AbstractID: 5806 Title: Multi-objective IMRT planning: a new algorithm, with clinical examples

Purpose: Intensity modulated radiation treatment planning for difficult cases is typically a time-consuming manual search for a plan which gives an acceptable tradeoff between tumor coverage and critical structure sparing. We develop a method to calculate the efficient tradeoff surface of a multi-objective IMRT inverse planning problem. This serves two purposes: to eliminate the time-consuming manual search process, and to provide the treatment planners with the complete tradeoff information, allowing them to make more informed decisions.

Method and Materials: We formulate a linear multi-objective IMRT treatment planning problem, the solution of which is a set of Pareto optimal treatment plans. Since each Pareto optimal plan involves a lengthy optimization, it is prudent to represent the complete surface with as few points as possible. Given the current set of Pareto surface plans, we use geometric considerations to formulate the optimization problem which computes the next plan. In this way, plans are added to the Pareto database until the surface is well represented.

Results: The algorithm is applied to two clinical cases. For the prostate case, we display a tradeoff between the prostate coverage, femoral head sparing, and rectal sparing. For the skull-based tumor, we display a tradeoff between tumor coverage, and the maximum doses of the chiasm, pituitary, and brainstem.

Conclusion: We provide a method to efficiently generate Pareto surfaces for treatment planning, even when the number of organs to be traded off exceeds two or three. The method is applicable to any convex objective functions, including equivalent uniform dose, as well as the more standard quadratic penalty IMRT formulations. We expect that the clinical benefit of being able to visualize the tradeoff information – e.g. exactly how a decrease in critical structure dose degrades the tumor coverage – during the planning process will inspire a surge of research in this field.