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Course Notes 10

INTRODUCTION TO VOLUME VISUALIZATION - IMAGING MULTI-DIMENSIONAL SCIENTIFIC DATA

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4. Paper Reprint		
	Elvins, T. T., ''A Survey of Algorithms for Volume Visualization,'' *Computer Graphics,* March, 1992. Volume 26, Number 3, pp. 34-44.	40
5. Annotated Bibliography		
	Elvins, T. T., ''An Annotated Bibliography of Volume Visualization Papers, 1991-1994,'' San Diego Supercomputer Center, Technical Report	48
6 Paper Reprint		
	Hersh, J.S., ''A Survey of Modeling Representations and Their Application to Biomedical Visualization and Simulation,'' *Proceedings of the First Conference on Visualization in Biomedical Computing,* IEEE Press, May, 1990.	61

1. Course Overview

1.1. Course Description

Volume visualization is a powerful computer graphics method used to gain insight into three-dimensional data sets. The technique works equally well for both acquired and simulation-generated data. This course will introduce fundamental volume visualization concepts and algorithms and will focus on how the attendee can immediately get started creating images from data.

Some researchers say that volume visualization is to computer graphics what perspective was to drawing and painting during the Renaissance. Volume visualization has a wide range of applications in micro-science, macro-science, medicine, and computer simulation. It has the potential to revolutionize data sets that span orders of magnitude, from molecular modeling to meteorology, from non-destructive testing, to radiation treatment planning, and from failure analysis of manufactured parts to orthopedic diagnosis.

The emphasis of this full day course will be on data-driven visualization techniques applicable to all disciplines; ie. how can a scientist immediately get started exploring and imaging data using existing systems. The course will begin with an introduction to the exciting field of volume visualization, its foundations, and terminology. Fields of applications, dozens of example images, data characteristics, and strategies for data reconstruction and classification will be shown. Fundamental concepts of volume visualization including interactive methods, surface-fitting methods, ray-casting methods, and projection methods will be discussed in-depth followed by a rigorous introduction to algorithm enhancements and optimizations.

Volume visualization architectures will be presented as well as a review of available state-of-the-art commercial, and public domain software. Some volume visualization research areas and references to further information will be discussed.

1.2. Course objectives

To enable attendees to immediately begin creating images from data by familiarizing the attendees with volume visualization concepts, techniques, tools, and the latest advances in the field. Through examples, students will learn the process of volume visualization in steps. These steps include data reconstruction, data exploration and classification, surface and direct-volume rendering, shading, and display. At the end of the day the student will be able to explain fundamental volume visualization methods and applications to others.

1.3. Level of Difficulty

The typical attendee will have had very little exposure to volume visualization techniques, but should be familiar with scientific data and fundamental mathematics. Some exposure to computer graphics would be useful.

1.4. Course Schedule

8:30am		**course begins**
Session #1	**Introduction to course and volume visualization fundamentals**	**90 minutes**
Break		**15 minutes**
Session #2	**Volume visualization algorithms**	**90 minutes**
Lunch		**90 minutes**
Session #3	**Quiz, Optimizations and enhancements, Hardware and software systems**	**90 minutes**
Break		**15 minutes**
Session #4	**Video - "State of the Art", Ethics, issues, futures, further information, evaluations**	**90 minutes**

1.5. Speaker Biography

T. Todd Elvins is a staff visualization programmer at the San Diego Supercomputer Center. Todd earned a B.A. in Business Economics and a B.S. in Computer Science, both at U.C. Santa Barbara, and a M.S. in Computer Science at the University of Utah.

In 1988, Todd accepted a position at SDSC, one of four National Science Foundation supercomputer centers in the United States. He leads a group of software engineers, animators, and media specialists who assist scientists in gaining insight into a wide variety of intellectual problems. Mr. Elvins has published numerous papers and has spoken in many courses on the subject of scientific visualization. He has taught several tutorials on visualization for Eurographics in the United Kingdom, and has given invited visualization talks in Russia, Brazil, Venezuela, and Austria. Elvins chaired the 1990 ACM San Diego Workshop on Volume Visualization.