AbstractID: 9086 Title: A Novel Digital Tomosynthesis (DTS) Reconstruction Method Using Prior Information and a Deformation Model

Purpose: Digital Tomosynthesis (DTS) is a quasi-3D imaging technique which reconstructs images from a limited angle of on-board projections with significantly lower dose and shorter acquisition time than full cone-beam CT (CBCT). However, DTS images reconstructed by the conventional filtered back projection method have low plane-to-plane resolution and can't provide full volumetric information for target localization. In this study, we developed a novel DTS reconstruction method using prior information and a deformation model to recover volumetric information.

Method and Materials: A patient's previous CBCT or CT data were used as the prior information, and the new patient volume was considered as a deformation of the prior volume. The deformation fields were solved by minimizing bending energy and maintaining data fidelity. A nonlinear conjugate gradient method was used as the optimizer. The algorithm was tested using simulated projections of a Shepp-Logan phantom, liver and head-and-neck patient data. The accuracy of the reconstruction was evaluated by comparing both pixel value and contour differences between DTS and CBCT images.

Results: In the liver patient study, the systematic and random errors for the live contour reconstructed using a 60-degree scan angle were 0.5 and 1.6mm, respectively, showing the new organ volume was accurately reconstructed. The pixel signal-to-noise ratio (PSNR) for 60-degree DTS reaches 23.5dB. In the head-and-neck patient study, the method using 60-degree scan was able to reconstruct the 8.1 degree rotation of the bony structure with 0.0 degree error. The PSNR for 60-degree DTS reaches 24.2dB.

Conclusions: A novel reconstruction method was developed to reconstruct DTS images using prior information and a deformation model. Volumetric information was accurately obtained using a 60-degree scan angle. Preliminary validation of the algorithm showed that it is both technically and clinically feasible for image-guidance in radiation therapy.

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