AbstractID: 11515 Title: Assessment of Registration Accuracy in 3D Transrectal Ultrasound Images of Prostates

Purpose: To evaluate the accuracy of our rigid and non-rigid registration methods to align three-dimensional (3D) transrectal ultrasound (TRUS) images of the prostate in order to improve repeat biopsy planning and guidance for prostate cancer diagnosis. **Methods and Materials:** Three 3D prostate ultrasound images were obtained from each of the 16 patients during 3D prostate ultrasound-guided biopsy procedures. These 3D images had identifiable calcifications and cysts, which were used as fiducials for the registration validation. For each prostate, images at two different time points (t_o and t_1) during the procedure were selected and the 3D coordinates of the identified fiducials were recorded. A total of 62 fiducials were identified. All images were then segmented manually and semi-automatically. Images at t_o were registered to the corresponding images at t_1 using rigid and non-rigid registration. Rigid and non-rigid registration was performed using boundary-based iterative closest point and thin-plate spline algorithms, respectively. We evaluated the registration methods by determining the target registration error (TRE), effect of segmentation variability on registration variability, the TRE dependence on fiducial distance from the transducer tip, and the fiducial localization error (FLE). **Results:** Tests showed that the FLE was 1.3mm. The mean TRE for manual and semi-automatic segmentation was 2.2mm and 2.3mm respectively in both rigid and non-rigid cases. There was little correlation between the TRE and the distance of the fiducials from the ultrasound transducer tip, and segmentation variability resulted in a 0.57mm standard deviation of the TRE. **Conclusions:** Our results suggest that both rigid and non-rigid registration techniques for 3D TRUS images during a biopsy procedure are accurate to within 2.3mm, which is less than the 5mm radius of the smallest tumors considered clinically significant. Future tests will evaluate registration accuracy for multimodal cases, specifically magnetic resonance to ultrasound images.