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Efficiency estimation of self-triggered antenna clusters for air-shower detection

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Air-shower radio array operate in low signal-to-noise ratio conditions, which complicates the autonomous measurement of air-shower signals without using an external trigger from optical or scintillator detectors. A simple threshold trigger for radio can be efficiently applied only in radio-quiet conditions, because for other cases this trigger detects a high fraction of noise pulses. In the present work, we study aspects of independent air-shower detection by dense antennas clusters with a complex real-time trigger system. For choosing the optimal procedures for the real-time analysis, we study the dependence between trigger efficiency, count rate, detector hardware and geometry. For this study, we develop a framework for testing various methods of signal detection and noise filtration for arrays with various specifications (geometry, hardware, background conditions etc.) and the hardware implementation of these methods based on field programmable gate arrays. The framework provides flexible settings for the management of station-level and cluster-level steps of detecting the signal, optimized for the hardware implementation for real-time processing. It includes data-processing tools for the initial configuration and tests on pre-recorded data, tools for configuring the trigger architecture and tools for preliminary estimates of the trigger efficiency at given thresholds of cosmic-ray energy and air-shower pulse amplitude. We show examples of the trigger pipeline developed with this framework and discuss the results of tests on simulated data.

Keywords

Self-triggering, radio detection, air-showers

Collaboration

other Collaboration

Subcategory

Experimental Methods & Instrumentation

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