

# PHOTONICS CENTER SEMINAR

Professor Joseph Culver, Washington University

*Mapping Brain Functions, Connections and Networks with Light*

*April 27, 2018*

*1-2 p.m.*

Room 206

*Photonics Center*

*8 Saint Mary's Street*

*Refreshments will be served!*



This talk will discuss optical techniques for imaging functional connectivity and networks in both humans and mouse models. Development of non-invasive neurophotonics for human's is motivated by the need to image patients at the bedside or with implants and cognitive neuroscience studies that require naturalistic open imaging environments (e.g. children). While optical imaging has long held promise, image quality has been lacking, particularly in comparison to the gold standard of functional magnetic resonance imaging (fMRI). New high-density diffuse optical tomography (HD-DOT) methods provide one strategy for improving image quality. This talk will discuss challenges in HD-DOT including the development of large field-of-view photonics instrumentation, imaging arrays, and anatomical light modeling. The implications of the new technology for mapping of higher-order, distributed brain function will be discussed along with explorations of HD-DOT in acute stroke patients and parkinson's patients with deep brain stimulators.

In animal models, a pressing interest amongst the fMRI community is development of a mouse equivalent measurement of functional connectivity so as to link human fMRI with mouse models of disease. We recently developed a method for functional connectivity mapping in mice using optical intrinsic signal imaging (fcOIS). Highly detailed mapping of functional networks is achieved across most of the cerebral cortex. Most recently we have been working to extend these methods to genetically encoded calcium indicators (GECI's) that provide a more direct measure of neural activity, with higher speed than hemoglobin contrasts. Finally, we are developing new large field of view two-photon microscopy systems with a  $>7$  mm field-of-view with the goal of mapping functional connectivity at the single cell level. In principle, these multi-scale optical methods enable new paradigms linking human cognitive neuroscience to mouse models where manipulations of disease, metabolism, and development are more readily possible.