Graphics Design and Production for Hemispheric Projection

Organizer
ED LANTZ
Astronaut Memorial Planetarium & Observatory

Lecturers
MICHAEL HUTTON
Astronaut Memorial Planetarium & Observatory

STEVEN SAVAGE
Sky-Scan, Inc.

CHRIS WARD
Lightspeed Design Inc.

Course 2 NOTES

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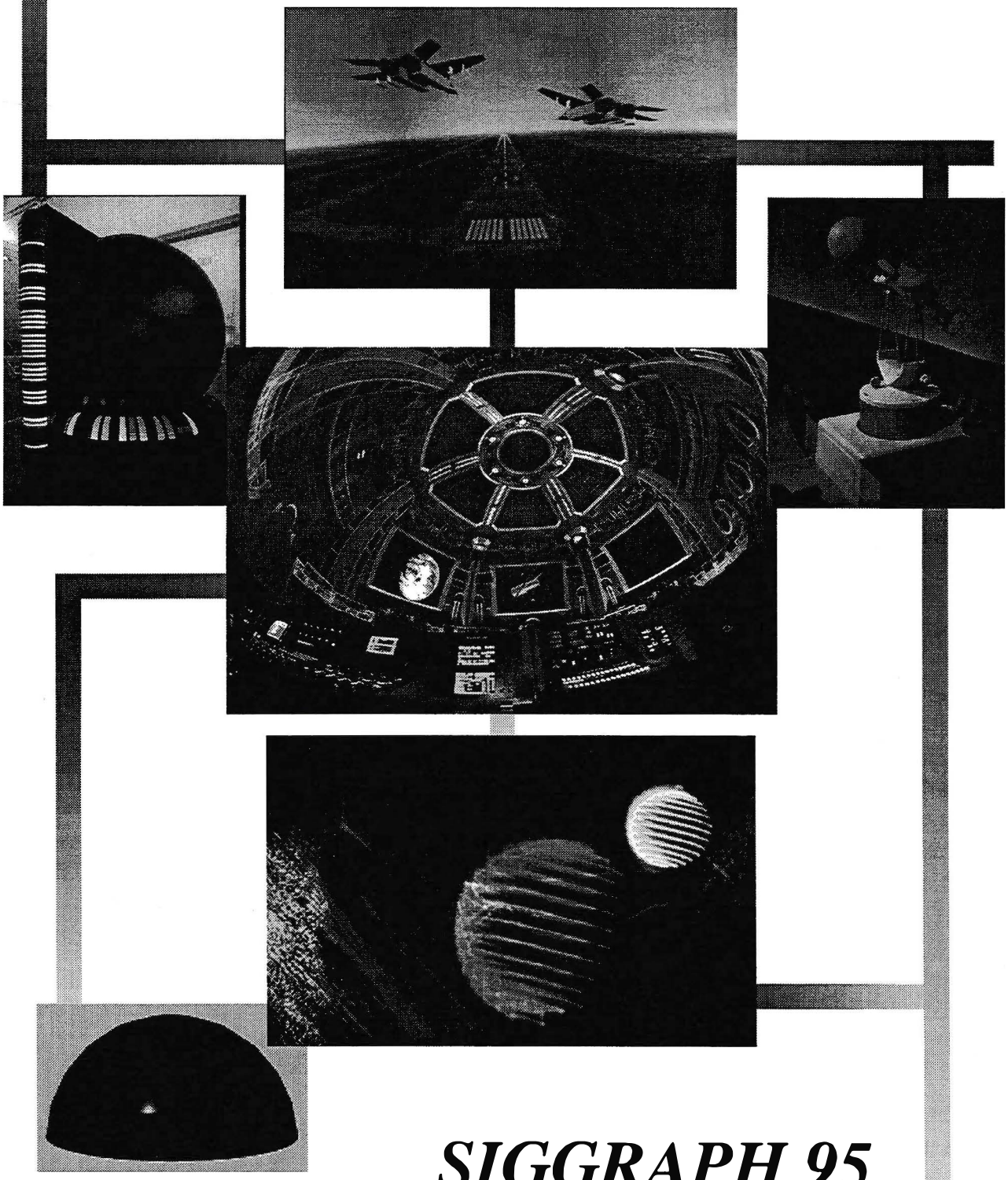

SIGGRAPH 95

Graphics Design and Production for Hemispheric Projection

Course Notes for SIGGRAPH'95

Course Organizer

Ed Lantz
Astronaut Memorial Planetarium and Observatory

Course Speakers

Mike Hutton
Astronaut Memorial Planetarium and Observatory

Steve Savage
Sky-Skan, Inc.

Chris Ward
Lightspeed Design, Inc.

Abstract

Walk-in immersive displays offer advantages over flat-screen and HMD technologies including group viewing, wide field of view, and high resolution without cumbersome headgear. Images reproduced on a domed screen provide a spherical perspective which best matches our spatial perception. This course presents techniques for producing graphics for hemispheric projection in planetaria, omni theaters, simulators, and other advanced hemispheric environments. Topics include the evolution of hemispheric theaters, technical overview of domed projection systems and environments, spherical perspective projections, and the integration of hemispheric multi-image, film, video, and laser graphics to create the illusion of presence.

Speaker Biographies

Ed Lantz

Ed Lantz is Chief Engineer at the Astronaut Memorial Planetarium and Observatory in Cocoa, Florida. He received the B.S. (1982) and M.S. (1984) degrees in Electrical Engineering from Tennessee Tech. He led optical signal processing research at Harris Corp. until early 1991, when he joined AMPO to develop next-generation planetarium systems. Accomplishments include a polychromatic acousto-optic modulator for laser graphics, advanced RGB laser graphics projector, DSP-based celestial motion control system, and an object-oriented planetarium scripting and control system for the Power Macintosh. Mr. Lantz's interests include spherical perspective transformation and rendering algorithms, domed video projection, and advanced techniques for group interactivity. *Address:* Astronaut Memorial Planetarium, Brevard Community College, 1519 Clearlake Road, Cocoa, FL 32922, *E-mail:* lantz.e@al.brevard.cc.fl.us, *Phone:* (407) 632-1111 x64172, *Fax:* (407) 633-4565.

Michael Hutton

Mr. Hutton is Director of the Astronaut Memorial Planetarium and Observatory. He has over 25 years experience in the planetarium field, and holds a B.S. in earth and space science and a Masters in Ed. Sci. Mr. Hutton has written and produced numerous planetarium shows, and is a past officer of C-360° Inc., a consortium of omni-film theaters and film producers. His most recent project is the newly renovated Astronaut Memorial Planetarium and Observatory which includes a 21.3 meter diameter hemispheric theater and an 8-perf 70 mm IWERKS film theater. His facility recently hosted the 1994 International Planetarium Society conference, where his revolutionary theater design was hailed as a new generation in planetaria. *Address:* Astronaut Memorial Planetarium, Brevard Community College, 1519 Clearlake Road, Cocoa, FL 32922, *E-mail:* hutton.m@al.brevard.cc.fl.us, *Phone:* (407) 632-1111 x63503, *Fax:* (407) 633-4565.

Steven T. Savage

Mr. Savage is president and owner of Sky-Skan, Inc. His company is a design consultant and worldwide supplier of audio and video projection automation and control systems, special effects projectors, and interactive audience response systems for planetaria and domed theaters in theme parks and EXPO's. Mr. Savage received his Bachelor's in Electrical Engineering Technology in 1977, and has over 20 years of experience in the planetarium field. His company has pioneered the use of video and computer graphics in hemispheric theaters, and is a leader in planetarium projection and control systems. *Address:* Sky-Skan, Inc., 51 Lake Street, Nashua, NH 03060-4513, *E-mail:* 73700.110@compuserve.com, *Phone:* (603) 880-8500, *Fax:* (603) 882-6522.

Chris Ward

Mr. Ward is President of Lightspeed Design, Inc. a leading laser display company that serves museums, amusement parks, and attractions. He is supported by Art Director, Bob Mueller who provides Lightspeed's primary artistic inspiration and Casey Stack current Chairman of the International Laser Display Association (ILDA) Technical Standards Committee. Recent projects include the Nintendo 3-D Laser Dome, Grand Casino's Biloxi Theater, St. Louis and Liberty Science Centers. Mr. Ward's art staff has received over 25 ILDA Awards, including 13 first place

entries. His latest project, "The Illuminated Brain", combines 3-D laser graphics, computer graphics, and biomedical imaging to take museum visitors on a tour through the human brain. Mr. Ward has over eight years of experience in the laser display industry, and is an officer in ILDA. *Address:* Lightspeed Design, Inc., 10900 NE 4th Avenue, Suite 600, Bellevue, WA 98004, *E-mail:* chrisw@lightspd.wa.com, *Phone:* (206) 644-0199, *Fax:* (206) 453-7588.

Credits and Notices

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Course Schedule

Graphics Design and Production for Hemispheric Projection

1:30 Course Introduction (Ed Lantz)

1:35 Technical Overview of Hemispheric Projection (Ed Lantz)
Evolution of Domed Theaters, pp. I-1 to I-7
Hemispheric Projection Theory, pp. I-7 to I-14
Psychophysics And Immersivity, pp. I-15 to I-18
Hemispheric Projection Systems, pp. I-18 to I-22
Domed Screens, pp. I-22 to I-26
Graphics Scripting and Control Systems, pp. I-27 to I-29

2:25 Working the Dome: From Theater Design to Show Production (Mike Hutton)
Domed Theater Design, pp. II-1 to II-26
Producing Images & Shows for Hemispheric Projection, pp. II-26 to II-30

3:15 Break

3:30 Hemispheric Projection of Computer Graphics (Steve Savage)
Introduction, pp. III-1 to III-3
Video Projection Systems, III-3 to III-6
Video Graphics Production, pp. III-6 to III-8
Future Video Projection Systems, pp. III-9 to III-11

4:20 Laser Graphics for Hemispheric Projection (Chris Ward)
The Nature of Laser Light Projections, pp. IV-1 to IV-3
"Laser Light Shows" and Domed Environments, pp. IV-3 to IV-4
Laser Display Technology Basics, pp. IV-5 to IV-12
Specific Applications of Laser Displays, pp. IV-13 to IV-15
The Future of Laser Displays, pp. IV-15 to IV-16

4:50-5:00 Wrap-Up Discussion (All Speakers)

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Course Overview

As 3D graphical tool users increase in numbers, there is a growing need for immersive displays which are simple, useful, and can be viewed for extended periods without fatigue. Immersive displays produce a greater sense of presence, facilitating ordinary spatial reasoning within 3D environments. Head-mounted display technologies are under development which should eventually provide sufficient field of view and resolution. Another promising display medium is the walk-in immersive or panoramic display such as the CAVE, developed at University of Illinois at Chicago. The CAVE surrounds viewers with 3 or 4 high-resolution video projection screens, allowing group viewing of wide field-of-view, high-resolution stereoscopic images without cumbersome headgear or head rotation tracking and its associated delays.

The rectilinear CAVE is a cubic approximation of a sphere. A spherical screen makes an ideal panoramic display surface. Spherical screens are free of discontinuities and can surround the viewer with a uniform 360° field of view. Hemispheric displays have a long history of use beginning with planetariums in 1926. More recent hemispheric displays include omni film theaters, themed entertainment simulators, and vehicle training simulators. This course examines a variety of domed display technologies and environments, spherical perspective projections, and the use of hemispheric multi-image, film, video, and laser graphics.

Section I presents the history of immersive theaters, introduces the basic concepts of spherical perspective transformation, and examines real-world hardware and software limitations.
Section II covers hemispheric/hypospheric theater design issues, and production techniques for creating the illusion of presence in a domed environment.
Section III looks specifically at present and future technologies for hemispheric video projection, including actual demonstrations of projection equipment.
Section IV concludes with a look at the latest developments in laser projection technology, including hemispheric laser projection and the use of lasers to enhance multimedia productions.

This course attempts to combine, for the first time, a review of all existing domed display technologies and applications within the context of an emerging spherical image representation paradigm. It necessarily covers a very broad range of multidisciplinary topics. We have prepared an introduction which will help build the conceptual groundwork for the material which follows. We hope that you will find this course interesting, informative and inspiring.