Data Exploration using Coordinated Visualizations

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Introduction

Our lab was presented with a dataset of terrorist activity in the hopes that we could create a visualization that would allow analysts to explore the data in both new and more efficient ways.

Heretofore, the traditional mode of exploration was through database queries and statistical analysis similar to those offered by excel. Although this is suitable for finding detailed information or for answering questions that the analyst already knows to ask, it is largely inappropriate for discovering patterns and trends.

To that end, we have built a visualization framework that supports multiple coordinated views that allow the user to explore the data in a much more flexible way, yielding information about individual events and about the data in general. In addition, we have developed a technique that informs the user of geographically uncertain information.

Background

Visualization techniques that present both data and a measure of its verity within one cohesive view remain a challenge within the visualization field. The general treatment of data within many visualizations is to assume that the data is absolutely correct and to then find the best presentation method possible

given that assumption. Perhaps most telling is the fact that one of the more popular papers still actively cited on uncertainty visualization, written by Alex Pang, Craig Wittenbrink, and Suresh Lodh, is over 10 years old.

Those interested in the Theme River metaphor used within this framework and techniques used to improve its accuracy are encouraged to investigate the work of Susan Havre, Elizabeth Hetzler, Paul Whitney, and Lucy Nowell.

Research

- Map View
  - In order to make the connections between geographically nearby events more obvious to the user, a map view was developed that presented terrorist event information at the location in which it occurred.
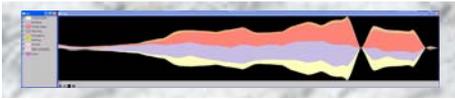 - A new method of uncertainty visualization needed to be developed to allow events with geographically dubious locations to nevertheless be displayed alongside credible data.
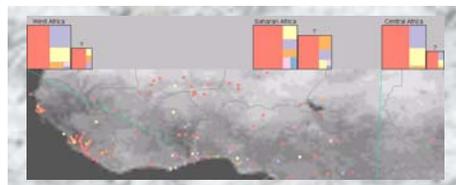
Glyphs denoted by "?" depict unmapped data

- Theme River
  - A theme river was implemented to identify trends as they evolved over time and to provide a broad overview of the data


Impact

- By combining the aforementioned views with others not mentioned here, a flexible exploratory tool has been developed.
- At this point, we've been able to make some interesting discoveries
  - The Spread of Terrorism- It seems that at the onset of the 1970's, terrorism was limited to only a few countries. However, as time progresses, this activity spreads outward. It seems that once terrorism events begin in a country, they never end.
  - Regional Trends in Target Selection- from what we've seen thus far, it seems that terrorist groups operating in Southern Europe mainly attack entities of the same nationality as the local government. In the Middle East and Northern Africa, however, foreign targets appear with much greater frequency.
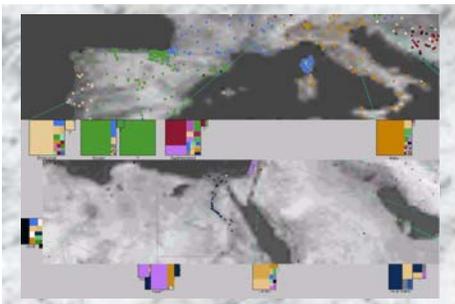
Countries in the upper region are dominated by one type of target (homeland). Countries in the southern region have more diverse targets.

Conclusions

During this summer, I learned a lot about:
- Fltk – a windows creating toolkit
- The art of creating effective visualizations
- How to approach research productively

Future Work

Our next challenge is to modify the border oriented uncertainty view to an in-map view. The hope is that this will make geographic trends easier to recognize. They key challenge to this goal is devising a way to locate a suitable place for this new content within the map that doesn't obscure already present information.