AbstractID: 1661 Title: Analysis of particle number and statistical error on the quality of the Monte Carlo simulated chest x-ray scattering pattern

The optimization of chest radiography can be studied using a tomographic phantom that provides information on organ doses and image quality. Monte Carlo methods are ideal for simulating both organ doses and the scattered portion of an x-ray. Geometry, particle energy, and resolution influence the required number of particles and corresponding error. This paper addresses the question of how to design a Monte Carlo simulation with minimum resources. EGS4 with a segmented VIP-Man phantom simulated the photon scattering processes. Using an energy of 150 keV to maximize the number of transmitted photons a subsection of the chest was analyzed. By using the maximum energy and a subsection of the chest, the effective particle fluence is increased by a factor of nearly 70 verses the full chest model at lower energy. Four runs with decreasing particle counts between 1 billion and 1 million were obtained using the same subsection. We assumed the subsection simulation using 1 billion particles was better than any possible full sized simulation and adopted it as our gold standard. The data sets were smoothed and compared to the smoothed gold standard. It was found that using a boxcar-smoothing algorithm convolving over a 24 x 24 area resulted in a deviation from the gold standard of only 0.57% and 1.57% when reducing the number of particles by one and two orders of magnitude respectively. We conclude that accurate simulations of the scatter pattern within chest radiography can be achieved in a reasonable time frame with acceptable error.