New 3-D display gives researchers an unusual imaging tool

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No, the group of people wearing 3-D glasses who are captivated by a moving image on the big screen are not watching a special showing of "Avatar."

Amy Rosenzweig, professor of molecular biosciences and of chemistry, and her research team are studying an important biological catalyst in the lobby of Northwestern University's Center for Advanced Molecular Imaging (CAMI).

CAMI, the state-of-the-art imaging facility that opened last year, brings all biological molecular imaging at Northwestern under one roof, in the east wing of the Richard and Barbara Silverman Hall for Molecular Therapeutics and Diagnostics.

Twenty-five 46-inch flat-screen televisions, stacked five by five on a lobby wall, operate as one, displaying 3-D images of everything from an atom up to a full animal. The wall offers viewers almost 52 million pixels of digital canvas. (A digital IMAX theatre typically offers about 8 million pixels). A ring of seating can be created around the display to provide an intimate classroom environment.

There are only about a half dozen comprehensive imaging centers like CAMI in North America, and CAMI's 3-D display provides a classroom unlike any other in the world.

To Rosenzweig and her students, the image of much-larger-than-life twirling ribbons of various colors and purple balls – the biological catalyst – is every bit as fascinating as “Avatar.”

“We were so excited that my lab ran right down to see our crystal structure in 3-D,” says Rosenzweig of CAMI’s new Tiled Stereoscopic Display. “We were blown away.”

She and her research team have been using the new advanced scientific visualization tool to study the chemistry of particulate methane monooxygenase. “This is the enzyme bacteria use to oxidize methane gas to methanol so it’s of great interest,” Rosenzweig says. “The 3-D display lets us interrogate the entire structure on a whole new level.”

The 3-D display is the product of a multi-year partnership between Thomas J. Meade, who designed CAMI and is now its director, and Northwestern University Information Technology (NUIT). It is the public’s eye on the imaging of living organisms being done by researchers from across the University as well as a tool for the researchers themselves.

“We want to involve everyone with this display -- from undergraduates to senior postdoctoral fellows and faculty as well as the general Northwestern and Evanston communities,” says Meade. “By introducing surprise and discovery, we want people to wonder, ‘What is that?’”

Meade is the Eileen Foell Professor in Cancer Research in the Weinberg College of Arts and Sciences and the Feinberg School of Medicine. He has appointments in four Northwestern departments -- radiology, chemistry, neurobiology and physiology, and molecular biosciences -- and epitomizes the type of researcher working in Silverman Hall.

In Silverman, chemists, biologists and engineers are addressing

fundamental questions in biomedical research and working to develop new medicines and diagnostics, such as for cancer research and treatment. This requires biological imaging on many different levels -- that of atoms, cells, tissues, organs and whole animals -- and CAMI provides all of that in one place.

To determine the best way to design CAMI, Meade toured 11 imaging facilities around the world, learning their pros and cons and spending three or four days at each facility. He also noted and admired many large, two-dimensional tile displays used for scientific visualization and brought this idea back to Northwestern.

Meade then teamed up with Matt McCrory, lead visualization engineer in NUIT's Academic and Research Technologies and also now for CAMI, to design and build CAMI's tile display. Meade and McCrory decided to take a leap and build a 3-D display, tapping into McCrory's experience in production animation.

"The human mind is accustomed to seeing things in three dimensions," McCrory says. "This gives researchers a unique glimpse of the image with as many perspectives as possible. They can see the structure as it is. The brain doesn't have to work to extrapolate a 3-D figure from two dimensions."

The glasses worn by viewers make the colorful and detailed images pop from the screen. Researchers can visualize their data in real time while studying molecular, cellular and tissue structures and interactions. Using a synced iPad, they can manipulate the displayed image by pinching and rotating it and zooming in and out.

"We wanted to give users as much control as possible," says McCrory, who worked at DreamWorks Animation prior to Northwestern. "They can adjust the color and opacity with the iPad. They can change between

seeing the bone and seeing only the soft tissue."

The imaging modalities currently available at CAMI include high-field magnetic resonance imaging (MRI), whole body bioluminescence and fluorescence imaging, photon microscopy and scanning probe microscopy of live cells.

Positron emission tomography (PET), computed tomography (CT) and single photon emission computed tomography (SPECT) will be the next to arrive, Meade says. Eventually 13 different modalities will be available to researchers. Images produced by any of the modalities can be projected onto the 3-D tile display.

The 3-D display also can be used for visualization imaging of data not collected at CAMI, Meade stresses, like Rozenzweig's enzyme. All that's needed is a 3-D data set.

The imaging center is designed to be a two-way conduit between basic science and the clinic. "We are basic science driven, but we are intentionally wired to go translational quickly," Meade says. "This has been missing in the past."

In addition to Evanston campus researchers, clinicians and physician-scientists from the Feinberg School of Medicine can come to one imaging center for collaborations. (CAMI also is open to researchers from the Chicago area, not just Northwestern.)

CAMI is "married at the hip" with the Feinberg School, particularly the department of radiology, which houses the Center for Advanced Magnetic Resonance Imaging (CAMRI). Reed Omary, professor of radiology at Feinberg, is CAMRI's director.

"The translational component is crucial -- it is our goal to have the basic

science research translate as seamlessly as possible to the clinic," Meade says. "At present, there is no translational facility like this in the Midwest."

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