AbstractID: 6914 Title: Optimization of Internal Margin to Account for Intra-fractional Organ Motion

Purpose: Intra-fraction organ motion may cause significant dosimetric uncertainty with respect to tumor coverage. Accounting for this motion by enlarging the internal margin also increases dose to normal organs near the tumor. Therefore, it is desirable to ensure adequate target dosimetric coverage while maintaining the smallest possible irradiation volume. We present an optimization of the internal margin used for intra-fraction organ motion and study its dependence on other treatment planning parameters.

Methods and Materials: Using a commercial treatment planning system, we created 3D conformal treatment scenarios for spherical targets of varying sizes. The treatment plans were designed to cover target with additional setup uncertainty and internal margins. Target dose was accumulated over 100 fractions using a custom developed software simulating treatment execution uncertainties as well as respiration motion. The internal margin was considered to be optimal if the dose to a moving target was equivalent to dose given to static target planned with no internal margin.

Results: The optimum internal amount was found to be much smaller than the full amplitude of the motion. Symmetric margins of 1, 3 and 5 mm were found to be adequate for peak-to-peak respiration amplitudes of 10, 15 and 20 mm respectively. The optimal internal margin was also observed to be approximately independent of the margin chosen for setup uncertainties. Optimizations for several patient target volumes also confirmed that margins smaller than full amplitude were adequate.

Conclusion: Our findings present significant implications for treatment planning of mobile targets, such as tumors found in the lung and upper abdomen. Using the full motion amplitude for the internal margin is overly conservative, and optimization of the internal margin provides improved sparing of nearby organs at risk without sacrificing dosimetric coverage for the target.

Conflict of Interest: Sponsored in part by GE Healthcare.