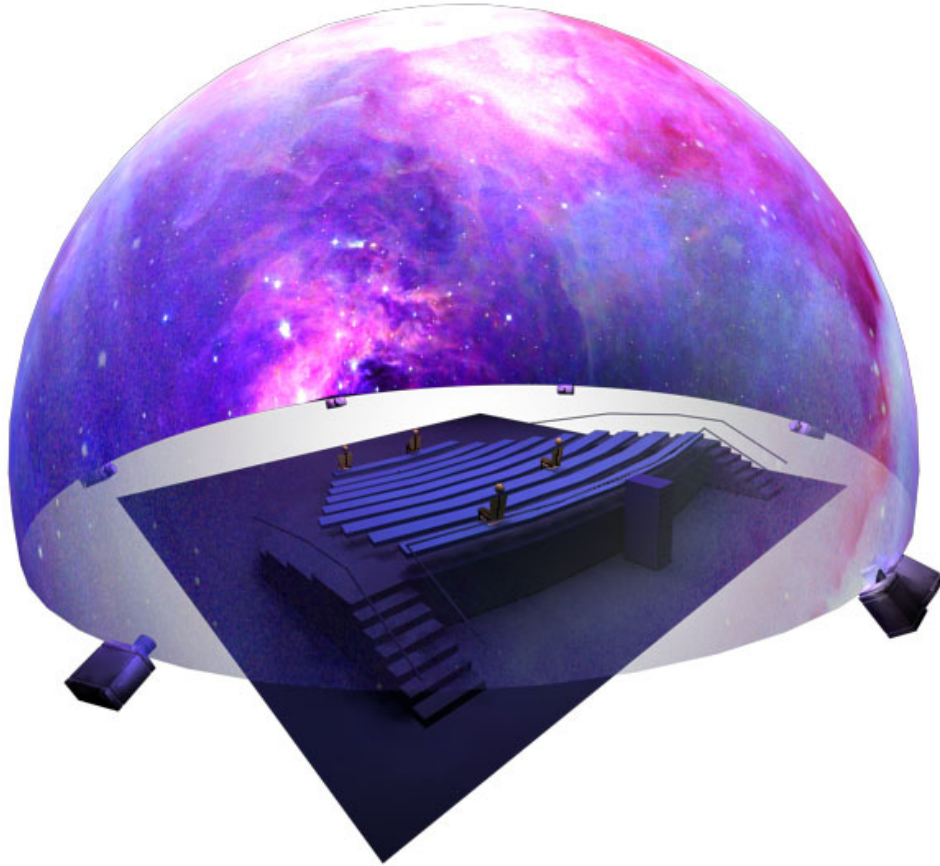


# ***Computer Graphics for Large-Scale Immersive Theaters***



*Course # 25*



**SIGGRAPH 2003**  
SAN DIEGO

# **Computer Graphics for Large-Scale Immersive Theaters**

## **Course Notes for SIGGRAPH 2003**

### **Course Organizer**

Ed Lantz  
Spitz, Inc.

### **Presenters**

Ed Lantz  
Brad Thompson  
Garland Stern  
Spitz, Inc.

Carter Emmart  
Rose Center for Earth and Space  
American Museum of Natural history

Kevin Scott  
Evans & Sutherland Computer Corp.

David Beining  
LodeStar Astronomy Center

### **Abstract**

Large-scale immersive digital cinema “fulldome” theaters utilizing video graphics projection onto dome screens are rapidly growing due to their acceptance by planetaria and other entertainment-based venues. This course provides an overview of large-scale immersive video systems, recent theater projects, and educational collaborations with immersive theaters. Cutting-edge immersive productions and student projects are showcased using the latest video projection technology in the Reuben H. Fleet Science Center’s IMAX<sup>®</sup> Dome Theater, which is celebrating its 30<sup>th</sup> year of operation as the world’s first Omnimax<sup>®</sup> system. Industry leaders provide a comprehensive look at computer graphics production tools and techniques for real-time and pre-rendered productions.

## Presenter Biographies

**Ed Lantz** - Product Development Manager, Spitz, Inc.

Ed Lantz is Product Development Manager for Spitz, Inc. He leads the development of advanced immersive visualization systems, supporting hardware and software. Ed pioneered Spitz's Immersive Visualization Environment products including the ImmersaVision® and ElectricSky® theaters. He has published numerous papers on dome theaters, was guest editor for the May 1997 issue of ACM's *Computer Graphics*, chaired a SIGGRAPH panel on VR in 1996 and organized previous SIGGRAPH courses on computer graphics for immersive projection in 1995 and 2001. Ed holds a Bachelors and Masters in Electronics Engineering from Tennessee Tech University.



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**Brad Thompson** - Lead Animator, Spitz, Inc.

Brad Thompson is a 3D computer graphics animator with a degree in Imaging and Digital Arts from the University of Maryland. Brad has worked extensively with 3D animation tools including Softimage, Alias Power Animator, 3D Studio Max, 3D World Builder, Truespace and others on platforms ranging from SGI to Windows NT to Macintosh. Brad is also an accomplished 2D compositing artist. Brad is currently responsible for production of immersive video content for Spitz's ElectricSky theaters. His work has led to the development of specialized techniques for creating and rendering images for the dome environment.



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### **Garland Stern – Computer Scientist, Spitz, Inc.**

Garland Stern is Computer Scientist at Spitz, Inc. where he leads the development of spherical image processing, compositing, and theater automation software. Dr. Stern earned a BA in Mathematics in 1970 from the University of Louisville and a Ph.D. in Computer Science from the University of Utah in 1977. He worked at the New York Institute of Technology computer graphics lab and has extensive experience in 3D graphics on a variety of platforms. He holds two patents in computer graphics technologies and was awarded an Academy Award in 2001 for technical achievements in computer graphics.



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### **Carter Emmart - Director of Astrovisualization, Rose Center for Earth and Space, American Museum of Natural History**

Carter Emmart has been a scientific illustrator and visualizer for 20 years. While with the NASA Ames Research Center he edited and illustrated the book "Strategies for Mars: A Guide to Human Exploration", that assess the state of issues regarding human missions to the planet Mars. He joined the National Center for Atmospheric Research from 1993-98 where he served as visualization specialist for the GENESIS Earth system modeling project and worked with various media, including IMAX large-format film. Carter has a diverse background in conceptualization and visualization of future space exploration, Earth-system simulation, and astronomical phenomena. He is currently directing the astrovisualization efforts at the Rose Center for Earth and Space, where models of the cosmos are turned into images that fill the 68-foot dome at the newly rebuilt Hayden Planetarium in New York. Carter holds a bachelor of arts in Geophysics from the University of Colorado.



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**Kevin Scott - Production Designer, Evans & Sutherland  
Digital Theater**

Mr. Scott has 10 years production and theater management experience in planetaria. He is a software engineer, interface designer, and content developer for Evans & Sutherland's Digital Theater Division. Mr. Scott obtained his B.A. in Film & Television Production and B.S. in Computer Science (1995) from Montana State University and his M.S. in Human-Computer Interaction (1998) from the Georgia Institute of Technology.

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**David Beining – Director, LodeStar Astronomy  
Center**

David Beining is director of the LodeStar Astronomy Center, a University of New Mexico project located at (and in partnership with) the New Mexico Museum of Natural History. LodeStar opened with its fulldome theater in 2000. Beining has been building informal educational institutions and creating educational programs for more than 10 years. His scholarly pursuit is understanding the social implications of new communication technologies. His programmatic passion is experiments in the integration of art and science. He lives in a submarine in Albuquerque with his wife Tracy and sons Gabriel and Aidan.



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## Credits and Notices

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Thanks to all the contributors of fulldome content for the Fulldome Showcase presented at the Reuben H. Fleet Science Center's IMAX<sup>®</sup> Dome Theater.

We especially thank the manufacturers who made possible the Fulldome Showcase by volunteering resources and equipment:

**Spitz, Inc.** for display system design, project management, system integration and operation, and immersive video formatting and editing, and for the loan of projection, playback and computing resources.

**DVS Digital Video, Inc.** for the loan of additional playback equipment.

**Elumens Corp.** for the loan of additional projection optics.

**JVC Americas Corp.** for the loan of additional projection equipment.

**Reuben H. Fleet Science Center** for the use of their IMAX theater and for their assistance with system integration and theater operation.

**SIGGRAPH 2003 Courses Committee** and other 2003 organizers who held the vision and dedicated the resources for this special course event.

Every attempt was made to provide a balanced treatment of this field without vendor preference. The organizer apologizes for any oversights or omissions.

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## Course Syllabus - Morning

**7:30** SIGGRAPH Bus to Reuben H. Fleet Science Center's IMAX<sup>®</sup> Dome Theater

**8:00** Introduction to Large-Scale Immersive Theaters Part I (E. Lantz)

Brief introduction to spherical video projection systems and overview of house video display.

**8:15** Fulldome Production Showcase

Various presenters introduce their works which are screened on the IMAX Dome theater using the house video system.

David Beining – LodeStar Astronomy Center

Brad Thompson & Mike Bruno - Spitz Creative Media

Carolyn Summers – Houston Museum of Natural Science

Tom Casey – Home Run Pictures

Kevin Scott - E&S Productions

Ted Artz - Drexel University & amalgamation house

Mike Murray - Clark Planetarium

**10:00** Break

**10:20** Fulldome Production Showcase, Continued

Steve Savage - SkySkan Productions

**10:45** Storytelling Through Immersive Data Visualization (C. Emmart)

From the Hayden Planetarium's latest production, entitled "The Search for Life: Are We Alone?," we will examine an eight minute segment that traverses 100,000 light years, and spans five billion years of solar and terrestrial evolution. This segment was created in collaboration with the San Diego Supercomputer Center and the National Center for Supercomputing Applications. Showcasing multiple visualizations from current observations and astrophysical simulation of process, we experience the latest science of what creates worlds by being placed within it. Demonstration on how a story is crafted by threading separate visualizations together with a continuous camera move will be discussed while highlighting scene construction by a composition of elements rendered with separate techniques.

**11:00** Lunch – SIGGRAPH Bus to San Diego Convention Center

## Course Syllabus - Afternoon

### **1:30** Introduction to Large-Scale Immersive Theaters Part II (E. Lantz)

Provides historical context for immersive graphics including large-format film and video projection and an overview of existing theaters

### **1:45** Spherical Image Generation and Projection (E. Lantz)

Review of various methods for getting video onto the sphere. Looks at popular spherical mapping and edge-blending methodologies, including software and real-time hardware approaches. Overview of dome video projection, image generation and playback.

### **2:15** Immersive Rendering Basics (B. Thompson)

Discusses basic technical and conceptual challenges encountered in rendering animations for spherical screens, and presents some of the methods that our industry has invented to deal with them. Technical hurdles include the absence of monitors to view spherical graphics, the need to adapt flat-view-plane rendering tools for spherical screens, and the need for massive amounts of storage space and rendering power to deal with the large-format spherical frame resolutions. Conceptual hurdles are substantial because spherical animation challenges a flat-screen cinematic language that's been subconsciously programmed into us from the first days of motion picture and video.

### **3:15** Break

### **3:30** Spherical Image Processing (G. Stern)

Demonstration of popular spherical image processing, compositing and editing tools and techniques. Techniques covered include spherical billboarding, image remapping, stitching of hemicubes, splitting of dome masters into multi-projector sub-images, and various edge-blending techniques.

### **4:00** Real-Time Graphics for Large-Scale Immersive Theaters (K. Scott)

Real-Time visualization and cinema moves out of the lab and into the hands of story tellers. This lecture will highlight the capabilities of real-time production systems and the development of real-time content. Lengthy rendering jobs are no longer necessary to provide rich, compelling audience experiences. Real-Time graphics provide unparalleled production flexibility enabled by PC clustering technology and COTS multimedia hardware. These systems are achieving new levels of visual performance and driving immersive theaters at affordable price points.

### **4:30** Educational Collaborations in Fulldome Productions (D. Beining)

Presents examples of formal and informal educational collaborations with immersive digital theaters and discusses the benefits to producers, audiences, and the theaters. Types of production/education programs include university coursework, community-based training labs, artist-in-residencies, and volunteer-based production teams directed by staff. Collaboration results include increased funding sources and community support, expanded educational roles and opportunities, an increased production community to create for the new medium, and a redefining of term 'planetarium.'

### **5:00** Wrap-Up and Q&A - All

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A sampling of related paper reprints.

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Additional profiles of featured immersive producers and their works.