Interaction

"We see more when we interact with a picture - especially if it reacts instantly - than when we merely watch."

Levels

– **Low-interaction**	**batch**
– **Medium-interaction**	**integrated**
– **High-interaction**	**instantaneous**

Brushing

Becker and Cleveland 87

- Scatterplots matrices

- **Highlighting**
- **Selection then action (delete, label, ...)**
- **Conditioning: 1D and 2D**
- **Prosection**
  - Furnas and Buja
- **Database query**
  - Schneiderman 94

Linking

<u>Defn</u>: **Visually identify corresponding items (points) in different views**

Methods:

- **Draw lines between the items**
- **Unique symbol/color for each item**
  - **Tukey's *alternagraphics***
  - **XGobi fig. 6**
  - **See Keim "Icon" pp. 18-26**
- **Common spatial references**
  - **Scatterplot matrix**
  - **Trellis**
  - **Tufte parallel plots**
- **Punt: Merge views**

See-Through Interfaces

Magic Lenses and Toolglass

- PARC

Portals

- PAD and PAD++

Basic ideas

- Output
  - » Previews
  - » Magnify
  - » Convert to wireframe
  - » Visualizations: graphs, bar charts, ...
- Input (click-through)
  - » Palettes
  - » Constrained selections
  - » Rubbings
- Composable

Information Visualizer

Robertson, Card, Mackinlay (CACM 93)

- **Principles**
  - **Large workspace**
  - **Real-time interaction**
  - **Visual abstractions**
  - **Agents**
- **Resource scheduler**

  Cognitive Co-processor = Impedance matcher
  - **Tasks**
    - » **Search and analysis**
    - » **Interaction and display**
    - » **User**
  - **Time scales (Newell)**
    - » **Perceptual processing: .1s**
    - » **Immediate response: 1s**
    - » **Task: 10s**

Information Visualizer

- **Information Visualization**
  - Hierarchical: Cone trees
  - Linear: Perspective wall
  - Spatial: Building
  - Continuous: Data sculpture
  - Unstructured: ?
- **Navigation**
  - 3D Rooms
  - Logarithmic motion

SAGE

Roth et al. CMU

- **Data sets**
  - Ordering
    - Quantitative (coordinates vs. amounts)
    - Ordinal
    - Nominal
  - Domains
  - Relations (mappings from set to set)
    - Functions
    - Hierarchies
  - Algebraic dependencies
- **Display techniques**
  - Position
  - Marker
  - Text
- **Display functions**
  - Accurate value lookup (tables)
  - Comparison (pairwise vs. n-wise)
  - Functional dependencies

SAGE: Cool Features

- **Aesthetically pleasing graphics**
- **Graphical templates**
  - **Graphemes and composition rules**
  - **Reusable graphs**
  - **Incorporation of design rules**
- **Integration**
  - **selection and aggregation**
  - **analysis**
  - **visualization**
- **Automatic generation of captions**