AbstractID: 11063 Title: Cone-beam CT Lag Correction Models: Effect of Optimized Parameter Selection

Purpose:
Image lag degrades image quality in cone-beam CT (CBCT). This work investigates the magnitude of lag artifacts and develops an optimized lag coefficient model to correct lag artifacts in CBCT images to improve guidance of radiotherapy(Elekta Synergy XVI).
Method and Materials:
Image lag and its relationship with various parameters including signal strength and frame number was investigated for a PerkinElmer (RID1640) flat-panel imager. A new lag correction model referred to as the "average-optimized lag coefficients model" (ALCM) is developed to correct CBCT images. The optimization of lag coefficients was purely based on quantitative improvement in lag corrected CBCT images. Each projection was corrected for lag effects by subtracting previous projections weighted by the magnitude of image lag. The quantification/measurement of lag coefficients for four different techniques including RESF(Rising-Edge-Step-Response-Function), IRF(Impulse-Response-Function), FESF(Rising-Edge-Step-Response-Function) and ALCM(Average-Optimized-Lag-Coefficient-Model) for the same detector. These models are applied/tested in correcting CBCT images of two customs made phantoms referred to as Ellipse_Lucite (MTF and skinline) and Irregular_Lucite (CNR).
Results:
Experimental results illustrate that the nth frame lag of the imager for all four model shows different behavior with frame number. The RCTN at 5 mm depth after lag correction was measured in CT# as 4.38±1.01, 10.51±1.35, 8.35±1.31 and 2.121±0.81 for RESF, IRF, FESF and ALCM, respectively. Similarly, the spatial frequency/cm for MTF(50%) before and after lag correction for RESF, IRF, FESF and ALCM was measured as 6.3±0.24, 5.7±0.23, 5.8±0.22 and 6.5±0.24, respectively. CNR for ALCMwas almost two times higher than nominal.
Conclusion:
Lag artifacts can be reduced by correction of the projection images using the ALCM model. Lag correction is most important for high contrast and irregularly shaped objects. The performance metrics suggest a significant improvement for RESF and ALCM and strongly support their use for lag correction in cone-beam CT.
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