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COURSE NOTES 11

**Introduction to Volume Visualization
Imaging Multi-dimensional Scientific
Data**

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Course Notes

SIGGRAPH '93

**Introduction to Volume Visualization:
Imaging Multi-dimensional Scientific Data**

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Elvins, T T, "A Survey of Algorithms for Volume Visualization," <i>Computer Graphics</i> , March, 1992 Volume 26, Number 3, pp 34-44	38
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Elvins, T T, "An Annotated Bibliography of Volume Visualization Papers, 1991-1993," San Diego Supercomputer Center, Technical Report	46
7 Paper Reprint	
Hersh, J S, "A Survey of Modeling Representations and Their Application to Biomedical Visualization and Simulation," <i>Proceedings of the First Conference on Visualization in Biomedical Computing</i> , IEEE Press, May, 1990	55

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 half 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, optimizations, & systems	90 minutes
Session close	Summary, questions, evaluations	15 minutes

1.5. Speaker Biography

Todd Elvins is an associate staff visualization programmer at the San Diego Supercomputer Center (SDSC) in San Diego, California, USA. 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 country. He works in a group of software engineers and animators who research new computer graphics techniques that allow scientists to gain greater insight into a broad variety of scientific problems. Todd has also been involved in the design and implementation of the SDSC Advanced Scientific Visualization Laboratory and has participated in numerous collaborative visualization projects with many SDSC users.

Todd has been active in the computer graphics community for the past eight years, has participated in numerous conferences, courses, and workshops, and has spoken at many visualization international meetings including a 1990 SIGGRAPH course entitled "State of the Art in Data Visualization", a 1992 SIGGRAPH course entitled "Introduction to Scientific Visualization Tools and Techniques". He served as Conference Chairman for the 1990 San Diego Workshop on Volume Visualization, and he chaired a SIGGRAPH 1991 panel entitled "Scientific Visualization on Advanced Architectures".

Todd is a member of the Association of Computing Machinery, the Special Interest Group on Computer Graphics, the Sun Users Group, and the Institute of Electrical and Electronic Engineers Technical Committee on Computer Graphics.

2 Quick Survey of Volume Visualization Packages

This is a quick survey of volume visualization software packages both public domain and commercial. Each package is listed with the platforms on which it runs, an approximate price, and a contact.

Package *SciAn*

Runs on SGI and IBM workstations

Price free

Who Supercomputer Computations Research Inst
Florida State University

Ftp ftp scri fsu edu (144 174 128 34)

Phone (614) 291-2229

Package *Explorer*

Runs on SGI and Cray

Price bundled with SGI OS

Who your local SGI salesperson

Package *Xdataslice, Viewit*

Runs on most any X device

Price free

Who NCSA

Phone (217) 244-0072

Ftp zaphod ncsa uiuc edu (141 142 20 50)

Package *dicer*

Runs on MacIntosh

Who Spyglass Inc

701 Devonshire Drive, C-17

Champaign, IL 61820

Phone (217) 355-1665

Package *VoxelBox*

Runs on DOS/Windows PCs

Price inexpensive

Who Jaguar Software Inc

573 Main St Suite 9B

Winchester MA 01890

Phone (617) 729-3659

Package *AVS and SunVision*

Runs on many platforms

Who AVS Inc

6 N ETC , 521 Virginia Road

Concord, MA 01742

Phone (508) 287-0100

Note get AVS modules via FTP at
avs ncsa org (128 109 178 23)

Package *FOTO*

Runs on Apollos, on IBM and SGI

Who Cognivision

319 Littleton Road Suite 100

Westford, MA 01886

Phone (508) 392-0881

Package *VoxelView*

Runs on SGI

Who Vital Images

PO Box 551

Fairfield, IOWA 52556

Phone (515) 472-7726

Package *Data Explorer*

Runs on IBM Workstations

Who your local IBM salesperson

Package *data visualizer*

Runs on SGI and other UNIX machines

Who Wavefront Technologies Inc

530 East Montecito St

Santa Barbara, CA 93103

Phone (805) 962-8117

Package *apE*

Runs on many X devices

Who TaraVisual

929 Harrison Avenue

Columbus, OH 43215