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.

Research sponsored by Phillips Medical Systems.