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Dealing with negatively weighted Events in DNN-based LHC Analyses — •Jörn Bach[1,2,3], Christian Schwanenberger[1,2], Peer Stelldinger[3], and Alexander Grohsjean[2] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany — [2]Universität Hamburg, Hamburg, Germany — [3]HAW Hamburg, Hamburg, Germany

The recent decade has seen a growth of machine learning algorithms across all disciplines. In LHC physics, a multitude of applications have been tested and - in particular Deep Neural Networks (DNNs) - have been proven to be very effective in various usecases, for example in particle tagging or for separating signal from background in analyses.

Since training data is primarily generated through Monte-Carlo (MC) simulation, specific challenges can emerge during DNN training due to partly negatively weighted samples. MC simulations produce negative event weights in the presence of destructive interference in the process or in the case of next-to-leading order simulations with an additive matching scheme. The negatively weighted training data impair the DNN convergence. Therefore, the current state of the art is to use reweighting methods that lead to consistently positive weights. However this alters the input distribution. We propose an alternative technique that is interpretable, computationally efficient and does not affect the input distribution. Furthermore, we show the method employed on a hypothetical search for a beyond the Standard Model heavy Higgs boson and discuss implications of negative weights throughout DNN based analyses.

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