AbstractID: 7073 Title: On-line Re-optimization of Prostate IMRT Plans for Image Guided Adaptive Radiation Therapy

Purpose: This study proposes a novel on-line adaptive planning technique for the prostate treatment by directly re-optimizing the IMRT plan based on both the “anatomy-of-the-day” and the original plan information.

Method & Materials: Using a commercial treatment planning system, an initial IMRT plan for prostate cancer treatment was optimized using seven co-planar 15-MV beams based on the structures of interest (SOIs) delineated in the planning CT. Then, the optimized plan with both intensity fluence maps and dose distributions was exported to an in-house adaptive planning platform. To correct for target variations, a set of on-board cone-beam CT (CBCT) images were acquired prior to treatment and the daily SOIs (“anatomy-of-the-day”) were identified. The original planning SOIs and daily SOIs were registered using a thin-plate-spline based deformable registration algorithm. The optimal dose distribution was then deformed to match the “anatomy-of-the-day” and served as the “prescription dose distribution” for the re-optimization process. Linear programming algorithm was used for re-optimization and could reach a solution in seconds. The algorithm also used the original IMRT plan information as the initial solution. Both hard and soft constraints were used to differentiate the priorities of meeting the prescription dose distribution. A proof-of-concept case using an IMRT prostate plan was presented. The dose-volume histograms from the original, the uncorrected and re-optimized plans were compared.

Results: The proposed re-optimization technique reached solutions within 1minute on a desktop PC. The D95(min/max) doses to the GTV were 99.3%(90.0%/104.1%), 83%(57.6%/104.1%) and 98.3%(90.0%/103.8%), for the original, uncorrected and re-optimized plans, respectively. The median doses to the rectum and bladder were comparable for the original and re-optimized plans (41.0% vs. 45.0%, and 14.0% vs. 16.4%, respectively).

Conclusion: It is technically feasible to perform on-line re-optimization based on the “anatomy-of-the-day” and to achieve results similar to the original dose distribution.