SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

NOVEL PET IMAGING TECHNIQUES FOR POINT-OF-CARE APPLICATION

PhD Preliminary Research Examination

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Abstract: Positron Emission Tomography (PET) provides in vivo measurement of imaging ligands that are labeled with positron emitting radionuclide. Since its invention, most PET scanners have been designed to have a group of gamma ray detectors arranged in a ring geometry, accommodating the whole patient body.

Virtual Pinhole PET incorporates higher resolution detectors being placed close to the Region-of-Interest (ROI) within the imaging Field-of-View (FOV) of the whole-body scanner, providing better image resolution and contrast recover. To further adapt this technology to a wider range of diseases, we proposed a next generation of virtual pinhole PET based on actively controlled high resolution detectors integrated on a robotic arm. By focusing the high resolution detectors to a specific organ of interest, we can achieve better resolution, maximum sensitivity and contrast recovery.

In another direction, we proposed a portable, versatile and low cost Point-of-Care (POC) PET imaging system that consists of one or more movable detectors in coincidence with a detector array behind a patient. The movable detectors make it possible for the operator to control the scanning trajectory freely to achieve optimal coverage and sensitivity for patient-specific imaging tasks. Since this system does not require a conventional full ring geometry, it can be built portable and low cost for bed side or intraoperative use. We developed a proof-of-principle prototype that consists of a compact high resolution MPPC detector mounted on a probe and a half ring of conventional detectors. The probe is attached to a MicroScribe device, which tracks the location and orientation of the probe as it moves. We also performed Monte Carlo simulations for two POC PET geometries with Time-of-Flight (TOF) capability.

To support the development of such PET systems with unconventional geometries, a fully 3D image reconstruction framework has been developed for PET systems with arbitrary geometry. For POC PET and next generation of Virtual Pinhole PET, new challenges emerge and our targeted applications require more efficiently image reconstruction that provides imaging results in near real time. Inspired by the previous work, we developed a list mode image reconstruction platform with the capability to model dynamically changing geometry. Ordered-Subset MAP algorithm is implemented on GPU to achieve fast reconstruction in the order of seconds, under practical data rate. We tested this using both experimental and simulation data. Fast image reconstruction is achieved on pre-clinical and plant PET systems, while whole body application still requires further acceleration techniques.

DATE:	Thursday, September 10, 2015
TIME:	4:15 p.m.
PLACE:	Green Hall, Room 0120

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

Washington University in St. Louis
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