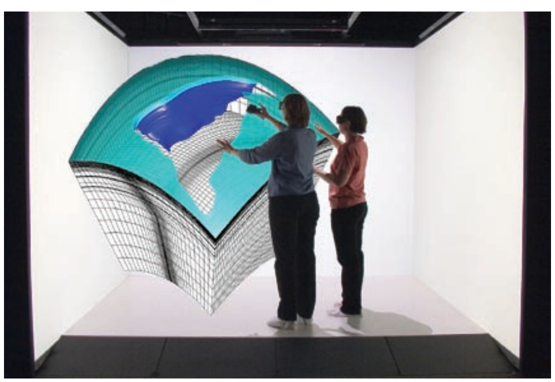
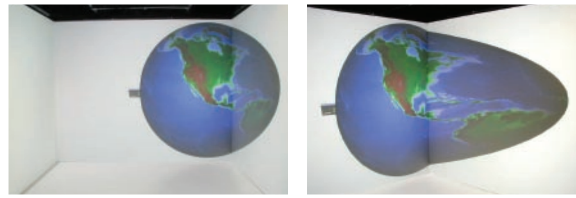
The KeckCAVES houses a four-sided FakeSpace CAVE, an immersive visualization environment consisting of three 10' x 8' walls and a 10' x 8' floor. Stereoscopic images are projected onto all four surfaces using one 3-chip DLP projector (Christie Mirage S+4K) each. The images are generated in such a way that a user perceives a seamless three-dimensional environment that can be explored by manipulating data within the 10' x 10' x 8' CAVE. A wireless 3D position tracking system (Intersense IS-900) synchronizes the 3D display with the position and orientation of a user's head and allows him or her to interact with the virtual environment in an intuitive and efficient fashion using a position-tracked handheld "wand" with six buttons and a joystick, data gloves, and other devices.



The CAVE is driven by a cluster of 6 high-end graphics workstations running Red Hat Linux and a custom virtual reality operating system called VRUI. A "head node" with two AMD Opteron CPUs at 2.2 GHz and 4GB of main memory controls the system, while the images for the projection are generated by four "render nodes," each with an AMD Athlon 64 CPU at 2.2 GHz, 2GB of main memory, and an Nvidia Quadro FX 4400G 3D graphics card.



Model of Earth. *Left:* The model appears virtually seamless even though it spans two of the CAVE walls. Photo was taken from the proper viewing position to ensure seamless projection onto any CAVE screen. *Right:* The exact same display photographed from a different viewpoint. Note how both halves of the image appear distorted. This photo shows why head tracking, and proper calculation of the screen projections, are essential for using stereoscopic display systems, such as CAVEs, effectively.

An additional "audio node" generates spatial sound using four speakers mounted at the corners of the CAVE enclosure. The cluster nodes are connected using Gigabit Ethernet, and the entire system is connected to the high-performance computing systems offered by the Center for Computational Science and Engineering (CSE) and the Institute for Data Analysis and Visualization (IDAV) with an Internet2 link.

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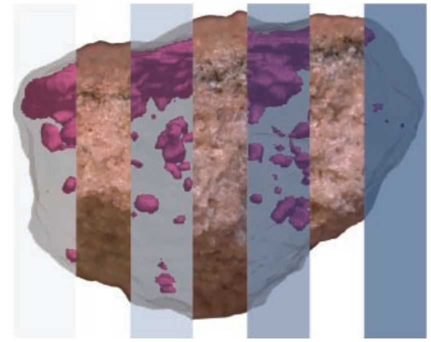

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The KeckCAVES advances understanding of the Earth by providing an environment for interdisciplinary collaboration founded in visualization of complex scientific data.

www.keckcaves.org

UC DAVIS

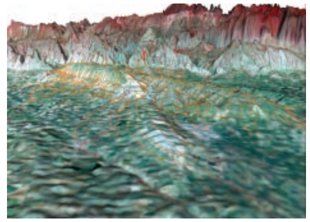
KECKCAVES

W.M. Keck Center for Active Visualization in the Earth Sciences

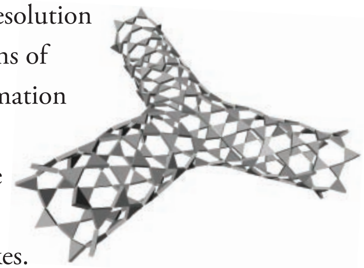
The KeckCAVES collaboration creates an intellectual and computational framework for the exploration, manipulation, and creation of 3-D datasets and models. Our focus is on developing and using tools for scientific research that cannot be accomplished using other techniques.

KeckCAVES at UC Davis

Earth science datasets have grown in size and complexity to the extent that new ways of understanding and interpretation are necessary to make significant scientific advances. The human brain excels at visually identifying patterns in large, complex datasets; and advanced visualization technology allows scientists to use their full visual capacity reasoning and interpretive abilities to identify previously unrecognized processes and interactions in complex systems. Interactive immersion in a visualization cave takes maximum advantage of the visual computational ability of the human brain to interpret data.



At the KeckCAVES, we are developing methods of interactive visualization, using immersive virtual reality (VR) environments to interact with models of Earth's surface and interior. Virtual mapping tools allow virtual "field studies" in regions that are inaccessible to human geologists. Interactive tools allow us to manipulate shapes, while feature extraction tools support quantitative measurement of structures that emerge from numerical simulation. Visualizing stress and strain in high-resolution computer simulations of elastic-plastic deformation improves our interpretation of the dynamical processes that drive earthquakes.



Reaping the full intellectual benefits of immersive VR requires us to tailor our approach to scientific problems that build on the visualization method's strengths, including both 3D perception and interaction with data and models, to take advantage of the skills and training of the geological scientists exploring their data in the VR environment. In doing so, we are developing a suite of tools that are adaptable to a range of problems.

Images (top to bottom): Locations of faults and folds precisely mapped directly onto the virtual topographic surface; three stretches of six-circumference carbon nanotube connected by a T-junction; Dimetrodon skull.

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