AbstractID: 5691 Title: Automatic Comparison between Reference and On Board Digital Tomosynthesis for Target Localization

Purpose: Digital tomosynthesis (DTS) is a method for reconstructing 3D images from cone-beam projection data acquired with limited angulation (e.g., 40°) of an x-ray source, and is much faster and lower dose than full cone-beam CT (CBCT). We previously developed a method for generating reference DTS images from a planning CT for registration with actual on-board DTS images. This study examines the accuracy of 3D-3D registration of reference and on-board DTS images to assess the potential of DTS for image-guided radiation therapy (IGRT).

Method and Materials: We simulated the online positioning of an anthropomorphic chest phantom with 6 noncoplanar reference BBs attached. Planning CT data of the phantom were acquired with a G.E. Lightspeed RT scanner. On-board CBCT projection data were acquired with a Varian 21EX Clinac, equipped with a kV on-board imager. On-board DTS images were reconstructed from a subset of the CBCT projection data (81 projections, 44°). True alignment of planning and on-board image data was achieved according to a 3D point-based registration of the 6 reference BBs in the CT and CBCT images. Single-axis rotations up to +/- 10° and 3-axis translations up to +/- 10 mm were simulated in the planning CT, prior to the generation of reference DTS images. A 67.5mm×162.5mm×20.8mm region of interest surrounding the spinal cord was extracted for registration. Mutual information-based 3D-3D registration of reference and on-board DTS images was performed, and residual registration error was recorded.

Results: Registration errors are within 0.7mm and 0.1 degree in all cases. The average registration error was 30% less for translations along the dimension of tomographic motion than for the other two dimensions.

Conclusions: 3D-3D rigid-body registration of reference and on-board DTS images is highly accurate, suggesting that DTS may be an effective IGRT technique.

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