AbstractID: 4854 Title: Deformable image registration in cone-beam CT images for image-guided adaptive radiotherapy

Purpose: With the availability of on-board imaging devices capable of constructing cone-beam CT (CBCT) images, it is expected that there will be great interest in using volumetric CBCT for image-guided adaptive radiotherapy. In order to fully utilize CBCT, automatic segmentation on CBCT images is one of key steps toward this goal. . The purpose of this study is to implement a robust deformable image registration for auto-segmentation.

Method and Materials: In four head and neck cancer patients, we used our previously developed, image intensity-based deformable image registration algorithm to register the planning CT with the 3-5 daily CBCT in three scenarios. First, the daily CBCT was directly used without modification. Second, we applied a generic look-up-table transformation to map the CBCT image intensity to the conventional CT intensity using the measured electron density calibration curves for both the conventional and CBCT scanners. In the third scenario, we proposed a wavelet-based dynamic window/level histogram matching algorithm to map the CT number from CBCT image to the conventional CT image. Then the deformable image registration was performed in the modified CBCT images to map the anatomical structures from the planning CT to the corresponding CBCT images.

Results: Without pre-processing, we found that the CT numbers in CBCT images were inconsistent, especially in soft tissue regions and in patients with large body circumferences. The deformable image registration using the window/level histogram matching method performed the best with good consistency in delineating soft tissue structures. The algorithm is also computationally efficient.

Conclusion: We implemented a wavelet-based window/level histogram matching algorithm to pre-process the CBCT to allow for more robust deformable image registration of with the reference planning CT. This implementation allows for volumetric CBCT-guided adaptive radiotherapy.