

AbstractID: 3996 Title: Fast Integer-Valued Smoothing of Beam Profiles in Intensity Modulated Radiation Therapy

Purpose: The delivery time for an intensity-modulated radiation therapy plan using the step-and-shoot method may be impractical for complex beam profiles that require a large number of segments. We propose a fast smoothing algorithm which smooths a beam profile to integer-valued intensities.

Method-and-Materials: An integer program was formulated that smooths a beam profile to integer-valued intensities. The user specifies the permitted intensity level values, the maximum number of intensity levels, and the percentage of total under-/over-dosage permitted. The IP minimizes the absolute difference between each beamlet intensity and a weighted average of the intensities of the beamlet's nearest neighbors (and itself) in the smoothed plan. The method is tested on two optimal head-and-neck plans, each with seven beams. Both plans were designed so that no pixel is permitted to have an intensity greater than 20. The number of intensity levels in each beam ranges from 71 to 124.

Results: For all beams, a feasible integer solution was obtained within 15 seconds. This held true even after the total intensity delivered by the smoothed beam profile was constrained to be either the floor or ceiling of the total intensity of the original beam profile. The smoothed profiles were permitted to use up to ten distinct integer values between 1 and 20.

Conclusion: This work indicates the potential of a quick heuristic for smoothing complex intensity profiles. The resulting beam complexity reduction improves deliverability of the leaf sequence of each beam. Further research is necessary to determine the effects of local changes in beamlet intensity on the dose received by the planning target volume and organs-at-risk.