AbstractID: 6564 Title: High-Throughput Computing in Condor Using a Nested Partitions Framework for IMRT Beam and Dose Optimization

Purpose: To utilize a ***High Throughput Computing*** (HTC) system to provide distributed computing on a network of computer workstations for a metaheuristic, Nested Partitions (NP), for ***beam angle selection*** (BAS) in IMRT.

Method and Materials: An important feature of the NP approach is that its partition/sampling processes are naturally ***parallelized,*** allowing the integration of this powerful optimization methodology with high-performance distributed environments such as the Condor system. Condor is a specialized workload management system that can used on existing computer networks for compute-intensive jobs, allowing the submission of many jobs at the same time, and performing these jobs by locating and utilizing idle computers in the network. Our algorithm first solves an integer programming formulation of the BAS problem that uses aggregate mean organ-at-risk data. Based on this initial angle set, NP uses sampling on a partition of the global solution space to generate alternative angle sets that are distributed via Condor for evaluation via dose optimization. The corresponding dose optimization problems for the beam set samples are thus solved in parallel. NP repeats this procedure iteratively to obtain high quality angle sets for IMRT.

Results: Compared to evaluating each beam angle set sequentially, parallel evaluation of the NP-selected beam angle sets via Condor on 15 workstations yielded a factor of 14 speedup. Overall, BAS for a difficult clinical case in this setting required 15-28 minutes. Using a weighted sum of percentage violations of DVH thresholds for OARs as an overall measure of solution quality, a 78% improvement (head-and-neck case) and a 30% improvement (pelvic case) were achieved over equally-spaced beams.

Conclusions: High-quality beam angle sets for IMRT can be efficiently obtained in an automated manner by utilizing an HTC system on an existing computer network to implement an NP-based metaheuristic.

Conflict of Interest: N/A