University of Rochester
Department of Electrical and Computer Engineering
Colloquia Series

Computational imaging for real-time Gigapixel and 3D wave-field imaging

Lei Tian

Monday, February 22nd
9:00AM – 10:00AM
CSB 209

Abstract: Computational imaging is a new frontier of imaging technology that overcomes fundamental limitations of conventional systems by jointly designing optics, devices, signal processing, and algorithms. In this talk, I will present recent advancements in computational wave-field imaging that enable Gigapixel and 3D phase imaging capability, breaking the limit of space-time-bandwidth product in traditional systems. In particular, I will describe a computational microscopy platform that implements coded illumination and nonlinear phase retrieval algorithms to reconstruct wide field-of-view and high-resolution phase images. Further, new illumination multiplexing techniques reduce data requirements by one order of magnitude, and acquisition times from minutes to sub-second. Experiments demonstrate quantitative dynamic imaging of rare events across multiple scales in both space and time. Finally, new 3D wave-optical model and reconstruction technique allow Gigavoxel reconstruction of 3D objects, achieving lateral resolution and depth sectioning well beyond the physical limit of traditional systems. Such computational imaging approach creates significant new capabilities by integrating hardware and computation at the system level. It promises wide applications, such as biomedicine, metrology, inspection, security and X-ray.

Bio: Lei Tian is a postdoctoral associate in the department of Electrical Engineering and Computer Sciences at University of California Berkeley. He received his Ph.D. in 2013 and M.S. in 2010, both from Massachusetts Institute of Technology (MIT). His research interests include computational imaging, computational-optical instrumentation, phase retrieval, imaging through 3D complex media, large-scale microscopy, and their applications in biomedicine, security, metrology, inspection, X-ray and EUV. Dr. Tian is the author of over 30 peer-reviewed articles and is a named inventor on 3 US patent applications. His recent work on coded illumination for Gigapixel imaging was awarded the Best Paper in Optical Society of America (OSA) Imaging Systems and Applications conference (2014). His work on optical coherence recovery using low-rank method was awarded the Emil Wolf Best Student Paper in OSA Frontier in Optics annual meeting (2011). Dr. Tian is currently serving as conference chair and program committee member in multiple conferences of OSA, SPIE, and IEEE.

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