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Adversarial mixture density network for particle reconstruction: a case study in collider simulation

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An adversarial mixture density network (AMDN) with gaussian kernels is used to simulate muon reconstruction in the setup of collider detectors. The network is trained on events generated using Madgraph5, Pythia8 and the Delphes3 fast detector simulation implementation for the Compact Muon Solenoid (CMS). It is observed that the network can reproduce relevant kinematic distributions with a very good level of agreement, and at the same time the underlying correlations between reconstructed variables. Without prior collider-specific constraints,the trained network also acquires the azimuthal symmetry, a key feature in CMS simulation. While popular generative models, such as generataive adversarial networks (GANs), demonstrates wide success in various research areas, our work demonstrates that an alternative algorithmic approach more specific to Monte Carlo simulation in collider physics can be favourable and help tackle the increasing computing demands from simulation in collider experiments.

Author: LO, Kin Ho (University of Florida (US))

Presenter: LO, Kin Ho (University of Florida (US))