AbstractID: 9158 Title: Accuracy of implicit registration between CT and 3D US in the radiotherapy simulation process

Purpose: The Clarity™ system (Resonant Medical) consists of 3D ultrasound (US) devices in both the CT-Sim and treatment rooms. The former provides fused CT/US datasets for treatment planning as well as a reference for daily US positioning. CT and US datasets are implicitly registered, i.e. they share a common coordinate system through calibration. The purpose of this retrospective study is to quantify the accuracy of the implicit registration on both phantom and patients.

Method and Materials: Accuracy is first validated by acquiring images of a phantom with structures visible on both modalities. Implicitly registered CT/US images of 19 sequential prostate patients were then analyzed. To validate the registrations, the bladder was used as the most reliable landmark because of its high contrast on both imaging modalities. The planning CT bladder contours were superimposed on the corresponding US images and shifted to best-fit the bladder neck. The prostate was used as a secondary landmark, where percentage overlap of independently contoured CT and US based contours was calculated. Probe pressure at the patient's skin was also calculated for each patient.

Results: The US and CT images of the phantom registered within 1 mm. The mean (standard deviation) shifts of the bladder neck between CT and US were –1.5 (1.3) mm, -0.3 (1.7) mm and 0.5 (1.0) mm in the A/P, L/R and S/I directions respectively. The percent prostate contour overlap was 89.9% (7.6%). Probe pressure depressed the skin on average by 37.6 (9.5) mm.

Conclusion: Implicit registration of CT and US is accurate on both phantom and patients despite a mean probe pressure of over 37 mm. The complementary nature of CT and US can thus be reliably used for treatment planning, and the 3D US images can be used as an accurate reference for US-to-US positioning in the treatment room.