AbstractID: 7142 Title: A Model to Evaluate the Spatial and Dosimetric Resolutions of IMRT for Desired High-Gradient Dose Distributions

Purpose: To create a 3D model to simulate IMRT treatment delivery. The model includes dose distribution resolution degradation from the MLC leaf width and dose deposition. The resulting deliverable distribution may be evaluated to determine conformity and the achievable spatial and dosimetric resolution.

Method and Materials: Phantom image sets were created to represent head and neck anatomy with critical structures. Image sets contained 128 slices, each 128x128 pixels, with 1mm pixel size. Target volumes with radioresistant subvolumes of varying size and shape were added to the image sets. A nine-field treatment technique was simulated. Slice-by-slice along the beam central axis, the image set was sampled in the direction perpendicular to leaf motion at each leaf width center. Each slice was convolved with a rect function representing MLC leaf width and convolved with a dose spread kernel appropriate for the depth along the central axis of the beam. The resulting 3D dose distributions for each field were summed to give the deliverable dose distribution for the nine-field treatment.

Results: The result of the model is a deliverable dose distribution in 3D. This deliverable dose distribution may be analyzed by comparison with the desired dose distribution. Information on the distribution's conformity may be attained by calculation of a distance-to-agreement map to provide information on spatial resolution, or by calculation of a map containing percent differences in dose to give insight into the dosimetric resolution. Dose intensity profiles may be extracted from the deliverable dose distribution as a means to determine achievable dosimetric gradients.

Conclusion: This 3D model simulates the degradation of an ideal dose distribution due to the IMRT treatment delivery process. The resulting deliverable dose distribution may be used for evaluating the achievable spatial and dosimetric resolution for the current IMRT technique.