Abstract
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Enhancing Web-Based Three-Dimensional Visualization of Scientific Data

The recent initiative to encourage more effective communication among researchers, educational institutions, government bodies, and industries involved in the nanotechnology field has inspired major growth within the scientific visualization community. Scientific visualization provides an effective means to facilitate the display of both large and multi-dimensional data sets from experimental and computational research. Although scientific data sets often exhibit a definitive pattern to the researching scientists, the same data sets are often a mystery to their collaborative partners. To help clear up some of these mysteries, scientific visualization has developed several data-rendering programs that allow individuals to use both visual and perceptive cues to analyze data. Effective visualization has essentially become a requirement within the collaborative scientific community due to the overwhelming need to enable other scientists to understand and interpret unfamiliar data sets without actual having to interact with the data itself. Creating better communication for collaborating scientists often focuses on three major parts; enhancing visualization rendering, creating stronger perception cues, and developing a better web-based interactive visualization system.

The research conducted was used in an effort to establish a simplistic communication system for collaborating scientists involved in the examination and visualization of research data produced by several of Purdue's nanotechnology-affiliated research groups. It was imperative that the data collected from the groups be unfamiliar and relatively difficult to interpret directly.

Three extremely varied groups interested in understanding how volume visualization could enhance their ability to analyze and portray their scientific data were contacted and used to support this research. The Computational Electronics Lab (CELAB) offered electrical engineering data representing the local density of states (LDOS) data for a double gate nano-scale MOSFET. The electronic tunneling behavior occurring within the device was examined visually with the aide of volume visualization and perceptive cues. The Biology Department also contributed to the research study. McGough Lab supplied volumetric data detailing the bonding of cofilin enzymes with actin filaments in order to identify the geometric structure of the bond. The Haptic capabilities of Advanced Visual System were also invoked to create a perceptive view of the bond configuration between the actin and cofilin. Lastly, the Catalysis & Materials group supplied data that allowed for the visualization of the electron potential distribution of a catalyst molecule.

The visual results taken from Purdue's nanotechnology-affiliated research groups were used to create a template for the proposed collaborative web-based visualization system. The main challenges now consist of developing methods to extract the same information shown using the commercial software packages, but through the use of an enhanced web-based visualization platform. The infrastructure for this system is based heavily on the implementation of the data management techniques proposed by Rhyne and the Feature Tracking and Event Detection techniques of Freek Reinders et al. These two implementations are the key to creating an effective web-based visualization service capable of producing visualizations of large multi-dimensional data sets that can be quickly and easily interpreted.

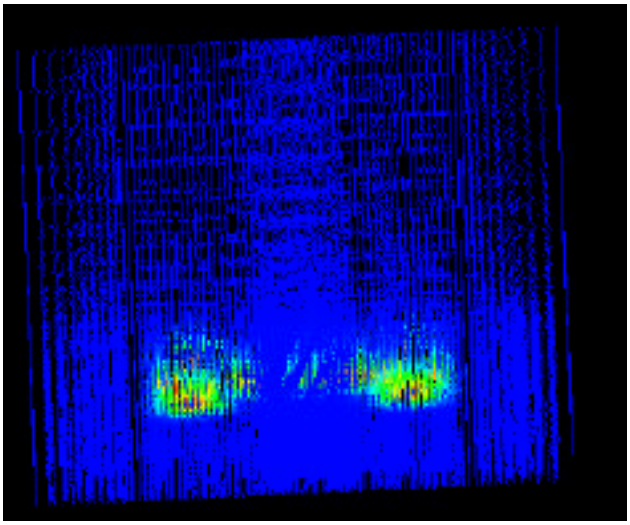
References:

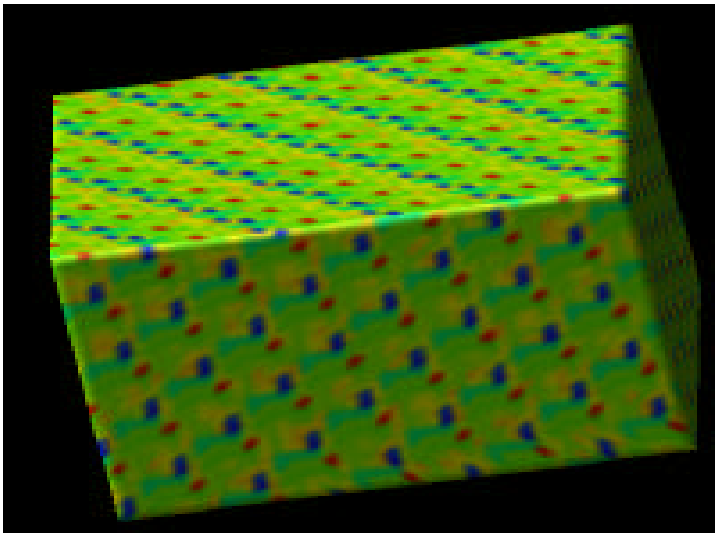
T.-M. Rhyne, "Two stepping information technology with visualization: a viewpoint from the u.s. epa scientific visualization center," *ACM SIGGRAPH Computer Graphics*, vol. 34, no. 1, pp. 45–47, 2000.

T.-M. Rhyne, "Scientific visualization in the next millennium," *IEEE Computer Graphics and Applications*, vol. 20, no. 1, pp. 20–21, 2000.

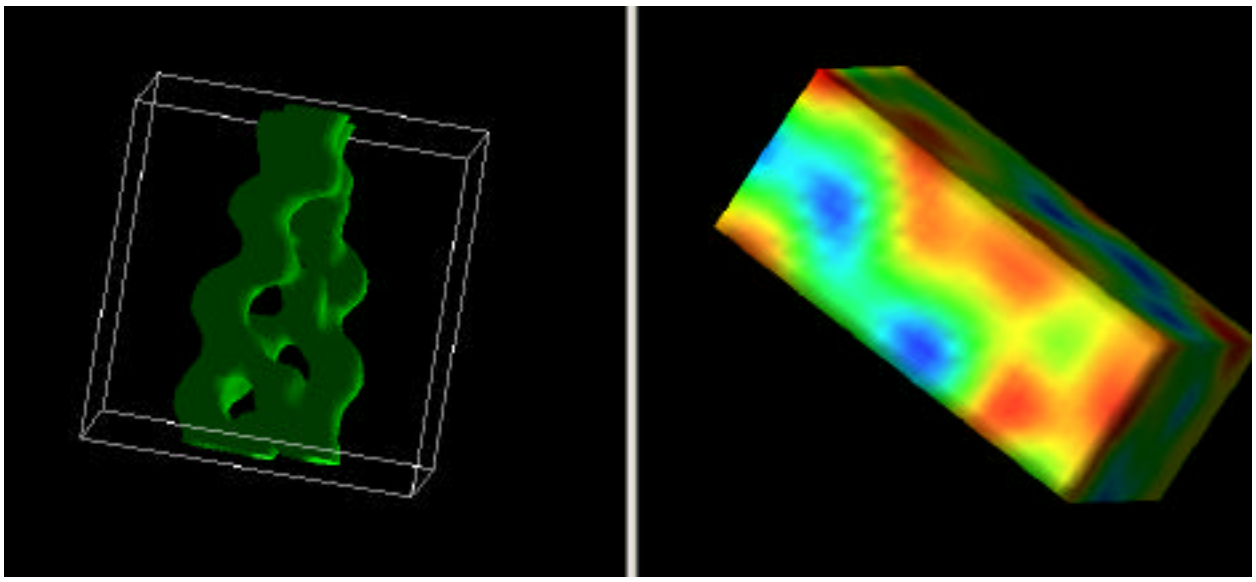
Freek Reinders et al. "Visulization of Time-Dependent Data using Feature Tracking and Even Detection," Visual Computer. Vol. 17 no. 1, p 55-71 2001.

Visualizations of the LDOS for a Double-Gate MOSFET





Visualization of the actin filament and cofilin bond



Visualization in Advanced Visual System