Changing the Face of Scientific Visualization and Collaboration

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Thomas A. DeFanti, director of visualization for the UC San Diego division of the California Institute for Telecommunications and Information Technology (Calit2), returned this week from an extended tour of universities in Australia and Singapore, where he presented a series of lectures and championed the latest in high-resolution, tiled display walls known as OptIPortables.

DeFanti is a pioneer in the field of 3D scientific visualization, and co-creator (with Daniel Sandin) of the original virtual-reality CAVE Automatic Virtual Environment (CAVE). The CAVE was developed at the University of Illinois at Chicago's Electronic Visualization Lab (EVL) and first unveiled to the public in 1992. At Calit2, DeFanti oversaw development and opening (in 2008) of a third-generation VR environment called the StarCAVE, and more recently invented the NexCAVE, a 3D system based on LCD displays rather than projection systems.

As virtual reality technologies have evolved, DeFanti's philosophies about their purpose and design have evolved as well. In a series of lectures during his Pacific Rim tour on "The Future of the CAVE," the research scientist presented his latest surprising contention: Scientists no longer want to depend on a dedicated VR room like the CAVE to enjoy the advantages of 3D virtual reality. "'Everything on wheels' is my new mantra," says DeFanti. "People don't want to go somewhere else to display their data. They want the display to come to them."

During his tour, DeFanti met with administrators, department chairs and university architects at Australia's Monash University in Melbourne (which funded the trip) and the University of Queensland in Brisbane, as well as Singapore's Nanyang Technological University. In his lectures, he made the case for LCD panels as the best technology for two-dimensional and 3D collaboration spaces, rather than fixed projectors or head-mounted displays. Among their merits (and in contrast with projectors), LCD panels don't require calibration or provision of space to accommodate rear projection, and they are so bright that they can be used in full ambient light.

"I'm making the argument for a new way of thinking about displays as 'collaboration supplies.' Like other supplies, they are consumed over time and must continually be renewed," explains DeFanti. "In business terminology, it shifts the budget from capex [capital expenditures] to opex [operating expenditures]."

Adds Calit2 director Larry Smarr: "University administrators need to change their mentality about display walls, which they typically consider to be 'fixed equipment' - something they buy once and try to maintain, but never replace. It's now cheaper to replace this kind of technology than it is to maintain it, since newer technologies tend to be more energy efficient."

The Smarr/DeFanti technological tag team has deep roots - they have worked together for 26 years, including 15 years in Illinois. Smarr was the most important early backer of the CAVE in 1991 as founding director of the National Center for Supercomputing Applications (NCSA), and he commissioned EVL to design the first production CAVE for NCSA shortly thereafter.

Smarr also led the NSF-funded OptIPuter project that first developed the OptIPortal technology. OptIPortals, which are wall-sized visualization facilities with resolutions 10 to 100 times that of a normal PC, permit simultaneous videoconferencing and visualization of very large data sets.

Like the OptIPortal, the OptIPortable derives its name from optical networking and its use of Internet Protocol (IP) - but the twist is its portability. The low-cost, networked displays allow researchers to collaborate remotely using HD video streams from anywhere in the world, and were designed by Calit2's Greg Dawe to be so compact that they can be transported in the back of a standard pick-up truck.

Explains DeFanti: "The purpose of my visit was to validate the OptIPortable approach among practitioners who not only want the latest and greatest in display technologies, but who also need to justify making these purchases as a reasonable cost of operations at an institutional level."

The basic OptIPortable consists of four 46"-diagonal, one-megapixel screens, accompanied by a separate 60" HDTV screen for videoconferencing. Users push content from devices they deeply understand, like their own laptops, tablets, or smart phones. Freehand drawing on the big display is easily enabled by adding a tablet device to the collaboration environment. Additional four-panel modules can be wheeled in easily to double or triple the OptIPortable's display "real estate." The OptIPortables use collaboration software and user interfaces supported by Calit2 (CGLX and CalVR) and EVL (SAGE).

When the OptIPortable is not in use or needs to be re-located, it folds up and fits inside a wheeled, foam-lined road case (ordered from a company that builds similar cases for touring rock musicians). The units are small enough to fit through any standard doorway and can be loaded (with the help of some strong people, a lift or a loading dock) onto the back of any pick-up truck. Preparing them for redeployment takes only a matter of minutes.

The basic OptIPortable four-LCD modules currently cost about $50,000 each, with one-third of that cost relegated to the LifeSize videoconferencing component (which could be replaced by the free but lower-quality Skype). DeFanti estimates that within a few years, the cost for building the OptIPortables will drop to about $10,000, as the price of computers and commercial signage displays continues to fall. Since the arrays are modular, they can be lined up and even stacked to create as large a wall of displays as desired.

Among his other recommendations, DeFanti advocated that Monash University adopt the OptiPortable technology as part of its new $89.9 million science and engineering research facility, known as New Horizons. The facility will focus on computational and physical modeling of manufactured products and services in the fields of bio-medicine, aerospace and renewable energy. DeFanti sees the high-resolution, whiteboard-sized OptIPortable as the perfect interface for enhancing visualization and collaboration.

"Australia has been aggressive in providing advanced networking to universities, through AARnet, and communities, through the National Broadband Network," said DeFanti, who is also funded through an International Research Network Connections grant from the National Science Foundation's (NSF) Office of Cyberinfrastructure to nurture international collaborations for science, engineering, and education that rely on high-performance networking.

Calit2 has a longstanding relationship with Australia (and Monash in particular) through several research initiatives, including the Pacific Rim Experiences for Undergraduates (PRIME) program and the Monash Undergraduate Research Projects Abroad (MURPA) program. The initiatives provide both Monash and UCSD undergraduates an opportunity to work abroad pursuing eight weeks of scientific research. To facilitate this exchange, Monash and UCSD communicate through high-definition videoconferencing at Calit2's Atkinson Hall, which enables transformative experiences for students and faculty that would not otherwise have been possible. The relationship earned the institutions the High Performance Networking Applications award from the Corporation for Education Network Initiatives in California (CENIC) this year.

Monash and the UCSD division of Calit2 are also original collaborators on the Pacific Rim Application and Grid Middleware Assembly (PRAGMA) project. PRAGMA is a group of leading Pacific Rim research organizations collaborating on advancing grid technology applications. The majority of the PRIME host institutions are members of PRAGMA.

Monash was also a destination in 2008 when Calit2 Director Larry Smarr embarked on the three-week speaking tour as the Australian American Dialogue Scholar, supported by the Australian American Leadership Dialogue (AALD) and AARNet. Smarr spoke at Monash, the University of Melbourne and seven other universities on "Coupling Australia's Researchers to the Global Innovation Economy."

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