State of the Field: InfoVis

Visualization Research Challenges
Fall Workshop, NSF/NIH

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Nomenclature
infovis, scivis
foovis, barvis

names are unfortunate historical accidents
but too late to change
infovis not unscientific
scivis not uninformative
not scivis iff data generated by scientists

Infovis/Scivis Distinction
is spatialization given (scivis) or chosen (infovis)

my infovis definition
interactive visual representation to help person do a
particular task

infovis: not just how, also which
huge space of possibilities: random walk ineffective
strive to create design guidelines, prescriptive advice

separation
now judged by somewhat different criteria
InfoVis Symposium vs. IEEE Visualization
funding bases different
intelligence vs. simulation

Stages
invention
invent new visual metaphors

characterization
when is which metaphor useful: design guidelines

automation
automatically determine which to use

scaling
handling big datasets

State of the Field
conveniently, considerable analysis lately!
10th InfoVis symposium in 2004
InfoVis Contest 04 data: history of the field

influential authors and themes
extracted from
www.cs.ubc.ca/~tmm/papers/contest04

Influential Themes
Focus=Context
Mackinlay/Robertson/Card (PARC), Furnas (Bellcore)

graphic design
Tufte (Yale)

sensemaking
PARC, including Rao, Pirolli

linked views
Cleveland/Becker (Bell Labs)

high dimensionality
Worlds within Worlds, Feiner
dimensionality reduction, Chalmers, (PNPL)

dynamic queries
Shneiderman (Maryland)
zoomable user interfaces [ZUIs]
Pad/Pad++, Bederson
space-scale diagrams, Furnas
Theme: Focus + Context
merge overview and detail into single view
many names
- Focus + Context [Rao 94]
- nonlinear magnification [Keahey 97]
- fisheye views [Furnas 86, Sarkar 94]
- pliable surfaces [Carpendale 95]
- hyperbolic methods [Lamping 95, Munzner 97]
- stretchable rubber sheets [Sarkar 93, Munzner 03]
navigation/layout technique
- not tied to particular dataset or application

F+C: Generalized Fisheye Views
Furnas (Bellcore), CHI 86
- source code, calendars

F+C: Cone Trees
Robertson, Mackinlay, and Card (PARC), CHI 91
- org charts, filesystems

F+C: Table Lens
Rao and Card (PARC), CHI 94
- spreadsheets

F+C: Stretchable Rubber Sheets
Sarkar et al (Brown), UIST 93
- maps

Theme: Graphic Design
Tufte trilogy (Yale): curated design gallery
- The Visual Display of Quantitative Information
- Envisioning Information
- Visual Explanations
guidelines only for explanatory, not exploratory!
Theme: Big Picture

PARC (including Pirolli)

- sensemaking
  - understand large document collections
  - very high-level task
  - information foraging

- cognitive co-processor
  - architecture for interactivity

- big picture, beyond single visual metaphor

Issue: 3D vs. 2D

- 3D extrusion pretty but not useful
- daily, weekly patterns hard to see

Theme: Linked Views

- Cleveland and Becker (Bell Labs)
- van Wijk and van Selow (Eindhoven)
  - Cluster–Calendar, InfoVis 99

Theme: High Dimensionality

- low–high: 4–10 dimensions
- Worlds within Worlds, n-Vision
- Feiner and Beshers (Columbia), UIST 90

HighD: Parallel Coordinates

- medium–high: dozens, Inselberg/Wegman, 89–90

HighD: Dimensionality Reduction

- high–high: dozens or hundreds of dimensions
  - multidimensional scaling, Chalmers
**HighD: Themescapes/Galaxies**

MDS output: beyond just drawing points (PNNL)
- galaxies: aggregation
- themescapes: terrain/landscapes

**Theme: Dynamic Queries**

Ahlberg and Shneiderman (Maryland), CHI 94
- databases: real estate, movies

**Theme: ZUI/Level of Detail**

zoomable user interfaces
space-scale diagrams
navigation trajectories
multiscale views

**ZUI/LOD: Pad++**

Bederson (Bellcore) and Hollan, UIST 94

**ZUI/LOD: Navigation Trajectories**

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

**ZUI/LOD: Level of detail**

Rivet: Stolte et al., InfoVis 99
processor performance tuning

- The instruction mix chart lets us see what types of instructions are in the pipeline during the time interval of interest.
- We can see patterns in the instruction mix over time.
- There are periods of increased pipeline stall throughout the execution.
- The overview displays stall and throughput information for the entire execution.
Other Important Ideas

- automatic design
- pixel-oriented techniques
- scalability

Automatic Design

APT, Jock Mackinlay PhD (Stanford), 1986

- later: SAGE, Roth (CMU)

Pixel-Oriented Techniques: VisDB

Keim and Kriegel, IEEE CG&A 1994

- databases

Pixel-Oriented Techniques: SeeSoft

Ball and Eick, Bell Labs, IEEE Computer 1996

- software engineering

Pixel-Oriented Techniques: displays

- high resolution
  - large size
  - immersiveness

Scaling Up: Stretchable Rubber Sheets

TreeXtastaper, Munzner et al, SIGGRAPH 2003
Scaling Up: Treemaps

MillionVis, Fekete and Plaisant, InfoVis 2002

State of Infovis (vs. Scivis)

strengths
- abstraction
- creating new visual metaphors
- design principles
- evaluation
- tasks, connection with users

weaknesses
- scalability
- adoption
- novelty for novelty's sake with visual metaphors
  need to characterize when effective
  hard to make effective ones

significant counterexamples both ways!