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Development of first level track trigger at Belle II using Deep-Neural-Network

Thursday 25 April 2024 17:00 (20 minutes)

The Belle II Experiment, located in Japan with the SuperKEKB, an energy-asymmetric electronpositron collider, is the next generation of B-factories. SuperKEKB targets a luminosity of $6\times10^{35}\mathrm{cm}^{-2}\mathrm{s}^{-1}$, enabling unprecedented new physics investigations and Standard Model parameters measurements.
However, the increase in luminosity faces escalating challenges, notably in the realm of level1 triggers. The level-1 trigger, implemented in deadtime-free pipelined hardware, performs online event reconstruction to mitigate substantial beam-induced background and identify signal events. It imposes stringent criteria for level-1 trigger, encompassing a latency under 5 μs, high efficiency, and a prerequisite for trigger rate below 30 kHz, which already reached unexpectedly 10 kHz at a luminosity of $4.7\times10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$. To tackle this challenge, this work introduces a novel Deep Neural Network (DNN) in the level-1 trigger system.
This work focus on the Central Drift Chamber (CDC) trigger system, responsible for reconstruction for charged tracks and rejecting the major beam background originating off the interaction point. The current CDC trigger, based on a single hidden layer neural network architecture, demonstrated approximately 95% efficiency with about 50% background suppression. We have developed a new track trigger with an optimized DNN architecture for fitting and classifying charged tracks, achieving an impressive 80% beam background suppression in simulations.
The DNN track trigger is implemented to Field Programmable Gate Array incorporates parallelized processing, reduced routing congestion, and optimized resource and latency consumption, utilized the newly deployed fourth-generation universal trigger board. In this talk, we present the simulation and hardware implementation for the DNN track trigger.

Minioral

Yes

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No

Are you a student?

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