Experimental verification of XVMC - a fast Monte Carlo code for photon beam treatment planning

An experimental verification of the recently developed XVMC code, a fast Monte Carlo algorithm to calculate dose distributions of photon beams in treatment planning is presented. The code is an extension of the Voxel-Monte-Carlo (VMC) model for electron beams. Photon transport is taken into account by exponential attenuation, ray tracing, and photon interaction cross sections (Compton scattering, pair production). The required material properties (electron stopping and scattering powers, electron density, attenuation coefficients) are determined directly from a given density distribution. The treatment head is modelled by a point source with energy distribution (primary photons) and an additional head scatter contribution.

XVMC has been compared to EGS4 and experimental data. It is demonstrated that the new algorithm is able to reproduce dose distributions with an accuracy of better than 2% in a water phantom with and without various slab inhomogeneities embedded. These measurements have been performed by a diamond detector. Furthermore, dose distributions in various solid state phantoms have been measured by film and thermo luminescent dosimetry (TLD). Also for these cases, measured and calculated dose distributions agree by taking into account experimental uncertainties. A beam parameter generation utility and an interface to commercial planning systems will allow the implementation of the code for routine treatment planning of clinical electron and photon beams.

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