AbstractID: 10772 Title: A Segmentation-based Deformable Registration Algorithm for Cone Beam CT and Helical CT Images

Purpose: Optical flow-based deformable registration algorithm, which assumes that the image intensity does not change during the deformation, is not suitable for cone beam CT (CBCT) and Helical CT (HCT) image registration because CBCT image possesses a intensity inhomogeneity due to Compton scatter effect. The objective of this study is to develop a new deformable registration algorithm for CBCT and HCT image registration.

Method and Materials: The proposed deformable registration algorithm for CBCT and HCT image registration is divided into two steps. First, a maximum *a posteriori* probability (MAP) based adaptive segmentation method is utilized to accurately segment the voxels of CBCT images and HCT images into four tissue types: air, fat, muscle and bone, even in the presence of severe image intensity inhomogeneity due to Compton scatter. The intensities of the segmented images represent the probability of each voxel belonging to different tissue types and are globally uniform. Thus, the image intensity inhomogeneity effect can be eliminated. Second, an optical flow based deformable registration algorithm is applied to the segmented images, instead of original CBCT and HCT image, to determine the deformation between CBCT and HCT images. Thus, the CBCT image can be deformed to match the HCT images.

Results: The performance of the proposed deformable registration algorithm was tested using both digital phantoms and clinical CBCT images. Our studies showed that the conventional optical flow-based method failed to converge to expected solution due to intensity inhomogeneity effect, and its registration results showed a severe mismatch on many detailed structures between CBCT and HCT images. In contrary, the proposed method matched CBCT and HCT image very well.

Conclusion: The proposed segmentation-based deformable registration algorithm is capable of CBCT and HCT image registration.