AbstractID: 2911 Title: 3D Prostate Model Reconstruction from 2D Transrectal Ultrasound Biopsy Images

Purpose:
Biopsy of the prostate using 2D transrectal ultrasound (TRUS) guidance is the current gold standard for diagnosis of prostate cancer. Physicians' procedural accuracy and precision is limited by working within the current 2D biopsy environment that is susceptible to uncertainties when targeting 3D biopsy locations, which can ultimately result in false patient diagnoses. We propose a technique for the reconstruction of a patient-specific 3D prostate volume from a sparse collection of 2D US biopsy images that may be utilized for intra-biopsy needle guidance and accurate prostate volume calculation.

Method and Materials:
2D TRUS axial and sagittal biopsy images, with known 3D coordinates, were simulated from 3D US prostate image volumes acquired from biopsy patients. The prostate boundaries were manually outlined from each simulated biopsy image and radial basis functions were used to estimate the 3D prostate capsule from collections of 2D boundary outlines varying from 6-16 contours. Each reconstructed prostate model was compared to a manually segmented, 3D planimetry model for volume and surface boundary accuracy as well as the clinical-standard prolate ellipsoid volume estimation technique.

Results:
Prostate models reconstructed from simulated biopsy images ranging from 8 – 16 contours demonstrated a consistent volume error range of 1.3% - 0.38%, which was less than the clinical standard calculation that produced a 1.44% error. The mean prostate surface boundary error for all generated models was consistently < 1 mm with a RMS ~= 1.1 mm.

Conclusion:
We have demonstrated a reconstruction technique capable of generating a 3D prostate model from a small sample of 2D TRUS biopsy images. Initial results suggest the fidelity of this reconstruction technique for generation of prostate models with accurate capsule surface contours and volume measurements, making it a potential tool for 3D intra-biopsy needle guidance and more accurate prostate volume calculations.