

AbstractID: 5334 Title: OpenGL Based 2D-3D Registration of a CT Image Dataset With OBI Images

Introduction. A limiting factor in registration of a three-dimensional (3D) computed tomography (CT) dataset with two-dimensional (2D) x-ray images has been the time-consuming generation of digitally reconstructed radiographs (DRRs). This can be overcome using a commercial graphics card for DRR generation enabling fast, robust, and accurate automatic image-based 2D-3D registration.

Methods and Materials. For the iterative registration process hundreds of DRRs are created using hardware rendering in OpenGL. Each DRR from a 512x512x100 CT volume is rendered in less than 0.1 seconds using an nVidia 7800GT graphics card. The registration is based on a publicly available implementation of Mattes Mutual Information (ITK, U.S. National Library of Medicine, Bethesda, MD). To improve speed, the registration is performed on a sub-image. A two-step registration strategy is adopted for robustness with the first pass using a larger margin around the sub-image and a down-sampled resolution. A thoracic phantom (Model 602, CIRS, Norfolk, VA) was imaged and setup according to our clinical protocol and then shifted from 0-1.5 cm along each of the major axes. Anterior-Posterior and Lateral kV x-ray images were acquired using a commercial patient imaging system (OBI, Varian Medical System, Palo Alto, CA).

Results. The mean registration times were 8 and 16 seconds without and with rotations respectively. We observed a systematic 1.1 mm offset in the longitudinal direction that we believe results from 2.5 mm CT slice spacing and OBI calibration. With this removed the mean three-dimensional distance of the registered positions from the phantom positions was 0.4 mm with the largest disagreement being 0.75 mm. The systems ability to calculate rotations was only tested numerically.

Conclusions. The speed and accuracy of this system demonstrate that it could be a viable tool for reducing daily setup uncertainty by automating the analysis of setup images.

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