

Lecture 9: Space/Layers/Order

Information Visualization
CPCSC 533C, Fall 2007

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Readings Covered

Ware, Chapter 8: Space Perception and the Display of Data in Space
Tufte, Chapter 3: Layering and Separation
Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danyu Hollan, Proc. InfoVis06, to appear
http://www.win.tu.nl/~dholan/papers/bundles_infovis.pdf
Tufte, Chapter 6: Narratives of Space and Time
VisDB: Database Exploration using Multidimensional Visualization, Daniel A. Keim and Hans-Peter Kriegel, IEEE CG&A, 1994
<http://www.dbs.informatik.uni-muenchen.de/bs/projects/papers/visdb.ps>

Ware: Space Perception

- static
 - occlusion
 - perspective projection
 - linear, texture gradient
 - depth of field
 - atmospheric (fog, depth cueing)
 - lighting and shadows
 - shape from shading
 - cast shadows
- moving
 - structure-from-motion
 - motion parallax (head motion)
- binocular
 - binocular disparity (stereopsis)
 - convergence
 - amount eyes rotate toward center of interest
 - like optical range finder

Ware: Space Perception

- droplines,
- background grids



depth cueing
[Ware, Information Visualization: Perception for Design, Chap 8]

Layering And Separation



[Tufte, Encountering Information, Chap 3]

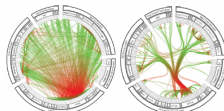
Visual Clutter

- subtler background than foreground



[Tufte, Encountering Information, Chap 3]

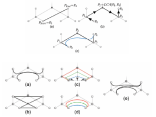
Hierarchical Edge Bundles



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danyu Hollan, Proc. InfoVis06.]

Hierarchical Edge Bundles

- bundle by hierarchy using splines



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danyu Hollan, Proc. InfoVis06.]

Hierarchical Edge Bundles

- alpha blending



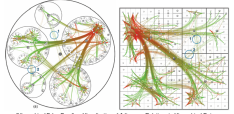
- bundling strength



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danyu Hollan, Proc. InfoVis06.]

Hierarchical Edge Bundling

- (mostly) agnostic to layout



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danyu Hollan, Proc. InfoVis06.]

Critique

- flexible and general idea
- simple - after you see it
- successful example of creating foreground layer

Space vs. Time: Showing Change



- animation: show time using temporal change
 - good: show process



[www.gnom.guic.edu/bschool/bschool/wwert.jpg]

Space vs. Time: Showing Change

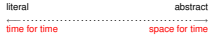


- animation: show time using temporal change
 - good: show process
 - good: compare by flipping between two things



[www.gnom.guic.edu/bschool/bschool/wwert.jpg]
[www.ssrshow.com/odpho/pluto.gif]

Space vs. Time: Showing Change



- animation: show time using temporal change
 - good: show process
 - good: compare by flipping between two things
 - bad: compare between many things



[www.gnom.guic.edu/bschool/bschool/wwert.jpg]
[www.ssrshow.com/odpho/pluto.gif]

Space vs. Time: Showing Change



- animation: show time using temporal change
 - good: show process
 - good: compare by flipping between two things
 - bad: compare between many things
 - interference from intermediate frames



[www.gnom.guic.edu/bschool/bschool/wwert.jpg]
[www.ssrshow.com/odpho/pluto.gif]

Space vs. Time: Showing Change



- small multiples: show time using space
 - overview: show each time step in array
 - compare: side-by-side easier than temporal
 - external cognition instead of internal memory

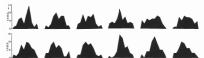


Space vs. Time: Showing Change

literal abstract

time for time space for time

- small multiples: show time using space
 - overview: show each time step in array
 - compare: side-by-side easier than temporal
 - external cognition instead of internal memory
 - general technique, not just for temporal changes



Space vs. Time: Showing Change

literal abstract

time for time space for time

- small multiples: show time using space
 - also can be good for showing process



[www.geom.uiuc.edu/graphics/vis/Products/Outside/project2d_comp.html]

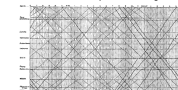
Animation vs. Small Multiples

- Tversky argument: intuition that animation helps is wrong
 - meta-review of previous studies
 - often more info shown in animation view so not a fair comparison
- carefully chosen segmentation into small multiples better than animation if equivalent information shown

[Animation: Can It Facilitate? Barbara Tversky, Julie Morrison, Mireille Bejancourt. International Journal of Human Computer Studies 57.4, pp 247-262, 2002.]

Derived Spaces: Slope

- narrative of space and time
- Marey train schedule, 1885
 - horizontal line length: stop length
 - slope: speed
 - intersection: time/place of crossing



[Tufte p.31, www.nap.edu/html/ncsh/images/125.gif]

Sorting and Ordering

- derived spaces for ordering
- spatial position as strongest perceptual cue
- finding the right order
 - automatically
 - through exploration

Manual Ordering: Bertin

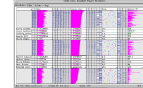
- reorderable matrices - manually!



[Bertin, Graphics and Graphic Information Processing, p 34]

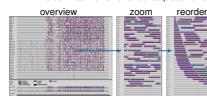
Interactive Ordering: Table Lens

- click to sort by columns
- also, is focus+context approach
- demo: www.inxight.com/products/sdks/tl



Interactive Ordering: Rivet

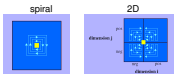
- performance analysis of parallel system
 - order: machine name vs. lock acquisition time



[Bosch, Performance Analysis and Visualization of Parallel Systems Using SimOS and Rivet: A Case Study, HPCA6, 2000. graphics.stanford.edu/papers/rivet_argus]

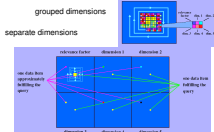
VisDB: Spacefilling Pixels

- how to draw pixels?
 - sort, color by relevance
- local ordering



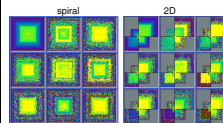
[VisDB: Database Exploration using Multidimensional Visualization, Kern and Kriegel, IEEE CGGA, 1994 www.dbs.informatik.uni-muenchen.de/dbg/projects/papers/visdb.pdf]

VisDB Windows



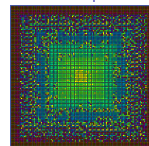
[VisDB: Database Exploration using Multidimensional Visualization, Kern and Kriegel, IEEE CGGA, 1994 www.dbs.informatik.uni-muenchen.de/dbg/projects/papers/visdb.pdf]

VisDB Results: Separate Dimensions



[VisDB: Database Exploration using Multidimensional Visualization, Kern and Kriegel, IEEE CGGA, 1994 www.dbs.informatik.uni-muenchen.de/dbg/projects/papers/visdb.pdf]

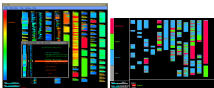
VisDB Results: Grouped Dimensions



[VisDB: Database Exploration using Multidimensional Visualization, Kern and Kriegel, IEEE CGGA, 1994 www.dbs.informatik.uni-muenchen.de/dbg/projects/papers/visdb.pdf]

Another Pixel-Oriented Example

- SeeSoft from AT&T



[Ball and Eick, Software Visualization in the Large, IEEE Computer 29.4, 1996 dl.acm.org/citation.cfm?id=294404]

VisDB Critique

- pixel-oriented methods have power
- but studies needed
 - are spacefilling curves understandable
 - when does visual complexity overwhelm