

# **Depth / Occlusion**

**Lecture 9 CPSC 533C, Fall 2004**

**18 October 2004**

# Reading

Ware, Chapter 8: Space Perception and the Display of Data in Space

Tufte, Chapter 3: Layering and Separation

Intelligently resolving point occlusion.

Marjan Trutschl, Georges Grinstein, Urska Cvek, Proc. InfoVis 2003, pp 131–136.

Extending Distortion Viewing Techniques from 2D to 3D Data.

M. Sheelagh T. Carpendale, David J. Cowperthwaite, and F. David Fracchia, IEEE Computer Graphics and Applications, Special Issue on Information Visualization, 17(4), pp 42 – 51, July 1997.

EdgeLens: An Interactive Method for Managing Edge Congestion in Graphs.

Nelson Wong, M. Sheelagh T. Carpendale, Saul Greenberg, Proc. InfoVis03, pp 51–58.

Optional:

Cheops: A Compact Explorer For Complex Hierarchies.

Luc Beaudoin, Marc-Antoine Parent, 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

## Smart Jitter

- intelligently resolving point occlusion

## Cheops

- deliberate occlusion for compact representation

# 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

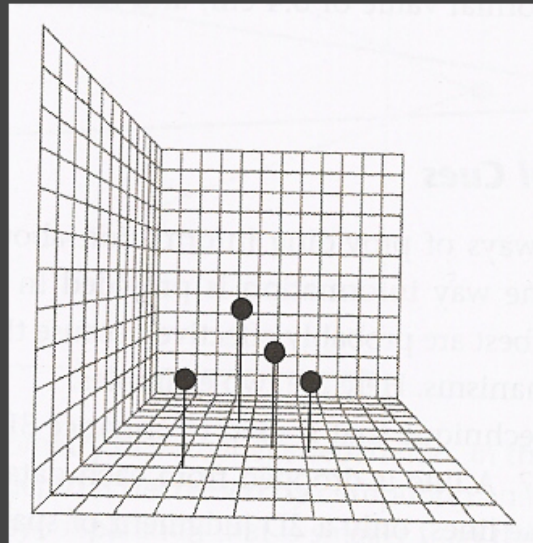
- structure-from-motion
  - motion parallax (head motion)

## binocular

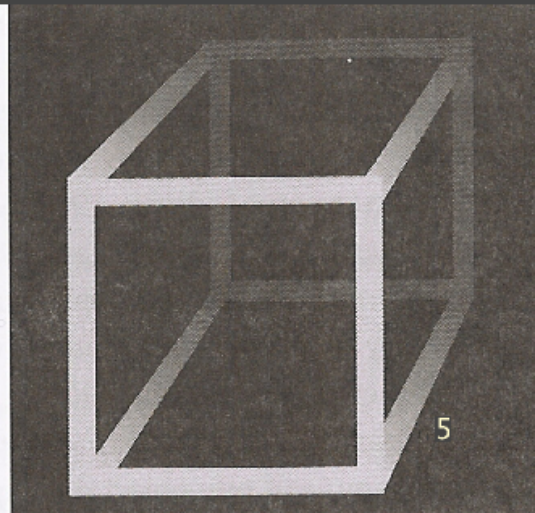
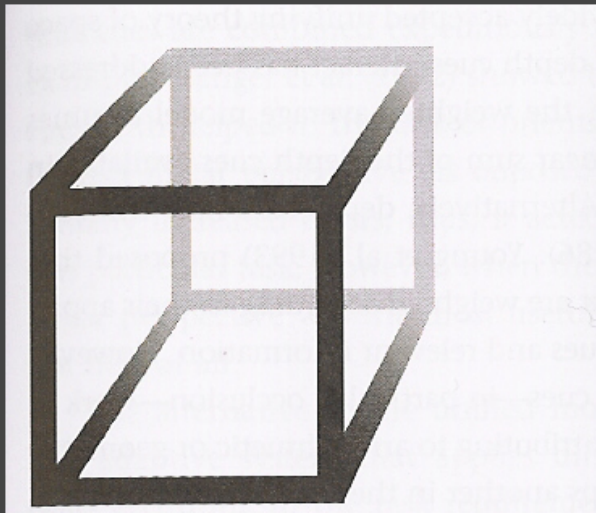
- binocular disparity (stereopsis)
- convergence
  - amount eyes rotate toward center of interest
  - like optical range finder

# Space Perception

droplines,  
background grids



depth cueing



# Binocular

less strong than occlusion

autostereopsis demo

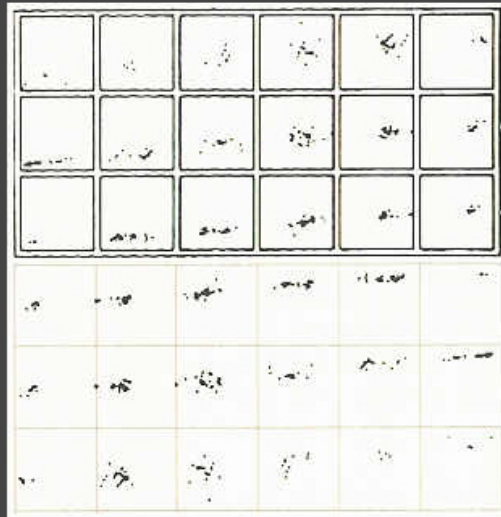
[[www.mrl.nyu.edu/~perlin/demos/autosshutter-talk.html](http://www.mrl.nyu.edu/~perlin/demos/autosshutter-talk.html)]

# Layering And Separation



# Visual Clutter

subtler background than foreground





# 3DPS

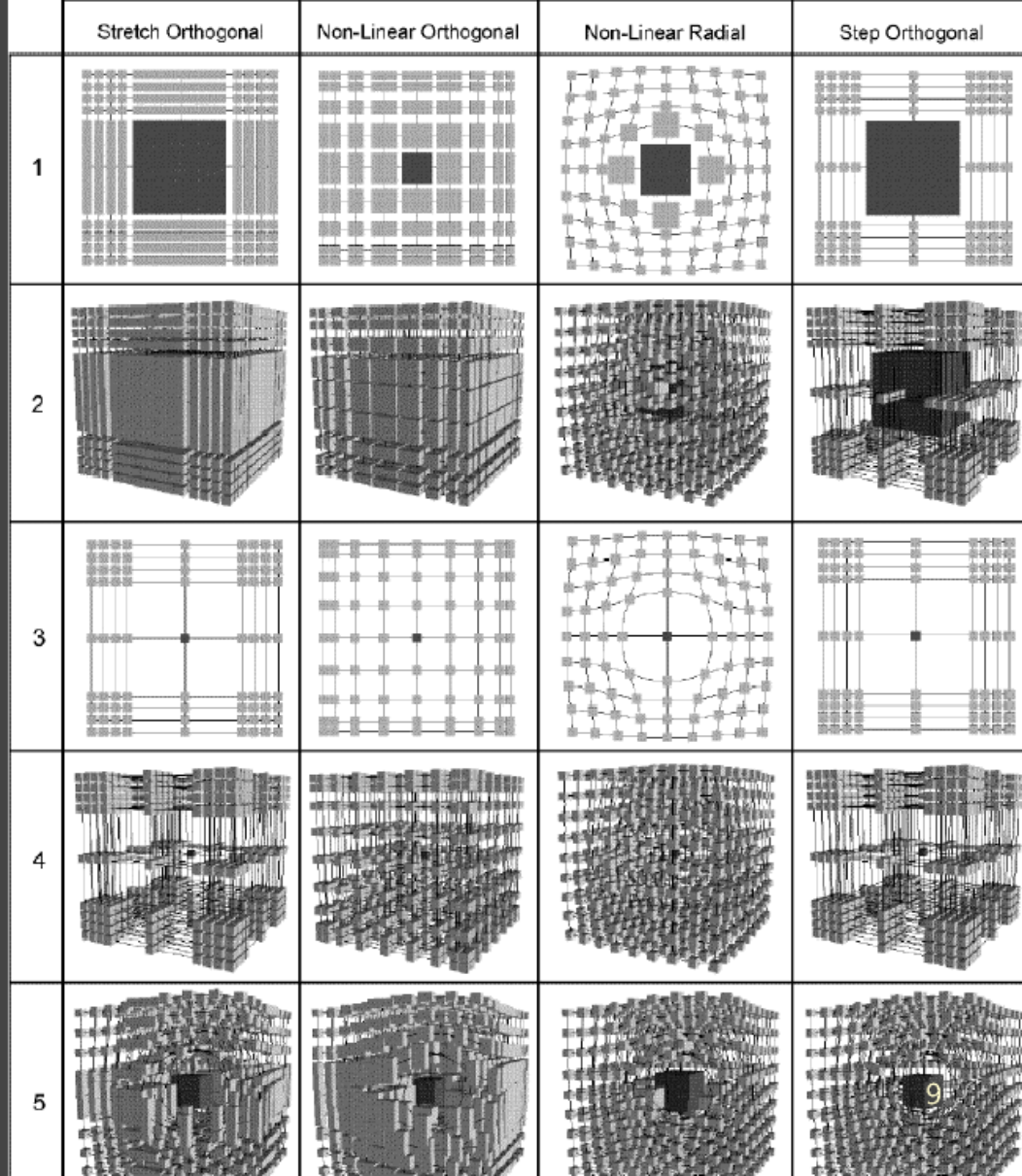
1: 2D displace+magnify

2: 3D displace+magnify

3: 2D displace only

4: 3D displace only

5: visual access distortion



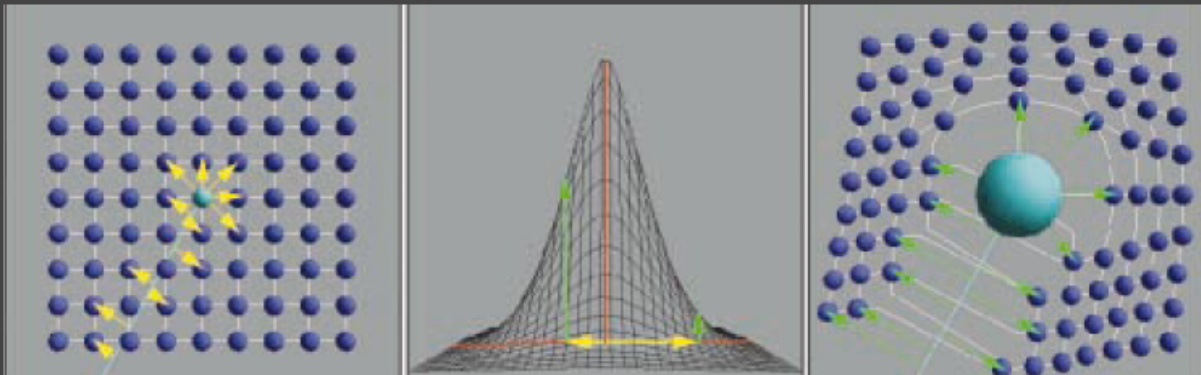
# Visual Access Distortion

naive 2D  $\rightarrow$  3D extension yields occlusion

- same problem as van Wijk

graph-based solution

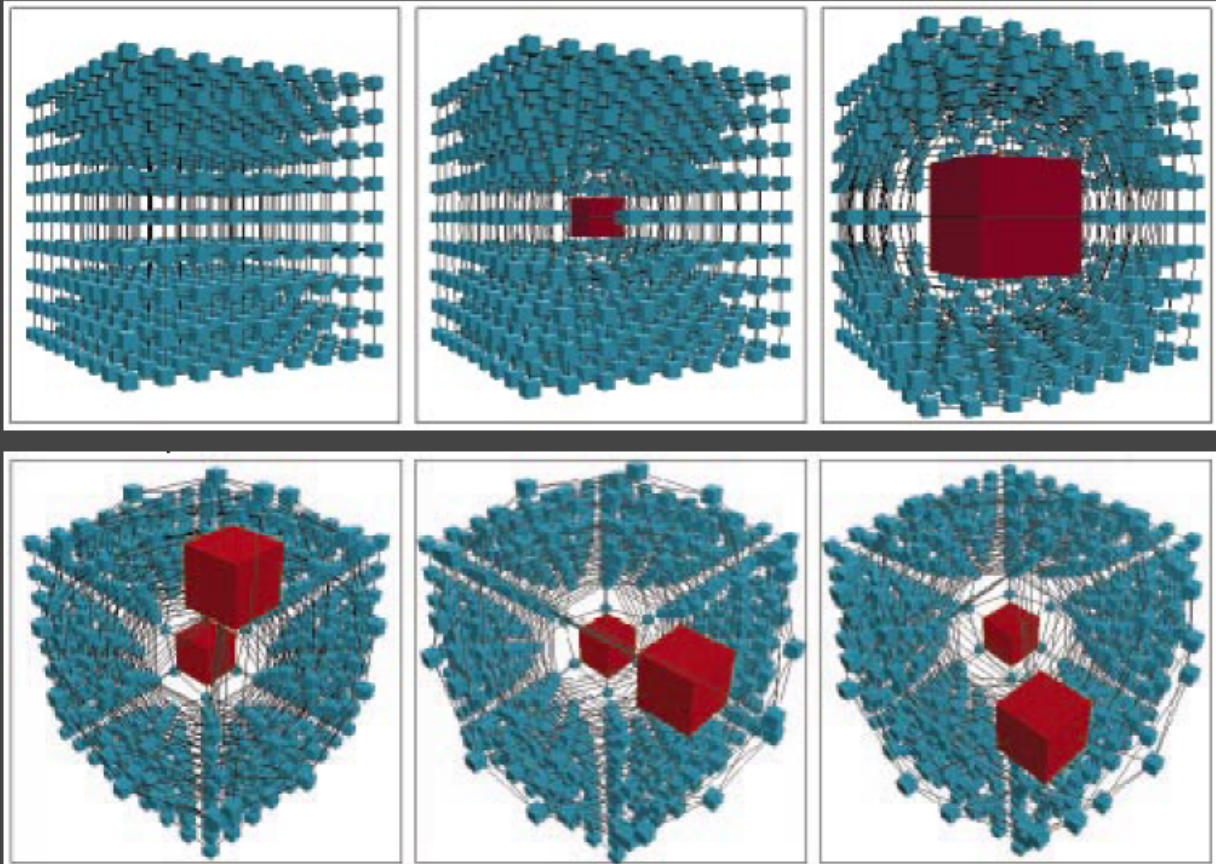
- move geometry according to viewpoint
- magnify focus only
- introduce curves into formerly straight lines



focus+context issues deferred to lecture 12

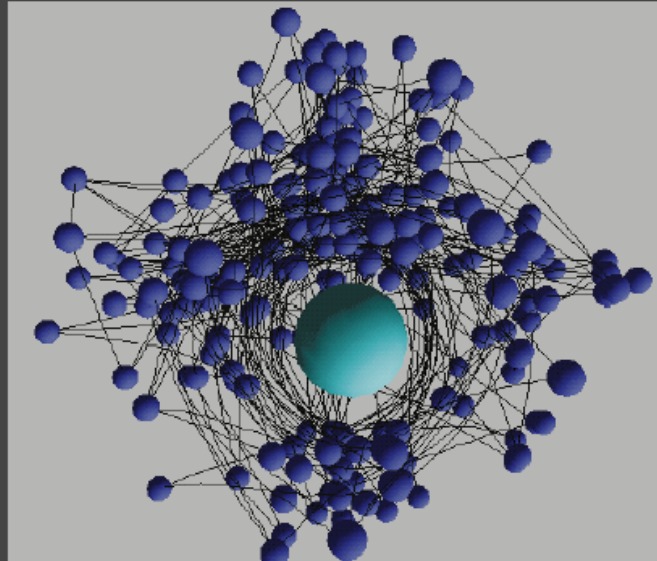
# Results

single, multiple foci



# Results

randomly positioned nodes instead of grid  
· closer to real dataset



# Critique

sophisticated way to navigate 3D graphs

nice technique paper

- not a design study

interesting discussion I'd like to see

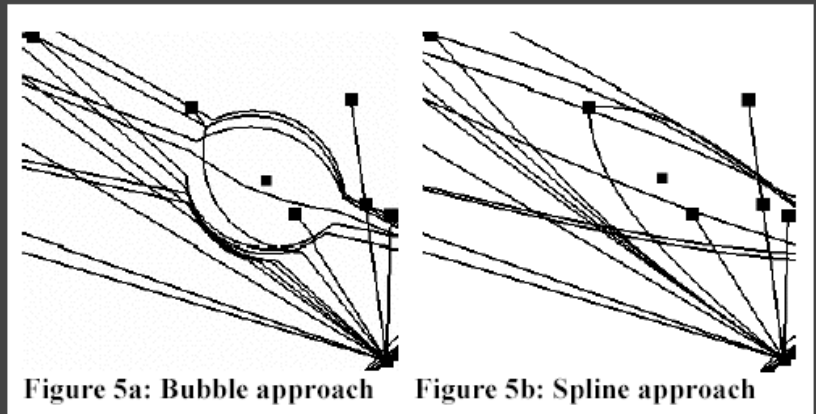
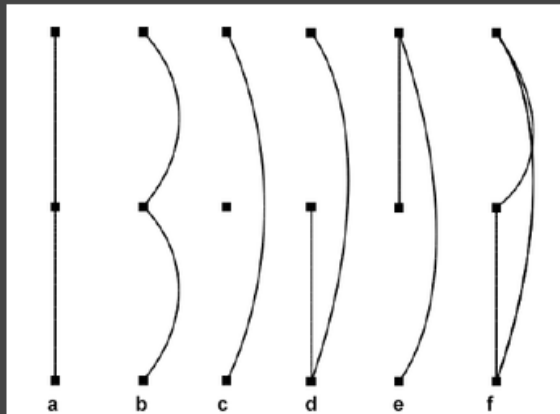
- more analysis of why 3D necessary
  - cites Ware 3x improvement
- occlusion workaround vs. occlusion avoidance

never shown on real data

- hard to draw conclusions from toy datasets

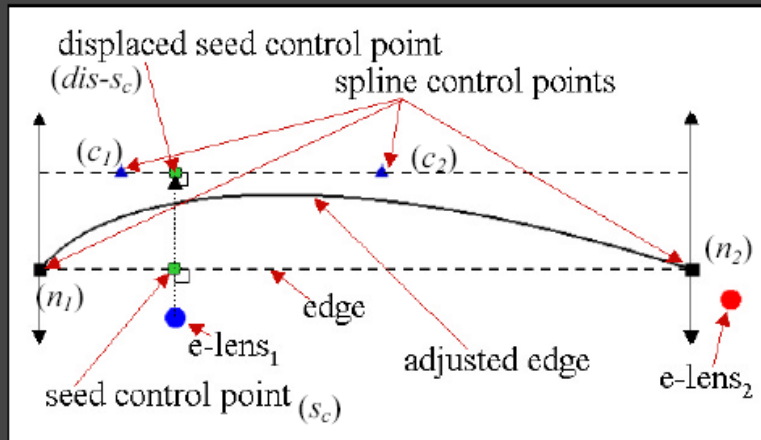
# EdgeLens

interactive control over edge occlusion



user study: spline better than bubble

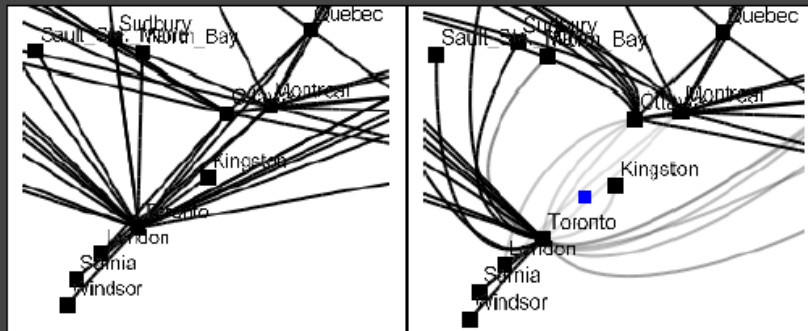
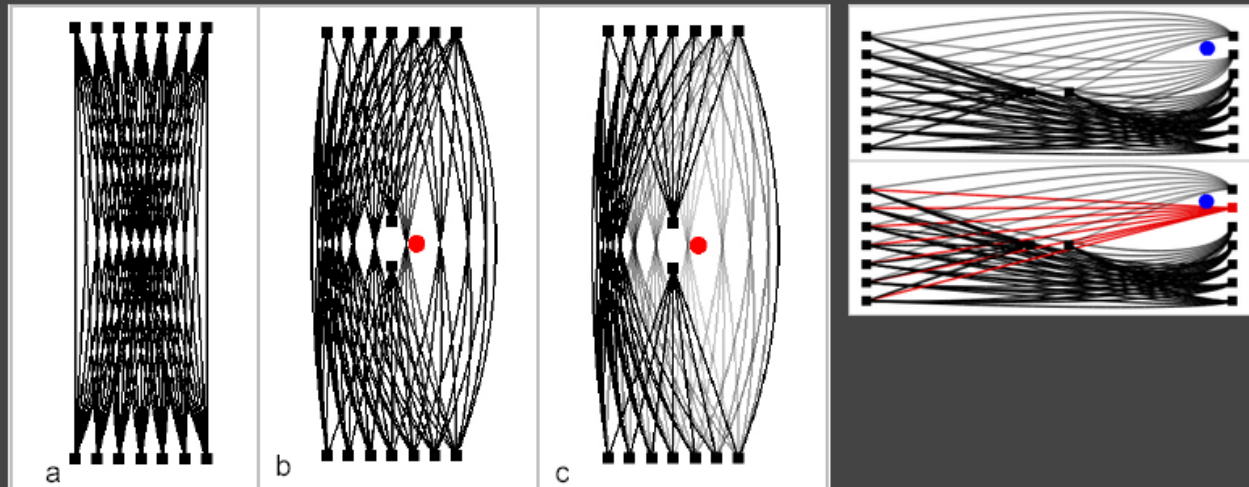
# EdgeLens Final Algorithm



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

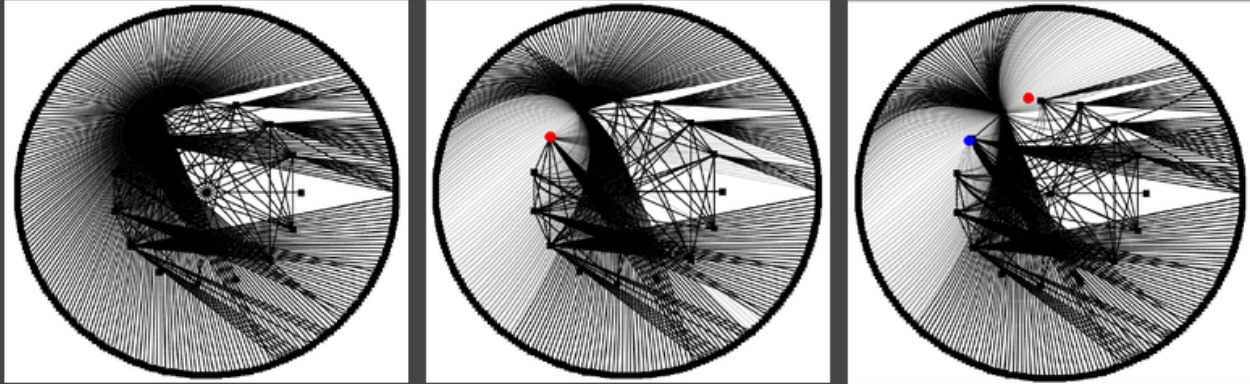
# EdgeLens Techniques

transparency, color





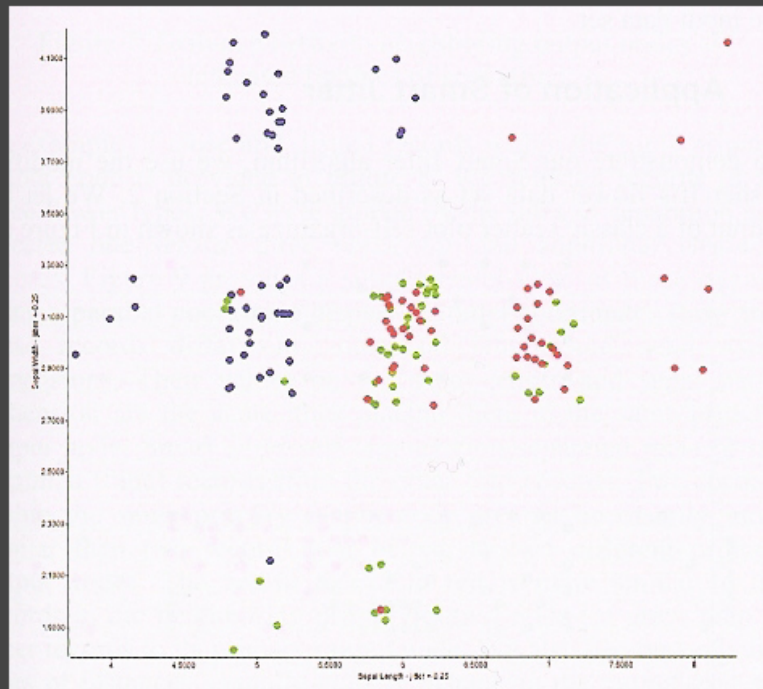
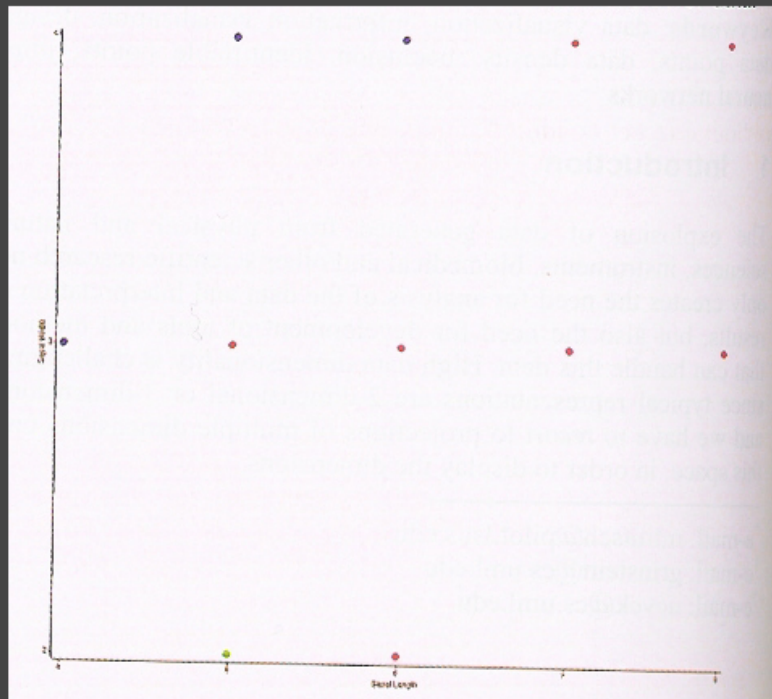
# EdgeLens Results



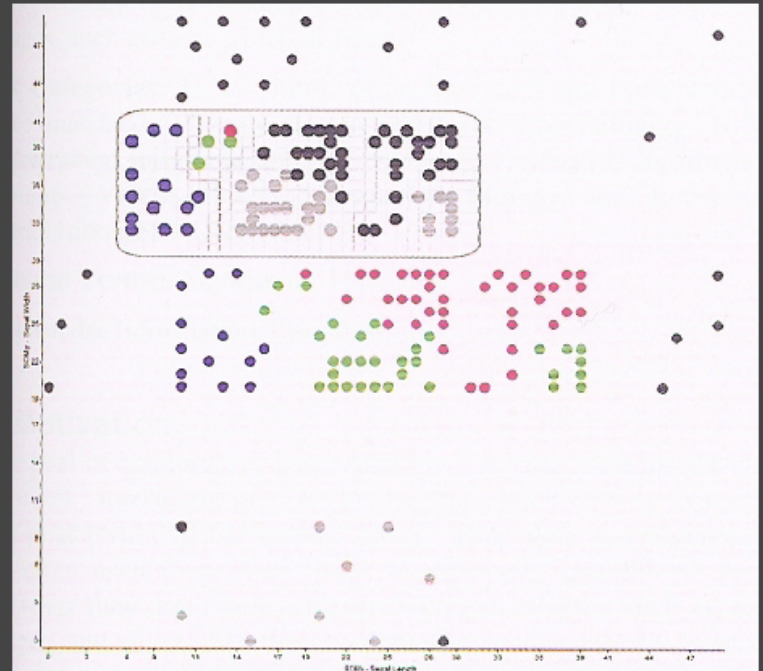
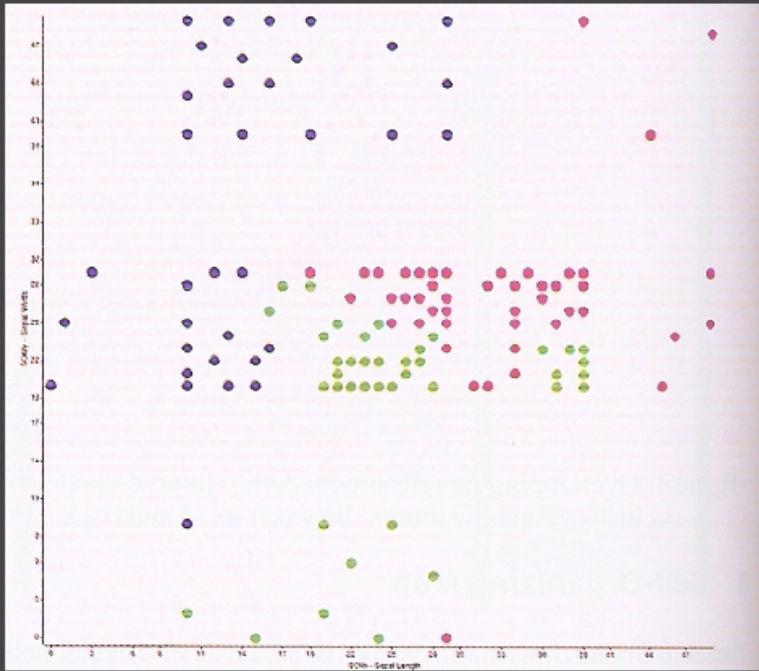
## critique

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

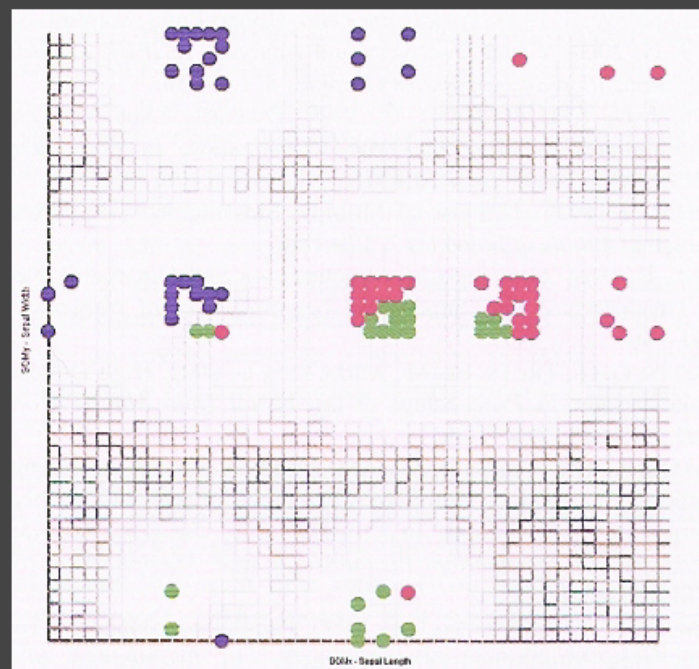
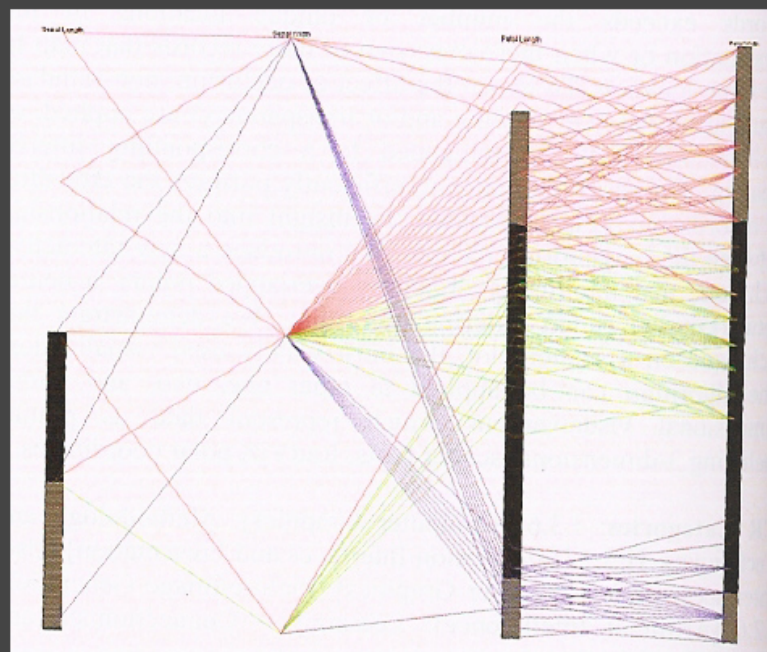
# Jittering As Occlusion Solution



# SmartJitter



# Jitter vs. Parallel Coords



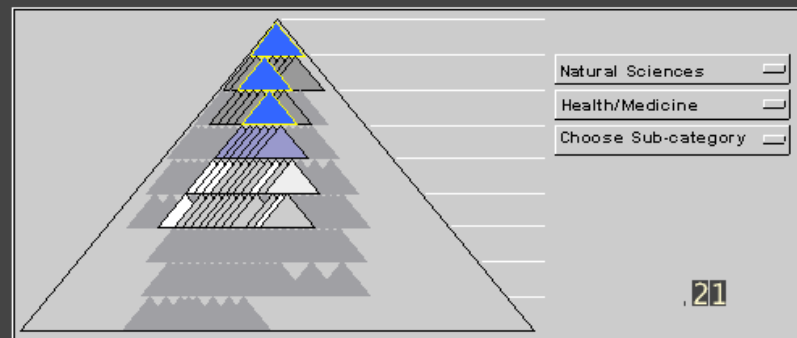
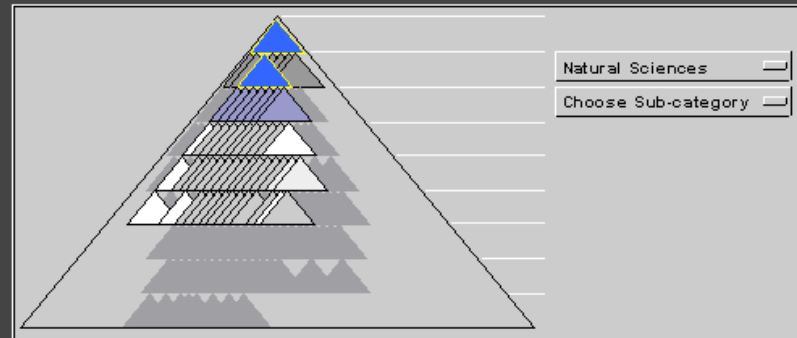
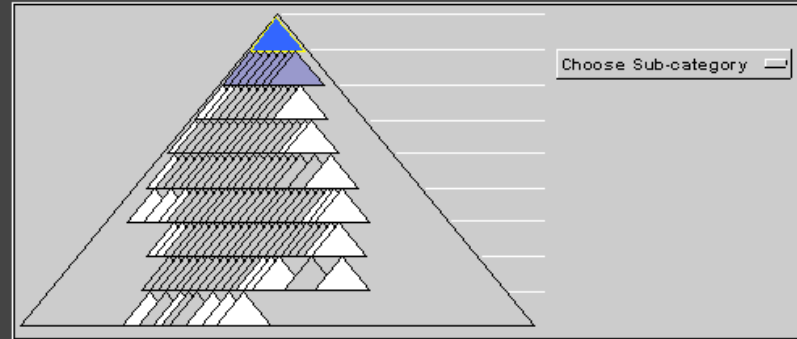
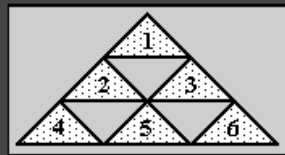
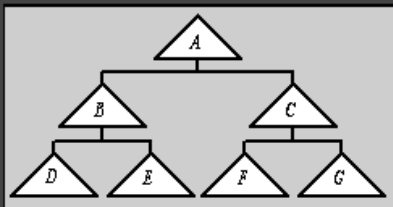
# Cheops

compact

show paths through tree

extreme occlusion  
deliberately

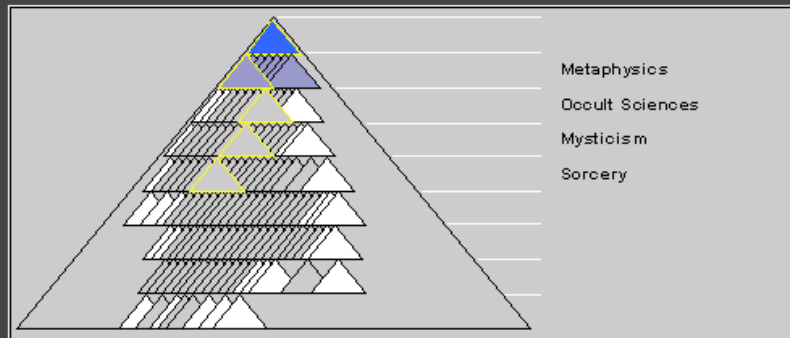
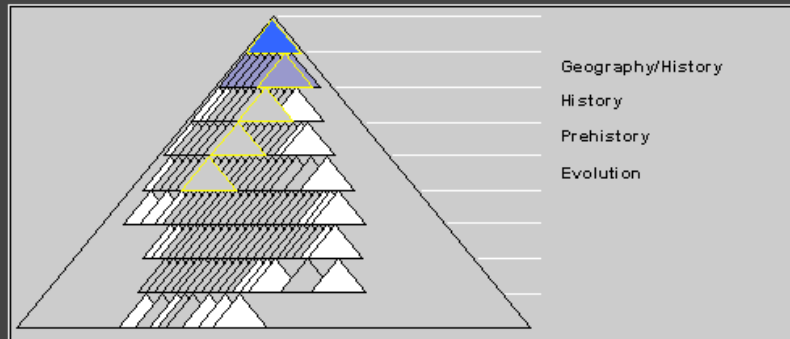
browsing/exploration, not  
topological analysis



# Cheops Interaction

"pre-selection"

- flip through overloaded visual representation choices



# Cheops Critique

## pro

- tiny footprint  
    suitable when main user focus is other task
- interaction techniques investigated  
    informal usability

## con

- relatively hard to understand
- singular nodes very salient, but not so important
- "pre-selection" name is confusing  
    perhaps "node cycling" instead?

# Presentation Topic Choices

software viz  
document collection viz  
computer networks viz  
databases/datamining viz  
cartographic viz  
social networks viz  
time-series data viz  
frameworks/taxonomies  
perception  
high dimensionality  
interaction  
focus+context  
navigation/zooming  
hierarchy visualization  
graph drawing  
evaluation  
glyphs  
animation  
brushing/linking



# Presentations

send me topics by Thursday Oct 21 at 5pm

slides due 10am day of class if using my laptop

# Projects

reminder: meet with me before Nov 5

software/data resources link from course page