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A Machine Learning tool for fast simulation

Monday 9 July 2018 12:00 (15 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 amount of 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 response. Eventually, it could be extended to replace 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 Geant4 Monte Carlo simulation, showing, in particular, the very good agreement we obtain for high level physics quantities (such as energy shower shapes) and detailed calorimeter response (single cell response). Finally we will show how this tool can easily be generalized to describe a larger class of calorimeters, opening the way to a generic machine learning based fast simulation approach.

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