AbstractID: 8218 Title: 3D ultrasound techniques for accurate dose delivery

Purpose: To evaluate the use of a 3D ultrasound system capable of multimodality image fusion for: inter-fraction image guided adaptive radiation therapy through an assessment of dose distributions to changing cervical node geometry; and prostate visualization and delineation through an assessment of contrast enhanced harmonic imaging.

Methods&Materials: An ultrasound transducer with active infrared emitters was used to collect spatial sequences of 2D ultrasound slices. A ceiling-mounted optical tracking camera acquired the position and orientation of the transducer in order to reconstruct a 3D volume, and to synchronize image positions with the room coordinate system. Two ultrasound probe-camera systems were used in this study; one located in the computed tomography simulator (CT) room for treatment planning and automatic fusion with the CT image, and the other located in the linac room for treatment delivery monitoring. A linear array transducer was used to monitor cervical node metastases in patients with primary sites in the head and neck. A curved array transducer was used in the pulse inversion harmonic imaging mode (PIHI) to acquire images of the prostate with the aid of an ultrasound contrast agent. For dose calculations the XVMC Monte Carlo code was used to transport particles through the patient.

Results: Fused with the CT images, the ultrasound information facilitated inter-fraction cervical node delineation, demonstrating changes up to 11% in the dose to 95% of the nodal volume within one week from the beginning of treatment. PIHI of the prostate perfused with contrast medium offered enhanced prostate delineation compared to the surrounding organs.

Conclusion: Non-invasive and fast, 3D ultrasound image acquisition, with the optional use of contrast agents, may lead to improved target delineation and monitoring throughout the course of treatment. And with the aid of Monte Carlo dose calculations, reconstructed ultrasound volumes of the target can facilitate adaptive radiation therapy.