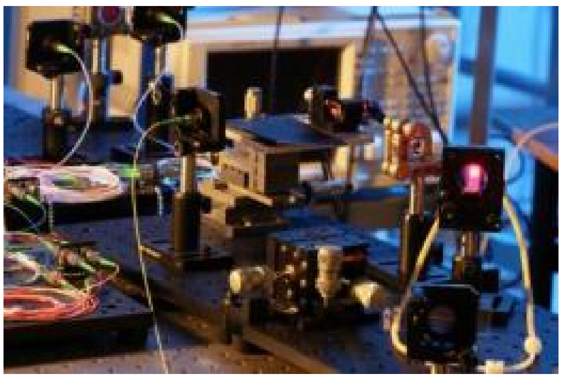
The embryonic heart: Imaging life as it happens

April 1 2010



Pictured is an interferometer used in the experimental system developed in Kirill Larin's lab, called Optical Coherence Tomography technique. Credit: Mark Lacy

Imagine being able to image life as it happens by capturing video of the embryonic heart before it begins beating. A professor at the University of Houston, in collaboration with scientists at Baylor College of Medicine, is doing just that.

Kirill Larin, assistant professor of biomedical engineering in the Cullen College of Engineering at UH, and his colleagues in the Texas Medical Center are documenting the formation of the mammalian heart through a high-resolution, non-invasive imaging device, providing perhaps the best live imagery taken of the vital organ.

"Everything we know about early development of the heart and formation of the vasculature system comes from in vitro studies of fixed tissue samples or studies of amphibian and fish embryos," Larin said. "With this technology, we are able to image life as it happens, see the heart beat in a mammal for the very first time."

Using optical-coherence tomography (OCT), a technique that relies on a depth-resolved analysis created by the reflection of an infrared laser beam off an object, Larin and his colleagues at Baylor College of Medicine's Dickinson Lab are using the technique to study what leads to cardiovascular abnormalities. Whereas ultrasound uses sound waves to create viewable, yet grainy, video images, OCT uses optical contrast and infrared broadband laser sources to help generate a real-time, high-resolution output.

"We are using OCT to image mouse and rat embryos, looking at video taken about seven days after conception, out of a 20-day typical mammalian pregnancy," Larin said. "This way, we are able to capture video of the embryonic heart before it begins beating, and a day later we can see the heart beginning to form in the shape of a tube and see whether or not the chambers are contracting. Then, we begin to see blood distribution and the heart rate."

Over the course of several years, Larin has been refining his laser-based spectroscopic imaging system to provide high-resolution images of protein biomarkers in blood samples and to study tissue samples to explore factors contributing to disease states. He has been working to adapt this technology to capture video of mammalian heart chambers, since they more closely relate to that of the human.

With funding from a $1.7 million grant from the National Institutes of Health, Larin plans to modify the device not only to improve the resolution but also speed the imaging process to further the study of developmental processes in animals with known heart abnormalities.

With these higher speeds and increased resolution, Larin says they will be able to observe the dynamics, what factors into the formation of the heart and what causes developmental problems. Ultimately, he and his collaborators aim to discover how different gene mutations affect cardiovascular development and reduce the number of babies born with abnormities, as well as shed light on how to prevent and treat heart-related problems before birth.

Provided by University of Houston