The AlloSphere offers an interactive experience of nano-sized worlds

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As part of the Multimodal Representation of Quantum Mechanics: The Hydrogren Atom project, this image shows the hydrogen atom with spin, representing an orbital mixture of two probability waves. Credit: Professor JoAnn-Kuchera Morin, Media Arts and Technology, UCSB, Professor Luca Peliti University of Naples Italy, Lance Putnam. Media Arts and Technology, UCSB

What would it be like to dive into the veins and arteries of the human body or weave through the layers of the brain? With the AlloSphere, a 33-foot diameter sphere built inside of a three-story echo-free cube, these feats are now possible.

The AlloSphere is one of the largest immersive scientific instruments in the world. It takes scientific data that is too small to see and hear and

visually and sonically magnifies it to a human scale so researchers can better analyze the data and find new patterns. Over twenty researchers can stand in the center of the sphere and be collectively immersed in multi-dimensional information.

"Think of the instrument as a large dynamically varying digital microscope connected to a computer cluster that can function as an interactive brain," said JoAnn Kuchera-Morin, Director of AlloSphere Research Laboratory and professor at the University of California, Santa Barbara.

The NSF-funded AlloSphere is located at the California NanoSystems Institute (CNSI) building at the University of California, Santa Barbara. The AlloSphere infrastructure was completed in March 2007 and it is a key part of the Digital Media Center located within the CNSI. The CNSI was established in 2000 as one of the California Institutes of Science and Innovation.

"The goal of the AlloSphere instrument and research group is to conduct research in interactive visualization and multimodal representation of complex scientific data, while working closely with researchers in data interpretation and finding new patterns in the information," said Kuchera-Morin.

Applications for the AlloSphere include audiovisual technologies, abstract arts and art entertainment, "green" technology, computers and networking, education, nanotechnology, physics, materials science, geography and remote sensing, human perception, behavior and cognition, medicine and telemedicine.

The AlloSphere demonstrates how audiovisual technology is transforming research. It also proves the extent that media art is

intertwined with science--and how media art can play a large role in scientific discovery and observation.

"Not only are we moving science forward through visualization and sonification of complex information, but we are also making compelling new art works that are scientifically correct," said Kuchera-Morin.

Kuchera-Morin suggested that art fits into science, technology, engineering and mathematics (STEM) initiatives, in a way that involves just as much complexity and creativity as these other fields.

"As media artists we are ... really helping to define the arts on an equal and integrated footing with STEM--not just using arts as design, but rediscovering it as a complex mathematics that will take visualization to a new level," said Kuchera-Morin.

The AlloSphere has implications for the art community, but also the education community, including K-12, undergraduate and graduate levels, as well as the general public.

Additional AlloSphere projects include: Multimodal Representation of Quantum Mechanics: The Hydrogren Atom, Artistic Patterning and Structural Growth New Atomic Bonding: Multi-Center Hydrogen Bond, AlloBrain and Artificial Nature. To learn more about these projects, visit The AlloSphere Research Facility website.

A Look into an AlloSphere: "Center for Nanomedicine Project"

In the "Center for Nanomedicine Project," Jamey Marth and the UCSB/Sanford-Burnham Center for Nanomedicine are using AlloSphere to develop an anatomically correct 3-D model of the human body in

which researchers can "fly" into the body to study its anatomy.

Kuchera-Morin and her team works with a team of researchers directed by Jamey Marth, biochemist and the Director of the Center for Nanomedicine. Their research explores how to deliver chemotherapy through nanoparticles that carry the medicine to tumors in the pancreas and liver, without harming healthy tissue.

Kuchera-Morin's team made a simulator out of MRI data from a real human body, mapping the geometries of the arteries, veins, pancreas and liver in the AlloSphere. The team created the simulation using their own language, or code, built from C++. The code is called "allocore," or "the core of the software that we use in the AlloSphere as well as on other computer platforms," said Kuchera-Morin. The code contains "math libraries," which store the data from the MRI measurements. Using the code, the team can map, color and provide "texture" to the organs in the simulation.

"We are in the process of building our fluid dynamics simulation to get the precise blood flow down the arteries and veins. Then we will get the nano particle geometries from our materials scientists and build a particle simulator so they will be able to run various tests virtually," said Kuchera-Morin.

The team plans to have the fluid dynamics developed within the next year. According to Kuchera-Morin, this will allow researchers to watch how different shaped particles react in the arteries. Researchers can use this information to conduct tests in their labs and develop research processes that use the information from the simulations in their experiments.

"The future goals are to build out the instrument to an intelligent reactive device making technology transparent to our every day experience, thus

integrating information technology naturally into our various research platforms," said Kuchera-Morin.

For instance, different devices are being used as interfaces to AlloSphere, such as wireless controllers, iPhones, iPads and cameras. Also, the team is developing mobile platforms so that scientists can connect remotely to the AlloSphere (from laptops, iPads, etc.).

"If we can make this general computational framework that will allow us to represent complex mathematical information across fields visually and sonically--using all of our senses while integrating information technology into our everyday work experiences--this will transform research, education and society as a whole," said Kuchera-Morin.

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