AbstractID: 10595 Title: Inverse planning for segment-modulated arc therapy (SMART) as a 0-1 labeling problem

Purpose: Segment-modulated arc therapy (SMART) is an efficient and precise radiotherapy modality which is recently available (e.g. Varian RapidArc). The purpose of this work is to propose a novel algorithm for SMART inverse planning by using the concept of binary image labeling. **Method**: The aim of SMART treatment planning is to find an optimal segment shape and weight for each of a series of consecutive control points to achieve a clinically favorable dose distribution. For this purpose, the planning objective is defined as the sum of a traditional dose/volume objective and a segment objective. By conceiving segmented field as a binary image (1 for open, 0 for close) defined on the MLC plane, the segment objective is set as the total-variation of the image along the leaf-motion direction. In the proposed algorithm, the segment shape is not managed by its boundary. Instead, a segment is directly modulated by opening or closing the pixels. To optimize the system, simulated annealing (SA) technique is utilized. Initially, a segment is set by randomly open/close the image pixels. In each step of SA, a beamlet is randomly selected and switched (0→1 or 1→0). The segment weights are determined applying quadratic programming to minimize the dose/volume objective. Then the segment objective and the total objective are calculated. SA algorithm stops when the planning criteria are satisfied. **Results:** The proposed algorithm was evaluated by a prostate case and it is observed that our algorithm produces a highly conformal IMRT plan. By applying the segment objective, the open pixels in a segment are gradually connected in leaf motion direction as the system converges and a deliverable segment forms. **Conclusions:** A novel SMART inverse planning algorithm, working on beamlet space by using binary labeling concept, was developed and tested.