SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

BASIS VECTOR MODEL METHOD FOR PROTON STOPPING POWER ESTIMATION USING DUAL-ENERGY CT

PhD Preliminary Research Examination

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Abstract: Proton beam therapy uses a beam of protons to irradiate cancerous tissues. One of the main advantages of proton therapy is that protons deposit the maximum energy at the end of the beam path, which is known as the Bragg peak. The position of the Bragg peak is determined by proton stopping power (SP) of material along the beam path. So the accuracy of SP estimation is crucial for accurate dose calculation and geometric targeting in proton therapy planning. In current clinical practice, patient-specific SP information is obtained from single-energy computed-tomography (SECT) images using the stoichiometric calibration method. However, SECT methods may introduce large intrinsic uncertainties into estimation results. Compared with SECT, dual-energy CT (DECT) has shown the potential to achieve more accurate SP estimation. We are developing a method to reduce the uncertainty in stopping power estimation by a novel combination of a linear, separable basis vector model (BVM) for material composition and a statistical, model-based DECT image reconstruction algorithm. Unlike post-processing DECT methods that reconstruct the two CT images separately using conventional methods, we model both photon attenuation coefficients and proton stopping powers of unknown materials by a simple combination of those of two reference materials. We use a model-based image reconstruction algorithm to estimate the model parameters, and then use these parameters to estimate the proton stopping power. To our knowledge, our method is the first application of an integrated statistical image reconstruction algorithm that operates on two DECT sinograms simultaneously to energy-uncompensated sinograms extracted from a commercial scanner for mapping proton stopping power. Our method is evaluated by simulation and experimental phantom studies and shows the potential to estimate proton stopping power with high accuracy and lower variance.

DATE: Wednesday, February 22, 2017
TIME: 9:00 a.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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