

AbstractID: 8547 Title: Tracking multiple moving fiducials during treatment based on simultaneous onboard kV and treatment MV imaging

Purpose: Intra-fractional organ motion can limit the advantage of highly conformal dose techniques as IMRT due to target position uncertainty. A new strategy has been proposed and investigated to track implanted fiducial markers during treatment on a LINAC with an onboard kV imaging system by using simultaneous kV and treatment MV beam imaging.

Method and Materials: A pelvic phantom implanted with three gold cylindrical seeds was tested on a moving platform on a Varian Trilogy. Two phantom verification plans for 3DCRT and IMRT treatments from real patients were delivered on this phantom while the platform was moving at different speeds. A new pattern matching algorithm has been developed to locate multiple cylindrical fiducials on MV and kV images. Their 3D positions were then calculated from simultaneous orthogonal MV and kV imaging results.

Results: Four issues were studied towards the clinical application of this method. 1) Multiple methods were adopted to predict marker positions and reduce search regions to achieve an analysis speed of 10 frame/second. 2) The kV and MV images were acquired while the phantom was moving at various speeds and fiducials could be successfully detected at a linear speed of 1.6 cm/s or less. 3) Varying MV field size and kV source to imager distance indicated that the detection of fiducials on kV images was not affected by the scattering from simultaneous treatment MV beams. 4) Prediction based on relative positions of fiducials was used to closely locate positions of fiducials blocked by a multileaf collimator.

Conclusions: These four studies pave the way to automatically track nearly real-time 3D positions of multiple moving fiducial markers during treatment based on simultaneous kV and MV imaging. It does not require extra hardware such as stereo kV imaging systems and utilizes the treatment beam to reduce dose.