AbstractID: 8622 Title: 3D Lung Tumor Motion Tracking using MV Cone-Beam CT Acquisition with Synchronized Respiratory Monitoring

Purpose: Raw cone-beam CT data consists of projection images acquired sequentially during gantry rotation. For lung imaging, respiratory motion is recorded in the projections, but is lost during back-projection reconstruction. The goal of this study was to measure the 3D respiratory motion of lung tumors from the raw MV cone-beam CT (MVCBCT) projection data. **Method and Materials:** A respiratory signal was captured using an external surrogate (Anzai/Siemens) during MVCBCT acquisition (MVision, Siemens) and time-synchronized with the projection data using the beam pulse signal. Projection images were processed to enhance anatomical structures then the lung tumor was segmented automatically. The tumor center-of-mass (COM) in the rotating coordinate system of the flat panel detector was computed for each projection frame. The respiratory signal amplitude was used to sort projections into 10 respiratory phase bins. Projections within each phase bin were analyzed in a pair-wise manner by trigonometric triangulation yielding multiple measures of the tumor COM. A weighted average COM was computed for each phase, with greater weight given to measures obtained from projection pairs with larger angular perspective. **Results:** Tests on phantoms containing point structures validated the accuracy (2 mm) of the methodology. Clinical MVCBCT of a patient with two lungs tumors yielded measures of the tumor centers' motion over the respiratory cycle, which agreed well with tumor motions measured from kV-4DCT. **Conclusion:** The analysis presented here gleans additional dynamic 3D information that is unique from the time-averaged 3D structure normally reconstructed in CBCT; and it is obtained without any additional radiation dose when CBCT is used for static IGRT. This method could prove useful for near real-time calibration/verification of the correlation between surrogate and tumor respiratory motion immediately prior to 4D treatment delivery. It may also be used for automated online motion tracking during rotational dynamic treatment delivery.