AbstractID: 10726 Title: Reconstruction from experimentally acquired transmission CT sinograms with the polyenergetic Alternating Minimization algorithm using an equivalent x-ray spectrum estimated from transmission measurements

Purpose: Polyenergetic Alternating Minimization (AM) is a statistical image reconstruction (SIR) algorithm that uses a precomputed estimated x-ray spectrum to directly model beam hardening effects in the course of iteratively reconstructing CT images. We hypothesize that SIR reconstructions, based upon a rigorous physical model of the CT signal formation process, are of better quality than filtered-backprojection images using conventional preprocessing beam-hardening corrections. This presentation focuses on the accuracy and magnitude of artifacts in polyenergetic Alternating Minimization (AM) images of homogeneous phantoms. **Method and Materials:** The x-ray spectrum of a Brilliance CT scanner was estimated from transmission measurements through varying thicknesses of aluminum and polymethyl methacrylate (PMMA) filters. An exhaustive search was used to find the semi-empirical Birch-Marshall x-ray spectrum that most closely reproduced the transmission measurements. The polyenergetic AM algorithm was used to reconstruct images of 4 homogeneous PMMA disks of varying diameters using the estimated spectrum and measured scatter corrections. A simple test of the algorithm is performed: reconstructing PMMA disks using a PMMA basis in the AM algorithm should reconstruct an image intensity of 1.0 for all disk diameters. Mean intensity and noise are evaluated for disk center and periphery. **Results:** Our estimated spectrum fits the PMMA transmission measurements to within 1.5%. The AM algorithm reconstructs uniform images of the PMMA disks with mean intensity within 0.8% of the expected relative PMMA density for all disk sizes and locations. Relative standard deviations of the reconstructed intensities about the mean vary between 1.9% and 0.6% (center and periphery) for the 30 cm disk and 0.15% and 0.14% for the 5 cm disk. **Conclusion:** The polyenergetic AM algorithm can reconstruct accurate images from experimentally acquired CT data. However, great care must be taken in the processing of the raw CT data and the x-ray spectrum estimation.