
- Deutsche Telekom AG, Zentralbereich Innovation
- Deutsches Diabetes-Zentrum
- Deutsches Krebsforschungszentrum (DKFZ)
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)

- DFKI – Deutsches Forschungszentrum für Künstliche Intelligenz
- Dimedis GmbH
- DIN Deutsches Institut für Normung, Berlin
- DLR Projektträger, Berlin
- Dolmar GmbH
- Dr. Frankenstein Computersysteme GmbH
- Dr. Schlage & Co. OHG, Hamburg
- Dresdner Bank AG
- DVZ – Datenverarbeitungszentrum Mecklenburg-Vorpommern, Schwerin
- DZI – Darmstädter Zentrum für IT-Sicherheit
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- EADS Corporate Research Center France, France
- EADS Deutschland GmbH
- ECS GmbH
- EDAG
- Edizone GmbH
- eHoltel AG
- EIKI Deutschland GmbH
- ÉLASIS S.C.p.A., Italy
- ELETTRA Synchrotron Radiation Source, Italy
- eLOKI Limited
- El-Op Electro-Optics Industries Ltd., Israel
- empolis GmbH
- Envitec GmbH, Wismar
- EON Reality, Inc.
- EPFL – Geodetic Engineering Lab, Switzerland
- Ericsson
- ESA/ESOC
- Esaote Bracco Information Technology Sanita, Italy
- EST – Engineering Systems Technologies
- Euratex, Brussels
- Euro Partners, The Netherlands
- Europäische Kommission
- European Media Laboratory GmbH
- European Microsoft Innovation Center
- European Surgical Institute
- Euroscope Automaten Winkels GmbH & Co. KG
- Eutelsat, France
- Exitech, Italy
- Fiat Auto, Italy
- fleXilution GmbH
- FlexSecure
- Flughafen Frankfurt
- Ford-Werke AG
- Forschungsinstitut Technologie-Behindertenhilfe der Evangelischen Stiftung Volmarstein
- Forschungsverbund Mecklenburg-Vorpommern e.V. (FMV)
- France Telecom SA
- Fraport – Frankfurt Airport Services
- Friderico Franciscum Gymnasium, Bad-Doberan
- FTB Forschungsinstitut Technologie-Behindertenhilfe der ev. Stiftung Volmarstein, Wetter/Ruhr
- FZI Forschungszentrum Informatik
- GEA Happel Klimatechnik Produktions- und Servicegesellschaft mbH
- GECKO Gesellschaft für Computer- und Kommunikationssysteme mbH, Rostock
- GeCo Business Consulting, Italy
- Gemluc SA, France
- Genias Graphics GmbH
- Genius Venture Capital GmbH
- GeometryFactory Sarl, France
- Gesamtverband der Deutschen Versicherungswirtschaft e.V.
- Gesellschaft für Informatik (GI)
- Gesellschaft für Medizintechnik (GFM)
- Giotto Technologies
- GISIG-Geographical Information Systems, Italy
- GIStec GmbH
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- GNS Systems GmbH
- GraphiTech, Villazzano (Trento), Italy
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- Hessische Zentrale für Datenverarbeitung
- Hessischer Rundfunk / hr3
- Hessisches Landesamt für Bodenmanagement und Geoinformation
- Hessisches Ministerium für Wirtschaft Verkehr und Landesentwicklung
- Hessisches Ministerium für Wissenschaft und Kunst
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- Hitachi Medical Systems, Japan
- Hitech, Greece
- Howaldtswerke-Deutsche Werft GmbH
- Human Interface Technology Lab New Zealand (HitLabNZ), Christchurch, New Zealand
- HumanScan GmbH, Erlangen
- Hy-Sportgeräte GmbH
- Hyundai KIA Motors, Korea
- IBM Deutschland GmbH
- ICEM Technologies GmbH
- ICIDO GmbH
- IG Metall
- IHK Rostock
- IHK Schwerin
- Ikerlan, Spain
- imedia
- IMG GmbH
- IM-Innovations Pte Ltd
- ImpactXoft Europa, Italy
- Index Werke Hahn & Tessky
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- INFITEC
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- INI-Navation GmbH
- inno AG, Karlsruhe
- InnoTech Ingenieurbüro GmbH, Neubrandenburg
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- INRIA-LORIA, France



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- Institut für Kommunikationstechnik, Switzerland
- Institut für neue Lehr- und Lernmethoden VIRTUS
- Institut Image / ENSAM, France
- Institut National de Recherche en Informatique et Automatique (INRIA), France
- Institute for Infocomm Research Singapore
- Institute for Information Technology, Hanoi, Vietnam
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- MEIKO Maschinenbau GmbH & Co. KG
- Merck KGaA
- Messe Düsseldorf GmbH
- Messe Frankfurt GmbH
- Messe München GmbH
- metaio. Augmented Solutions GmbH
- Meticube, Ltd., Coimbra, Portugal
- mica – music information center austria
- Microsoft Deutschland
- Mimundo TV
- Ministry of Manpower Singapore
- Minusplus Architects, Budapest
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- Moscow Engineering Physics Institute
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- Motorola Limited
- Multiple Image Tools GmbH, Rostock
- MVweb GmbH & Co. KG, Schwerin
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- NEC Deutschland
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- Netlab GmbH
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- NOKIA Corporation, Finland
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- Ogilvy Interactive, Greece
- OKTAL, France
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- opsira GmbH
- OTLO VR Systeme GmbH, Rostock
- Oy Arbonaut, Finland
- Page & Park Architects, Great Britain
- Palm Germany GmbH
- ParaRede Information Communication Technology, Lisbon, Portugal
- Paregos, Stockholm
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- plan_b Media AG
- Planet internet commerce GmbH, Schwerin
- Polydimensions
- PRO Management GmbH, Essen
- Propad Mobile Computing GmbH
- ProSTEP iViP Verein
- ProSTEP GmbH

- R+W Antriebselemente GmbH
 - Regierungspräsidium Darmstadt
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 - Symah Vision
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 - TBI Technologie-Beratungs-Institut GmbH
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 - T-Systems International GmbH
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 - UGS PLM Solutions, Uni-graphics Solutions GmbH
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 - USD AG
 - VDO
 - Verband Deutscher Maschinen- & Anlagenbau e.V. (VDMA)
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 - visionapp GmbH
 - Visual Space, Portugal
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 - ZDK (Zentralverband des Deutschen Kraftfahrzeuggewerbes)
 - zeitform Internet Dienste OHG
 - Zeitreisen Erlebnisagentur
 - Zenon SA, Athens, Greece
 - Zentrum für Graphische Datenverarbeitung e.V. (ZGDV)
 - ZF Friedrichshafen AG
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- Fraunhofer-Anwenderzentrum Großstrukturen in der Produktionstechnik AGP, Rostock
 - Fraunhofer-Einrichtung für Systeme der Kommunikationstechnik ESK, München
 - Fraunhofer-Institut für Algorithmen und Wissenschaftliches Rechnen SCAI, Sankt Augustin
 - Fraunhofer-Institut für Angewandte Informationstechnik FIT, Schloss Birlinghoven, Sankt Augustin
 - Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF, Jena
 - Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO, Stuttgart
 - Fraunhofer-Institut für Autonome Intelligente Systeme AIS, Schloss Birlinghoven, Sankt Augustin
 - Fraunhofer-Institut für Betriebsfestigkeit LBF, Darmstadt
 - Fraunhofer-Institut für Biomedizinische Technik IBMT, St. Ingbert



- Fraunhofer-Institut für Experimentelles Software Engineering IESE, Kaiserlautern
- Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF, Magdeburg
- Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung IFAM, Bremen
- Fraunhofer-Institut für Integrierte Publikations- und Informationssysteme IPSI, Darmstadt
- Fraunhofer-Institut für Integrierte Schaltungen IIS, Außenstelle Entwurfs-automatisierung, Dresden
- Fraunhofer-Institut für Integrierte Schaltungen IIS, Erlangen
- Fraunhofer-Institut für Keramische Technologien und Sinterwerkstoffe IKTS, Dresden
- Fraunhofer-Institut für Materialfluss und Logistik IML, Dortmund
- Fraunhofer-Institut für Medienkommunikation IMK, Schloss Birlinghoven, Sankt Augustin
- Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme IMS, Dresden
- Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI, Berlin
- Fraunhofer-Institut für Offene Kommunikationssysteme FOKUS, Berlin
- Fraunhofer-Institut für Produktionsanlagen und Konstruktionstechnik IPK, Berlin
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- Hochschule für Gestaltung
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- Hochschule Zittau/Görlitz
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- HUT Technische Universität Helsinki, Finland
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- Kungl Tekniska Högskolan (Königlich Technische Hochschule) Stockholm
- Linköping University, Sweden
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- Università Degli Studi Di Salerno, Italy

Project cooperation with the following Universities and Colleges

- Aarhus Universität, Danmark
- Aristotle University of Thessaloniki, Greece
- CENS-CMA, Tallinn University of Technology, Estonia
- Chalmers University of Technology, Sweden

- Università Degli Studi Di Trento, Italy
- Universität Bergen, Norway
- Universität Bonn
- Universität Bremen (BIBA)
- Universität des Saarlandes
- Universität Dortmund
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- University of Florence, Italy
- University of Leeds, Great Britain
- University of Otago, New Zealand
- University of Reading, Great Britain
- University of Tampere, Finland
- Utrecht University, The Netherlands
- Weiterbildungs-gesellschaft an der Universität Rostock e. V.



Applications





Applications

Software for Product and Production Development

Applications

Software for Product and Production Development

Especially in these times of transition from an industrial society to an information and service society the product development domain has considerably gained in economic relevance. The striving for better and better products in shorter and shorter development cycles has become the mainspring for the development of software supporting the product and production development. In spite of the fact that the supporting software has gained ground in the market during the last few years, the area of product and production development is still getting more and more strategic importance in current research work.



Interview with Dr. André Stork

Dr. Stork, you are head of the department »Industrial Applications«, the leading department of the business field »Software for the product and production development« of Fraunhofer IGD. What exactly does this business segment deal with?

Dr. Stork: Our business area is mainly focusing on computer-based product development, i.e. Computer Aided Design (CAD) and Computer Aided Engineering (CAE). Among the most important tasks are the visualization, data management, information and knowledge management, as well as all fields of construction analysis and simulation. We develop software and thus tools to support these tasks of product development as successfully as possible.

Which is the motivation at the bottom of developing software for product development?

Dr. Stork: Here as anywhere else the same applies: quicker, better, cheaper. Due to the decreasing life cycles the development of products shall become faster and the production cheaper. The sooner the product tests and analyses are finished, the fewer resources are needed, the cheaper the production. Another important aspect is the product quality, which we seek to improve with our software.

Where is your software used today? Which application areas can you imagine for the future?

Dr. Stork: The application areas of our developments include the end users using this software for product development, and the software providers distributing our software to the end users. Main industrial sector is the automotive industry and their subcontractors. Currently we are working a lot in the field of construction and architecture. We shall continue to supply all product developers with the tools for an efficient product development. New application areas could also be found with the oil and gas industry.

Which is the target group of the business field?

Dr. Stork: The target group of the business field principally includes all product developers working with development software, e.g. industrial design, automobile design, and many other engineering and simulation disciplines like crash simulation or aerodynamics simulation in the aerospace industry.



Dr. André Stork

What is the significance of product and production development for research and development activities?

Dr. Stork: The capital of a company is their product. Accordingly the product development is the source of all applied research and is the company's business field showing the highest research cost. Much money is invested for improving the product, both the hardware and the software research being important for the product development.

Which is the potential you see for the business field? Which direction will it head for?

Dr. Stork: Things are always produced everywhere. This will remain unchanged. Therefore, our business area is seminal and expandable. In the future, our research shall increasingly address the domains of electronics. The business field will gravitate into a multidisciplinary co-operation of electronics, software development, and mechanics. Here also computer graphics will increasingly gain in importance. The software must be able to deliver a better and precise representation of the object and allow different simulations. A nearly perfect realism as to look and functional behavior of the product is required for simulations and tests, and this is exactly what our research work aims at.

Dr. Stork, many thanks for the interview.

Applications

Software for Product and Production Development

Artesas

The goal of the ARTESAS project is to develop technologies for the industrial deployment of Augmented Reality in the application domains development, production and service. It is funded by the German Ministry for Research and Education BMBF. To succeed, we pursue a comprehensive approach covering software and hardware aspects.

The emphases on software are the development of robust, feature-based tracking methods for real-time use. Such technology is needed for blending context-sensitive, in-correct positional arrangement information into the field of view of the user. While the previous project ARVIKA relied on artificial markers in the real environment, this brand new type of algorithms detects and recognizes features of the real world and estimates position and orientation of the user. The emphases on hardware are towards mobility and display systems.

Fraunhofer IGD is responsible for the development of feature-based, real-time tracking algorithms, which are suitable for initialization (get first valid tracking result), re-initialization (get a valid result after tracking failed, because no feature could be detected) and the actual tracking phase. One of the core algorithms is a line-based tracking method. Based on a 3D edge model of the real environment, the algorithm tries to find the edges of the model in the images delivered by the camera. In case the algorithm finds a match, it can calculate the position and orientation of the camera. Furthermore IGD develops a framework where different tracking technologies can be integrated and interlinked. It also offers the possibility to include an inertial sensor to improve tracking

results. The application itself will be based on the well-known ARVIKA AR Browser technology.

After deployment of the software prototype, end-users like EADS, Siemens and BMW will evaluate the technology in real-world test scenarios.

Contact

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The real view into the engine bay



Virtual objects in correct positional arrangement seamlessly blended into the view



IMPROVE - Improving Display and Rendering Technology for Virtual Environments

Advanced applications in automotive and architectural domains such as collaborative design review and Augmented Reality sketching require advances in the following fields:

- lightweight stereoscopic transparent HMDs
- calibration techniques for high resolution tiled displays
- Augmented Reality rendering techniques to seamlessly embed virtual objects into real scenes
- interaction techniques for collaborative mobile VR and AR
- markerless large-area tracking algorithms to support AR interactions
- real-time video transmission to untethered mobile users

To realize the scenarios mentioned below the above technologies are being further developed.

Application scenario 1: Automotive design review

Today, design review sessions in the automotive industry are mainly performed using large screen displays and Virtual Reality visualization systems. The design team sits in front of the display wall examining various aspects of the design from arbitrary points of view. The team uses an input device to rotate the virtual model at will.

In contrast to that, the observer moves relative to the physical prop when reviewing a physical model. In such a review, more than one person is visually exploring the looks of a new design. IMPROVE's automotive application scenario is motivated exactly by this real world example.



Standard OpenGL Lighting



Physikally based light simulation.



Application scenario architecture: Outdoor Design Review

A combination of tracking, interaction, Augmented Reality rendering and real-time video transmission techniques allows several mobile users to carry out collaborative mixed reality design review sessions. They can virtually annotate models in 3D to suggest changes. Annotations can later be reviewed to check whether changes have been performed between successive review sessions.

Application scenario 2: Architectural design and review

The architects involved in the project first want to draw up computer-based sketches of their model at the construction site, then carry home these first sketches for refinement using their desktop architectural modelling tools, such as VectorWorks, and finally show and review the results with their customers either indoors or outdoors.

When showing an architectural model, correct lighting simulation is essential without shadows, the virtual object looks as if it were floating above the ground and disconnected from its physical environment.

The following technological developments stand out in IMPROVE:

The OLED-based HMD

To facilitate Augmented Reality design review a new kind of head mounted display (HMD) is being developed by two project partners.

The new HMD makes use of organic light emitting diodes (OLEDs). OLEDs are very efficient in terms of power consumption and costs. The HMD is very lightweight and provides stereoscopic optical see-through capabilities. The physical layout of the HMD provides an excellent view of the physical environment - no tunnel effect occurs. In a next step, the HMD shall be extended by a light blocker to partially block the incidence of external light, thus allowing a proper superposition of physical objects by virtual ones.

Physically based Augmented Reality rendering

Another key technology is physically-based Augmented Reality. The aim is to seamlessly integrate virtual objects into real environments by using the lighting information present in the physical scene when rendering virtual objects.

Large-area markerless tracking

Large-area tracking is also crucial for realizing the IMPROVE scenarios. For large areas, marker-based tracking

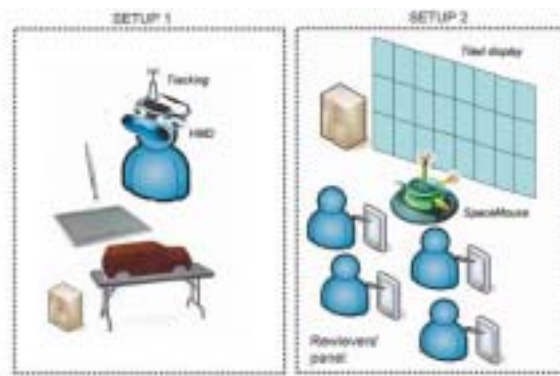
becomes less and less attractive since many markers and/or many cameras are needed.

A more elegant and less expensive alternative is markerless tracking. Based on information extracted from the images that are captured by a small video camera attached to the HMD, the pose and position of the head is estimated. For interaction with the virtual objects in the field, tablet PCs are used.

Further information is available at <http://www.improve-eu.info>.

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Hardware Setup: Combination of PowerWall, TabletPCs and Head Mounted Displays (HMD)



Multi-CAD Data Visualization

Data preparation of CAD data for visualization purposes is still a process involving a lot of manual work. In the past, the department »Industrial Applications« of IGD has developed a data conversion tool directly linked to the CAD system CATIA V4. Now that the industry has finally realized the switch to CATIA V5, the demand for data conversion tools processing CATIA V5 is increasing.

Beside data conversion of one format, data integration of CAD files stemming from different CAD systems becomes more and more important. Therefore, as follow-up activity on our CATIA V4 converter we decided to implement a general approach allowing to convert CAD files in seven different formats (CATIA V4, CATIA V5, Pro/Engineer, IGES, STEP, SAT, VDAFS).

As a peculiarity our converter offers the possibility to convert to tessellated models or to NURBS surfaces. When tessellating, different parameters allow controlling the accuracy. Trimmed NURBS can be tessellated on-the-fly with appropriate visualization tools. The converter supports OpenInventor (trimmed NURBS and polygons), VRML and OpenSG (polygons) as output formats.

In 2005 we carried out a prototype implementation for a big German car maker; for 2006 commercialization is planned.

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SR-Pro - Simulated Reality in Product and Production Development

Simulated Reality (SR) is the bi-directional interplay between Virtual Reality (VR) and Simulation/Optimization for interactive support of decision processes.

This aim is being addressed in the Fraunhofer project SR-PRO in two application scenarios: automotive scenario (crash worthiness) and production optimization of non wovens.

VR functions as an intuitive and interactive interface to the simulation and eases the understanding of abstract simulation results through visualization techniques which support the optimization process. The mathematical simulation of usually partial differential equations is based on solving physical models and allows - in conjunction with multi criterion optimization - an interactive decision process in real-time.

Scenario Automobile (Crash)

The crash behaviour of cars has become a decisive purchase criterion for car buyers. The classification of cars according to NCAP and the appropriate number of »stars« is used heavily as a marketing instrument by car vendors. Thus, optimization of crash behaviour is one of the key development aims in the car industry.

For years, automotive industry has been using crash simulation based on digital models (CAD and CAE models of cars) to gain insights into the crash behaviour of a car in early stages of the development process.

Beside crash behaviour, a set of other development objectives like reduction of weight and emissions exist that conflict with maximizing crash stability.



Example of a converted CAD model in the OpenSG-based viewer

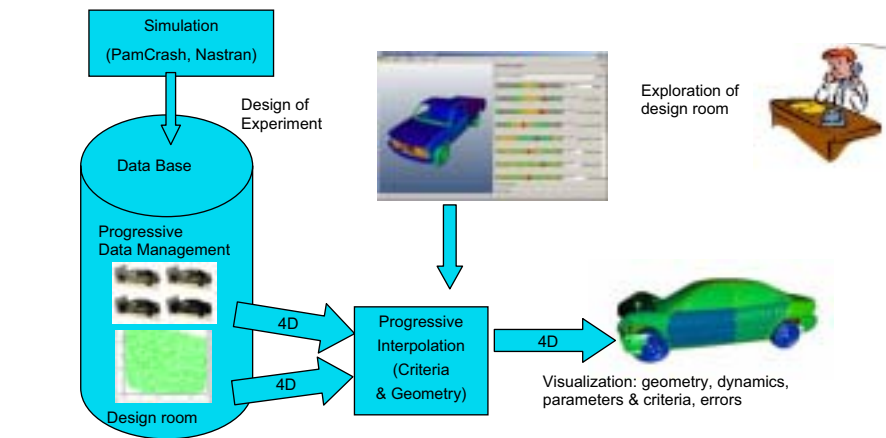
Thus, the development process becomes a multi-domain optimization problem.

In addition to quantifiable criteria, soft issues such as the aesthetics of the car body need to be considered which makes it impossible to formulate the development objectives in a mathematical form to be optimized with mathematical means. Therefore, we are following a user-centred interactive optimization process. In such a process the user can visually inspect intermediate results of the simulation and gain in-sights to further steer the optimization.

For this end, first a set of simulations is run sampling the parameter space and creating a passel of simulation results which build the basis for an interactive visual exploration step. After approximating the result set with a mathematical model, the user can interact with the objectives. Weighting various objectives differently he/she can inspect the interdependencies of parameters and objectives. Using interpolation methods, geometric representations are derived from the existing simulation results even for parameters that have not been simulated.

This visualization helps the simulation engineer to understand the meaning of certain values and effects to the geometry of the car under development. Thus, we accelerate the gain of experience and insight to further drive the optimization in a goal oriented manner.

Different technological developments have been carried out to achieve the aim described above:



SR-Pro Design Process

- compression of simulation results
- deduction of mathematical substitution functions representing the dependencies between objectives and parameters
- interactive exploration method
- interactive work place supporting the visual exploration of the design space
- Interpolation methods between simulation results
- progressive transmission and rendering of massive simulation results (250 GB of simulation results)

The developments have been done in co-operation with Fraunhofer SCAI.

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ULTRA – Ultra Portable Augmented Reality for Industrial Maintenance Scenarios

The goal of ULTRA (Ultra Portable Augmented Reality for Industrial Maintenance Scenarios), a project which is funded by the EC, is the development of an AR core system specially designed for PDA and handheld devices. The challenge is to cope with the limited resources of such devices as well as the available operating systems. ULTRA embraces the development of both the runtime system and authoring tools for content creation. The runtime system comprises the image registration, rendering and control of the workflow. This component is optimized for the PDA. The authoring component is targeted towards creation of complex service manuals. Furthermore ULTRA encompasses the development of a light display system.

The research topics of IGD within this project are the development of a scenegraph based rendering system

for PDA and the authoring suite. The rendering system is compatible to VRML97, features video backgrounds, rendering of animated, virtual 3D models and displaying of multimedia content based on the SMIL standard. Furthermore the runtime system allows acquisition of images from an external camera, tele-conferencing and controlling the workflow. The authoring suite features an easy to use interface, plugin architecture to allow enhancements of the software and several functions for the creation of service manuals.

The project started at the end of 2004. A first prototype of the rendering system and the authoring tool is already available. A second extended prototype is scheduled for the end of the project term after 30 months.

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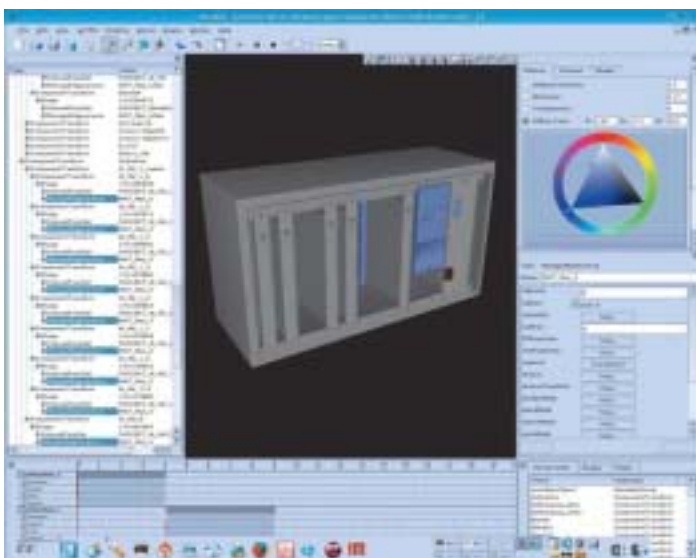
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Virtual Prototyping of Garments

Introduction

The production workflow from the design to the production of new garments is not completely digitized yet and involves a long process chain. In particular, during the review of the garment fit, a large number of prototypes have to be handcrafted. These prototypes are then used to decide if further changes to the garment patterns are necessary. If the number of prototypes could be reduced enormous time and cost savings would be possible. This can be obtained by the use of virtual prototyping of garments.

For this purpose the federal ministry for economy and labor (Bundesministerium für Wirtschaft und Arbeit, BMWA) is funding a project within the PRO INNO II program, which will realize a virtual product development system for a seamless CAD-based 2D-pattern construction, and 3D-fitting simulation. The cooperating partners of this project are the Assyst Bullmer



Top: Augmented Scenery on a PDA

Left: Authoring system for creation of service manuals

GmbH, the German market leader in the area of CAD/CAM solutions for the clothing and textile industry, and the Fraunhofer IGD, which has been working in the area of 3D garment simulation for several years.

In this virtual product development system the evaluation of the fit and optical appearance of a garment worn by anthropometric correct avatars will be possible already in the construction phase, without the necessity of crafting real prototypes wasting textile material.

Virtual Prototyping Work Flow

At first the two-dimensional patterns are constructed by using conventional 2D garment CAD software. Then the patterns are annotated with additional information for 3D positioning and for sewing them together. These annotations allow an automated computation of the 3D positions of the patterns around the avatar. A physically-based simulation sews the pre-positioned patterns together and computes the final fit of the garment. The triangulated patterns serve as the basis for a particle system, which is used to carry out the numerical simulation. Besides gravity, structural properties and bending forces in the textile material and friction between the cloth and the avatar are considered. Simultaneously, the simulated garments and the avatar are visualized in real-time. This rendering incorporates self-shadowing caused by an area light source which was acquired from an existing real environment.

During the simulation, the fit can not only be evaluated but also changed interactively. To assist this process, additional properties like the distance to the body or stretch within the cloth (cf. Figure 2), can be visualized. Now, the garment maker is able to make changes to the 2D patterns within the

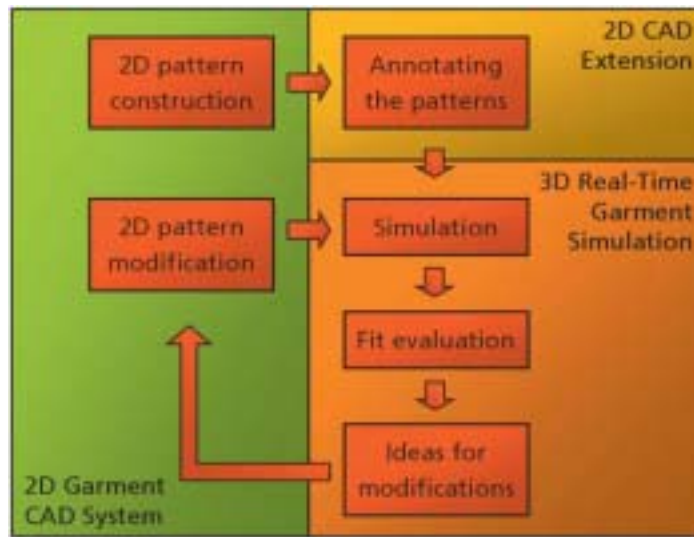


Figure 1: Illustration of the work flow during virtual prototyping of garments



Figure 2: Left: Interaction by using pins. – Right: Visualization of stretch.



Figure 3: Multi-layered garments



CAD system and to directly evaluate the effects on the fit of those changes on the 3D garment. By the assistance of this virtual fitting evaluation garments can be constructed considerably faster than before. The whole workflow is outlined in Figure 1.

Technologies

To provide a clear evaluation of the fit of the virtual prototype, the collision detection for multilayered garments is carried out by specialized algorithms (cf. Figure 3). The high quality of the visualization is achieved by providing display capabilities for seams and imprints (cf. Figure 4). Furthermore, the user can modify the fit during the virtual try-on.

To map the process of a fit evaluation of real garment on a person or a mannequin to virtual reality, it is necessary to digitally acquire the body and the properties of the textile materials. A person is described by its body measurements. This data is then used to adapt a generic avatar to it. Alternatively,

the avatar can be adapted to certain garment sizes. This allows try-on of garments of arbitrary sizes on appropriate avatars. For the acquisition of textile materials optical and physical properties are considered. For weight, bending, stretch and sheer properties, several virtual testing scenarios will be used for measuring and verification against real material behavior.

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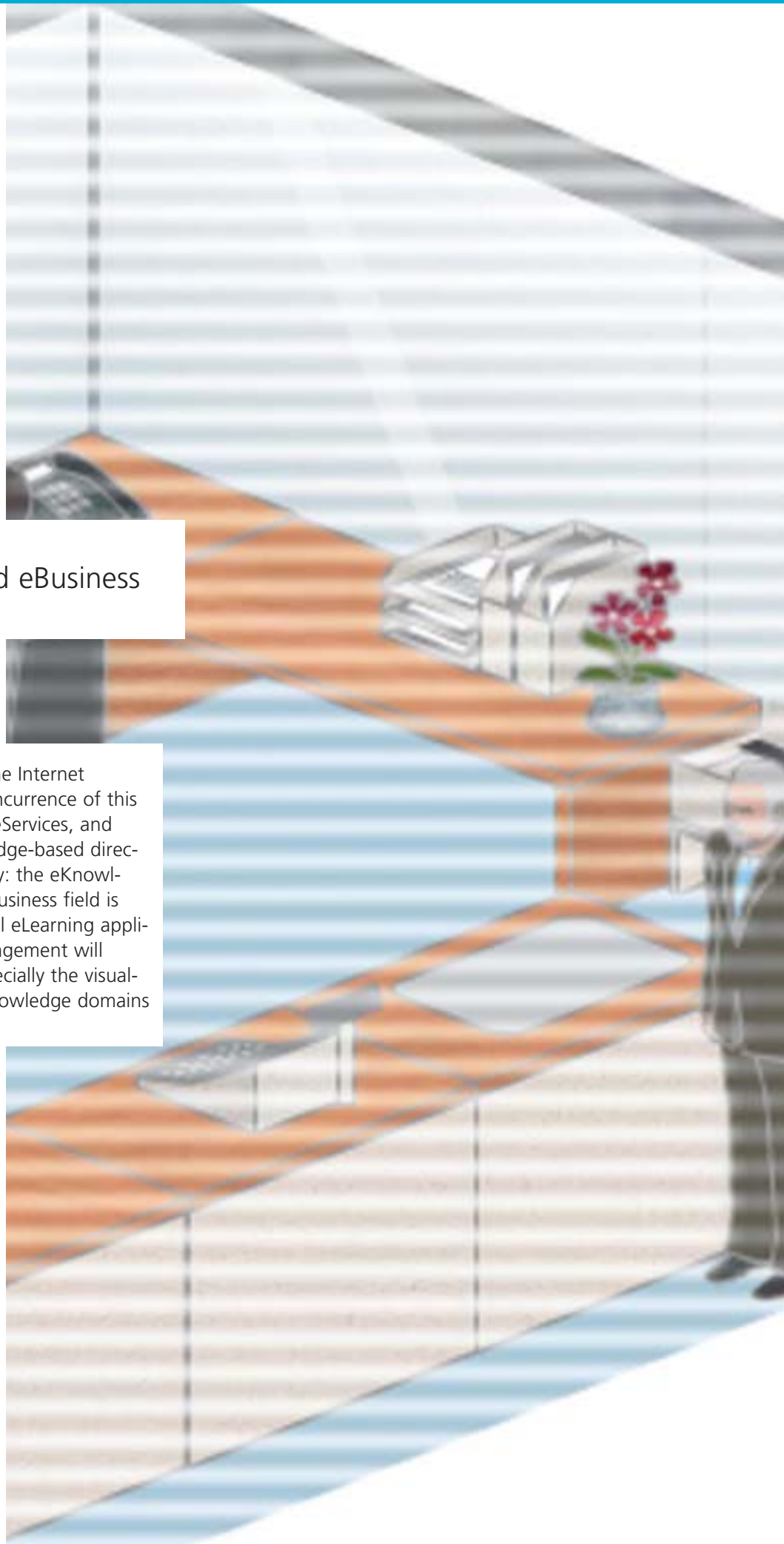


Figure 4: A dress with additional visualization of seams and an imprint.

Applications

eApplications, eServices and eBusiness

The use of applications and services in the Internet increasingly gains in importance. The concurrence of this application area is called eApplications, eServices, and eBusiness. It is developing into a knowledge-based direction resulting in a completely new quality: the eKnowledge Internet. An essential part of this business field is dealing with eLearning applications. In all eLearning applications the inclusion of knowledge management will become more and more interesting. Especially the visualization and graphical manipulation of knowledge domains gain in importance.





Interview with Dr. Christoph Hornung

Dr. Hornung, you are head of the department »eLearning and Knowledge Management«, the leading department of the business field »eApplications, eServices, and eBusiness« of Fraunhofer IGD. What do terms like eLearning and eKnowledge exactly mean?

Dr. Hornung: eLearning comprises all forms of eLearning-supported learning and teaching for advanced training and professional qualification and includes all forms of informal knowledge acquisition in virtual learning and knowledge worlds. eKnowledge comprises all areas of the Internet-based handling of knowledge.

How would you therefore describe the tasks of your business field »eApplications, eServices, and eBusiness«?

Dr. Hornung: The business field deals with the definition of system architectures, methods for the visual management of eLearning and eKnowledge content, and the interfacing to existing business infrastructures. Of special interest is the research of networked solutions like those already realized in the multiple-player games. Another main focus of research is the support of mobile end devices.

Which are the main target groups you are addressing with the eLearning applications?

Dr. Hornung: You can generally divide the target groups into two sections: on the one hand, there is the field of basic education comprising schools but also universities, on the other hand, we have the domain of advanced training like e.g. the internal training of employees. Additionally we have the area »Enterprise-Training« (knowledge management and advanced training in enterprises) where, for instance, realistic business games are carried out.

Dr. Hornung, what do you think will be the future role of knowledge management in the field of eLearning applications?

Dr. Hornung: In future, eKnowledge and eLearning will coalesce and be included in informal, institutional, and formal learning.

Which potential do you see for the further development and chances of the business field »eApplications, eServices, and eBusiness«?



Dr. Christoph Hornung

Dr. Hornung: Due to the coalescence of eLearning and eKnowledge an innovation and integration potential arises. This means innovations in the field of virtual knowledge worlds with playful user interfaces, but also the visual management of very big eKnowledge and eLearning domains. This also applies to the area of designing system architectures for an integrated preparation of eLearning and eKnowledge scenarios. The integration of knowledge acquisition in theory and the knowledge use in practice contributes to enhance the internal qualification of persons and, in the same time, serves to increase the productivity of enterprises - learning and knowledge change from a cost to a productivity factor. This is especially true for the development of the field of knowledge management and advanced enterprise training. The experience gained here may also serve to apply the knowledge management methods to the other key points of the business field.

Dr. Hornung, many thanks for the interview.

ALF

The Project ALF »Arbeiten und Lernen im Fachbereich« (Working and Learning in Industrial Production) was a combined intention of DaimlerChrysler AG, Union of Metal Industrial (IG Metall) and Fraunhofer Institute for Computer Graphics (Fraunhofer IGD). This project was ended successfully end of June 2005.

The goal of this project was to develop and test a web-based and work-integrated advanced vocational education system for skilled workers in industrial production, which combines the competence development in production processes with new career opportunities.

In the last years, post-taylorist work forms like group work and lean production have interspersed increasingly in the industrial production, which raised the qualification demands on skilled workers. On one hand the dynamically changing working environment requires lifelong learning support for skilled workers. On the other hand, there is a lack of conven-

tional further qualification offers for skilled workers in the industrial production.

On the base of these initial considerations in the project ALF, the partners aim at an exemplary implementation of the innovative labor agreement for the metal and electrical industry in Baden-Württemberg (qualification offensive for industrial workers) to offer advanced vocational education. In order to provide flexible and individual further training (life-accompanied and work-integrated learning) for skilled workers, the development of a future enterprise learning strategy is aimed by exhaustion of modern and worker friendly on-the-job eLearning technologies.

Achieved Results

The Fraunhofer IGD has conducted Research and Development work for an eLearning infrastructure and a Virtual Production Line (VPL). The work for the eLearning infrastructure covered provision and adaptation of an eLearning and eWorking infrastructure. A web based infrastructure was established which supports different desktop and web based work and

learning forms. Particularly, the multi-user virtual learning world was to be supported. The following activities have been carried out for the realization of an eLearning infrastructure.

- Analysis of Fraunhofer IGD's Modular Training System (MTS) for the eLearning standard SCORM compliance
- Analysis to support multi user scenarios with MTS
- Support for eLearning and eWorking with MTS
- Development of web based didactic data base (DiDaba, DaimlerChrysler)

In the area of the virtual production line, a Graphical User Interface »Virtual Production Line« and an authoring tool for virtual production line have been developed. The Virtual Production Line (VPL, see Figure below left) offers the workers an interactive and dynamic graphical map of a real production line and shows the spatial coherences. It offers an interactive navigation through the work places and visualizes learning content related to work places and provides an orientation within the real production line as well.



Top: VPL Authoring Tool

Left: Virtual Production Line



An authoring tool »VPL Authoring Tool« (see Figure below right) for the virtual production line is available to authors. With »VPL Authoring Tool«, a new production line can be built and existing components like workplaces and work groups can be modified. Authors have the possibility to position work places and add work places to groups and production lines.

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DIRECT INFO (Media Monitoring and Multimodal Analysis)

Sports sponsorship is one of today's most important marketing instruments worldwide. A huge number of companies are spending significant amounts of money to be publicly associated with a certain sports team or athlete. However, the return on invest associated to the sponsorship activities is not easy to measure. Therefore knowledge about how often and in which context a sponsor is mentioned in connection with the sponsored party would be a direct indicator for executive managers to measure the success of their sponsorship endeavours. On the other hand, the sponsored parties are also interested in this information since it could motivate potential sponsors to invest in their teams.

Today, information about sport sponsorship is gathered through global advertisement expenditure measurement, which is performed by media monitoring companies. However, this type of business intelligence is a very complex task, since it is labor intensive because of the large number of media channels that have to be monitored.

The focus of the DIRECT INFO project, which is partially funded by the European Commissions IST-program, is to create an application for semi-automatic sponsorship tracking with the aim to speed up the manual monitoring process and to reduce the associated costs. Human intervention in DIRECT-INFO is limited to verification and validation of results, which are provided by a variety of content analysis subsystems including logo detection, speech recognition, video OCR, genre classification, text analysis and multimodal video analysis. The overall

results of the content analysis subsystems are integrated by a data fusion and mining approach.

The information extracted by the DIRECT INFO system can be accessed through a delivery system, which provides information of interest for the end user of the system as the overall time a company logo was visible in a given broadcast or whether a company (their representatives, sponsors or products) appeared in positive or negative contexts in a given period in the media.

In addition to the sponsorship tracking scenario the DIRECT INFO system is designed to reflect a number of different media monitoring scenarios as evaluation of political election campaigns, company image tracking, news monitoring, etc.

Fraunhofer IGD is contributing to the DIRECT-INFO project by two different subsystems, the multimodal analysis component and the delivery system.

Multimodal Video Analysis

The multimodal analysis approach as it is developed by Fraunhofer IGD as part of the DIRECT-INFO project aims to achieve a segmentation of the broadcasted video stream into logical units, which are annotated with semantic information derived by the classification of the visual and audio context (scene modeling) and with the information derived through an OCR engine.

For the description and identification of scenes, the detection of several basic events belonging to the different modalities is necessary:

- Transition edits in the visual modality as hard cuts or gradual transitions, which results in the segmentation of the video stream in coherent shots.
- Overlaid text events represented by uninterrupted textual expressions.
- Cuts in the auditory layout, representing changes in the sound signal. This includes transitions from silence to music, speaker changes, classification of audio segments into speech, music and noise.

system intends to differentiate e.g. complete news stories, anchormen, interviews, trailers and advertisements whereas for sport broadcasts especially football, it is envisaged to differentiate trailers, background reporting, interviews, highlights and the game itself. The multimodal event analysis additionally is accompanied with the results of the OCR engine that recognizes the results of the basic text overlay detection and passes it via the MPEG 7 document server to the text analysis module.

- A Personal section allowing the end user to configure his access information.
- An Appearance section showing every single appearance of the considered company together with all related information. The end user has the possibility to watch a video showing the scene or story related to an appearance.
- A Charts section providing graphs and charts on statistical information for certain time periods.

Starting from basic events in video corresponding to the pure perceptual level as shots, noise, music, text-overlays, etc., the multimodal scene classification approach aims on the identification of logical units of coherent content. The segmented units are annotated using predefined semantic attributes that are derived automatically from the underlying event model describing the context of the extracted scene (e.g. attribute »named face« through combination of a detected face and a textual overlay within the same region). For news broadcasts the

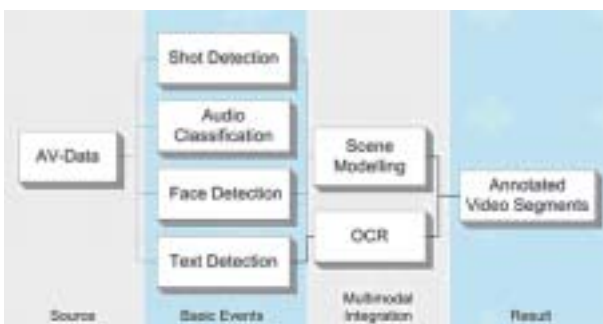
Delivery system

The user interface was developed by Fraunhofer IGD. It provides the sponsorship information derived by the analysis subsystems to the final user of the system. The user interface is completely web based, whereas the information is organised in four different categories:

- A personalized Home section giving the most relevant information of interest for an individual user at a glance.

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Workflow of the multimodal segmentation process



WebFronted DIRECT-INFO Delivery System



ELQ – eLearning Quality

eLearning has developed into a form of learning which ideally complements the conventional teaching and learning methods, especially in the further education sector. However, high-quality eLearning courses are not always the result of well structured development processes. In order to improve the quality of educational offers including eLearning components and to support a systematic approach to the development process, the German Institute for Standardization DIN published a reference model, DIN PAS 1032-1:2004. Meanwhile, this reference model has been published as ISO IEC 19786-1, too.

The research project »ELQ« develops an action model based on the DIN reference model and including general paradigms of systems engineering. This action model describes a systematic procedure starting with the analysis of an educational problem and its context, followed by the development of ideas for an educational concept, production up to realization and

evaluation of the educational offer. Every phase of this procedure is divided into single action steps. Each action step is described by a set of action aids in order to support practitioners in carrying out the developments and in drawing up the results. Gender aspects as well as the diversity of individual learning are considered within the scope of the action aids.

The workflow of the development process is supported by so-called artifacts which are assigned to single action steps. A role model, a method collection, a list of literary sources as well as a glossary, tool descriptions and format descriptions complement the action model.

The use of the action model as well as the action aids are tested within the ELQ project by applying them to develop three educational offers with eLearning components (Blended learning). These educational offers (»Usability engineering«, »Operational quality management and quality assurance« and »Mobile learning«) are thematically innovative and are developed standard-compliant. At the same time

action model and action aids are critically reflected on in collaboration with the educational institutions using them.

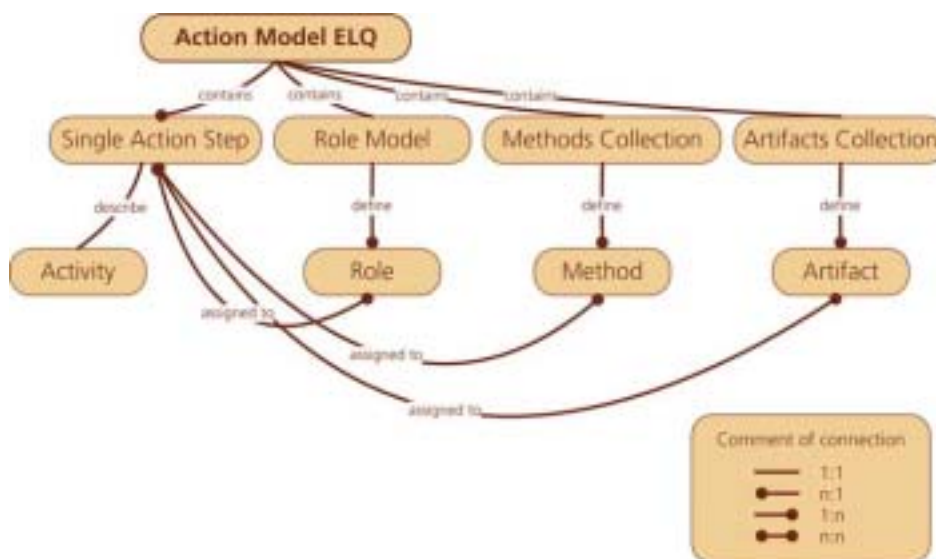
To support the working process, especially all action steps carried out with computers, the action model and action aids are transformed into a multimedia document structure (hyper-text), too. In addition, the artifacts are prepared as electronic documents to be worked with.

The Fraunhofer IGD Rostock has developed the action model, the concept for action aids as well as the action aids for all action steps. Furthermore, the action aids have been tested by producing and running the educational offer »Usability engineering« including eLearning components.

The project »ELQ« is supported by the state of Mecklenburg-Vorpommern and the European social fund.

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Elements of the action model

Hyperlearn – Research and Development of New Cooperative Learning Methods for eLearning

In the last years, eLearning became an integral part of education. Main parts of education in North America and Great Britain are carried out with eLearning today. In Germany, the part of eLearning in education and training is growing continuously. Cooperative learning methods are vital parts in these areas. They will be used depending on learning goal and learner to enhance the learner's basic competence of virtual and real collaboration.

The main distribution media for eLearning content are the internet and the WWW. In the coming years, the interactive, digital television is a new opportunity to deliver eLearning content. This is the reason why it is interesting and necessary to discover the potentials of this new media.

Established cooperative learning methods in the eLearning area use the potentials of new information and communication technologies only partially. They are often adaptations of traditional methods for the new media. In many cases, they do not have a significant benefit.

The Hyperlearn research project develops the theoretical knowledge for the learning method of collaborative annotations. This was the base for the prototype development of collaborative annotations. The Hypervideo technique of ZGDV was especially enhanced and integrated into the smartBLU learning management system (LMS) of IGD Rostock. The media video carries the annotations in the Hypervideo system. This electronic version of annotations enables the user to enhance content and to work with content in a collaborative way. Annotations can save additional information in documents. This information can occur on different media types, e.g.

pictures, text, data tables or video. Annotations can be created by the learner, by the tutor or by the author of the content. In association with a learning management system like smartBLU, the result is a new option of content placement.

eLearning contents were produced and evaluated with the goal to verify the practical relevance of the Hypervideo system. Furthermore, a study was created to analyze the potential use of Hypervideo in the context of interactive, digital television.

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Cooperative Learning with smartBLU



The Virtual Car Dealer

In the area of education and extended vocational training a lot of learning environments and learning portals have been established to support the learning procedure with basic knowledge and professional competence of a domain. Within these virtual learning environments the learner is faced with all kinds of methods to keep his attention and continuity. Most of the applications are targeting the teaching of facts and barely mentioning the global context, the inclusion within an ongoing process or the professional context. The interactive virtual learning world established with the Virtual Car Dealer bridges the gap between education inside the company and in school, as practised in the dual mode education. It offers a tool for teaching graduates from an automotive salesman program in school lessons.

The Virtual Car Dealer is based on the concept of teaching sales trainees in domain specific facts attached to their relevant business processes in the area of trade associated knowledge. The goal is, to learn the particular activities and understand their logical overlapping linkage within the business process.

In the Virtual Car Dealer exemplary business processes are divided into logic sub-processes and authored by an interdisciplinary team of computer scientists, engineers, designers and pedagogues. These web based training modules are based on domain specific knowledge which is provided and compiled in cooperation with partners from the automotive sector.

The virtual learning world is brought to the learner in form of a 3D learning environment in which the business processes are represented and can be trained. The virtual learning world offers several technical functionalities that the learner can use to play activity based scenarios and learn daily required business activities. Learning of domain specific activities and procedures is supported by offering an emulated sales oriented world to sustain activities such as the calculation of financing a car by credit purchase. Due to the modularity of the virtual learning world environments can be represented in a realistic way, the strong division of content and representation offers the opportunity to establish different domains and their specific processes.

The project Virtual Car Dealer is a joint project by Fraunhofer IGD in Darmstadt, German Association for Motor Trades and Repairs (ZDK) in Bonn and German trade union for metalwork (IG Metall) in Frankfurt. The project is funded by the German Federal Ministry of Education and Research (BMBF) for a term of 3 years.

The technical and content related design of the project is established by Fraunhofer IGD. The partners ZDK and IG-Metall are cooperative partners managing the dissemination and anchorage within the companies and vocational schools.

In 2005, the project was presented to the public at international fairs related to the automotive sector as well as fairs in the eLearning sector. Scientific results were also presented on international conferences. Three use case studies were held successfully in 2005 with a large group of trainees.

Further information on the project is accessible on the project website www.vah-projekt.org.

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The Virtual Car Dealer and its functionalities



Interactive objects as an access tool to the virtual learning world

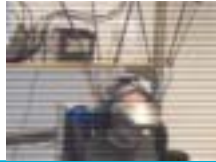
Applications

IT for Medical Applications

In the past years, the medical science has radically changed by new software solutions. More precise diagnoses and target-oriented therapies have entered the everyday medical practice. Imaging methods have become a basic part of medical diagnosis and therapy planning. Instead of a three-dimensional representation of objects a 4D representation has become possible including the time factor as a fourth dimension. All this is attributed to the increasingly establishing information technology in the field of medicine constituting an improvement not only for physicians but also for patients.

Another research area of the information technology is the one of content-based retrieval. This is focusing on the control of multimedia content in radio and television advertising, broadcasts, supplied by content providers. We aim at offering to the content providers a method to analyze and utilize the content of broadcasts.





Interview with Professor Dr. Georgios Sakas

Professor Sakas, you are head of the department »Cognitive Computing and Medical Imaging«, the leading department of the business field »IT for Medical Applications« of Fraunhofer IGD. What is your business field dealing with?

Professor Sakas: The business field is divided into two areas. The first focus lies on medical information technology, the second field is content based retrieval, i.e. content-based information extraction from multimedia content. The field of medical information technology deals with the realization of three-dimensional, meanwhile also four-dimensional imaging methods. Among them are methods like the conventional CT, MR, ultrasound, PET, or similar, providing a set of layer pictures through the body. Meanwhile, the methods are able to deliver such three-dimensional images not only at a certain time but also over a longer period. This allows, e.g., to observe the beating heart of a patient. While, previously, our work was concentrating on diagnosis, we are now focusing on therapy planning and intervention support.

Which are the target groups of the fields IT for Medical Applications and Content Based Retrieval?

Professor Sakas: Since the results of our work in the field of medicine do not always have the product status implicating a responsibility as to CE, accreditation, disciplined development, traceability of errors, and similar, our target group mainly consists of companies from the field of medical technology, and only secondarily of end users like physicians or hospitals. So our work primarily consist in extracting the added value from medical images, in demonstrating it to the client, and in selling it to medical companies, less frequently directly to the client.

In the area of Content Based Retrieval, however, we are near the completion of products which can be used both by companies and the clients themselves. A first product is the MediaSeeker, a tool for an automatic evaluation of advertisements, e.g. in TV broadcasts. The testing phase has successfully been finished and we are now negotiating with interested parties.

In which sectors the developments of the area Medical Information Technology have been used so far?



Prof. Dr. Georgios Sakas

Professor Sakas: At the moment, we have two large application fields: The first one is cancer therapy and the second one cardiology. Furthermore, we have further application areas like telemedicine and also simulation and training which we are going to extend in the near future.

We have dealt with cancer therapy for 10 years now. This experience has resulted in technologies which were sold e.g. to MedCom GmbH and further developed to products. On the one hand, there is the irradiation system EXOMIO, on the other hand, a 3D ultrasound system already used in the field of prostate irradiation. They are both well-established commercial systems which are used hundredfold in the everyday routine of hospitals.

In the field of cardiology, we have developed a new software system enabling a fully automatic evaluation of 4D pictures. As mentioned before, the present-day devices do no longer generate just fixed images, they can now take a whole cycle. So it is possible to get several hundred to several thousand layers per shot, covering the whole heart cycle. Hence you can three-dimensionally how the heart is pumping. The necessary data amount generally ranges between one and two gigabyte per patient and examination, making a manual evaluation just impossible. We have developed an evaluation system for the three- to four-dimensional images. Therefore it has become possible to segment the heart, to measure its volume over a certain period, to identify the flexibility of the myocardium and the expulsion and the pumping capacity of the heart, and to automatically find and diagnose possible vasoconstrictions. This technology is also able to perform comparative controls at follow-up examinations over a certain period.

The field of telemedicine is an evergreen which we have addressed with success since 1997. Due to health over-care, sufficient infrastructure, and the lack of a bill of cost telemedicine is not really in demand in Europe, and there is presently no noteworthy commercial value for it.

Telemedicine is by definition meant to countervail the medical under-care in certain regions, there are, however, relatively few countries in Europe with undersupplied regions. Furthermore, those countries do not like to comment on this subject. In Brazil, however, we have already organized a network which we will extend per satellite into the Amazon region with the support of the European Space Agency before summer. We are in contact with Cuba and Venezuela about the installation of new networks or their connection to the existing network in Brazil respectively. Furthermore, we participate in a project with further partners in Colombia.

It is the aim of the application area Simulation und Training to allow the surgeon to practice with a patient not lying before him. So even risky operations can be trained easily and without risks. I prophesy a great future for this business field. The same applies to Telemedicine. In both fields, however, the present has not yet caught up with the future.

Another area already established is dental CAD/CAM, from which we have already delivered a system to HintELs GmbH. It uses the knowledge base evaluation to automate the manufacture of inlays, coronas, and bridges. The system is in use and enjoys an increasing popularity, and we are proud of being awarded the European IST prize for this system in March 2006. We dispose of further ideas, clients, and other interested parties in this promising field so that we will continue our efforts in this respect.

Professor Sakas, how do you assess the potential of IT for Medical Applications?

Professor Sakas: In the field of cancer therapy I consider the horizon of the development cycle for independent developments as narrow. Since the systems are becoming too complex and are anyway handled by big providers meanwhile, we alone can no longer create fundamentally new developments. We can only make essential contributions by adding components to a big system. Fortunately we are linked with several large and medium-sized providers and approved by them because of our achievements so far.

In cardiology I see a potential of continuing to set individual accents. The further development of devices for the three-dimensional to the four-dimensional diagnosis has created a high demand that is far from being satisfied by existing software systems. We will continue to exploit it for two or three years. Telemedicine, however, is and will remain a sustainable topic. If we succeed in establishing in the Third World or in those countries respectively that are in case of need there will be interesting tasks waiting for us in this domain.

The field of Simulation and Training is in its early stages. We can show completed and running activities, the subject has, however, not yet reached the providers and consumers. In any case, there is a five-year perspective. Then, it remains to be seen how the business field will have developed world-wide. For the time being it is necessary to establish the problem in people's mind and to sensitize purchasers and users to it. This will take much time before commercialization can start.

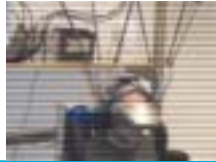
The area of CAD/CAM is steady and we have a knowledge head start at our disposal that is unreachable in the short run. This gives us much confidence for the future.

Which trends are on the horizon in the area of IT for Medical Applications? Which new research areas could develop?

Professor Sakas: The diagnosis options are mostly exhausted. The cardiology will further develop due to the new devices. The need of therapy planning systems has been accepted not by all but at least by some of the customers. Here we have a perspective for several years.

The telemedicine will remain a research and development area, it must, however, be relocated to where there is a demand. Due to the above-mentioned reasons Germany can rather use and offer telemedicine as a service or export it as technology. This implies that the handling of the technology must become as simple as that of a telephone. If the telemedicine will succeed in doing this qualitative leap then it will have a chance in the future. In the less developed regions of the Third World countries the technological and infrastructure aspects must of course be focused on before the knowledge aspect can actually become relevant.

There is a considerable need for research and development in Simulation and Training. The term simulation is well-known from mechanical engineering, but it has not really found its way into biological and medical processes yet. It should, however, be possible in the future to simulate e.g.



cancer growth, the effects of drugs, or the impact of an operation to a body and the resulting aftereffects. This should take place on three levels: cell biology, organs, and intervention. Here I see a long-term, big, and profitable development potential.

Professor Sakas, beside the IT for Medical Applications your business field also comprises Content Based Retrieval. What is it about?

Professor Sakas: It deals with multimedia content, typically broadcasts. An example is television. It is about understanding the content of such broadcasts (so-called rich media) and to evaluate and utilize it. At present, our focus is on the control of radio and television advertising and the evaluation of newscasts. It is analyzed how and when, i.e. on which days, in which months, and at which times a spot is broadcasted. This shall be done 365 days a year, 24 hours, and at intervals of seconds, and it shall be retrievable for the clients.

Which target groups does Content Based Retrieval address?

Professor Sakas: This domain has two target groups: on the one hand, TV broadcast stations, media agencies, advertisers, or media intelligence service providers, on the other hand, the control of copyright violations. In the first case it is about a statistical analysis and data mining, supporting the customer in preparing his advertising strategy or in comparing his efficiency with that of his competitors and showing him in which areas he could improve his efficiency. In the second case, the license owner of a broadcast wishes of course to control when and how often his programme is broadcasted and whether he gets the due payment / license. The international commercialization of such content by distributors and the explosive multiplication of distribution ways like stations, channels, Internet, mobile radio, etc. increasingly complicates this process, so that incomplete settlements or even piracy can only be detected with a considerable effort if ever. Content Based Retrieval serves the license owner to control his own contents, to suppress / trace piracy, or to effect complete settlements.

Where are the developments of Content Based Retrieval already used?

Professor Sakas: The business field is too young, but in a test mode the success has been clearly proved. Both in the field of advertising analysis and license monitoring there are serious accomplishments. One of our first projects is just now being established in Singapore. Imported and revised

(i.e. censored) movies are automatically controlled, and authorized import DVDs are checked with respect to the authorities' demands being met. As to the advertising analysis we are in negotiation with a large international media intelligence provider, furthermore we have launched a spin-off to offer the product as a service. For this aim we are also having advanced talks with investors.

What will be the course of development of Content Based Retrieval in the future?

Professor Sakas: Due to the mere size of the market and its international diversification the potential is gigantic and so are the challenges, since nobody has succeeded so far to establish a really serviceable and regionally adaptable technology. The trends, however, are perfectly clear: There are more and more multimedia contents distributed by permanently new infrastructures (TV, cable, IP-TV, Internet, mobile phones), and nobody keeps track so far. Even a structured search in the sense of a search machine is not possible. This issue is on the top of the priority list of all big Internet search machines. All cable providers intend to develop from mere transporters to content providers or to connect to content providers in the medium term, i.e. within the next five years. AOL and Time Warner were the precursors in this domain at that time; however, the technology was not yet developed enough for such a cooperation making sense. Meanwhile the technology is available area-wide and the infrastructure is being developed at full steam. That remains to be seen, but in this domain huge amounts of money are involved, the need of research and development is enormous, and the trend is irreversible.

Professor Sakas, many thanks for the interview.

Virtual Reality Assisted Diagnosis and Therapy of Whiplash

Functional malfunctions of the cervical spine are the reasons for chronic pain after whiplash and they cause immense costs for the health care system. Thereby whiplash is problematic due to its diagnostic insecurity and thus the missing therapeutic strategy. Image based diagnosis can only be applied in the case of structural injuries that occur only in 3% to 5% of the cases. For the remaining 95% to 97% of patients no injury can be imaged although symptoms like pain, mobility restrictiveness, vertigo or vegetative diseases are deplored. Thus the problematic of whiplash-associated disorders cannot be restricted to a

classification into »structural damage« and »simulated complaints«, this would only cover a small part of the cases. For the bigger part of cases an adequate solution has to be found pursuant to diagnosis, therapy and last but not least insurance law. Within the project »VR Whiplash«, systems for computer assisted whiplash diagnosis and therapy have been developed. Thereby the head motion is recorded and analyzed. With the combined use of Virtual Reality (VR) technology and measurements of the muscular activity of the musculus semispinalis capitis new diagnostically relevant information can be received resulting in a specific therapy plan. For a therapy itself a specific training system for the neck muscles has been developed.

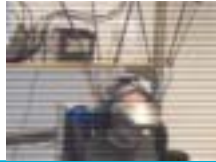
Using the Head Mounted Display (HMD) the patient will be placed into a Virtual Reality world. Here he has the task to follow the motion path of an optical signal (e.g. a flying butterfly) with his gaze. Thus he is animated to follow specific head movements. The restricted field of view of the HMD excludes eye movement, thus the patient is always forced to move his head when he wants to follow the VR signal. The head motion is tracked in all possible motion axes (flexion/extension, rotation and side flexion) and it is synchronised to a captured fine-wire-EMG of the Musculus semispinalis capitis. Speed and motion path of the optical signal can be adjusted in real-time according to EMG measurements. Correlating the tracked head motion and the EMG



Top: Using the HMD for diagnosis



Right: Force-Feedback-System for HWS therapy



signal, the basis for the whiplash diagnosis is established. This diagnosis relies on the detection of pathological patterns in muscle activity as a result of local musculoskeletal pain. This pathological pattern in muscle activity is always the same and reproducible independent of the origin of pain. That means the method indirectly detects a functional disorder of the cervical spine, but cannot differentiate the structure where the pain and pathology originates. Patients with psychosocial pain origin do not have pathological muscle activation. Therefore the method is able to distinguish between patients with structural and those with psychosocial reasons for the symptoms and gives important information concerning therapy. The physiological basis of the diagnostic method is based on the thesis that pain leads to an inhibition of the agonistic muscles and an activation of the antagonistic muscles. This again leads to a reduction of the amplitude and velocity of motion of the affected body part.

Additional to the diagnosis a force feedback system has been developed supporting the display of adjusted counterpoises to the head motion in carefully measured amounts. Here the head-mounted display is integrated into a parallelkinematic robotic. Two tripods can display forces onto the patient head to support a specific training of the neck muscles. Thus the training system allows rotation and translation of the cervical spine over all three axes and in all three planes at any position during locomotion. The goal is to improve muscle fatigue capacity.

As a result of the project »VR Wiplash« a new method for whiplash diagnosis and therapy has been developed. With this method the diagnostic insecurity occurring for the most

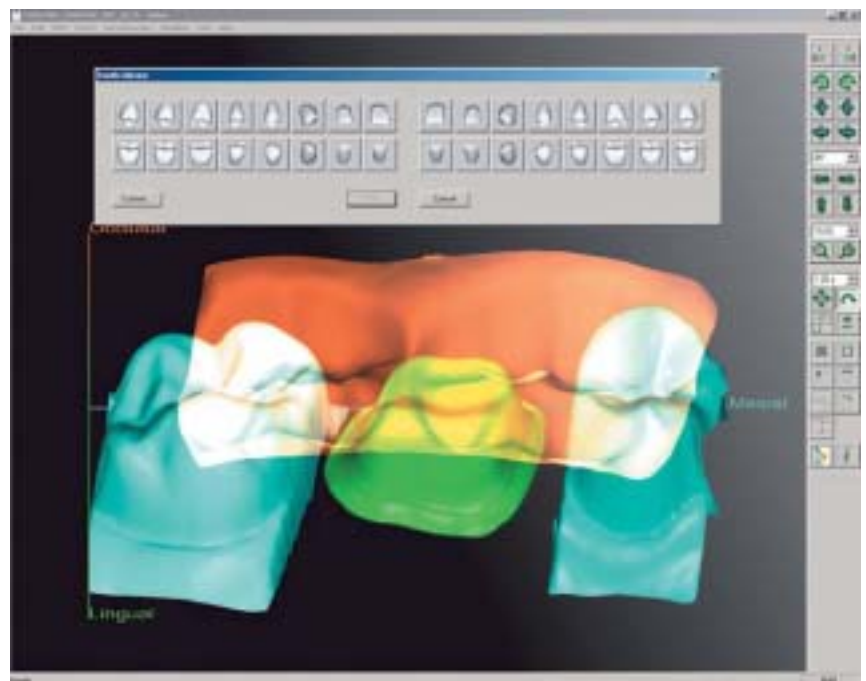
whiplash cases at the moment can be significantly reduced. The diagnostic system is in evaluation at the moment in voluntary tests and patient test at the University Hospital Ulm. The first results of this evaluation are very promising and the values for specificity and sensitivity will be reported after completion of the studies. Also the development of the force feedback system has reached a stadium that the clinical tests have been started.

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viRus – Virtual Tooth Reconstruction System

In the last few years, the acceptance of ceramic inlays as opposed to plastic and gold inlays has increased perceptibly. Ceramic restorations possess an inconspicuous appearance like natural teeth and exhibit similar hardness. Furthermore, in contrast to amalgam ceramic inlays they have no toxicological pertinence and a long durability. Proportional to the ceramic market the number of dental labs using CAD/CAM-systems for tooth restorations, like crowns or inlays, has grown. Using CAD/CAM systems reduces the design and the manufacturing time and for this reason the costs of a restoration. Conventional systems require a large amount of user interaction and three-dimensional power of imagination as well for the construction of an inlay.



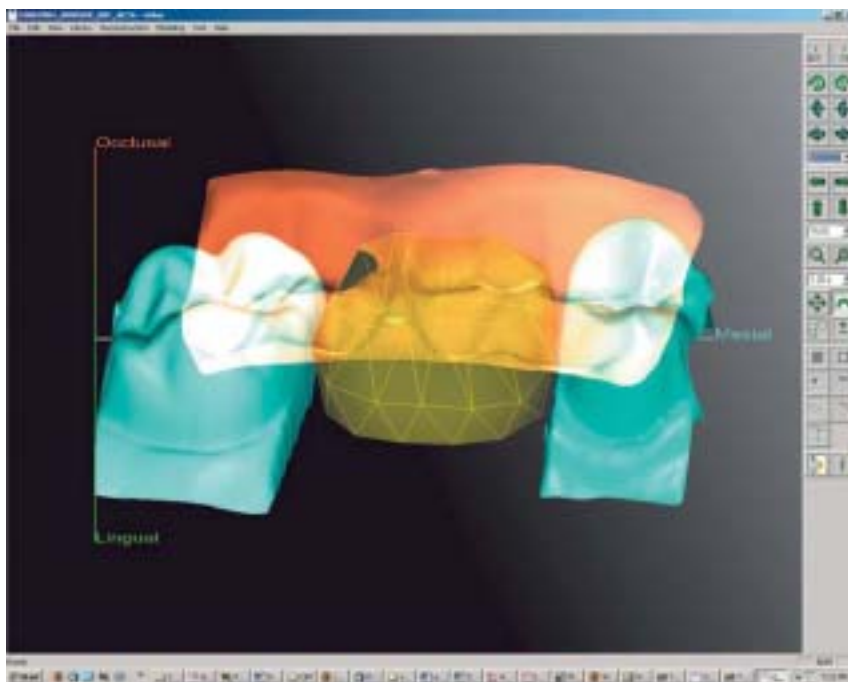
Choosing an appropriate tooth model for the prepared tooth (green) of the tooth library

viRus is a CAD-software for the fully automatic design of tooth restorations. Every restoration is processed in the same way. The user does not have to distinguish anymore among different restoration types, e.g. anatomic coping, full-crown or inlay or between the tooth position, e.g. veneer or molar. The user-interaction and therefore the period of vocational adjustment are very low. On that account the dentists / dental technicians save a lot of time and money for the handling compared to similar systems. Moreover viRus is the only CAD-system allowing its users to preserve the patient's tooth anatomy for later use.

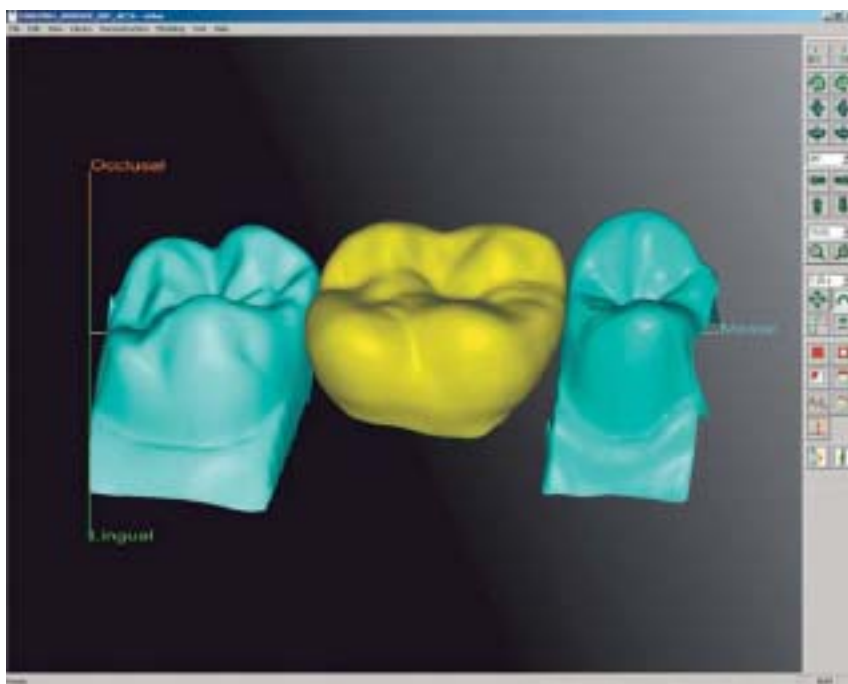
The main challenge designing a tooth restoration is the reconstruction of the defective tooth surface. An automatic tooth reconstruction process is only possible if the typical geometry of the teeth is known by the system. The innovative approach of the CAD-system developed at Fraunhofer IGD is the explicit use of dental medical knowledge in form of a number of typical tooth models. These models have the ability to adapt to the patient's tooth anatomy automatically. Therefore the original shape of a tooth surface is reconstructed by the model and its adjustments to the remaining intact tooth surface (see figures).

Besides the automated process we want to enable the user to design the restoration according to his esthetic principles or using the patient's own tooth anatomy. In the first case the user has the possibility to use deform-tools to modify the suggested restoration.

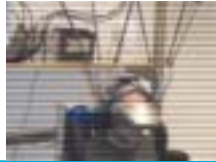
In the second case the user has to preserve the patients tooth anatomy when still undamaged. As a positive side effect, the model based approach enables us to provide the user with



The raw tooth model (yellow) is automatically placed between the neighbor teeth (turquoise) and the antagonist (orange).



Screenshot after full automatic adaptation of the tooth model.



the possibility to create tooth models by himself, e.g. tooth models with the patient's personal tooth anatomy. This enables him to create a database which holds tooth models bearing the patient's personal tooth anatomy. So in case that next time a restoration will be necessary, he can use the patient's own tooth model to reconstruct a defect.

ViRus is a part of the CAD/CAM system for tooth restoration offered by Hint-ELs. The Hint-ELs system consists of a scanner, the construction software for bridges, crowns and inlays and a milling machine. With the scanner, the dentist or dental technician digitizes the prepared tooth. Then he designs the tooth restoration using viRus. Finally, the restoration is produced out of the desired material with a milling machine or by selective laser melting.

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ViVera (Virtual Network of Excellence for Virtual and Augmented Reality)

Interventional endoscopy has a high exposure of risk because of the so-called keyhole surgery character of the operation. The main problem of every endoscopy intervention is the missing visual and haptic control. The regions of interest are often behind a constriction or occlusion, respectively, or beyond the endoscopic visible cavities.

VIVERA uses individual patient data (CT or MRI) of different cases of diseases over DICOM-3 format. After automatic image preprocessing and the segmentation of the interesting area, the segmentation result (e.g. of the bronchial tree) is visualized with VR-methods which are based on volume rendering and haptic feedback to provide an insight into a realistic endoscopy and surgery simulation.

Transfer functions of the volume data can be mapped in different transparencies, so that an analysis of complex volume data will be supported. With the aid of virtual reality technology an interactive navigation is realized. A haptic force-feed-back-system is used to simulate an endoscopic interaction. On the one side the force-feed-back-system is registering the user interaction and on the other side it expends the forces, if collision of the virtual instrument and the patient model is detected.

Due to the visual and haptic feedback the surgeon obtains an endoscopic and surgeon simulation for detailed planning. Moreover during the simulation complications might be recognized and exercised.

Exemplary cases of disease were collected in medical routine to establish a growing and living training system. Within the scope of the ViVera project a prototype for training education and



Set-up of an operation simulator including a haptic force-feed-back-system.

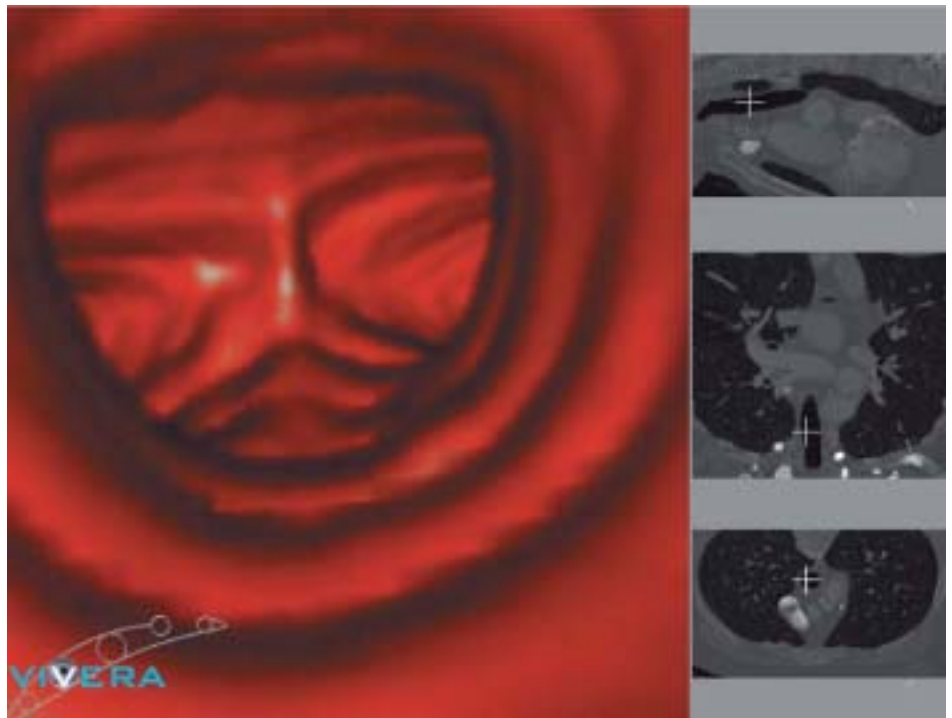
operation planning for the ENT surgery and bronchoscopy will be developed and evaluated.

The following features will be supported:

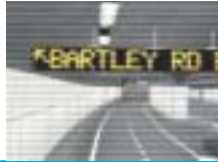
- Automatic Segmentation
- Virtual Bronchoscopy
- ENT Surgical Planning
- All Simulations with haptic Force-Feedback
- Intervention Planning
- Resection Planning
- Biopsy Navigation
- Training / Education Mode

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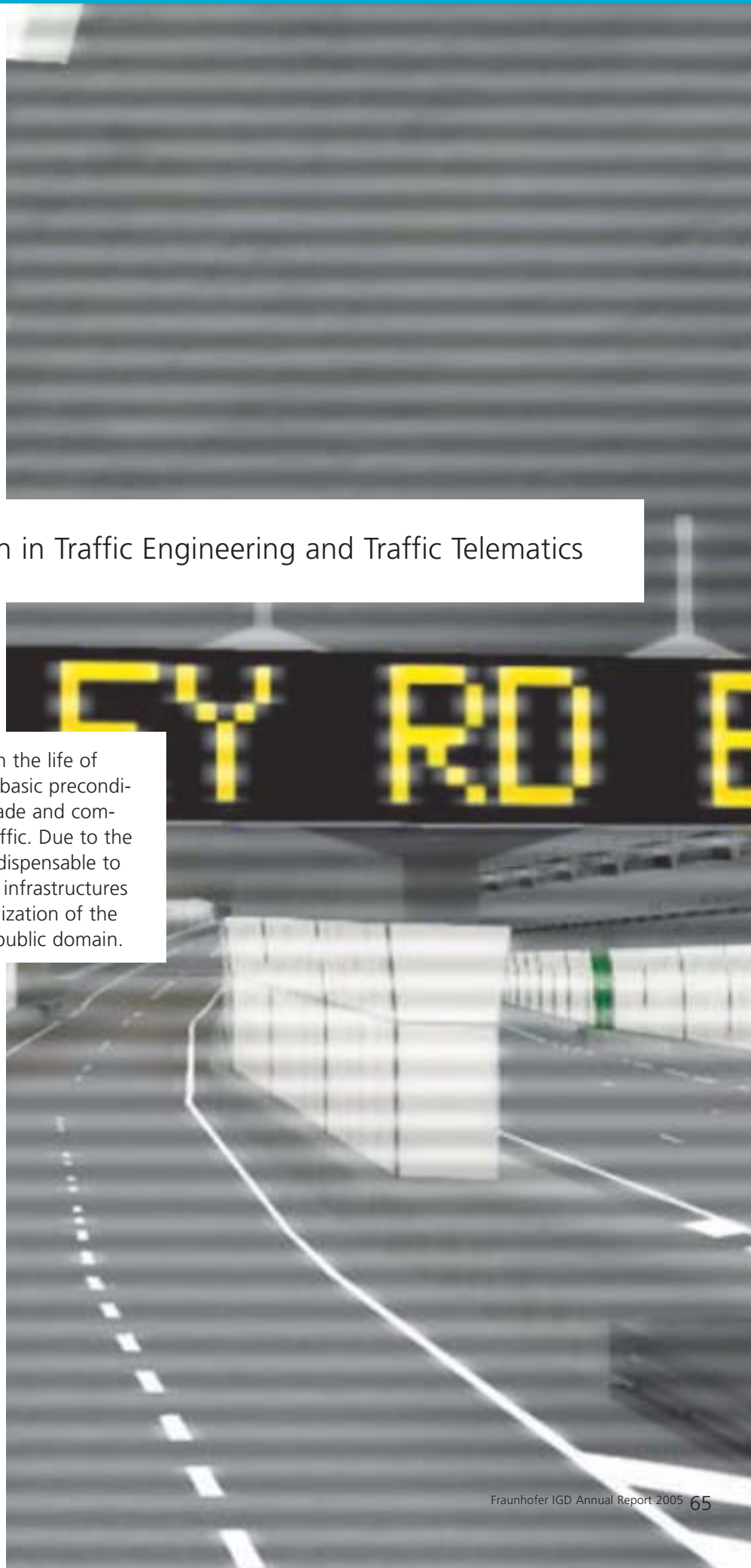
Flight through the bronchial tree with real-time volume rendering. On the right side the corresponding CT slice is shown for orientation.



Applications

Visualization and Interaction in Traffic Engineering and Traffic Telematics

The subject mobility plays a crucial role in the life of everybody. The warranty of mobility is a basic precondition for economic success, whether in trade and commerce or in the passenger and goods traffic. Due to the constantly growing traffic volume it is indispensable to safeguard the performance of the traffic infrastructures and to have an efficient long-term organization of the traffic both in the private as well as the public domain.



Interview with Mr. Daniel Holweg

Mr. Holweg, you are head of the department »Graphic Information Systems«, the leading department of the business field »Visualization and Interaction in Traffic Engineering and Traffic Telematics« of Fraunhofer IGD. What does your business field deal with?

Holweg: The business field is dealing with securing the mobility of our society. In fact we focus on three areas. The first area includes the infrastructure and its operation. Our work covers IT support systems for the planning and management of infrastructure systems and the simulation of their use. The second area concentrates on individual mobility, i.e. that of the particular traffic participant. Here, a special focus is laid on the »aspiring« traffic domains like the cycle traffic. The individual mobility enables the user to manage his own mobility, e.g. by intelligent and intuitive routing systems. The third domain is the experience of mobility. Here, mobility itself is in the centre of interest. It is the aim to turn mobility into a real experience for the traffic participant.

Which are the research objectives of the business field and which are the key aspects?

Holweg: Our research interest concentrates on the use of big, heterogeneous information spaces and the resulting need for a situation-adapted provision and visualization of information. Special attention is paid to the mobile individual and therefore to the supply of information on mobile hardware which often has a restricted performance.

Which is the target group you wish to address with your concepts and developments?

Holweg: It is our final aim to have our concepts be used by the wide public. Those who will address these end customers and therefore represent our target group are infrastructure operators, mobility service providers, telecommunication enterprises, and the upcoming providers of mobile services.

Mr. Holweg, which new trends are looming in the field of traffic technologies and traffic telematics?

Holweg: The crucial trend especially concerning our work is that traffic areas previously less in the focus like the cycle traffic are gaining in importance. Therefore also the subject intermodality is still attracting interest. Furthermore the



Daniel Holweg

implementation of the toll in Germany has led to a discussion about the question of which part of mobility can be liable for costs.

Which new research areas could arise within the next time?

Holweg: We will possibly call the business field no longer »traffic«, but »mobility« according to our true concern, which makes allowance for the increasingly important aspect of the individual security in the context of mobility.

Which developments do you expect for the business field? How do you assess the potential of traffic technology and traffic telematics?

Holweg: Traffic has been and will always be a long-running issue - not least, of course, in view of the increasing standing of Germany as a transit country in the European market. We aim at creating a large information space where data are managed, analyzed, and maintained. On the other side, we have the requirements of individualized services to generate value from information. The key aspects of research will continue to be Mobile Computing, Information Visualization, as well as Semantic Web Services.

Mr. Holweg, many thanks for the interview.



3D Route Planning – Mobility Support of Hikers and Cyclists by 3D GIS

The CityServer3D technology of the Graphic Information Systems department (GIS) of Fraunhofer IGD serves as a basis for 3D GIS solutions and as a system for the support of navigation and mobility. In connection with standard services the Internet-based server provides added-value services for different end user groups. In research and development projects extensions have been realized allowing to generate, manipulate, and administer routes. The route output is done by graphics content and XML-based data which can easily be processed by connected systems.

The CityServer3D system has been developed to apply new concepts and mechanisms for 3D GIS in current and future projects. Due to its architecture the CityServer3D supplies a functionality which can be easily extended by new modules. The system is based on a three-tier model and offers intelli-

gent data sources. The access can be realized via different service interfaces. The administered models are stored in a database, computed by server components, and then transmitted to the customers. These may be CityServer3D customers or third parties.

The CityServer3D consists of different components together forming a system for visualizing, manipulating, and handling 3D data like city models and digital elevation models. The system serves as a technical platform for realizing solutions for different application scenarios like tourism, navigation, risk management, decision finding systems, or city planning.

The CityServer3D can be adapted for the realization of such solutions, e.g. by the so-called route extensions. To support the mobility of travelers like hikers and cyclists the CityServer3D has been extended by three components which allow the user to store routes and complete them to tourist guides. The system is used by three different user groups (roles). First the data administrator has to maintain the

stored models mostly consisting of routes, two-dimensional vector-based mapping data, and digital elevation models. As a second group so-called authors are using the system to create, define, import, and store routes as part of tourist guides. As a third group end users are browsing tourist guides getting the opportunity to buy interesting guides.

During implementation the travel portal had to be extended by the CityServer3D. Therefore the travel portal (as guiding system) has the function to store the guide as a whole and to provide the user interface. The CityServer3D acts as server for the travel portal and its communication via http. It uses secure authentication mechanisms. Within the CityServer3D routes are generated, imported, and administered. They are transferred to the portal by an XML-based description (route, route points, places of interest, and segments) and also by PNG graphics. These graphics are calculated using the CityServer3D components.



Authoring tool for the definition and modification of routes

The authoring tool is realized as a Java applet enabling the author to manually generate a route or to import a route generated by a GPS device like the Garmin-geko series. The new or modified route is stored in the CityServer3D system, firstly as an XML file and, secondly, as survey map and elevation profile which can be configured by several parameters. The figure shows a profile example and the use of colors to display the gradients of the route segments.

For the calculation of the profile 2D routes are connected with a digital elevation model. We use an elevation model of the SRTM (Shuttle Radar Topography Mission). This allows us to achieve a world-wide coverage with a resolution of three arc seconds.

The authoring tool is part of the graphic user interface of the portal so that the CityServer3D system cannot be seen by the end user or the authors. The Figure shows the user interface for the route manipulation.

The CityServer3D can also be easily ported to other applications by extending the server functions as shown in the presented solution. In our case a 3D GIS is used for the calculations and the simple integration of new mechanisms. 3D-based visualizations working with this system will be integrated in following versions.

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servingo – IT-supported Service Platform Infotainment & Logistics on the Occasion of the FIFA World Cup 2006 in Germany.

Within the project servingo a comprehensive service platform around infotainment and logistics is realized by an interdisciplinary consortium in view of the FIFA World Cup 2006. The services are mainly made available to the mobile end devices of visitors; they connect different basic services with advanced technologies and developments.

The project mainly focuses on:

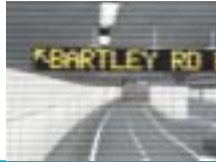
- Innovative personalized and communicative portal functionality, i.e. access to interesting (sport) information but also the recording and communication of individual experiences with latest weblogging approaches

- Target group oriented support of mobility, i.e. mobile logistic support with routing, public transport information, and further elements like hotel information
- Innovative sport-related content generation and delivery like generation of interactive 3D scenes of a game
- Target group oriented multichannel publishing of content, i.e. use of an innovative transfer mix of Internet, GSM, UMTS, and especially IP Data-cast via DVB-H to mobile end devices

The mobility of the World Cup visitors from all over the world is supported by servingo, e.g., with detailed information about public transport, parking, venues, and an individual mobile routing. This allows people unfamiliar with the location to reach the stadium in time before the kick-off, either by train, by bus, or on foot, to orient themselves at stations and airports, or



Prepared for the FIFA World Cup 2006



to query city maps, event notes, and information about hotels, restaurants, and sports bars. For this aim, the project participants are establishing a distribution platform providing the different target groups with service offers and information. This is done both via mobile radio (UMTS, GSM) and Internet, as well as via broadband DVB-H which will within short allow many users simultaneously to receive great amounts of data on their mobile end devices.

Another central service is the personalization of services. After setting up an interest profile, the visitor can access information about his favorite teams, particular games and stadiums, about sights at the venues, and the like. Furthermore, with an individual schedule the visitor can arrange his world cup visit in Germany according to his wishes. Furthermore he can not only mark interesting locations for his individual mobility support on a city

map but also deposit media files like photos taken with the mobile phone. So he can, e.g. easily find his car in a huge parking area after the game, for he has previously recorded its position in his mobile phone. Or the fan stores an Italian restaurant which has attracted his attention on his way to the stadium to be led there after the game.

Using servingo sport fans can also view a sensational goal, skilful moves, a controversial foul, and other important scenes a little later on their multimedia telephones - as three-dimensional computer reconstruction.

This generates an entirely new world of experience not achieved by television. The sporty user can move himself interactively in the scene, determine the speed, and take different perspectives, e.g. that of the goal scorer, the ball, or the referee. For this aim a program is being developed reproducing

the movements of the players from the shots of the TV camera by means of virtual characters in a realistic way. A player database especially generated for this purpose contains a great number of these so-called avatars. The football fan can choose. He either navigates himself interactively in the selected 3D scene or he falls back upon animated films of the most important sequences in MPEG format. It is also possible to transfer interesting pictures per SMS to his telephone.

The project volume of servingo amounts to approximately eight million euros and is partly funded by the German Federal Ministry for Economics and Labor.

First preliminary results were already presented to the public at the Confederation Cup in June 2005. The consortium will realize a prototype until FIFA World Cup 2006 and thereby open a view into a new dimension of sports



Servingo, a comprehensive service platform for the FIFA World Cup 2006

experience which will be digitally supported. Also the organizers will benefit, for the system will help them with an efficient organization and offer integrated logistics solutions for this big sports event. The tasks Fraunhofer IGD is performing for servingo are the organization and management of the work packages, architecture conception and testing, and the evaluation of the results. The additions of the Graphic Information Systems department to the project are the experience in managing spatial data and their Internet-based provision in information systems as well as their expertise in conceiving and implementing applications for mobile phones.

Project partners besides Fraunhofer IGD are: CAS Software AG, DAI-Labor of TU Berlin, ehotel AG, GISTec GmbH, Fraunhofer Institute for Material Flow and Logistics (IML), infoRoad GmbH, Intergraph (Deutschland) GmbH, itCampus Software- und Systemhaus GmbH, T-Systems International GmbH, and, as coordinator the Computer Graphics Center (ZGDV e.V.).

servingo is understood as a partner-spanning service platform with associated partners and sponsors who accompany and support the project externally.

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TouristGuide

In 2005 the department »Mobile Multimedia Technologies« of Fraunhofer IGD Rostock developed an innovative tourist guide application for mobile phones and introduced it for the Hanseatic city of Rostock.

The TouristGuide is a mobile city information system which contains about 250 different sightseeing items as well as current event information of the next three weeks. The application is downloadable by using a premium SMS. The TouristGuide runs on every modern standard mobile phone. After an inexpensive download of about 10 seconds it can be used as often as the user likes without any charge.

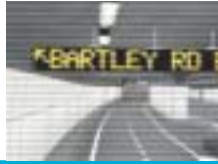
The framework of the development of TouristGuide is the mobile information system xGuide, which has been used

for more than 100 national and international fairs and exhibitions by thousands of users since 2000.

For an easy and intuitive use, the TouristGuide uses a very effective and comfortable visualization technology for maps. Since displaying city maps on mobile phones is very complex, unhandy and resource intensive, the development of a dynamic visualization concept on vector images was necessary. Therefore Fraunhofer IGD has developed a two-point-map with animated presentation of the current position and the point of interest by displaying heading and distance information. This technology enables pedestrians to navigate in the city and supports decisions about the choice of taking a taxi, public transportation or having a walk. The TouristGuide can be easily adapted to any city or location to provide a map with additional information. The latest version of



TouristGuide of the Hanseatic City Rostock



TouristGuide includes the support of built-in or external GPS receivers. Hereby the own position is set automatically and precisely put into relation to the sightseeing items.

Because TouristGuide is an electronic media, it is available in any amount of copies at any time and anywhere. In comparison to traditional printed media it isn't inconvenient by size or weight. The application does support the use of personalized tours or storage of favorites. The content of TouristGuide is processed by the core technology of data adaptation for mobile devices, developed by Fraunhofer IGD Rostock, called XyberScout platform.

Beside the useful information for the user, TouristGuide provides high benefits for tourist organizations and tourist agencies. This includes a higher attractiveness of the city, a leading of the visitor flow and a new chance of income for cities by holding shares of the application download fees. Furthermore TouristGuide is a modern and innovative service system for visitors and new publication media for advertising.

More information is available on the Web at:

www.igd-r.fraunhofer.de/IGD/Abteilungen/AR3/Produkte_AR3/TouristGuide/index_en.html

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KPE Tunnel

With more vehicles hitting the roads in a place where land area is scarce, it has become an increasing challenge for Singapore to ease its road congestions, meet the high traffic volume demand and to give motorists a wider choice of travel routes to make their journeys as smooth as possible.

As such, the construction of the 12-km Kallang/Paya Lebar Expressway (KPE) is an on-going project by the Land & Transport Authority (LTA) Singapore to cater to the fast growing population in the North East area and to provide an alternative route between the city and the estates in the north of the island.

Together with NTU's School of Civil and Environmental Engineering and the Centre for Advanced Media Tech-

nology (CAMTech), LTA has jointly collaborated with these two Centers to study drivers' responses along the KPE tunnels, so as to find out ways to optimize the use of various new design features and technologies inside the tunnels. More specifically, the study will investigate driver preferences for various design features of the tunnel (e.g., lane use signs, variable speed limits, etc.)

Since the KPE is still under construction, the study of driver behavior inside the long tunnels of KPE requires an approach combining field surveys and laboratory observation with the use of a high performance driving simulation system to simulate realistic driving experience inside the KPE tunnels. CAMTech is in charge of the development of a realistic visualization of the driving scenes and to provide an experiment environment for testing of various design options at KPE and



Visualization of realistic driving situations in the KPE tunnel

Applications

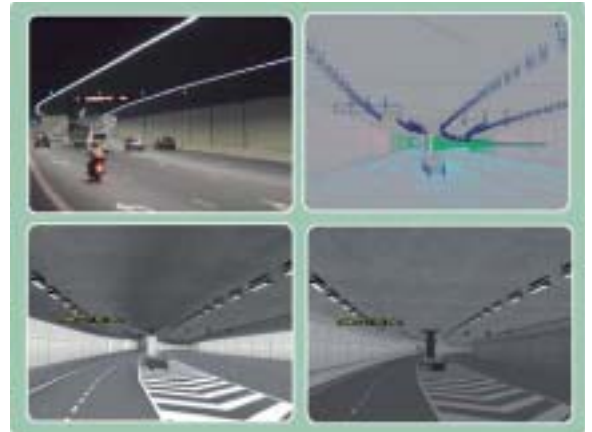
Visualization and Interaction in Traffic Engineering and Traffic Telematics

to study users' responses to the various settings of those options. The overall system includes the complete digital 3D KPE model, the enhanced driving simulator system and triple graphics pipe output with high resolution signals. The system is located in the NTU Reality Theatre and the first wave of pilot surveys and studies is currently being conducted with a group of 250 volunteers.

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Various design features of the KPE tunnel shown in the driving simulator.



Dynamic traffic guidance system in the simulation of the KPE tunnel



Applications

Games and Edutainment

Computer games exist in a great number of variations. From simple learning games for children over complex simulation and strategy games to online role-playing games with thousands of players nearly all combinations of genres, technologies, and target groups are possible.



Interview with Mr. Holger Diener

Mr. Diener, you are head of the department »Entertainment Technologies«, the leading department of the business field »Games and Edutainment« of Fraunhofer IGD. What does your business field deal with?

Diener: Computer games have properties which are also desirable for business software: They encourage communication and cooperation as online games show. Games are instructive and they easily get across their functionality, e.g. by playable tutorials and simple, intuitive user interfaces. The business field deals with the analysis and transfer of such concepts and features of computer games into the most different business applications, from text processing to CAD systems, but also with the utilization of innovative technologies for the game industry itself.

Which is the target group the developments of the business fields address?

Diener: The target group is very heterogeneous. So tools for the quality and process management can be introduced in the game industry. To save cost more production steps must be automated. Supporting tools like story editors and generators of 3D objects that can also be used by newcomers will play a major role in the future.

For the target group software industry new human-centered structures and interaction possibilities for user interfaces are necessary to enable the increasing rate of functionality being offered in a still user-friendly way.

Playful aspects can be found in the target group production industry in the field of product presentation, among other things. Here the data from the production process must be transformed into appealing presentations to cut the cost of expensive re-modeling.

Which are the advantages of the use of playful elements in learning applications?

Diener: Within edutainment applications playful elements are successfully combined with eLearning concepts. Both the higher motivation of the players and the addressing of different learning types improve the learning result and increase the success. Playable tutorials, introduction levels, and different degrees of difficulty enable the playful understanding of the user interfaces of games. Especially for



Holger Diener

users who have little contact to IT technologies learning games and simple, intuitive user interfaces will offer better chances to participate in the digital future.

Which trends do you see in the field of Games and Edutainment?

Diener: Computer games are now even used in serious applications like education and training, process control, or even decision making. Under the term 'serious games' this potential of games is investigated.

How do you assess the potential of edutainment applications? Which new research areas could develop in the next time?

Diener: New research areas like Digital Storytelling and Game Based Interfaces analyze the impact of stories or playful elements respectively onto the interaction behavior of the users. Especially for virtual characters there is a broad application spectrum from consultants in web presentations to assistants in desktop applications and virtual environments. It is also important to investigate how people accept software systems, e.g. how good the users feel and how effective they are, to react to it adequately with the application.

Mr. Diener, many thanks for the interview.



StepMan – Aural Support for Sports

Introduction

Today mobile devices like PDA's and cellular phones are no longer only characterized by their performance, but increasingly by their multiple functionalities. They are not only »better diaries« anymore, but supporting devices in daily life, sports and spare time. The Fraunhofer Institute for Computer Graphics Rostock has developed a mobile system for supporting sportsmen acoustically in the areas of fitness and healthcare. Combining algorithms for the real time transformation of audio signals and biometric

sensor technologies makes it possible to create completely new applications in the health and rehabilitation sectors.

StepMan Rhythm of Music fits Step Frequency of Joggers

Many joggers do not listen to music during sports, because the music does not fit with their running rhythm. Running with the favorite music not only makes fun. Different studies have showed that jogging with music improves stamina and performance. Joggers keep the right rhythm and run more relaxed. Breathing is deeper and more even. Based on sensor data, the StepMan technology modifies the rhythm of the music to fit with the

rhythm of sportsmen. Special algorithms for audio manipulation make it possible to modify the music without unnatural sound effects like changing the pitch.

StepMan – Personal Trainer

Marathon runners frequently have the problem that they adapt themselves intuitively to the step rhythm of their neighbors and lose their own running rhythm. That reduces the efficiency and runners can overexert themselves. The StepMan offers the possibility of defining training profiles. These are conveyed to the sportsman with the manipulated rhythm of the music - so the StepMan can be used as musical



Top: StepMan on Siemens SX1

Left: Test of the new StepMan prototype

metronome for joggers. Runners must only train to the rhythm of music in order to be trained optimally.

Technologies

As a result of the high public and industrial resonance the StepMan technologies were extended to other hardware platforms like mobile phones and MP3 players. Current algorithms for the manipulation of speed in audio data were optimized for the usage on mobile devices with limited performance. Also, the quality of the modified music was increased.

To increase the comfort of a mobile StepMan system it was necessary to examine wireless and miniaturized sensor technologies. Using micro mechanical acceleration sensors and Bluetooth transmission for the step detection, it was possible to remove all disturbing cables. Based on a wireless pulseoxymeter the StepMan can analyze oxygen saturation and heart frequency of the sportsman. These biometric data can be used to optimize the training in real time.

In cooperation with Siemens AG we adapted the developed technologies for Series60 based smart phones, the RunSTER system. Currently used algorithms were optimized for the usage on mobile devices with limited performance. Also, the quality of the modified music was increased and real time rhythm detection was integrated. The project results were presented on the CeBIT 2005.

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Virtual Human

Preface and Motivation

The aim of the project »Virtual Human« is the development of virtual characters as personal dialog partners by cooperation of leading German research groups in the fields of computer graphic and multimodal computer human interfaces. Educational software is one possible application area, because the personification of the tutor system leads to demonstrably more efficient and effective learning. In addition, interactive web interfaces, especially in eBusiness solutions, show a big potential for technologies of this project. Also the possibility of scalability of the end system from web client as internet seller over desktop scenarios up to big displays like Caves for presentations and eLearning is to be taken into account.

Within Virtual Human Fraunhofer IGD is working on real-time rendering and authoring.

Real-time Rendering

Main emphasis of Fraunhofer IGD is on the real-time rendering, deployment of features of the newest graphics hardware to achieve a high visual realism of the presented virtual character. Realistic representation of skin and hair, dynamic simulation of hair, face and body are the main areas IGD is working on. Furthermore we have developed an authoring tool for hair cutting, the virtual barber. It allows easily creating new hairstyles and immediately using them in the real-time environment.

All algorithms are embedded in the in-house developed Mixed Reality System Avalon, which serves as the one and only Rendering Platform for the whole



The barbershop



Virtual Human system. Avalon is 100 percent compatible to X3D and VRML97 and offers additional components useful for character animation like skin and bone animation and morph targets.

Authoring System

The complexity of story scenario creation is hard to manage only by text editors. In addition, the hard coding by programming specialists is not manageable over a long time. Thus, an intuitive authoring system is necessary. Especially story authors that are not firm using computers to create a storybook need intuitive software. To handle the complex structures the author needs control mechanisms and previews of his work. Motivation and the aspect to get familiar with the system are important things to increase usability. The author should have the possibility to create his story in his

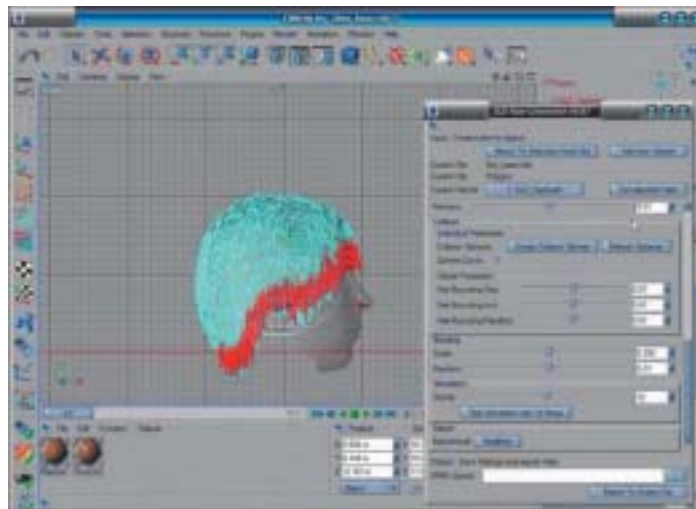
usual way and his ordinary order. Creating characters and controlling the story flow should be possible without programming knowledge.

Up to now, authors of classical linear stories would have the ability to write a story, including character description and linear dialogs. A storywriter of an interactive fiction will also be able to describe the skeleton of a story at different levels and to specify relations between these elements. Therefore, a branched structure with story flow depending on user actions will be possible. The logical structure described in section »story model« gives a good base to systematize the complex scenario and provides a quick access to set different properties. Additional graph visualization, active help and checklists are necessary tools to achieve a better usability.

Story Model

With the aid of the target group - designer and story authors - requirements and proceedings were discussed. The result is a hierarchical model of the story in scenes, actions and activities, which was developed in cooperation with the ZGDV. Lowest layer is the activity layer. Small dialog and gesture parts associated to one character can be processed there in parallel. Several of these activities can compose one action.

The actions are ordered sequentially and represent a scene. On the same layer as scenes, also characters, requisites and interactions were defined. Inside the scene, acting characters and requisites can be chosen. Each action can be the starting point for a transition to another scene. There are four different transition types. Total and theme reset are transitions to prede-



Real-time hair simulation

defined start scenes. Beside the default transition, which represents the normal story flow, the important user interactions trigger the fourth type of transition. Depending on interaction types and corresponding values different scenes can be reached. This allows the author to set up a series of criteria, which will determine a virtual directors cut each time the interactive fiction is performed.

Interface design

Based on the described story model we have developed an authoring system, shown on the picture below. One of the major parts is the development of game based interfaces to provide the author with useful help and hints to complete the story. Integrating game strategies should increase motivation. The author will be motivated to complete the story like a quest game. Achieving a good position on a high score stands synony-

mous for reaching all checklists for a complete story. With the aim of achieving a maximum of usability, we work together with usability experts especially to improve factors like effectiveness, efficiency and easy usability. The result is a convincing and powerful tool for authors and storywriters.

Preview element

The preview element allows the simulation of specific story lines in order to perform plausibility tests with a variety of checklists. Possible story lines and single scenes can be tested regarding their logical structure and completeness. A control system for plausibility tests within the whole story is a useful completion of the preview element.

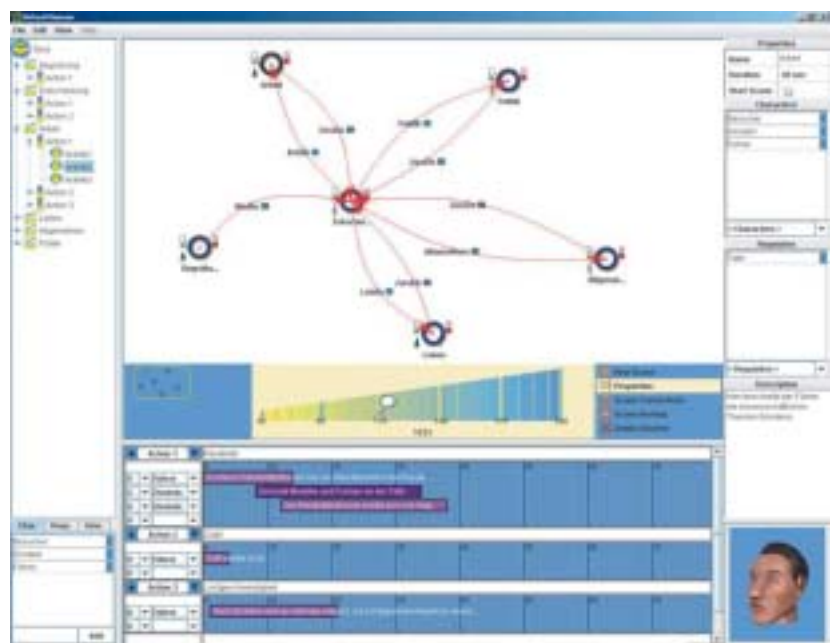
The simulation of different story lines gives a good overview of the story and makes it easier to edit the timing of the story, especially the timing of dialogs and gestures: Errors can be

identified early. Authors can use the better feedback for a more comfortable work with the editor.

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Virtual Human Story Editor



The Messel Pit – A Virtual Experience

Since 1995 the Messel Pit is listed as a UNESCO world heritage site and is one of the most famous and richest mammal fossil sites world-wide. Geoscientists recovered more than 40.000 findings, e.g. mammal predecessors (so called »Urpferdchen«), fishes, insects, reptiles, amphibians and plants.

This uniqueness is not revealed to visitors of the pit at first sight. The pit is a depression with a diameter of 900m and a sparse vegetation and the interesting parts are hidden beneath the earth.

In this project we use novel technologies to raise the attractiveness of the Messel Pit and present the beauties of the pit to visitors in a new way. Two exhibits were realized:

- The Augmented Reality Telescope XC-01: The telescope was installed at the viewing platform, which is located at the rim of the pit. When looking through the telescope, the visitor is able to see the real pit and additional virtual overlays, like the finding place of a special fossil or the different rock formations. Such overlays have fixed locations in the real world, thus the visitor is able to explore the Messel Pit by moving the telescope and trying to find all virtual overlays.
- Interactive Maar explosion: The second installation is an interactive Virtual Reality exhibit, which is located in the Messel Pit Information Center and explains the genesis of the pit. Two virtual characters named Prof. Ludwig and the kid Fabian are discussing the secrets of the Messel Pit, how it was created



Dr. Ludwig explaining the Pit to Fabian



»Urpferdchen« in the AR Telescope XC-01. Dr. Ludwig: »The most popular of the fossils of the Messel Pit was found here: the 'Urpferdchen'. Known as Propalaeotherium Parvulum it used to grow to the size of fox terrier.«

Applications

Games and Edutainment

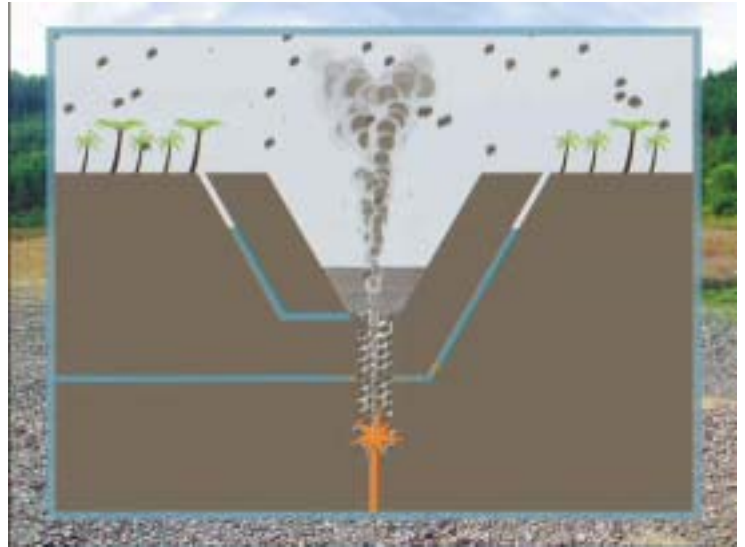
and why we know this today. The visitor is able to influence the flow of the story.

The Information Center was officially opened on September 28th, 2005 by Udo Corts, the minister of research and art of the state of Hessen. He presented both exhibits for the first time to the whole world.

Fraunhofer IGD knows about the importance and uniqueness of the Messel Pit. Therefore we supported and financed a large amount of the research and development on our own.

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Scheme of a Maar explosion



View of the Messel Pit: Udo Corts at the Augmented Reality Telescope XC-01, when he officially opened the Information Center on September 28, 2005.



WebVenue™

Today information exchange and continuing education are fostered and strengthened while many open days, conferences, workshops and similar events are provided by different institutions or private enterprises. WebVenue™ provides the coverage of presentations at events and gives the possibility to webcast presentations live and make them available for online or offline playback at a later time. Participants of an event will be able to remember the presentations with the help of WebVenue »Multimedia Notes«. WebVenue features full-automatic synchronization of PowerPoint slides, video and audio. WebVenue provides a full customizable presentation output to serve your needs and your corporate identity.

With WebVenue you can stream presentations live and record them digitally. An interested user can easily follow a presentation with standard software free of charge (web browser) and usual Internet connection (ISDN - Broadband). The video quality is automatically adapted to the Internet connection of any end-user.

WebVenue records not only audio and video of a presentation, but also synchronized PowerPoint slides. While encoding, all relevant information is automatically stored so that no time-consuming post processing is needed. Furthermore you can scroll through the slides and selectively hear the statements to a slide.

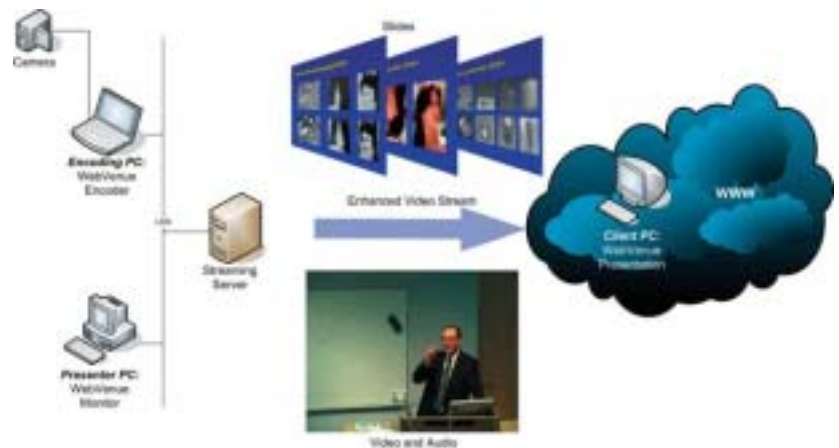
The solution requires almost no extra effort from the presenter or the body organizing the event. The conference/workshop is organized in a simi-

lar way as before, with the only difference that inside the venue a camera is recording the event.

Using WebVenue increases the attractiveness and future orientation of your events with very simple instruments.

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Top: WebVenue™ Architecture

Left: WebVenue™ Frontend

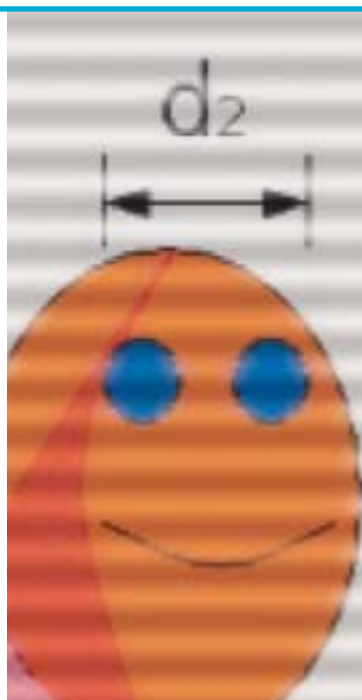
Applications

IT Security and IT for the Security in our Society

Applications

IT Security and IT for the Security in our Society

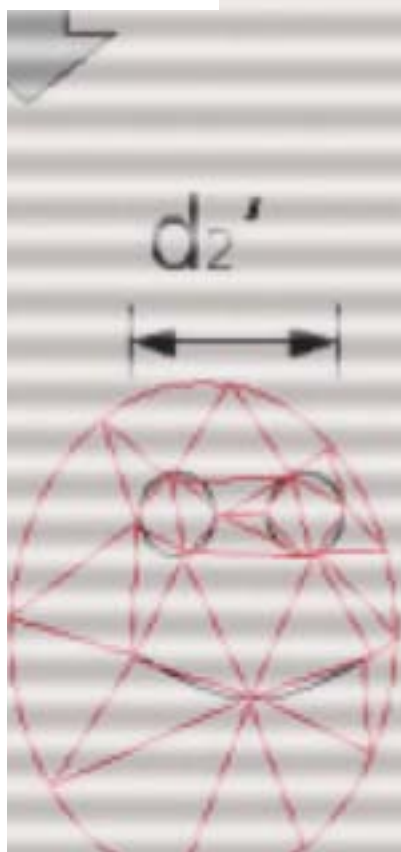
Computer Graphics contributes to achieve a higher level of security whether in the defense against terrorism, the protection of copyright and personal rights, or the search of brand pirates. The subject security concerns all of us and all areas.



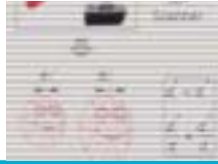
$$d_1 < d_2$$



3D-Scanner



$$\begin{aligned} d_1' &< d_2' \\ \frac{d_1'}{d_1} &= \frac{d_2'}{d_2} \end{aligned}$$



Interview with Mr. Alexander Nouak

Mr. Nouak, you are head of the department »Security Technology in Graphics and Communication Systems«, the leading department of the business field »IT security and IT for the security in our society« of Fraunhofer IGD. What does your business field deal with?

Nouak: The business field generally deals with two aspects: on the one hand, with the security of information structures, and, on the other hand, with the security of the society by information technology. The information technology offers, for example, an efficient means of access control in the field of biometrics where other methods have only pretended security so far. The identity of the user is controlled by means of his stored biometric properties, e.g. by means of the finger print, the face, or the iris. Especially the 3D face recognition can contribute to improve security.

Which are the target groups the development of the business field is addressing?

Nouak: In principle, we are addressing everybody. Our offer is, however, primarily used by the public authorities. Restrictions accrue from the fact that IT security is very time-consuming and complicated and the general user does not want to deal with it unnecessarily long. This is one of the reasons why we will also concentrate on the operability of security technologies.

Which will be the role of IT Security in our society?

Nouak: It will play a great role. Even today data protection and personal protection are argued hotly. The question is how to deal with it in future. If you take a look at America you will see that they are handling the personal rights of the individual in a much more rigorous way. It remains to be seen which direction the discussion will take over here.

Mr. Nouak, how does computer graphics contribute to improving the general security?

Nouak: Due to higher bandwidths and lower costs for storage graphical data are generally playing an increasing role, and consequently also in the security domain. This is especially evident in biometrics which is very much depending on image data. On the other side, the graphical data must be protected against attacks and forgeries, e.g. concerning data communication or the protection of copyrights.



Alexander Nouak

Which trends are looming? Which new research areas could arise for the business field?

Nouak: The discussion about data protection and personal rights will continue even more intensively. Biometrics for an enhanced security at access controls, but also the security of spatial information data or visualization data for securing sensitive infrastructures will undoubtedly also be a focal point within the next five years.

Mr. Nouak, many thanks for the interview.

BioFaceV

In this subproject of the BioFace sequence the performance of 3-D face recognition systems is identified in form of a comparative investigation of commercial and prototypal developments.

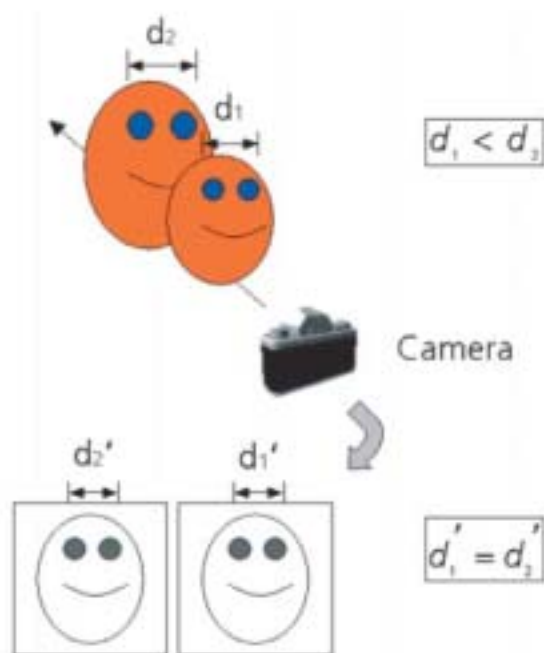
The acquisition of the face data is done with special 3-D scanners generating a geometric and, if necessary, additionally textured model, e.g. by a sequential projection of stripe patterns. The 3-D data are available with a defined scaling and without perspective distortion and can be rotated and transferred without loss. Since in practice no defined pose of the person to be identified can be achieved without some greater effort and a considerable loss of user acceptance the head orientation and position between the shots differ with both 3-D face data and 2-D face pictures. The possibility of a lossless correction and the transfer to a standard position is an essential feature for the processing and recognition of faces. There are more robust identification results of persons with 3-D systems than using 2-D systems, which are more heavily affected by varying face poses. There is also a positive effect of the three-dimensional scanning on the security of the face recognition system.

To which extent the 3-D face recognition systems available will be able to comply with these expectations and promises is the central question of the project. For clarification several commercial and prototypic systems were selected and tested in a 30-day field test with 50 to 200 persons. Another object of the investigation was the evaluation of possible combinations with two-dimensional approaches. After adjusting pose and illumination textured 3-D face data can also be

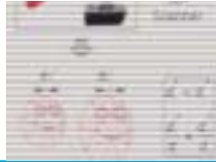
rendered into a two-dimensional representation and then be processed by a 2-D face recognition system.

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2-D face recognition: Levelling of the eye base



BioFinger II

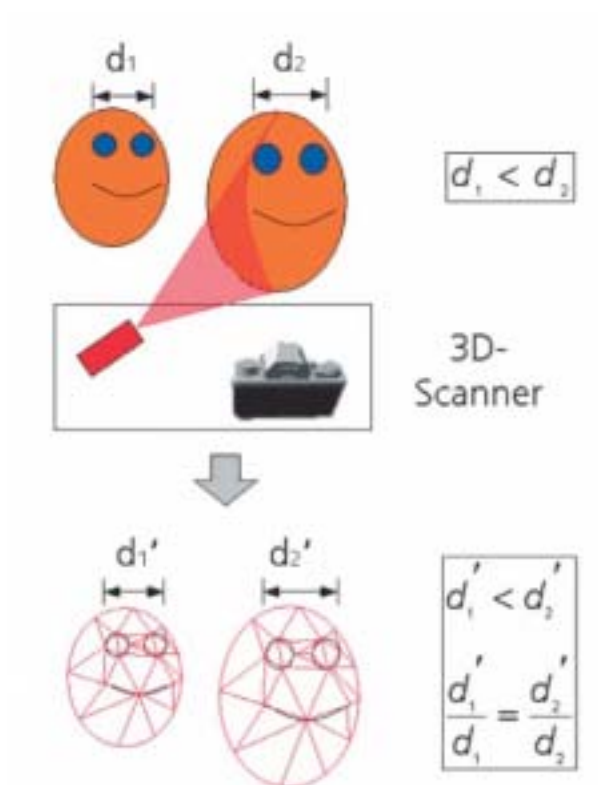
The fingerprint is the oldest biometric property ever used and the term often stands for identity and uniqueness, e.g. »genetic fingerprint«. This also adds to the fact that the sensor technology is comparably multifaceted and highly advanced. In the framework of the »Comparative study of fingerprint recognition systems - BioFinger« the properties of fingerprint recognition systems are analyzed. Background for this project is a possible integration of fingerprints into German personal documents aiming at improving the verification of identification card owners in the stages of entry and residence control.

Due to the particular requirements to personal documents like validity of 10 years the long-term stability of fingerprints as to their property to identify persons, among other things, is investigated. Fraunhofer IGD is performing this project on behalf of and in collaboration with the German Federal Office for Security in Information Technology (BSI) and the Federal Bureau of Criminal Investigation (BKA).

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3-D face recognition: Defined uniform scaling of the eye base

iDetective - Automated Discovery of Brand Piracy on the Internet

Brand and product piracy refers to the faking or counterfeiting of products. This violates trademarks, patents, or other industrial or intellectual property rights.

The DIHK (German Association of Chambers of Commerce and Industry) estimates that the annual economic damage caused by brand and product piracy amounts to 30 billion Euros for Germany. In addition there is an estimated abolition of 70,000 jobs within the last few years.

Specialized service providers offer brand and product monitoring for customers to survey and protect the use of their brands. This is achieved by so-called Internet detectives searching the World Wide Web for web sites that

contain the brand name or the logo of their customer or distribute fake merchandise via the Internet. So far the search itself has been executed manually or using current search engines as Google, Yahoo, etc.

The iDetective control and analysis tool enables Internet detectives to efficiently retrieve web content and analyze it on the basis of customer-specific criteria. In several steps the data is processed in flexibly configurable modules and analyzed under different criteria, such as semantic, syntactic and logic aspects. The search space includes Internet auctions (e.g. eBay, hood.de), price search machines (e.g. pricegrabber.com), or URLs mentioned in chat rooms.

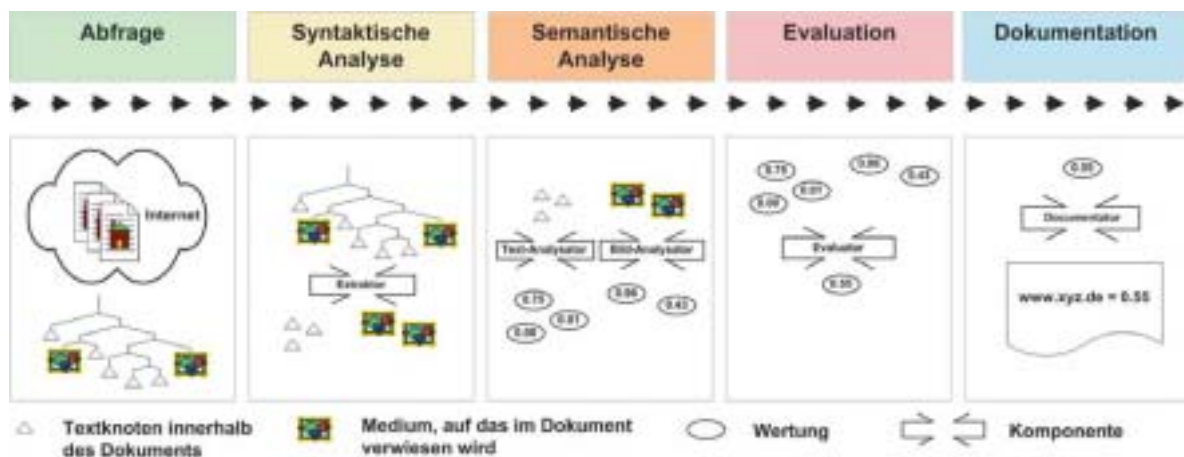
The search tool extensively uses innovative technologies such as text analysis as well as watermarking and fingerprinting methods. Using

watermarking technology it is possible to extract copyright information embedded in company logos and product images. Current fingerprinting systems provide the possibility to identify identical or similar multimedia data according to their perceptual hash value. This allows detecting also e.g. modified and scaled images.

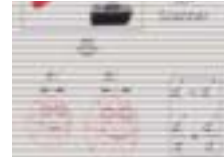
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Schematic diagram of data extraction and evaluation for the automated search of brand and product piracy



SicAri

The potential of today's information technology can only be exploited if the underlying infrastructure and the used applications sufficiently allow for the IT security aspects. The superordinate research objective of the project

»SicAri -A Security Architecture and its Tools for the Ubiquitous Internet Use« consists in developing a security architecture and the related tools for a secure use of the information technique. The infrastructure is realized by developing a modular kit with the corresponding instructions. The modular conception is the basis for a broad application field.

The SicAri project is jointly executed by several departments of Darmstadt Technical University (Darmstadt Center for IT Security), the Fraunhofer Institutes SIT and IGD as well as several partners from industry.

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AXMEDIS - Automating Production of Cross Media Content for Multi-channel Distribution

Due to the high pricing pressure music companies, multimedia providers, and the film industry must reduce their costs to remain successful and competitive in the market. Providers, dealers, and distributors of content need new mechanisms to enhance their performance. This can be reached by restructuring, automation, and by an acceleration of the production process. Present-day information technology and artificial intelligence can contribute to make the production process faster and cheaper. For this aim the production chain and the production process are simplified and automated by means of P2P technology and supported by production and formatting tools. Different content management systems are integrated and interoperably connected with each other by a P2P network. The copyright of the involved parties remains unaffected, protected by an innovative and flexible Digital Rights Management tool.

Within the project a framework is developed accelerating and optimizing the production and distribution of content (Production-on-Demand). The most important goal of the project is to develop consistent business models for projects and services based on the demonstration models. The development and the results of AXMEDIS are continuously evaluated and distributed by training activities, publications, and demonstrations at conferences and fairs.

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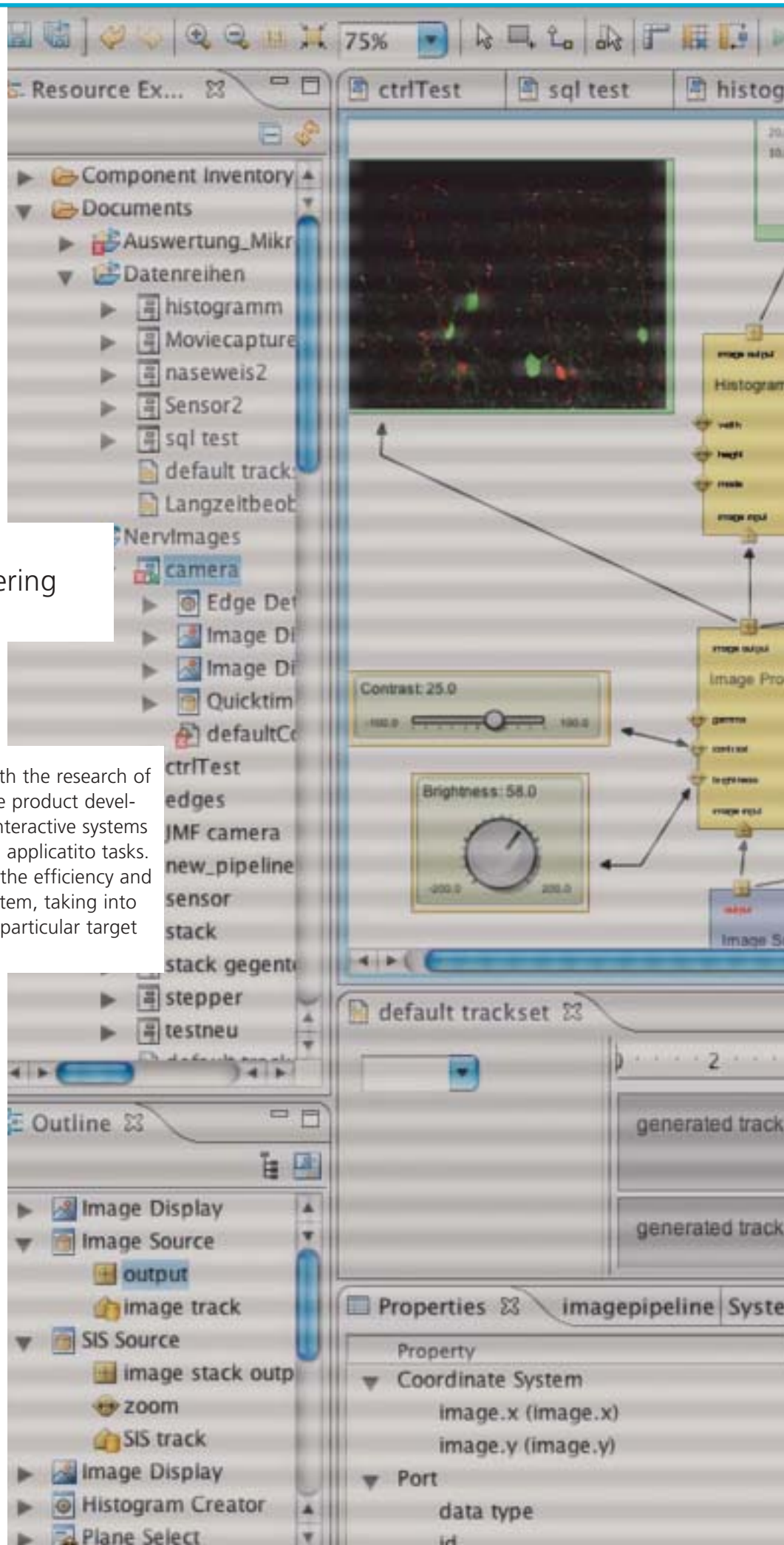
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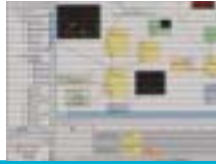
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Applications

Usability and Utility Engineering

Usability and Utility Engineering deals with the research of methods applied at different times of the product development cycle to secure the usability of interactive systems in view of the particular user groups and applicatio tasks. We attach great importance to securing the efficiency and on the satisfaction of the user with a system, taking into account the application context and the particular target group.





Interview with Dr. Jörg Voskamp

Dr. Voskamp, you are head of the department »Human Centered Interaction & Technologies«, the leading department of the business field »Usability and Utility Engineering« of Fraunhofer IGD. What does this business field deal with?

Dr. Voskamp: Among other things, Usability und Utility Engineering serves to secure the effectiveness of new visualization and interaction techniques in the context of different applications. Further aspects deal with securing the efficiency and with the satisfaction of a user interacting with a system, taking into account the application context and the particular target group.

Which is the target group of the business field?

Dr. Voskamp: Year after year, researchers all over the world are developing new technologies which are to present more information to the users of interactive devices - whether desktop computers or user interfaces of other computer-controlled systems and devices - and support them using these products.

In which domains Usability and Utility Engineering is already being used today?

Dr. Voskamp: Application fields for the Usability and Utility Engineering can be found where people work with mechanical or computer-supported user interfaces. This includes increasingly complex software applications in the office area and information visualization in application areas where it is possibly vital to acquire and process the displayed information in time. If, e.g., accident alerts, basing on analyzed traffic data, are visualized in motor cars via so-called head-up displays it must be ensured that these alerts are perceived by the driver.

Which research aspects are pursued by the business field?

Dr. Voskamp: Usability and Utility Engineering investigates methods applied at different times of the product development cycle to secure the usability of interactive systems in view of the different user groups and application tasks. In order to achieve this goal the following research aspects are pursued: The development of usability and utility methods for all stages of the product development process, the integration of Usability und Utility Engineering into the product development process, the development of criteria



Dr. Jörg Voskamp

and taxonomies for novel interaction techniques and new user groups, and the development and use of automated qualitative and quantitative evaluation tools.

What are the strengths of Usability and Utility Engineering?

Dr. Voskamp: Usability and Utility Engineering presents itself as a research area, the strength of the business field, however, becomes especially apparent in the fact that, beside research work, also services are offered and asked for by the industry, e.g., to support and secure the development of usable products.

How do you assess the potential of Usability and Utility Engineering? How could the business field develop in the next years?

Dr. Voskamp: The user interfaces of new systems are getting more and more complex due to their vast functionality and this trend will continue for single devices. Here a service and task domain for the Usability and Utility Engineering unfolds. We will have an increasing need of research in the use of newly developed technologies like Ambient Intelligence or Affective and Perceptual Computing, since the research in view of the potential of the Usability and Utility Engineering is still in its infancy.

Dr. Voskamp, many thanks for the interview.

Consultation on the Development of a New User Interface for the arivis Platform

With its new product »arivis Platform« the company arivis - Multiple Image Tools GmbH develops new ways for acquiring, visualizing and analyzing experimental data in science and technology. The objective of the system is to develop a flexibly but intuitively usable toolkit which allows working with data of different dimensionality and origin. Because of the complexity of the workflows to be depicted especially when analyzing heterogeneous data, an intuitive usability of the user interface is of immense importance. Therefore it is necessary to define suitable interaction metaphors and their consistent usage throughout all parts of the user interface of the product. The introduction of the above men-

tioned new concepts on data management makes it necessary to develop new interaction concepts and metaphors as well and to evaluate their usability.

The main objective of the project was to increase the intuitivity of user interaction with the product and therefore the improvement of the market acceptance of the product »arivis Platform«.

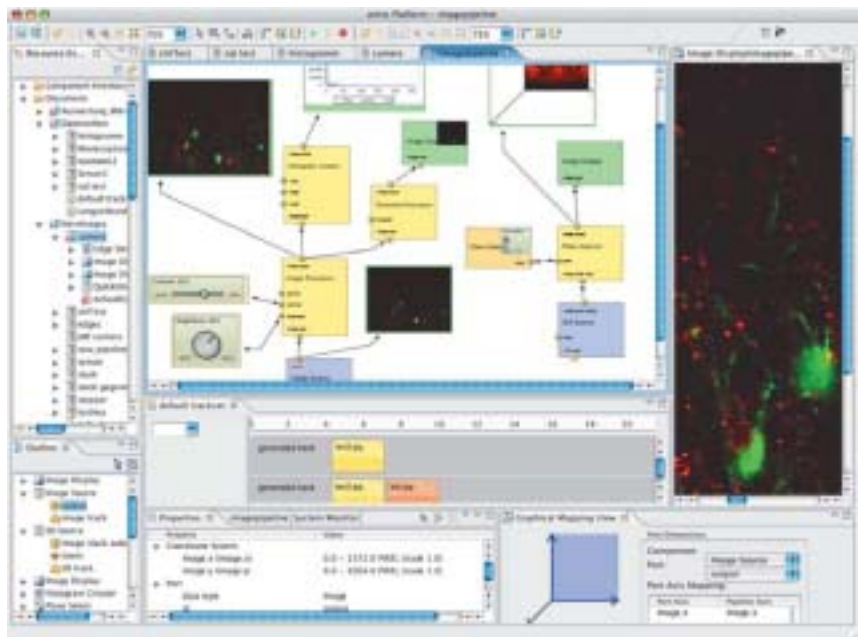
The development of the user interface of the product »arivis Platform« has been accompanied in a consulting way by Fraunhofer IGD Rostock. The usability of the new user interface has been evaluated and optimized by systematic usability evaluation.

The usability experts of Fraunhofer IGD Rostock have been integrated into the development process of the new user interface of the »arivis Platform«.

Therefore they took part in several workshops that have been carried out in regard to the development of new interaction metaphors. Basing on current internal prototypes Fraunhofer IGD Rostock evaluated the new user interface of the »arivis Platform«. The evaluation bases on heuristics and guide lines for interface design and dialogue behavior of interactive applications following the state of the art.

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Sample application of »arivis Platform«

The objective of the project »Usability expertise ARGUS ND« was to evaluate the usability of the application »ARGUS ND« by usability and user interface experts.

After a quick examination of the application, deficits and optimization potential of the user interface of »ARGUS ND« have been identified based on guide lines and heuristics for user interface design and dialogue behavior of interactive applications following the state of the art.

The outcome of the project was a usability expert's opinion, containing a prioritized package of measures to be the basis for continued application development.

The realized debit-credit comparison of the usability expertise for the user interface of »ARGUS ND« has been oriented on existing guidelines and heuristics like DIN EN ISO 9241-10 or DIN EN ISO 13407.

Identified deficits and optimization potential have been prioritized, showing the respective problem weight, and complemented by recommendations for improvements.

In a finalizing workshop the project results have been presented and made available in printed form. They will support the project leader and the leading partner of development of »ARGUS ND« when implementing further versions.

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Main screen of the application
»ARGUS ND«

Applications

Ambient Intelligence

To make the vision of an intelligent environment come true we need a combination of different technologies and research areas. It is the aim to create an intelligent proactive environment, therefore Ambient Intelligence, in which not only the human being can communicate with the devices but also the devices and the sensors communicate with each other. So they will realize the objectives of the user and react according to his wishes.



Interview with Dr. Reiner Wichert

Dr. Wichert, you are head of the department »Ambient Intelligence«, the leading department of the business field »Ambient Intelligence« of Fraunhofer IGD. What does the business field deal with?

Dr. Wichert: Ambient Intelligence deals with the networking of intelligent devices and sensors in the environment. The sensors have the task to identify the different wishes and needs of the users in the environment. This is achieved by combining the sensor information and then interpreting it. In this way the aims of the user can be derived and realized on the devices close-by.

Which target groups does the business field address?

Dr. Wichert: The business field can be divided into quite a number of categories. Those areas that are probably realizable best for the near future are production and logistics, home environment and office, travel and health assistance, and support for elderly or handicapped persons.

In which areas Ambient Intelligence is already used?

Dr. Wichert: Facets of Ambient Intelligence are already used in homes, e.g. with intelligent access systems to buildings or rooms and control systems of devices like the control of the room temperature by adjusting the blinds or the heating system control. Ambient Intelligence as an overall reactive environment is, however, only tested in cooperation of homes with research institutions so far.

Which do you think will be possible application areas for Ambient Intelligence in the future?



Networking of devices and sensors in the environment of the user (auditorium) forming an ad-hoc ensemble.



Dr. Reiner Wichert

Dr. Wichert: As already mentioned the fields of production and logistics, home environment and office, travel and travel assistance, as well as health and old people assistance will play a major role. Because of the permanently advancing state of the art the future will bring along an extension of the device networks. This means we go from single solutions to a complete device network reacting as a whole. The devices will increasingly be invisibly integrated into the environment so that the user will no longer perceive them explicitly. He will rather communicate directly with the environment. The environment will interact autonomously or will make suggestions to the user.

Which potential do you see in the field of Ambient Intelligence? Will the intelligent environment be ubiquitous one day?

Dr. Wichert: The potential is enormous. Limitations might only result from a too big flood of information in environments with an extreme number of devices and sensors and the capacity of the network itself. A complete networking of our environment will perhaps be possible as early as in ten years, if all device manufacturers agreed on a uniform standard. But until this goal will be reached some difficulties must still be overcome.

Dr. Wichert, many thanks for the interview.

DynAMITE - Dynamic Adaptive Multimodal IT-Ensembles

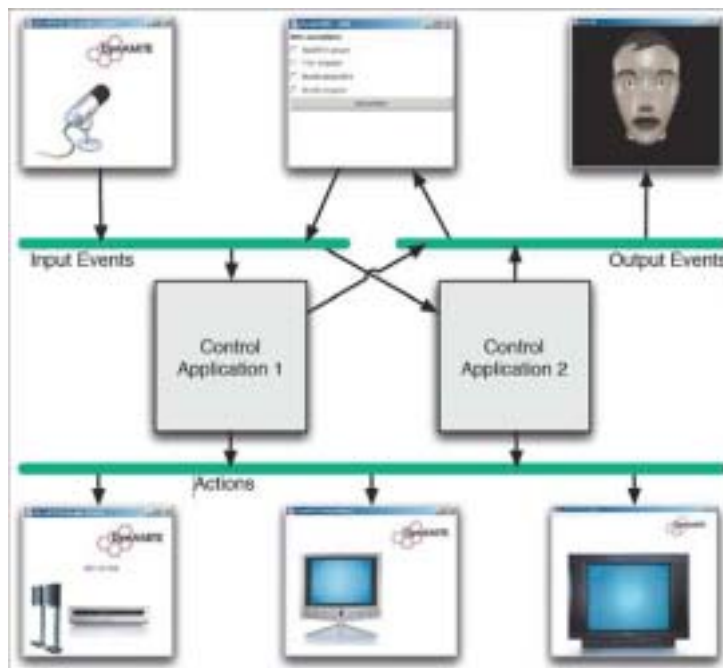
In the future devices that offer an extensive amount of functionalities will be replaced by device ensembles that will connect dynamically and will cooperate in an ad-hoc fashion. Consequently more flexibility and assistance with regard to the users will be possible compared with today's »heavy weight« devices. The main goal of the DynAMITE project is to realize and to support the communication and cooperation of spontaneous device ensembles. The software infrastructure that is developed in DynAMITE bears down some disadvantages of conventional and well-known approaches. Communication infrastructures that are basing on central routing components or distributed infrastructures, respectively, that are using publish/subscribe principles with component based service discovery mechanisms are not suited for the realization of spontaneous and

dynamic device ensembles. In order to realize this kind of self-organization the dynamite infrastructure allows the definition of component topologies and the implementation of ontology-based conflict resolution strategies that guarantee the reliability of the underlying communication mechanisms. Consequently this approach makes it possible that additional devices are able to integrate themselves into the communication model of already existing device ensembles. Also the execution of the conflict resolution mechanisms is able to solve upcoming conflicts of competing devices (e.g. for the same message or task) in a cooperative manner. The DynAMITE software infrastructure is implemented completely distributed. Thus device ensembles can be built up without the need to define a master device. At the moment DynAMITE supports devices that are using the UPnP (Universal Plug and Play) standard. An additional research focus of DynAMITE lies within the interaction of humans with dynamic device

ensembles. Because humans will interact with distributed devices in a comprehensive manner, DynAMITE is developing strategies for the interpretation of those interactions as well as strategies that support multiple input and output modalities. In DynAMITE interactions of the users' are interpreted by distributed strategic components, whose action plans are executed by the actuators of the participating devices. After the realization of the distributed software infrastructure and the distributed conflict resolution strategies (some demonstrators implemented in the Java programming language are available on the project web site <http://www.dynamite-project.org>) the DynAMITE project partners are building up some prototypes within the home environment and office domain.

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Components and topology of the DynAMITE project



PECo – Personal Environment Controller

The Personal Environment Controller (PECo) is a digital assistant system developed by the Fraunhofer IGD. The software solution - coming from the Ambient Intelligence group - provides the user with a single system for interaction with various devices of complex environments.

PECo connects the user with his environment at home, at his office or while traveling. PECo provides the user with a 3D-visualization of his environment showing him the current situation of the room and its devices. The 3D-visualization links the real environment with the virtual 3D-objects thus allowing the user to interact with all devices of his environment; even with tiny devices invisibly embedded into the environment.

The user can manipulate the environment by just clicking on the 3D-object. For example the user can present his slides on a specific projector by just applying a Drag & Drop operation. He picks the corresponding file and drops it on the 3D-object of the target display. In the same manner, the user can darken blind shutters by just clicking on the corresponding 3D-object. By doing so, the user is able to access devices based on their position, orientation within the room and their look. He does not need to have knowledge about special device names, IP numbers or device paths. The user can store own preset actions for different environments which are stored in form of macros.

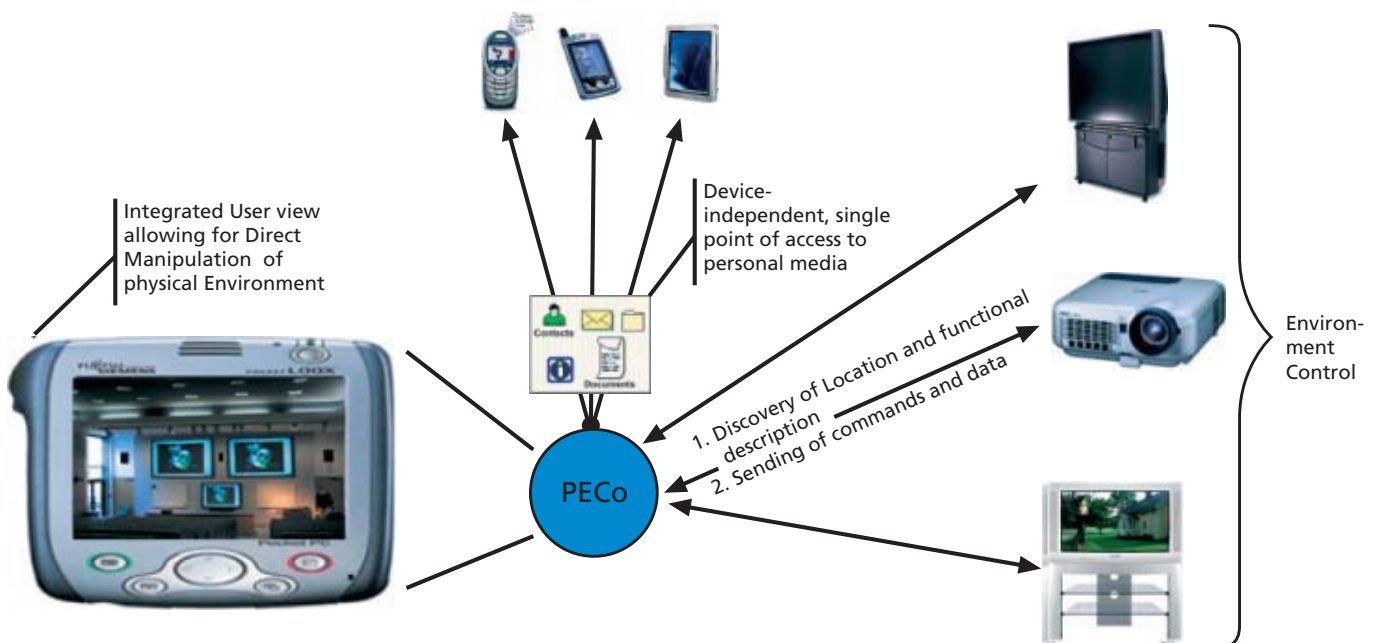
The PECo system is deployed to two conference rooms of the Fraunhofer IGD where it has been used for media control since last year.

The PECo system consists of the following functional components.

The environment is composed by the physical room, embedded stationary and mobile devices (i.e. light, TV, beamer) as well as by the user's personal appliances such as his notebook and smart phone. Furthermore, the environment embeds also sensing components.

The Environment Control component provides services for accessing the user's physical environment. It is the interaction appliance running on a PDA or tablet pc (see Figure below).

The novel 3D-based user interface serves as a control point for the whole system. It provides means for Human-Environment-Interaction and serves as a dialogue management system. It performs the detection and integration of the devices available in a room. The 3D visualization makes a direct link between physical devices and their 3D representation. These virtual links help the user to orientate himself in complex environments.



PECo Interaction Appliance

Applications

Ambient Intelligence

The Media Management component is a device-independent single point of access to personal media. It makes media that are distributed over the user's personal appliances accessible for him, providing a unified facility to organize and address the different media repositories, which the user has at his disposal.

The components for Environment Monitoring and Personal Agenda enable situation-aware assisting. They provide an environment model, which integrates device profiles, geometry model, description of services providing access for a certain device and a 3D model of the ambient and containing devices.

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The Environment Monitoring component provides relevant context information for the PECO system.



Names, Dates, Events



Events

Fraunhofer IGD at the CeBIT 2005

In 2005, the Fraunhofer IGD introduced innovative developments in computer graphics at the world's largest trade fair, CeBIT, in Hannover, Germany. The exhibits presented by the Fraunhofer IGD ranged from digital assistance systems and mobile geo information systems to innovative security technologies.

Firm grip on multimedia

Personal Environment Controller - it's the full name of the digital operating assistant PECo developed by Fraunhofer researchers. The innovative software solution from the field of »Ambient Intelligence« enables the user to control the most varied devices interactively with only a single remote control for the first time.

In an uncomplicated way, PECo connects the user with the technology integrated in his environment - in the office, at home or while traveling. The software, e.g. installed on a PDA, is intuitively controllable through the display. Three-dimensional representation of the environment allows the user rapid and easy access to all the devices surrounding him. Also inside unknown technical infrastructures like an unfamiliar conference hall, the speaker finds his way around easily with PECo. Touching the display suffices to control the multimedia equipment per radio, not requiring technical training.

Mobile and extremely well informed

Soon a mobile phone will suffice to find the way in a strange city, inform oneself about interesting sights and be in the picture about upcoming events. This is enabled by the mobile and location-related services developed by researchers of the department Graphic Information Systems. Adapted to the



All devices under control with PECo

specific demands of the relevant terminal device, these mobile services provide, amongst others, interactive city plans, audiovisual presentations and numerous interesting additional information directly on the mobile phone.

If a visitor wishes information on a building or sight, choosing the relevant symbol on the mobile phone display suffices and the corresponding background info appears in the shape of 3D models, graphics, video sequences or texts.

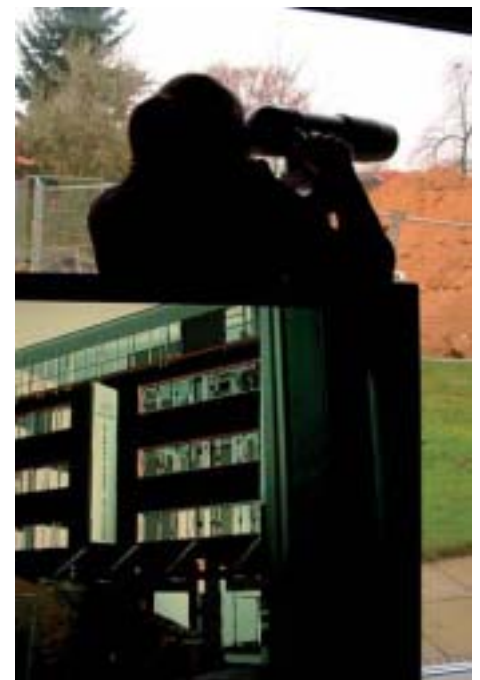
But what when a visitor does not know the name of the building in front of him? For this case the researchers have developed the so-called SketchQuery. Contrary to conventional navigation and information systems SketchQuery is not text-, but graphic- and sketch-controlled. Here it will do when the user draws up a rough sketch of a building or object on the display of his mobile phone and he is shown a map, the name,

location, route plan and further interesting additional information. For this the system compares information from the sketch with its database and presents the target areas in question to the user. All information is intuitive and playfully simple retrievable.

View into hidden worlds

Purely from the outside, the AR Telescope hardly distinguishes itself from its predecessors, the coin-operated telescopes that any tourist knows from viewing platforms. But a view through its ocular opens fascinating worlds. Animal species long extinct awake to a new life, buildings from past centuries stand in new splendor and even buildings not yet finished rise to their future shape before the viewer's eyes.

This becomes possible as the telescope works with Augmented Reality technologies: in the AR Telescope the real view is superimposed by a computer-generated world. This makes archaeological bygones, invisible geological



Already in 2005, the AR Telescope showed what the future building of the INI-GraphicsNet Stiftung was going to look like in 2006.



matter or buildings-to-be visible in their real surroundings. For this purpose, the scenery is being filmed with a camera mounted on the front of the telescope. Sensors measure the telescope's alignment and thus provide the computer with the information in which direction the viewer is currently watching. The mix of virtual and real images then becomes visible on a small monitor fixed behind the ocular. In addition, further information like geographic, demographic or historic data can be shown in real time.

The multitude of information that can be communicated by the AR Telescope, as well as its intuitive operation, opens a broad spectrum of possible application areas, from pure information systems up to entertainment and knowledge transfer at museums or tourist sights.

New technologies for more security BioFace - the face as key

Instead of keys, cards, PIN-numbers and identity papers, soon fingerprints, iris and face shape will serve to identify us forgery-proof and unmistakably. One of the options of biometric identification is face recognition.

In the course of the BioFace project series a group of researchers of the department Security Technology in Graphics and Communication Systems is working on the conversion of face-recognizing algorithms, as well as on researching the performance and reliability of this procedure. Here, 3D face recognition systems promise a more reliable identification than conventional two-dimensional systems. This was to be researched in BioFace V. With a 3D face recognition system, the faces of those with entry authorization will be scanned first. For better recognition the scanner does not only take in the shape of a face, but also eye and hair colors. After this the scanned

face is saved on the computer. If one of these registered users wishes to enter the building, he will have his face scanned at the entry, the system will recognize it and the doors open.

GEOMARK: 3D data reliably protected

There was hardly a way to protect three-dimensional models until now. To close this gap, researchers of the department Security Technology in Graphics and Communication Systems in Darmstadt, Germany, have developed the GEOMARK system. With GEOMARK, data on copyright protection, model authentication, license information or something similar can be integrated in polygon models, through which illegal copies can be traced back. With the aid of a secret key the developer builds the data into the model and only those who know this key can pick out the watermark. For the user however, it remains invisible. Wolfgang Funk, who works on the development of GEOMARK, sees its high robustness as a further advantage to conventional systems. Contrary to other methods, GEOMARK is resis-

tant to the most varied processing steps and is also preserved when the data format is changed.

Mobile phone brings the beat

A special software technology for mobile phones, developed by researchers of the Fraunhofer IGD in Rostock will allow joggers in future to run synchronal with their favorite music. A motion sensor, which is connected to the mobile phone via Bluetooth can be easily attached to the body, measures the runner's step frequency and adapts the speed of music - without distorting the quality. »The mobile phone has become a daily companion for man and is not only used for calling or sending text messages anymore«, thus Holger Diener, head of the Entertainment Technologies Department of the Fraunhofer IGD Rostock. »Particularly in the fitness and health area the evermore powerful mobile phones can be well applied in various ways.« Numerous studies confirm that music not only motivates the runner, but also contributes to his performance.



The 3D-Scanner allows for a reliable identification of persons.

Lange Nacht der Wissenschaften – Long Night of Science

Who says that computer scientists only sit in their little chamber, feeding dry figures into the PC and programming? For the first time the Fraunhofer Institute for Computer Graphics IGD and Computer Graphics Center ZGDV took part in the »Long Night of Science« and invited to Rostock-Südstadt on April 28, 2005. The researchers of both institutes gave interesting insights into developments and applications for numerous visitors in the field of computer graphics. Themed »Experienceable Computer Worlds« the guests could find out, which novelties the scientists fiddle about in the House of Graphics actually.

More than 400 visitors had the possibility to experience and test the developed products and results by themselves. The guests tested running with the »StepMan« in the optimum beat of the music, did a computer simulated tour into the interior of a ship, read books virtually or experienced a flight over Rostock and Warnemünde. Various live-demonstrations were supported by talks and also by a panel discussion »How do computers influence our life? Where are the borders?«.

During the »Long Night of Science« the guests could listen to the band »Zweieck« in the foyer of the Fraunhofer Institute.

Traffic Day – New media prepare local public transport for the future

Demographic change, increasing pressure of costs and decreasing subsidies increasingly force local public transport (ÖPNV) to adapt its offer to customer needs. To cope with these demands, local public transport companies are increasingly using modern information and communication systems, which help to make available structured offers and dynamic passenger information. In addition to the information displays already frequently used at stops, the customer is also more and more offered the possibility to check information on departure times, entry and changing points or local public transport offers, order tickets or use other services, via Internet or mobile phone.

To cope with these demands, the Fraunhofer IGD in Darmstadt, Germany, is developing innovative solutions in a multitude of projects. Whether you think of new tools to simulate and manage faults, efficient information systems, or mobile service platforms, modern information and communication systems contribute to

more customer-oriented working of local public transport companies in many and varied ways.

An exiting and practical view into new and innovative technologies that contribute to shape local public transport more customer friendly, was offered by the Fraunhofer IGD in the course of Traffic Day on Tuesday May 17, 2005.

Noted experts from renowned businesses and institutions demonstrated in interesting short lectures which demands and aims of their customers local public transport companies are confronted with and which technical innovations can meet these demands.

The participants of the TrafficDay were given a practical insight into this topic by different demonstrations. Among other things, the Mobile Ticketing was presented: The user can book any ticket (e.g. for public transport, an event, etc.) using his mobile terminal.

The presentation of the EU project »Virtual Fires« showed »three-dimensional fires« »laid« to test the effectiveness of fire fighting measures: Fire-brigades can plan their actions using simulated fire situations in buildings, vehicles, or tunnels, securely and ecologically harmless. Other demonstrations were given concerning mobile traffic information systems, 3D navigation and traffic management support in the Internet.

ZGDV and Fraunhofer IGD presented »Fascination Computer Game«

More than one billion Euros are spent on computer games in Germany each year. It is long ago that only children and teenagers were fascinated by games. The game virus more and more infects adults. They are hunting virtual poultry, replay soccer world

cups or plan the conquest of enemy kingdoms during large-scale strategic games.

However, what makes computer games so fascinating to grown-ups and kids? Why did a simple game idea »Moorhuhnjagd« become such a major success? How can game elements be used in education and training to increase learning success?

During the GameDays from May 24 to 26, 2005, we were getting to the bottom of these and many more questions on computer games. The event was initiated and organized by the Computer Graphics Center ZGDV in Darmstadt and the Fraunhofer Institute for Computer Graphics Research IGD in Rostock, in cooperation with Prof. Dr. Maic Masuch from the Institute for Simulation and Graphics at the Otto-von-Guericke Universität Magdeburg. During numerous presentations and lectures renowned science and business experts gave insight into the fascinating world of computer games.

Science meets business

The first two days of the GameDays were themed by the slogan »Science meets Business« and mainly intended for industry and research participants. Visitors were introduced to the latest computer games and playful learning applications and offered insight into the technological background.

On Tuesday, May 24, the lectures dealt with the topics »Computer games: theory and praxis« and »Playful learning applications in education and further training«. On Wednesday, May 25, presentations covered the topics »Technology, Modeling & Rendering«, »Hardware«, »Mobile computer games and Augmented Reality« and »Soccer World Cup 2006«.



Up: On the GameDays' family day, children could try numerous games by themselves.

Right: Townsman 2 presented by HandyGames.



Corpus Christi is family day

On Corpus Christi, the last day of the GameDays, the whole family was invited to experience computer games live. This day provided the opportunity to catch up on current developments of the ZGDV and the Fraunhofer IGD. Parallel to this a child lecture introduced the world of computer games, a play-cave offered entry to Computer Graphics and children had the opportunity to develop their own computer game.

Workshop on Visual Analytics

Experts from both the United States and Europe were invited to the Fraunhofer Institute of Computer Graphics in Darmstadt to discuss visions and ideas in the emerging field of Visual Analytics. The workshop was jointly organized by Fraunhofer IGD and the University of Konstanz. The goal of the workshop was to bring together leading experts to exchange ideas as well as to clarify terms and present agendas in this young field.

The talks in the workshop covered a number of issues regarding the research agenda for the mid-term future of Visual Analytics, especially the treatment of very large data-sets and the role of perception. Other presentations provided an in-depth view on topics like semantics, geographical information analysis, and visualization of time-dependent data. Deliberately much room was left for discussion and the workshop was closed by a panel discussion on the Top 10 research topics and application areas for the near future.

Though no final ranking order could be agreed upon, it became apparent that future research centers around the following topics: Human Information Discourse, Semantics, Visualization Evaluation, Scalability, Data Streams, Synthesis for different Applications, Data Quality / Uncertainty, Data Provenance, User Adaptability.

ZGDV and Fraunhofer IGD active at »hessen-IT around the clock«

»hessen-IT around the clock« was the motto of the first Hessian 24-hour IT congress. From September 7 to 8, themes like IT security, eLearning, or the mobile office were in the focus at the Campus West end in Frankfurt. In a 24-hour non-stop program numerous workshops, demonstrations, and an exhibition presented the latest trends and innovations of the information and communication technology to the visitors. The event, organized by the Ministry of Economics, Traffic, and State Development of the State of Hesse addressed the whole IT sector: producers, users, public administration, service providers, students, and scientists of all age groups had the opportunity to get in touch with each other. Open during the whole time, the exhibition invited to learn about and to test the latest technologies.

Among these were also some developments of Computer Graphics Research Center ZGDV as well as a development of the Fraunhofer Institute for Computer Graphics Research.

The StepMan, for example, developed by the researchers of Fraunhofer IGD in Rostock makes sure that joggers don't come out of step, for the StepMan automatically adjusts the beat to the speed of the jogger. The visitors of the hessen-IT congress could see for themselves that this does not derogate the quality of sound.

Another highlight were the many night events. From 10 p.m. to 9 a.m. the visitors could take part in more lectures and demonstrations, marvel at performances of action artists, experience an impressing image quality in the digital cinema, or relax in the game lounge.

Unobstructed View for Doctors

MEDARPA - this is the name of the joint project that will considerably facilitate minimal-invasive operations. Among the eight partners of the MEDARPA Consortium are the Center for Computer Graphics Research ZGDV, Fraunhofer Institute for Computer Graphics IGD, and MedCom GmbH. Within the project the Darmstadt researchers have developed the so-called »Augmented Reality Window«. This transparent display enables the surgeon to get a virtual view into the body of the patient during the operation. This Augmented Reality, AR, superimposes the real view, spatially and in real time, with additional information.

In the MEDARPA (Medical Augmented Reality for Patients) project the previously acquired patient data, e.g. of ultrasound or computer tomography examinations, are visualized three-dimensionally in the AR window.

Looking through the display, the surgeon sees both the patient and the superimposed data. So, even at »key-hole operations«, the surgeon can freely navigate in those parts of the body not directly visible to him.

Since 2002 the system has been tested in the cardiosurgery at the university hospital Frankfurt/Main and at the radiation hospital in Offenbach for operations and used for medical training. In 2005, Michael Schnaider, Bernd Schwald, and Helmut Seibert (all ZGDV), Stefan Wesarg and Georgios Sakas (both Fraunhofer IGD), as well as Pawel Zogal (MedCom) were awarded the Medical Prize at Eurographics 2005. The AR navigation system prevailed over the competitors on the second place.

Eurographics is the leading association in the field of Computer Graphics and celebrated its 20-year jubilee this year.

The annual conference took place in Dublin, Ireland from August 29 to September 2, 2005. The prize is awarded biennially.

An Easy Way of Learning

In the scope of the German eLearning Symposium of the Gesellschaft für Informatik (Delfi) and the annual convention of the Gesellschaft für Medien in der Wissenschaft (GMW) Fraunhofer IGD, together with the University of Rostock, organized the workshop »Game-Based-Learning« on September 13, 2005. Contributions of the Institute, the Universities of Rostock, Duisburg-Essen, Magdeburg, the UAS Erfurt as well as the Games Academy Berlin were the basis for creative discussions where the participants exchanged their ideas about how playing and learning techniques from the field of computer games can be integrated into the conventional training concepts. It is the aim to add



MEDARPA used in an operation theater test scenario at University hospital Frankfurt/Main, Germany.



fun and emotions to the learning process as well as interaction offers. »The playful learning, often conjured up as a didactic means for motivation, can be used for all age groups. Different learning contents, from basic arithmetic operations over historic events up to complex issues, can be imparted by simulation and strategic games,« so Prof. Dr. Urban, head of Fraunhofer IGD Rostock and the eLearning department, »the programs allowing for the individual learning progress.« By an immediate application and testing of the newly acquired knowledge the game-based learning generates a lasting memory effect. »To call computer games pure stopgaps for leisure times is not adequate«, Holger Diener said, head of the Entertainment Technologies department of Fraunhofer IGD. »Games show features which are also desirable for the eLearning domain: They stimulate communication, are instructive, they easily convey their functionality through different levels of difficulty or by means of virtual characters, and they motivate due to their entertainment character.« Another advantage: a new independence of the time and place of learning. The regular attendance of specific training institutions at fixed times will therefore be a thing of the past.

Interactive, Three-dimensional, Mobile – Geodata in a New Dimension

The Graphic Information Systems department of Fraunhofer Institute for Computer Graphics deals with the processing of spatial 3D data by means of geo information systems in various projects. Some of these developments were introduced at the largest fair worldwide for geodesy, geo information, and land management, INTER-GEO 2005, from October 4 to 6, 2005, in Düsseldorf.

One of the technologies presented is the CityServer3D. This is a 3D geodata server, able to access different database systems and formats and thus allowing for an efficient management and storage of the data. Geometries as well as their topologies, materials, facts, and meta information like level of detail or addresses can be stored in it.

Due to this detailed and structured information it is possible to perform specific queries with thematic and time conditions, to filter single elements, or extract complete landscape models.

The core of the CityServer3D is the server component. It enables the access to the data stored in the database via different interfaces. Furthermore, it is structured in a way that further data sources can additionally be accessed in form of external databases or files. For this purpose the server possesses a meta model in his kernel which processes the transferred data and transfers them in 2D or 3D format to the clients or other servers via different interfaces.

On the basis of the CityServer3D technology it is, possible e.g., to realize three-dimensional city maps on the mobile phone. These city maps do not only facilitate the orientation of tourists, they also give additional information on hotels, sights, or events. They enable a virtual trip through different epochs so that the tourist can not only navigate through the present streets and sights but also experience how the city has changed in the course of time. He can also navigate through three-dimensional architectural models, look at details, and in this way explore the building virtually.

Dental CAD Software »viRus« Awarded with IST Prize 2006

Coronas and inlays made of ceramics are increasingly used for dental restoration. They are hardly visible in the mouth, show a similar degree of hardness as the natural tooth, and are by far more durable than e.g. amalgam. Following this trend, also CAD and CAM systems used for modeling these dental pieces gain in importance. The conventional systems, however, require numerous manual operations and a good spatial sense of the dental technician. This decreases the quality and, at the same time, raises the prices. By order of and in cooperation with the HintEL's GmbH Fraunhofer Institute for Computer Graphics IGD are developing the CAD software viRus allowing to fully automatically reconstruct, visualize, and modify coronas and inlays. The system reduces manual operations to a minimum and thus minimizes the expenditure of time and the treatment cost. Inaccuracies which can easily occur in the conventional multi-level process are avoided with viRus.

Basis of the reconstruction is a three-dimensional model of the patient's dentition made by the dentist using an intra-oral camera or by scanning a gypsum model. It shows the affected tooth, the two adjacent teeth, as well as the antagonists. In contrast to other systems viRus possesses a database with virtual tooth models. Instead of reshaping the replacement the dentist simply selects from the database. The model that resembles best the natural tooth of the patient is then virtually superimposed with the remaining piece and suited to the affected tooth and the surrounding teeth. To be able to execute final manual corrections viRus provides various tools to enable the dentist to individually adjust the indentations and edges of the tooth. Even an individual tooth database for

particular patients is realizable with viRus. If such a database has been started for a patient the dentist can, if necessary, implant an exact copy of the original tooth. In the meantime, HintEL's are marketing their technology worldwide.

The innovation force of viRus was awarded the European Information Society Technologies Prize 2006, shortly IST Prize 2006, on October 6, 2005. The prize has been awarded by the European Council of Applied Sciences and Engineering on behalf of the European Union since 1995 to honor the development of particularly innovative products all over Europe.

Fraunhofer IGD Presents the Media Technology of the Future

Promising technologies in the media domain were the focus of the workshop »Future Challenges for Media Management and Monitoring«. The workshop took place on the premises of Fraunhofer Institute for Computer Graphics in Darmstadt on October 17 and 18, 2005. It was organized by the Cognitive Computing and Medical Imaging department of Fraunhofer IGD and funded by the IST research program of the European Commission.

The growing availability of broadband networks and digital contents offers chances for new applications to the media industry, but, at the same time, entails big challenges. The amount of content offered is growing every day and the progressing approach of television and the Internet additionally contributes to this development. As a result, the demands on an effective management of the digital media are increasing too. How can we cope with these challenges? Which new technologies have already been used by the companies? Which is the direction the technological developments take?



Numerous guests attended the interesting lectures of the workshop »Future Challenges for Media Management and Monitoring«.

The exhibit of the workshop »Future Challenges for Media Management and Monitoring« offered the attendees the possibility to try new technologies by themselves.



Which are the benefits for the media consumers? These and many other questions were answered by international expert from science and business in the course of the event.

The two-day workshop was split up into four thematic blocks. The first block dealt with new technologies for controlling digital media from the field of market research, e.g. for the generation of advertising statistics or the pursuit of sponsoring activities. The topics included the requirements for such systems resulting from the medium television becoming a digital media.

The second thematic block gave an overview of the current state of the art of the analysis, management, and search of digital media. Dr. Jutta Williamowski, scientific assistant at the research department of Xerox, explained how they categorize pictures easily and quickly by means of a predefined classification. Holger Großmann of Fraunhofer IDMT presented a system serving to search for music using metadata technologies.

In a third part experts from renowned companies presented methods for the media production and media archiving. Within this scope David Rayers, scientific assistant of the BBC R&D, explained the new role of television



stations in times of manifold medial distribution channels. He showed the different distribution technologies BBC are already using and the technical and organizational challenges resulting from using many different distribution channels.

The fourth and last thematic block dealt with the expected video and audio consumption. Jean Pierre Evain, executive developer of the European Broadcasting Union, the largest professional association of national broadcasters worldwide, pointed out which challenges the broadcasters have to cope with, resulting from new developments like TV-Anytime. Furthermore, André Zehl, T-Online, introduced success criteria for future media offers. During the two days, these and many other short talks of established experts gave a comprehensive insight into innovative media technologies and the media management in the digital age.

eLearning Made in Mecklenburg-Vorpommern – 3rd Regional Conference on computer-aided Learning

eLearning is no longer a buzzword: In Mecklenburg-Vorpommern the computer-aided learning has developed into one self-contained area of expertise. Local providers, companies, researchers, and users met at the two-day conference on October 24 and 25, 2005, to share experiences and new ideas.

Just under a third of the German enterprises have their staff be trained by mouse click. eLearning offers many advantages for them: This kind of professional learning is easily available and saves costs and time. »The companies' acceptance of the new way of training still needs encouragement - this is also true in Mecklenburg-Vorpommern«, Sybille Hambach, co-orga-

nizer of the conference and head of the eLearning group of Fraunhofer IGD Rostock, said. »Especially small and medium-sized enterprises still show considerable reservation.« Developers, providers, researchers, and users exchanged the latest ideas, concepts, and solutions to optimally meet the eLearning requirements of all parties. »While the developers are including the latest state of the art making the most of the technical means the users are rather interested in the suitability for the daily use and the practicability of eLearning applications«, Sybille Hambach explained.

What is meant by customer orientation in the field of eLearning? What are the experiences companies make using eLearning applications? What are the current development trends like? These and other questions were answered by experts from science and practice. Besides interesting expert contributions of research institutions like the Universities of Rostock and Hamburg, the Universities of Wismar and Stralsund, the Universities of applied sciences of Wismar and Stralsund, the Center for Computer Graphics Research (ZGDV) and Fraunhofer IGD as well as established companies like ANOVA Multimedia Studios Rostock, PLANET internet commerce, MarineSoft Rostock, TTLline, and many educational institutions, interested participants discussed different aspect of computer-supported learning in working groups. The workshops informed e.g. about technologies of advanced training for the maritime industry, discussed business fields for eLearning, presented project results and new education concepts.

Adding to Mobility Using Location-based Services – »Science meets Business« event »Mobile Applications and Location-based Services« at Fraunhofer IGD Darmstadt on November 21, 2005

What makes business models for mobile services successful, and which technologies are necessary for promising applications, these were the issues of renowned experts from research and practice at the »Science meets Business« event on Mobile Applications and Location-based Services at the Fraunhofer IGD Darmstadt on November 21, 2005.

Professor Hofmann of the University of Applied Sciences of Aschaffenburg, e.g., introduced a personalized »database model« as business model of modern telecommunication services. Dr. Dirk Balfanz of the Center for Computer Graphics Research ZGDV gave an insight into the servingo project which will be finalized for the FIFA World Cup 2006 offering mobile services, information, and a new dimension of sports experience to the fans. New approaches for the protection of privacy at Location-based Services, one of the most sensitive elements of this business field were introduced by Lothar Fritsch, scientist at the faculty for M-Commerce of the Frankfurt University. The present situation on the mobile radio market and current developments in this dynamic market were presented by Jürgen Grützner, managing director of VATM, the association of the providers of telecommunication and added-value services (Verband der Anbieter von Telekommunikations- und Mehrwertdiensten e.V.). Dr. Andreas Böhm of T-Systems International gave an insight into the chances and limits of Location-based Services. Finally, in his contribution, Guido Burger, Business Development Manager at ORACLE Deutschland, presented the basis technologies for

mobile services. Several demonstrations provided the attendees of the workshop with an idea of the current developments.

3D Image Analysis – A Computer Learns Stereoscopic Vision

Since 1995 the Heidelberg Image Processing Forum has been aiming at conveying a comprehensive image of the latest progress in this domain to the industrial users of image processing. With three events per annum the forum gives an overview of the latest research results for industrial realization and new applications of image processing in science and technology. It supports the information exchange between universities, research institutes, and industry.

On November 23, 2005 the Heidelberg Image Processing Forum took place for the 29th time. Under the motto »New Concepts for Users« the main topic of the event was 3D Image Analysis.

This is increasingly used today, for a multitude of problems require the development and application of three-dimensional analysis methods.

The 3D Image Analysis is a method allowing computers to recognize, analyze, and visualize spatial patterns. Devices equipped with 3D sensors are able to »see« stereoscopically and provide three-dimensional data.

The Fraunhofer Institute for Computer Graphics has developed a fully automated system working quasi at the push of a button. It consists of a swiveling robot arm with a 3D scanner. The 3D scanner with the appendant software autonomously and quickly digitizes objects by automatically recording and analyzing all geometry information like exact distances, proper coordinates, and pre-

cise volume data. In this way, especially in the fields of industrial design, automotive engineering, shipbuilding, inverse engineering, etc. high-precision design prototypes can be quickly recorded, visualized, and processed at low cost. In the domain of furniture design the system supports the difficult three-dimensional visualization of upholstery. The 3D geometry of the furniture and other objects can be transferred into digital catalogs to simulate furnishing scenarios.

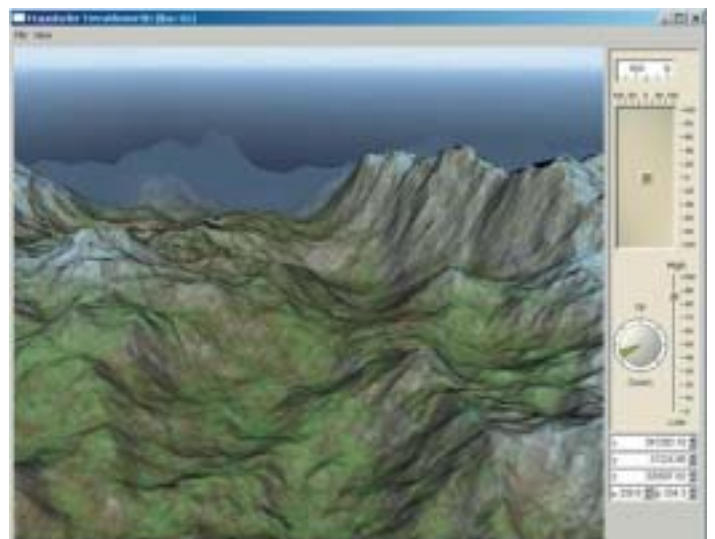
The quality of the 3D image analysis depends to a great extent on the 3D image sensor technology. The sensor technology is constantly improved

with innovative devices and new methods for the acquisition of three-dimensional information. It allows many new and increasingly complex applications in industry and science. Due to this progress of the three-dimensional image sensors the 3D image analysis faces great quantitative and qualitative challenges.

How to meet these challenges and which the advances are in the field of 3D image analysis, was shown at the 29th Heidelberg Image Processing Forum. It was organized by AEON Verlag & Studio in cooperation with Fraunhofer Institute for Computer Graphics in Darmstadt, under the sci-



serving offers information, navigation and entertainment to the visitors of the FIFA World Cup 2006 in Germany.



TRAVO was introduced at the LBS-Day 2005. It enables 3D data on various and even mobile end devices.



entific direction of Prof. Bernd Jähne of the IWR of the University of Heidelberg. Konrad Klein of Fraunhofer IGD introduced the 3D scanner. Christof Reinhart of Volume Graphics GmbH illustrated the volume visualization and 3D surveying of industrial 3D data and Steven Oeckl of the Development Center Y-Ray Technology of Fraunhofer IIS exemplified new methods for the analysis of 3D computer tomography data. There were also system demonstrations offered.

IT Research from Mecklenburg-Vorpommern Meets Business in Berlin

On 28th November 2005, under the patronage of the Patent- und Verwertungsagentur Mecklenburg-Vorpommern (PVA-MV patent and exploitation agency) research institutions like the University of Rostock, the University of Technology, Business and Design Wismar, the Center for Computer Graphics (ZGDV), and the Fraunhofer IGD Rostock presented their application-oriented projects to the industry at the meeting »IT Research Meets Business« in Berlin. In dialog with the representatives from industry the scientists wanted to prove that Mecklenburg-Vorpommern has more

to offer than idyllic silence, seawater, and fertile fields. »We want to convince supra-regional decision makers of medium-sized and big enterprises that many innovative ideas and IT technologies deservedly bear the cachet ‚Made in MV‘«, Antonio Martinez-Arbizu, Managing Director at PVA-MV AG, says. »Our region is also a software country that employs more than 14,000 people in this domain.«

Network and XML technologies, information management, computer and business games as well as user interfaces were the central IT themes of the event in the Fraunhofer IuK branch. »To make our wide-ranging IT research landscape known beyond the borders of our region and to create new networks and possible cooperations, this is our main objective«, so Prof. Bodo Urban of Fraunhofer IGD Rostock, who organized the meeting in Berlin.

The event was patronized by the Federal Ministry of Education and Research in the scope of the exploitation campaign. The PVA-MV is part of this campaign and supports universities and other research institutions with the registration and exploitation of their patents.

Visual Analytics – Countering the Information Flood

We all know the problem: The performance of computers is growing steadily. So is, as a result, the amount of information made available. But how to sift out just the information you really need to make precise and speedy decisions? And how to document your way of decision finding to be able to justify it in case of doubt?

A solution to this problem is offered by »Visual Analytics«: Its methods support us in quickly grasping all relevant data, they make use of the par-



Up and left: Numerous guests of the meeting »IT Research Meets Business« caught up on the latest developments in the field of IT.

ticular ability of the human brain to recognize regularities. The existing data are presented in a way that we can easily identify patterns. By presenting the data visually »Visual Analytics« reveals coherences which otherwise would be covert to us. Due to this way of representation we can hypothesize, draw conclusions, and find answers to our questions. So the tools of Visual Analytics can support us in making reasonable and comprehensible decisions. This form of information visualization and analysis will increasingly gain in importance. Fraunhofer IGD has reacted to this development by opening the new Visual Analytics Lab.

The lab, a strategic investment of Fraunhofer Gesellschaft, consists of a state-of-the-art computer cluster. The 32 dual-core workstations networked with each other, each of them featuring a high-performance graphic processor unit, are optimally equipped for processing graphic data.

Research and development work in the Visual Analytics Lab primarily addresses decision makers and analysts from the fields of bioinformatics and finance. But the Visual Analytics technologies can also be applied in other domains like pharmacy research, earth sciences, meteorology, or disaster management.



The staff members of the Department Real-time Solutions for Simulation and Visual Analytics in the new Visual Analytics Lab.



Participation in Committees

The Director and/or the staff members of the Fraunhofer IGD work for the following national and international boards, partly in managerial positions:

- ACM SIGGRAPH
- Advisory and Accreditation Board of imedia – The ICPNM Academy
- Advisory Board von CIP4
- Advisory Committee for Nanotechnology Exhibition @ Singapore Science Centre
- American Telemedicine Association
- Beirat »ARTESAS«, Projekt des BMBF
- Beirat »EXIST«, Existenzgründerprogramm des BMBF
- Beirat der Telekom Business Academy
- Beirat der Uni Minho
- Beirat der Uni Rostock
- Board of Advisors: School of Creative Media, Hongkong
- CAST e.V.
- CEN/ISSS Focus Group on Biometrics
- CIVR – Board of Experts of the Committee for the Evaluation of Research, Italy
- COTEC Portugal, Advisory Board
- CURAC – Deutsche Gesellschaft für computer- und roboterassistierte Chirurgie e.V.
- Deutscher Dachverband für Geoinformation (DDGI)
- DIN Arbeitsgruppe „Modularisierung«, Referat Entwicklungsbeleitende Normung
- DIN NI 36
- DIN NI 37
- Direktorium der Fraunhofer IuK-Gruppe
- Editorial Board Computer Aided Geometric Design (North Holland)
- Editorial Board Computers & Graphics (Pergamon Press)
- Editorial Board INFORMATIK-F&E (Springer Verlag)
- Editorial Board Visual Computer (Springer Verlag)
- EUROGI WAG Applications
- Europaen Umbrella Organisation for Geoinformation (EUROGI)
- EXIST
- Facharbeitskreis Informations- und Kommunikationstechnologien der Innovationsagentur Mecklenburg-Vorpommern
- Feldafinger Kreis
- Fernseh- und Kinotechnische Gesellschaft (FKTG)
- FhG, Lenkungskreis IT Service-Management
- FhG, Präsidium
- FhG, Sprecherkreis der IT Manager,
- FhG, Sprecherkreis der IT-Sicherheitsbeauftragten
- FhG, WTR
- Forum für Virtual Reality-Technologien im Schiffbau des ZGDV e.V. (ProVR Forum)
- Geschäftsführung des Forum für Informations-Services Mecklenburg-Vorpommern ISMV
- GI Arbeitskreis Computergraphik & eLearning
- GI Arbeitskreis Computerspiele
- GI Fachgruppe eLearning
- GI-FB GDV, Fachgruppe Graphische Simulation und Animation (ANIS)
- GI-FB GDV – Graphische Datenverarbeitung
- Gremien der INI-GraphicsNet Stiftung
- IEEE SMC Germany
- IEEE/FIPA
- InGeoForum Informations- und Kommunikationsforum für Geodaten des ZGDV
- ISO/IEC JTC1 SC37
- ISTAG der EU, Information Society Technologies Programme Advisory Group
- JT User Group
- Kompetenzzentrum für Multimedia-Technologien des Landes Mecklenburg-Vorpommern Forum des ZGDV e.V. (KOMM-MV Forum)
- Kuratorium des Forschungszentrums Informatik (FZI) in Karlsruhe
- Lenkungskreis Forschungsverwertung und des Regionalprogrammes RIS++MV (Seed Fonds) in Mecklenburg-Vorpommern
- Multimediabeirat des Landes MV
- Münchener Kreis
- Nationaler Arbeitskreis Prüfstellen und IT-Sicherheitskriterien des Bundesamts für Sicherheit in der Informationstechnik
- OpenGeospatialConsortium (OGC)
- ProSTEP iViP
- Prüfungskommission für den Masterstudiengang »Medien & Bildung« an der Universität Rostock
- RCIEP – Rede de Conselheiros para a Internacionalização da Economia Portuguesa, Portugal
- SIG 3D GDI-NRW
- Steering Committee der ISMAR (International Symposium on Mixed and Augmented Reality)
- TeleTrust AG6
- Unternehmerverband Rostock und Umgebung
- VDMA
- Vorstand der Innovationsagentur Mecklenburg-Vorpommern
- Vorstand der IT-Initiative Mecklenburg-Vorpommern
- Wissenschaftlichen Beirat ScienceNet MV
- Wissenschaftlicher Beirat für Weiterbildung, Fernstudium und Studienberatung der Universität Rostock
- Wissenschaftsverbund Informations- und Kommunikationstechnologien der Universität Rostock
- Workshop Committee of »Role of Emotion in Human-Computer-Interaction« at HCI Conference, Edinburgh, Great Britain

Fairs and Exhibitions

1. Kooperationsbörse »Wirtschaft trifft Wissenschaft«, Wismar, Germany, November 2, 2005

AMI, Leipzig, Germany, April 2 – 10, 2005

ATZ/MTZ, Stuttgart, Germany, June 20 – 21, 2005

Berufsbildungskongress, Bad Wildungen, Germany, May 20 – 21, 2005

CADFEM 2005, Bonn, Germany, November 9 – 11, 2005

CeBIT 2005, Hannover, Germany, March 10 – 16, 2005

E12-Gipfel, München, Germany, December 1 – 2, 2005

EuroMold 2005, Frankfurt, Germany, November 30 – December 1, 2005

European IST Prize 2005, Brüssel, Belgium, November 30 – December 3, 2006

Exhibition at IDA 5th Infocomm Technology Roadmap Symposium, Singapore, March 8, 2005

Future Challenges for Media Management & Monitoring, Darmstadt, Fraunhofer IGD, Germany, October 17 – 18, 2005

GlobalTech, Brazil, May 18 – 21, 2005

IDS 2005 (Internationale Dental-Schau), Köln, Germany, April 12 – 16, 2005

Index 2005, Genf, Switzerland, June 7, 2005

Integrated Systems Asia 2005, Singapore, October 12 – 14, 2005

INTERGEO, Düsseldorf, Germany, June 4, 2005

IT-Forschung aus MV trifft Wirtschaft, Berlin, Germany, November 28, 2005

Learntec, Karlsruhe, Germany, February 15 – 18, 2005

Medica, Düsseldorf, Germany, November 16 – 19, 2005

Online Educa, Berlin, Germany, November 29 – December 2, 2005

Print '05, Chicago, USA, September 9 – 15, 2005

ProSTEP iViP Symposium, Berlin, Germany, April 20 – 21, 2005

Workshops/Events

29. Heidelberger Bildverarbeitungsforum, Darmstadt, Germany, November 23, 2005

3. Landeskonferenz »eLearning in Mecklenburg-Vorpommern«, Rostock, Germany, October 24 – 25, 2005

Future Challenges for Media Management & Monitoring, Darmstadt, Germany, October 17 – 18, 2005

Future Of Styling Workshop, Darmstadt, Germany, March 9, 2005

GameDays 2005, Darmstadt, Germany, May 24 – 26, 2005

International Workshop on SASO+STEPS 2005, Software Architectures for Self-Organization and Software Techniques for Embedded and

Pervasive Systems, Conference Workshop of Pervasive 2005, München, Germany, May 11, 2005

IT-Forschung aus MV trifft Wirtschaft, Berlin, Germany, November 28, 2005

JT User Group Meeting, Darmstadt, Germany, October 12, 2005

Lange Nacht der Wissenschaften – Erlebbarer Computerwelten, Rostock, Germany, April 28, 2005

Mobile Anwendungen und Location-based Services, Darmstadt, Germany, November 21, 2005

Pre-Conference Workshop »Game Based Learning« zur Delfi 2005, Rostock, Germany, September 13, 2005

ProSTEP iViP Science Days 2005, Darmstadt, Germany, September 28 – 29, 2005

Servingio stellt sich vor, Frankfurt, Germany, June 28, 2005

Site tour to CAMTech at EuroSingapore ICT Co-operation Event, Singapore, Januar 26, 2005

SPATIAL European Forum 2005, Frankfurt Airport, Germany, November 8 – 9, 2005

SPATIAL HOOPS Seminar, Darmstadt, Germany, April 28, 2005

TrafficDay, Darmstadt, Germany, May 17, 2005

Visual Analytics – Chance für den Finanzsektor, Darmstadt, Germany, December 1, 2005

Visual Analytics Workshop, Darmstadt, Germany, June 4, 2005



Workshop »Didaktische Vielfalt«, Rosstock, Germany,
November 24, 2005

Workshop »Emotion in Human-Computer Interaction« (im Rahmen der HCI 2005), Edinburgh, United Kingdom,
September 6, 2005

Workshop on Industry Challenges in Geometric Modeling and CAD - 2005, Darmstadt, Germany,
March 8 – 9, 2005

Visitors

January 13, 2005
Pedro M. de Sampaio Nunes, Secretary of State for Science and Innovation of Portugal,
J. de Vallera, Botschafter von Portugal, Berlin

January 20, 2005
G. Lazzari, ITC-IRST, Italy

January 20, 2005
Prof. Schizas, Prof. Nikiopolos, Dr. Theiopoulos, Univ. Zypern

January 20, 2005
Dr. B. Thelen, Carl Schenck AG

January 21, 2005
Dr. K. Zürl, Advanced Realtime Tracking GmbH

January 25, 2005
Th. Heinrich, Dr. M. Lades, ASSYST GmbH

January 28, 2005
Prof. Fellner, TU Graz

February 3, 2005
D. Pritchard, Glasgow School of Art

February 4, 2005
Dr. J. Stjepandic, ProSTEP AG

February 14, 2005
Dr. B. Breuer, BMBF

February 15 – 16, 2005
Ch. Barrera, S. Richard, Oktal, A. Martinez, A. Pujana, Ikerlan

March 1, 2005
A. Barbosa, EFACEC Group, Portugal

March 2, 2005
Lions Club, Darmstadt

March 7, 2005
A. Donadoni, F. Croce, Vitrociset

March 7, 2005
Dr. Yongmei Wu, J. Lilienthal, A. Ebert, Hoffmann, Volkswagen AG

March 7 -10, 2005
IISTech; Iranische Delegation

March 14, 2005
M. Johansson, Eon-Reality, USA

March 22, 2005
Dr. K. Manse, SAP, H. Grabowski, T-Systems, M. Pirker, Siemens AG

April 7 – 8, 2005
Prof. Myoung-Hee Kim, EWHA Womans University, Korea

April 15, 2005
Prof. Hamann, Univ. Of California, USA

May 10 – 11, 2005
G. Svensson, E. Brink, E. Steenberg, KTH Stockholm, P. Lundén, P. Becker, S. Siltanen, L. Savioia, Helsinki University of Technology – Interactive Institute

May 10 - 11, 2005
Prof. L. Guimareis, CETA Brasil

May 17, 2005
E. Boos, BeamYourScreen GmbH

May 19, 2005
Prof. Slusallek, Univ. Saarbrücken

May 19, 2005
E. Badiqué, M. Lemke, Ph. Gelin, European Commission

May 20, 2005
Prof. Raymond D. Bellem, Embry-Riddle Aeronautical University, Florida

May 23, 2005
H.S. Kang, M.W. Lee, Hyundai Moto Company
J.W. Lee, G.H. Kim, Kia Motors Corporation

May 24, 2005
A. Koerfer, P. Schickel, BitManagement Software GmbH

May 25, 2005
J. Szebel, Dr. Seidl, Dr. A. Huber, Dr. M. Rösler, Dr. V. Hilarius, Merck KGaA

May 26, 2005
Dr. Gollan, Univ. Of Nebraska, USA

May 27, 2005
Dr. G. Ernst, DLR

May 31, 2005
Dr. K. Friedrich, GRAFIS-Software

June 2, 2005
Dr. Bandl, G. Thomas, Burda Digital, Offenburg

June 9, 2005
M. Tillmann, Ch. Losch, B. Marl, MAXON Computer GmbH

June 17, 2005
Dr. M. Symietz, S. Haupt, J. Merkl, Volkswagen AG

June 22, 2005
G. Rauh, Deutsche WertpapierService Bank, Frankfurt

June 22, 2005 U. Biewer, IBM Deutschland GmbH	August 23, 2005 H. Sinzig, H. Heinrich, SAP	November 15, 2005 Dr. Koh Tsu Koon, Chief Minister of Penang, Malaysia
June 27, 2005 Prof. E. Pereira, CETA, Brasil	September 14, 2005 T. Cruz, Radiotelevisão, Lisbon, Portugal	November 17, 2005 Prof. M. Leyton, Rutgers University
June 30, 2005 Prof. Heuser, SAP	September 20, 2005 A. Pinho, Portugiesische Botschaft	November 18, 2005 Prof. O. Ruiz, EAFIT University, Medellin
July 4, 2005 Prof. Giunchiglia, Univ. Trento, Italy	September 23, 2005 Dr. Kürpick, Software AG	November 23, 2005 H. Raffler, Dr. H.-U. Schön, Siemens AG
July 6, 2005 M. Maurer, Vitronic	September 26, 2005 A. Kerstan, Dr. U. Groh, S. Selg, Dr. G. Kaufholz, D. Münk, E. Jung, IBM Deutschland	November 23, 2005 Dr. Kahlbrandt, Hertie-Stiftung
July 11, 2005 M. Oliveira, Universidade Tecnica de Lisboa, Portugal	October 4, 2005 H. Vigdorovitch, Delegation der Moscow State Academy of Instrument-Making and Informatics	December 1-30, 2005 Prof. Zhigeng Pan, Zhejiang University, China
July 12, 2005 D. Kok, SAP-Delegation, South Africa	October 5, 2005 Prof. Keim, Univ. Konstanz Dr. E. Gschwind, St. Ernst, CoCreate Software GmbH & Co.KG	December 1, 2005 Dr. Jens Neumann, Loewe Opta GmbH, Dr. Y. Ding, European Media Laboratory
July 13, 2005 Dr. K. Pulli, NOKIA Inc.	October 10, 2005 Dr. San-Goo Lee, Dr. Dong-Kyung Nam, SAIT/SAMSUNG, Seoul, Korea Dr. R. Mendgen, Robert Bosch AG	December 9, 2005 Dr. M. Mattingley-Scott, IBM
July 18, 2005 Prof. Ertl, Universität Stuttgart	October 13, 2005 Delegation der Exzellenz-Universitäten (Zürich, Tokyo, Peking)	
July 19, 2005 StS. Lemke, MinR M. Welker, HMWK Wiesbaden	October 28, 2005 Dr. Hyung-Kyu Lim, President, CEO, Dr. Seung-Yong Park, Director of Comm. Lab, Dr. Yongjo Park, Dr. Sang-Gook Lee, SAIT, Dr. Eui Chan Jang - SAIT, Dr. Chulhong Park, Samsung	
July 20, 2005 A. Mello Castro, Portug. Konsul		
July 21, 2005 Dr. F. Teichner, Uni Frankfurt		
July 25, 2005 Prof. J. Uhlmann, TU Dresden		
July 26, 2005 H. Unger, IRC Hessen		
August 1, 2005 Dr. B. Tritsch, visionapp GmbH	November 10, 2005 Dr. M. Schön, M. Bürgmann, ZF Friedrichshafen AG	
August 2, 2005 M. Zeisberger, Telekom Business Academy	November 14, 2005 A. Gittinger, UGS	

Scientific Publications

Scientific Publications

The results of research activities of our staff is coined also in the year 2005 by numerous publications, patent applications, bachelor, master, study and diploma theses and seven successful dissertations. These results reflect the wide spectrum of research done around Fraunhofer IGD.

Many presentations at renowned international conferences and congresses contributed to stress the wide range of research done at institutions around Fraunhofer IGD and the growing internationalization of the network. The best publications of all institutions of the INI-GraphicsNet are again collected in »Selected Readings in Computer Graphics 2005«.

At this year's seventh Darmstadt »Computer Graphik Abend« held December 1, 2005 at the Fraunhofer Institute for Computer Graphics IGD in Darmstadt, again outstanding achievements of researchers were recognized.

The »Patent Award« showed the importance of securing innovative developments. Among eight awards was an innovative system from medicine, that allows a therapy of so called whiplash. Another award was given to a development from the area of industrial applications, that significantly simplifies future prototype development in the car manufacturing industry.

Consecutively this year's PhDs at Fachgebiet Graphisch-Interaktive Systeme (GRIS) of the Technische Universität Darmstadt were recognized. The broad spectrum of Computer Graphics were demonstrated by topics like interactive mediation of knowledge

using virtual and augmented reality, or specific digital systems for copy protection of audio data.

The »Best Thesis Award« follows the tradition to recognize excellent diploma and study theses and thereby motivate young researchers. Two theses fulfilled all criteria for an outstanding scientific result out of a total of over 50 theses taken into consideration: The master thesis of Thorsten Reitz deals with the »Architecture of an interoperable 3D-GIS with the focus on visualization applications«. The diploma thesis of Wolfgang Schotte describes the »Simulation of the dynamic Behaviour of Cables for Assembly Simulation in VR«. The prize was a certificate and a voucher for a trip to a Eurographics congress of their choice.

A further highlight was the »Best Paper Award«, that honoured three teams of authors from institutions of the INI-GraphicsNet for their outstanding scientific publications. The team of university experts around Professor Dieter Fellner had the difficult task to nominate the top papers from 41 pre-selected papers from »Selected Readings in Computer Graphics 2004«. Christian Dold, Evelyn Firlé, Georgios Sakas, Stergios Stergiopoulos, Jeff Winter, and Waheed Younis received the first prize for their publication »The compensation of head motion artifacts using an infrared tracking system and a new algorithm for fMRI«. They describe the development of a diagnostic system that allows to identify, measure and reduce the effects of undesirable motion during magnetic resonance imaging. By means of their system, blurs of magnetic resonance images caused by respiratory movements of the patient can be eliminated. Consequently the time used for the exposure as well as the cost are reduced. The second ranked

author team Marc Alexa und Francesca Taponecco was honoured for their publication »Steerable Texture Synthesis«. The author team Michael Arnold and Zongwei Huang received the third prize for »Fast Audio Watermarking: Concepts and Realizations«.

A lecture of Professor Dr. Jivka Ovtcharova of the Institute für Rechneranwendung in Planung und Konstruktion at Karlsruhe University concluded the award ceremony. In an exciting performance, she showed how a successful scientific career can emerge out of the INI-GraphicsNet. The »Computer Graphik Abend« has been celebrated since 1998 and, with its awards, documents among other things the successful synergies of the international research network INI-GraphicsNet, of which the Fraunhofer Institute for Computer Graphics IGD, the Computer Graphics Center ZGDV, both in Darmstadt and Rostock, the Interactive Graphics Systems department at the Technische Universität Darmstadt, and other institutions in Germany and abroad (USA, Singapore, Portugal, Spain, Italy, Korea) are part of.

The following pages show a selection of outstanding publications, e.g. from »Selected Readings in Computer Graphics 2005«, the PhD theses 2005, monographs and journals, an overview of bachelor, master, study and diploma theses, and a list of lectures as well as the collection of patent applications from the year 2005.



Selected Papers

Aehnelt, Mario; Hambach, Sybille; Riss, Uwe V.:

Technology for Sharing Learning Content.

In: TESI 2005 Conference Proceedings CD-ROM: Training, Education & Simulation International. [Maastricht], 2005, 10 p.

Benölken, Paul; Graf, Holger:

Direct Volume Rendering of Unstructured Grids in a PC Based VREnvironment.

In: Skala, Vaclav (Ed.); European Association for Computer Graphics (Eurographics): Journal of WSCG Volume 13 No. 1-3, 2005. Proceedings. Plzen: University of West Bohemia, 2005, pp. 25-32

Bhatti, Nadeem; Godehardt, Eicke; Hornung, Christoph:

Modular Virtual Learning World.

In: Kommers, Piet (Ed.) u.a.: Association for the Advancement of Computing in Education (AACE): Proceedings of ED-Media 2005: World Conference on Educational Multimedia, Hypermedia & Telecommunications [CD-ROM]. Norfolk, 2005, pp. 146-153

Bieber, Gerald; Diener, Holger:

StepMan - A New Kind of Music Interaction.

In: HCI International 2005. [Proceedings CD-ROM]. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc., 2005

Bisler, Alexander:

Emergent Behavior of Interacting Groups of Communicative Agents.

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Prof. Dr.-Ing. J. L. Encarnação

Prof. Dr.-Ing. R. Westermann, Universität München

Graduation: TU Darmstadt, FB Informatik, FG GRIS, February 2005

Jörn Kohlhammer

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Supervisors:

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Prof. Dr.-Ing. M. Alexa

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Eric Blechschmitt

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Marcus Roth

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Steuerung der Wiedergabe von Audioinformationen
 Gerald Bieber, Holger Diener, Malte Korten, Mathias Mainka

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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.

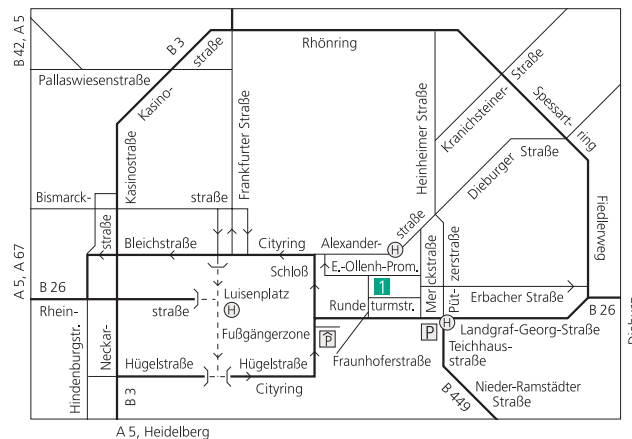
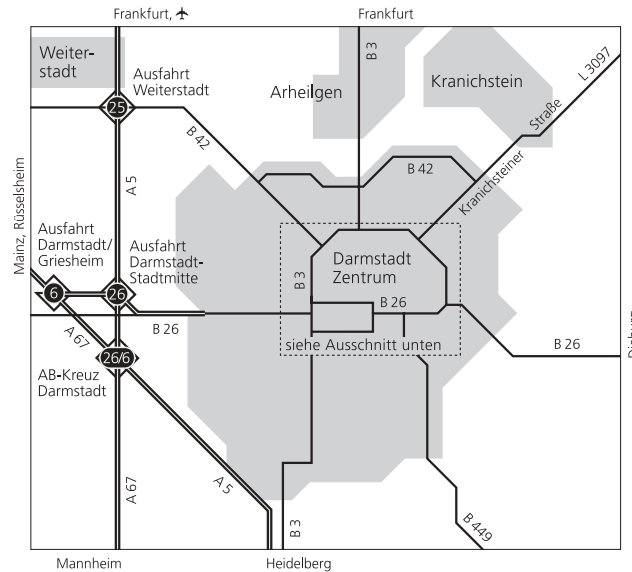
From the Central Station

Near the main entrance (east) of the central train station, you will find the central bus station (ZOB) with the following connections:

Take Bus H (direction »Kesselhutweg«) to »Alexanderstrasse/TU« and exit there. Going back along »Alexanderstrasse« a little, turn left into »Erich-Ollenhauer-Promenade«, which will lead you straight to our main entrance. Or take Bus K (direction »TU/ Lichtwiese«) to »Luisenplatz«, change to Bus L (»Ostbahnhof«) to »Teichhausstrasse« and exit there. 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 shuttle bus »Airliner« transfers passengers every (half an) hour from Frankfurt airport (Terminal 1, bus stop #14 or Terminal 2, Area D/E) to the main station in Darmstadt. From the central bus station (ZOB), which is located at the east side of the central



Lageplan Darmstadt

- 1 Fraunhofer-Institut für Graphische Datenverarbeitung IGD
- P Parkhaus im Justus-Liebig-Haus
- P Parkplatz am Alten Finanzamt

train station, you take bus K (direction »TU/Lichtwiese«) and exit at »Luisenplatz«. Catch bus L (»Ostbahnhof«) and exit at »Teichhausstrasse«. Walk back along the »Landgraf-Georg-Strasse« a little and take the second turning on the right (»Fraunhoferstrasse«). Following this street, you will find the institute's entrance on the right hand side. Or you take bus H (direction »Kesselhutweg«) to the bus stop »Alexanderstrasse/TU«. Exit there and walk back along »Alexanderstrasse« a little, turn left, and the »Erich-Ollenhauer-Promenade« will take you straight to our main entrance.

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 street 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)

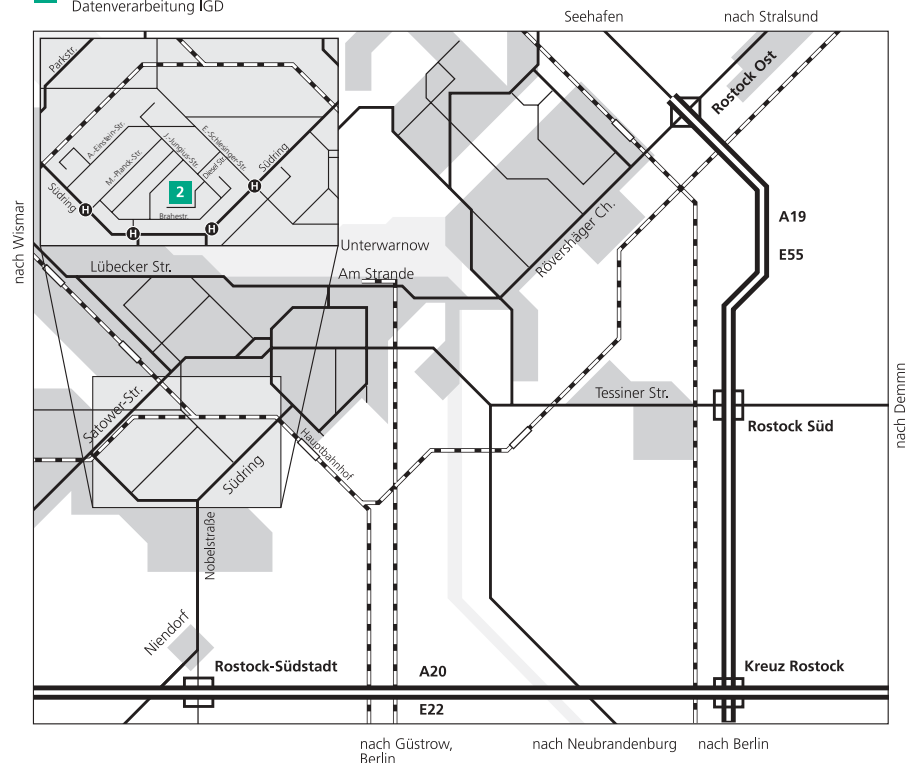
Exit the E22 (A20) at »Rostock-Südstadt« and follow the signs to Niendorf. On the country road L132, follow the signs to Rostock. Follow the »Nobelstrasse« to the »Südring«. Turn right towards the center of Rostock (»Rostock-Zentrum«). Turn right at the first crossing and follow »Erich-Schlesinger-Strasse«.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

Lageplan Rostock

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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 this airport, take a taxi to Rostock.

By Bus

By Taxi

By Car



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For further information, please tick the according boxes and send or fax a copy of this page to our Darmstadt address.

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- ☐ Interactive Multimedia Appliances
- ☐ Industrial Applications
- ☐ Realtime Solutions for Simulation and Visual Analytics
- ☐ Virtual and Augmented Reality
- ☐ Graphic Information Systems
- ☐ eLearning and 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

More information is also provided on our Website www.igd.fraunhofer.de.

Periodica and Brochures

- ☐ another Annual Report
- ☐ Computer Graphik topics
- ☐ Selected Readings in Computer Graphics
- ☐ Ambient Intelligence
- ☐ Augmented Reality
- ☐ Collaborative Visualisation
- ☐ Cultural Heritage
- ☐ E-Learning und Knowledge Management
- ☐ Electronic Commerce
- ☐ Games and Edutainment
- ☐ Human-centered User Interface Design
- ☐ INI-GraphicsNet
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- ☐ Mobile Computing
- ☐ Security Technology
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- ☐ Virtual Engineering

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Notes





Notes
