USC Viterbi School of Engineering
Ming Hsieh Department of Electrical and Computer Engineering

Seminar

Implantable CMOS Optoelectronics for Bidirectional Neural Interfacing

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Date: Monday, March 27, 2023
Time: 2:00pm
Location: EEB 248

Abstract: Optical neurotechnologies use light to interface with neurons and overcome the limitations associated with penetrating electrodes and glial scarring in electrophysiology. Miniaturized microscopes monitor and manipulate neural activity with high spatial-temporal precision over large cortical extents; however, current implementations still require a chronic opening in the dura and skull that matches or exceeds the field-of-view of the implant. Viable translation of these technologies to human clinical use will require a much more noninvasive, fully implantable form factor. In my talk, I will introduce the first subdural CMOS optical probe (SCOPe) for bidirectional optical stimulation and recording in mouse and nonhuman primates. This radical improvement in implantability is achieved through the design of a CMOS ASIC consisting of monolithically integrated SPADs for low-light-intensity imaging and dual color flip-chip bonded micro-LEDs for light emission. Along with a fully flexible electronic packaging, I will present the heterogeneous integration of the light sources, filters, and lens-less computational imaging masks required for a high-performance optical neural interface. This transformative, ultrathin, miniaturized device was validated in a sequence of *in vivo* mouse and nonhuman primate experiments and defines a path for the eventual human translation of a new generation of brain-machine interfaces based on light.

Biography: Eric H. Pollmann received the Ph.D. degree in 2023 advised by Kenneth Shepard in the Department of Electrical Engineering at Columbia University. Previously, he received the B.S. degree in Electrical Engineering from the Georgia Institute of Technology in 2017, and the M.S. degree in Electrical Engineering from Columbia University in 2018. His research lies at the intersection of integrated circuit and system design, applied optics, and neurotechnology and has resulted in multiple publications in top-tier IEEE conferences and journals. In addition to research work, he was the recipient of the 2021 IEEE CASS Predoctoral Fellowship.