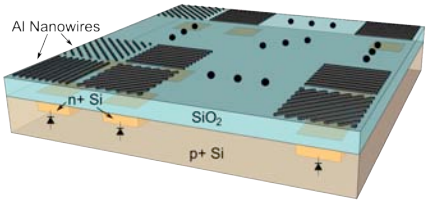
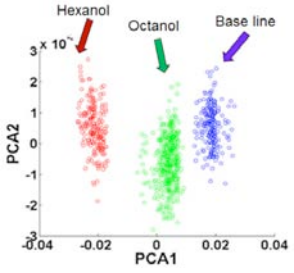
Neuroengineering Seminar

Spectral Polarization Focal-Plane Sensing for Functional Neural Imaging





Viktor Gruev

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Monday, March 11, 2013
4:00-5:00pm
Fung Auditorium, Powell-Focht Bioengineering Building
University of California San Diego

Recording neural activity using light has opened up unprecedented possibilities in the quest of understanding functionality of the nervous system. Light offers great advantages over electrophysiology such as: incredible spatial resolution, which is limited by the diffraction of light, contact-less probing capabilities, which avoids physical damage and interference with neural activity during recording, and simultaneous recording from large ensemble of neurons. However, in order to record an optical signal from a neuron, the electrical signal must be converted into an optical signal via a molecular reporter. The use of a reporter to translate the language of the neurons from electrons to photons currently has two major limitations: photobleaching and photodamage.

In order to address the above limitations of the current state-of-the-art optical neural recording devices, we have develop a novel imaging technique which avoids the use of molecular reporters and relies on the neuron's intrinsic changes during an action potential. The main premise for our work is the following: light reflected from the surface of a neuron is partially linearly polarized and the degree of linear polarization is a function of neural activity. In order to capture this neural activity, we have developed polarization sensitive imaging sensor with high spatial and temporal resolution. In this talk, I will describe the key components of our imaging system, such as nanofabrication of sub-wavelength metallic nanostructures acting as linear polarization filters and monolithic integration of nanostructures with imaging arrays; image processing algorithms tailored for this new class of sensors and validation of this imaging technique via in-vivo recording of neural activity from the antenna lobe of a locust.

Biography: Viktor Gruev received his B.S. in electrical engineering with distinction from Southern Illinois University in 1997. He completed his M.S. and PhD. in electrical engineering from Johns Hopkins University in 2000 and 2004 respectively. Dr. Gruev was a postdoctoral researcher at the University of Pennsylvania before he joined the Computer Science and Engineering faculty at Washington University in St. Louis in 2008. His current research interests are in: polarization imaging and integrating nano-fabrication techniques with CMOS technology, camera-on-a-chip, polarization image sensors, mixed signal VLSI systems, 3-D image sensors, VLSI systems for adaptive optics and computer vision.

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