AbstractID: 9663 Title: Nearly Real-Time Tumor-Position Monitoring during Arc Therapy with Combined MV and kV imaging

Purpose: To examine the feasibility and accuracy of using treatment MV beam and on-board kV imaging for monitoring of the positions of implanted fiducials during arc therapy.

Method and Materials: A Varian Trilogy LINAC with onboard kV imager was used for the study. A phantom with 13 ball bearings at known locations was used to calibrate the hybrid MV/kV imaging system to determine the spatial transformation matrix from the pixel coordinates to the radiation-source-centered coordinates. The feasibility and accuracy of the fiducial tracking system was examined using a 4D motion phantom capable of moving in accordance with a pre-programmed trajectory. During an arc delivery, MV images acquired by the EPID and cine kV images were obtained simultaneously using a two-channel frame-grabber for real-time analysis. A fast fiducial detection algorithm was developed to extract fiducial coordinates. Tracking results are compared with the preset trajectories. The accuracy of the tracking system was evaluated for a number of fiducial motion trajectories and for a variety of kV beam sampling rates ranging 15fps to 0.5fps.

Results: The studies showed that it is feasible to use treatment MV beam and the orthogonal kV beam to monitor the fiducial motion in nearly real-time during arc therapy. A time delay of ~150ms was observed, which was caused by the imaging electronics and data analysis. This delay does not pose any significant error in fiducial tracking for the motion speed commonly seen in the clinics and can be compensated by a motion prediction algorithm when needed. Overall, the spatial accuracy was found to be better than 1mm.

Conclusion: Nearly real-time monitoring of implanted markers using hybrid MV/kV imaging during arc treatments is achievable. The system requires no hardware modification and delivers much less dose to the patient as compared with the conventional stereoscopic imaging technique.