Lecture 9: Item Reduction Methods

Information Visualization
CPSC 533C, Fall 2011

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UBC Computer Science

Wed, 5 October 2011

Required Readings

Chapter 7: Item Reduction Methods

A review of overview+detail, zooming, and focus+context interfaces. Andy Cockburn, Amy Karlson, and Benjamin B. Bederson. ACM Computing Surveys 41(1), 2008.

Further Reading

Space-Scale Diagrams: Understanding Multiscale Interfaces George Furnas and Ben Bederson, Proc SIGCHI 95.

Pad++: A Zooming Graphical Interface for Exploring Alternate Interface Physics Ben Bederson, and James D Hollan, Proc UIST 94.

Smooth and Efficient Zooming and Panning. Jack J. van Wijk and Wim A.A. Nuij, Proc. InfoVis 2003, p. 15-22

SpaceTree: Supporting Exploration in Large Node Link Tree, Design Evolution and Empirical Evaluation. Catherine Plaisant, Jesse Grosjean, and Ben B. Bederson. Proc. InfoVis 2002.

The Hyperbolic Browser: A Focus + Context Technique for Visualizing Large Hierarchies. John Lamping and Ramana Rao, Proc SIGCHI '95.

Data Reduction

- how to reduce amount of stuff to draw?
  - crosscuts view composition considerations
- item reduction
  - this time
  - rows of table
- attribute reduction
  - next time
  - columns of table

Item Reduction Methods

- filtering and navigation
  - leave some things out
- aggregation
  - merge things together
- overviews
  - temporal through nav
  - separate dedicated view
  - focus+context
    - selective filtering
    - geometric distortion
    - distortion costs/benefits

Filtering and Navigation

- filter: choose which items to show/hide
    - widgets: sliders, buttons, lists

- navigation: filter based on viewpoint
    - unconstrained / constrained nav
        - constrained: anim trans to new viewpoint
    - geometric / semantic zoom

    - straightforward / nonliteral

Space-Scale Diagrams

- reasoning about navigation and trajectories

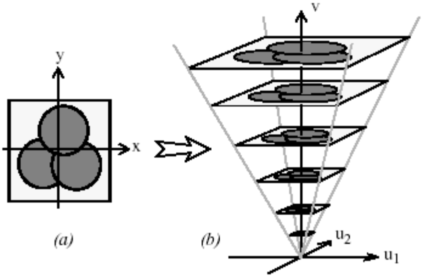
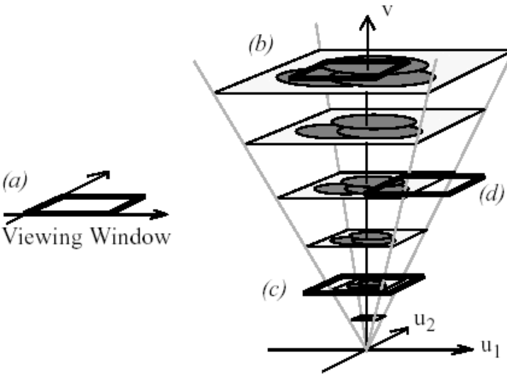


Figure 1. *The basic construction of a Space-Scale diagram from a 2D picture.*

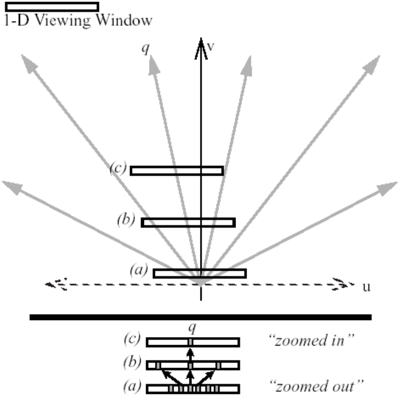
[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

Viewing Window



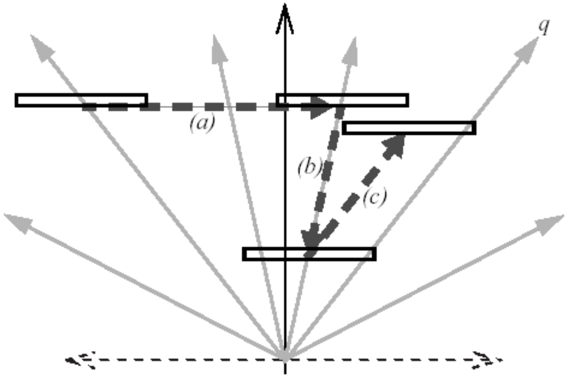
[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

1D Version



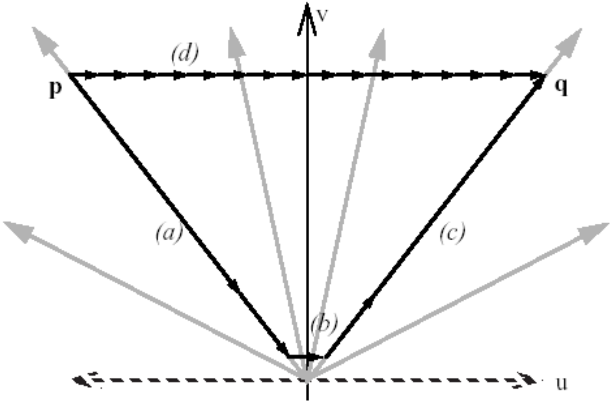
[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

Pan-Zoom Trajectories



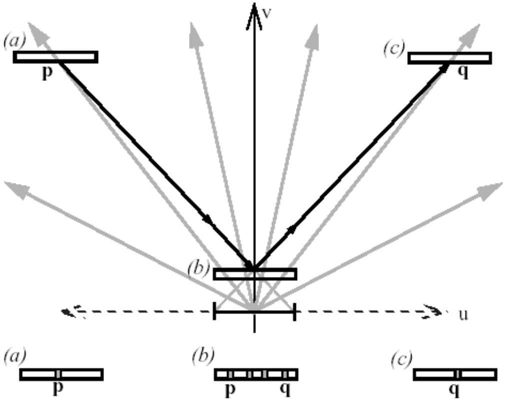
[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

Shortest Path



[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

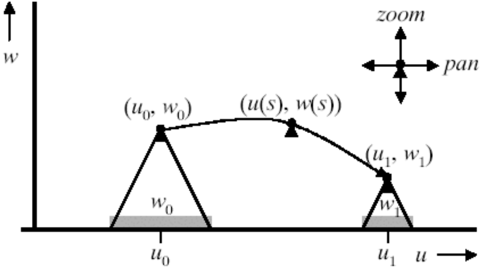
Shortest Path, Details



[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

Smooth and Efficient Zooming

- uw space: u = pan, w = zoom
  - horiz axis: cross-section through objects
  - point = camera at height w above object
  - path = camera path

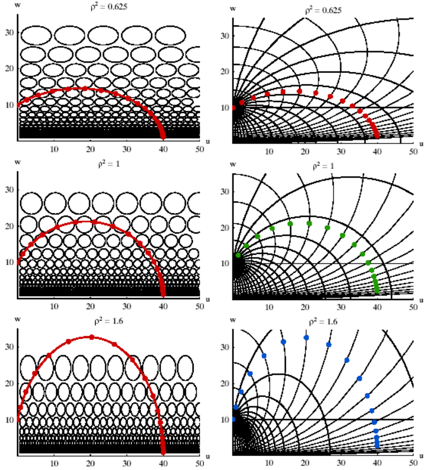


Smooth and Efficient Zooming and Panning. Jack J. van Wijk and Wim A.A. Nuij, Proc. InfoVis 2003, p. 15-22

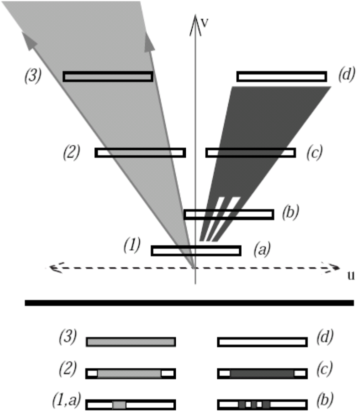
Optimal Paths Through Space

- at each step, cross same number of ellipses
- cross minimal number of ellipses total

Smooth and Efficient Zooming and Panning. Jack J. van Wijk and Wim A.A. Nuij, Proc. InfoVis 2003, p. 15-22



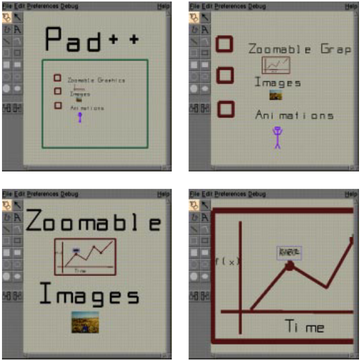
Semantic Zooming



[Space-Scale Diagrams: Understanding Multiscale Interfaces. George Furnas and Ben Bederson, Proc SIGCHI '95.]

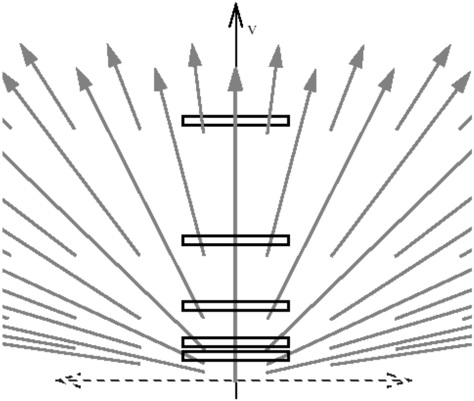
Pad++

- "infinitely" zoomable user interface (ZUI)



[Pad++: A Zooming Graphical Interface for Exploring Alternate Interface Physics. Bederson and Hollan, Proc UIST 94]

Multiscale Display



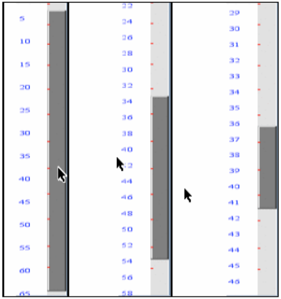
Space-Scale Diagrams: Understanding Multiscale Interfaces

George Furnas and Ben Bederson, Proc SIGCHI '95.

www.cs.umd.edu/hcil/pad++/papers/chi-95-spacescale/chi-95-spacescale.pdf

OrthoZoom: Multiscale Navigation

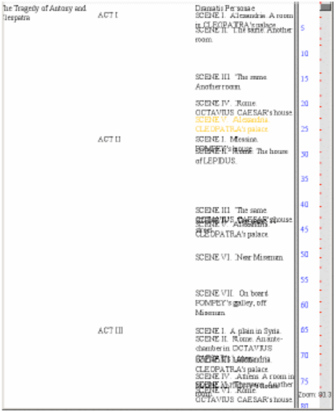
- scale/zoom ratio target
  - index of difficulty: $\text{ID} = \log(1 + D/W)$
  - D = target distance, W = target size
- control area larger than graphical representation
  - zoom factor is orthogonal cursor-slider distance



[OrthoZoom Scroller: 1D Multi-Scale Navigation. Catherine Appert and Jean-Daniel Fekete. Proc. SIGCHI 06, pp 21-30.]

OrthoZoom

- multi-scale table of contents [video]



[OrthoZoom Scroller: 1D Multi-Scale Navigation. Catherine Appert and Jean-Daniel Fekete. Proc. SIGCHI 06, pp 21-30.]

Aggregation

- combine items (vs. eliminate them w/ filtering)
- derived attributes: min/max/avg/sum (SQL)
- challenge: avoid averaging out signal

Overviews

- strategies: both filter and aggregate
  - simple: geometric zoomout
  - complex: aggregation
- methods
  - temporal through nav
  - separate dedicated view
  - embedded/integrated focus+context

Survey

- taxonomy
  - overview+detail: spatial separation
  - zooming: temporal separation
  - focus+context: integrated/embedded

  - cue-based: selectively highlight/suppress
    - crosscutting
    - differs from book taxonomy
- structure
  - describe technique
  - empirical study results
    - low-level task: target acquisition
    - high-level task: explore search space

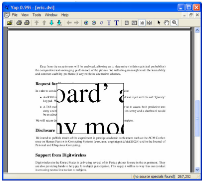
A review of overview+detail, zooming, and focus+context interfaces. Andy Cockburn, Amy Karlson, and Benjamin B. Bederson. ACM Computing Surveys 41(1), 2008.

Overview+Detail

A review of overview+detail, zooming, and focus+context interfaces. Andy Cockburn, Amy Karlson, and Benjamin B. Bederson. ACM Computing Surveys 41(1), 2008.

Overview+Detail Issues

- linked navigation
  - shortcut navigation, thumbnail to detail
  - explore overview without changing detail
    - if fully synchronized could not explore
  - detail changes immediately shown in overview
- their defn: lens as O+D
  - since O and D separated in z/depth
  - nonstandard usage; I consider F+C



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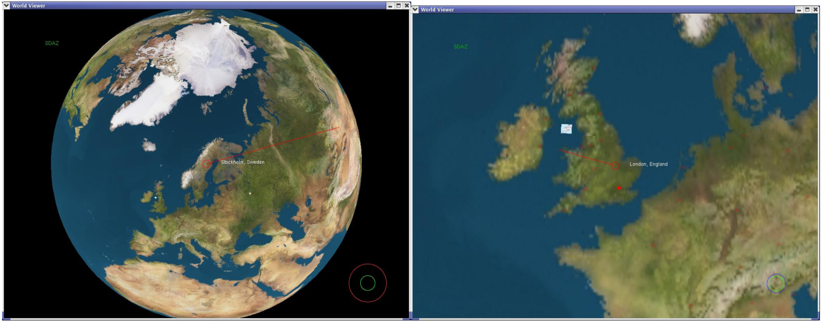
Zooming



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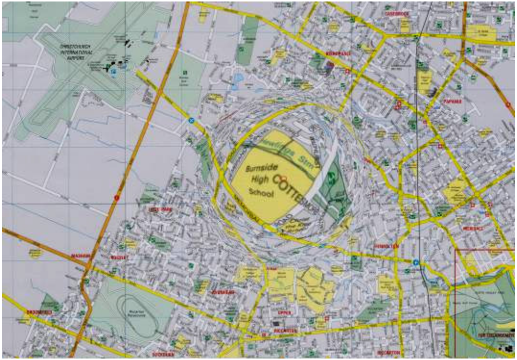
Zooming

- geometric zooming
  - hard to make intuitive zoomout control
- semantic zooming
  - different representations at different scales
  - zoomable user interfaces (ZUIs)
- space-scale diagrams
- challenge: stability

Focus+Context

- integrate focus and context in single view



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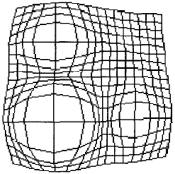
Focus+Context

- selective filtering
- geometric distortion
- distortion: costs/benefits

F+C Formalism: Degree of Interest

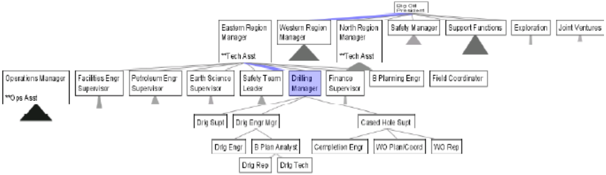
- DOI: I(x) - D(x,y)
  - I: (a priori) interest
  - D: distance, semantic or spatial
  - x: data element
  - y: current focus
- DOI for selective presentation vs. for distortion
- infer DOI through interaction vs. explicit selection
- single vs. multiple foci



[A Review and Taxonomy of Distortion-Oriented Presentation Techniques. Leung and Apperley, ACM ToCHI 1(2):126-160, Jun 1994.]

F+C Elision: SpaceTree

- focus+context tree (like DOITrees Revisited)
  - selective filtering w/ elision

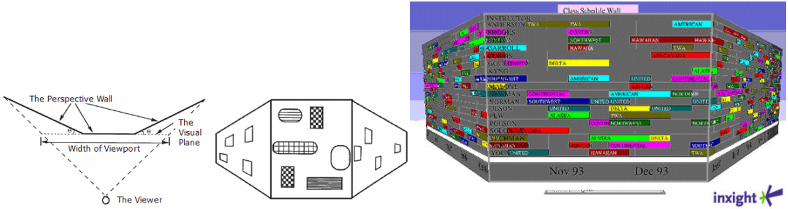


- semantic zooming / aggregation

- demo

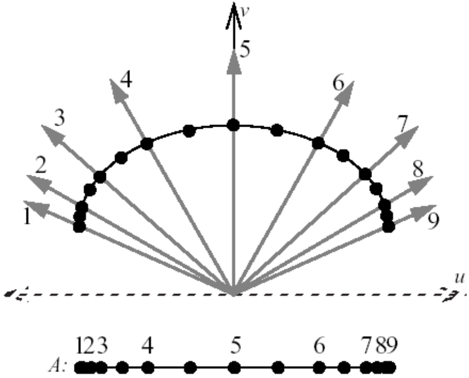
F+C Distortion: 3D Perspective

- move part of surface closer to eye
  - Perspective Wall



[A review of overview+detail, zooming, and focus+context interfaces. Cockburn, Karlson, and Bederson. ACM Computing Surveys 41(1), 2008. From Perspective Wall, Mackinlay Robertson and Card 1991]

F+C Distortion: Fisheye



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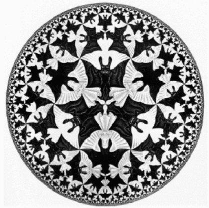
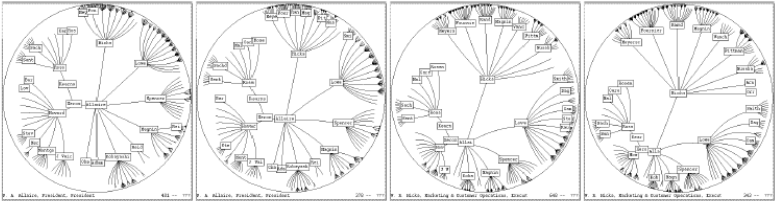
George Furnas and Ben Bederson, Proc SIGCHI '95.
www.cs.umd.edu/hcil/pad++/papers/chi-95-spacescale/chi-95-spacescale.pdf

2D Hyperbolic Trees

- fisheye effect from hyperbolic geometry
  - video: open-video.org/details.php?videoid=4567





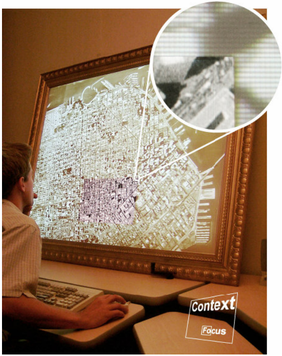
[The Hyperbolic Browser: A Focus + Context Technique for Visualizing Large Hierarchies. John Lamping and Ramana Rao, Proc SIGCHI '95.]

Distortion Challenges

- unsuitable if must make relative spatial judgements (length)
  - graph topology as least problematic case
- overhead of tracking distortion
  - constrained and predictable maybe safest
- how to visually communicate distortion
  - gridlines, shading
- target acquisition problem
  - lens displacing items away from screen loction
- mixed results comparing to separate views, temporal nav
- fisheye followup: concern with enthusiasm over distortion
  - *what* is being shown: selective filtering
  - *how* it is shown: distortion as one possibility

F+C Without Distortion

- specialized hardware



[A review of overview+detail, zooming, and focus+context interfaces. Cockburn, Karlson, and Bederson. ACM Computing Surveys 41(1), 2008. From: Baudisch 1992.]

Reading For Next Time

Chapter 8: Attribute Reduction Methods

Glimmer: Multilevel MDS on the GPU. Stephen Ingram, Tamara Munzner and Marc Olano. IEEE TVCG, 15(2):249-261, Mar/Apr 2009.

Reminders

- Project meetings due 10/19
    - two weeks from today
- Office hours today after class (5-6)
    - or schedule specific meeting time by email