indicating the reproducibility of the registration has a 2mm uncertainty for the difference between the two repetitive MRI/KVCT registrations, indicating the reproducibility of the registration has a 2mm uncertainty for GTV. Compared to the kVCT/MRI registration, kVCT/MVCBCT registration can be performed reproducibly with automated registration, resulting in close to 100% Dice index and 0 uncertainties. Conclusions: An intrinsic 2mm error was observed for MRI/KVCT registration but not between the kVCT and MVCT. The results indicate the necessity of taking the 2 mm uncertainties into consideration in contour transfer from MRI to CT.

SU-E-J-37
An Open Platform for 2D-3D Image Registration Experiments

J Balter1*, Y Long1, M Folkerts2, G Sharp3, T Bortfeld3, J Fessler1, An Open Platform for 2D-3D Image Registration Experiments

Purpose: To provide a flexible environment for experimenting with various combinations of input images, arc length and resolution, projection geometries, search methods, and cost functions for projection-to-volume (“2D-3D”) image registration Methods: A MATLAB graphical interface was developed to align a series of orthogonal pairs of radiographs acquired during arc therapy to projections through a region of interest of a reference CT image volume. The projection and volume geometries are based on a distributable image registration toolbox. Experiments can use single or orthogonal radiograph series, simulations from second input volumes, modified volumes of the reference CT such as additive noise, and variable regions of interest. Two forward projection algorithms (Siddon and separable footprint) are incorporated, both mutual information and SSD metrics can be used, and search engines include conjugate gradient (for SSD), simplex, as well as direct mapping of the cost function in a user-defined local search region. Results: A number of initial experiments have been performed with this interface. The tradeoffs of local contrast and detail versus angular range, image noise, and angular resolution for identifying local transformations have been explored. The impact of removing, maintaining, or reducing CT signals outside the region of interest for alignment to radiographs has been tested. Modifications including temporal regularization to monitor movement during arc rotation are easily implemented within this open framework. Conclusions: This environment is continuously expanding, and should support collaborative investigations across institutions on common problems and solutions for projection-based image registration.

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SU-E-J-38
Tracking Changes in Head-And-Neck Rotation and Flexion Using Megavoltage Cone-Beam CT and Deformable Image Registration

I Cheo1*, S Yom1, U Ueda1, J Quivey1, M Aubin1, J Pouliot1, University of California San Francisco, San Francisco, CA

Purpose: Megavoltage cone-beam CT (MVCT) images used for patient positioning can also detect complex changes in neck flexion and head rotation. Deformable image registration (DIR) algorithms can automate detection of positional variability and facilitate adaptive therapy strategies. This study investigates the ability of DIR to track changes in neck flexion, jaw position, and head tilt in MVCT images of head-and-neck radiotherapy patients. Methods: Landmark points at the base of skull, along the cervical vertebral column and on the mandible were identified and annotated on planning kVCT and MVCT images of patients. Baseline MVCT images were first fused to the kVCT via rigid registration, and distances between corresponding landmark points were computed. The same MVCTBCT images were then fused via DIR, and the vector displacement between landmark points and deformed points was calculated. The change in the distance using DIR versus rigid registration was used to quantify how well the deformation algorithm tracked the shift of landmark positions. The same tests were also performed by registering and deforming the baseline MVCTBCT to another MVCTBCT taken at a different time. Results: Data for 11 reference points and images from five patients were analyzed. Changes in landmark distance of greater than 1 mm were considered. Deforming the MVCTBCT to the kVCT, one patient showed an average decrease in landmark distance of 3 mm after DIR. However, the landmark distance increased by an average of 2 mm for another patient. When deforming the baseline MVCTBCT to another MVCTBCT, all five patients showed an improvement in landmark matching. The average decrease in landmark distance varied from 0.4 mm to 3.4 mm Conclusions: Deforming MVCTBCT to kVCT images of the head-and-neck region did not consistently improve landmark matching. However, DIR consistently improved landmark matching when applied to two MVCTBCT images acquired at different times.