



## Researchers and Students at INI-GraphicsNet

Due to its international nature, the INI-GraphicsNet is obliged to a long tradition of exchanging researchers and students. Visitors in research and academia from all over the world have been hosted in INI-GraphicsNet institutes, which are adjoined to local universities and participate in university research, teaching and life. The Portuguese Centro de Computação Gráfica (CCG) is related to the University of Minho, CAMTech in Singapore to the Nanyang Technological University (NTU) and CRCG in the US to RISD and Brown University. The German institutes are adjoined to the University of Rostock, the Darmstadt University of Technology and the Johann Wolfgang Goethe-University in Frankfurt (Main). Recently several new institutes joined the INI-GraphicsNet. VICOMTech in San Sebastian/Spain, NEMETech in Seoul/Korea and GraphiTech in Trento/Italy. And of course not to forget the new partnerships with the affiliated universities. These are the Universidad del País Vasco Euskal Herriko Unibertsitatea (University of the Basque Country), the Ewha Womans University in Korea and Università degli Studi di Trento in Italy. Student exchange programs between IGD and CRCG in Providence or CAMTech in Singapore directly support the exchange of students between these institutes. This way it's very easy and much less bureaucratic for students to get financial support. But of course there are other possibilities to get funding for exchanges where non of these internal exchange programs apply. Several hints on how to find these scholarships can be found on the studINI Web Site (<http://www.inigraphics.net/students/studinilindex.html>).

Of course the student exchange appointee will assist you too, if you have further questions. Another good starting point for a search for scholarships is [www.daad.de](http://www.daad.de).

Marie Curie Fellowships for example provide European placements for pre and post-doctoral researchers, usually up to the age of 35, and for experienced researchers. Last December the first calls for proposals under the 6th framework have been published. Individuals may have a look at [http://europa.eu.int/comm/research/fp6/mariecurie-actions/action/fellow\\_en.html](http://europa.eu.int/comm/research/fp6/mariecurie-actions/action/fellow_en.html) to find the actual proposals and the deadlines for applications. The time for the application for some of the programs ends at the 12th of march, for some at the 21st of may. The next Deadlines would be February the 12th or 18th in 2004.

While Marie Curie Fellowships are targeting experienced researchers, there are other funding opportunities for internships. The Leonardo Da Vinci program for example supports exchanges for internships within Europe. Due to the increased number of INI-GraphicsNet institutions within the European community, this program seems to be very promising. In corporation with the Fraunhofer IIS we are able to offer several of these Leonardo Da Vinci Fellowships, which makes the process of applying for it easier and faster for the applicant. Stay tuned for more information on that subject on the studINI website mentioned above. And of course, contact [studini@igd.fhg.de](mailto:studini@igd.fhg.de) for information on availability and for assistance with the application.

Additionally there are some new calls for application for PPP projects, programs for the exchange of persons in predefined projects. These programs are offered by the DAAD and are available for a special exchange country and typically a German project partner.

The countries with open calls and the deadlines are as follows:  
France: 31st of May 2003,  
Poland: 31st of July 2003,  
Slovakia: 31st of July 2003,  
Czech Republic, 31st of July 2003  
More information on that subject you can find at (<http://www-zv.upb.de/~eb/neu%20eu%20web/ppp.htm>) (in German)

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Addressing former staff  
members of INI-GraphicsNet:

## The INI-Graphics- Alumni Forum

is a meeting-place and pool  
for former staff members of  
the INI-GraphicsNet. If you  
wish to become a fellow  
member please contact:

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Dr. Uwe von Lukas and Prof. Dr. Bodo Urban celebrate the graduation

**Dr. Uwe von Lukas**  
**»Modeling und methodology for integration-based tele co-operation in product creation«**

July 8th, 2002

Supervisors: Prof. Dr. B. Urban,  
 Prof. Dr. J. L. Encarnação,  
 Prof. Dr. F.-L. Krause

Supporting teams of distributed engineers is an increasing demand of industry – amplified by organizational concepts such as virtual enterprises or strong supplier integration. However, many users do not accept additional collaboration-aware tools for their single-user CAD, Digital Review or simulation system. The Application Coupling approach, presented in this thesis, avoids new tools by enhancing existing application with functionality for synchronous collaboration. Providing a reference model and an algebraic description of the coupling, the thesis gives a sound foundation for Application Coupling in general. The work is completed by a practical methodology, guiding the software engineer step-by-step to a conferencing application on top of a given graphical application. Furthermore, a set of system services is presented, which are designed to support typical implementation tasks,

such as telepointers, floor control and conference management. The feasibility of the concept is demonstrated by five different implementations that also demonstrate the flexibility of Application Coupling. A detailed evaluation of the collaborative AutoCAD demonstrates several advantages of Application Coupling over the traditional Application Sharing systems (e.g. Netmeeting) in terms of data volume, interaction behavior and flexibility.

**Dr. Stefan Göbel**  
**»Intelligent graphic-interactive access to geodata archives«**

November 8th, 2002

Supervisors: Prof. Dr. J. L. Encarnação,  
 Prof. Dr. Christine Giger

The more information and data are produced in the actual information society, the more important become mechanisms and systems which organize data and provide information where to find which data. Most popular peculiarities of such information systems are web-based search engines (e.g. AltaVista, Yahoo or Google), digital archives, metadata information systems (MIS) or catalogue systems (CS) for geodata. From the technical point of view, the most important of weakness of existing approaches are missing appropriate graphic user interaction techniques or visual feedback are missing in the different steps of the information retrieval process, especially concerning result presentation and query modification. Additionally, semantic mechanisms and concepts such as semantic networks for geodata are necessary to bridge the different geodata disciplines, description formats and data exchange protocols and to provide access to the widespread information spectrum of geodata archives. Based on this situation, the author of this work describes methods and concepts for the development of a personalized metadata browser for the graphic-interactive user guidance to geodata archives. The most significant result represents GeoCrystal as a new 3D visualization technique providing support in all steps of the information retrieval process: Query formulation, search result presentation,



Dr. Stefan Göbel celebrates his graduation

analysis and comparison of result sets and query modification. GeoCrystal is integrated into a 3D information and navigation space and uses both spatial metaphors in the form of a GIS system and common library metaphors. The structure of the geodata library is based on a semantic network for geodata, which has been developed within this work. The network contains content-related semantic relationships between geodata application areas, corresponding terminology, geodata archives and metadata as well as geographic-topologic relationships between spatial entities. The graphic-interactive user guidance within the personalized metadata browser uses the semantic network in all steps of the information retrieval process and provides corresponding graphic interfaces within the metadata browser components »access«, »retrieval«, »visualization« and »repository«. The developed methods and concepts as results of this work have been prototypically implemented and integrated within the InGeo Information Center as existing metadata infrastructure for geodata in Germany. Further on, the results build the conceptual basis for the EU-funded project INVISIP referring to the usage of metadata based information visualization techniques in site planning.

**»Processing of information of a 3D city model for the determination of position and line of sight«**

*Diploma thesis by: Joachim Fass  
Supervisor: Ursula Kretschmer*

This work is part of a project, in which a prototypical learning game about the history of Heidelberg has been developed. It is combined with AR technology and GIS data. The user of the system has a mobile computer and a graphic output device, which is used to fade in virtual content into the observed picture. The content and information of the virtual picture should match to the buildings observed by the user. This is the reason, why the exact position and line of sight of the user must be determined.

The content of this thesis deals with this tracking component of the system. Here, position data should be obtained as exact as possible. Direction sensors and a GPS device can attain rough information about position and line of sight. For the determination of the exact values a video based tracking method is necessary. With this technique the data of a 3D city model is accessed and compared to the video data, which is taken at the viewpoint of the user. The alignment is achieved on basis of building characteristics. They are extracted from the video stream and the 3D city model. This thesis presents a concept for the extraction of significant characteristics from a given 3D model, without the hitherto common rendering of the entire 3D scene. One of the significant characteristics is the contour, which describes all areas with discontinuous depth information within the 3D model. In addition, significant locations were examined, which are characterized by strong changes concerning the surface-normal of the triangle mesh. This occurs in case of edges, corners and radii. These areas were recognized by the comparison of the triangle-normal of the triangles adjacent to the tested edge. The result of this procedure is an edge picture, which can be compared with the picture information from the video stream.

**»Paralleliertes Volumen-Rendering mit 3D Texturen«**

*Diploma thesis by: Bernd Hühner  
Supervisors: Dr.-Ing. Volker Luckas,  
Dipl.-Math. Sascha Schneider*

The computer-based simulation of physical procedures, especially the domain of CFD (computational fluid dynamics), produces a large amount of data. The visualization in an interactive and useful way of this data is a difficult task for its solution special-purpose hardware was required. The latest developments of consumer graphics hardware enables a high-quality and interactive displaying of large datasets using a standard pc workstation.

Using 3D textures and shaderprogramming languages as well as applying parallel programming techniques, one can develop a powerful concept for visualizing scalarfields respectively scalar volume-data. The system is based on the technique of pre-integrated volume-rendering which provides high-quality results at interactive rates. The parallelized pre-computation step as well as the integration in the already existing framework for parallel and interactive visualization of scientific-data permits the user to explore unknown data in a simple and flexible way. Visualization-modules for iso-surface rendering and direct volume rendering, this means the appliance of arbitrary transfer-functions for classification, are implemented. Thereby every light-calculation are performed on per-pixel level using shaderprogramming, With additional subdivision of the total data area, the realisation is not bound to any resource-limits which results from the graphics hardware. The field of application reaches from CT-Scan rendering to animated simulation physical procedures like fire and smoke propagation or distribution of temperature.

**»Secure Inter-Agent Communication«**

*Diploma thesis by: Stivens Milic  
Supervisors: Dipl.-Inform. Jan Peters,  
Dipl.-Ing. (FH) Ulrich Pinsdorf*

Communication is one of the most important services of mobile agent systems. Mobile agents are independent software programs that perform tasks on behalf of their users autonomously. In doing so they should be capable of performing its tasks independently. If this is not possible, as it is the case with complex tasks for example, they should have the possibility of sharing their knowledge and intentions with other agents through its communication mechanisms. Further, agents should through

its communication capability be able to share their knowledge and interact with systems, services and applications. The data that on this way is going to be exchanged, is generally in unsecured environment like internet exposed to different threats. It could be spied out, manipulated or even destroyed. The aim of this diploma thesis was to make the secure communication in mobile agent system SeMoA (Secure Mobile Agents) possible. The implementation was based on the existing mechanism for communication in SeMoA. In order to protect communication from the threats, the most important aspect of secure communication were considered – authentication of communication partners, encryption and integrity check of communication data. For that reason, some of the current security solutions in the field of communication – IPSec, S/MIME and SSL/TLS were examined for its suitability in SeMoA. For the protection of communication we choose SSL/TLS, due to some crucial advantages. Afterwards, a concept of a service for secure communication between SeMoA platforms was developed by considering the given requirements. The first part of this work gives an introduction to the fundamentals of mobile agents and agent communication theory. Further, the basic principles of security were introduced and at the end of theoretical part, already mentioned security solutions (IPSec, S/MIME and SSL/TLS) were presented in detail. The second part is intended introducing the practical part of the diploma thesis. Here you can find the description of the defined concept and its implementation. The practical part ends with the description of the taken tests on implementation and their results. With the integration of implemented services in SeMoA and the followed test could have the functional efficiency and suitability for purposes of communication between mobile agents proven.

**»Design of methods and concepts for implementing a 3D-Geodata-Library«**

*Diploma thesis by: Thorsten Rasel  
Supervisor: Dr. Stefan Göbel*

Nowadays, the amount of geodata takes 80-85% relating to all new data produced in our information society. In order to structure all of these geodata it is necessary to find appropriate methods and concepts as well as technical infrastructures. Based on a semantic network for geodata conceptualized by Dr. Göbel, the focus of this thesis has been the development of a metaphor-based 3D information and navigation environment to access the

multi-faced semantic network and to find appropriate geodata. As primary metaphor, a 3D library for geodata has been established. Here, books are used as metaphors to represent datasets. Bookshelves, floors and levels are used to structure the library in a semantic way. This semantic, content-related structure is based on the 20 ISO theme codes (ISO 19115: Geographic information – metadata) which categorizes all geodata application areas into 20 classes (domains). Book-shelves within a 3D information and navigation room located at a reception desk on the ground floor are used for temporary presentation purposes concerning searches for geodata. From the technical point of view, the conception of a search and navigation system for geodata has been the central point of this work.

The navigation system enables users of most categories (age, usage, etc) to find their way through the 3D-world by using specific navigational elements. The elements implemented are classified in two different types: First, the user-only type in which the user has full control over his movements inside the world and where he only gets navigational aids by a small map of the world in which his current position will be displayed. He can also enable markers for the way which he can follow to find the desired target point. Second, the system-type. Here the user only chooses the target of where he wants to get. The system automatically moves the user to his chosen position by displaying the walked way in an automatic camera movement. From the structured geodata and the navigation system, a combination of both was generated to build the search and navigation system for geodata using books as metaphors for datasets. A user can search for a geodata or metadata and can get into the archive using this system. With those elements, a user can automatically be brought to the book in the archive to search adjacent themes in the shelf.

### »Collision Detection and Handling between Highly Deformable and Rigid Bodies«

*Diploma thesis by: Roland Sarrazin  
Supervisors: Dipl.-Inform. Arnulph Fuhrmann, Dr.-Ing. Volker Luckas*

Today's computer and graphics hardware makes it possible to imagine more and more realistic applications. In this context, physically based simulation plays a major role, since it models the virtual environment by using real physical laws. In a simulated virtual environment, the actually simulated object and the environment in which it is moving are often differentiated.

Taking this difference into account, physically based simulation is divided into two distinct problems: On the one hand the determination of the newly desired state of the simulated object using physical laws; On the other hand collision handling, which prevents the simulated object to penetrate the environment, also referred to as the collision scene. The comparison of the running times of these two partial problems indicates that collision handling is often the bottleneck of physically based simulation. This is even more obvious in the case of a highly deformable simulated body, since most of the components of the virtual environment are constantly colliding. A typical example of such a situation is the simulation of textile material in the context of virtual dressing. In this work, a method was developed which takes advantage of the property of the virtual environment to consist on the one hand of a highly deformable simulated object, and on the other hand of a rigid collision scene. Previous collision handling methods did not make use of this property, so that their running times were high as well as particularly erratic. For this reason, these methods cannot be set in the envisaged real-time applications. On the contrary, the method developed in this work uses this property to speed up the collision handling by deferring the expensive tasks in a precomputing step.

This method is based on the concept of distance fields. A distance field is a regular spatial grid, whose vertices contain the signed distance to the collision scene. There is a unique distance field per collision scene, so that it can be computed in a preliminary step. Its generation is based on a kd-tree, a spatial data structure, to avoid a brute-force distance determination. During the actual collision handling, the distance field is queried so that the collisions are firstly detected, then appropriately resolved. Thus the collision handling runs in constant time. A prototype of this method was implemented in an existing Java simulation environment, so that an immediate comparison of the running times of different methods could easily be realized. This comparison confirms the constant running time of the method. It also shows its robustness, its stability and its higher speed by an order of magnitude compared to previous methods. Thus this method is appropriate for virtual environments with many collisions and various applications can be imagined, such as virtual dressing or more general particle-system-like models. Moreover, the animation of the collision scene is possible, so that this method allows a wide application area.

### »Integration of Virtual Reality and CAD on the Basis of CAD Services«

*Diploma thesis by: Matthias Vahl  
Supervisors: Prof. Dr. Bodo Urban,  
Dr. Uwe von Lukas*

The usage of Virtual Reality in the field of product creation (e.g. automotive or ship-building industry) is a promising way to overcome problems of usability. However, today this technology is more or less limited to immersive visualization and navigation. Creating or modifying objects in a natural but precise way is not available in VR.

The thesis follows an integrative approach by coupling VR systems to commercial CAD systems over standard interface: the CAD Services specification of the Object Management Group (OMG). Concepts for both horizontal (i.e. temporal) coupling and vertical (i.e. data related) coupling have been developed and implemented. The feature-based design has been identified as a promising way to bring in line natural interaction and precise layout.

Using AutoCAD's Mechanical Desktop application and ZGDV's VR toolkit Java Studierstube, a prototype has been set up to evaluate the CAD Services interface. The integrated system proved to handle various feature-based modifications in an immersive environment, where the CAD system acts as a server in the background. Although some improvements to the interface have been proposed to improve the overall performance, the CAD Services are an adequate way to link CAD and VR systems in a bidirectional manner. Even sophisticated algorithms such as progressive refinement and region-of-interest can be implemented on top of the OMG interface.