

Dynamic Statistical Graphics in Highly Immersive Environments

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- Virtual Reality
- Dynamic Statistical Graphics
- DSG in Immersive Environments
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VIRTUAL REALITY – DEFINITION

- Different understandings of the term VR:
 - Pimentel, Teixeira: "Virtual reality is the place where humans and computers make contact."
 - Newby: "VR has to do with the simulation of environments."
 - Anonymous: "Virtual reality is a media to recreate the world in which we live and to create illusions of new and yet unknown worlds."
 - Cruz-Neira: "Virtual reality refers to immersive, interactive, multi-sensory, viewer-centered, three-dimensional computer generated environments and the combination of technologies required to build these environments."

VIRTUAL REALITY – DEFINITION

- Related Terms:
 - Artificial Reality
 - Virtual Environments
 - Cyberspace

VIRTUAL REALITY – HISTORY

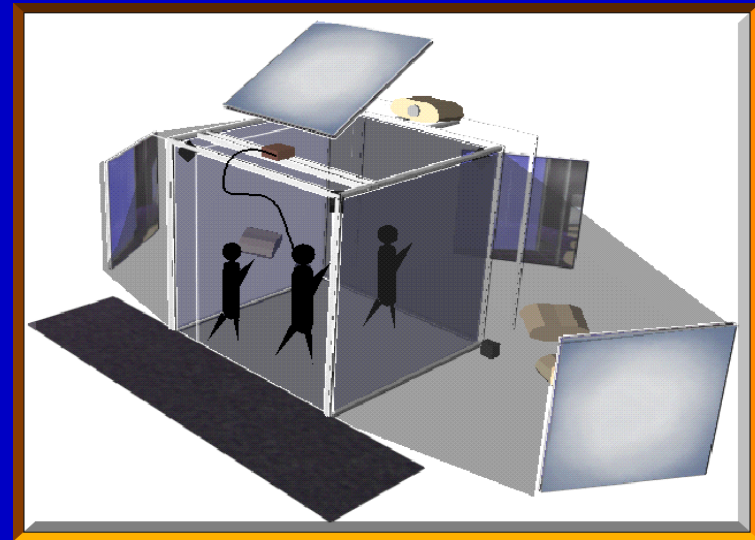


IMMERSIVE ENVIRONMENTS – HISTORY

- 1991 CAVE: Electronic Visualization Laboratory, Univeristy of Illinois, Chicago
- 1996 Iowa Center for Emerging Manufacturing Technology, Iowa State University, Ames

IMMERSIVE ENV'S – TECHNICAL DETAILS

- Projection-based, uses
 - 3D computer graphics
 - Position tracking
 - Auditory feedback



- Projections onto three side walls and floor
- Floor print of 12 x 12 feet
- Height of 9 feet

IMMERSIVE ENV'S – 3D ILLUSION

- Created through LCD shutterglasses and high-performance SGI graphics computers
- Alternating left and right eye viewpoints at 96hz
- User's brain combines two views into 3D stereoscopic image
- Position and orientation of user's hands and head determined through magnetic based tracker, cyberglove, and hand-held wand
- Audio feedback through multiple speakers

IMMERSIVE ENV'S AND OTHER VR DEVICES

- Easy to learn
- High resolution
- Full field-of-view
- Visual acuity
- Lack of intrusion
- Lightweight and unrestrictive equipment to be worn
- User's hands and body are in the environment and don't have to be drawn

IMMERSIVE ENV'S AND OTHER VR DEVICES

- Multiple viewers can share the same virtual environment at the same time for collaborative work
- New user can join a guide (expert navigator) to get introduced to the problem

IMMERSIVE ENV'S – APPLICATIONS

- **Outside DSG:**
(real) 3–dimensional data that is modeled, i. e.,
 - Architectural walk throughs
 - Molecular modeling
 - Viewing the solar system

- **DSG:**
 - Interaction with high–dimensional data
 - Not 3–dimensional, but p–dimensional data

DSG – EXAMPLES

- (Multiple) low-dimensional views
- High-dimensional rotation and interaction
- Brushing / linked brushing

DSG IN IMMERSIVE ENV'S – IDEAS

- 1–, 2–, or 3–dimensional projections of p–dimensional data
- Viewing data in form of point clouds or modeled surfaces
- Multiple views or continuous sequence of views
- New user interface
 - Most DSG programs: like a desktop
 - Immersive environment: whole room for data analysis

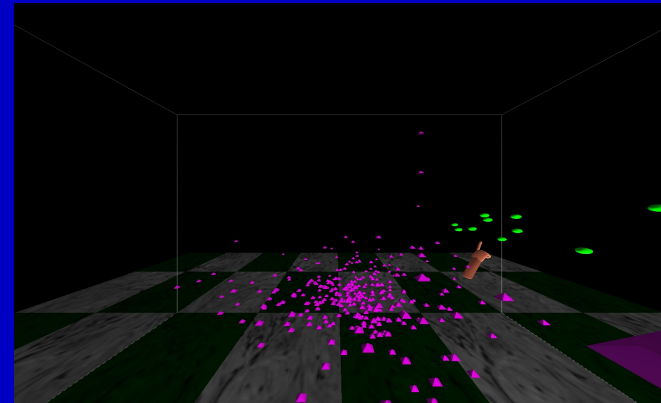
DSG IN IMMERSIVE ENV'S – TOOLS

- Viewing box
- Speed pole
- Variable spheres
- Goody boxes
- Glyph types

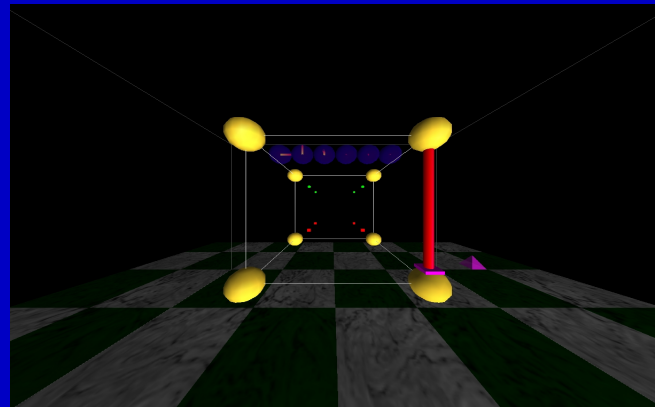


DSG IN IMMERSIVE ENV'S – APPLICATIONS

- Map view and 3-dimensional point cloud of "places data" (Boyer & Savageau, 1981)



- 3-dimensional grand tour of 6-dimensional cube



SOME THOUGHTS

- Huge potential for data analysis
- Much more than gain of one additional dimension of viewing space
- Ideal for geographically referenced data
- New and unexpected problems to be solved

FUTURE WORK

- 3D user interface for DSG
 - 3D menus
 - What to do with brushes
 - How to place objects (e.g., maps)
 - Sound (e.g., voice identification of points)
- Inclusion of maps and geographic information for spatial data (e.g., satellite images)
- Connections to supercomputers for processing of massive data

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