SDSC, UCSD Researchers Develop New Way to Visualize Vector Data

'GlyphSea' Helps Determine Direction and Intensity of Movements at Macro, Micro Levels

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Researchers at the San Diego Supercomputer Center (SDSC) and other organizations within the University of California, San Diego, have developed a novel way to encode and display vector data that clearly shows magnitude and direction. This new visualization technique may help seismologists to accurately analyze ground movements for an earthquake, measure magnetic turbulence in deep space, or allow medical researchers to study areas such as blood flow and nutrient absorption.

Called *GlyphSea*, the project's name refers to the use of glyph shapes, such as ellipsoids or spheres, which are marked at each end to allow observers to easily identify both the direction and intensity of the movement. To illustrate the project, SDSC researcher Amit Chourasia and his team at UC San Diego created a narrated video of movements and earthquake visualizations using these glyphs, which have a white dot on the end of the glyphs moving towards the observer's field of view, and a black dot on those moving away.

The visualization project was recently awarded as part of a four-way tie for second place in the International Science & Engineering Visualization Challenge, a collaboration between the National Science Foundation (NSF) and the journal *Science*. Awardees in the latest challenge can be found here.

"By varying size and color to show magnitude, *GlyphSea* can display any kind of motion intuitively, from a major earthquake on the San Andreas fault to magnetic turbulence in stars millions of light years from Earth," said Chourasia, whose team included SDSC graduate research assistant Emmett McQuinn; Jean-Bernard Minster, professor of geophysics with UCSD's Scripps Institution of Oceanography; and Jurgen Schulze, an assistant research scientist with the California Institute for Telecommunications and Information Technology (Calit2) at UCSD.

"The strength of this method is that it is not only simple, but very intuitive." said Chourasia, in noting that the application could potentially be used across a wide range of science domains. "*GlyphSea* could also be used to render visualizations to display the magnitude and direction of movement within the human body, such as blood flow. That's because one of *GlyphSea's* key benefits is that it can be used to show features at both the macroscopic and microscopic level. Moreover, the application is interactive, where various parameters could be customized and changes could be viewed in real time."

Referring specifically to the to seisomological visual rendering created by the research team, SIO's Minster said that *GyphSea's* technique of encoding and displaying orientation information of vector data by using procedural dipole texturing is what makes this application so unique.

"This allows seismologists to study the ground motion dynamics at a level of detail not seen before," said Minster. "We can clearly and easily identify P-waves and S-waves for ground motion using this new method."

P-waves or primary waves are longitudinal or compressional waves and can travel through gases, liquids, and solids. S-waves or secondary waves are transverse or shear waves, but slower than a P-wave, and can move through solids but not through gases or liquids.

Additional credits for the *GlyphSea* **visualization include** Kim Olsen, Steve Day, Geoffrey Ely, and Thomas Jordan of the Southern California Earthquake Center (SCEC). Data Credits include Point Source Simulation by Geoffrey Ely and Emmett Mcquinn; TeraShake Simulation by Kim Olsen and Yifeng Cui (SDSC) et al., SCEC MHD simulation by Alexei Kritsuk and Mike Norman (SDSC), and Sergey Ustyugov (*Keldysh* Institute of Applied Mathematics, Russia).

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About SDSC As an organized research unit of UC San Diego, SDSC is a national leader in creating and providing cyberinfrastructure for data-intensive research, and celebrated its 25th anniversary in late 2010 as one of the National Science Foundation's first supercomputer centers. Cyberinfrastructure refers to an accessible and integrated network of computer-based resources and expertise, focused on accelerating scientific inquiry and discovery. SDSC is a founding member of TeraGrid, the nation's largest open-access scientific discovery infrastructure.

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