AbstractID: 13944 Title: Delivery Time Minimization for Robotic Radiosurgery and IMRT Treatments

Purpose: Robotic radiation delivery systems can accurately deliver conformal dose distributions for clinical applications throughout the body. Here we describe methods to reduce treatment times for step-and-shoot robotic radiation delivery while maintaining the dosimetric quality of the treatment plan. **Method and Materials:** Treatment delivery time, excluding patient setup, depends primarily on three parameters: beam-on time, number of positions (called nodes) of the linear accelerator, and the number of beams delivered per node. New optimization techniques reduce treatment time by direct reduction of the number of nodes and beams. These techniques iteratively remove low-utility nodes and beams from the solution space and optimize the beam weights of the remaining beams. Annealing schedules are developed based on a user-specified treatment time and the number of nodes in the solution set. The algorithms were evaluated on plans for standard fractionated prostate robotic IMRT, hypo-fractionated prostate radiosurgery, spine radiosurgery, and lung SBRT. **Results:** The algorithms reduced treatment delivery times (excluding patient setup time) per fraction by as much as 60% for prostate robotic IMRT, 35% for prostate radiosurgery, 25% for spine radiosurgery, and 50% for lung SBRT. The implementation of the new optimization features allows the user to explore trade-offs in treatment plan quality and delivery time by generating a family of plans that correspond to varying treatment times. Substantial time reductions were obtained for most cases while maintaining plan quality and meeting established clinical criteria (e.g., RTOG-0238 for prostate radiotherapy and RTOG-0618 for lung radiosurgery). Although the number of nodes was reduced, the remaining nodes still encompassed a large non-coplanar workspace. **Conclusion:** New optimization techniques are described that significantly reduce delivery times for robotic radiosurgery, SBRT, and IMRT treatments. Reduced treatment times increase patient throughput and improve patient comfort. **Conflict of Interest:** The authors are employed by Accuray Incorporated, Sunnyvale, CA.