Readings Covered

Ware, Chap 10: Interacting With Visualizations (2nd half)

Tufte, Chap 2: Macro/Micro

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


Further Reading

Speed-Dependent Automatic Zooming for Browsing Large Documents Takeo Igarashi and Ken Hinckley, Proc. UIST 00, pp. 139-148.


Tuning and testing scrolling interfaces that automatically zoom Andy Cockburn, Joshua Savage, Andrew Wallace. Proc CHI 05.
What Kind of Motion?

- rigid
  - rotate/pan/zoom
  - easy to understand
  - object shape static, positions change
  - morph/change/distort
  - object evolves
    - beating heart, thunderstorm, walking person
  - multiscale/ZUI
    - object appearance changes by viewpoint
  - focus+context
    - carefully chosen distortion
Ware Chapter 10 - Spatial Navigation

- world in hand
  - good: spinning discrete objects
  - bad: large-scale terrain
- eye in hand
  - explicitly move camera
- walking
  - real-world walking
  - terrain following
- flying
  - unconstrained 6DOF navigation
- other: constrained navigation!
Rapid Controlled Movement

- move to selected point of interest
  - normal to surface, logarithmic speed
- trajectories as first-class objects

Spatial Navigation

- real navigation only partially understood
  - compared to low-level perception, JNDs
- spatial memory / environmental cognition
  - city: landmark/path/whole
- implicit logic
  - evolved to deal with reality
  - so we’ll learn from synthetic worlds
  - but we can’t fly in 3D...
- how much applies to synthetic environments?
  - even perception not always the same!
Design Guidelines for VE Landmarks

- Ware’s derived guidelines
  - enough so always can see some
  - visually distinguishable from others
  - visible and recognizable at all scales
  - placed at major paths/junctions

- others, only some of of these crossover for infovis!
  - need all 5 types of landmarks
    - path, edge, district, node, landmark
  - concrete not abstract
  - asymmetry: different sides looks different
  - clumps
  - different from “data objects”
  - need grid structure, alignment

Macro/Micro

- classic example: map
  - arms-length vs. up-close
- paper vs. computer screen
  - 300-600 dpi vs. 72 dpi (legally blind)
  - finally changing
- possibly available for projects
  - 22” 200dpi IBM T221 display
  - 9 Mpixels (4000x2000)
Pad++

- “infinitely” zoomable user interface (ZUI) [video]

[Pad++: A Zooming Graphical Interface for Exploring Alternate Interface Physics Bederson and Hollan, Proc UIST 94]
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.
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Space-Scale Diagrams: Understanding Multiscale Interfaces
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Pan-Zoom Trajectories

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Joint Pan-Zoom Problem

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

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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.
Semantic Zooming

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George Furnas and Ben Bederson, Proc SIGCHI '95.
Smooth and Efficient Zooming

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

Optimal Paths Through Space

at each step, cross same number of ellipses cross minimal number of ellipses total Smooth and Efficient

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

- Critical Zones in Desert Fog: Aids to Multiscale Navigation
  - Susanne Jul, George W. Furnas UIST 98
- Environment devoid of navigational cues
  - not just Pad: 6DOF navigation where object fills view
- Designer strategies
  - explicit world creation - fog not made on purpose
    - games - partial counter example
  - island of information surrounded by desert fog
- Pad: min/max visibility distances
View-Navigation Theory

- Effective View Navigation, CHI 97
  - George Furnas
- characterizing navigability: viewing graph
  - nodes: views
  - links: traversible connections
- 1. short paths between all nodes
  - true in ZUIs (e.g. speed-dependent zooming)
- 2. all views have small number outlinks
  - not overwhelmed by choices
Critical Zones

- region where zoom-in brings interesting views
  - show with navigation "residue"
- unambiguous action choice
  - visible critical zone "residue" of stuff beneath
  - zoom out if see nothing
- extension to VN theory
  - 3. all views contain good residue of all nodes
  - 4. all links must have small outlink-info
  - must build support for these into ZUIs
- do not have "minsize", always use a few pixels
  - they don’t address clutter/scalability
What’s This?

Space-Scale Diagrams: Understanding Multiscale Interfaces
George Furnas and Ben Bederson, Proc SIGCHI ’95.
Fisheye Focus+Context View!

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

- scale/zoom ratio target: 32 bits, 1:3B
  - 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

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