Generalized Sensitivity Scatterplots for Sensitivity Analysis

Yu-Hsuan Chan, Carlos D. Correa, Tarik Crnovrsanin, Kwan-Liu Ma
University of California, Davis
Scatterplot

- Scatterplot is frequently used to reveal correlations between x-y variables.
  - (+) Intuitive
  - (-) Bad projection
  - (-) Limited # of variables

- Scatterplots can potentially show global trends.

Courtesy of Wikipedia
Scatterplot

- What are local trends of the dark red nodes?
Flow-based Scatterplots

Scatterplot

Flow-based Scatterplot
Generalized Sensitivity Scatterplot

Flow-based Scatterplot

Generalized Sensitivity Scatterplot
Generalized Sensitivity Scatterplot w/ Z
Generalized Sensitivity Scatterplot w/ Z
Sensitivity

Scatterplot

\[ \text{Position} = (x_0, y_0) \]

\[ \text{Velocity} = \frac{\Delta y}{\Delta x} \]

\[ \text{Sensitivity Derivatives} = \frac{\delta Y}{\delta X} \]

Sensitivity-augmented scatterplot

a scattered collection of position and velocity measures.
Streamlines

- Streamline: integrate sensitivity along a given direction.
- More coherent view
Adjustable Kernel

- $R$: the radius of the neighborhood in computing sensitivity.
- Increase $R$ to show trend from local to global
Smoothness of a Projection

• Regions with large variance in sensitivity are not smooth.

$$C_i : \text{complexity of a node } i$$

$$S : \text{smoothness of the projection} \quad = ( - 1 ) \left( \sum_{i=0}^{N} C_i \right)$$

$$S = -0.17272$$

$$S = -1.8551$$
Sensitivity Views and Widgets

- Fans
- Radar Graphs

- Small Kernel
- Large Kernel
Clustering by Sensitivity
Selection by Streamlines
Conclusion and Future Work

• A novel generalized visual augmentation of scatterplots.
  • Sensitivity Lines
    • local variable correlations
    • differentiation before projection
  • Streamlines: correlation patterns
  • Non-linear transformations: Clustering and Selection
• View and Visual Widgets:
  • Ranking View
  • Sensitivity Fans and Radar Graphs
Thank you

- This research was supported in part by the U.S. National Science Foundation through grants CCF-0938114, CCF-0808896, CNS-0716691, and CCF-1025269, the U.S. Department of Energy through the SciDAC program with Agreement No. DE-FC02-06ER25777 and DE-FG02-08ER54956, and HP Labs and AT&T Labs Research.

- chany@cs.ucdavis.edu
- NetZen v1.0 http://vis.cs.ucdavis.edu/software/