AbstractID: 10874 Title: Quantitative Assessment of Automatic Anatomy Segmentation of 4D CT Images Using a Deformable Image Registration Algorithm

Purpose: Quantify the accuracy of Small Deformation Inverse Consistent Linear Elastic (SICLE) deformable image registration to auto-segment contours on 4D thoracic CT images.

Method and Materials: A process of automatic contouring based on SICLE deformable image registration of respiratory CT phases from 4DCT scans was integrated into our image-guided-radiotherapy-computing-framework. The gross tumor volumes (GTVs), right and left lungs, cord and esophagus were manually-drawn by the same physician for all ten respiratory phases. Registrations were performed using three intensity windows: 0-900 (lung only), 900-1300 (remaining tissue excluding lung) and 0-1300 (whole image). For each respiratory phase, the differences between the manually-drawn and deformably-mapped contours for each phase were quantified using fractional volume differences (FVDiff), differences in center of mass coordinates (COMdiff) and volume overlap index (VOI) and 3D maps of perpendicular distance between manually-drawn and deformably-mapped boundaries. The results were also compared against the previously-implemented viscous fluid-based registration.

Results: The VOI for GTV and heart varied from 0.85 to 0.90, from 0.9 to 0.97, respectively. As expected, the smallest FVDiff were found be for the lungs (<0.027). The SICLE (0-900) and viscous fluid methods yielded similar GTV COM in superior-inferior direction. COMdiff were largest for the esophagus (~0.36 cm) since the esophagus is difficult to visualize on CT, especially in the lower thorax. Overall, visual comparison of GTV manual and auto contours showed good agreement. However, large discrepancies (up to 2cm) were found at the most inferior portion of the lung. This disagreement was also very evident from 3D maps of perpendicular distances between manually-drawn and deformably-mapped contours.

Conclusion: Automatically-generated contours using SICLE algorithm can produce high quality contours on subsequent respiratory CT phases. Deformable image registration may reduce or even eliminate the manual contouring workload and can be used for manually-drawn contour quality assurance.

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