AbstractID: 3631 Title: A Practical Monte Carlo MU Verification Tool for IMRT Quality Assurance

Purpose: Quality assurance (QA) for intensity-modulated radiation therapy (IMRT) treatment planning and beam delivery, using ionization chamber measurements and film dosimetry in phantom, is time consuming. The Monte Carlo method is the most accurate method for radiotherapy dose calculation. However, a major drawback of Monte Carlo dose calculation as it is currently implemented, is its slow speed. The goal of this work is to bring the efficiency of Monte Carlo into a practical range by developing a fast Monte Carlo monitor unit (MU) verification tool for IMRT.

Method and Materials: A special estimator for dose at a point called the point detector has been used in this research. The point detector uses the next event estimation (NEE) method to calculate the photon energy fluence at a point of interest and then convert it into dose by mass energy absorption coefficient assuming the presence of quasi charged particle equilibrium. An improvement to this method is to initiate the electron transport at the surface of a sphere centered at the point of interest to account for the effect of electron disequilibrium and patient heterogeneous anatomy. The point detector method is implemented with the MCNP Monte Carlo code system.

Results: The MU verification tool can be used for both patient dose verification and phantom QA calculation. Dose calculations in a water phantom have been performed using the point detector method. Results were compared with direct Monte Carlo simulations using EGS4/MCSIM, which is a well-benchmarked Monte Carlo code. The results between the point detector and MCSIM agreed within 1%. A factor of 10 speedup can be achieved with the point detector method compared with direct Monte Carlo simulations.

Conclusions: An effective and efficient Monte Carlo MU verification method has been developed as a practical routine procedure for IMRT QA.