

Purpose: The prostate contours drawn by physicians on CT images tend to overestimate the real volume due to the poor contrast between the prostate and the surrounding soft tissues. The aim of this study was to utilize ultrasound (US)-CT to guide a more accurate prostate segmentation for prostate IMRT planning.

Method and Materials: In US-CT modality, the ultrasound system (Restitu™, Resonant Medical System, Montreal, Canada) was integrated with CT-Sim through an optic camera system, which was calibrated to the intersection point of wall lasers of CT-Sim and was able to trace the position of ultrasound probe in real-time. Thus, for each patient, the CT scan and ultrasound scan can take place at the same position and almost the same time. After compensating for the mechanical inaccuracy of CT-sim and the image distortion of 3-D US images due to inconsistent ultrasound wave propagation speed in different tissue types, 3-D CT and 3-D US images can be superimposed together naturally, since they share the same spatial coordinate system. Thus, the prostate contour drawn on 3-D Ultrasound images can be transferred into CT images for IMRT planning.

Results: Five patients underwent 3-D US-CT scan in this study. First, a physician contoured the target volumes and surrounding critical organs on CT images. Then the prostate was contoured on US images for comparison. The fused US-CT images revealed that the discrepancy between the prostate volume drawn on CT images and ultrasound images takes place mostly at the lateral surface of prostate and the interface between prostate and rectum. The volume of the prostate drawn on US images is 30%~50% less than that obtained from CT.

Conclusion: Ultrasound-CT, a new multi-modality imaging system, has a potential to provide a more accurate prostate anatomy definition for prostate IMRT planning thereby reducing radiation dose to surrounding critical structures.