ID de Contribution: **43** Type: **Non spécifié**

Simulating the LHCb experiment with Generative Models

vendredi 29 avril 2022 16:30 (15 minutes)

During Run 2 of the Large Hadron Collider at CERN, the LHCb experiment has spent more than 80% of the pledged CPU time to produce simulated data samples. The upcoming upgraded version of the experiment will be able to collect larger data samples, requiring many more simulated events to analyze the data to be collected in Run 3. Simulation is a key necessity of analysis to interpret signal vs background and measure efficiencies. The needed simulation will far exceed the pledged resources, requiring an evolution in technologies and techniques to produce these simulated samples.
In this contribution, we discuss Generative Models powered by several algorithms and strategies to effectively parametrize the high-level response of the single components of the LHCb detector, encoding within neural networks the experimental errors and uncertainties introduced in the detection and reconstruction process. Where possible, models are trained directly on real data, resulting into a simulation process completely independent of the detailed simulation used to date. The models developed can then be pipelined into a consistent purely-parametric simulation framework, or used as single entities to complement the samples obtained with detailed simulation.

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Classification de Session: AI and physics conference