

Monte Carlo generated kernels are widely used in Medical Physics for convolution calculations. Analytical kernels are also used to obtain closed forms for the energy deposition. Analytical approximations for the “first scatter” energy, the energy deposited by charged particles that are set in motion by photons that have been scattered exactly once, are of particular interest.

The validity of this approach has not yet been completely addressed. The energy range where this approximation is valid is well known, but calculations based on analytical formulas assume that the photon energy is deposited locally. There is no explicit consideration of electron transport. Moreover, analytical kernels may sometimes include local energy deposition from interactions of the secondary electron which may be inconsistent with the definition of first scatter kernels. Finally, Klein-Nishina cross-sections do not properly account for binding effects or coherent scattering.

A comparison is made here of the Monte Carlo generated kernel’s first scatter component and the analytical kernels obtained using the Klein-Nishina cross-section equation. By analyzing the radial and angular kernel distributions we show the regions where first scatter analytical kernels are reliable.