

AbstractID: 8612 Title: Impact of Prescription Dose Gradient Discretization on Dose Painting

Purpose: Continuous prescription gradients may not be practical or necessary in the implementation of dose painting. This study optimized dose distributions to various discrete prescriptions and tested them for conformity to continuous, non-uniform prescriptions.

Method and Materials: The planning geometry consisted of a virtual cylindrical water phantom, containing a concentric heterogeneous tumor volume. The tumor was prescribed a uniform dose with boost subvolumes receiving escalated doses of 20, 50, or 100 % relative to background. Variable dose gradients extended up to 2 cm from the edge of 1 cm radius boost regions. Prescriptions were defined over gradient regions either continuously or in discrete steps. An iterative linear least squares method was employed to optimize helical tomotherapy dose distributions. Tumor, normal tissue, and subvolume importances were fixed relative to one another. Dosimetric evaluation included quantification of the volumetric percentage of boost and gradient regions whose plans conformed to prescriptions within 5 %.

Results: Dose conformity to prescriptions in high dose contrast boost regions increased from 47 % of the volume for an infinite gradient to 100 % of the volume for a continuous gradient over 2 cm. In high contrast gradient regions of 1 cm radial distance, conformity ascended from 22 % of the volume for a single step to 91 % of the volume for a continuous gradient. To achieve dose conformity in 90 % of a 1 cm gradient region volume at low contrast, the prescription step size must be no larger than 0.5 cm.

Conclusions: Results demonstrate that finite thresholds in prescription discretization exist to ensure planned dose conformity to continuous prescriptions. Adequate prescription gradient step size is dependent on beamlet dimensions, boost region size, and local gradient magnitude. Evaluation of prescription discretization may impact dose painting treatment planning protocols in its application to clinical cases.