

Automatic machine learning methods for analyzing radioxenon isotopes spectra

One of the verification methods used for the Comprehensive Nuclear-Test-Ban-Treaty (CTBT) is the measurement of environmental radionuclides. Measuring the activity concentration of radionuclides isotopes (^{131}mXe , ^{133}mXe , ^{133}Xe , ^{135}Xe) and discrimination from each other and from ^{214}Pb which is daughter of ^{222}Rn as interference factor in the nuclear detector is a challenge and interesting area of research for the CTBT. Different systems have been developed to detect and measure the activity concentration of these isotopes including beta-gamma coincidence spectroscopy. In this work, a range of robust classification machines (CM) such as MLP_BP, KNN, RNN, etc. were selected amongst various families of learner algorithms in order to analysis of beta-gamma coincidence spectra with different activities that were simulated with GATE V6.2 code. For this purpose, we considered a feature extraction algorithm (FEA) such as FCM (Fuzzy C means) for initial feature extraction. Eventually, the accuracy for each method was reported and compared. The results showed that, employing appropriate optimization tools (such as Q-learning) and hybrid system can prepare intelligent analyzing radionuclides spectra hence accuracy of 97% and 99% for prediction of presence of radionuclides isotopes and determination of activity concentration were achieved, respectively.

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