Implementation of a fast algorithm for 3-D inverse treatment planning for IMRT

Deriving accurately and efficiently the optimized beam angle and beam intensity pattern, given certain constraints for the tumor to be treated and the critical organs to be spared, is the key to successful delivery of IMRT (Intensity Modulated Radiation Therapy). The search for the optimized parameters consists of two processes: dose calculation and the adjustment of parameters to achieve the objective. In this study, we have used evenly spaced beam angles. For each beam angle, the beam opening is divided into two-dimensional matrices of beam intensities. Dose calculation is performed for each of these voxels using beam tracing and FFT convolution of electron transport kernels and scatter kernels. A reduced size of the matrices is chosen in order to increase the calculation speed while maintaining the calculation accuracy. Dose to the tumor and critical organ due to each beam voxel is scored. The optimized weighting of beam voxels is obtained by using the Cimmino simultaneous projection method, which solves a system of inequalities without resorting to repetitious dose calculations. The time required for the optimization of beam intensity of five 10x10 cm^2 fields (1x1 cm^2 voxels) with 0.5x0.5x0.5 cm^3 dose resolution for the phantom is on the order of 5 minutes on a standard 300 Mhz pentium PC.