AbstractID: 10932 Title: Converting Cone-beam CT to in-room Conventional CT by a Deformable Image Registration Method

Purpose: Poor image quality in Cone-beam CT (CBCT) usually poses a challenge for soft tissue based target localization or accurate dose calculation for adaptive radiotherapy. The purpose of this study is to develop an effective post-processing method to drastically improve CBCT image quality without losing anatomical and geometric information it provides.

Method and Materials: We used an image-based deformable registration algorithm to establish dense correspondence among voxels of the daily CBCT and the planning CT images. Once the voxel-by-voxel correspondence is obtained, conventional CT numbers from the planning CT can be mapped to the geometrically aligned voxel locations of the daily CBCT. The converted CBCT (Mapped-CBCT) maintains the geometrical information of the daily CBCT while retaining the more accurate electron density information from the original planning CT. A previously validated, in-house developed "demons" algorithm was used in combination with an intensity pre-processing method.

Results: Soft tissue contrast is greatly enhanced in each of the prostate, lung, and head & neck cases we tested. In addition, various CBCT imaging artifacts, caused by beam hardening, detector response lag, scatter, and organ motion during CBCT acquisition etc., were all disappeared. Histogram distribution of voxel intensities in the soft tissue region showed a better tissue/fat separation in the mapped CBCT than the original CBCT. For a prostate case, we observed a *41%* reduction in entropy, which further demonstrates improved soft-tissue discrimination. Correspondence ambiguity in some anatomical objects is one limitation for this method. For example, the daily variation of rectal gas will not be presented if the rectum is empty in the planning CT.

Conclusion: We demonstrated an effective voxel mapping procedure to match the CBCT image to the quality of a conventional CT, which should improve online image evaluation or provide a more accurate CT data set for adaptive replanning or dose accumulation.