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FPGA Accelerated Computing for Particle Identification in High-Energy Physics Experiments

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The key challenges in the recent nuclear and High-Energy Physics (HEP) experiments are high reaction rate and data rate. The data rate, the product of the event size and the reaction rate, ranges from 107 up to more than 1011 Bytes/s. This huge amount of data cannot be entirely recorded and processed during offline analysis. Interestingly, physicists have interest only in a very small proportion of all the event data that occur only once within one million interactions. Hence it provides the possibility to utilize an efficient online Data Acquisition (DAQ) and Trigger system to reject uninteresting events while identify and retain interesting ones in real-time.

The paper assesses the machine learning assisted particle identification algorithms on an FPGA based computing platform for HEP experiments. To achieve the highest classification accuracy in particle identification the combination of particle recognition algorithms and random decision forests algorithms are laid on an accelerated computing platform utilizing the FPGA cluster to classify the particles of interest. The simulation results of this implementation achieve many benefits through dynamic and intelligent design management, such as efficient resource utilization and high performance-cost ratio.

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