

AbstractID: 5615 Title: Fast Monte Carlo-based computation of aSi-EPID dose images for IMRT treatment field through phantom

Purpose: During-treatment IMRT dosimetric verification can be accomplished with exit dose portal dosimetry; however, differential beam hardening and patient scatter radiation results in inaccuracies in invariant kernel-based calculation methods. The purpose of this study is to develop an accurate, yet efficient Monte-Carlo (MC) based algorithm to predict during treatment dosimetric aSi-EPID images to compare with measured images for plan delivery quality assurance.

Method and Materials: To compute EPID images, the VMC++ MC algorithm is used to transport particles through the patient geometry. Particles exiting the patient are scored into 19 energy-differential fluence-matrices at the EPID surface. Computed EPID images are generated by summing the contributions of each fluence-matrix convolved with MC generated mono-energetic energy deposition kernels. Kernel-based method validation was performed for open, MLC-blocked, intensity test-pattern and a prostate-IMRT field with and without a 20 cm thick phantom by comparing with full MC computation of EPID images. Additionally, the prostate-IMRT plan was computed through a pelvic phantom. A cone-beam CT of the pelvic phantom was used for dose computation particle transport. Comparison metrics include image profiles and gamma-metric evaluation.

Results: For the test fields, kernel-based methods had >95% of voxels with $\gamma < 1$ for 1%, 1mm criteria and >99.1% with a 2%, 2mm criteria with respect to the MC-calculated fields. For the pelvic phantom, 92.6% of pixels had $\gamma < 1$ for 1%, 1mm criteria. The systematic discrepancy (~0.5%) is well below the statistical uncertainty (~3%).

Conclusion: The kernel-based convolution method is comparable in accuracy with full MC while requiring substantially less computation time than a full MC EPID simulation. Image computation time is independent of MC statistical precision and adds <1min to the MC simulation time. Comparison of measured images with MC-computed portal images may be a practical method to perform during-treatment dose validation.

Conflict of Interest: Supported in-part by Varian Medical Systems.