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(G) Denoising High-Purity Germanium Detector Signals using Cycle Generative Adversarial Network

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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 physics. Due to the infrequent occurrence of signal events, extraordinary measures are taken to reduce background interactions and extract the most information from data. An efficient signal denoising algorithm can improve measurements of pulse shape characteristics, resulting in better energy resolution, background rejection and event classification. It can also help identify low-energy events where the signal-to-noise ratio is small.

In this work, we demonstrate the application of Cycle Generative Adversarial Network (CycleGAN) with deep convolutional autoencoders 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 show that CycleGAN applied on autoencoders allows for more realistic model training conditions. This includes training with unpaired simulated and real data, as well as training with only real detector data without the need of simulation.

Keyword-1

HPGe detectors

Keyword-2

machine learning

Keyword-3

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