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Conditional Wasserstein Generative Adversarial Networks for Fast Detector Simulation

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Detector simulation in high energy physics experiments is a key yet computationally expensive step in the event simulation process. There has been much recent interest in using deep generative models as a faster alternative to the full Monte Carlo simulation process in situations in which the utmost accuracy is not necessary. In this work we investigate the use of conditional Wasserstein Generative Adversarial Networks to simulate both hadronization and the detector response to jets. Our model takes the 4-momenta of jets formed from partons post-showering and pre-hadronization as inputs and predicts the 4-momenta of the corresponding reconstructed jet. Our model is trained on fully simulated $t\bar{t}$ events using the publicly available GEANT-based simulation of the CMS Collaboration. We demonstrate that the model produces accurate conditional reconstructed jet transverse momentum (p_T) distributions over a wide range of p_T for the input parton jet. Our model takes only a fraction of the time necessary for conventional detector simulation methods, running on a CPU in less than a millisecond per event.

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