AbstractID: 13699 Title: The Impact of Cone-beam Computed Tomography (CBCT) Artifacts on Deformable Image Registration Algorithms

Purpose: Deformable image registration algorithms capable of rapidly contouring kV and MV cone-beam computed tomography (CBCT) images would greatly facilitate new adaptive radiotherapy techniques. However, the CBCT imaging geometry produces well-known image artifacts. The goal of this study is to quantify the impact of these artifacts on a commercially available deformable image registration algorithm and suggest maximum acceptable artifact levels. **Method and Materials:** In-house programs were used to modify conventional CT images of several head-and-neck radiotherapy patients to simulate common, previously reported CBCT artifacts such as noise, global shifts in Hounsfield units (HU), and reduction in bone contrast. The contours drawn on the original CTs were deformed to the modified CTs using the MIM software suite's deformable registration algorithm (Mimvista, Cleveland, OH). Dice similarity indices (DSI), the volume of the contours' overlap divided by their average volume, were calculated and used to determine the impact of CBCT artifacts on contour deformation accuracy. **Results:** The addition of moderate levels of noise had little effect on accuracy. Brainstem and temporal lobe contours were most affected with DSI values of ~0.9 for a 70 HU noise level (1 standard deviation). Global shifts in HU created large discrepancies in the deformed contours. Large deviations were observed for a global shift of -75 HU for the parotids (DSI ~ 0.77), brainstem (DSI ~ 0.68) and especially the temporal lobe (DSI ~ 0.57). Suppression of the bone CT numbers from 900 HU to 151 HU had marked effects on the deformed contours of the cochleae (DSI~0.48), mandible (DSI~0.63), and TMJs (DSI~0.57). **Conclusions:** Additional noise in CBCT images has a small effect on the accuracy of a commercial deformable registration algorithm. However, global shifts in CT number and the suppression of bone CT numbers can produce significant errors depending on the magnitude of the change in HU.