AbstractID: 13659 Title: Using Tumor Motion Trajectory as a Constraint for 4D-IMRT Treatment Planning

Purpose: To develop a 4D-IMRT treatment planning technique by adding a tumor motion trajectory (TMTJ) as a constraint in a commercially available Treatment Planning System (TPS). The goal is to create an IMRT plan with a set of MLC segments catering for the motion of the patient anatomy extracted from 4D-CT images.

Method and Materials: 4D-CT images were obtained from three lung cancer patients. The 4D protocol divided the breathing cycle into ten phases followed by a Maximum Intensity Projection (MIP) volume reconstruction. ITVs were contoured based on the MIP volumes. GTVs were contoured on all ten CT phases to generate a TMTJ, defined as the position of the centroid of the GTV on all phases. A tube shaped contour (TBC) with about 1 cm diameter along the TMTJ and inside the GTV was generated. TBC was added to the objective function as a constraint with minimum dose-volume histogram (DVH) set to prescribed dose. IMRT plans were generated by using Pinnacle DMPO with and without the TMTJ constraint.

Results: The IMRT plans generated with TMTJ constraints optimized the MLC segment shapes and weights for each beam with the TBC being forced/encouraged to inside of the segmented fields. The percentage of total MUs delivered to the largest area segments in each beam increased from 16.4% of the total MUs to 21.5%. The MU weight increased up to 20% by using TMTJ constrain. The DVHs for PTV and ORs, dose distributions and total MUs for plans with/without TMTJ constraints were very similar.

Conclusion: The 4D tumor motion trajectory information can be used as a constraint in the Pinnacle DMPO to obtain tempospatially optimized IMRT plans. The method shows the potential to significantly reducing the dosimetric inaccuracies introduced by the interplay between organ motion and multileaf collimator (MLC) motion for IMRT.