AbstractID: 7248 Title: Impact of sinogram modeling inaccuracies on image quality in x-ray CT imaging using the alternating minimization algorithm

Purpose: To provide a scientific basis for setting sinogram modeling accuracy targets based on impact of such errors on image quality. Modeling inaccuracies in photon spectrum and scatter distribution assumed by statistical image reconstruction (SIR) algorithms lead to systematic image artifacts.

Methods and Materials: A synthetic two-dimensional phantom (25x35 cm) was used to generate both noiseless and noisy sinogram data, based upon a 120 kVp spectrum filtered by 12 mm Al (66.6 keV mean energy)and variable scatter levels (4%, 20%, and 100% of the minimum primary transmission through the phantom). A third generation Siemens Somatom Plus 4 scanner geometry was assumed. The SIR algorithm was the alternating minimization (AM) algorithm [IEEE TMI 26: 283]. 500 AM iterations using 22 ordered subsets were applied to the data. Various mismatches between the assumptions in the algorithm and the truth were studied, including erroneous spectra (110kVp to 130kVp, filtration from 6 mm to 18 mm Al, or 62.2 to 69.7 keV mean energy) and erroneous scatter levels (0.25 to 4.0 times the actual sinogram scatter).

Result: AM image quality was evaluated in terms of bias, noise, contrast ratio, etc. To assure +/-2% accuracy in the reconstructed attenuation image, photon spectrum uncertainties corresponding to 2 keV shifts in mean energy can be tolerated. For a 30 cm thick subject, this corresponds to errors in primary transmission of 6%-8%. For 20% scatter levels, the maximum tolerated discrepancy in scatter-to-primary ratio (SPR) is about 5% to 8% and 30%-50% for typical MSCT scatter levels.

Conclusions: This work indicates AM and other SIR algorithm image estimates are sensitive to errors in the detector response models assumed by the algorithms. For thick patients, a sinogram modeling accuracy of 6% is needed to support reconstructed images of 2% accuracy.
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