

AbstractID: 3910 Title: Influence of Respiratory Motion on Cone-Beam CT (CBCT) Imaging of Thorax and Abdomen

Purpose: To quantify the interplay between respiratory motion and CBCT imaging in thoracic and abdominal region.

Method and Materials: A Varian Acuity CBCT simulator was used to scan a motion-simulation phantom and three patients (a pancreatic and two lung cases). Motion phase of the phantom or the patients was stamped with a Varian RPM system. For phantom study, three CBCT gantry rotation speeds (5° , 10° , and 15° per second) were used. Several different motion patterns and speeds of the phantom, simulating a variety of clinical situations, were also investigated with CBCT gantry speed of $10^\circ/s$. The patient scans were done with $10^\circ/s$ rotation speed. The resultant images were compared against the 4D-CT images acquired on a GE LightSpeed scanner. The HU profiles of the two types of images were analyzed.

Results: Given the fact that a regular breathing cycle takes $\sim 4s$, a CBCT scan is usually a time-average over ~ 10 breathing cycles. Large artifacts and anatomical distortions were observed in both phantom and patient scans. In the phantom study, the onset of motion artifacts started at very low “breathing” motion rate, suggesting that CBCT is less proof against motion. The CBCT image quality was worsen as the “breathing” rate increased but this became saturated when the phantom motion rate reached to a certain level. For the patient study, the discrepancies between the CBCT and 4D CT images were also found to be large. The tumor contours, for example, delineated based on the two types of images can differ up to 1cm

Conclusion: Respirator motion greatly degrades the quality of CBCT and presents a problem in thorax and abdomen imaging. It is urgently needed to develop a clinically practical means to minimize the adverse effect of breathing motion.