AbstractID: 5816 Title: Direct Aperture Optimization for On-line Adaptive Radiation Therapy

Purpose: To investigate a novel technique for on-line adaptive radiation therapy (ART) that uses direct aperture optimization (DAO)

Methods and Materials: A model simulating the geometry of a prostate case was created. The prostate, rectum and bladder are represented by an ellipsoid, cylinder and sphere, respectively (the dimensions and positions of these structures are based on patient image data). This configuration represented the "original geometry" and was used to create the original IMRT treatment plan. The plan was created using an in-house DAO system with seven beams (40, 80, 110, 250, 280, 310, 355 gantry angles) and six apertures per beam. Four different "deformed geometries" were created by systematically deforming the original geometry to various degrees (0.25, 0.50, 0.75 and 1.00 cm maximum deformations of rectum and prostate). For each deformed geometry, a new treatment plan was created by modifying (adapting) the original treatment plan using DAO. The quality of the resulting plans, together with the optimization time efficiency of the plan adaptation, was used to assess the suitability of DAO for on-line ART. The effects of altering different DAO parameters were investigated by varying the maximum leaf step size, maximum aperture weight change and optimization cooling schedule.

Results: The plans created by adapting the original treatment plan met the imposed dose constraints for all four deformed geometries. Adapting the original treatment plan was much faster than performing a completely new re-optimization. Furthermore, by appropriately limiting selective DAO parameters the convergence to an acceptable plan was significantly accelerated. The optimal choice of DAO parameter limits was correlated to the degree of geometry deformation.

Conclusion: This study demonstrated that DAO is highly suitable for on-line ART. The treatment plan adaptation was efficient and the resulting plans met the imposed dose constraints.