3D for Information Visualization

CMSC734 Class Presentation
by Martin Stolen and Sureyya Tarkan
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Why 3D?

- High data resolution
- Close to “real world”
- 3D enhances spatial memory
  - 2D/3D symbols and setting
  - Time taken to locate object
  - Better performance with
    - Objects located in a non-planar setting
    - Objects with a 3D representation
3D Interface for 3D Tasks

- Scientific Visualization
  - Continuous variables
  - Surfaces, volumes
  - Physical entities
- Medical imaging
- Computer Aided Design/Engineering
- Teleoperation
  - Controlling robotic systems remotely
    - Mars rovers
    - Unmanned Aerial Vehicles
  - Operates in real world - 3D
Can we do Better than 3D?

- **Super-human capabilities**
  - Beyond “natural”
  - Tools that empower

- **Teleoperation example**
  - Occlusions and blind spots
    - Overlay model of known environment
    - “X-ray vision”
  - Multiple coordinated views
    - Add views of “impossible” angles
    - Overviews through birds-eye-views
  - Landmarks recognizable at any distance
Better than 3D - More Guidelines

- Allow teleportation
- Details on demand
- Tools to select, mark and measure
- History keeping
- Rich user actions on objects
- Enable remote collaboration
- Dynamic queries to filter out unwanted items
- Support semantic zooming
- Novel 3D icons
3D for Information Visualization

- Want effective use of pixels
- Categorical variables
- Discovery of
  - Clusters
  - Patterns
  - Trends
  - Outliers
  - Gaps
- Large number of variables
  - Scatterplot suitable
  - 3D versions do exist
  - 2D slices an option
3D for Hierarchical Visualizations

- **Cam Tree**
  - Tree of cones
  - Rotation of cones
  - Semi-transparent
  - Text overlapping
  - Occlusion

- **Information Cube**
  - Nested cubes as tree
  - Semi-transparent
  - A lot of vasted space
  - Small elements disappear
  - Occlusion
Demo

- GeoTime
- Hot Spot Matrix
- Order Execution Viewer
- Metropolitan Demographics
- Synchronization Viewer
- Risk In Motion
- 3D Performance Benchmark
2D and 3D Information Visualization of Web Content

- User interface designs for 3 Web browsers:
  - XML3D: integrates interactive view of the link structure of a site in 3D hyperbolic space with 2D list components.
  - Windows Explorer: traditional collapsible outline tree browser.
  - Snap Web site: edited, hierarchical structure navigated from an overview page.
User Study

- **Participants**
  - programmers of >2 yrs

- **Tasks**
  - Find an existing category or add new category to the directory scheme
  - Target category or requested response involves a single parent/path or multiple parents/paths

- **Procedure**
  - Locate the content directory in 3 min.
  - Answer the questions of choice of where to add
User Study (cntd)

- Results

![Bar chart showing results of User Study](chart.png)
Summary

- **Benefits**
  - 3D better for 3D tasks
  - Improves spatial memory

- **Limitations**
  - Occlusion
  - Inefficient use of screen space
  - Not better than 2D for multidimensional data