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Machine Learning for Simulation of Collision Events

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The speed-up of generation of simulated collision events is of utmost importance for the benefit of the HEP community. Currently, almost all event simulations are done with the Geant4 framework, which can take minutes for complex events like those expected at the HL-LHC. Previous work in that area has resulted in approaches like the ATLAS FastCaloSim and the CMS FastSim, in which the authors report large speed-ups on the calorimeter simulation. Both approaches promote the speed-up by optimizing algorithms for simulating the various components of the calorimeter, but at the expense of sacrificing some of the accuracy of the simulation.

An alternative approach is to employ machine learning techniques to improve the performance of simulations. We are investigating graph-based Generative Models, such as Generative Adversarial Networks, Autoencoders, and Autoregressive models which are able to account for both the irregular geometry of the detector and the sparsity of the readout data. We will present some of our recent results with the usage of the graph-based networks.

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