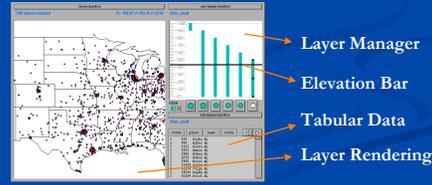


Constant Information Density in Zoomable Interfaces

Allison Woodruff, James Landay, Michael Stonebraker

The DataSplash Environment

- Direct-manipulation interface for constructing pannable/zoomable database visualizations
- Users can specify how much information is displayed at different elevations by a *layer manager*



The Problem

- The *Principle of Constant Information Density* – Number of objects per display unit should be constant -> Amount of information should remain constant as users pan and zoom
- DataSplash's users have difficulty constructing *well-formed applications* that conforms to this principle, displaying constant level of detail at all elevations.

The Solution - "Measure, Visualize, Bound"

- Give users visual feedback about information density as they create each layer
- Guide users to maintain constant density

Visual Information Density Adjuster

- Measures
 - Density Metrics: number of objects or number of vertices
 - Other density functions can be defined
- Visualizes
 - Width of layer bars encodes density at a given elevation
 - Color of the elevation gauge indicates whether a level is too dense
- Bounds
 - Enforcing density boundaries is left to visualization designers

Semi-automatic Adjustment of Layer Density

- *Modification Functions*: modifying a layer's density via
 - Creating views of data table (select/join)
 - Changing the graphical presentation of data

Original Visualization Select Aggregate Reclassify

Chg Shape Chg Size Chg Color Remove Attribute Assoc.

Critique

Strengths

- Comprehensive description of techniques
- Extensive considerations of problems and possible solutions
- Encoding density with width is intuitive, because the cumulative width of all layers at a zoom level = cumulative density

Weaknesses

- A lot of repetition
- Pilot trial added as an after-thought and only mildly relevant to the paper's topic

Speed-dependent Automatic Zooming for Browsing Large Documents

Takeo Igarashi & Ken Hinckley

Rate-Based Scrolling – Scroll faster as you move your mouse faster

Problem 1: Motion Blur (Excessive Visual Flow)

Problem 2: Multiple pan/zoom needed

SDAZ – Automatic zoom-out to cover more distance instead of scrolling faster

SDAZ Implementation

- Mouse speed simulated by displacement of mouse cursor
- Scroll/Zoom is engaged by holding down a mouse button
- Releasing the mouse button will trigger a zoom-in with the center of the screen as reference
- The scale is first calculated

$$scale = s0(dy-d0)/(d1-d0)$$

$s0, d0, d1 = \text{const: minimum scale, starting mouse movement, maximum mouse movement}$

- Then scrolling speed is calculated

$$Scrolling\ Speed = v0 / scale$$

$v0 = \text{const: initial scrolling speed}$

Reverse and Cessation Problems

Introduce a zoom-in delay factor to avoid "swellings" when changing direction

Introduce a constant default zoom-in rate for when the user simply stop holding down the mouse button.

Test Applications

Slow scrolling Fast Scrolling

Web-browser with semantic zooming

Map viewer

Other Applications

- Image Browser
- Dictionary with semantic zooming (word-skip)
- Sound editor (zooming the waveform)

Usability Studies

- Web-browser: SDAZ vs. Scrollbars
 - Task completion time: roughly equal
 - Subjective preference: SDAZ
 - Video game players performed better
 - Constant flow of text can cause dizziness
 - Isometric input (joysticks) might improve performance, but not tried
- Map Viewer: SDAZ vs. manual zoom-in/out buttons
 - Task completion time: mixed to negative (for SDAZ)
 - Subjective preference: roughly equal
 - Overshoot and course-correction problem
 - Many subject develops coping strategies

Critique

Strengths

- Works well for 1D apps like web or image browser
- Requires no extra screen real estate
- Requires very simple input device
- Good for mobile!

Weaknesses

- Demanding high-dexterity, especially for 2D apps
- Unclear whether performance comes from SDAZ or semantic-zooming

Critical Zones in Desert Fog: Aids to Multiscale Navigation

Susanne Jul & George W. Furnas

Desert Fog

Does this view contain anything?

How can this view look like the other one? (minimum object rendering size)

Where do I go from here? (zoom out/in? pan?)

Can be mitigated at the info design/embedding stage

Particularly bad when encountered at navigation time

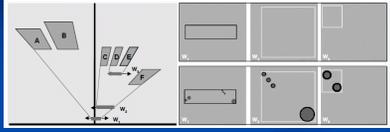
Fighting Desert Fog – Residues of Objects

Multiscale Residue of Objects: red squares visible at all scales

Objects are clustered spatially, recursively to reduce the number of residues as you zoom out

Problems: placement of landmarks, landmarks changing position during zoom-in, landmark can suggest false semantic associations

Fighting Desert Fog – Residues of Views (Ztracker)



Critical Zones: residues of interesting views, zooming in reveals more interesting views (and critical zones representation of them)

Calculating 1 crit-zone: Bounding box of all objs in current view

Sub-divide and recurse:



Critical Zone rectangle changes color when covers all world objects

View Navigation Analysis

- *View-navigation theory* provides a characterization of the properties that make an information structure navigable, adapted for spatial data
- *Viewing-graph* a d-graph, nodes = views, links = traversible paths between views
- A *traversable world*
 - Short path must exist between all nodes
 - All nodes must have small number of outlinks
 - "Small" and "Short" is relative to the complexity of the viewing graph

Navigation Requirements

- All views must have good residue on all nodes
 - All views must have small outlink info
 - *Good residue*: correctly points out the shortest link to a node
- => In a zoomable world, merely providing residues solve the desert fog problem, because the lack residue means zoom-out
- *outlink-info*: the representation of the residue. E.g. a text label
 - *Small*: Relative to number of overall views? Or navigator's info processing capabilities?
- => Grouping such as landmarking and ZTracker

Critique

Strengths

- Novel concept: providing residue of views, not objects
- Thorough treatment of the subject from an implementation pov and a theoretical pov

Weaknesses

- Ztracker algorithm might be expensive. Some heuristics?
- Repeating diagrams with small differences makes navigating the paper confusing
- More examples of desert fog please?

Q&A

Thomas Dang, dqluan@gmail.com