AbstractID: 13117 Title: Increasing the delivery efficiency of IMRT DAO-based plans through segment reordering

Purpose: To develop and test an algorithm intended to optimize with regard to time the ordering of segments for DAO-based step-and-shoot IMRT plans.

Methods and Materials: After DAO-based step-and-shoot IMRT plans are developed in our commercial treatment planning system (TPS), they are exported as rtp files that are processed by an in-house software. For each gantry position, all segments are imported and the maximum distance traveled by a leaf pair is determined for each segment. The program then semi-exhaustively explores the solution space to reorder the segments such that the sum of the maximum distance traveled by leaves is minimized. We assume that this will lead to delivery time reductions. Once all segments are ordered, the program writes a new rtp file. A second, in-house developed software program checks this new file to ensure that every segment in the newly re-ordered rtp file corresponds exactly to one in the original file. The delivery time for plans corresponding to both rtp files was measured and compared to assess the gain achieved through plan re-ordering.

Results: In all 12 cases investigated here, we observed reductions in treatment time (i.e. efficiency gains), ranging from 6 s to 1 minute; with an average time reduction of 0.55 minutes per treatment. A fairly strong correlation ($R^2=0.744$) was seen between the decrease in delivery time and the total number of segments in the plan, suggesting that the 'longest' treatment plans have the most opportunity for reduction in treatment delivery time.

Conclusion: We successfully developed and tested an in-house computer program for re-ordering segments of a DAO-based IMRT step and shoot treatment plan. The re-ordering was measured on clinical plans to provide average reductions of delivery time of 0.55 minutes per treatment. Such improved efficiency is beneficial for both intrafractional motion management and increase of patient throughput.