SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

THE BETA-GAMMA IMAGER AND TASK-DEPENDENT ASSESSMENT OF IMAGE QUALITY

Ph.D. Preliminary Research Examination

Homayoon Ranjbar
Ph.D. Candidate

Preston M. Green Department of Electrical and Systems Engineering
Washington University in St. Louis

Abstract: Quality of images obtained from medical imaging modalities, Positron Emission Tomography (PET) in particular, may be defined based on the task for which the measurements are made. This requires adopting different types of metrics and figures of merit to evaluate the quality of the images for a wide spectrum of applications ranging from plant imaging to lesion detection in cancer studies. Measurements and resulting images from PET are not quantitative in young plant structures or in plant leaves due to poor positron annihilation in thin objects. To address this problem we have designed, assembled, modeled, and tested a nuclear imaging system, simultaneous beta–gamma imager. The imager can simultaneously detect positrons (β+) and coincidence-gamma rays (γ). A forward model for positrons is proposed along with a joint image reconstruction formulation to utilize the beta and coincidence-gamma measurements for estimating radioactivity distribution in plant leaves. Detection of small metastatic lesions in a body remains an unmet challenge clinically, the single most critical task for which Whole-body PET/CT technology was designed. Our group has developed the so-called virtual-pinhole PET insert technology to provide zoom-in images using existing PET/CT scanners. While the improvement in image resolution has been demonstrated using a prototype device in proof-of-principle studies, its ability to improve the detectability of metastatic lymph nodes in cancer patients is yet to be demonstrated. Design of an observer that takes into account the loci of the detectors, the image reconstruction algorithm, design and performance of the imaging systems, patient-specific tumor location patterns, and signal-to-noise characteristics, is needed in order to advance this technology. A clear analytical approach for a more realistic implementation of tumor-present/tumor-absent decision task, including but not limited to Hotelling observer model, will be studied. The effects of inserts' loci and data acquisition duration for each bed positions, manifest themselves in the detection efficiency of the observer model. These are studied further to enhance the imaging system performance and to guide imaging protocols and standard operation procedures for virtual pinhole PET technology.

DATE:	Tuesday, May 31, 2016
TIME:	3:00 p.m.
PLACE:	Green Hall, Room 0120

Thesis advisor:
Dr. 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