Contribution ID: **183** Type: **Flashtalk with Poster**

FlashSim: an end-to-end fast simulation prototype using Normalizing Flow

Tuesday, 30 April 2024 17:10 (3 minutes)

Analyses in HEP experiments often rely on large MC simulated datasets. These datasets are usually produced with full-simulation approaches based on Geant4, or exploiting parametric "fast" simulations introducing approximations and reducing the computational cost.

In the present work, we discuss a prototype of a fast simulation framework that we call "FlashSim" targeting analysis level data tiers (namely, CMS NanoAOD). This prototype is based on Machine Learning, in particular the Normalizing Flows generative model.

We present the physics results achieved with this prototype, currently simulating several physics objects collections, in terms of: 1) accuracy of object properties, 2) correlations among pairs of observables, 3) comparisons of analysis level derived quantities and discriminators between full-simulation and flash-simulation of the very same events. The speed-up obtained with such an approach is of several orders of magnitude compared to classical approaches. Because of this, when using FlashSim, the simulation bottleneck is represented by the "generator" (e.g. Pythia) step. We further investigated "oversampling" techniques, reusing the generator information of the same event by passing it multiple times through the detector simulation, in order to understand the increase in statistical precision that could be ultimately achieved. The results achieved with the current prototype show a higher physics accuracy and a lower computing cost compared to other fast simulation approaches such as CMS standard FastSim and Delphes-based simulations.

Primary author: VASELLI, Francesco (Scuola Normale Superiore & INFN Pisa)

Presenter: VASELLI, Francesco (Scuola Normale Superiore & INFN Pisa)

Session Classification: 3.2 Physics-informed AI & Integration of physics and ML

Track Classification: Session B