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Virtual trip visits pig's bloodstream

New UCI center to display animation in 'Fantastic Voyage' vein.

By GARY ROBBINS
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Joerg Meyer

IRVINE • Remember the old sci-fi movie "Fantastic Voyage"?

Hollywood miniaturized a medical team and put it in a tiny submarine, then injected it into a scientist's bloodstream so it could try to destroy a blood clot in the brain.

Joerg Meyer conjures up similar visuals, though not for cheap entertainment. The UC Irvine computer scientist creates virtual tours of the bloodstream and other biological pathways, giving physicians and medical researchers a sense of perspective they otherwise wouldn't have.

Meyer's latest creation: a virtual tour of a pig's blood vessel. The animation will be on display today when UCI opens its newest research center, the California Institute for Telecommunications and Information Technology, or CAL(IT)2.

We discussed the animation with Meyer while he was preparing to do more work in the center's Graphics, Visualization and Imaging Technology lab.

Q: Why did you create animation

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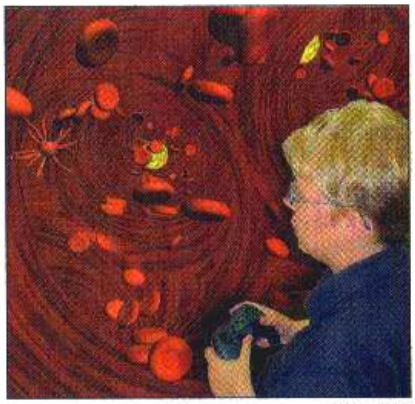
UC IRVINE

STRAIGHT FROM THE HEART: UC Irvine student Elke Moritz "flies" through a blood vessel. Creator Joerg Meyer says the virtual tour can have medical and educational uses.

MEYER

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of a blood vessel in a pig's heart?
A: Our hope is that this kind of animation will give us a better understanding of the underlying causes of coronary heart disease.

A pig's heart is as close as we can get anatomically to the heart of humans, and we can cast pig hearts more easily than we can do it with people. We also can create particles that move through the virtual bloodstream like red blood cells and platelets.

We use wireless game controllers to navigate through the blood vessels, past the cells and platelets. It's a way of flying through the model, like the submarine in "Fantastic Voyage."

Q: What do you learn from such virtual trips?
A: In our "fly-throughs," we are trying to identify topological structures that are more prone to accumulate plaques, such as sharp angles or narrow pathways that can become a bottleneck. There is a common belief that heart attacks usually arise from arteries being clogged up by atherosclerotic plaque.

Q: How do you "cast" a heart?
A: A cast of a pig's heart is made by extracting the heart from the body and replacing the blood with a contrast agent. The agent makes the blood vessels clearly visible in a CT scan. A scanner produces a sequence of cross-sectional images. Then we stack all the image slices (sometimes more than 100) to obtain a complete model of the heart. Once we have it in the computer, we can electronically remove the muscle tissue so that we can clearly see the vessels.

Q: What obstacles do you face with this technology?
A: The resolution of the images is still a problem. Our medical scanners are not good enough to show us the small capillary vessels. Therefore, we need to develop mathematical models to simulate them. Also, the enormous amount of data that we get from a single scan of a heart is still a challenge. Even with supercomputing facilities we are not able to process all data as fast as we would like. So we are developing smarter software strategies, such as hierarchical data storage and real-time data compression, to overcome these hurdles. The intelligence is not in the hardware, it is in the software.

Q: Many college students are obsessed with computer games. Can you learn anything from these games and apply it to your work?
A: Absolutely. The UCI research group has realized that the gaming industry is really one of the driving forces of the visualization community.

Affordable, commodity PC graphics cards have enabled us to do things now on a PC that we could only dream of two years ago, and that were not even possible on the latest supercomputers. For this reason, CAL(IT)2 has established a new Game Culture Lab. I am personally involved and very interested in the game culture because we want to disseminate the results of our research not only to other researchers, but, of course, we want the public to benefit from our work.

Imagine you turn the "Fantastic Voyage" into a game where high-school students can interactively navigate through a heart on their PCs in the classroom, and without knowing it, learn about the different types of blood cells that they encounter. One student could play the role of a white blood cell and form a strategy with others to attack an enemy – say, a virus. That is what we are currently working on. All we need to do is change the user interface and develop strategies to deliver our huge data sets in a reduced form over the Internet to a PC in the classroom.