Rice researchers see the big picture: Visualization lab allows interaction with scientific data on 200-inch 3-D screen

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Erik Engquist, manager of the Chevron Visualization Lab at Rice University, shows the 200-inch display that will allow researchers to study data interactively in three dimensions. Credit: Jeff Fitlow

Rice University scientists and students have a new way to see the big picture. The NSF-funded DAVinCI visualization wall at Rice's Chevron Visualization Laboratory enables scientists to boost data into three dimensions to probe details in ways that were not possible until now.

The 200-inch wall (measured diagonally) lets users display and analyze images of all types, from atoms to galaxies. This studio is expected to help researchers in Earth science, biomedicine, engineering, art, architecture and other fields gain extraordinarily clear pictures of their data sets, be they bacteria or bridges.

"I can take my 3-D seismic images, project them here and walk around inside them," said Alan Levander, Rice's Carey Croneis Professor of Earth Science and principal investigator of the Data Analysis and Visualization Cyberinfrastructure (DAVinCI) project. "With a tracking device in my hand, I can go through and choose the features that I want to look at." The DAVinCI project adds to Rice's extensive supercomputing resources, which also include Blue Gene/P, among the 500 most powerful supercomputers in the United States.

The studio, in planning for several years with construction beginning last August, was made possible by an ARRA grant from the National Science Foundation, with additional support from Chevron, for DAVinCI, which includes a 25-teraFLOP computing cluster.

"Adding the visualization wall, which completes the DAVinCI project, gives us another way to help support our researchers prepare students for increasingly data-intensive industries," said Jan Odegard, executive director of Rice's Ken Kennedy Institute for Information Technology. "The ability to work with scientific visualization on this scale is a valuable skill, and we want our students to be fluent and capable."

The futuristic wall of 50-inch high-resolution projection monitors supports two- and three-dimensional visualization needs at extremely high resolution and clarity, Odegard said. Backed by custom graphics engines, the wall allows data to be displayed in three dimensions using modern active stereo shutter glasses, often seen in home 3-D TV systems but far more sophisticated than glasses used at a 3-D movie theater.

The shutters are linked wirelessly to the graphic engines so that, in effect, only one eye is open at a

time, and it matches the left or right images displayed on the screen. But this all happens very fast, at a frame rate of 120 times a second, so users see no flicker in their images.

Erik Engquist, manager of the lab who joined Rice last year, has been demonstrating the system with geological, molecular and other 3-D data that float in front of the screen and allow viewers to see details that might be invisible on flat images, no matter how big. The system has two other advantages over standard 3-D displays. The 32-megapixel screen can track researchers with an infrared system (also tied into the glasses) and allows them to walk around inside an image. Researchers can also interact with the data by turning them this way and that in midair to get a different perspective and interpret the data quantitatively.

"If you have a 10-dimensional data space - which is not uncommon - you can't visualize it in 10 dimensions, but you can visualize any three at a time," Levander said. "You can walk through complicated multidimensional space looking at what are called 'hypercubes.' You can interact with them and look for correlations in complex systems."

Engquist, an applied mathematician, said the 16 projection monitors were chosen for their display brilliance and their narrow borders that leave only a thin strip of black between individual screens. "It's far less intrusive than if we had used regular TV monitors, which have a large bezel," he said. "If the images have a black background, you barely see the lines; in fact, after a while you don't really notice them, since your focus will be on the data."

"Erik is probably the most important part of this investment," Odegard said. "I am excited about the fact that we have somebody who can not only build the wall and develop software but also understands how to work with users to prepare the data and develop the workflows that will permit them to focus on the research and not on the technology."

"The DAVinCI project is another example for how the partnership between the Ken Kennedy Institute for Information Technology and the Office of the Vice Provost for Information Technology is working with faculty to develop and support research cyber-infrastructure at Rice," Levander said.

The visualization laboratory will be formally dedicated Sept. 5, but Odegard said it is currently available not just for Rice faculty, but also for researchers in the Texas Medical Center and Houston area. In the long term, he said, the big screen will serve as the hub of a system with spokes leading to other, smaller screens around campus on which researchers can prepare data for the studio. At the studio, they will be able to share images with as many as 25 students or colleagues wearing special glasses or even with other facilities whose participants are represented by on-screen avatars.

"Chevron is proud to continue its support of Rice through our University Partnership Program," said William Hunter, portfolio manager for university affairs at Chevron. "Our partnership with Rice is a key part of Chevron's efforts to hire top-quality students necessary to help us meet energy demands around the world. We believe that the new Chevron Visualization Lab will provide state-of-the-art training for Rice students in Earth science and other disciplines."

More information: www.rcsg.rice.edu/davinci/

Provided by Rice University