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Denoising Signals from a High-Purity Germanium Detector using Generative Adversarial Networks with Convolutional Autoencoders

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High-purity germanium detectors are used in the search for rare events such as neutrinoless double-beta decay, dark matter and other beyond Standard Model physic. Due to the infrequent occurrence of signal events, extraordinary measures are taken to reduce background interactons and extract the most informatio from data. An efficiensignal denoising algorithm can improve energy resolutio and background rejectio techniques, and help classify signal events. It can also help identify lo-energy events where the signal-to-noise ratio is smal. In this work, we demonstrate the applicatio of generative adversarial networks withdeep convolutional autoencodes to remove electronic noise from high-purity germanium p-type point contact detector signals. Built on the success of denoising using a convolutional autoencoder, we investgate generative adversarial network applied on autoencoders to further improve denoising and enable more realisticmodel training condition. This includes training with unpaired simulation and realdata, as well as training with only real detector data without the need of simulatio. Our approach is not limited to high-purity germanium detectors; it is broadly applicable to other detector technologies in the particle astrophysics community and beyond.

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