Assignment 3

Submitted by:
Anirban Ghosh - 3279100 - s6anghos@uni-bonn.de
Kajal Puri - 3305398 - s6kapuri@uni-bonn.de
Shilpa Chaterjee - 404788-shilpa.chatterjee@rwth-aachen.de

Course: *Visual Data Analysis (MA-INF 2222)* – Professor: *Dr. Thomas Schultz*
Submission Date: *May 10th, 2020*

Exercise 3

a) In addition to standard PCPs, the authors test eight variations. For each of them, briefly describe the proposed modification, and why the authors expected it to improve the visualization. Use 1-2 sentences for each of the eight cases. (8P)

Answer.

1. The first variant of PCP is used to prevent the extremely dark regions in the plot that gets overdrawn in case of outlier visibility. This is a standard 2D PCP with 25% opacity on a white background. They use constant blending to create a modern and minimalistic representation of PCP.

2. The second variant of PCP is about embedding scatter plots into PCP. They accomplish this goal by embedding scatter plots between each pair of adjacent PCP axes and rotating scatter plot by $45°$.

3. The third variant is a technique uses color and opacity based method to highlight fuzzy clusters based on local neighborhood density of each data point. Although this density-based coloring technique has the disadvantage of not assigning unique colors in case of similar densities. However,a discrete palette is used that contains a fixed number of different colors, provided by ColorBrew.

4. The fourth variant, is actually an advanced version of third variant where instead of using density-based coloring they introduced density-based blending. In this method they control polyline opacity by setting the enhancement value to 0.25 and 1 for the visualizations.

5. In fifth variant, they combine third and fourth variant i.e. density-based coloring and blending.

6. The sixth variant of PCP employs spline-based drawing to reduce ambiguity. In this method, the "reflected" polylines are replaced by introducing curves to resolve ambiguity. In addition, cubic Bezier splines are used to draw curve segments between adjacent PCP axes.

7. The seventh variant of PCP is the random tour technique to generate non-cyclic animations reflecting always new patterns. This is done by generating a random permutation of data dimensions and rotating the time-dependent matrix to create a rotation matrix that further rotate all data points.

8. The eighth variant of PCP is the permutation tour animation technique. This involves smoothing of cycles through various permutations demonstrating all axis adjacencies in an animated way. The final rotation matrix is responsible for the rotation of all data points by interpolating the permutations.

9. The ninth variant of PCP is based on wobble animation scheme suited for localized animations. It utilises PCP polylines that wobbles around a fixed base position in a sinusoidal way. It also keeps clusters fixed, creates a helpful motion that eases the process of visual tracking.

---

b) Within the user study, what task did the subjects have to perform? Name another task for which Parallel Coordinates are frequently used in practice, but which was not included in the study.

Answer. The user study was designed so that each subject counts the number of clusters/ribbons using PCP variations i.e. how many clusters are being displayed (possible range is from two to six). Each subject would choose the number keys on keyboard to enter their answers after pressing the "Space bar".

The parallel coordinates are also used to plot time-series data and allows the analysis of trends in time as well as the exploration of changes in the relationship between the two time-dependent attributes.

---

c) To which extent did the results of the study match the authors' hypotheses?

Answer. The authors hypotheses expected order was - [ColorBlend, Color, SP, Curved, Blend, Wobble, RT, PT, Standard]. Much to authors' surprise the user study gave unexpected results, the actual outcome order was - [SP, Standard, Color, Blend, Color-Blend, Curved, Wobble, RT, PT]. The Color was expected to rank higher but was lower probably due to the fact that coloring method did not assign fully unique colors to all clusters in case of similar densities. SP was ranked highest because all participants considered SP to be least difficult. The results are somewhat limited but encouraging and the key takeaway is that a visualization should not be considered an improvement for the sake of feasible point of view but should be formally evaluated through various user studies.

---

d) Which of the explored modifications would you consider using when designing a visualization based on Parallel Coordinates? Briefly justify your answer.

Answer. I'd consider choosing the fifth variant i.e. the combination of ColorBlend and Color as this would help me distinguish various clusters in different colors and polyline indicating the distinct enhancement.

Anirban Ghosh - 3279100 - s6anghos@uni-bonn.de
Kajal Puri - 3305398 - s6kapuri@uni-bonn.de
Shilpa Chaterjee - 404788-shilpa.chatterjee@rwth-aachen.de