Contribution ID: **398** Type: **Oral**

Learning high-level structures in HEP data with novel Deep Auto-Regressive Networks for Fast Simulation

Monday 4 November 2019 14:30 (15 minutes)

In High Energy Physics, simulation activity is a key element for theoretical models evaluation and detector design choices. The increase in the luminosity of particle accelerators leads to a higher computational cost when dealing with the orders of magnitude increase in collected data. Thus, novel methods for speeding up simulation procedures (FastSimulation tools) are being developed with the help of Deep Learning. For this task, unsupervised learning is performed based on a given training HEP dataset with generative models employed to render samples from the same distribution.

A novel Deep Learning architecture is proposed in this research based on autoregressive connections to model the simulation output by decomposing the event distribution as a product of conditionals. The aim is for the network to be able to capture nonlinear, long-range correlations and input varying dependencies with tractable, explicit probability densities. The following research report analyses the benefits of employing autoregressive models in comparison with previously proposed models and their ability for generalisation in the attempt of fitting multiple data distributions. The training dataset contains different simplified calorimeters simulations obtained with the Geant4 toolkit (such as: PbWO4, W/Si). Finally, testing procedures and results for network performance are developed and analysed.

Consider for promotion

Yes

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Session Classification: Track 2 –Offline Computing

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