AbstractID: 3851 Title: TOMAS, a Tool for Organ Motion AnalysiS

Purpose: On line cone-beam x-ray CT is a promising technique for image-guided-radiation-therapy (IGRT) by virtue of its ability to provide soft tissue contrast in 3D. IGRT enables correction for inter-fraction set-up error and organ motion, which can improve accuracy and opens potential for using smaller set-up margins. The key to IGRT margin determination lies in understanding intra-fraction organ motion, representing a paradigm shift from conventional treatments, where inter-fraction motion dominates. We present a technique and software tool to study intra-fraction motion, and present preliminary applications to cervix and prostate.

Methods and Materials: Single shot fast spin echo (SSFSE) MR sagittal images were acquired every 2 seconds at several slice locations through the target volume in several patients. Images were acquired over a period of twenty minutes, corresponding to a typical treatment fraction. Images were analyzed in a motion analysis software tool developed in Matlab. Special functions were developed to quantify aspects of target motion, including rigid body translations, drift, deformation, and rotation. Explicit functionality was also developed to analyze frequency aspects of intra-fraction motion.

Results: Significant inter-patient variability of organ motion has been observed over time periods consistent with typical daily treatment time. In a cervix case a general drifting and rotation of the target position was observed (15 degrees), correlating with bladder filling. This was not observed in other cases. Observations of prostate motion suggest that the prostate maintains a relatively stable mean position and has only transitory discursions of up to 1cm related to rectal gas.

Conclusion: Preliminary investigations of cervix and prostate target motion indicate that characterization of intra-fraction motion is an important pre-requisite for determining optimal margins in IGRT treatments. A tool incorporating analysis of the frequency of motion will be presented to translate characterized motion into meaningful tumor margins.