3D Imaging and Optogenetic Pacing of *in Vitro* and *in Vivo* Model Systems

Chao Zhou, PhD
Professor
Department of Biomedical Engineering
McKelvey School of Engineering
Washington University in St. Louis

Abstract:
Optical coherence tomography (OCT) is a promising research tool for non-invasive imaging of biological tissues. OCT can be used to capture images of the beating Drosophila heart in vivo and 3D human heart organoids in vitro with micrometer resolution and video-rate imaging speed. Due to its non-invasiveness nature, OCT enables longitudinal, label-free imaging of the sample development over time. Optogenetics is a powerful tool that allows tissue specific control with light activation. The use of opsins has allowed investigators to incorporate light-sensitive control of select tissue in different model organisms. We developed transgenic Drosophila models with excitatory and inhibitory opsins (ChR2, ReaChR and NpHR, respectively) expressed in the heart and successfully stimulated tachycardia, bradycardia, and cardiac arrest through non-invasive cardiac control at the different developmental stages. The heartbeat of Drosophila can be precisely manipulated in real-time by modifying the frequency and pulse width of the excitation light. The combination of noninvasive OCT imaging and optogenetic pacing establishes a powerful research platform to study heart development in organoids and Drosophila models.

Biography:
Dr. Chao Zhou graduated from Peking University in China, obtained his Ph.D. degree from the University of Pennsylvania, and received post-doctoral training from the Massachusetts Institute of Technology. Before joining Washington University in St. Louis in 2019, he was an Associate Professor in Electrical Engineering and Bioengineering at Lehigh University. Dr. Zhou has extensive experience in biophotonics and contributed to the development and validation of novel imaging modalities for various applications ranging from measuring brain function to monitoring cancer treatments. He has published over 80 peer-reviewed journal articles and book chapters, which have been cited >7,000 times. Dr. Zhou is an Editorial Board Member of Communications Biology, an associate editor for Photonics Research, IEEE Photonics Journal and Medical Physics. He is a Fellow of American Heart Association (AHA) and a senior member of the International Society for Optical Engineering (SPIE), Optica (formerly OSA), Institute of Electrical and Electronics Engineers (IEEE). He is a recipient of numerous honors and awards, including the National Institute of Health (NIH) K99/R00 *Pathway to Independence Award (2011),* the *National Innovation Award* (2017) from TechConnect World Innovation Conference and National Innovation Summit, the *RPB Stein Innovation Award (2021) from the Research to Prevent Blindness Foundation, and the Innovative Research Award (2021) from the Clayco Foundation.*