AbstractID: 8425 Title: Establishing a trade-off between number of beams and plan quality in robotic radiosurgery

Purpose:
To study the potential trade-off between the number of beams and the plan quality in robotic radiosurgery. Specifically, to assess, whether the number of beams can be reduced by repeating the series of optimization steps on a subset of substantially weighted beams.

Method and Materials:
We use a linear programming formulation of the planning problem, where objective terms are matched by corresponding constraints. The optimization is decomposed into a series of steps. When a plan with acceptable quality has been obtained, the activation time of the beams is studied. Beams with an activation time below a threshold are removed from the plan. We then compare the effect of (A) rescaling the weight of the remaining beams to obtain at least 98% of the previous coverage, and (B) to re-optimize the beam weights by applying the series of optimization steps to the reduced set of beams. The methods are applied to three clinical cases, a spinal lesion, a head and neck tumor, and a prostate case.

Results:
We removed up to 17.6%, 52.3%, and 28.4% of the beams for the spinal, the head and neck, and the prostate case, respectively, while retaining the plan quality with reoptimization. In contrast, rescaling changed the dose distribution substantially and the plan quality metrics degraded to an unacceptable level.

Conclusion:
Removing low weighted beams can reduce the number of active beams, and hence the overall treatment time. Reoptimization using the original series of optimization steps leads to better plan quality compared with rescaling. The potential to reduce the number of beams while retaining plan quality depends on the clinical case, and the fraction of beams that is removed.

Conflict of Interest (only if applicable):
Research partially sponsored by Accuray Inc.