

AbstractID: 5509 Title: Deformable Image Registration with Auto-mapped Control Volumes

Purpose: Conventional deformable registration treats all image volume equally and the calculations are “brute-force” in nature. In reality, some regions can be mapped between the moving and fixed images with high confidence. In this work we investigate a strategy of using *a priori* knowledge about the system to reduce the dimensionality of the deformable image registration.

Method and materials: We propose a two-stage deformable image registration algorithm that incorporates prior knowledge into the system through auto-mapping of control volumes. In the first stage, a set of control volumes is selected on the fixed image. Each control volume is mapped on to the moving image using a rigid transformation. Control volumes are placed on distinct features for robust auto-mapping. In the second stage, a BSpline grid is defined over the moving image. For each control volume, the nearest point on the grid is located based on the Euclidean distance. An upper bound that is dependent on the displacement of the control volume in the auto-mapping is imposed on the corresponding grid point. The BSpline deformable transformation is determined for registration of the two images subject to the bounds on the displacements of the grid points as described. The utility of the new method is demonstrated by clinical case studies.

Results: The algorithm was applied to register phases of 4D-CT images for mapping lung and liver deformations. Experimental results show that the algorithm is fast, robust and practical with a registration accuracy of ~2mm.

Conclusions: We have developed a deformable registration mechanism that incorporates *a priori* system knowledge to improve the performance of registration. The algorithm is based on the BSpline deformable transform with displacement constraints based on auto-mapped control volumes. The algorithm has been found to be practical for registration of phases of 4D-CT images of lung and liver.