

SEMINAR NOTICE

Department of Electrical and Systems Engineering

EXPERIMENTAL AND COMPUTATIONAL IMAGING APPLICATIONS: SPECTRAL IMAGING FOR BRAIN FUNCTION, AND MICROMAGNETICS

by

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Neural activity in the mammalian brain can be observed and mapped indirectly by measuring related changes in blood flow and oxygenation. Such hemodynamic-based "neuroimaging" is now widely performed non-invasively in humans using magnetic resonance imaging and positron emission tomography. If the brain is exposed, neuroimaging with much higher temporal and spatial resolution can be performed optically with video recording under visible light. This approach currently has limited use with humans, but it is frequently applied to characterize cortical activity in animals. The brain surface is typically illuminated with white light and imaged through an optical filter whose spectral profile is chosen to emphasize changes in red blood cell (RBC) oxygenation (red profile) or RBC volume (green profile). This work describes the design, characterization and testing of an instrument built to image the brains of anesthetized mice with greater spectral resolution. It consists of a fixed magnification "standard" imager, similar to the video microscopes used by other researchers, and a type of Fourier transform interferometer called the digital array scanning interferometer (DASI). Both the standard imager and the DASI view the sample through the same objective lens. Each device is coupled to its own CCD camera. A frame from the DASI camera provides a measurement of reflected light spectra from points along a narrow line on the sample. A stepping motor scans the sample perpendicular to this line to give the DASI access to both spatial dimensions. Illumination is provided by independently controlled, colored LED's (white, red and green). Custom programming synchronizes the DASI and standard imager cameras with the illumination and the stepping motor so that images with red and green illumination are interleaved with DASI data collected with white illumination. This permits direct comparison of the novel DASI approach with the video microscopy techniques typically found in the literature. The animal study conducted with this instrument involves imaging the response in anesthetized mice to whisker stimulation. Discrete groups of neurons within the mouse cortex called barrels are associated with individual whiskers. The hemodynamic response of these and surrounding regions to whisker stimulation is a convenient, reliable and well-studied phenomenon. Results from observations of the mouse brain are presented and the potential of the DASI as a neuroimaging tool is discussed.

DATE: Wednesday, July 2, 2008
TIME: 10:00 a.m.
PLACE: Bryan Hall, Room 305

Thesis advisor:
Joseph O'Sullivan

This seminar is in partial fulfillment
of the Doctor of Philosophy degree

 **Washington University in St. Louis**
SCHOOL OF ENGINEERING & APPLIED SCIENCE