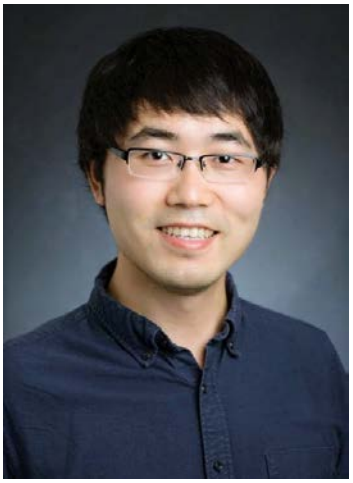
UCLA Engineering
HENRY SAMUELI SCHOOL OF
ENGINEERING AND APPLIED SCIENCE

BIOENGINEERING

PRESENTS

Developing Next Generation Multidimensional Optical Bioimaging Devices



THURSDAY, Jan. 31st, 2019
12:00 – 1:00 PM
2101 ENGINEERING V

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ABSTRACT:

When performing optical measurement with a limited photon budget, it is important to assure that each detected photon is as rich in information as possible. Conventional optical imaging systems generally tag light with just two characteristics (x, y), measuring its intensity in a 2D (x, y) lattice. However, this throws away much of the information content actually carried by a photon. This information can be written as (x, y, z, θ, φ, λ, t, ψ, χ): the spatial coordinates (x, y, z) are in 3D, the propagation polar angles (θ, φ) are in 2D, and the wavelength (λ), emission time (t), and polarization orientation and ellipticity angles (ψ, χ) are in 2D. Neglecting coherence effects, a photon thus carries with it nine tags. In order to explore this wealth of information, an imaging system should be able to characterize measured photons in 9D, rather than in 2D.

This presentation will provide an overview of the next generation of multidimensional optical bioimaging devices which leverage advances in computational optics, micro-fabrication, and detector technology. The resultant systems can simultaneously capture multiple photon tags in parallel, thereby maximizing the information content we can acquire from a single camera exposure. In particular, I will discuss our recent development of three game-changing technologies—a snapshot hyperspectral imager, image mapping spectrometry (IMS), an ultrafast imager, compressed ultrafast photography (CUP), and a snapshot volumetric imager, light field endoscopy (LFE)—and how these techniques can potentially revolutionize biomedical diagnosis and treatment.

BIOGRAPHY:

Dr. Liang Gao is currently an Assistant Professor of Electrical and Computer Engineering department at University of Illinois Urbana-Champaign. He is also affiliated with Beckman Institute for Advanced Science and Technology. His primary research interests encompass multidimensional optical imaging, including hyperspectral imaging and ultrafast imaging, photoacoustic tomography and microscopy, and cost-effective high-performance optics for diagnostics. Dr. Liang Gao is the author of more than 40 peer-reviewed publications in top-tier journals, such as *Nature*, *Science Advances*, *Physics Report,* and *Annual Review of Biomedical Engineering*. He received his BS degree in Physics from Tsinghua University in 2005 and Ph.D. degree in Applied Physics and Bioengineering from Rice University in 2011. Dr. Liang Gao is a recipient of NSF CAREER award in 2017 and NIH MIRA award for Early-Stage Investigators in 2018.