AbstractID: 11125 Title: Optimal Material Selection of Primary Modulator for Scatter Correction Based on the K-Edge Discontinuity

Purpose: To select an optimal material for the primary modulator in order to minimize its effect of beam hardening (BH). A measurement-based scatter correction method that uses a checkerboard pattern of attenuating material (primary modulator) placed between the X-ray source and the object has been developed and verified. In the practical implementation, BH is a limiting factor because the signal modulation depends on the object in the field of view (FOV). **Methods**: The transmission factor for different modulator materials (Be, Al, Cu, Ag, W, Ho, Er and Tm) was calculated for object thicknesses ranging from 0 to 30 cm equivalent water by using a simulated spectrum of our tabletop cone-beam CT system at 120 kVp. We then generated scatter-free projection images of a 30-cm diameter water cylinder, with and without the modulator in place, and reconstructed CT slices after demodulation. Visibility of rings was compared for no noise, and with 2% added Gaussian noise. We also measured the transmission factors of 25 μm of Cu, W and Er for different combinations of Al (0-8 mm) and Cu (0-0.3 mm) filtration. **Results**: For a transmission factor of ~0.9, simulations show that Er provides the least amount of variability as a function of added filtration (max variation<1.8%). The ring artifacts in simulated reconstructions were significantly reduced when using the Er, particularly in the presence of noise. Measured variability of transmission factors were 2.5%, 1.0% and 8.6% for 25 μm of Cu, Er and W, respectively. **Conclusions**: An optimization of modulator material to minimize BH artifact was proposed and validated. The variation of the transmission factor as a function of X-ray energy reaches a local minimum when the K-edge of the modulator material is near the mean energy of the spectrum. Design and evaluation of an Erbium modulator is underway.