Parameterization of Pb X-Ray Contamination in Simultaneous Tl-201 and Tc-99m Dual-Isotope Imaging

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\textbf{Abstract} In simultaneous Tl-201 and Tc-99m dual isotope imaging, Pb X-rays are a significant source of contamination in the Tl image. In order to characterize this contamination, we simulated images of line sources in the Tc and Tl photopeak windows using an experimentally verified Monte Carlo program. The line sources were placed at various distances from the collimator face and emitted photons with energies from 88 to 140.5 keV. The Pb X-ray contamination line source response function in the Tl window was fitted well by a Gaussian plus an exponential function. The width of these two functions changed linearly with distance. Parameterization of the Pb X-ray response was done by simultaneously fitting the Pb X-ray response functions at various distances with fitting functions that were determined empirically to model the distance dependence of the Gaussian and exponential components of the Pb X-ray response. The parameterized model of Pb X-ray contamination is useful in developing methods to model Pb X-ray contamination in Tl-201 data by Tc-99m. This Pb X-ray contamination model can be used in iterative reconstruction-based cross-talk compensation for simultaneous Tc/Tl dual isotope imaging.

\textbf{Index Terms} : Monte Carlo N-Particle (MCNP), Monte Carlo simulation, Pb X-ray contamination, simultaneous dual-isotope imaging, Tc-99m, Tl-201.

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