AbstractID: 3626 Title: Optimizing IMRT Plans with Geometric Uncertainty

Purpose: To examine the use of robust optimization methods for IMRT planning with geometric uncertainties.

Methods and Materials: A simulation study was performed to compare several approaches of optimizing under uncertainty. We used simple example cases where the optimization produced treatment plans that appear excellent on average, but are clinically unacceptable for some fraction of patients. To remedy this, we first defined an objective function and minimized the objective of the expected dose. Next we generated a sample patient population, computed the objective for each patient individually, and minimized either the average or the maximum of these objectives.

Results: Cases were identified in which optimizing the expected dose distribution yields unacceptable dose distributions when the dose is delivered. This was particularly evident if a small number of fractions were delivered or if there were systematic errors present. Using robust optimization techniques, we were able to produce acceptable dose distributions for a high percentage of simulated deliveries. For cases with a small number of fractions or large systematic error, the optimal result was similar to a margin approach. Using the same technique with a high number of fractions and small systematic errors yields a better dose distribution than is possible with a margin approach.

Conclusion: This work indicates that it should be feasible to replace a standard planning treatment volume approach with a robust optimization that automatically takes geometric uncertainty into account. In cases with limited information of systematic errors, such a solution would likely be very similar to the manually designed margins used today. If the uncertainties are random with well known statistics, however, significantly improved tumor coverage and normal tissue sparing can be achieved.