

AbstractID: 3985 Title: A Model for Technique Optimization of Dual Energy X-Ray Imaging

Purpose: With increased clinical acceptance of dual-energy radiography, there is rising interest in the application of dual-energy techniques to other clinical problems. This paper describes the creation and experimental validation of a polyenergetic signal-propagation model for technique optimization of new dual-energy applications. The utility of this model is demonstrated with phantom verification of technique optimization of intravenous urography (IVU).

Method and Materials: The model is composed of a spectral signal propagation component and an image-processing module. The spectral propagation component accepts detector specifications, spectra, phantom, and imaging geometry as inputs, and outputs detector counts and estimated noise. The image-processing module performs the dual-energy logarithmic subtraction and returns statistics such as contrast and CNR that can be evaluated in conjunction with Monte Carlo calculations of dose. The technique is then optimized and correlated to data from phantom images.

Hypotheses were investigated and model results compared with results from phantoms imaged in the laboratory. For IVU optimization, a phantom of polymethylmethacrylate and aluminum, and iodinated contrast agent filled tubes was imaged. Model and laboratory results were compared by dose, clinical suitability, and system limitations to yield optimized technique recommendations.

Results: The model results accurately describe the images obtained in a low scatter environment. IVU-optimized dual-energy techniques differ from chest, and enable improved CNR over standard techniques without significant increases in dose, and with minimal degradation in the accompanying standard image. Alternatively, techniques without an accompanying standard image offer significantly lower dose and higher CNR.

Conclusion: We have developed a model to predict optimized dual-energy acquisition techniques. Its utility has been demonstrated for IVU. For this application, model and phantom results indicate that significant improvements in CNR can be obtained without significant increases in dose compared to conventional techniques.

Conflict of Interest:

All authors are employed by GE Healthcare.