AbstractID: 10823 Title: Development of a Dynamic kV Collimator for Low Diagnostic Dose Real-Time 3D Motion Tracking during Radiation Therapy by Combined MV-kV Imaging

Purpose: Currently, real-time 3D MV-kV monitoring requires the use of continuous kV imaging throughout the treatment process leading to high diagnostic dose costs. For MV-kV tracking purposes the only needed kV image information are the projected images of the metallic fiducial markers. Generally these markers are small (3mm in length and 0.8mm in diameter), and for a standard 40cm x 30cm kV image comprise less than 1% of the total area. The proposed technique here uses a dynamic kV aperture to confine the kV exposure to a small region of interest (ROI) encompassing only the markers. As the internal markers move, the aperture is dynamically updated using feedback information provided by the last known marker positions.

Method: A Varian Trilogy equipped with both an EPID and a kV imaging system was used. The kV collimator was mounted over the kV source and consists of four lead blades placed orthogonally on low friction linear guide rails. The position of each blade was controlled independently using a servomotor. MV-kV imaging was performed and software was used to calculate a suitable ROI that will be used as an input for the kV collimator. As the internal markers move, the aperture will be dynamically updated using the last known marker positions.

Results: The combination of controller circuitry and chosen servomotors allows for blade travel speed of up to 11mm/s, depending on orientation, with an accuracy of 0.2mm in the collimator plane. This should be sufficient to keep the ROI properly centered on nearly any fiducial cluster.

Conclusion: The technique proposed here would potentially lower the kV exposure by a factor of 50–500 depending on the speed, number, and spatial separation of the fiducials. The technology is directly applicable to any kV imaging system where only selective ROI information is required.