AbstractID: 4430 Title: Monte Carlo II: MC for Source and Machine Characterization

Monte Carlo algorithms have the ability to accurately model dose distributions for arbitrarily complex treatment delivery scenarios and changing patient geometries. These properties make Monte Carlo ideal for clinical planning, or for benchmarking clinical planning systems. Building on the discussion of the role of Monte Carlo in treatment head simulation (from the first course), this second Monte Carlo course will focus on patient planning applications. The goal of the course is to familiarize clinical medical physicists with the use of Monte Carlo in treatment planning, including advanced treatment techniques such as IMRT and motion compensated 4D treatment, and to discuss how Monte Carlo-based planning differs from planning with conventional algorithms. We will demonstrate the various approaches used in modeling beam modifying devices, such as the multi-leaf collimator (MLC), including methods to effectively model the dosimetric consequences of the detailed the MLC geometry. We will review methods used to reduce Monte Carlo-based clinical dose calculation time, such as variance reduction techniques, and discuss how factors specific to the MC method, such as statistical uncertainties, impact dose distributions and clinical decision making. We will illustrate how a properly benchmarked Monte Carlo algorithm can play a unique role in the modeling of complex delivery procedures, such as IMRT and how Monte Carlo fluence prediction can be combined with analytic dose algorithms to estimate patient dose. Finally, we will show how Monte Carlo can include organ motion in 4D dose calculations without an increase in computation time. In addition to illustrating the role of Monte Carlo in complex treatment planning, a focus of this course will also be to review some of the practical issues associated with the implementation, verification and clinical use of Monte Carlo-based dose calculation algorithms.

Educational Objectives:

1. To familiarize clinical physicists with some of the issues associated with implementation and experimental verification of Monte Carlo-based dose algorithms in the clinical setting.
2. To understand the factors specific to Monte Carlo-based dose algorithms, such variance reduction techniques and statistical uncertainties.
3. To become familiar with the various approaches used in Monte Carlo-based modeling of the MLC and the tradeoffs associated with these methods.
4. To recognize the potential clinical outcome benefits of Monte Carlo-based dose distributions.
5. To understand the use, benefits and limitations of the Monte Carlo method for IMRT optimization and QA.
6. To become familiar with the role of the Monte Carlo method in motion compensated (4D) treatment planning.