

Photon Dose Algorithms and Physics Data Modeling in modern RTP

Radiation Treatment planning has been constantly evolving over the past 20 years. It was not long ago that we talked about the benefits of 3D treatment planning and the need for comprehensive QA for such planning systems. Today we use routinely IMRT and we have already seen early implementations of 4D and adaptive planning. While the emphasis of development has been given in the implementation of faster, more efficient, and more comprehensive optimization algorithms to solve the inverse problem and to integrate more imaging in the RTP, some progress has also been made in the implementation of accurate dose calculation algorithms. The convolution/superposition algorithm is the most popular photon dose engine used in treatment planning, while fast, pencil beam like implementations continue to be popular with IMRT and now with adaptive radiotherapy. The Monte Carlo algorithm although now clinically available, is becoming an option as a secondary dose verification rather than as the principal optimization engine for IMRT planning, primarily due to calculation speed issues.

In this presentation we will discuss the algorithms that have historically been used for photon beam treatment planning with emphasis on the convolution/superposition method that is currently the most widely used algorithm. We will discuss the clinical implementation of such algorithm and the modeling parameters that have to be established prior to its clinical commissioning. Clinical examples will also be presented to demonstrate the use and outcome of dose calculations in homogeneous and heterogeneous media and to discuss the effect of modeling parameters.

Educational Objectives:

1. Overview of dose calculation algorithms for photon beams
2. Review and principles of the convolution/superposition (CS) type algorithms
3. Discussion on the typical modeling parameters for CS based RTP
4. Clinical examples and demonstration of the effect of dose algorithm selection in IMRT planning
5. QA for modern RTP