EFFECT OF NOISE ON MONTE CARLO-BASED INVERSE TREATMENT PLANNING

When using Monte Carlo, the calculated dose distributions are always burdened with statistical noise. The noise introduces two types of error. One is the well-known *statistical error* because of the finite number of simulated particle histories. In addition the *convergence error* occurs because the optimisation algorithm converges to the optimum for the noisy data, which is different from the optimum for the noise-free data.

A 2D Monte Carlo-based inverse treatment planning algorithm MCI was used for this study. This algorithm combines Monte Carlo dose calculation with simulated annealing optimisation to obtain the optimal solution for a given objective function. The narrow beam dose distributions (corresponding to narrow beams from multileaf collimators) were calculated to different precision for this purpose.

For the statistical error it was established, that the absolute error was larger in the target volume as outside, because of the higher total dose delivered to the tumour. Initially acceptable dose volume histograms revealed significant deviations when the almost noise-free (less than 0.1% error) dose calculation was used. For the convergence error, the absolute error was larger outside the tumour volume, because of the large variations in the calculated intensity distribution of the narrow beams. Dose outside the target volume, delivered from a small number of narrow beams, is affected more than dose inside the tumour volume, which is delivered from a large number of narrow beams. Levels of acceptability of the plans for both types of errors were determined.