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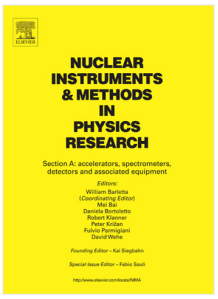

Analysis of complex gamma-ray spectra using particle swarm optimization

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Analysis of complex gamma-ray spectra using particle swarm optimization

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Abstract

Analysis of gamma-ray spectra is an important step for identification and quantification of radionuclides in a sample. In this paper a new gamma-ray spectra analysis algorithm based on Particle Swarm Optimization (PSO) is developed to identify different isotopes of a mixed gamma-ray source and determine their fractional abundances. PSO is an iterative algorithm that imitates the social behaviors observed in nature to solve complex optimization problems. The PSO method is used for complex fitting to the response of a 3×3 inch NaI (Tl) scintillation detector and the fitting process is controlled by a test for significance of abundance and computation of Theil coefficient. To test the developed algorithm, a number of experimentally measured gamma-ray spectra related to a mixed gamma-ray source including different combinations of ^{60}Co, ^{137}Cs, ^{22}Na, ^{152}Eu and ^{241}Am isotopes are analyzed using information of whole spectrum. The performance of the developed PSO algorithm is compared to the multiple linear regression (MLR) method as well. The results of the developed PSO algorithm show a better match with the real fractional abundances than that of MLR method.

Keywords: Gamma-ray spectroscopy, Particle swarm optimization, Whole spectrum analysis

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