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Radionuclide Detection Using Deep Neural Networks

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One of the implementations to support the CTBT instrument measurement is radionuclide identification. An automatic real-time identification radionuclide can be an option for some applications, including monitoring of environmental contamination and prevention of nuclear terrorism. This research is about the automatic algorithms that provide feedback about the presence of any radiations anomaly. In addition to designing better hardware, a sophisticated computer algorithm is also a needed for automatic detection of radioactive materials by developing a method for supervised learning model from identified gamma spectrum using deep learning. The gamma-ray detector data for this study was obtained from public data from ORNL for research and development purposes.
For the simulations, OpenMC and Geant4 is used to generate data files in a time-series manner and modeling standard NaI(Tl) detector resolution at 661keV. The data set contains six different types of source combinations: High enriched uranium (HEU), Cesium 137, Iodine 131, Cobalt 60 , Technetium, and LEU, in total 10000 data files with ground truth were provided in the dataset. Experiments on simulated spectra suggest that deep learning methods (RNN + LSTM) can achieve a higher F1 score at difficult testing conditions compared to the best performing traditional machine learning models, obtaining a 91.11% score during evaluation.

Promotional text

This research can be used for radionuclides identification in any various fields, including in the difficult areas. Besides, it also can be used for environmental monitoring system. By doing this research, the author also might open any collaborations from another participants.

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