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Regression-based refinement of fast simulation

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At experiments at the LHC, a growing reliance on fast Monte Carlo applications will accompany the high luminosity and detector upgrades of the Phase 2 era. Traditional FastSim applications which have already been developed over the last decade or more may help to cope with these challenges, as they can achieve orders of magnitude greater speed than standard full simulation applications. However, this advantage comes at the price of decreased accuracy in some of the final analysis observables. In this contribution, a machine learning-based technique to refine those observables is presented. We employ a regression neural network trained with an optimized combination of multiple loss functions to provide post-hoc corrections to samples produced by a standard FastSim application based on the CMS detector. The results show considerably improved agreement with a detailed MC application and an improvement in correlations among output observables and external parameters. This technique is a promising replacement for existing correction factors, providing higher accuracy and thus contributing to the wider usage of fast simulation applications.

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