AbstractID: 12972 Title: DMLC implementation of a prostate intrafraction motion correction strategy based on failure detection concept

Purpose: To develop a dynamic MLC-based real-time motion tracking system through stereoscopic MV-kV target localization and to utilize a failure detection concept to reduce kV imaging dose while maintaining high targeting accuracy. **Methods and Materials:** Continuous MV-kV target localization, although informative, imposes excessive kV imaging dose. In order to reduce kV usage, we attempted for a first step to only detect potential motion beyond a pre-defined threshold using MV images and in a second step, through applying as-needed MV-kV imaging, to confirm the over-threshold event and obtain accurate marker position information which could be used to instruct instantaneous MLC adjustment. This technique is particularly useful for slow non-periodic motion. A Varian Trilogy linac with onboard imaging and a Millennium 120-leaf MLC was used to examine selected typical prostate trajectories using a 4D motion platform. Geometric and dosimetric tracking performances were evaluated by tracking a moving gold marker during dose delivery from 7 gantry angles. In-house designed software was used for marker extraction, decision making, and MLC adjustment. **Results:** Total system latency from occurrence of an over-threshold motion to the end of MLC repositioning was found to be 0.5 – 0.6 sec. The target was kept within a preset 2.5mm range 99% and 96% of the beam-on time requiring only 1 and 13 kV-on for a slow drifting and a high-frequency motion case, respectively. The MLC repositioning accuracy is ~0.5mm with system calibration. Dosimetric benefits are seen in reduced failure rate of the gamma-test applied to dose measurements. **Conclusions:** Cine MV imaging during therapy delivery provides a valuable tool for detecting non-negligible intrafraction prostate motion and facilitates intelligent kV use to significantly reduce imaging dose. Successful integration of this monitoring strategy and DMLC motion compensation is demonstrated. The developed system is intriguing for prostate intrafraction motion management with low kV imaging overhead.