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A Generic Data Acquisition System for Multidisciplinary Detector R&D

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Time-domain triggering on a raw stream of data, where the triggering is generally threshold-based or randomly acquired, is critical for many scientific applications from rare-event searches to condensed matter system characterization to high-rate high-energy physics experiments. Generic data acquisition (DAQ) systems that quickly and efficiently process such data are thus necessary for effective detector R&D. In the SPLENDOR Collaboration, we are developing the Python-based SPLENDQA package for this exact purpose—it offers two main features for offline analysis of continuous data: a threshold-triggering algorithm based on the time-domain optimal filter formalism and an algorithm for randomly choosing nonoverlapping segments for noise measurements. Furthermore, we are developing an online FPGA triggering algorithm for a DAQ system called the Moku, a product created by Liquid Instruments. Using MATLAB Simulink and machine-generated HDL code, we can create and compile a live version of the same algorithm. Here, we discuss the underlying principles of this generic DAQ package and give concrete examples of its utility in various applications.

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