AbstractID: 4669 Title: Assessment of a Model-Based Deformable Image Registration Approach for Radiotherapy Planning

Purpose: To assess the accuracy of a surface-based deformable image registration strategy as a function of the elasticity model for the integration of multi-modality imaging, image-guided radiation therapy, and quantification of geometrical change during and following therapy.

Method and Materials: A surface-model based deformable image registration system has been developed that enables quantitative description of geometrical change in multi-modal images. Based on the deformation of organ surfaces represented by triangular surface meshes, a volumetric deformation field is derived using different volumetric elasticity models (Thin-Plate Splines, Wendland functions, Elastic Body Splines) as alternatives to finite-element modeling.

Results: The system was demonstrated on five liver cancer patients, ten prostate cancer patients, thorax in five healthy volunteers, and abdomen in five healthy volunteers. The accuracy of the system was assessed by tracking visible fiducials (bronchial bifurcations in the lung, vessel bifurcations in the liver, implanted gold markers in the prostate). The maximum displacements for lung, liver and prostate were 5.3 cm, 3.2 cm, and 1.8 cm respectively. The largest registration error (direction, mean ± standard deviation) for lung, liver and prostate were (inferior-superior, -0.21 ± 0.38 cm), (anterior-posterior, -0.09 ± 0.34 cm), and (left-right, 0.04 ± 0.38 cm) respectively, which was within the image resolution regardless of the deformation model. The computation time (2.7 GHz Intel Xeon) was on the order of seconds (e.g. 10 seconds for two prostate data sets), and image deformation results could be viewed at interactive speed (less than 1 second for 512x512 voxels).

Conclusion: Surface-based deformable image registration enables the quantification of geometrical change in normal tissue and tumor with acceptable accuracy and speed.

Conflict of Interest (only if applicable):