AbstractID: 8959 Title: A Unified Approach to Beam Angle Selection and Dose Optimization with High-Throughput Computing for IMRT

Purpose: To present a unified approach to solving the Beam Angle Selection (BAS) and Dose Optimization (DO) problems in radiation treatment planning using a Nested Partitions (NP) framework.

Method and Materials: The NP framework is a powerful new optimization paradigm that combines adaptive global sampling with local heuristic search. It uses a flexible partitioning method to divide the search space into regions that can be analyzed individually and then coordinates the results to determine how to continue the search, that is, where to concentrate additional computational effort. This partitioning/sampling approach makes the NP framework uniquely well-suited for high-throughput computing. Beam angle space is partitioned and sampled. DO algorithms are incorporated during the evaluation of the quality of a selected angle set. After the execution of our proposed method, we not only obtain a set of beam, but also the optimized intensity for each beam in 3DCRT or “intensity maps” for each angle in IMRT.

Results: Using a 3DCRT data set of a pancreas case, we demonstrated the following improvements in OAR dose relative to a equi-spaced beam set: cord, 66%; kidney, 78%; liver 36%. We also considered an IMRT head-and-neck case, and obtained a 28% reduction in dose to normal tissue as well as improvements in the right parotid dose with no significant changes in dose to other tissues.

Conclusions: We have demonstrated that our framework provides an effective and automated approach to obtaining high-quality solutions to the unified BAS and DO problems in both 3DCRT and IMRT. Relative to beam-angle sets constructed via expert clinical judgment and other approaches, the beams and doses via NP with HTC showed significant reduction in the radiation delivered to non-cancerous tissue near the tumors.