Monte Carlo treatment planning with Monaco Matrix

Abstract:
The photon dose calculation can even with state of the art treatment planning systems be erroneous under certain circumstances. Monte Carlo methods promise a higher accuracy. We have used the photon transport code CHILD of the GSF-Forschungszentrum, Neuherberg near Munich, which was developed to calculate dose in diagnostics radiation protection matters.
The code was refined for application in radio therapy for high energy photon irradiation and should serve for dose verification and QA in individual cases. The irradiation phantom can be entered as any desired 3D matrix or be generated automatically out of an individual CT database. The particle transport takes into account pair production, photo and Compton effect with certain approximations. A Gauss electron multiple-scattering scheme was implemented. Efficiency is increased with Woodcock tracking and the method of „fractional photons".
The developed Monte Carlo code Monaco Matrix was tested with simple homogeneous and heterogeneous phantoms through comparisons with simulations of the well known, but slower EGS4 code. The results were within 2%. The use of a point source with a direction independent energy spectrum as simplest model of the radiation field from the accelerator head is shown to be sufficient for simulation of real accelerator depth dose curves and profiles except the penumbra.
With this code an equivalent fast non-iterative inverse Monte Carlo optimization (IMCO) algorithm was developed.