University PhD Dissertation Defense
Department of Electrical Engineering

Yirong Yang

Utilizing Spectral Information from Photon Counting CT
Advisor: Adam S. Wang

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Recently, Photon Counting Computed Tomography (PCCT) systems have represented a significant advancement in the medical imaging industry, revolutionizing multi-energy imaging. These novel medical imaging systems utilize semiconductor materials to directly convert incident x-ray photons into electron-hole pairs, enabling fast and accurate x-ray photon counting under high flux rate conditions. Compared to conventional energy integrating detectors (EIDs) that have been used for decades, photon counting detectors (PCDs) offer notable advantages, including immunity to electronic noise, built-in spectral imaging, higher spatial resolution, and higher dose efficiency.

However, despite these promising advantages, PCCT has various non-idealities, such as charge sharing, K-fluorescence, non-ideal energy response, and pulse pileup, which degrade image quality and limit clinical applications. These limitations highlight the need for continued research to improve PCCT performance and expand its clinical applications.

In my talk, I will present three contributions from my research aimed at extracting and encoding spectral information from PCCT measurements: (1) I developed a linear energy-weighting strategy to reduce data volume while preserving the essential spectral information, addressing the trade-off between high data volume and the limited data transmission bandwidth in PCCT systems; (2) I leveraged a linear energy-weighting strategy within conventional grayscale image generation frameworks to reduce data dimensionality and enhance the detection of tissue abnormalities; (3) I proposed a cost-effective strategy for generating customized anthropomorphic multi-energy CT (MECT) phantoms using office laser printers for PCCT system evaluation and optimization.