A Multi-User System for Viewing and Manipulating Large 3D Volume Datasets

Arthur W. Wetzel, Stuart M. Pomerantz, Démian Nave, Anjana Kar, Matt Mathis, Jason Sommerfield, David Deerfield

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Main Goal

- “The Volume Browsing system of the Pittsburgh Supercomputing Center (PSC) is designed to allow up to 40 users to independently navigate through any 3D data (including Visible Human data) at the same time in a networked working environment.”

Browsers that View 3D Datasets

- Transverse plane – Visible Human created from transverse cuts
- Coronal and Sagittal planes – data has been reorganized
- Other specific pre-rendered planes of anatomical importance
- What about arbitrary cutting planes defined by the user?

Method 1 – Central Server

- Central server stores entire 3D volume
- User specifies parameters and image is transmitted across the web for viewing
PROS/CONS

GOOD: carefully pick one image and pause between images

BAD: doesn’t work well with many users seeking different data at the same time

Method 2 – Standalone System

- Places entire dataset locally on a PC or workstation

Go with the hybrid approach!

- Uses a 64-bit server that links with PC’s over the net
- Users request sub-volumes of data from server
- Computation and manipulation takes place on PCs
- Optimizes the overall price to performance ratio!
- Data Available:
  - Volume data
  - Voxel identification
  - Anatomic database entries
  - Surface meshes
PSC’s Volume Browsing Client-Server Architecture

- **Server**
  - Volume server software
  - Compressed data
  - 3D79 and cache
  - Interception mode
  - Voxel server software
  - Interception architecture (real)
  - Web server software
  - Master/packer
  - Collaboration server software
  - Interception mode

- **Client**
  - Volume browser
  - Interception mode
  - Pixelate Core browser
  - PSC’s Volume browser
  - Epigtam3D

**Client-Side Software**
- Hop server that interacts with server
- Graphical user interface
  - User interacts with GUI to request data
  - GUI determines which cubes intersect the defined cutting plane images and planes requests to the hop server for these cubes
  - Hop server responds immediately with cached data and forwards other requests to the PSC’s volume server
  - Hop server decompresses cube data and sends to GUI
  - GUI constructs free 3D data with interpretations and displays overlays

**Sending Different Levels of Detail**
- Voxel data sent in coarse resolution
- Finer resolution displayed when navigation slows
- Continuous zooming from sampling and interpolating the base resolutions

- 1150:1
- 205:1
- 85:1
- 32:1 ~lossless

**Sending Compressed Data**
- Avoids directional sensitivity
- Only server disk activity is to write log files
What does PSC Volume Browser look like?

Figure 6 – PSC Volume Browser with Visible Human Dataset

Capabilities of PSC Volume Browser

- Bookmarking function
- Measuring devices
- Collaborative mode

More Capabilities

- User-controlled segmentation and labeling

Figure 7 – Spline Tracing of Liver and Kidneys

A curved path following the spinal cord is easily seen from a planar sagittal view.

Warping the viewing plane to the curved path of spinal cord provides useful information not available directly from planar slice data.

Without warping only a small segment of the spinal cord can be seen as it intersects any single planar slice.

http://www.psc.edu/biomed/research/VH/PVB/
Conclusions

- 40 users can simultaneously navigate independently through the Visible Human data using the Visible Human Volume Browser that takes advantage of:
  - 64 bit server
  - Home, office, or school computer
- Want to try it out?
  - http://www.psc.edu/biomed/research/VB/
- 3D browser

Paljon Kiitoksia!

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