Ph.D. Dissertation Defense Seminar

# Quantitative Neurologic and Oncologic PET: Overcoming Practical and Structural Barriers


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## Wednesday, March 19, 2014
## 1:00 PM
## Morton Conference Room, 24-132 CHS


ABSTRACT: Positron Emission Tomography (PET) is an inherently quantitative tool for measuring in vivo biological phenomena. However, there are still many barriers, both practical and structural, to robust quantification of data in clinical and pre-clinical settings.

First, I present methods for improving quantification of neurologic PET in Alzheimer's disease imaging. Due to the variability in patient anatomy and disease state, it is difficult to accurately compare homologous structures between subjects. Here we examine methods of image normalization and automatic image analysis that allow for greatly reduced variance in data measurement. We show that through these methods, both the diagnostic and prognostic utility of the data can be greatly improved.

Additionally, we address the structural barriers to quantification in oncologic PET in radio-labeled custom antibodies. These large, high-affinity, tracers have been shown, both in silico and in vivo, to display high degrees of heterogeneous binding in target tissues. Due to this phenomenon, classical ODE models of tracer kinetics are no longer valid. We develop and test a new set of non-linear PDE models to accurately represent tracer activity in vivo. We show that the use of classical ODE models will result in high levels of parameter estimate bias, and the new PDE models can accurately fit both in silico and in vivo data with the inclusion of Bayesian priors.


**Doctoral Committee:** Henry Huang, D.Sc. (Chair), Jorge R. Barrio, Ph.D., Elliot M. Landaw, M.D., Ph.D., Kenneth Lange, Ph.D., Anna M. Wu, Ph.D.