Unfolding of Full-Energy Peaks from Plastic Gamma Spectra using a Convolutional Autoencoder

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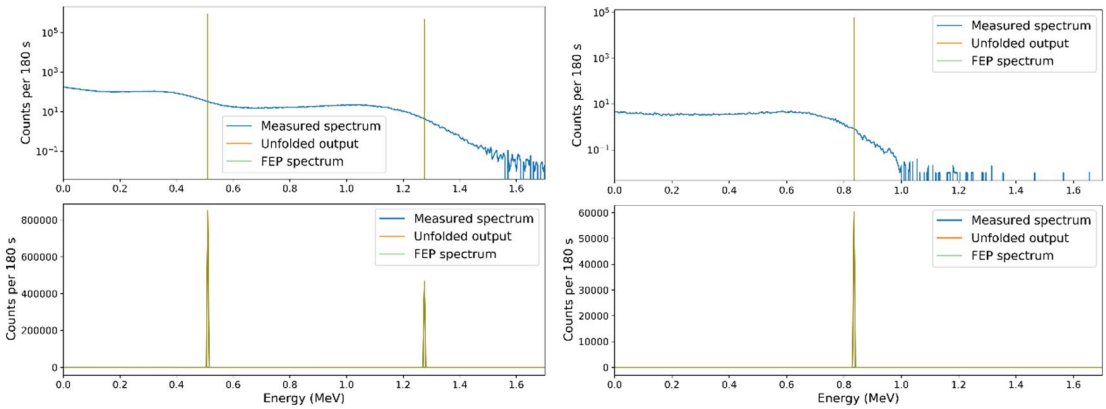
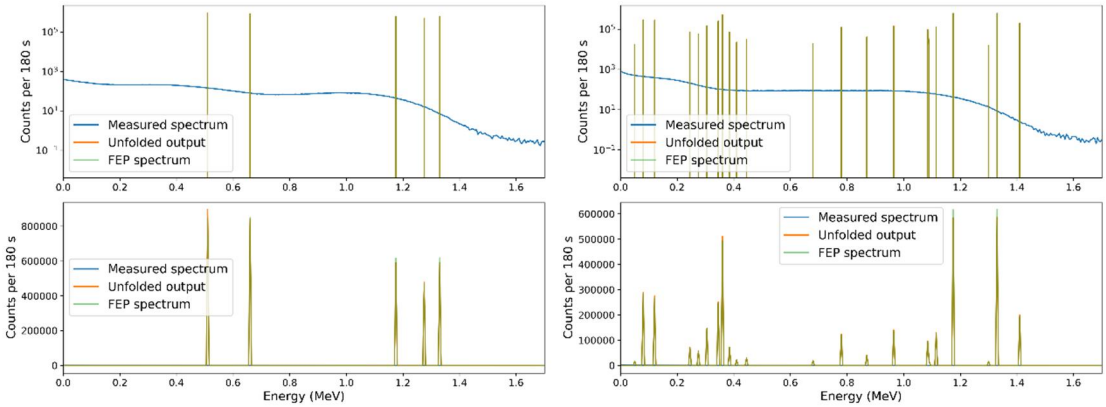
Keywords: plastic gamma spectrum; photo peak; unfolding of full-energy peaks; deep learning; convolutional autoencoder

Although plastic scintillation detectors have poor spectroscopic characteristics, they are widely used in various fields for radiation measurements. Many methods have been proposed to allow the use of plastic scintillation detectors for spectroscopic measurements. However, a majority of them only allow the identification of radioisotopes. In this study, we presented a deep learning model for unfolding full-energy peaks from plastic gamma spectra. A convolutional autoencoder was trained via supervised learning. For dataset generation, eight gamma ray sources were used. We utilized spectra simulated by MCNP 6.2, measured by a polyvinyl toluene detector, and generated by referring to the information on the gamma ray sources. Spectra for single and multiple gamma ray sources were generated via the random sampling technique and used as the dataset to train our model. We tuned hyper-parameters of our model with the Bayesian optimization method using the generated dataset. The performance of our model was verified by using the measured plastic gamma spectra. Furthermore, we evaluated the minimum unfoldable counts for single isotopes with the metric of mean squared logarithmic error to verify the unfolding performance according to the number of counts. We confirmed that our model unfolds full-energy peaks even from spectra containing statistical uncertainties.



(a) (b)



(c) (d)

Fig. 1 Unfolding examples on plastic gamma spectra for single and multiple isotopes

Acknowledgments

This work was supported by the Korea Atomic Energy Research Institute (KAERI project No. 79755-20), the Ministry of Oceans and Fisheries (KIMST project No. 20200611) and the Ministry of Science and ICT (NRF project No. 2020M2C9A1068149).