AbstractID: 5271 Title: A ray tracing method to generate initial conditions for IMAT optimization

Purpose: To investigate the utility of using ray tracing to extract intrinsic information from CT, contour and primary dose data in order to determine initial conditions (number of arcs, arc weights, arc ranges and leaf positions) that can be input into an Intensity Modulated Arc Therapy (IMAT) optimization routine.

Methods and Materials: Patient CT and contour data was ray-traced to determine PTV and PTV-OAR arcs. An additional arc was determined by the calculation of a ray importance factor (RIF) through ray tracing of the primary dose ray-tracing of the PTV. All three sets of arcs were then input into a previously described leaf position optimization algorithm. This method was tested on two geometries by ray tracing 27 equi-spaced beams. The optimized arc deliveries (number of arcs, arc weights, arc ranges and leaf positions) were then input into a fast dose calculation algorithm, NXEGS (NumeriX LLC) for dose calculation and comparison with primary dose as calculated by ray tracing.

Results: RIF arc addition reduced the objective function by 20% for geometry 1 and 8% for geometry 2. Leaf position optimization further reduced the objective function by 27% for geometry 1 and 29% for geometry 2. Calculation of dose using NXEGS provides accurate dose distributions for IMAT.

Conclusions: Ray tracing can quickly provide information about number of arcs, arc ranges, arc weights and leaf positions with very little user input. Leaf position optimization can improve leaf positions once the initial number of arcs and arc ranges are determined. Together these two steps can produce intensity modulated arcs for further optimization with a more accurate dose calculation algorithm.