AbstractID: 13528 Title: Electromagnetic Detection and Real-time DMLC Correction of Rotation During Radiotherapy

Purpose: A novel system has been developed to detect and correct tumor rotation in real-time during radiotherapy delivery. The aim of this study was to quantify the geometric accuracy of the system.

Method and Materials: A research Calypso system was integrated with a real-time DMLC tracking system, employed on a Varian IX linac. Three 3mm diameter tungsten balls (markers) were embedded in the phantom, along with implanted electromagnetic transponders. EPID images were acquired for an elliptical beam, from which the beam aperture and tungsten balls were synchronously observed. For static rotation, the couch was used; for dynamic rotation, the couch was manually rotated continuously from 90 deg to 180 deg through the console. The dynamic rotation experiment was also performed by overlying the EM embedded phantom on a motion platform, rotating with a period of approximately 8 seconds. For all measurements, the beam-target rotational alignment was determined as the difference between the major axis of the ellipse best fitting the rotated beam aperture and the marker orientation of the rotated target. The beam-target translation alignment was determined by the different between the beam aperture center and the geometric center of the markers.

Results: For static rotation, the beam-target rotational alignment error was 0.9 ± 1.7^0. For dynamic rotation the alignment error was 0.3 ± 1.4^0. Both tests demonstrate sub-degree accuracy for the tracking system. The beam-target translational alignment error was 0.2±0.2mm.

Conclusion: For the first time, real-time target rotation has been accurately detected and corrected during treatment via MLC adaptation. The beam-target rotational alignment accuracy is <1 degree; translational alignment is <1mm. The results show promise for improving radiotherapy targeting accuracy for a variety of tumor sites and motion types.

Conflict of Interest: Supported by Calypso, NIH R0193626 and Varian.