AbstractID: 5776 Title: Efficient IMRT Delivery -- Fast Generation of Integer-Valued Beam Profiles

Purpose: The delivery time for an intensity-modulated radiotherapy 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 algorithm that simplifies beam profiles to integer-valued intensities, which results in dramatic reduction of leaf-segments, while maintaining the ``goodness'' of the original-optimized-plan.

Method-and-Materials:An optimization model was designed to simplify a beam profile to integer-valued intensities. The user specifies the permitted intensity level values, the maximum number of intensity levels, and the acceptable percentage of total under-/over-dosage. The model 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 resulting plan. The method is tested on several cases of head-and-neck and prostate cases, each with seven beams. In the original-optimized-plan, the number of intensity levels in each beam ranges from 97 to 153.

Results:For all beams, an optimal integer solution was obtained within 15seconds. This held true even after the total intensity delivered by the simplified-beam-profile was constrained to be either the floor or ceiling of the total intensity of the original beam profile(the tightest possible). The simplified-beam-profiles were permitted to use up to ten distinct integer values(between 1-20). There is virtually no difference in conformity, homogeneity and dose distribution in PTV(all within 0.02%), as well as in all OARs. The total intensities deposited between the original-optimized-plan versus the resulting simplified plans are within 0.45%. Running through Siochi's leaf-sequencer, the resulting segments reduce from 89-151 to 14-39 for all simplified plans.

Conclusions:This work indicates the potential of a quick algorithm for simplifying complex intensity profiles while maintaining good plan quality. The resulting beam complexity reduction improves deliverability of the leaf sequence of each beam. The algorithm takes only seconds to complete, thus making it realistic for clinical implementation.