AbstractID: 4598 Title: Implementation of Monte Carlo code VMC++ for photon beam treatment planning

Purpose: To implement the VMC++ Monte Carlo code for radiotherapy treatment planning of photon beams. The implementation includes the sampling of particles from a multiple-source model, modeling of accessories, and commissioning of the model based on beam data measurements.

Method and Materials: In this work**,** the radiation output from a linear accelerator was modeled using a multiple-source model with separate sub-sources for primary radiation, extra-focal radiation and electron contamination. This approach enables the commissioning of an individual accelerator using a previously developed procedure, which determines the model parameters by minimizing deviations between measurements and superposition dose calculations. The same source model was used both for the superposition and for the Monte Carlo based dose calculation method. Physical wedges, MLCs, blocks and compensators were modeled by transporting particles sampled from the source model through a detailed geometrical model of the specific accessory. The MLC model accounts for tongue-and-groove, divergent leaf alignment, air cavities between adjacent leaves, and rounded leaf tips.

Results: The accuracy of the developed algorithm was studied by comparing calculations to measurements for open fields, wedged fields, and irregular MLC apertures for 6 MV and 18 MV beam energies. The agreement between measurements and calculations was within statistical uncertainties for all of the studied cases. The calculation of a typical treatment plan takes from minutes to few hours, depending on the required statistical accuracy.

Conclusion: It has been demonstrated that VMC++ with an optimized multiple-source model and particle transport through accessories results in accurate dose distributions in a wide range of conditions. The developed algorithm has acceptable calculation speed, and has large potential for improving dose calculation accuracy in complex situations and heterogeneous cases compared to traditional dose calculation algorithms.

Conflict of Interest: Research sponsored by Varian Medical Systems Inc.