AbstractID: 1701 Title: Fast treatment head simulations for photon beams using VMC++

Monte Carlo (MC) simulations of the treatment head of linear accelerators are a valuable tool for the development of source models needed for dose computations in RTP. This paper presents a new set of variance reduction techniques, called Directional Radiative Splitting (DRS), that significantly speeds up MC simulations of the treatment head for photon beams. DRS is a combination of interaction splitting for the various processes that produce photons, Russian Roulette, use of the cylindrical symmetry of the treatment head and importance biasing. DRS is an extension of the Directional Bremsstrahlung Splitting (DBS) technique technique recently introduced into the BEAMnrc system. When used with VMC++, DRS results in the generation of 5 (18 MV) to 12 (6 MV) million photons per minute on a 1.53 GHz Athlon CPU. This is about a factor of 70 faster than BEAMnrc with DBS and a factor of about 500 faster than BEAMnrc with Selective Bremsstrahlung Splitting, which was the fastest option available in BEAMnrc prior to DBS. As VMC++ uses a splitting technique for the transport in the patient, thus effectively transporting each photon many times, the time spent for the treatment head simulation is a small fraction of the CPU time needed for the simulation in the patient (about 10%). Future work will involve the implementation of VMC++ geometrical modules for MLC, wedges and compensators. Once this is completed, a complete on-the-fly simulation of the treatment head for each patient dose calculation with a negligible CPU time penalty will be possible.