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Machine learning for QCD theory and data analysis

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We describe a multi-disciplinary project to use machine learning techniques based on neural networks (NNs) to construct a Monte Carlo event generator for lepton-hadron collisions that is agnostic of theoretical assumptions about the microscopic nature of particle reactions. The generator, referred to as ETHER (Empirically Trained Hadronic Event Regenerator), is trained to experimental data along with dedicated detector simulators in order to map out faithfully the multi-particle distributions at femtometer scales. We will discuss how the resulting generator can be a useful tool for the QCD theory and experimental communities. As a further application of machine learning, we present new strategies based on NNs for QCD global analyses where NNs are trained to map the parameter space for the underlying quantum probability distributions into experimental observables. Such mappings will facilitate online visualizations of the correlations between experimental data space and the space of possibilities for the quantum probability distributions. The resulting product will be a critical tool for the nuclear and high energy physics communities, opening up new possibilities for collaboration with computer science in the exploration and visualization of the inner structure of hadrons and nuclei.

Consider for promotion

Yes

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