AbstractID: 10352 Title: Planning Methods for Rotational IMRT on Linear Accelerators

The process and concept for rotational IMRT (R-IMRT) planning are similar to that of fixed-field IMRT. However, the increased complexity of a R-IMRT plan makes it significantly more computationally difficult to plan. The main differences are the increased number of beams used in the optimization and the consideration of interconnectivity of beam apertures in leaf sequencing. These obstacles have slowed the clinical implementation of R-IMRT despite its clinical advantages.

Within the past few years, planning methods for R-IMRT have attracted great interest in the radiation oncology community in order to exploit its significant clinical advantages. The two fundamental methods for R-IMRT planning parallel that of fixed-field IMRT: a two-step approach (utilizing optimization and leaf sequencing) and an aperture based approach. With the two-step approach, the optimization does not differ much from fixed-field IMRT, where static beams are defined and fluences subsequently optimized for each beam angle. However, the leaf-sequencing aspect is significantly more complicated due to the interconnectedness of the apertures within an arc. The physical limits of the linear accelerator and dosimetric differences between discrete and continuous leaf movement limit the distance leaves can travel between adjacent beam angles within an arc. For aperture based approaches, these limits are typically included in the optimization itself.

The first conceptualization of R-IMRT, intensity modulated arc therapy (IMAT), was proposed by Yu as a series of overlapping arcs, whereby the linac gantry rotates multiple times about the patient. Overlapping arcs produce intensity modulation at any given beam angle. While multi-arc IMAT has considerable dosimetric advantages, delivering R-IMRT plans in a single gantry rotation has drawn much attention recently primarily due to the extremely fast delivery times. Commercial applications have been developed for the planning and delivery of single-arc R-IMRT plans, most notably RapidArc from Varian.

An overview of current planning techniques for both multiple-arc and single-arc R-IMRT will be given. Particular attention will be paid to the delivery limitations and the associated challenges in planning will be discussed. Both aperture based and leaf-sequencing techniques, along with their benefits and drawbacks will be examined.