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Real-Time Event Filtering in Complex Multi-Detector Systems

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The quest to develop a fundamental understanding of the nuclear interaction is aided greatly through measurements made with complex, multi-detector systems. As these systems allow for both an increase in total efficiency due to greater angular coverage as well as correlation measurements in both time and space, the information which can be probed using these detectors is greatly increased over single-detector systems.

With an increase in both number of detectors and complexity of detector systems comes challenges in data acquisition. As each detector can obtain data independently, the required throughput of the data acquisition system also increases. To address this problem, real-time event filtering can be performed on the data to only process and store events with certain characteristics. Traditional methods for event filtering require large arrays of electronics to perform logic on unprocessed data. This approach comes with a large up front cost both in money and effort in order to purchase, set up, and test electronics. Finally, for small laboratories, the scaling of these approaches can be a limiting factor as an increasing number of detectors also increases the number of electronic modules, as well as the space and power consumption of the data acquisition system.

At the Nuclear Science Lab (NSL) at Simon Fraser University (SFU), we implement a single-unit, computer controlled XLM72S universal logic module to perform real-time event filtering. The XLM72S contains a field programmable gate array with two operational firmwares developed for the NSL at SFU. The first of these performs both anti-coincidence logic and multiplicity filtering for up to twenty independent Compton Suppressed Spectrometers, as well as coincidence logic with up to four auxiliary detectors. The second is designed to perform coincidence logic on up to 128 individual inputs through the daisy-chaining of multiple XLM72S logic modules, a feature which can be achieved with both firmwares. Through daisy-chaining of XLM72S modules, scaling real-time event filtering to large-scale, complex, multi-detector system is easily achievable.

Details of the module and the two firmwares developed for and implemented in the NSL at SFU will be discussed in this talk.

Author: MARTIN, Matthew (Simon Fraser University)

Co-authors: TOKE, Jan (J-Tech Instruments); STAROSTA, Krzysztof (Simon Fraser University)

Presenter: MARTIN, Matthew (Simon Fraser University)

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