Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Spring 2024 Seminar Series

Imaging Across the Scales: Development of Optical Imaging Techniques

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Woods Hole

Optical imaging is one of the core technologies used in biomedical sciences. Despite the wide range of imaging techniques available, there is no one universal imaging system suitable for all scales and types of biological samples. Also, development of new optical imaging systems that can bridge existing gaps between cellular and organismal imaging is vital. Confocal and light sheet microscopes are two popular modalities that are routinely used for imaging live and fixed samples at multiple spatial and temporal scales. For the first portion of this talk, we will discuss our group's efforts to advance these technologies for imaging large or rapidly growing samples at high spatial and temporal resolutions. Specifically, we will present our implementation of a confocal microscope for improving imaging speed by a few orders of magnitude for large samples. Additionally, we will present how microscope's performance can be quantified using nanofabricated structures and show some early efforts in this area. We will then show the use of this imaging technique, in collaboration with your colleagues, to answer important biological questions in systems ranging from living zebrafish embryos to whole cleared mammalian organs.

In the second half of my talk, we will discuss our efforts in developing a multimodal multiparametric system to enable us to use fluorescence for mapping spatial, spectral, orientation and lifetime of fluorescent molecules for biological applications. We will discuss the computational tools we are developing and using for these imaging modalities. We will conclude by sharing our lab's vision for the future and plan to integrate nanophotonics to augment imaging modalities.

ABOUT the SPEAKER

Abhishek Kumar is an MBL Investigator and Chan-Zuckerberg Initiative (CZI) Imaging Scientist at the Josephine Bay Paul Center for Comparative Molecular Biology and Evolution at the Marine Biological Laboratory. He is a physicist by training and his research interests are developing novel optical microscope systems and complimentary image analysis methods. He received his PhD in Physics from the University of Massachusetts Lowell and his MS in Physics from Indian Institute of Technology Kanpur, India. Kumar did his postdoctoral research as a joint fellow at the National Institutes of Health (NIH) and Yale University. Subsequently, he was Assistant Research Scientist at the University of Maryland College Park and a visiting fellow at the National Institute of Standards and Technology (NIST) before moving to the MBL in 2019. Kumar is leading the effort to establish the MBL's Imaging Initiative. Currently, his lab's focus is to harness computer vision with home built multi-view optical microscopes imaging across scales and enable biological discoveries. He is the recipient of the Chan-Zuckerberg Initiative (CZI) Imaging Scientist Award (2019), Arnold and Mabel Beckman Foundation Lightsheet Award (2020), Grass Fellowship (2015), University of Massachusetts Lowell Chancellor Medal (2012), American Physical Society Chemical Physics Graduate Fellowship (2011) and SPIE Graduate Student Fellowship (2011).

Monday, February 26 at Noon
1003 Engineering Centers (Tong Auditorium)