AbstractID: 12717 Title: Multi-criteria treatment planning for IMPT

Purpose: To describe three components of a new multi-criteria intensity modulated proton therapy (IMPT) system. The components are: an optimization solver, a Pareto database generation procedure, and a visualization-based Pareto surface navigation technique

Method and Materials: We develop an IMPT solver based on the technique of projection onto convex sets (POCS). This method is fast, capitalizing on the structure of the IMPT optimization problem, and has almost no memory overhead – the only memory needed is the memory needed to store the dose-influence matrix. The database generation strategy is based on varying dosimetric constraints, since the solver works via constraints and not weighted objective sums. It can be used to generate plans in parallel, so can take advantage of multi-processors. The navigation method is based on a 2D view of the high-dimensional tradeoff space, with the user choice of which two objectives to currently view while allowing the constraints of the other objective values to be dynamically varied.

Results: Computational results are shown for the solver. Compared to general purpose industry standard algorithms, the POCS algorithm applied to IMPT is orders of magnitude faster and more memory efficient. We demonstrate the database generation procedure and the navigation method on clinical data sets.

Conclusion: The three modules constitute the core treatment planning optimization method for a new planning system in development. The speed and minimal memory requirements of the solver will allow us to incorporate robustness by considering multiple instances of patient set-ups and proton ranges. The navigation style allows for a visualization of the dose tradeoffs inherent to radiation therapy treatment.

Conflict of interest: none