

AbstractID: 3823 Title: Optimization of a real time dual-energy subtraction technique based on a flat panel detector.

Purpose: To determine the optimal x-ray spectra for dual-energy subtraction with a flat panel detector (FPD), and to quantify the effects of dynamic filtration and FPD gain settings on image quality, tube loading, patient exposure, and overall system performance.

Method and Materials: A simulation study was performed using available empirically determined data of x-ray spectra. The lungs and mediastinum of the chest were modeled with 12.5 cm and 20 cm thick regions of Lucite, respectively. Coronary calcification was modeled with a 1 mm thickness of bone-equivalent plastic. The FPD was modeled as an ideal detector with a 600 micron thick layer of CsI. Scatter was not considered in this study. Low and high energy images were normalized to a desired energy deposit in the detector dependent on FPD gain. A figure-of-merit (FOM) was used to quantify the overall system performance. The effects of various silver filter thicknesses (0-1000 microns), high to low energy image signal ratios (1-8), and two dual-energy noise reduction algorithms were evaluated for their effect on image quality, patient entrance exposure, tube loading, and FOM improvement.

Results: As the thickness of the high-energy filter increased, image contrast, contrast-to-noise ratio, FOM and tube loading increased. Patient exposure was reduced by approximately 10% for the range of filter thicknesses studied. The FOM was maximized with a FPD signal ratio of approximately 3 without application of dual-energy noise reduction. However, dual gain operation did not show any improvement after noise reduction.

Conclusion: An optimal dynamic filter combined with dual-energy noise reduction can improve the system FOM by a factor of 5. There is no further improvement in the system FOM when dual detector gain is used in conjunction with dual-energy noise reduction.