ID de Contribution: **19**   Type: **Non spécifié**

Realtime Anomaly Detection with the CMS Level-1 Global Trigger Test Crate

lundi 4 mars 2024 16:30 (25 minutes)

We present the preparation, deployment, and testing of an autoencoder trained for unbiased detection of new physics signatures in the CMS experiment Global Trigger test crate FPGAs during LHC Run 3. The Global Trigger makes the final decision whether to readout or discard the data from each LHC collision, which occur at a rate of 40 MHz, within a 50 ns latency. The Neural Network makes a prediction for each event within these constraints, which can be used to select anomalous events for further analysis. The implementation occupies a small percentage of the resources of the system Virtex 7 FPGA in order to function in parallel to the existing logic. The GT test crate is a copy of the main GT system, receiving the same input data, but whose output is not used to trigger the readout of CMS, providing a platform for thorough testing of new trigger algorithms on live data, but without interrupting data taking. We describe the methodology to achieve ultra low latency anomaly detection, and present the integration of the DNN into the GT test crate, as well as the monitoring, testing, and validation of the algorithm during proton collisions.

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Classification de Session: Contributed