

AbstractID: 5007 Title: Improving Soft Tissue Contrast in 4D CT Images of Liver Cancer Patients Using Deformable Image Registration Method

Purpose: To investigate image quality improvement in 4DCT images of liver cancer patients by using deformable image registration. The low soft-tissue contrast in liver CT images is always a challenge for accurate target delineation.

Method and materials: Ten patients with liver cancers were selected in this study. These patients received 4DCT scans for radiotherapy treatment planning using 120kVp and 150mA on a GE PET/CT system. The 4DCT images were retrospectively sorted and binned into 10 equispaced phases. The end-expiration phase was chosen to be a reference phase, and the images from the other 9 phases were co-registered to the reference phase using an intensity-based, automatic deformable image registration algorithm. Then the 10 matched 4DCT images were averaged to give a single, high quality reference-phase CT image for tumor target delineation. The image quality enhancement was quantified relative to the original CT by calculating the signal-to-noise ratio (SNR) inside the liver region. The incremental improvement in image quality was also studied by combining fewer 4DCT data sets.

Results: The image contrast in the soft tissue region is noticeably improved. SNRs inside the liver increased for all patients by a factor of at least 2.3 (average at 3.0). The improvement in image quality is not linearly proportional to the number of images averaged. Averaging 6 CTs can achieve 85% of the SNR enhancement obtained by averaging all 10 CTs of different phases.

Conclusion: We developed an effective method to improve soft tissue contrast in the liver by co-registering and combining multiple CTs within the 4DCT data set using a deformable image registration method. The resultant, high-quality, single-phase CT could be used for better delineation of tumor target volume and critical avoidance structures. The deformable image registration method can also map these contoured structures back to each individual phases for motion-compensated 4DCT planning.