VICA: A Voronoi Interface for Visualizing Collaborative Annotations

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Abstract. Large-scale scientific investigation often includes collaborative data exploration among geographically distributed researchers. The tools used for this exploration typically include some communicative component, and this component often forms the basis for insight and idea sharing among collaborators. Minimizing the tool interaction required to locate "interesting" communications is therefore of paramount importance. We present the design of a novel visualization interface for representing the communications among multiple collaborating authors, and detail the benefits of our approach versus traditional methods. Our visualization integrates directly with the existing data exploration interface. We present our system in the context of an international research effort conducting collaborative analysis of accelerator simulations.

Keywords: multiple location collaborative design applications, information visualization, user interaction, cooperative visualization.

1 Introduction

Many human endeavors require the combined intellectual horsepower of multiple collaborators. Frequently several collaborators work from geographically disparate locations, and less convenient means of communication are necessary. The ubiquity of networked computers has provided a variety of electronic communication methods to address this need. One interesting technique for remote collaboration is the "post-it note" method for collaborative annotation. Using this method, collaborators can attach annotations to points of interest in a data set within the primary investigation tools.

Despite their obvious utility, collaborative annotations have some drawbacks, primarily due to their typical presentation in the user interface. Most often, annotations are shown as a textual list of titles, perhaps augmented with size information, authorship, or a time stamp. As the investigator works within the collaborative software, the list changes to reflect the currently selected data. This presentation method fails to effectively illustrate underlying annotation patterns. For example, it is difficult to determine which data points are discussion "hotbeds," to identify heavy contributors, or to understand the overall temporal evolution of the annotations. This lack of clarity contributes to collaborator information overload, which can impede a discovery available only though

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combined thinking. Visually separating the annotations from the data places an unnecessary navigation burden on the user, particularly when a large number of annotation operations are necessary.

We propose VICA, a novel visualization interface which clearly illustrates the collaborative annotations, and greatly simplifies the navigation of these documents. VICA presents far more annotation information than traditional display methods. The interactive mechanisms offer even more annotation information, including overall temporal evolution of annotation creation. The visualization is integrated directly with the existing data set displayed in the investigator's tool. With VICA, collaborators can now effectively and efficiently answer questions such as "Where have my co-workers been recently focusing the most attention?", "Which annotations by Maria contain the most content?", and "Which data points have substantial annotations written by Andrew?". These types of questions could only be answered with great difficulty using traditional displays, yet VICA answers them at a glance.

The impetus for our work came from the ModeVis project, an existing online collaboration system. Our data sets come from the International Linear Collider (ILC) project [1]. Researchers from SLAC (Stanford Linear Accelerator Center), KEK (High Energy Accelerator Research Organization) in Japan, DESY (Deutsches Elektronen Synchrotron) in Germany, and various U.S. national labs use ModeVis explore data from the ILC project. In ModeVis, a data set consists of a group of points displayed on a two-dimensional area, and both the horizontal and vertical axis carry meaning for the scientists. Figure 1 shows the ModeVis interface. A key component of ModeVis is the collaborative annotation feature. Our goal was to keep the visualization intuitive and conceptually simple, so that the myriad of presented information would not overwhelm the utility. Though ModeVis drove our initial design, our system could benefit any collaborative system with a 2D data navigation mechanism in which the relative point positions are important.

2 Related Work

Viégas [2] et al. presented the history flow visualization, a technique for effectively presenting the collaboration of many authors on a wiki article. Their work focus primarily on visualizing the evolution of a single, co-authored document. Document visualization drives much research, of which [3], [4], and Granitzer's InfoSky [5] are examples. The Galaxy of News [6] also presents a means of navigating and understanding large, interconnected document collections.

Space partitioning visualizations are a widely used type of information display. Balzer [7] describes the use of voronoi diagrams to augment previous treemap algorithms. Heilmann [8] provided a space-filling technique which used rectangular partitions. Our method also utilizes space partitioning using voronoi diagrams. However, our visualization is integrated with an existing 2D information display, and the data points in this display constrain our partitions.