Solid State Technology and Devices Seminar

Computational Optics for Control and Readout of Neural Activity

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Abstract: Nearly all aspects of cognition and behavior require the coordinated action of multiple brain regions that are spread out over a large 3D volume. To understand the long- distance communication between these brain regions, we need optical techniques that can simultaneously monitor and control tens of thousands of individual neurons at cellular resolution and kilohertz speed. To meet the challenge of high throughput in both space and time, I developed 3D multi-site photo-stimulation technology for parallel optogenetic control and holographic two-photon microscopy with volumetric detection technology for 3D imaging of neural activity. To image through scattering brain tissues, I developed two-photon microscopy combined with image processing algorithms to achieve high-throughput and high signal-to-noise ratio imaging in vivo in the mouse brain. I also focus on decoding both fluorescence and non-fluorescence information that is scrambled by scattering using computational optics. These techniques will open new avenues in basic neuroscience and could form the basis for powerful neuroprosthetic devices to treat mental disease and motor dysfunction.

Bio: Yi Xue is a postdoctoral scholar at UC Berkeley with Prof. Laura Waller in EECS, collaborating closely with Prof. Hillel Adesnik in Molecular and Cell Biology. Yi Xue received her Ph.D. and S.M. in Mechanical Engineering at MIT, advised by Prof. Peter So and closely collaborated with Prof. Elly Nedivi and Prof. Ed Boyden in Brain and Cognitive Sciences. Her research interest, computational optics, exploits the synergies between state-of-the-art computational algorithms and optical instruments to improve imaging throughput, resolution, and signal-to-noise ratio for biological applications. Yi Xue received the JenLab Young Investigator Award and many other awards for her research on computational optical microscopy for biomedical imaging.