



Dr.-Ing Matthias Finke
September 20th, 2005
»Supporting Collaborative Knowledge Construction by means of Hypervideo«

Supervisors:

Prof. Dr. José L. Encarnação

Prof. Dr. Dr. Friedrich W. Hesse

This work covers the problem of supporting collaborative knowledge construction on the basis of hypervideo content. Thereby, hypervideo is defined as video based hypermedia that combines non-linear information structures with dynamic audio-visual information presentations. Video as the primary content type for hypervideo has become a media of increasing importance in past years. Thereby, videos can constitute an origin for communicating complex and dynamic visual information in an intuitive and effective fashion. This makes video an ideal content for knowledge construction within distributed environments. The concept of collaborative hypervideo enhanced the advantage of video in terms of group based discussions and/or conversations. With collaborative hypervideo, group members can easily share their ideas and views with others and so establish knowledge trans-

fer among each other. This is achieved by the introduction of shared video annotations, in which users can accentuate objects out of the video context and combine these with further multimedia content or other video objects. In such a way a non-linear information structure will be created that can be easily applied for information access.

The conceptual part of this work is based on an interaction model, a reference architecture and a data model for collaborative hypervideo. The model defined a user interface concept in terms of the hypervideo visualization and interaction within a collaborative environment. The reference architecture provides a logical view of an abstract system. This architecture contributes to concrete system realisations within different application areas. The data model defines a core concept of how elements of a collaborative hypervideo structure like nodes, links, anchors and metadata sets, are organized in an effective manner. The general concept of collaborative hypervideo has been validated by means of four empirical field studies with over 130 participants. The results gave great evidence for the conceptual work fulfilled and proofed that with collaborative hypervideo the construction of knowledge within a group based scenario is achieved.



Dr. Matthias Finke celebrating his graduation

STUDY & DIPLOMA THESES

Adaptive Simulation of Cloth and Hair in Real Time

Diploma thesis by: Anne-Kathrin Braun
Supervisor: Alexander Rettig

For a credibly and realistically looking animation of virtual characters, a correct simulation of cloth and hair is very important. Modeling the dynamics in real time represents a great computational challenge. To improve performance, an approach of adaptive structuring is used.

In this diploma thesis, the use of level of detail (LOD) is examined to reach a real-time hair and cloth simulation. An overview of adaptive structures is given and different kinds of LODs for hair and cloth are presented. The implemented adaptive hair simulation shows the possibilities and advantages of such an approach.

As control structure for the dynamic simulation, a mass-spring system is used. The LOD is applied to the control structure and the geometry. Therefore, a hierarchy is pre-computed by subdividing the control structures and the geometries. The appropriate level of this hierarchy, stored in a quad-tree data structure, is selected by the following criteria: motion of the hair and viewing distance. If strong forces are applied or the viewer is close to the hair, a finer level is selected, while descending the quad tree.

The simulation system has been integrated in the VR-environment Avalon. The OpenGL-based API OpenSG is used for rendering. The tested models were created by the Cinema4D-PlugIn Hair-Department.

Segmentation of the Myocardium Using MRI Data

Diploma thesis by: Andreas G. Grimm
Supervisor: Christian Dold

One of the frequent causes of death in richer countries is the cardiac infarction. 8,2% of deaths in Germany in the year 2002 were caused by such. One can get information from MR images, which can be used for the prophylaxis of a cardiac infarction. For this information retrieval a segmentation of the myocardium can be appointed. The challenge of this segmentation is the partially inexistent difference of grey values of the myocardium and its

environment in the MR images. Two methods for the segmentation of the myocardium were conceived in the thesis and realized in the platform MIP.

One approach is based on a Geodesic Active Contours (GAC) segmentation, the other one on a new technique: the Measure and Estimate (MAE) segmentation.

The GAC approach is based on a segmentation chain which was used for a segmentation of the liver, which is, however, inapplicable for the segmentation of the myocardium. This chain has been optimized regarding the special ambition of the segmentation. Characteristics of the so achieved filter chain are the automatic setting of the multitude of necessary seed points (which are used for an applied Fast Marching Filter) and the usage of Region Growing segmentations of the myocardium and the ventricle in the pre-process of the segmentation.

The MAE approach is based on a part of the pre-process of the optimized GAC segmentation chain. But it completely varies in the segmentation itself. The pre-process is followed by an analysis which was conceived in this thesis. In the analysis it is calculated which parts of the myocardium contour are allocable and which must be estimated. The inner contour is received by an analysis of a Region Growing segmentation of the ventricle. The detection of the outer contour is based on a Region Growing segmentation of the myocardium allowing to recognize which areas of the outer contour can be measured and which must be estimated. Then the estimation follows. This collected knowledge results in the segmentation itself.

Automatic Detection to Split Screen in Digital Video

Diploma thesis by: Andrea Huber
Supervisor: René Cavet

Every day several hours of video are broadcasted worldwide. Especially for the marketing research it would be important to know the content of these videos. For this reason the Fraunhofer Institute for Computer Graphics IGD in Darmstadt has developed the so-called MediaSeeker tool. The MediaSeeker performs a real-time content-based video analysis.

This method is based on the analysis of the whole image. But especially in German television the so-called split screen method is used regularly to show several actions at the same time. For split screen commercials this means that in the major part of the screen the commercial clip is shown, while the rest of the screen is used for example for the credits or previews. If a video which contains a split

screen is analysed by the MediaSeeker, there will not be any matches found, as the whole image which is analysed is built out of several content areas. Instead it would make sense to analyse the different contents of a split screen separately. For this analysis the size and position of the different content areas must be known. For this reason it is necessary to develop a system which is able to detect split screens in a video and returns their position, size, and duration.

Identification of music scores based on music sheets

Master thesis by: Gert Kremser
Supervisor: Martin Schmucker

A goal of this diploma thesis is the development and evaluation of a system for the identification of music sheets. It is to be examined, which characteristics are suitable for music scores to the identification of a music sheet, since existing identification procedures for pictures can not be used efficiently for music sheets. Possible differences in the composition of a music sheet of same music pieces make it possible to determine also the publisher of music sheets by the way of this procedure.

The fundamental principles of all identification procedures is alike. Dependent on the procedure first different characteristics are extracted from the data and afterwards reduced, in order to be able to store it effectively in databases. A goal of this procedure is to find a compromise by reduction between compactness and robustness. One assumes, that suitable characteristics already exists before. The consideration is whether it is possible to use the principal component analysis to search for suitable characteristics. Concluding a robustness test was accomplished to assess the introduced identification procedure.

Design of a Multimodal Volume Visualization System

Diploma thesis by: Matthias Keil
Supervisors: Dipl.-Math. Evelyn Firlé,
Dipl.-Phys. Stefan Wesarg

Using medical imaging techniques physicians and scientists get insight into the human body. A combined presentation of registered volume data sets of the same object, furthermore acquired with different imaging modalities (multimodal visualization), enables to make use of the advantages of the individual imaging techniques and also to compensate for their disadvantages. In addition complementary information which results from

the specific characteristics of the imaging techniques can be presented together. A three-dimensional visualization also offers a natural view of the object. For this purpose a multimodal volume visualization system for the three-dimensional visualization of pre-registered medical data sets has been designed and implemented. For the visualization of the image data Direct Volume Rendering has been selected using multi-dimensional transfer functions (TFs) for color and transparency.

Histograms on the image intensity and the gradient magnitude of the image data form the basis for multi-dimensional TFs. By using Spatialized Transfer Functions and the associated semiautomatic classification of the 2D histogram into areas which represent structures in the volume data the specification effort for the user was reduced to simply selecting interesting classes. The concept of the visualization system covers two approaches. In the so-called multi-intensity based approach the user defines a common TF for the two volumes, which are to be visualized. This TF is defined over the intensity values of the two data sets. In the gradient-based approach a STF is specified for each volume and thus two separate volume visualizations are generated. These renderings can be fused afterwards to a common multimodal visualization. The gradient-based approach permits an interactive change of the transformation which describes the registration of the data sets. With the implemented volume visualization system multimodal visualizations were successfully generated facilitating communication of diagnostic results. In addition the registration results were examined on the basis of these visualizations.

Secure Partial Results – Empowering Mobile Agents

Diploma thesis by: Marian Mohr
Supervisors: Dipl.-Inform. Jan Peters,
Prof. Dr. Jörn Altmann

Mobile agent technology has been around for many years, yet it has not had its break-through thus far, a major bottleneck being the security aspects of this technology. This thesis evolves around a protocol called Secure Partial Results that seeks to ensure the security of partial results generated at some remote host. To this end, the different classes of mobile agent security are introduced on the basis of which this protocol is put into context with already existing research work. Thereafter, various approaches of how to ensure mobile agent security and recent developments in these areas are evaluated, followed by

an analysis of various security properties used in similar protocols. The implementation of the Secure Partial Results protocol and its evaluation constitute the core of this thesis effort. A summary of the chief elements of this thesis alongside an outlook on the future of this paradigm round off this document.

Dialogue Management Systems for Interactive Storytelling

*Bachelor thesis by: Martin Ruskov
Supervisor: Ido Iurjel*

Interactive storytelling systems are a new, but very prospective field of software development. In this work I present and compare several state-of-the-art systems. As they have very different motivations and requirements, I discuss their differences and derive a proposal for the further development of a storytelling platform developed at ZGDV and more specifically for a game called Ask&Answer. Special attention is paid to the use of natural language processing, content organization, and automation of the authoring process

Generating Avatars Using Body Measurements for Garment Design

*Master thesis by: Stefan Böhm
Supervisor: Dipl.-Inf. Arnulph Fuhrmann*

For the simulation of garments the avatars which wear the clothes are of great importance. In order to test garments of different sizes avatars with varying body geometries are needed. The modeling of human figures is in general a difficult and labor-intensive task. In this master thesis a system for the automatic modeling of human figures by the input of sizing parameters is introduced. Through a graphical interface the user can input selected measures from the textile industry or alternatively ready-to-wear measures. On the basis of this measures a synthetic avatar generated with a standard modeling tool will be automatically adapted to the given measures. The deformation of the geometry is driven by the underlying skeleton of the avatar and done without the utilization of real persons' data.

The measuring is executed according to the rules for measuring real human bodies by locating feature points on the surface of the avatar. These are used as starting points for determining the measures. The calculation is done by an individual heuristic procedure for each of the feature points. At the feature points »virtual tape measures« are applied to simulate the real measuring instruments and

methods. In order to achieve a local deformation of the geometry during the deformation the used technique for skeleton animation is modified. The adjustment of the geometry is done by an iterative approximation process in which the skeleton parameters are successively modified until the destination measures are reached. For this purpose the correlation between skeleton parameters and body measures will be calculated and stored automatically. The adjustment is done separately for length and girth measures. Because of the restricted applicability of the girth adjustment by the skeleton-driven deformation an alternative approach using the simulation of fat growth is proposed. Here the deformation is done by displacing every vertex along his normal in dependence of fat values. The body will therefore be divided in different regions with varying fat values. For this thesis a prototype was implemented in Java to test the introduced concept with respect to visual results and computing time.

Segmentation of Fuzzy Edged Objects in Medical Image Data – Implementation, Validation, and Enhancement of the Region Growing by Hojjatoleslami and Kittler

*Diploma thesis by: Torsten Schröder
Supervisors: Prof. Dr. Hartmut Dickhaus,
Prof. Dr.-Ing. Georgios Sakas,
Stefan Wesarg*

Main focus of this diploma thesis is on a special 2D region growing algorithm for segmenting image objects with fuzzy edged borders. One problem for its application is the decreasing performance with increasing object size. Different solutions regarding the speed-up of the computation are presented in detail in this work.

First, the proposed algorithm was validated by programming an ITK (Insight Registration and Segmentation Toolkit) conformable 2D prototype. The algorithm's characteristics described in the literature could be reproduced, but the application's speed was unacceptable, as expected. For the development of the three dimensional expansion of the algorithm several data structures have been investigated - for example, linked lists, vectors combined with binary search, specialized binary trees, and red-black trees. The speed-up was continuously measured along all tests and is discussed in detail.

The most significant performance increase could be achieved through multi resolution approaches, similar to those introduced for image registration. Now

even large data sets could be segmented in acceptable time. The final algorithms have been tested on all kind of medical image data, such as computed tomography, magnetic resonance, or ultrasound. Many structures could be successfully segmented, e.g. coronary arteries, stent implants, ventricle and white matter of the brain, and others. Beyond that, a quantitative test has been executed, which measures the algorithm's precision on objects with Gaussian shaped edges.

Although the speed-up and the precision of the region growing is good, special pre-processing is essential for performing a special segmentation task. The main advantage of this region growing technique is its high degree of automation compared to standard region growing approaches.

Physically Based Lighting Simulation of Human Skin

*Diploma thesis by: Tobias Tost
Supervisor: Christian Knöpfle*

The Fraunhofer Institute for Computer Graphics Research IGD in Darmstadt is a project partner of the network project Virtual Human promoted by the Federal Ministry for Education and Research. IGD is responsible for the output components, i.e. the visualization of the human avatars. In this context, new methods are presented and established algorithms are evaluated and applied to achieve physically based high-quality human skin appearance.

Subsurface scattering effects in the skin, surface reflections, aging and skin reactions to emotions are regarded. Additionally an approach for dynamic, soft shadows is introduced in order to increase the visual quality further. As a result, the stated algorithms for the application were implemented on mainstream hardware and evaluated based on their performance.