AbstractID: 3140 Title: Effect of the photon counting CT acquisition on beam hardening artifacts

Purpose: Low noise performance of the photon counting x-ray image acquisition applies also to CT when CT projections are acquired using a photon counting detector. However, the photon counting detector assigns a different weighting factor to the photons as compared to charge integrating, and the photon energy spectrum in the output of the detector is represented differently. This results in different magnitudes of the beam hardening artifacts in CT images acquired with photon counting and charge integrating detectors. Purpose of this work was to evaluate the effect of the photon counting on beam hardening artifacts in CT.

Methods and Materials: CT images of the head and breast equivalent phantoms including high and low contrast inserts were simulated at 120 kVp and 90 kVp x-ray tube voltages. Photon counting, charge integrating and energy weighting detectors with photon energy weighting factors of 1, E and E^{-3}, respectively, were considered. Magnitudes of the beam hardening artifacts were quantified and compared for these detectors.

Results: Photon counting detector resulted in 4.5% increase of the magnitude of beam hardening artifacts from bone inserts as compared to charge integrating. The most optimal weighting of E^{-3}, which provides the highest SNR, however, resulted in 18% increase in beam hardening artifacts from bone inserts. The magnitude of the "cupping" artifacts was higher by 2% and 5% for photon counting and energy weighting detectors, respectively, as compared to charge integrating. Only the photon counting provided accurate representation of the beam hardening effect due to its flat energy weighting. The charge integrating and energy weighting distorted the beam hardening effect because of energy dependent weighting factors.

Conclusion: It is concluded that the low noise capabilities of the photon counting CT will not be compromised by the slight increase on appearance of the beam hardening artifacts.