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Particle shower simulation in high granularity calorimeters using 3 dimensional convolutional Generative Adversarial Networks

Monday 4 November 2019 14:45 (15 minutes)

The future need of simulated events for the LHC experiments and their High Luminosity upgrades, is expected to increase dramatically. As a consequence, research on new fast simulation solutions, based on Deep Generative Models, is very active and initial results look promising.

We have previously reported on a prototype that we have developed, based on 3 dimensional convolutional Generative Adversarial Network, to simulate particle showers in high-granularity calorimeters.

As an example of future high-granularity geometries, we have chosen the electromagnetic calorimeter design developed in the context of the Linear Collider Detector studies characterised by 25 layers and 5mmx5mm cell granularity

The training dataset is simulated using Geant4 and the DDSim framework.

In this talk we will present improved results on a more realistic simulation of different particles (electrons and pions) characterized by variable energy and incident trajectory. Detailed validation studies, comparing our results to Geant4 Monte Carlo simulation, show very good agreement for high level physics quantities (such as energy shower shapes) and detailed calorimeter response (single cell response) over a large energy range. In particular, we will show how increasing the network representational power, introducing physics-based constraints and a transfer-learning approach to the training process improve the agreement to Geant4 results over a large energy range. Initial studies on a network optimisation based on the implementation of Genetic Algorithms will also be discussed.

Consider for promotion

Yes

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