

Purpose: Assume image system in the treatment room provides the information about target motion/deformation during therapy in real time. The ultimate utilization of this information calls for applying it to the intensity modulated therapy so that intensity maps dynamically shift and deform in conjunction with the target motion. This presentation describes algorithms for the control of MLC leaves that deliver real time image guided therapy described above.

Method and Materials: Target motions and deformations are modeled from data registered in real time. Real time IMRT aims for (1) delivery of predetermined intensity to target and surrounding tissue, (2) minimized time of delivery and (3) limitation of maximum speed of leaf motions to below the speed of maximum velocity admissible for MLC. As goals (1) and (3) constitute indispensable conditions of IMRT delivery the minimization of the time of delivery (2) has to be sacrificed. Thus the original set of equations relating leaf positions and velocities to deliver the predetermined intensity is set as the problem with over-restrictive conditions on leaf speeds. Random perturbations are then imposed over target motions and relationships between leaf velocities are appropriately modified to respond to perturbations. This assures that the slope of local intensity is properly shaped at each point of moving target with unpredictable real time registered motions of the target.

Results: A sequence of representative examples delivering real time IMRT to moving/deforming targets is presented. Examples considered are characterized by varied intensities and different pattern of target motions/deformations. Deliveries of planned intensities, with and without corrections for changes in target motions/deformations, are calculated and inter-compared.

Conclusion: MLC leaf motions can be controlled in real time so that image guided DMLC IMRT delivery is feasible provided image system in the treatment room communicates to MLC controller target motion/deformation data during therapy in real time.