Contribution ID: **129** Type: **Poster**

Performance of the Gaussino CaloChallenge-compatible infrastucture for ML-based fast simulation in the LHCb Experiment

Thursday, 14 March 2024 16:10 (30 minutes)

Efficient fast simulation techniques in high energy physics experiments are crucial in order to produce the necessary amount of simulated samples. We present a new component in the Gaussino core simulation framework that facilitates the integration of fast simulation hooks in Geant4 with machine learning serving, based on Gaudi's scheduling and data processing tools. The implementation supports both PyTorch and ONNXRuntime.

We will also show how this new component can be used to integrate generic ML models developed within the scope of CaloChallenge, a collaborative community-wide initiative aiming to develop and benchmark ML models for modeling of calorimeter shower. A few simple examples within the Gaussino framework, including full observability of the inferred variables, as well as conversion mechanisms to the experiment's event model, will be shown.

Finally, we will present the very first, production-ready implementation of a ML-based fast simulation model for electromagnetic showers in the calorimeter of the LHCb experiment. It is a Vartiational Autoencoder (VAE) with a custom sampling head that increases throughput and improves energy precision. Performance and results of the model and infrastructure, along with insights gained from its utilization, will be presented.

Significance

In this talk, the very first, production-ready ML model for fast simulation of calorimeter showers in the electromagnetic calorimeter in the LHCb Experiment will be presented. The inference/training of that model is based on the adaptation of the CaloChallenge setup and generic ML infrastructure in Gaussino, the experiment-agnostic core simulation framework, that can be used by any other HEP experiment.

References

https://indico.jlab.org/event/459/contributions/11528/
https://indico.jlab.org/event/459/contributions/11549/
https://iopscience.iop.org/article/10.1088/1742-6596/2438/1/012108
https://doi.org/10.22323/1.414.0225
https://www.ncbj.gov.pl/seminaria/prototypes-large-scale-detectors-monte-carlo-simulations
https://doi.org/10.1109/NSS/MIC42101.2019.9060074
https://doi.org/10.31577/cai_2021_4_815

Experiment context, if any

LHCb Experiment

Primary author: MAZUREK, Michal (CERN)

Co-authors: CORTI, Gloria (CERN); KMIEC, Mateusz (National Centre for Nuclear Research (PL))

Presenter: MAZUREK, Michal (CERN)

Session Classification: Poster session with coffee break

Track Classification: Track 1: Computing Technology for Physics Research