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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 radioxenons. Measuring the activity concentration of radioxenon isotopes (131mXe, 133mXe, 133Xe, 135Xe) and discrimination from each other and from 214Pb which is daughter of 222Rn 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 radioxenon spectra hence accuracy of 97% and 99% for prediction of presence of radioxenon isotopes and determination of activity concentration were achieved, respectively.

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