Dynamic Statistical Graphics in Highly 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, University 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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