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Multimodal optical coherence tomography and selective-plane illumination microscopy for embryonic imaging

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Abstract

Fluorescent selective-plane illumination microscopy (SPIM) can enable to provide cell information such as cell proliferation, cell type identification, and cell signaling while optical coherence tomography (OCT) can capture the complementary structural information. We developed very first multimodal high-resolution embryonic imaging system to combine the benefits of OCT with SPIM. SPIM allows high-resolution 3D imaging with low phototoxicity and photobleaching than laser scanning confocal microscopy which enhances more robust information from the targeted sample. The OCT and SPIM beams were coupled by using a beam splitter. Utilizing a galvanometer-mounted mirror and the same objective lens, the OCT probe and LSFM excitation beams were merged and scanned. The resulting light sheet thickness was ~13 μm and transverse resolution of SPIM was ~2.1 μm. With a lateral resolution of 15 μm and an axial resolution of 7 μm, the Michelson interferometer-based swept source OCT system provides structural information on the same plane as SPIM. The capabilities of the multimodal imaging system were demonstrated using images of fluorescent microbeads and a fluorescently tagged mouse embryo at gestational day 9.5. Due to the co-alignment of the OCT and SPIM systems, image registration was simple and allowed for high-throughput multimodal imaging without the use of sophisticated registration methods.

Biosketch

Md Mobarak Karim is a Ph.D. student and graduate research assistant at University of Houston as a member of Biomedical Optics Lab. He received his Bachelor's degree in Electrical and Electronic Engineering from International Islamic University Chittagong(IIUC) in Bangladesh and MS in Biomedical Science and Engineering from Gwangju Institute of Science and Technology(GIST) in South Korea. Recently he has been awarded Zuegel Family award for his performance at Siegman International Laser School-2022 in Poland. His research interests are in one-photon light-sheet microscopy, two-photon light-sheet microscopy, Optical coherence tomography, tissue optical properties method development and embryonic development.