AbstractID: 1561 Title: Four-dimensional Monte Carlo simulations of step-and-shoot and sliding window in IMRT

Four-dimensional Monte Carlo (4D-MC) simulation to account for treatment head variations during dose delivery is getting increasing attention. We implemented 4D-MC dose calculation within the general purpose toolkit GEANT4, especially focusing on leaf motion in step-and-shoot and sliding window delivery in IMRT. In addition to delicate physical models and powerful geometry description, GEANT4 is unique in allowing the change of geometry during a simulation. The time-involving information such as the movement of the parts in the treatment head and the motion of organs in a patient can be readily implemented. To facilitate the study, some aspects in the GEANT4 code were modified to adapt to the special requirements for true 4D-MC simulations. The new features assure much faster geometry change, CT voxel localization, and scoring. In our work, the entire treatment head of Varian Linac 2100 was modeled. The most complicated part, the Millennium 120 MLC, was modeled in great details, based on the schematics from the manufacture. The leaf positions at any time point can be obtained from the IMRT leaf sequence files. For sliding window, because of the allowance of a small step in simulations, more realistic leave movement without random sampling of leave positions can be performed. These implementations allow one to simulate dose delivery in the most realistic way, i.e. by continuously moving leaves in a MLC during the dose calculation in a single simulation. It is thus possible to study interplay effects between beam delivery and target motion taking into account temporal sequence of events.