Purpose:To evaluate the direct versus composed registration in inter-fraction deformable image registration of 4D CT scans of thoracic cancer patients.
Methods:Lung cancer patients treated under an institutional IRB protocol were selected for this study. Each patient had a planning and subsequent weekly 4D CT images that were acquired at ten discrete respiratory phases during their treatment course. GTV, lungs, heart, cord, and esophagus were manually delineated for all ten phases on each image set. A Small Deformation Inverse Consistent Linear Elastic (SICLE) non-rigid-registration algorithm was utilized for the generation of displacement vector fields (DVFs). The end of inhalation phase images from the weekly on-treatment 4DCTs were deformably-registered to the end of inhalation phase image from the planning 4DCT using two different registration permutations. In the 'Composed' method, each end of inhalation phase image was registered to the subsequent weekly image, and the resulting DVFs were composed or 'chained' to create the mapping from any weekly image to the planning image. For evaluation, contours on different image sets were mapped back to the planning 4D CT. Deformation maps generated by "Direct" versus "Composed" registration methods were evaluated using "volume histograms of the vector difference length for each structure", "Jacobian", "Dice similarity coefficient (DSC)" and Center of Mass (COM).
Results:The average spatial discrepancy for all structures was less then 1mm using "direct" vs. "composed" registration. The differences in the average Jacobian for all structures obtained with "direct" vs. "composed" DVFs were also negligible. Differences between deformably-mapped GTV, lung and esophagus contours obtained with "direct" and "composed" registration DVFs were <0.5mm.
Conclusions:The evaluation of the "direct" versus "composed" registration of weekly 4D CT scans showed that there are very small differences in "Direct" vs. "Composed" registration DVFs although there are numerically noticeable differences.
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