

3305 Newell Simon Hall, Time: 3:00 – 4:00 p.m.
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Imaging without focusing: A computational approach to miniaturizing cameras

Abstract: Miniaturization of cameras is key to enabling new applications in areas such as connected devices, wearables, implantable medical devices, in vivo microscopy, and micro-robotics. Recently, lenses were identified as the main bottleneck in miniaturization of cameras. Standard smaller lens-system camera modules have a thickness of about 10 mm or higher, and reducing the size of lenses leads to a smaller aperture, inferior light collection, and noisier and worse resolution. In this talk, I will present our efforts in creating cameras with a compact form factor of 10x smaller thicknesses and weights. We achieve this by replacing the focusing lens optics with a thinner optical mask placed close to the imaging sensor and employing computational approaches to reconstruct quality images from coded, non-image like measurements. In essence, we are shifting the "focusing" operation of a lens to computation, hence breaking the size limits of traditional optics. I will discuss the design principles of the optical masks in terms of camera performance and the computational algorithms needed to recover images. I will show, with results, the applications of our camera in (1) high-resolution imaging, (2) refocusing, (3) 3D imaging, (4) microscopy, and how to extend the design for computer vision applications.

Bio: Vivek Boominathan is currently a Postdoctoral Researcher at Rice University. He is part of the Computational Imaging Group, the Scalable Health Lab, and the Neuroengineering Group at Rice University. His research is primarily in the fields of Computational Imaging and Machine Learning, where he designs both the optical systems and computational algorithms to improve vision performance while reducing the physical size of the devices. Mr. Boominathan received his Ph.D. in Summer 2019 and an M.S. degree in 2012, both from the Department of Electrical and Computer Engineering at Rice University. He obtained his B.Tech degree in Electrical Engineering from the Indian Institute of Technology, Hyderabad in 2012.

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