AbstractID: 9480 Title: Synchronized Moving Aperture Radiation Therapy (SMART): Superimposing Tumor Motion on IMRT MLC Leaf Sequences under Realistic Delivery Limitations

Synchronized Motion Adaptive Radiation Therapy (SMART) has recently been proposed as a new technology for treating tumors in thorax and abdomen where respiration-induced organ motion is often non-negligible. The idea is to develop IMRT MLC leaf sequences that can deliver the desired dose distribution to a mobile target with predictable motion pattern under breath coaching. One way to implement this idea is to perform IMRT inverse planning and leaf sequencing for the tumor geometry 'frozen' at a particular breathing phase, then superimpose on the leaf sequence the tumor average trajectory (ATT) measured during the simulation. It is crucial to have the leaf positions well defined in temporal domain, and beam interruptions and dose rate modulations should be eliminated during the delivery. In the present work we study how to develop a motion-incorporated leaf sequence under realistic delivery limitations such as limiting leaf velocity, the leaf position tolerance, collision avoidance, acceleration effects, and the communications delay in the control system. We also investigate the dependence of the motion-superimposed leaf sequence on dose rate, initial breathing phase when the treatment starts, and the collimator angle. With all factors considered, a practical procedure is developed for superimposing the tumor motion onto an MLC leaf sequence. The procedure is validated by comparing the desired fluence maps and the delivered fluence maps in the target system.

Supported by the Whitaker Foundation.