AbstractID: 4769 Title: Inverse Treatment Planning using Volume Sampling with Monte Carlo Dose Calculations

Purpose: We investigated three methods of random sampling of voxels within regions of interest (ROI), using Monte Carlo dose calculations for inverse treatment planning. We studied their effects on file size, accuracy of dose volume histograms, computation time and accuracy in the objective function and determined the impact of number of simulation histories on the objective function.
Method and Materials: A dose distribution, stored as double precision, of a clinical lung cancer plan was calculated using Monte Carlo simulation (NXEGS NumeriX, LLC). Only the dose in the ROI (excluding the external) is required, and is stored as integers. Three equations were tested to determine the number of sampling points within each ROI. The first was to keep the same relative percentage of volume for all ROIs. The second was proportional to the hyperbolic tangent of each ROI volume, while the third was proportional to the cube root of the volume. A least square objective function was calculated on all resulting sampling methods.
Results: By saving dose values as integers instead of doubles, a 75% reduction is seen in file size, while keeping accuracy to 0.001%. The objective function computational efficiency improvement is directly proportional to the data storage reduction. A further reduction of 94% and 73% occurred when using the cube root and hyperbolic tan of the volume respectively, while producing a 0.03% and 1.8% difference in objective functions compared to that calculated with full ROI volumes.
Conclusion: By sampling ROIs where the number of points is proportional to the hyperbolic tangent of the volume there was a savings of approximately 75% of data stored which directly translated into reduction in objective function computational time, with a 0.03% difference in objective function compared to that with full volume calculations.