AbstractID: 9661 Title: Low Dose Dual Energy Breast Imaging with An Energy Resolving Photon Counting Detector

Purpose: To investigate the feasibility of low dose dual energy imaging with an energy resolving photon counting detector using a single exposure / single kVp technique for the measurement of breast density (the percentage of glandular breast tissue) in mammography.

Method and Materials: An analytical simulation model was developed to determine the mean glandular dose required to quantify breast density with a novel energy resolving photon counting detector to within an accuracy of 1%. The detector was modeled as a 3 mm thick layer of CdZnTe. All detected photons above 15 keV were counted and separated into either a low or high energy bin as determined by a user defined threshold. Only stochastic x-ray noise sources were considered. The breast was modeled as a semicircle 10 cm in radius with homogenous equal thicknesses of adipose and glandular tissues, corresponding to a density of 50%. Polyenergetic spectra from a tungsten target anode x-ray tube were simulated from 20 – 150 kVp. Tube filtration was 1.0 mm Be and 0.5 mm Al. At each kVp, the threshold energy was varied to determine the optimal dual energy SNR in the breast density image.

Results: For a 4.2 cm breast, the optimal beam energy determined from simulation was determined to be 95 kVp with a threshold separating low and high energy beam spectra at 30 keV. The predicted required minimal mean glandular dose for the dual energy image was low (< 1 μGy), and the corresponding incident photon fluence was approximately 10,000 photons per square millimeter.

Conclusions: The results suggest that breast density, a quantity strongly associated with the risk of breast cancer, can be accurately measured at low dose, with an energy counting photon counting detector.