Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Spring 2024 Seminar Series

Chemical imaging: Artificial intelligence–powered label-free biomedical microscopy

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In biomedical sciences, stains and human examination of morphology are used to Inform many research and clinical decisions. An alternative is emerging in which the intrinsic chemical content of tissue is used to provide contrast in images. This approach utilizes infrared spectroscopy to record the chemical data and computational methods to visualize information within. This knowledge can be parsed by computer programs - making the approach entirely digital and with extensive contrast in a single imaging measurement. We first describe the current state of the technology and its capabilities. Using artificial intelligence for knowledge extraction, a very powerful modality emerges in which a single recording of data from unperturbed samples can be related to a variety of pathophysiologic states. For cancer pathology, both tumor and microenvironment characteristics (molecular and spatial) can measured at the same time. This opens new opportunities for insight into disease progression that considers the entire tissue as an integrated system. Designed instrumentation, numerical methods, samples and statistics all play inter-related roles in the quality of information obtained. We present case studies of rapid analysis of samples for cancer pathology, in which practical technologies that can be useful for clinical diagnoses and research are becoming apparent. We describe the synergy of measurement technology and machine learning to provide examples of better and easier disease diagnoses. Finally, we describe approaches for fast nanoscale IR imaging that may lead to complete chemical profiling of cells and tissues.

ABOUT the SPEAKER

Rohit Bhargava serves as Grainger Distinguished Chair in Engineering, Professor of Bioengineering, and the Director of the Cancer Center at the University of Illinois, Urbana-Champaign. Rohit is recognized for his contributions to the development of infrared chemical imaging with numerous advances in theory, instrumentation, and applications. Using artificial intelligence techniques, recent work in his laboratories focuses on clinical translation of the technology to enable “digital chemical histopathology” for better diagnoses and decision-making. Rohit graduated with a B.Tech. dual-degree from the Indian Institute of Technology, New Delhi (1996) and received a doctoral degree from Case Western Reserve University (2000). After postdoctoral research at the National Institutes of Health, he has been at Illinois as an Assistant (2005-2011), Associate (2011-2012) and Full Professor (2012-). Rohit has also served to connect the research community at the convergence of engineering and cancer. He was the first external hire in the University of Illinois Bioengineering department, a part of the founding committee of the Carle Illinois College of Medicine, and founded the Cancer Center at Illinois.

Monday, March 4 at Noon
1003 Engineering Centers (Tong Auditorium)