AbstractID: 6855 Title: Registration of Ultrasound Tissue-Typing Images with CT Images for Image-Guided Prostate Cancer Radiation Therapy

Purpose:
To develop an image registration scheme, which combines both rigid and deformable registration techniques, to map the ultrasonic tissue typing (UTT) images to the computed tomography (CT) images for tumor targeted prostate IMRT treatment.
Method and Materials:
UTT spectrum analysis can identify the cancerous regions inside the prostate to guide prostate radiation therapy. Current IMRT treatment plans for the prostate are designed on CT images. We developed a rigid registration followed by a deformable registration scheme for tumor region mapping between CT and UTT images. The rigid registration was achieved by adjusting the relative position of the two image sets until the mutual information between them was maximized. The deformable registration was based on a biomechanical model and finite element method (FEM). The prostate from both image sets was outlined by the clinician and the surface deformation between the two contour sets were fed into the FEM software algorithm to derive the volumetric displacement inside the prostate. When the voxel points correspondence between two image sets were known, the tumor area detected with UTT was mapped onto the CT images and used for 3D planning for dose escalation.
Results:
The algorithm was validated using a tissue mimicking deformable prostate phantom and ten prostate specimens. The urethra served as a marker for verifying the registration process. For phantom and *ex vivo* study, the displacement of the urethra matched well between the CT images and the deformed ultrasound images. The distribution of the 2D matching errors for the urethra central point had a mean and standard deviation of 2.0mm ± 1.1mm. We started to apply our registration scheme using *in vivo* prostate scans.
Conclusion:
We validated our registration scheme with our phantom and *ex vivo* studies. We demonstrated the feasibility of clinically employing this UTT method for intra-prostatic tumor dose escalation.