Contribution ID: **458** Type: **presentation**

Generative Models for Fast Calorimeter Simulation: LHCb Case

Monday, 9 July 2018 11:45 (15 minutes)

The goal to obtain more precise physics results in current collider experiments drives the plans to significantly increase the instantaneous luminosity collected by the experiments . The increasing complexity of the events due to the resulting increased pileup requires new approaches to triggering, reconstruction, analysis, and event simulation. The last task brings to a critical problem: generating the significantly higher amount of Monte Carlo (MC) data, required for analysis of the data collected at higher collider luminosity, without a drastic increase in computing resources requires a significant speed up of the simulation algorithms.
The largest part of computer resources in simulation is currently spent in the detailed GEANT modeling of particles interacting with the material of the experimental apparatus, in particular the shower development in electromagnetic and hadronic calorimeters.
To accelerate these computations we use approach based on methods of sample creation by generative models, which are nowadays widely used for computer vision and image processing.
These models are based on maximizing likelihood between real data and samples produced by a generator. The two main approaches to this problem are Generative Adversarial Networks (GAN), that takes into account explicit description of the real data, and Variational Autoencoders (VAE), that uses latent variables to describe ones.
In this contribution we present both approaches being applied to the calorimeter simulation for the LHCb experiment at LHC, discuss advantages and possible problems of these approaches, and compare the results.

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Session Classification: T2 - Offline computing

Track Classification: Track 2 –Offline computing