Development of a Noise Reduction Program of a Prompt Gamma Spectrum based on Principal Component Analysis for an Explosive Detection

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This work demonstrates a developed program to reduce noises of a prompt gamma-ray spectrum measured by irradiating neutrons into baggage. The noises refer to random variations mainly caused by electrical fluctuations and also by a measurement time. Especially, since the short measurement time yields such a noisy spectrum in which its special peak can not be observed, it is necessary to extract its characteristic signals from the spectrum to identify an explosive hidden in luggage. Principal component analysis(PCA) that is a multivariate statistical technique is closely related to singular value decomposition(SVD). The SVD-based PCA decreases the noise by reconstructing the spectrum after determining the number of principal components corresponding important signals based on the history data that sufficiently describe its population. In this study, we present a visualized program of the above procedure using the MATLAB 7.04 programming language. When our program is started, it requires an arbitrary measured spectrum to be reduced and history spectra as input files. If user selects the files with menu, our program automatically carries out the PCA procedure and provides its noise-reduced spectrum plot as well as the original spectrum plot into an output window. In addition, user can obtain signal-to-noise ratio of an interesting peak by defining the peak and noise ranges with menu.