AbstractID: 8329 Title: Monte Carlo for Radiation Therapy Dose Calculations

Due to its ability to accurately compute dose in complex geometries, Monte Carlo (MC) has been touted as the dose calculation methodology of the future. Several research institutions have integrated MC dose algorithms into their treatment planning programs, and at least one commercial vendor supplies MC dose calculation as an option. Other vendors are certain to follow suit in the near future. The aim of this refresher course is to address issues that are unique to treatment planning with MC dose calculation algorithms. The primary emphasis will be on MC treatment planning for photon and electron beams.

Following a historical review and a brief summary of the basics of the MC method, the methods used to commission an MC dose calculation algorithm will be covered. This will include methods to determine the initial phase space description of the accelerator by matching MC computed dose profiles with measurements and the use of a single-point normalization to convert dose per incident particle into dose per monitor unit.

For patient calculations, the conversion of CT data to materials used during the MC transport will be discussed, as will the difference between MC computed dose-to-material and non-MC calculated dose-to-water. The impact of statistical noise on MC dose distributions and, particularly, the effect on isodose lines, dose-volume histograms, and maximum and minimum doses will be examined. Methods to reduce the impact of noise, such as smoothing or de-noising algorithms, will be discussed.

MC will be compared with pencil beam and super-position/convolution algorithms for 3DCRT and IMRT cases. Various methods to incorporate MC dose calculation into IMRT treatment planning will be discussed, and the role of MC in treatment verification presented. Finally, the prospect of using MC for transmission dosimetry during patient treatment by predicting portal images will be covered.

Educational Objectives:

1. To understand the MC method as it applies to the transport of photons and electrons for treatment planning dose calculation
2. To understand the general commissioning treatment planning procedures for an MC dose calculation algorithm
3. To understand the effect of statistical noise on MC dose distributions, identify ways to reduce the impact of such noise, and understand the pitfalls of using maximum and minimum dose with MC dose calculations
4. To understand methods to compare MC dose computations in heterogeneous media with conventional dose calculations in the same geometry
5. To identify the potential clinical significance of MC dose calculation