AbstractID: 8588 Title: An Accuracy Improvement of Ultrasound-CT modality for Ultrasound Guided Prostate IMRT Planning

Purpose: Ultrasound (US)-CT modality has a potential to provide accurate target definition for prostate IMRT planning. However, several physical uncertainties, such as the US speeds in different soft tissues and the US probe pressure on abdomen, may degrades the accuracy of this modality. The aim of this study is to improve the accuracy of US-CT modality for US-guided prostate IMRT planning.

Method and Materials: Five patients were evaluated in this study. A 3-D US-CT scan was performed for all patients. Three steps were adopted sequentially to reduce the uncertainties of US-CT modality. First, three BBs were placed on the patient's skin to compensate for the mechanical inaccuracy of wall lasers of CT-sim and table sag. Second, a finite element method was applied to trace the displacement of prostate induced by US probe pressure. Finally, CT images were used to distinguish soft tissues which corresponded to different US propagation speed. The three-dimensional vector displacement of prostate obtained from these three steps was applied into US-CT match. A physician contoured the prostate and bladder on both Ultrasound and CT images. The accuracy of such correction was evaluated by the overlapping volume ratio (OVR), which is the ratio of the overlapped prostate volume between US and CT over the prostate volume on US images.

Results: For all the patients, the US probe-induced abdominal skin deformation and fat thickness ranged from 2cm to 4.7cm and from 1.7cm to 5.2cm, respectively. Compared to the US-CT match without correction, the proposed method increased OVR value from 0.796±0.189 to 0.972±0.041.

Conclusions: To obtain more accurate US-CT match for US guided prostate planning, the US speed in different soft tissues and the probe-induced deformation has to be taken into account, especially when subcutaneous fat is thicker than 3cm or the deformation of abdominal skin is larger than 2cm.