AbstractID: 8954 Title: Lung tumor setup using 2D-3D registration of respiratory-gated oblique x-rays and the planning 4D-CT

Purpose:
To investigate the feasibility of using intensity based 2D-3D registration to directly setup on respiratory gated lung tumors using x-ray source angles tailored for each patient.

Methods and Materials:
A 2D-3D registration software was developed in-house which renders digitally reconstructed radiographs (DRR) in real time with a consumer graphics card. The user was then able to conveniently view DRRs at various source angles to choose the angles where the tumor is less obstructed by surrounding structures during the planning phase. The 2D-3D software, using mutual information, simultaneously aligned DRRs from the end-expiration planning 4D-CT with four end-expiration projection x-rays (lateral, Anterior-Posterior (AP), and 2 oblique) on a sub-image based on the projection of the tumor. For the analysis, the x-ray projection data was taken from three lung patients in a separate research protocol for 4D cone-beam CT. The 2D-3D results were compared with 3D-3D alignment of the end-expiration 4D cone-beam CT with the end-expiration planning 4D-CT on a region around the tumor. Respiration phase information was deduced from a commercial external fiducial system (Real-time Position Management, Varian Medical Systems). The volumes of the three tumors were 14.0 cc, 45.8 cc, and 17.9 cc. The extents of motion in the Superior-Inferior (SI) direction were 2 mm, 4 mm, and 11 mm.

Results:
The mean differences between the 3D-3D and 2D-3D registrations were -0.1 mm, 0.1 mm, and 1.6 mm in the lateral, AP, and SI directions respectively. The standard deviations were 2.2 mm, 1.8 mm, and 1.0 mm.

Conclusion:
We have demonstrated the feasibility of direct lung tumor setup with per-patient x-ray source angles. The preferred oblique x-ray angles were anterior and posterior angles on the same lateral side as the tumor. Future work will investigate the optimal number of x-rays and the lower limit of the tumor's size.