

Model Based Dose Calculation Algorithms in External Beam Therapy

Accurate photon dose calculation models are today mainly based on dose calculation algorithms in which the dose distribution is predicted from first principles, i.e. model based algorithms. Basically a convolution is performed between the energy released in each voxel and a dose spread kernel. Due to limitations in computer speed and incomplete physics approximations have been introduced. They are to a first level the pencil beam convolution models and secondly the collapsed cone convolution models. This lecture will present these models and discuss the pros and cons for them and when possible also discuss the individual implementations in commercial treatment planning systems.

The models covered are pencil beam models which today still are the basis for most dose calculations in 3DCRT and IMRT optimisations. Secondly, the new pencil beam implementation including modelling of changes in electron transport especially in the lateral direction will be discussed. Finally the highly accurate collapsed cone models will be covered which produce results of the same quality as Monte Carlo simulations. The latter approach is not the topic of this first part of the lecture, however, it will be used to benchmark results from model based algorithms and to highlight limitations of these.

Educational Objectives:

1. To provide an educational review of the physics and techniques behind model based algorithms e.g. convolution/superpositioning models.
2. To review the methods used to improve the simulation efficiency i.e. pencil beam and collapsed cone convolutions.
3. To briefly review the vendor codes currently used for clinical treatment planning.
4. To briefly review the potential clinical implications of accurate calculated dose distributions.