ThermalPlot: Visualizing Multi-Attribute Time-Series Data Using a Thermal Metaphor

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ThermalPlot Technique

- Multi-attribute time-series data
  - Large number of items with multiple attributes changing over time
  - Economics, sensor networks
- Challenges
  - Overview of items showing interesting temporal developments
  - Integrating multiple heterogeneous attributes of a collection of items
  - Multiple levels of temporal dynamics
- Solution
  - ThermalPlot visualization technique!
  - Encoding changes in attributes into an item's position
  - Position based on a degree-of-interest (DOI) function

Previous work

- Multi-attribute item comparison
  - Across multiple attributes of a single item
  - Across a single attribute of multiple items
  - Superimposing multiple curves in a line chart
- Temporal dynamics
  - Mapping time to time
  - Animations, Gapminder Trendalyzer
  - Mapping time to space
    - Cycle Plot
    - Small multiples, LiveRac
  - Trajectories
    - DimpVis

ThermalPlot Concept

- Fundamental idea
  - User-specified degree-of-interest (DOI) value

Math behind the DOI

- DOI
  - $\Delta(DOI) = \sum_{i=1}^{N} (y_i - y_{max}) \times \frac{y_{max}}{\Delta(DOI)_{max}}$
- Delta(DOI)
  - $\Delta(DOI) = \sum_{i=1}^{N} (y_i - y_{max}) \times \frac{y_{max}}{\Delta(DOI)_{max}}$
- Normalization
  - $y_{norm} = \frac{(y_i - y_{min})}{\Delta(DOI)}$

Clutter Reduction Strategies

- Semantic Zooming
- Orthogonal Stretching

Data Flow

- Time Window
- DOI Computation for each item
- Representation
- Orthogonal Stretching

Use case

- Multi-Attribute Time Series
- Time Window
- DOI Computation
- Representation
- Orthogonal Stretching

Analysis Summary

- Why: Action
  - Discover
  - Browse
  - Identify
- Why: Target
  - Trends
  - Distribution

User tasks

- Monitor the development of multiple items in a certain time window
- Select attributes and define their interestingness
- Detect items that are most interesting
- Understand why the items are considered to be interesting
- Monitor the development of a single item
Critique

- **Strength**
  - Wise choice of item's position
  - Capability to handle large data sets
  - Use of overview and details on demand
- **Weakness**
  - No look-up scenarios anticipated
  - Animation for live data streaming
  - Adjusting the representation borders

THANKS!