

AbstractID: 5106 Title: A hybrid dose evaluation method for rapid Monte Carlo-based IMRT optimization

Purpose:

To develop and test a hybrid method for optimizing IMRT plans using Monte Carlo (MC) dose calculation algorithms which retains the accuracy of MC while reducing the MC dose computational requirements.

Method and Materials:

A hybrid dose calculation strategy in which initial optimization is performed with a fast pencil beam (PB) algorithm using deliverable-based IMRT optimization. Following convergence, doses are re-computed with the VMC++ MC algorithm to determine correction factors for further PB-based optimization. The correction/re-optimization procedure is repeated until convergence. The hybrid method was benchmarked with respect to MC-deliverable-based optimization for 5-prostate IMRT plans. Figures of merit included number of MC dose computations required, final plan quality score, and optimization dose-volume indices.

Results:

The hybrid method required a maximum of 3 MC dose calculations to converge to a result which provided equivalent dose coverage to the complete MC-based optimization plan. The complete MC-based optimization required between 6 and 9 MC dose computations to converge, depending on the specific patient. After 2 MC dose computations, the hybrid plan quality score was equal to or less than the MC-based score for 4 of the 5 plans, the remaining plan required 3 iterations to achieve a score equal to that for the MC-based optimization. Monitor units for the hybrid and complete MC-optimization were within 5%.

Conclusion:

Hybrid PB-MC-IMRT dose calculation method is practical and results in plans equivalent to those achieved when MC-dose calculation is used for all optimization iterations. The hybrid method reduced the number of MC calculations by a factor of ~3, reducing overall optimization time by a factor of 2.8, and allowing for VMC++ MC-based optimization to be completed in <30 min on a 20x2.4 Ghz CPU cluster. (Supported in part by NIH-R01CA98524).