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A Deep Learning tool for fast simulation

Tuesday, 10 April 2018 11:50 (20 minutes)

Machine Learning techniques have been used in different applications by the HEP community: in this talk, we discuss the case of detector simulation. The need for simulated events, expected in the future for LHC experiments and their High Luminosity upgrades, is increasing dramatically and requires new fast simulation solutions. We will describe an R&D activity, aimed at providing a configurable tool capable of training a neural network to reproduce the detector response and replace standard Monte Carlo simulation. This represents a generic approach in the sense that such a network could be designed and trained to simulate any kind of detector and, eventually, the whole data processing chain in order to get, directly in one step, the final reconstructed quantities, in just a small fraction of time. We will present the first application of three-dimensional convolutional Generative Adversarial Networks to the simulation of high granularity electromagnetic calorimeters. We will describe detailed validation studies comparing our results to standard Monte Carlo simulation, showing, in particular, the very good agreement we obtain for high level physics quantities and detailed calorimeter response. We will show the computing resources needed to train such networks and the implementation of a distributed adversarial training strategy (based on data parallelism). Finally we will discuss how we plan to generalize our model in order to simulate a whole class of calorimeters, opening the way to a generic machine learning based fast simulation approach.

Intended contribution length

30 minutes

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