

2025-2026 Seminar Series



INFRARED SPECTROSCOPIC IMAGING: ENGINEERING A NEW TECHNOLOGY FOR PRACTICAL BIOMEDICAL USE



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Friday, February 27, 2026 | 11:00 a.m.

Gallogly Hall, Room 126



ABSTRACT

Infrared (IR) spectroscopy is ubiquitous in chemical analyses due to fundamental molecular vibrational absorption providing a quantitative, sensitive and reproducible fingerprint of a sample's composition. This ease of use and confidence in results is diametrically opposite to the complex processes used to diagnose cancer with desirable, but yet unattainable, precision. By developing IR spectroscopic imaging technology, our goal is to bridge the two worlds and enable universal cancer diagnoses by using the native chemical composition of tissue. Our approach relies on theoretical models of light propagation and sample interactions in an IR microscope that we devised to formulate design rules for optimal image quality. Using quantum cascade lasers as spectrally tunable sources, we report here new optics to realize theoretically limited performance in an optimized microscope. This system simultaneously allows ~micron-scale image quality and better spectral quality than common bulk spectrometers. Integrating artificial intelligence workflows, this integrated imaging system was translated to a clinic and is being tested for real-time cancer pathology. We present examples of use cases to show the potential of this emerging technology. Similar modeling and instrument developing ideas are now allowing us to explore the limits of IR imaging. Finally, we describe the development and performance of a nanoscale IR imaging instrument that promises practical imaging speeds and high spectral quality at tens of nm resolution.

BIO

Rohit Bhargava serves as a Professor of Bioengineering, Grainger Distinguished Chair in Engineering and the Phillip and Ann Sharp Director of the Cancer Center at Illinois at the University of Illinois Urbana-Champaign as well as Associate Director and Co-PI of the NSF STC on Quantitative Cell Biology. His contributions to theory, instrumentation and applications have helped develop the field of infrared chemical imaging since its inception. Current research focuses on the applications of chemical imaging to histopathology and to quantitative cell biology. Using a combination of advanced manufacturing techniques, novel imaging and artificial intelligence, another major direction in his laboratories is to advance production of designer tumor models. Rohit has also served to connect the research community in new directions. He was the first external hire in the UIUC Bioengineering department, developed the NIH T32-supported Microenvironment Training Program, and founded the Cancer Center at Illinois – a basic cancer center at the convergence of engineering and oncology. He is a leading national proponent of the emerging field of Cancer Engineering. Rohit holds a B.Tech. degree from the Indian Institute of Technology, New Delhi as well as a doctoral degree from Case Western Reserve University, Cleveland and conducted postdoctoral research at the National Institutes of Health, Bethesda, prior to joining the faculty at Illinois. He is a fellow of the National Academy of Inventors, American Association for the Advancement of Science and several disciplinary societies, including BMES, AIMBE, Optica, and SAS. His research has been recognized internationally, including by the Lippincott Award, SAS Gold Medal and Meggers Awards.