AbstractID: 9480 Title: A real-time dynamic-MLC control algorithm for delivering IMRT to targets exhibiting 2D rigid motion in the beam's eye view

Purpose: We have developed a real-time MLC control algorithm that allows for delivery of dynamic-MLC (DMLC) IMRT to targets exhibiting 2D rigid motion in the beam's eye view (BEV).

Method and Materials: The control algorithm consists of two components: 1) Construction of baseline DMLC leaf trajectories, and 2) real-time control loop. The synchronized baseline leaf trajectories are constructed using target motion data that is collected prior to delivery. Only target motion that is aligned with leaf travel is included in this step. To account for target motion in the BEV that is not aligned with leaf travel, we have implemented a real-time leaf-pair switching mechanism, which allows the MLC to track motion along this axis in discrete increments of the leaf width. Using patient data, 36 target trajectories were constructed. One of these trajectories was used to construct the baseline leaf trajectories, and the others were used to simulate a 35 fraction IMRT treatment. Errors were analyzed using difference maps and a distance-to-agreement analysis.

Results: The results indicate that 2D tracking resulted in deliveries that were superior to both no tracking and 1D tracking. A 160ms system lag time produced errors that were approximately equal those that resulted from ignoring one component of motion altogether. Additional results show that the algorithm's performance is very insensitive to the level of agreement between the target motion collected prior to delivery, and the motion observed during delivery.

Conclusion: Over the course of a fractionated IMRT treatment, the MLC tracking algorithm is able to accurately compensate for 2D rigid target motion in the BEV. The performance of the algorithm is insensitive to the difference between the target motion measured during planning and the motion that actually occurs during delivery.