AbstractID: 2852 Title: DMLC leaf-pair optimal control for mobile, deforming target

Purpose: Tumors in the lung and abdomen tend to move and deform during the course of respiratory cycle. To deliver the intensity modulated therapy, in which intensity map dynamically shifts and deforms in conjunction with the target motion, algorithms have to be developed that control appropriately leaf progression in DMLC IMRT. Description of such algorithms is the purpose of this presentation.

Method and Materials: Target motions and deformations are simulated by analytic, periodic functions dependent on position and time. Derived infinitesimal relationships between leaf velocities at all leaf positions assure delivery of the predetermined intensity map. Derived formulas lead to a system of interdependent ordinary, differential equations. When minimization of time of DMLC IMRT delivery is required equations are uniquely defined by scalar fields that are determined by intensity function, target local velocities and target local parameters of deformation, together with constraints on maximum leaf speeds. Integration of differential equations provides trajectories for MLC leaves and thus determines the algorithm for relevant DMLC motion controls.

Results: A representative example of DMLC IMRT delivery to deforming target is presented. The example shows the delivery of analytically defined double parabolic intensity function to target undergoing oscillatory type deformation. Target deformation is assumed to be spatially uniform. Deformation of the target, as well as trajectories of leading and following leaves, are calculated and graphically represented for this example. The snapshots of leaf positions at various stages of intensity delivery are also shown.

Conclusion: Algorithms are developed for the control of MLC leaf motions that make possible delivery of DMLC IMRT to targets experiencing deforming motions. These realizations of IMRT therapies to deforming targets prevent any discrepancies, rooted in target's dynamic distortions during treatment, between intended and actual intensities delivered to the target.

Conflict of Interest: None