Applying Multi-Player Rating Schemes to Manage User Studies of Visual Analytics Designs

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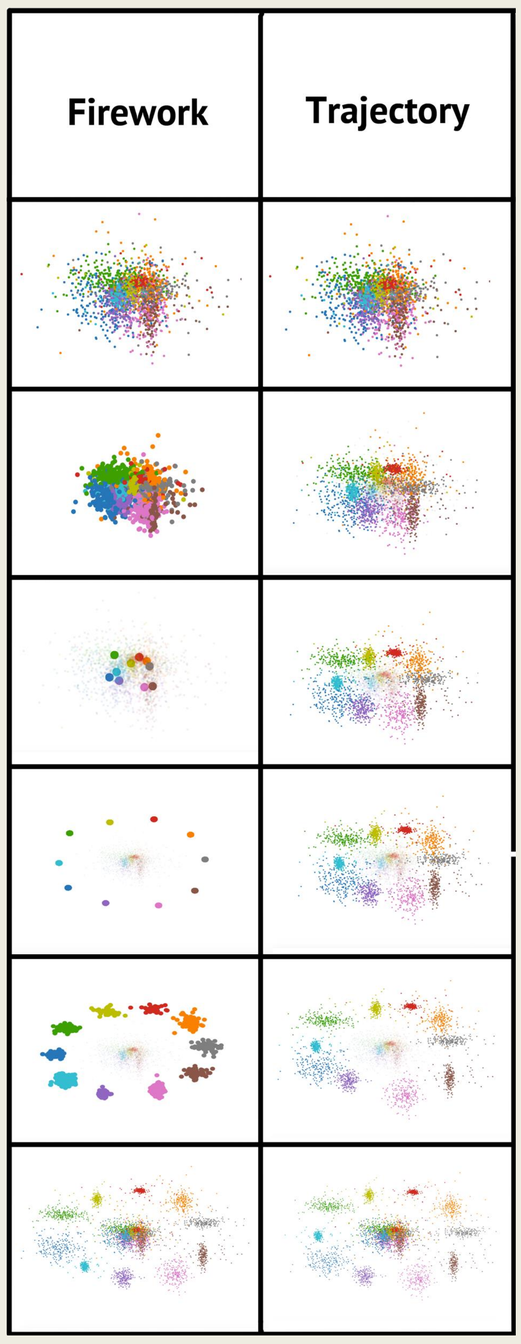
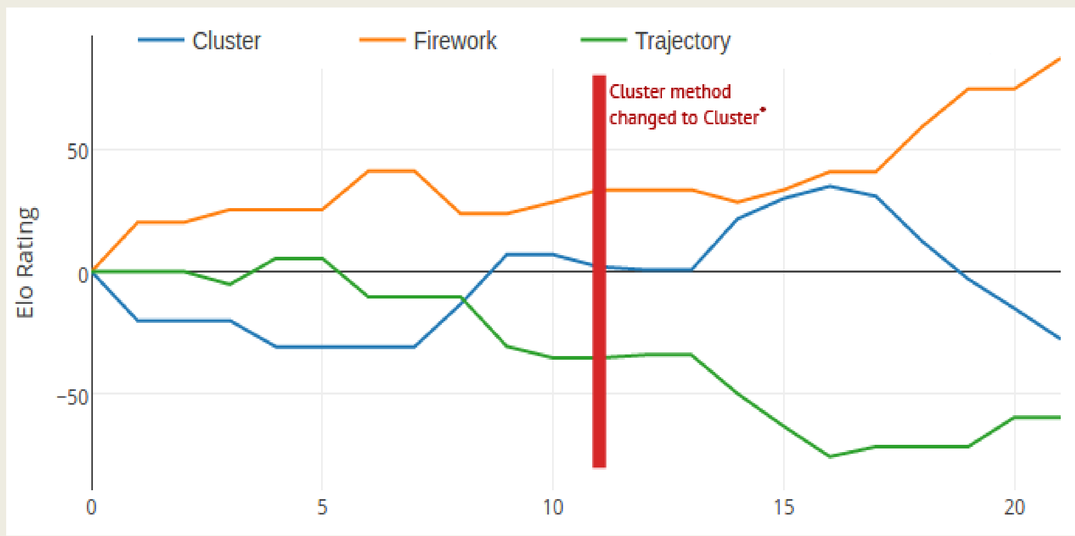
Introduction

Oftentimes researchers want to evolve the design of a visualization layout and monitor its performance as judged by human users recruited via crowdsourcing. We propose a modified version of the *Elo rating system* to compare visualization designs in an efficient and asynchronous manner.. Elo is a popular rating scheme in chess and online games. We study our method for testing small multiple designs. Small multiples is a very popular technique to reduce clutter in visualizations. However, they can be difficult to interpret for people who are not entirely familiar with them. We designed various exploded view methods to make small multiples comprehensible and then compared them using our adaptation of the Elo rating system.

EXPLODED VIEW DESIGNS (1)



ELO-RANKED SURVEY RESULTS OF EVOLVING DESIGN OVER TIME

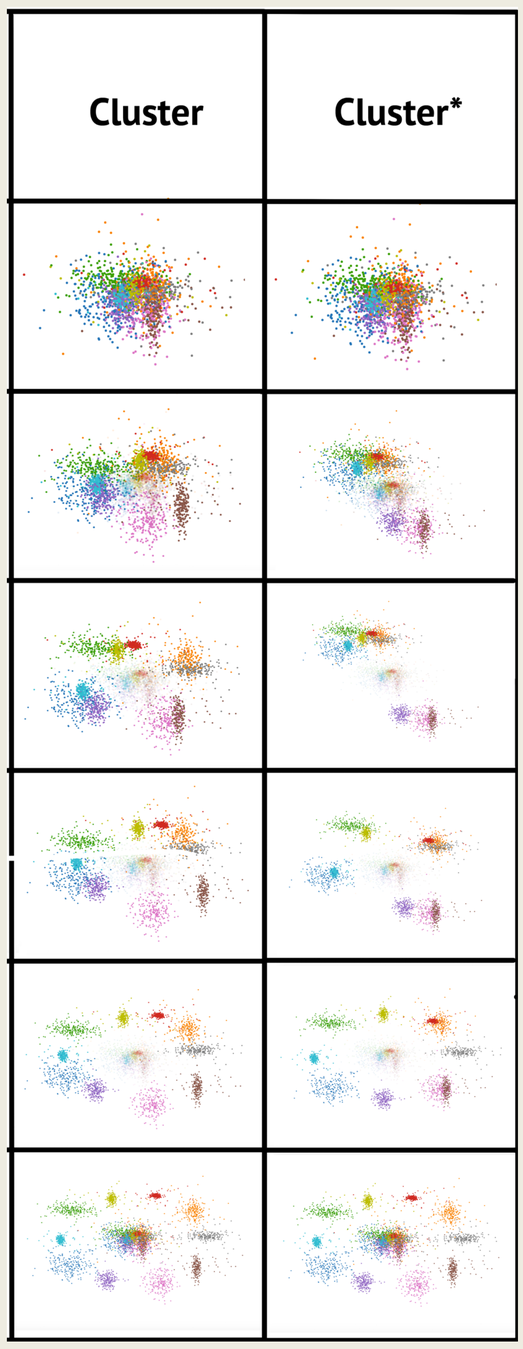


We see that the effectiveness of the Cluster method has decreased after the change was introduced (red bar). After a brief short-term increase, its long-term competitiveness falls drastically while the Fireworks method dominates. Conversely, the Trajectory method never really catches on.

The Elo Rating Scheme

Elo is a very popular rating scheme. It was introduced as a chess rating system by Aprad Elo. In this scheme, after each match, the rating of a player goes up or down depending on the result and the ratings of the competitors. Using the ratings of the competitors the algorithm determines the expected winning probability for each player. If the expected winning probability for a player is greater than the actual result, the player's ratings will decrease and vice versa. The magnitude of the change is dependent on the difference between the expected result and the actual result. In our approach, the evolving visualization designs are the players.

EXPLODED VIEW DESIGNS (2)



Intro to Exploded Views

Small multiples is a displacement technique that has been widely used in data analysis. However, they can be difficult to understand for people who are not familiar with them. Conversely, an exploded view is a diagram in which the different components of an object are suspended in the space around the object, giving the impression that the object is midway through an explosion. Exploded view diagrams are very useful in capturing the relationships between different objects as well as revealing the assembly and structure of an object. We felt that an exploded view is a very natural solution to make the small multiples easier to understand. We use a force directed layout scheme to determine the positions of the components during the explosion. We designed three different methods for the exploded view to test the utility of our rating scheme for evolving designs.

Experiment & Results

We used the modified Elo rating scheme to compare the three different Exploded View designs and identify the one emerging as the best one, Each participant was asked to compare three pairs of Exploded View designs. In a comparison, the subjects were asked to solve multiple choice questions by using the exploded view. The questions were related to the outliers, clusters, and density of the data. The survey was divided into two parts. In the first part we recruited 11 participants. The results show that the firework method is the best followed by the cluster method, whereas the trajectory method does not do too well. For the second part of the survey we made a small change to the Cluster method to see if that would improve our results (10 participants were recruited for the second part). However, the changes reduced the effectiveness of the cluster method and improved the ranking of the Fireworks method even more.

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