

WebViz: A web-based collaborative interactive visualization system for largescale data sets

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With larger, faster, and more affordable multi-core and massively parallel computers coming to the market and with the introduction of general purpose GPU computing, the number and size of data sets being produced by the scientific community is on a steep rise. Additionally, with the rise of digital communication technologies, it is more and more common for scientists to engage in international collaborations across large geographical distances. To make sense of the large amount of data now being produced and to make collaboration between scientists easier, a new paradigm for data visualization is necessary. We propose that collaborative visualization tools and a web-based approach to data visualization is an attractive solution [Woodward et al., 2007; Damon et al., 2008; Greensky et al., 2008; McLane et al., 2009].

We have created a web-based application for multi-user collaborative visualization called WebViz. Our web application allows users in geographically disparate locations to simultaneously and collectively visualize large data sets (on the order of gigabytes) over the Internet. Furthermore, by providing data visualization services "in the cloud," users all around the world can leverage our service regardless of their local compute capabilities.

WebViz leverages asynchronous java and XML (AJAX) web development paradigms via the Google Web Toolkit (<http://code.google.com/webtoolkit/>) to provide remote users with a web portal to LCSE's

(<http://www.lcse.umn.edu>) large-scale interactive visualization system already in place at the University of Minnesota. LCSE's custom hierarchical volume rendering software provides high-resolution visualizations on the order of 15 million pixels and has been employed primarily for visualizing data from simulations in astrophysics, geophysics, and computational fluid dynamics [Porter, 2002; Porter et al., 2002; Greensky et al., 2008; McLane et al., 2009].

In the current version of our WebViz application, we have implemented a new, highly extensible backend framework built around HTTP "server push" technology. This design allows us to provide a rich collaborative environment and a smooth end-user experience. Furthermore, the web application is almost completely platform independent and is accessible via a variety of devices including netbooks, iPhones, and other web- and javascript-enabled cell phones.

Features in the current version of WebViz include: the ability for (1) users to launch multiple visualizations, (2) a user to invite one or more other users to view their visualization in real-time, (3) users to delegate control aspects of the visualization to others and (4) engage in collaborative chat and instant messaging with other users. These features are all in addition to a full range of visualization functions including 3D camera and object orientation/position manipulation, timestepping control, and custom color/alpha mapping.

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