AbstractID: 9651 Title: Fiducial Placement Guidelines for Thoracic Radiation Therapy Determined by 4DCT

Purpose: To determine the volume of lung where a fiducial would accurately represent lung tumor motion
Method and Materials: A 4DCT scan with spirometry was performed on 4 patients, and the results were evaluated by a deformable image registration and a lung motion model was applied to determine motion vectors for each point in the lung. The position vector of the lung tumor centroid at peak inhalation, peak exhalation, mid inhalation and mid exhalation of was compared to the position vector of points throughout the rest of lung to find the difference in relative positions.
Results: Cubes were constructed containing a volume in which we could accurately predict the position of the tumor within 2mm, 3mm and 4mm. These cubes showed at least 95% of the contained points having motion differences below the selected thresholds. The average side length of the cube for patients with upper lobe tumors when the motion was followed within 2 mm was 2.5 cm. These side lengths increased to an average of 4.3 cm and 6.0 cm for thresholds of 3 mm and 4 mm respectively. For patients with lower lobe lung tumors, the average side lengths of the cubes were 1.0 cm, 1.8 cm, and 2.6 cm for thresholds of 2 mm, 3 mm, and 4 mm respectively.
Conclusion: 4DCT scans as evaluated with a lung motion model show that points near lung tumors have similar trajectories as the lung tumor itself. It is also apparent that fiducials need to be placed closer to lower-lobe tumors compared to upper lobe tumors. As expected, allowing for an increased difference between the motion of the tumor and other points in the lung yields a larger volume. Further work will focus on extending these results past average breathing cycles.