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Refining fast simulation using machine learning

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At the CMS experiment, a growing reliance on the fast Monte Carlo application (FastSim) will accompany the high luminosity and detector granularity expected in Phase 2. The FastSim chain is roughly 10 times faster than the application based on the GEANT4 detector simulation and full reconstruction referred to as FullSim. 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 a sophisticated combination of multiple loss functions to provide post-hoc corrections to samples produced by the FastSim chain. The results show considerably improved agreement with the FullSim output 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 FastSim.

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