Contribution ID: **71** Type: **Poster + Flashtalk**

Pulse pile-up reconstruction using 1D-CAE for signal discrimination in nuclear experiments

Pulse pile-up is a common issue in nuclear spectroscopy and nuclear reaction studies, degrading energy and timing accuracy in particle identification. This work presents a novel method for reconstructing pile-up events using a one-dimensional convolutional autoencoder (1D-CAE). The method effectively separates and reconstructs overlapping pulses, enabling acceptance of these events and allowing for signal discrimination. This technique successfully reconstructs over 80% of the pile-up events acquired on a 64-bit processor. The proposed reconstruction technique has been successfully implemented on the 32-bit microprocessor of the PINQZ2 platform (ARM Cortex-A9), achieving similar performance as implementations on 64-bit processors. Furthermore, ongoing work is adapting the model to the Artix-7 FPGA of the PINQZ2 using the HLS4ML Python package. The results will be presented at the conference. This advancement paves the way for real-time pulse reconstruction in high-rate nuclear experiments, significantly enhancing data acquisition and analysis accuracy.

AI keywords

Pile-up, real-time, FPGAs, one-dimensional convolutional autoencoder, machine learning

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Track Classification: Hardware & Design