AbstractID: 13569 Title: Segment-modulated arc radiation therapy: single arc inverse planning with binary programming and exact leaf-sequencing algorithm

Purpose: The challenge of arc radiation therapy inverse planning mainly comes from the increased optimization problem size and the strong MLC constraints due to the fast gantry rotation. Many optimization algorithms have been proposed in the literature with different strengths and drawbacks while an ultimate solution is yet to be found. **Method and materials:** In this paper, we propose a novel inverse planning algorithm referred to as segment-modulated arc radiation therapy (SMART). The optimization problem has a quadratic dose objective, and the decision variables include binary status (open or close) of each beamlet and the segment weight for each field. In the optimization process, each iterate is decomposed into the following steps: (1) A small number of (typically 36) binary MLC patterns are created by the binary simulated annealing algorithm, which are then used to generate trial aperture shapes for the 180 control points in the 360 degree arc; (2) A fast pattern-decompose algorithm is then applied to generate an aperture for each of the 180 control points under the constraint of MLC hardware; (3) The dose distribution is calculated by using the apertures and the beamlet-kernels and then the planning objective are evaluated; (4) Go to step 1 if the convergence condition is not met; Otherwise, save the plan. **Results:** The proposed approach was demonstrated using a pancreas case and a prostate case and compared with DAO method. Our results show that the method produces a highly conformal IMRT plan, which requires ~ 3 minute to deliver. **Conclusion:** The derived plans achieve dose distributions equivalent or superior to the direct-aperture optimization (DAO) based arc therapy treatment planning.