

Purpose: To develop reference data sets of common Monte Carlo simulations in medical imaging research for use by researchers who are learning how to implement Monte Carlo simulations or needing to validate their own Monte Carlo simulations.

Methods: Complete implementation specifications and results for different Monte Carlo simulations reflecting common medical imaging research conditions were developed. The specifications include: full geometry details, material compositions, particle energies, spectral definitions and scoring details. The specifications for each of these simulations will be implemented in five different Monte Carlo software packages: EGSnrc, Geant4, MCNP, Penelope and Sierra.

Results: A total of eight commonly performed Monte Carlo simulations for five different imaging applications were developed: (i) production of x-rays, (ii) half-value layer estimation, (iii) radiographic dosimetry, (iv) x-ray scatter in radiography, (v) mammographic dosimetry, (vi) x-ray scatter in mammography, (vii) CT dosimetry of simple volumes and (viii) CT dosimetry of voxelized volumes. The simulation conditions and the results for all five implementations will be published, in detail, in the Task Group report and will be made available online in the AAPM website. Once published, we will invite scientists to submit their results when simulating these conditions.

Conclusion: The publication of reference data sets for common Monte Carlo simulations will be a useful tool for imaging researchers new to the field of computer simulations or seeking to validate their newly-developed simulations before performing new experiments. Upon successful completion of this initial data set, we envision the extension of this work to include other modalities, such as nuclear medicine imaging.