SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

DEVELOPMENT OF RECONSTRUCTION TECHNIQUES FOR GENERALIZED VIRTUAL PINHOLE PET GEOMETRY

PhD Preliminary Research Examination

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Abstract: PET is a functional imaging technique, involving radio isotopes that decay through the emission of positrons, which annihilate at a short distance from the decay point, forming back-to-back gamma rays. The back-to-back gamma rays are observed using crystalline detectors, arranged outside the body of interest. Image formation involves estimating a map of activity concentration from the measured coincidence data. Traditionally, PET systems are limited to ring geometries. Introduction of higher resolution detectors, with smaller size crystals, close to a region of interest, can improve image resolution and contrast recovery locally. This technology, named Virtual Pinhole PET, allows for building application specific PET inserts, as well as unconventional PET systems. A potential advantage is that such systems could maintain whole body imaging capability.

Our lab has built a half ring PET insert, which is integrated in a conventional clinical Siemens Biograph scanner. The work in this presentation is focused on image reconstruction, and validation of performance improvement when utilizing Virtual Pinhole PET. To further this goal, a geometry-specific reconstruction code has been written and tested, with corrections needed in order to reduce artifacts in the image. Feasibility studies for breast cancer imaging were performed, using Monte Carlo and phantom studies. For breast cancer applications, we address a previously unmet need of simultaneously imaging both primary tumors with high resolution as well as axillary and mediastenum tumors. Additionally, this work also focuses on translating research to clinic, with first human studies involving head and neck tumors.

The unconventional design of our PET system exposes challenges in system modeling and image reconstruction. There exists a need for a general reconstruction technique, independent of system geometry. Furthering the Virtual Pinhole PET concept, it might be feasible to design an optimal placement of detectors, to achieve a specific imaging task, related to a particular tumor, its location, signal to noise ratio or image resolution. Optimization of computation in reconstruction is another challenge. Future work will explore these aspects of the problem.

DATE: Tuesday, December 13, 2011
TIME: 2:30 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
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