

Assessment of the Accuracy of Registration between Magnetic Resonance Imaging and Three Dimensional Trans-rectal Ultrasound Imaging of Prostate Cancer

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Prostate cancer is the third most common cancer in the world and becomes more prevalent with age. Diagnosis of PCa requires a biopsy, and transrectal ultrasound (TRUS) is often used to guide biopsy needle placement. TRUS-guided biopsies often underestimate or fail to detect the presence of prostate cancer. Magnetic resonance imaging (MRI) has been shown to be extremely sensitive and specific for the detection of prostate cancer. Fused MRI and 3D TRUS images may dramatically reduce the false negative rate of biopsies guided by TRUS alone. To validate the accuracy of registering MR images to 3D TRUS images, a polyvinyl alcohol prostate phantom was constructed with embedded fiducial markers. MRI of the phantom was performed on GE 3T MRI with a combined surface-coil array and endorectal prostate coil. 2D axial T2-weighted MRI images were obtained from the phantom using a fast spin echo sequence. US of the phantom was performed with a Philips HDI 3500 and axial US images were obtained using standard clinical protocols. MRI and TRUS images of the phantom were segmented and registered. The fiducial localization error (FLE) and target registration error (TRE) between corresponding fiducial markers in the registered images were measured. The FLE for US was 0.6 ± 0.4 mm and 0.3 ± 0.3 mm for MRI and the TRE was 1.1 ± 0.1 mm. Neither FLE nor TRE were found to vary significantly with marker position. These results suggest that our technique is sufficiently accurate to allow combined MRI/TRUS image guidance of prostate biopsies.

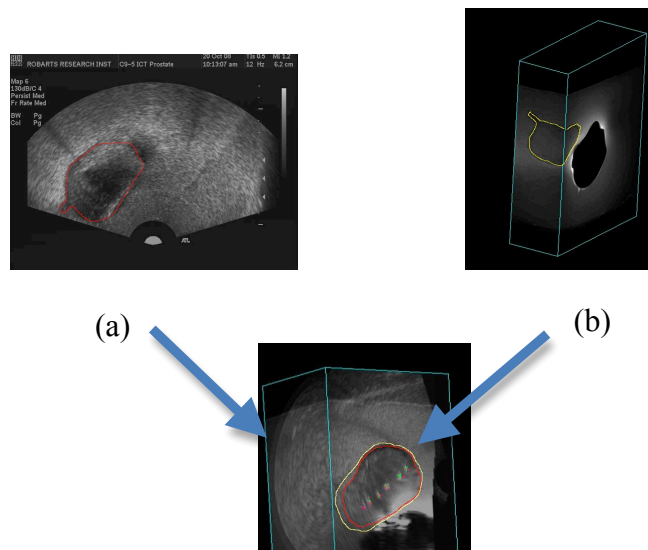


Figure 1: (a) 2D US image of prostate phantom. Red line indicates manually segmented prostate surface. (b) 2D T2 weighted MRI image of prostate phantom. Yellow line indicates manually segmented prostate boundary. (c) Fused US (red line) and MRI (yellow line) volumes after registration along with the surface contours and marker positions (pink (MRI) and green (US) crosses).