AbstractID: 8743 Title: Application of the Genetic Algorithm and Distributed Computing to Gantry Angle Optimization in IMRT

Purpose: IMRT treatment planning involves the selection of several angle parameters, as well as the specification of structures and constraints employed in the optimization process. Including these parameters in the combinatorial search space vastly increases the computational burden, and therefore the parameter selection is normally performed manually by a clinician, based on clinical experience. We have investigated the use of a genetic algorithm (GA) and distributed-computing platform to optimize the gantry angle parameters and to provide insight into additional structures which may be necessary in the dose optimization process to produce optimal IMRT treatment plans.

Method and Materials: For an IMRT prostate patient, we produced the first generation of 40 samples, each of five gantry angles, by selecting from a uniform random distribution, subject to certain adjacency and opposition constraints. The dose optimization was performed by distributing the forty-plan workload over several machines running a commercial treatment planning system. A score was assigned to each resulting plan, based on how well it satisfied clinically-relevant constraints. The second generation of 40 samples was produced by combining the highest-scoring samples using the techniques of crossover and mutation. The process was repeated until the sixth generation, and the results compared with a clinical (equally-spaced) gantry angle configuration

Results: In the sixth generation, 34 of the 40 GA samples achieved better scores than the clinical plan, with the best plan showing an improvement of 84%. Moreover, the resulting configuration of beam angles tended to cluster toward the patient's sides, indicating where the inclusion of additional structures in the dose optimization process may avoid dose hot spots.

Conclusion: Additional parameter selection in IMRT leads to a large-scale computational problem. We have demonstrated that the GA combined with a distributed-computing platform can be applied to optimize gantry angle selection within a reasonable amount of time.