

Lecture 7: Depth/Occlusion

Information Visualization
CPCSC 533C, Fall 2006

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3 October 2006

Readings Covered

Ware, Chapter 8: Space Perception and the Display of Data in Space
Tufts, Chapter 3: Layering and Separation
Extending Distortion Viewing Techniques from 2D to 3D Data. M. Sheelagh T. Carpendale, David J. Cowperthwaite, and F. David Fraconia, IEEE Computer Graphics and Applications, Special Issue on Information Visualization, 17(4), pp 42-51, July 1997.
<http://papers.cpsc.ucalgary.ca/~sheelagh/personal/pubs/ig497.pdf>
EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. Nelson Wong, M. Sheelagh T. Carpendale, Saul Greenberg, Proc. InfoVis03, pp 51-58.
<http://papers.cpsc.ucalgary.ca/~sheelagh/personal/pubs/2003/wong-carp-intovis03-submit.pdf>

Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten, Proc. InfoVis06, to appear
http://www.win.tue.nl/~dholten/papers/bundles_intovis.pdf

Further Readings

Chaps: A Compact Explorer For Complex Hierarchies. Luc Beaudoin, Marc-Antoine Parant, Louis C. Vroomen, Proc. IEEE Vis 1996, pp 87-92.

Depth and Occlusion

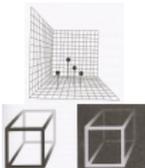
- Space Perception
 - depth
- Layering and Separation
 - visual layering
- 3DPS
 - graphs embedding in 3D vs. 2D
- EdgeLens
 - interactive occlusion control of 2D graph edges

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

Space Perception

- droplines,
- background grids
- depth cueing



Ware, Information Visualization: Perception for Design, Chap 8

Layering And Separation



Tufts, Envisaging Information, Chap 3

Visual Clutter

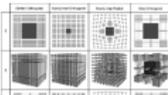
- subtler background than foreground



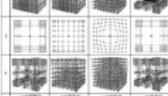
Tufts, Envisaging Information, Chap 3

3DPS

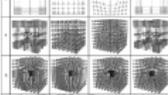
2D displace+magnify



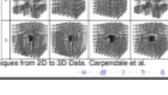
3D displace+magnify



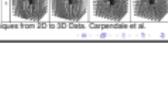
2D displace only



3D displace only



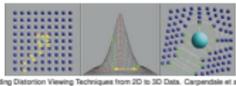
visual access distortion



[Extending Distortion Viewing Techniques from 2D to 3D Data. Carpendale et al. CGAA 17(4):42-51, July 1997]

Visual Access Distortion

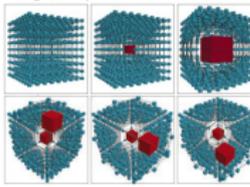
- naive 2D -- 3D extension yields occlusion
 - same problem as van Wijk
- graph-based solution
 - move geometry according to viewpoint
 - magnify focus only
 - introduce curves into formerly straight lines
- focus+context approach



[Extending Distortion Viewing Techniques from 2D to 3D Data. Carpendale et al. CGAA 17(4):42-51, July 1997]

Results

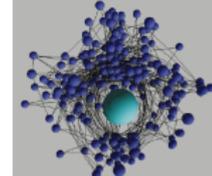
- single, multiple foci



[Extending Distortion Viewing Techniques from 2D to 3D Data. Carpendale et al. CGAA 17(4):42-51, July 1997]

Results

- randomly positioned nodes instead of grid
 - closer to real dataset



[Extending Distortion Viewing Techniques from 2D to 3D Data. Carpendale et al. CGAA 17(4):42-51, July 1997]

Critique

Critique

- sophisticated way to navigate 3D graphs
- purely technique paper
 - not a design study
- interesting discussion I'd like to see
 - more analysis of why 3D necessary
 - cites Ware 3x improvement
 - occlusion workaround vs. occlusion avoidance
- never shown on real data
 - hard to draw conclusions from toy datasets

Information Density: Codimension

- want balance between clutter and void
- topological approach to describing density
- diff between structure and surrounding space

	dim space	- dim structure	= codim	
webviz	3	1 circle	2	sparse
H3	3	2 hemisphere	1	
3DPS	3	3 cubic grid	0	dense

EdgeLens

- interactive control over edge occlusion
- user study: spline better than bubble

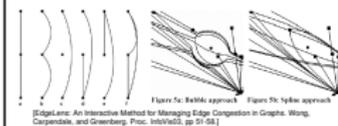
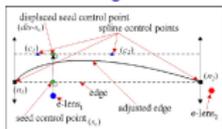


Figure 7a: bubble approach Figure 7b: spline approach
[EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. Wong, Carpendale, and Greenberg. Proc. InfoVis03, pp 51-58]

EdgeLens Final Algorithm

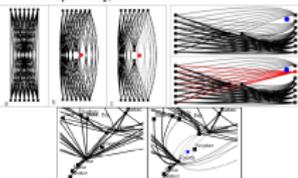


- decide which edges affected
- calculate displacements
- calculate spline control points
- draw curves

[EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. Wong, Carpendale, and Greenberg. Proc. InfoVis03, pp 51-58.]

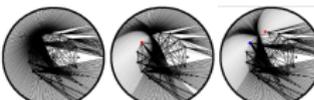
EdgeLens Techniques

- transparency, color



[EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. Wong, Carpendale, and Greenberg. Proc. InfoVis03, pp 51-58.]

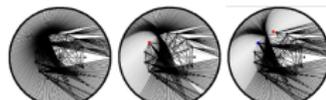
EdgeLens Results



[EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. Wong, Carpendale, and Greenberg. Proc. InfoVis03, pp 51-58.]

- critique

EdgeLens Results

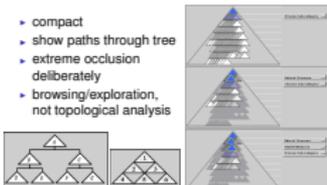


[EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs. Wong, Carpendale, and Greenberg. Proc. InfoVis03, pp 51-58.]

- critique
 - very nice technique
 - compelling need
 - shown on real data

Cheops

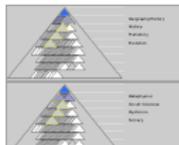
- compact
- show paths through tree
- extreme occlusion deliberately
- browsing/exploration, not topological analysis



[Cheops: A Compact Explorer For Complex Hierarchies. Scaudun, Parent, and Vismont. Proc. IEEE Vis 1996, pp 87-92.]

Cheops Interaction

- flip through overloaded visual representation choices

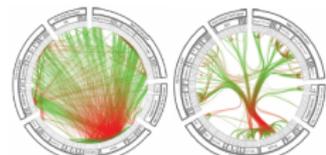


[Cheops: A Compact Explorer For Complex Hierarchies. Scaudun, Parent, and Vismont. Proc. IEEE Vis 1996, pp 87-92.]

Cheops Critique

- pro
 - tiny footprint
 - suitable when main user focus is other task
- con
 - relatively hard to understand
 - singular nodes very salient, but not so important

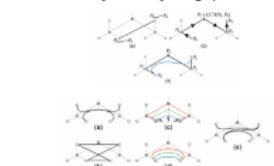
Hierarchical Edge Bundles



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten. Proc. InfoVis04.]

Hierarchical Edge Bundles

- bundle by hierarchy using splines



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten. Proc. InfoVis04.]

Hierarchical Edge Bundles

- alpha blending



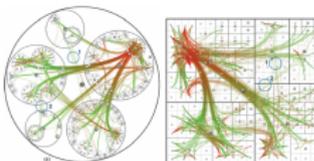
- bundling strength



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten. Proc. InfoVis04.]

Hierarchical Edge Bundling

- (mostly) agnostic to layout



[Hierarchical Edge Bundles: Visualization of Adjacency Relations in Hierarchical Data. Danny Holten. Proc. InfoVis04.]

Project Resources