AbstractID: 7047 Title: An Empirical Method for Lag Correction in Cone-Beam CT

Purpose: Image lag degrades image quality in cone-beam CT (CBCT), resulting in contrast reduction, lack of CT number accuracy and uniformity, and skin-line artifacts. This work investigates the magnitude of such degradation and demonstrates a lag correction method based on measured data from a system for CBCT guidance of radiotherapy (Elekta Synergy XVI).

Method and Materials: Image lag and its relationship with various parameters including signal strength, photon energy and frame number was investigated for a PerkinElmer (RID1640) flat-panel imager. An empirical lag correction based on measurements of image lag was developed to manage lag artifacts. The CatPhan phantom within an irregular body annulus was used to demonstrate the magnitude of artifacts before and after correction. Each projection was corrected for lag effects by subtracting previous projections weighted by the magnitude of image lag. The subtraction of previous projections was limited up to 51 frames due to uncorrelated noise. The reconstructed images before and after correction were analyzed for skin-line and radar type artifacts, CT# accuracy, uniformity and contrast of several inserts. Reconstructed images were transformed into polar coordinates for analysis.

Results: Experimental results illustrate that the first frame lag of the imager is less than 2.3%, and is independent of the kVp value (70-120 kV) and pixel saturation (20-80%). Lag correction improves the skin-line artifact and reduces radar artifact by 40%. Contrast enhances by 20% and improves the CT# accuracy for water by 2.5%. It improves water uniformity by 5% compared to the nominal images.

Conclusion: Lag artifacts can be reduced by correction of the projection images. Lag correction is most important for high contrast and irregularly shaped objects. For a circularly shaped object, lag correction does not improve the skin-line artifact but can be useful for soft-tissue visibility adjacent to bony anatomy.

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