Interaction Support for Visual Comparison
Inspired by Natural Behavior

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Motivation

• How to compare patterns in tabular visualization?
  – Procedure:
    • Navigate to pattern A
    • Store A in short-term memory (STM)
    • Scroll to another pattern B
    • Compare B to mental image of A
  – Ineffective and error-prone

• Goal: Better support for comparison tasks
Related Work

Comparison in visualization:

- Survey* lists more than **110 references**
- Mostly **visual** solutions (special layouts, visual encoding)
- No general solution, but **limited** to specific data / techniques

*Munzner et al., 2003  Holten & van Wijk, 2008  Tominski et al., 2008  Jiang et al., 2008

Approach

Develop **general solution** by approaching the problem from a different angle!

Focus on **interaction**!
Get inspiration from **natural** behavior!
Natural Comparison

Inspiration from **natural behavior** of people comparing information printed on paper

Novel Interaction Approach

Imitate the natural comparison workflow and environment

- Virtual workspace and supplementary tools
  1. Specification of comparison objects
  2. Arrangement to suit comparison
  3. Resolving of occlusion to facilitate comparison

Design goals: natural, fluid*, supportive, general

* Elmqvist et al.: Fluid Interaction for Information Visualization, 2011.
Virtual Workspace

• Combine* zoomable 2D space with multiple views

• Plug in any visualization
  – Table
  – Node-link
  – Scatter plot matrix
  – ...

• Classic interaction

* Plumlee & Ware: Zooming versus multiple window interfaces: Cognitive costs of visual comparisons, 2006.
1. Flexible Specification

- **Select** region of interest
- **Create** new view from ROI
  - Extract information from parent view (image data or raw data)
  - Detach fully-fledged view
- **Collect** views in a hierarchy
  - Maintain parent-child relationship
  - Keep views in front of parents
  - Help users keep track of views
2. Interactive Arrangement

• **Relocation** of views to suit comparison
  – Translate, (scale, rotate, ...)

• **Alignment** tools to aid in relocation
  – Snapping to grid, (objects, features, ...)

Comparison arrangements
  – **Juxtapose**: No occlusion, but eyes need to move frequently
  – **Superimpose**: Only little eye movement required, but occlusion
3. Resolving Occlusion

• **Shine-Through**
  – Alpha-blending of superimposed views

• Easy and intuitive, but merging of graphical information
3. Resolving Occlusion

• **Folding**
  – Peel off occluding view*
  – Uncover information under cursor
  – **No corner-grab**, but simple heuristic to compute the folding

• Easy and intuitive, but collateral occlusion

3. Resolving Occlusion

- **Folding**
  - Balance information richness, naturalness, and occlusion
  - Different folding styles
Supporting Tools

– Reduce interaction costs: shortcuts **Go-To** and **Bring-In**
– Offload cognitive costs to verbal memory*: view **annotation**
– Maintain orientation: indicate **origin** of views
– Explicitly encode differences: similarity **LEDS**

* Plumlee & Ware: Zooming versus multiple window interfaces: Cognitive costs of visual comparisons, 2006.
Demo

• Prototype implementation with table visualization
• Available at: http://goo.gl/LwREL
Evaluation

• User study with 18 participants
• Three different visualizations: table, matrix, NodeTrix
• Think-aloud and questionnaire

• **Positive feedback**
  – “Better than natural”
  – “Feels realistic”
  – “Very harmonic”

• **Negative feedback**
  – “Folding too flexible”
  – “Snapping only on demand”
  – “When to use which?”
Summary

• Novel interaction approach
  – Generally applicable to many different visual representations
  – Support for all types of comparison*: superposition, juxtaposition, and explicit encoding
  – Easy to learn and enjoyable to use

• Future work
  – Better support finding and creating candidates (e.g., dynamic queries)
  – Automatic arrangement based on similarity
  – Which interaction for which visual encoding and which task?

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