Course Notes 71

Visualizing Planet Earth

ORGANIZER
Randi Rost
Kubota Pacific Computer, Inc.

LECTURERS
Jeff Dozier
University of California, Santa Barbara
Bill Hibbard
University of Wisconsin
Peter Kochevar
Digital Equipment Corporation
Lloyd Treinish
IBM T.J. Watson Research Center
Tom Van Sant
Geosphere Project

Visualizing Planet Earth

SIGGRAPH '93

Course Notes

Organizer: *Randi J. Rost, Kubota Pacific Computer*

Speakers: *Jeff Dozier, UCSB/Sequoia 2000*
Bill Hibbard, Univ. of Wisconsin/SSEC
Peter Kochevar, DEC/Sequoia 2000
Lloyd A. Treinish, IBM
Tom Van Sant, Geosphere Project

Contents

Course Syllabus

8:25 - 8:30	Introductions and logistics	
8:30 - 9:05	*Jeff Dozier*	**Challenges in Information Management for the Study of Global Change**
9:05 - 9:40	*Peter Kochevar*	**Intelligent Visualization and User Interfaces**
9:40 - 10:15	*Bill Hibbard*	**Interactive Visualization Techniques for Large Environmental Data Sets**
10:15 - 10:30	break	
10:30 - 10:40	Questions and Answers	
10:40 - 11:15	*Lloyd Treinish*	**Visualization and Analysis of Global Data**
11:15 - 11:50	*Tom Van Sant*	**The GeoSphere™ Project**
11:50 - 12:00	Questions and Answers	

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Course Abstract

Today's rapidly changing world is faced with enormous challenges: Earth resource information is being collected faster than it can be processed or analyzed, news and information now flows around the globe in seconds or minutes rather than days or weeks, the economy is becoming more global than national, and political boundaries are becoming less and less important. For these reasons, there is a growing need for tools to visualize, analyze, process, and share information that is of global interest. Scientists and policy makers are seeking out new ways to utilize interactive computer graphics and imaging technology to learn what is happening to the planet on which we live.

This tutorial brings together some of the leaders in the field of global visualization. This field is characterized by the enormous demands it puts on conventional computer systems. A single database may be many terabytes in size, and images may have a resolution of several thousand pixels in each dimension. Geometry to be rendered might contain millions of sample points, each of which changes over time as additional samples are collected. These data may be multidimensional (e.g., spatial, temporal or spectral), multirank (e.g., scalar, vector, tensor) and multiparameter.

During this tutorial we will discuss new and innovative ways that computer graphics and imaging technology is being used to gain new insight into global phenomena, and we will discuss the shortcomings of current technology and what is being done to correct them.

In particular, our goal is to provide course attendees with some insight into the following questions:

1) What does 'global visualization' mean? How does it fit into or relate to other disciplines?
2) What aspects of global visualization make it a uniquely demanding graphics/imaging discipline?
3) What new or unique visualization techniques have been developed for use in this field?
4) How is global data exchanged and ingested into visualization packages?
5) What tools are available (needed) to assist collaboration efforts in global visualization?
6) What progress is being made on the frontiers of global visualization research?

Organizer Biography

Randi J. Rost
Chief Architect, Graphics Software
Kubota Pacific Computer, Inc.
2630 Walsh Ave.
Santa Clara, CA 95051-0905

Randi Rost is chief architect for graphics software at Kubota Pacific Computer, Inc. He is responsible for leading KPC's efforts to design and implement a rich and flexible software environment for KPC's line of high-performance graphics and imaging systems. In addition, Randi is responsible for participating in emerging graphics standards efforts and developing technology relationships with other organizations. He was one of the chief architects for PEX and served as the PEX document editor for the first four years of the effort. He participated in the design of OpenGL as well as the design of the GPC committee's Picture Level Benchmark. He received NCGA's 1993 Achievement Award for the Advancement of Graphics Standards. Randi has previously participated in SIGGRAPH tutorials on PEX and evaluating graphics workstations and was the course organizer for the SIGGRAPH '92 tutorial on OpenGL.

Speaker Biographies

Jeff Dozier
Professor of Geography
Center for Remote Sensing and Environmental Optics
University of California
Santa Barbara, CA 93106-3060

Jeff Dozier is a Principal Investigator on an interdisciplinary grant in NASA's Earth Observing System (EOS) and, with Michael Stonebraker of UC Berkeley, co-Principal Investigator on Digital Equipment Corporation's flagship external research project, *Sequoia 2000: Large Capacity Object Servers to Support Global Change Research*. From 1990–1992 he served as the EOS Senior Project Scientist. He provides the perspective of a working scientist who is well versed about computing challenges in modern Earth science. He has published more than 150 articles, chapters, and books in his research interests: snow hydrology, Earth System Science, radiative transfer in snow, remote sensing and data systems, image processing, and terrain analysis. Jeff is a Fellow of the American Geophysical Union, Editor of *Geophysical Research Letters*, and a Distinguished Visiting Scientist at the Jet Propulsion Laboratory. For the National Academy of Sciences, he is a co-author on two recent committee publications that surveyed the hydrologic and computational sciences: *Opportunities in the Hydrologic Sciences* (1991) and *Computing the Future: A Broader Agenda for Computer Science and Engineering* (1992). Jeff is a Professor of Geography at the University of California, Santa Barbara. He was formerly a Senior Member of the Technical Staff of the Jet Propulsion Laboratory, California Institute of Technology, and he was employed at NASA Goddard Space Flight Center as a Visiting Scientist by Universities Space Research Association.

Bill Hibbard
Researcher
Space Science and Engineering Center
University of Wisconsin
1225 West Dayton Street
Madison, WI 53706

Bill Hibbard is a researcher at the University of Wisconsin-Madison Space Science and Engineering Center (SSEC). He has been working with earth science data since 1978. In 1984 he began adapting SSEC's McIDAS

system to generate three-dimensional animations of a wide variety of earth science data. In 1988 this work evolved into the VIS-5D system running on high-performance graphics workstations and providing interactive exploration of large numerical simulation data sets. VIS-5D is available by anonymous ftp and has become very widely used by atmosphere and ocean modellers. Bill also developed the VIS-GI software for exploring global satellite data sets, and initiated the effort to port the enormous McIDAS system to UNIX workstations. More recently, he has led the development of the VIS-AD system for interactive algorithm visualization, and has led development of distributed versions of VIS-5D and VIS-AD.

Peter Kochevar
Principal Software Engineer
DEC External Research Program
San Diego Supercomputer Center
P.O. Box 85608
San Diego, CA 92186

Peter Kochevar is a principal software engineer in Digital Equipment Corporation's External Research Program. He is presently at the San Diego Supercomputer Center leading the data visualization research efforts of the Sequoia 2000 Project. Sequoia, the successor to Project Athena, is a collaboration of Digital and several campuses of the University of California. The intent of this project is to bring together earth scientists and computer scientists in order to develop computing systems which will help in the understanding of global environmental change. Driven by the needs of earth scientists, the Sequoia visualization group is developing a next-generation visualization system that is faster, easier to use, and provides more insight to researchers than its predecessors. Peter received a PhD in Computer Science from Cornell University in 1989 where he was a member of the Program of Computer Graphics. Peter has previously helped conduct SIGGRAPH tutorials on introductory computer graphics and on advanced rendering techniques.

Lloyd A. Treinish
Research Staff Member   work (914) 784-5038
SK-Y57   fax (914) 784-5077
International Business Machines Corporation   lloydt@watson.ibm.com
Thomas J. Watson Research Center
Post Office Box 704
Yorktown Heights, NY 10598

Lloyd A. Treinish is a research staff member in the Visualization Systems Group of the Computer Science Department at IBM's Thomas J. Watson Research Center in Yorktown Heights, NY. He works on techniques, architectures and applications of data visualization for a wide variety of scientific disciplines within this group, which is the group that developed the IBM POWER Visualization System and the IBM Visualization Data Explorer. His research interests range from computer graphics, data storage structures, data representation methodologies, data base management, computer user interfaces, and data analysis algorithms to middle atmosphere electrodynamics, planetary astronomy and climatology. In particular, Lloyd is interested in generic or discipline-independent techniques for the storage, manipulation, analysis and display of data, and has applied these ideas to the study of global atmospheric dynamics and ozone depletion. Earlier he did similar work in the development of advanced scientific data systems, including studying space and atmospheric phenomena, for over a decade at the National Space Science Data Center of NASA's Goddard Space Flight Center in Greenbelt, MD.

A 1978 graduate of the Massachusetts Institute of Technology with an S.M. and an S.B. in physics, and an S.B. in earth and planetary sciences, Lloyd has been at IBM since April 1990. He is a member of the IEEE Computer Society (IEEE-CS), the IEEE-CS Technical Committee on Computer Graphics, the IEEE-CS Visualization Conference Committee, the Association for Computing Machinery (ACM), ACM SIGGRAPH, the National Computer Graphics Association, the Planetary Society, and the American Geophysical Union. He also served as technical liaision for global information services for the SIGGRAPH '92 conference.

Tom Van Sant
Executive Director
Geosphere Project
146 Entrada Drive
Santa Monica, CA 90402

work (310) 459-4342
fax (310) 459-8299
(not accessible via email)

Tom Van Sant is the founder and director of the Geosphere Project, a non-profit organization whose mission is to make complex global systems understandable. With various project underway, the Geosphere Project is using graphics and imaging technology to create visualizations that illustrate and enhance our understanding of earth processes. Through the use of appropriate and enlightening visualizations, Tom and the Geosphere Project are seeking to influence policy makers and ordinary citizens so that we can progress from being earth resource users to earth resource managers. Tom has participated in earth resource conferences around the globe, including the Earth Summit in Rio de Janeiro in 1992 and in the 1992 World's Fair in Seville, Spain. The Geosphere Project has technology agreements in place with many providers and consumers of earth resource data, and is currently working to install "Earth Situation Rooms" which incorporate Geosphere's visualization technology into several dozen sites around the world, including the Smithsonian Air & Space Museum in Washington, D.C.

Tom is also a sculptor, painter, muralist, environmental planner and architectural designer. In thirty years of professional work he has executed over sixty major sculpture and mural commissions for public spaces around the world. These include the Central Lobby of the Honolulu International Airport, the Pacific Mutual Life Insurance headquarters in Newport Beach, the City of Inglewood Civic Center, the Century Park Sheraton Hotel in Manila, and the Taipei International Airport in the Republic of China. He created the rows of hanging banners at the Thomas Bradley Terminal of the Los Angeles International Airport, and designed and built the gently curving pedestrian bridge linking the Los Angeles City Hall with the North Mall across Temple Street. In 1987, Van Sant completed the giant stained glass window for the Glenkirk Presbyterian Church in Glendora, California.- Tom has had fifteen one-man exhibits in the United States, Europe and Australia. His work is represented in both public and private collections around the world, including the collections of King Hussein of Jordan, Millard Sheets of California, and S. Edward Tomaso. He is also known for his innovative design of large-scale kites, which have been flown and exhibited in museums of art and museums of science and industry in the United States and Europe.