Evaluation of a Prototype Inverse Treatment Planning System

Over the past several years, three-dimensional radiation treatment planning (3D-RTP) vendors have begun developing inverse treatment planning capabilities for generating intensity modulated radiotherapy (IMRT) treatment plans. However, all of these systems are still in the development phase and are not available for general release. One such system is the prototype inverse planning software under development for use with the ADAC Pinnacle[3] treatment planning system. This software uses an iterative algorithm with a user defined objective function to solve the inverse problem.

This system is currently able to optimize step-and-shoot intensity modulated treatment plans. The IMRT optimization process starts by calculating dose distributions for 3D conformal treatment fields with blocks, but without any additional modifiers, using the standard convolution/superposition models. The desired optimization parameters, such as the minimum allowable target dose and the maximum allowable normal tissue doses, are defined for the contoured regions of interest. During optimization, isodose lines, isodose clouds, dose volume histograms (DVHs) and normal tissue complication probabilities (NTCPs) are calculated and updated in real-time. After optimization, a leaf sequencing algorithm can be used to generate MLC treatment files.

The capability of the inverse treatment planning software was evaluated using a variety of specially designed test objects, where the solution to the inverse problem was known. After optimization, the results were compared to the known solutions and an excellent agreement was observed in all cases.