AbstractID: 6462 Title: A tissue-based registration method using morphological information

Purpose: Conventional deformable registration treats every voxel in an image set equally. In reality, not all regions are equal: some parts are rigid and some are deformable. We investigate a strategy of using *a priori* knowledge of the system to improve the accuracy and robustness of deformable registration.

Method: Our calculation consisted of two natural steps. First, the input images are auto-classified into feature regions based on the intensity information. The feature regions in the fixed and moving images are matched as feature region pairs using SIFT (scale-invariance feature transformation) method. Secondly, the established feature region pairs are used as *pre-determined* control point associations to facilitate the thin plate spline (TPS) deformable registration. Because of the pre-association of the feature pairs, there is no need to manually place the homologous control points, which is a difficult task (as detailed anatomy knowledge is often required) and has been a major source of inaccuracy. The proposed algorithm is evaluated by using a digital phantom and five sets of 4D CT images of different disease sites.

Results: A method of incorporating prior knowledge into TPS deformable image registration has been developed. Using SIFT method, the feature region pairs can be easily identified. For example, for a region inside or close to a piece of bony structure, the correspondence can be found using SIFT because of the lack of deformation. In the digital phantom experiments, the new TPS algorithm is able to obtain a transformation matrix, which agrees with the known ones to within 3%. For the patients, similar level of success was achieved. A comparison with conventional TPS or BSpline approaches, the technique improves the accuracy and robustness.

Conclusions: With incorporation of feature pairs, the deformable registration is significantly improved and much robust and accurate registration is attainable.