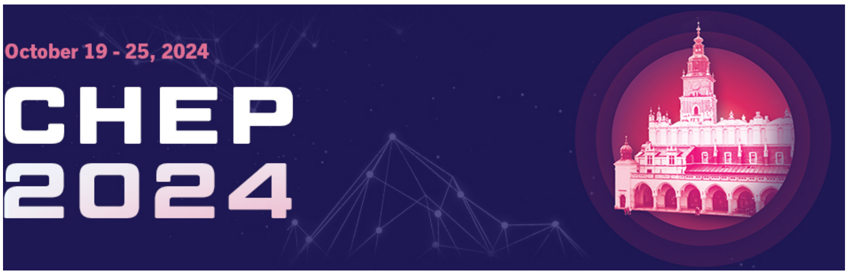

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Normalizing Flows for Physics Data Analyses

Monday 21 October 2024 16:00 (15 minutes)

Monte Carlo (MC) simulations are a crucial component when analysing the Standard Model and New physics processes at the Large Hadron Collider. The goal of this work is to explore the performance of generative models for complementing the statistics of classical MC simulations in the final stage of data analysis by generating additional synthetic data that follows the same kinematic distributions for a limited set of analysis-specific observables to a high precision. A normalizing flow architecture was adapted for this task and its performance was systematically evaluated using a well-known benchmark sample containing the Higgs boson production beyond the Standard Model and the corresponding irreducible background. The applicability of normalizing flows under different model parameters and a restricted number of initial events used in training was investigated. The best performing model was then chosen for further evaluation with a set of statistical procedures and a simplified physics analysis. We demonstrate that the the number of events used in training coupled with the flow architecture are crucial for the physics performance of the generative model. By implementing and performing a series of statistical tests and evaluations we show that a machine-learning-based generative procedure can can be used to generate synthetic data that matches the original samples closely enough and that it can therefore be incorporated in the final stage of a physics analysis with some given systematic uncertainty.

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