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Ensemble Generative Models for Calorimeter Simulations

Foreseen increasing demand for simulations of particle transport through detectors in High Energy Physics motivated the search for faster alternatives to Monte Carlo based simulations. Deep learning approaches provide promising results in terms of speed up and accuracy, among which generative adversarial networks (GANs) appear to be the most successful in reproducing realistic detector data. However, the GANs tend to suffer from a missing modes problem and unstable convergence. Various ensemble techniques applied to image generation proved that these issues can be moderated either by deploying multiple generators or multiple discriminators. This work follows a development of a GAN with two-dimensional convolutions that reproduces 3D images of an electromagnetic calorimeter. We build on top of this model and examine the influence of using ensemble techniques for the task of calorimeter simulations, focusing on the reproducibility of rare modes and the overall performance.

Significance

The development of fast simulation tools in HEP is crucial as the required number of simulations is expected to increase sharply with the future LHC experiments and the High Luminosity upgrades. Current GAN-based models provide a speed-up of several orders of magnitude but still struggle with reproducing the rare modes and low energy hits in the calorimeter. Hence, examining methods like ensemble techniques that can improve the performance is of high importance.

References

Speaker time zone

Compatible with Europe

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