AbstractID: 9260 Title: Cone beam CT beam hardening and scatter preprocessing for improved image quality in image-guided adaptive radiation therapy

Purpose: To improve cone beam CT (CBCT) image quality in terms of CT number uniformity and accuracy to better support key image-guided adaptive radiation therapy tasks such as intensity-driven deformable image registration and adaptive treatment planning.
Method and Materials: Subtractive scatter corrections to Varian on-board imager (OBI) CBCT projections utilized Monte Carlo simulated scatter profiles based upon the known phantom geometry. A first-order water linearization correction was developed based upon the measured x-ray beam central ray spectrum with mathematical spectral correction for the bowtie filter thickness associated with each detector pixel. Projections corrected for scatter and beam hardening and further corrected using Varian's scatter normalization phantom, were reconstructed with an in-house FDK reconstruction engine. The preprocessing algorithm was applied to both half-fan and full-fan projection sets with and without the bowtie filter.
Results: CBCT images corrected with the described preprocessing method showed improved CT number uniformity and reduction of the notorious CBCT cupping artifact. For a 20 cm diameter water phantom, the cupping artifact was reduced from about 15% to within 2%.
Conclusions: Model-based scatter and beam-hardening preprocessing procedures improve the on-board CBCT image quality, improving its utility for image-guided adaptive radiation therapy.
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