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

Holger Stitz, Samuel Gratzl, Wolfgang Aigner, Marc Streit.
Presented by: Arash Shadkam

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

\[ DoI_{raw}(t) = \sum_{i=1}^{n} w_i \times v_i(t) \mid \sum_{i=1}^{n} w_i = 1. \]

\[ DoI(t) = \alpha \times DoI_{raw}(t) + (1 - \alpha) \times (DoI_{raw}(t - 1) + DoI_{trend}(t - 1)). \]

\[ DoI_{trend}(t) = \beta \times (DoI(t) - DoI(t - 1)) + (1 - \beta) \times DoI_{trend}(t - 1). \]

• Delta(DOI)

\[ \Delta DoI(t) = DoI(t) - DoI(t - \Delta t). \]

• Normalization

\[ v_{rel}(t) = \frac{v(t) - v(t_{index})}{v(t_{index})}. \]
• 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
Problem?!
Clutter Reduction Strategies

• Semantic Zooming
• Orthogonal Stretching
Data Flow

**User Input**
- Index Point
- Time Window
- Dol Editor
- Representation Borders

**Data Input**
- Multi-Attribute Time Series

**Dol Computation for each item**

\[ x_{doi} = \text{Dol}(t_e) \]

\[ y_{doi} = \Delta \text{Dol}(t_e - t_s) \]

**Orthogonal Stretching**

\[ x_{doi}, y_{doi} \]

**Output**
- Item Position
- \( x, y \)
Use case
a) Negative stocks with positive trend

b) Positive stocks with positive trend

c) Positive stocks with negative trend

d) Negative stocks with negative trend
Analysis Summary

• What: data
  ➢ Time-series, multiple attributes, multiple items
• What: derived
  ➢ DOI and Delta(DOI) values based on user input
• How: encode
  ➢ Item’s position
  ➢ Diverging colors
• How: Manipulate
  ➢ Select
• How: Facet
  ➢ Juxtapose
• How: Reduce
  ➢ Focus+Context
• Why: Action
  ➢ Discover
  ➢ Browse
  ➢ Identify
• Why: Target
  ➢ Trends
  ➢ Distribution
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!