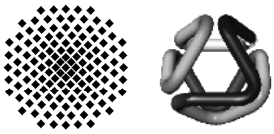

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NIH/NSF Visualization Research Challenges Workshop

Systematic exploration of new visualization techniques:

In the years since the 1987 NSF report visualization as a field has seen a tremendous development, but only few really fundamental SciViz techniques have been found. For 3D scalar fields we moved from isosurfaces to direct volume rendering, for vector fields we moved from streamlines to texture advection. Both innovations are built on exploiting traditionally unused perception capabilities. For VolVis we added depth through semitransparent rendering, LIC-type techniques are based on our recognition of correlations in texture patterns. In both cases, we were able to generate perceptually denser images and based on that a more global visualization of higher resolution data. Both techniques were slow when invented and did not become interactive before advanced texture support was available in graphics hardware. If we extend the traditional classification scheme of domain (geometry related vs. abstract) and data type (continuous vs. discrete) by the dimensions perception mechanisms and graphics functionality, will we be able to systematically search for new visualization techniques? In order to determine the entries in the perception axis (like texture, motion, object segmentation), new knowledge about cognitive aspects and their usability need to be integrated. Can we better estimate the implications when the next hardware paradigm after programmable GPUs comes along?

Benchmarking visualization:

As our discipline matures, more and more research contributions become incremental improvements of well-known techniques. Many of them are orthogonal to each other, e.g. improving speed vs. quality. In order to assess the utility of proposed improvements, the researchers need to agree on qualitative and quantitative results for comparison. This requires a rich set of publicly available datasets and agreed upon criteria. Those measurements should not only be technical like frames per second but also evaluate understanding and analysis like features detected or time needed to complete a task. Some of these results will require standardized user studies. I do not believe that providing and maintaining a database of datasets, results, and procedures can be successfully done on a voluntary basis. It requires institutionalized funding with a long-term perspective. Having such a VIS SPECmark will stimulate competition and will improve the fast transfer of new techniques into products.

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Visualization: the killer-app of the next user interface generation?

The base layers of future user interface toolkits are moving fast towards graphics. Microsoft's Avalon will have 3D graphics and the web already provides XAML examples for classical Windows GUI programmers. SVG is taking off as an important API for applications and user interfaces on mobile devices. This opens up new possibilities for ubiquitous graphics applications beyond games and animated icons. Will the visualization community be able to adapt their techniques (especially from InfoVis) to provide new solutions for the everyday user? This is especially necessary for dealing with the increasing amount of available measurement data resulting from sensor networks. I am convinced that ambient intelligence will manifest itself in innovative visualization applications. We will again need perception based adaptivity to scale those presentations from mobile phones to large projection walls.

Large data sets and visualization applications:

The visualization of large data sets (high dimensional, multi-field data on complex grids) is far from being solved and has to be tackled on a larger scale. Visualization experts still have to deal with parallelizing and distributing their algorithms and getting the most out of the available graphics hardware. However, they also have to interface to the grid community to access the distributed data and processing services. Partial solutions to the large data set problem will probably be much closer to the application domain, even more increasing the demand for publication of visualization applications. As it is hard to draw the line between results to be presented in the application domain or in the visualization community, guidelines have to developed what constitutes a valid visualization application.