AbstractID: 4364 Title: A Segmentation and Leaf Sequencing Algorithm for IMAT

Purpose: To develop an intensity segmentation and leaf sequencing algorithm specifically for intensity-modulated arc therapy (IMAT), which can be applied to optimized intensity patterns derived from existing commercial IMRT inverse planning software.

Methods and Materials: Three phantom cases, as well as a clinical case were planned using a Hi-Art II (Tomotherapy Inc, WI.) planning station. The end of planning sinograms were then extracted and inputted into our IMAT conversion algorithm. The number of required arcs, deliverable MLC segments for each arc and the relative intensity weighting of each arc were outputted. The number of arcs (modulation) could be controlled by a user parameter, α. The resulting MLC segments were then fed into a fast monte-carlo dose calculation algorithm, NXEGS (NumeriX, LLC) to obtain 3D dose distributions. Dose statistics (max, min, mean) and dose volume histograms of relevant structures were calculated and compared against the results generated by the Hi-Art II system.

Results: Each plan was converted in under three minutes on a typical desktop PC, with the arc numbers varying between 4 and 15 360° arcs. Qualitatively, the dose distributions obtained from the IMAT plans were similar to the tomotherapy results, as well as planned doses. Quantitatively, the IMAT plans were slightly degraded, with the average dose to normal structures being 7.5% higher for IMAT vs. tomotherapy. However, the IMAT plans generally met planned values, being 9.1% below for maximum doses to normal structures. The number of arcs and therefore the resulting dose distribution could be varied according to α.

Conclusions: IMAT segmentation and leaf sequencing produced deliverable IMAT MLC segments and relative arc weights directly from Hi-Art II optimized plans. The algorithm was computationally efficient, and produced similar dose distributions. Additional optimization could improve resulting dose distributions further. IMAT back-up for tomotherapy is another potential application.