

MCDOSE – A dose calculation tool for radiotherapy treatment planning

An EGS4 usercode, MCDOSE, has been developed for radiotherapy treatment planning (RTP). MCDOSE is designed as a dose calculation module suitable for adaptation to host RTP systems. MCDOSE can be used for both conventional photon/electron beam calculation and intensity modulated radiotherapy (IMRT) treatment planning. MCDOSE uses a multiple-source model to reconstruct the treatment beam phase space. Based on measured beam data acquired during commissioning, source-model parameters are adjusted through an automated procedure. Beam modifiers such as jaws, physical and dynamic wedges, blocks, electron cutouts and bolus are simulated in MCDOSE together with a 3D rectilinear patient geometry model built from CT data. Comparisons of dose distributions calculated using MCDOSE show excellent agreement with those calculated by the EGS4/DOSXYZ code. Heterogeneity correction factors for layered-lung or layered-bone phantoms as calculated by both codes agree with measured data to within 1%. Variance reduction techniques are implemented in MCDOSE to achieve a speedup factor of 10 – 20 compared to DOSXYZ. CPU time required for clinical electron beam plans with 0.1 – 1.0 cm³ dose grids is 0.1-1 h and 0.5-5h for clinical photon beam plans on a PentiumPro 200 MHz PC. Discrepancies up to 10% (or a 1 cm shift in the 90% isodose line) are observed between the dose distributions calculated using MCDOSE and conventional dose algorithms. MCDOSE has also been used to calculate beamlets for an IMRT planning study and for retrospective dose verification of clinical IMRT patient treatments.