AbstractID: 9346 Title: Automated, On-line Registration of MV CT Tomotherapy Images: Accuracy and Reproducibility in the Clinical Setting

Helical tomotherapy provides on-line MV CT scans for setup and dose verification. The tomotherapy system is equipped with automated and manual fusion interfaces for registration of on-line MV CT images to reference kV CT images. The automated registration algorithms employ voxel-based Mutual Information (MI) or Extracted Feature Fusion, a variation of MI in which images are thresholded prior to registration. Here we investigate the performance of these algorithms in a clinical setting. Sources of experimental error in addition to the performance of the algorithms will be discussed. To determine the accuracy of registration, the Rando head phantom was shifted with respect to the initial position and scanned using the tomotherapy machine. Then on-line MV CT images were registered with the reference kV CT image, and the known offsets were compared to the relative displacements reported by the algorithms. Reproducibility was evaluated by taking multiple MV CT scans in one setup position, fusing them to the reference scan, and comparing registration parameters. For a scan width of 6.8 cm in the longitudinal direction (17 slices), standard deviations were under 0.25 mm in each translational direction and under 0.5 deg rotationally around each axis. This agrees with previously published theoretical limits for this algorithm of 0.5-pixel translational error and 0.5 deg rotational error. The influence of number of adjacent slices on reproducibility was also considered, and it was found that adding slices improved registration consistency, especially in the longitudinal direction.