AbstractID: 6736 Title: Simulation Studies on Contrast Enhanced Dual Energy Mammography

Purpose: Technique optimization for contrast-enhanced dual energy mammography in a breast CT scanner.

Method and Materials: Using kVp accuracy and HVL measurements physically performed on the x-ray source of a dedicated cone beam breast CT system, a mathematical spectral model was calibrated to have the same spectral and output properties as the physical system. Mathematical breast phantoms were fabricated by generating random sized and randomly placed glandular spheres on an adipose background to approximate the anatomical noise of the breast. The simulated imaging geometry matched that of the breast CT system. Quantum noise was simulated using Poisson model and a validated random number generator. Contrast-enhanced dual energy mammography was optimized for parameters including kVp, x-ray spectral filtration, and mAs distribution between high and low energy images. Mean glandular dose to the breast was calculated using dose coefficients generated from previously published Monte Carlo simulations. A figure of merit of the contrast-to-noise ratio at constant mean glandular dose was chosen for the optimization task to maximize image quality at minimal radiation dose levels. Optimization was carried out over a range of breast diameters, breast compositions, and iodine concentrations.

Results: Spectra study suggested the optimal kVp to be between 120kV and 140kV for the high energy image, and between 50kV and 60kV for the low energy image, for the studied ranges of breast diameters and compositions. Added copper filtration up to 1mm for the high kVp spectra continued to improve CNR at set dose levels. Iodine as diluted as 0.05% of the 350mg/mL standard solution could be detected with a 2.5mGy total dose. Optimized mAs distribution suggested a higher dose proportion for the low kVp image than for the high kVp image.

Conclusion: An optimized contrast-enhanced dual energy mammography can efficiently suppress anatomical noise and significantly improve contrast detection.