Contribution ID: **27** Type: **poster**

Real-time compression of CMS detector data with machine learning

Monday 14 October 2024 17:35 (5 minutes)

The upcoming high-luminosity upgrade to the LHC will involve a dramatic increase in the number of simultaneous collisions delivered to the Compact Muon Solenoid (CMS) experiment. To deal with the increased number of simultaneous interactions per bunch crossing as well as the radiation damage to the current crystal ECAL endcaps, a radiation-hard high-granularity calorimeter (HGCAL) will be installed in the CMS detector. With its six million readout channels, the HGCAL will produce information on the energy and position of detected particles at a rate of 5 Pb/s. These data rates must be reduced by several orders of magnitude in a few microseconds in order to trigger on interesting physics events. We explore the application of machine learning for data compression performed by the HGCAL front-end electronics. We have implemented a conditional autoencoder which compresses data on the ECON-T ASIC before transmission off-detector to the rest of the trigger system.

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Session Classification: Poster Session / Reception