UNIVERSITY of HOUSTON | ENGINEERING

Department of Biomedical Engineering

Monday, May 17th, 2021

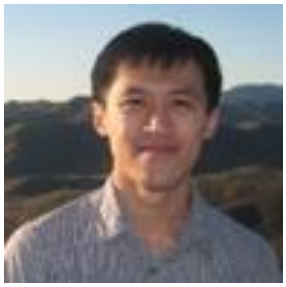
9:00 AM

Defense held online via Zoom

Richard Su

PhD Dissertation Defense

Dr. Alexander Oraevsky and Dr. Kirill Larin, Faculty Advisors



"Laser Optoacoustic Imaging System for Molecular and Functional Imaging Research in Small Animal Models"

Abstract

Optoacoustic tomography is an emerging field of medical imaging that is rapidly developing due to its unique capability to visualize and display molecular content of biological tissues with quantitative accuracy and excellent spatial resolution scalable with depth within live tissues. The main merit of optoacoustic tomography is in deep tissue imaging where resolution and contrast of pure optical imaging methods are limited by the strong optical scattering. The dominating tissue chromophores in the spectral range of laser wavelengths (650 nm to 1100 nm) that penetrate deep within tissues are hemoglobin and oxyhemoglobin of blood. Potential capability of functional optoacoustic tomography systems to measure concentrations of hemoglobin and oxyhemoglobin in humans provides for a variety of medical applications in the fields of diagnostics, therapeutic interventions and surgery. Using the methods of molecular imaging, it is also possible to visualize distribution of molecules that do not possess strong optical absorption in the near infrared spectral range, but can be targeted by special molecular and nano-particular contrast agents designed with strong optical absorption and high efficiency of acoustic wave emission through thermal expansion.

Despite great promises, the full potential of optoacoustic tomography in functional and molecular imaging has not been realized yet. In order to achieve capabilities of functional and molecular imaging, the optoacoustic tomography system has to overcome the tradeoff between high sensitivity of detection and ultrawide-bandwidth of ultrasonic frequency detection. Furthermore, quantitative imaging is only possible with knowledge of the optical fluence distribution through the entire volume of interest at each of the multiple wavelengths of spectral illumination. We took on a challenging task to develop such an advanced tomography system and enhance it with the methods of quantitative data analysis and image reconstruction. We designed and assembled a full view three-dimensional Laser Optoacoustic Imaging System (LOIS-3D) and demonstrated its capability of functional and molecular imaging in preclinical mouse models. The system technical specifications were characterized and its performance was demonstrated in specific molecular and functional imaging experiments performed in live mice.

Zoom ID: https://uofh.zoom.us/j/98707427144?pwd=V3VKNlN2Yy80a3FiMHlhRFI0cTBtZz09