SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

ALTERNATING MINIMIZATION ALGORITHMS FOR DUAL-ENERGY X-RAY CT IMAGING AND INFORMATION OPTIMIZATION

DISSERTATION DEFENSE

By

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Abstract: Dual-energy X-ray computed tomography (CT) is a technique used for diagnostic imaging purposes, which has the advantage of exposing the patient with two different energy spectra. This work in dual-energy X-ray CT imaging is motivated by applications in radiation oncology including dose prediction in proton therapy.

Compared to standard linear reconstruction techniques such as filtered back projection (FBP), an iterative alternating minimization (AM) algorithm can produce X-ray images with lower variance and higher contrast, and can produce equivalent images with lower dose. However, it has been observed that as iterations continue, often the reconstructed image tends to become noisier. This motivates researchers to incorporate neighboring pixel interactions in the algorithm to explicitly trade off image smoothness and data fitting.

This work first explores the regularization behavior in the AM algorithm for dual-energy X-ray CT imaging by using an edge-preserving penalty function. Both simulated and real data, axial and helical data were used for reconstruction with series of regularization parameters, which can provide a good guideline for regularization parameter choice. In order to further speed up the convergence, a linear integral alternating minimization (LIAM) algorithm is developed which estimates the linear integrals of the component images first, then the component images can be recovered by an expectation minimization (EM) algorithm or linear regression methods. Both simulated and real data are reconstructed by LIAM algorithm, showing much better convergence performance compared to regular AM algorithm, while at the same time maintaining image estimation accuracy.

This work also explores the reconstruction of image differences from tomographic Poisson data. Given two measurements of an image and a modified version of the image, we seek reconstructions of both the original image and the difference of the images. Both noiseless data and noisy data simulations are carried out to demonstrate the capability of our algorithm to reconstruct sparse difference image.

DATE: **Thursday August 21, 2014**
TIME: **10:00 a.m.**
PLACE: **Green Hall, Room 0120**

Dissertation 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