

How to generate all possible simulations with GANs?

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The development of faster simulation methods is one of the crucial tasks currently undertaken at CERN. A part of this process in the ALICE experiment is the deep learning-based simulation tool for the Zero Degree Calorimeters (ZDC).

Generative models such as GANs that are currently used in the fast simulation framework successfully replicate the results for input particles that produce consistent calorimeter responses. However, those methods struggle to reflect the variety of possible outcomes for highly non-deterministic input particles. Existing techniques for increasing the diversity of GAN results are able to mitigate this shortcoming but at the price of producing unrealistic and less precise results for consistent particle data.

To address this problem, we propose a novel method for the selective increase of diversity in GAN-generated samples. Our approach encourages the model to generate diverse results for input particles that allow for many possible simulation outcomes by penalizing an insufficient variety of generated results. At the same time, we allow the model to generate low-diversity results for input particles that produce consistent responses. This improvement successfully increases the diversity of generated samples for a selected subset of input data. Our method leads to higher simulation fidelity, decreasing the differences between the original and fast simulation and smoothing the distribution of the generated results.

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