AbstractID: 5524 Title: Quantifying the properties and accuracy of a deformable image registration algorithm for 4D treatment planning

Purpose: A necessary tool to facilitate automated four-dimensional and adaptive radiotherapy planning is deformable image registration (DIR). The purpose of the current study was to quantify the accuracy of a DIR algorithm by comparing automatically transferred and manually segmented structures on 4DCT images.

Method and Materials: 780 structures were manually segmented on thirteen patient 4DCT image sets each consisting of 10 respiratory phases. A large deformable diffeomorphic DIR algorithm, integrated with a commercial treatment planning system, was used to map each CT set from the inspiration respiratory phase CT image set respiratory phase images. The calculated displacement vector fields were used to deform and transfer structures defined on the inspiration CT to the other respiratory phase CT image sets. The manually and automatically segmented structures were compared using volumetric, displacement, and surface congruence metrics.

Results: Deformation with respiration was observed for the lung tumor and normal tissues. This deformation was verified by examining the mapping of high contrast objects, such as the lungs and cord, between image sets. The auto- and manual methods showed similar trends, with a smaller difference observed between the GTVs than other structures. The auto-contoured structures were more consistent both in terms of centroid displacement and volume as a function of respiratory phase than manual contours. 1.6% of the time, deficiencies of manual contouring has been detected using auto contouring. Image artifacts play a crucial role in auto contouring.

Conclusion: An automated system is established to auto-contour structures starting from one 4DCT image phase to other 4DCT image phases. The auto-contoured structures generally agree with the manually drawn structures. However the auto-contoured structures are more consistent in trajectory and volume, and also highlighted some large errors in the manually drawn contours. Careful assessment is needed in the presence of 4DCT artifacts.