AbstractID: 5661 Title: Analysis of Residual Geometric Artifacts from 4DCT

Purpose: 4DCT has been shown to provide improved imaging of the thoracic and abdominal region, reducing the temporal artifacts observed from traditional "free-breathing" helical CT methods. However, the reconstruction accuracy of a 4DCT exam is dependent on the reproducibility of a patient's respiratory cycle (amplitude, period). Variation of this respiratory can introduce residual geometric uncertainty in the resulting 4DCT data. This work examines the geometric uncertainties introduced in phase resorted 4DCT imaging arising from the variability of patient respiration, comparing computational simulation with phantom measurements.

Method and Materials: Examples of residual 4DCT artifacts were obtained by scanning a moving phantom capable of reproducing patient respiratory motion along the patient superior-inferior and lateral axes. Motion of the phantom stage was driven by RPM signals recorded from actual patient 4DCT scans. Geometric dimensions of the target volumes scanned on the moving phantom were compared to phase reconstructed 4DCT target images. A new computational tool was developed to examine the continuous variation of patient respiration upon cine CT image reconstruction. This tool reproduces basic 4DCT acquisition, allowing variation of patient and scan parameters such as scan start time relative to the RPM signal, multi-slice CT dimensions, amplitude of patient respiration and target volume dimensions.

Results: Variation of 4DCT target volume has been observed to be as great as 13% from measured values. Spherical phantoms have shown as much as 17% deviation from the known value when compared to 4DCT reconstructed images.

Conclusion: While 4DCT provides superior reconstruction of respiratory motion, it is not completely free from artifacts. A complete understanding of residual motion artifacts from 4DCT imaging is necessary before incorporating this data into patient treatment planning, especially with respect to techniques involving mid-phase (between exhale and inhale) images where the motion artifacts are most significant.