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Online track detection in triggerless mode for INO

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The India based Neutrino Observatory (INO) is a proposed particle physics research project to study atmospheric neutrinos[CITATION INO06 \l 16393]. INO –Iron Calorimeter (ICAL) will consist of 28,800 detectors having 3.6 million electronic channels expected to activate with 100 Hz singles rate producing data at the rate of 3GBps. Data collected contains a few real hits generated by muon track and the remaining noise induced spurious hits. Estimated reduction factor after filtering out data of interest from generated data is of the order of 103. This makes trigger generation critical for efficient data collection and storage. Trigger is generated by detecting coincidence across multiple channels satisfying trigger criteria[CITATION Das12 \l 16393], within a small window of 200ns in the trigger region. As the probability of neutrino interaction is very less, track detection algorithm has to be efficient and fast enough to process 5 * 106 events/sec without introducing significant dead time so that not even a single neutrino event is missed out.
A hardware based trigger system is presently proposed for on-line track detection considering stringent timing requirements. Though the trigger system can be designed with scalability, a lot of hardware and interconnections make it a complex and expensive solution. Also its flexibility is limited. A software based track detection approach working on the hit information offers an elegant solution with possibility of varying trigger criteria for selecting various potentially interesting physics events. An event selection approach for an alternative triggerless readout scheme has been developed. The algorithm is mathematically simple, robust and parallelizable. It has been validated by detecting simulated events for energies of the primary neutrinos of the range of 1 GeV –10 GeV with 100% efficiency at a processing rate of 60µs/event on a 16 core machine. The algorithm and result of a proof-of-concept for its faster implementation over multiple cores is presented. The paper also discusses about harnessing the compute capabilities of multi-core computing farm, thereby requiring only optimum number of nodes for the proposed system.
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