Axes-Based Visualizations with Radial Layouts

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Outline

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• VisAxes Framework
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Introduction
Visualization

- Multivariate data sets are everywhere: business data, scientific data, census data, human health data, etc.

- Data must be analyzed in order to make it valuable

- Visual analysis have proved to be an effective means
Introduction

Motivation

- Data often inherit a dependency on one dimension of reference
- Task: Depict the dependency of multiple variables on the dimension of reference
- Approaches:
  - Standard techniques like *line charts*
    + Expressive for depicting this dependency,
    - Difficult to visualize multiple variables
  - Special techniques like *Parallel Coordinates*
    + Expressive for visualizing multiple variables
    - Hard to comprehend dependency for all variables
- Idea: Join the efficiency of both approaches
Axes-Based Visualization
General Approach and Requirements

- General approach
  - Variables of a data set are mapped to axes
  - Axes are appropriately scaled and arranged on screen

- A conceptual distinction of axes design and axes arrangement is necessary

- Requirements
  - Development of general axes-based framework
  - Provide different axes for different visualization tasks and different data types
  - Allow for a direct variable-axis-mapping manipulation
  - Examine expressiveness of different axes arrangements
Axes-Based Visualization

Axes Design

- **Simple Axis**
  - Constitutes a min-max-mapping of a variable

- **Scroll Axis**
  - Sub-range of a variable is mapped onto the axis
  - Slider depicts sub-range and can be used to interactively adjust the sub-range
Axes-Based Visualization

Axes Design

- **Focus+Context Axis**
  - Constitutes a non-linear min-max-mapping
  - Focus slider for interactive focus and magnification adjustment
- **Hierarchical Axis**
  - Hierarchically organized variables like time are represented by a hierarchical axes
  - Nodes can be expanded or collapsed
Axes-Based Visualization

Axes Arrangement

**TimeWheel**

- **Motivation:** Point out the dimension of reference
- **Approach:**
  - Centrally exposed axis representing the dimension of reference
  - Radially arranged axes representing depending variables
  - Data records are depicted by line segments

- Axis of reference
- Variable axes
- Lines connecting time and variable values
Advancing the *TimeWheel*

- Interactive rotation allows “focusing” different variables

- Emphasizing axes in focus
  - Aid users during data exploration and de-clutter the display
  - Axes length adjustment and color-fading
MultiComb

- Motivation: Make use of the expressiveness of line charts
- Approach:
  - Arrange plots radially
  - Each plot represents a depending variable and the dimension of reference directly
  - Two variants:
    - Plots extending outwards from the central point
    - Plots extending around the central point
Advancing the *MultiComb*

- Use the center of the *MultiComb* to provide additional information
  - Aggregate view in combination with a scroll axis
    - Aggregated “history” values are mapped to small arcs
  - Spike glyph for easy value comparison
    - Each value of a data record is mapped to the length of a spike in the spike glyph
Axes-Based Visualizations

Visualization Examples

- Change form increase to decrease
- Change form decrease to increase
- Outliers
- TimeWheels on a map
- Decreasing variable
- Increasing variable
The Framework VisAxes

Architecture

- The presented techniques have been realized in the interactive framework VisAxes
- DataBox, ToolBox and VisAxesWindow are main components of the architecture
- .Net and C# have been used as development environment
The Framework VisAxes

Demonstration
Conclusion & Future Work

- Innovative interactive axes for easy data exploration
- New axes arrangements for emphasizing one dimension of reference in a multidimensional data set
- Implementation of the concept in the modular axes-based framework VisAxes

Future work
- Automatic variable-axis-mapping (similarity, correlation, ...)
- Extension of the techniques to 3D
- User tests to prove eligibility of the approach