AbstractID: 11941 Title: Dual Energy CT Image Reconstruction Algorithms and Performance

Dual energy X-ray computed tomography (CT) is becoming more important, in part due to the availability of multi-row scanners that collect data using two source energy spectra. An X-ray source emits a spectrum of energies for each setting of the source. The energy dependence of Beer's Law leads to the relationship between the overall attenuation function and the mean measured data; the statistics of the data given the mean data determine a more accurate model. In many approaches, linear approximations to these inherently nonlinear phenomena are used to derive algorithms.

The data can be used to form two attenuation images that can be interpreted as coefficients corresponding to component attenuation spectra; given additional constraints such as nonnegative attenuation and a sum of fractional contributions equal to one, a third attenuation image can be recovered. Component attenuation spectra may correspond to physical processes (photoelectric and Compton effects), to known materials (for example, fat and bone), or to spectra that nearly span the set of spectra (for example, computed using a singular value decomposition).

Three classes of dual-energy algorithms are discussed: prereconstruction, postreconstruction, and statistical iterative reconstruction (SIR), the latter recovering multiple images simultaneously using all data. The tradeoffs in performance of these algorithms are discussed. Analytical techniques for bounding achievable performance based on data models may be used in system analysis and design. Performance in actual systems may vary somewhat from the analytical predictions, due to inevitable differences between the model used for computing reconstructions and the clinical devices. This discrepancy in actual and predicted performance can be quantified in many situations. The approaches described extend in a straightforward fashion to data acquisitions using three or more energy bands.

Learning Objectives:

1. Understand the assumptions underlying dual-energy image reconstructions.
2. Understand the centrality of the nonlinear data model in dual-energy CT.
3. Understand the different methods that may be used to compute the image reconstructions.
4. Understand the role of image performance prediction and limitations of performance prediction.