AbstractID: 11654 Title: Intrafraction prostate motion monitoring with cine-MV and minimal as-needed onboard kV imaging

Purpose: To examine the feasibility and performance of using treatment MV beam imaging with prior knowledge to estimate 3D prostate intrafraction motion and to instantaneously reposition based on information from minimal usage of on-board kV imaging during IMRT. **Methods and Materials:** In contrast with current motion monitoring techniques which seek to accurately and continuously localize a moving target, we attempted for the first step only to detect potential motion beyond a pre-defined threshold using MV images and in the second step through combined MV-kV imaging (by turning on the kV imager) to confirm the over-threshold event as well as obtaining accurate position information which could be used for instantaneously repositioning. EPID images were used to measure 2D prostate displacement in the imaging plane. By taking into account the strong correlation between prostate SI and AP motion, small displacement in the LR direction, and data from a previous IMRT session (different gantry angle), we estimated in-line prostate motion as well which in turn allowed us to detect potential 3D over-threshold motion. To minimize the influence from training data, no statistical motion probability distribution information was used. Simulation has been done using 536 patient-measured trajectories from 17 patients. Experiments were performed on a Varian Trilogy linac using a motion phantom programmed for selected typical trajectories, and the results were compared with simulations. **Results:** Prostate displacement beyond a set threshold (3mm) was detected for over 99% of the time at the cost of negligible kV dose (< 3 images/fraction on average). The position information required for repositioning was found to have sub-millimeter accuracy using combined MV-kV data. **Conclusion:** Significant reduction of adverse effects of intrafraction prostate motion is achievable. The technique can be readily implemented in clinics and incurs minimal imaging dose to the patient as compared with other stereoscopic imaging techniques.