Abstract ID: 15318 Title: Next-generation angiography: A theoretical comparison of signal and noise in photon-counting and dual-energy approaches

Purpose: Energy-resolving photon-counting (EPC) x-ray detectors are being developed in a number of research laboratories around the world. An exciting prospect for these detectors is the ability to suppress non-iodinated structures in an angiographic image without motion artifacts that limit the use of conventional digital subtraction angiography (DSA). However, dual-energy technology also has the potential to provide background-removed angiograms without motion artifacts. We develop a general theoretical framework for estimating image signal and noise in background-suppression techniques in angiography and use it to directly compare image quality in dual-energy angiography (DEA) with image quality anticipated using EPC detectors

Methods: We developed a method for estimating iodine signal and noise in a general background-removal technique that uses either energy-integrating or EPC x-ray detectors. We applied the developed framework to the task of separating iodine from soft tissue using DEA with low and high applied tube voltages of 50 kV and 80 kV, respectively, and energy-resolved angiography (ERA) with a 70-kV applied tube voltage and an EPC detector with three energy bins. We compared the signal-difference-to-noise ratio (SDNR) in an iodine specific image that could be obtained with each technique. We compared the theoretical predictions to calculations obtained using Monte Carlo simulations of the same imaging task.

Results: Under the imaging conditions considered, SDNR obtained using ERA is only higher than that obtained using DEA by a factor of 1.1. The theoretical SDNR predictions compared very well with results from the Monte Carlo calculations for both DEA and ERA.

Conclusions: We found that, for the task of isolating iodine in soft-tissue, SDNR obtained with ERA is only greater than that obtained with DEA by 10 % for the same patient entrance exposure. This suggests that research resources may be better spent on developing dual energy methods by improving detectors for dual-energy applications.