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Implementation of multi-GHz digital shaper for high-rate nuclear spectroscopy

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In recent years, nuclear spectroscopy has benefited from advances in the field of high-speed digital signal processing (DSP), enabling improved detector response and reduced dead time. The trapezoidal shaper, has been widely used for pulse processing in nuclear spectroscopy applications. Trapezoidal allows to fine tune the energy resolution and sustainable rate by selecting the shaping time. The filter is typically implemented in FPGA using a recursive architecture. At the state of art, the recursive implementation of the trapezoidal filter allows to operate no more than 250-300 MHz on modern devices. However, with the advent of very fast detectors such as photomultiplier tubes (PMTs), diamond sensors, and fast silicon photomultipliers (SiPMs), the demand for even higher-speed implementations has grown.
In this paper, we present a novel high-speed implementation of the trapezoidal shaping method that can operate at up to 5 GSPS for trapezoidal filters with a maximum length of 1024 samples and at 2.5 GSPS for filters with a maximum length of 8192 samples. This significant improvement in speed was achieved by parallelizing all digital blocks within the FPGA-based digital pulse processing architecture.

Minioral

Yes

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No

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No

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