AbstractID: 9497 Title: A Distributed-Computing Platform for Monte Carlo Dose Calculations and Beam-Weight Optimization

Purpose: Monte carlo (MC) algorithms remain the gold standard in dose calculation routines. However, their long calculation times generally make them infeasible for clinical implementation, especially for IMRT optimization which requires rapid pencil-beam dose computation. In a preliminary study, we are investigating how high-throughput computing may be employed to perform MC dose calculations and rudimentary optimization using non-commercial software.

Method and Materials: Two non-commercial software packages were used for this project, VMC++ and CERR. VMC++ is an MC dose calculation package which is more efficient than general-purpose MC routines due to its use of variance reduction techniques. A combination of particle splitting and *Russian Roulette* methods is employed in VMC++ for photon transport modeling, which enhances the efficiency and speed of the calculation, making it approximately 50 times faster than the BEAMnrc code. CERR is an open-source environment for radiotherapy calculations. We used the data-importation and beam-shaping features of CERR in conjunction with the dose-calculation routines of VMC++ to perform dose computation on a 4-field 3D CRT prostate case. We then optimized the beam weights using DVH-based constraints and the Nelder-Mead simplex technique, a multidimensional unconstrained nonlinear minimization algorithm. Collaborating with members of an academic supercomputing facility enabled us to perform the calculations on a subset of a cluster of 1000 dual-core Linux-based computers.

Results: The dose calculation and optimization, involving several million particle histories, required only a few minutes to complete. The resulting plan was optimal based on the constraints provided to the system, and indicated that additional constraints may be necessary for clinical feasibility.

Conclusion: We have shown that, using a distributed-computing platform, an MC routine may be employed for treatment planning in a reasonable amount of time. This work will be extended to IMRT and beam-angle optimization by combining a variety of techniques.