AbstractID: 10254 Title: Assessment of an interpolated ray trace algorithm for deriving motion from CBCT scans

Purpose: To asses the accuracy of an interpolated ray-trace algorithm for deriving respiratory motion from megavoltage cone beam computed tomography (MVCBCT) scans.

Method and Materials: 21 Siemens Oncor MVCBCT scans were taken of a tungsten pin attached to a motion phantom positioned with various orientations and table shifts to create motion with variable amplitudes of up to 1 cm along posterior-anterior and right-left axes and 3 cm in the cranio-caudal axis. Edge detection found the pin in all 200 CBCT raw data projections. The intersection of ray-traces, from the pin's image to the source, for two full exhale projections defined the exhale bounding point, while using two full inhale projections yields the inhale bounding point. These bounding points were ray-traced into all projections. The position of the pin's image, relative to the projected bounding points, was used to interpolate between bounding points to find the pin's room coordinates for all projections. A plot of pin position versus projection time stamp was compared to the expected motion.

Results: A bounding box, whose opposite corners are the projected bounding points, will contain the tungsten pin only if angular separations between projections used for bounding point determination are between 15 and 163 degrees, and differences in full inhale amplitudes are accounted for. Under these conditions, deviations between expected and calculated cranio-caudal motion are primarily due to flat panel geometry error. The errors are worst at the edges of the CBCT reconstruction volume, with maximum and mean errors of 1.06 and 0.34 mm, respectively. When flat panel errors are corrected, the worst case mean error is 0.16 mm.

Conclusion: For bounded motion of up to 3 cm, the interpolated ray-trace algorithm will contribute little to the overall error for applications that determine diaphragm motion from patient CBCT scans.