Modelling of high energy photons transport in single photon emission tomography

Doctoral thesis topic defense

The quality and accuracy of determining physical quantities from image data in single-photon emission computed tomography (SPECT) are limited by the attenuation and scattering of gamma rays, penetration and the characteristics of detector. Monte Carlo (MC) simulations enable the modeling of these processes to calculate the distribution of activity in volume of interest, which can improve image reconstruction algorithms. The aim of the research is to experimentally validate MC calculations of quantitative image data obtained using the SIMIND and SIMREC algorithms by comparison with experimental measurements of the distribution of ^{99m}Tc and ^{123}I. The research includes the evaluation of correction methods for scatter and penetration effects, the assessment of the quantitative accuracy of determining activity concentration from image data, and the optimization of collimators made of high atomic number materials. The expected result is an MC-based methodology for determining activity from SPECT images, as a prerequisite for MC simulation-guided optimization of detector characteristics and reconstruction algorithms.

Keywords: Monte Carlo, iterative image data reconstruction, SIMIND