9.07.2007

E I N L A D U N G

Im Rahmen eines Sonderkolloquiums des Fachbereichs gemeinsam mit dem Internationalen Graduiertenkolleg „Visualization of Large and Unstructured Datasets“ sprechen:

Professor Dr. Charles Hansen

Scientific Computing and Imaging Institute and School of Computing
University of Utah, USA

9.00 – 9.45 Uhr

über das Thema

“Suppose the World was Piecewise Plastic?”

Is it ridiculous to think of the world has nothing but plastic? That is precisely an assumption most scientific visualization renders make by using the Phong illumination model. Direct volume rendering has proven to be an effective and flexible visualization method for interactive exploration and analysis of 3D scalar fields. While widely used, most if not all applications render (semi-transparent) surfaces lit by an approximation to the Phong local surface shading model. This model renders surfaces simplistically (as plastic objects) and does not provide sufficient lighting information for good spatial acuity. In fact, the constant ambient term leads to misperception of information that limits the effectiveness of visualizations. Furthermore, the Phong shading model was developed for surfaces, not volumes. The model does not work well for volumetric media where sub-surface scattering dominates the visual appearance (e.g. tissue, bone, marble, and atmospheric phenomena). As a result, it is easy to miss interesting phenomena during data exploration and analysis. Worse, these types of materials occur often in modeling and simulation of the physical world. Physically correct lighting has been studied in the context of computer graphics where it has been shown that the transport of light is computationally expensive for even simple scenes. Yet, for visualization interactivity is necessary for effective understanding of the underlying data. We seek increased insight into data analysis through the use of more faithful rendering methods that take into consideration the interaction of light with the data itself.

Prof. Dr. Thomas Wischgoll

Computer Science and Engineering Department
Wright State University, USA

10.00-10.45 Uhr

über das Thema

"Visualization and Analysis of CT Data in Cardiovascular Research"

Coronary heart diseases are the major cause of deaths in the United States as well as in most other countries. Approximately 16.7 million people die from heart diseases every year according to estimates of the World Health Organization (WHO). Recent studies show that common methods of treatment, such as bypass surgery, do not necessarily help avoid coronary heart disease. Consequently, there is a need for a better understanding of the functionality of the heart. Here, virtual models depicting structure and/or operation of the heart can help. In the same way, visualization is required to aid in the analysis of these virtual models. In this talk, an overview of different visualization and analysis tools will be given that help improve on the understanding of cardiovascular diseases to aid in finding better treatment options.

Professor Dr. Min Chen

Visual and Interactive Computing Group
Swansea University, UK

11.00-11.45 Uhr

über das Thema

"The Complexity of Video Visualization"

Video visualization is a computation process that extracts meaningful information from original video data sets. Such visualizations can convey much more information, especially spatial-temporal information, than a few statistical indicators. With carefully prepared visualizations, the human vision system, perhaps the most intelligent vision system, is able to become accustomed to certain kinds of "normal" visual patterns, and react to unusual levels or patterns of activities that need further investigation.

In this talk, the speaker will give an overview of the state of the art of video processing and video visualization, and compare the general complexity of a computation pipeline for video processing with that for video visualization. The speaker will also briefly present the recent work, carried out jointly by Swansea and Stuttgart. He will describe the use of combination of volume and flow techniques for video visualization, a user study to examine whether users are able to learn to recognize visual signatures of motions, and to assist in the evaluation of different visualization techniques, and the application of the developed techniques to a set of application video clips. This work has demonstrated that video visualization is both technically feasible and cost-effective. It provided the first set of evidence confirming that ordinary users can accustom to the visual features depicted in video visualizations, and can learn to recognize visual signatures of a variety of motion events.

Dr. Gordon Kindlmann

Laboratory of Mathematics in Imaging (LMI),
Brigham and Women's Hospital and Harvard Medical School, USA

12.00-12.45 Uhr

über das Thema

"Recent Developments in the Visualization, Interpolation, and Analysis of Diffusion Image Data and its Models"

Diffusion Tensor MRI (DTI) has become a popular way of non-invasively assessing micro-structural orientation and organization in biological tissue, especially the central nervous system. In algorithms for processing DTI, a common ingredients is interpolating between two tensor values. We describe a new class of interpolation paths for tensors, termed geodesic-loxodromes, which explicitly preserve clinically important tensor attributes, such as mean diffusivity or fractional anisotropy, while using basic differential geometry to interpolate tensor orientations. On the other hand, simpler tensor interpolation methods can indirectly reveal features in fiber tract orientation through the differential structure of the scalar anisotropy field. We describe a method of extracting surface models from DTI, called anisotropy creases, that seem to delineate the major white matter features. However, the single tensor model that underlies this research is just one model that can be fit to the original diffusion-weighted image (DWI) data acquired by MRI. Other recent work, for example, has explored fitting two tensors per voxel. With more complicated models, however, come more complicated algorithms for doing the model fitting. Visualization can play a role in understanding the behavior of DWI modeling algorithms, so that the relationship between known anatomy, underlying DWI data, and estimated models can be explored in a quantitative but intuitive way.

Prof. Dr. Chris Johnson

Director, Scientific Computing and Imaging Institute, Distinguished Professor, School of Computing, University of Utah, USA

13.15-14.00 Uhr

über das Thema:

“Visual Computing: Case Studies and Research Challenges“

Computers are now extensively used throughout science, engineering, and medicine. Advances in computational geometric modeling, imaging, and simulation allow researchers to build and test models of increasingly complex phenomena and thus to generate unprecedented amounts of data. These advances have created the need to make corresponding progress in our ability to understand large amounts of data and information arising from multiple sources. In fact, to effectively understand and make use of the vast amounts of information being produced is one of the greatest scientific challenges of the 21st Century. Visual computing, which relies on and takes advantage of, the interplay among techniques of visualization, computer graphics, virtual reality, and imaging and vision, is fundamental to understanding models of complex phenomena, which are often multi-disciplinary in nature. In this talk, I will first provide several examples of ongoing visual computing research at the Scientific Computing and Imaging (SCI) Institute as applied to problems in computational science, engineering, and medicine, then go on to discuss future research opportunities.

Prof. Dr. Torsten Möller

Scientific Visualization and Computer Graphics Department
Simon Fraser University, Vancouver, Canada

14.15-15.00 Uhr

über das Thema

“A Spectral Analysis of Function Composition and Its Implications for Sampling in Direct Volume Visualization”

In this talk we investigate the effects of function composition in the form g(f(x)) = h(x) by means of a spectral analysis of h. We decompose the spectral description of h(x) into a scalar product of the spectral description of g(x) and a term that solely depends on f(x) and that is independent of g(x). We then use the method of stationary phase to derive the essential maximum frequency of g(f(x)) bounding the main portion of the energy of its spectrum. This limit is the product of the maximum frequency of g(x) and the maximum derivative of f(x). This leads to a proper sampling of the composition h of the two functions g and f. We apply our theoretical results to a fundamental open problem in volume rendering -- the proper sampling of the rendering integral after the application of a transfer function.

Zeit: **Freitag, 13.07.2007, Beginn 09.00 Uhr**
Ort: **Gebäude 57, Rotunde**