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Latent Generative Models for Fast Calorimeter Simulation

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Simulation of calorimeter response is a crucial part of detector study for modern high energy. The computational cost of conventional MC-based simulation becoming a major bottleneck with the increasingly large and high granularity design. We propose a 2-step generative model for fast calorimeter simulation based on Vector-Quantized Variational Autoencoder (VQ-VAE). This model achieves a fast generation < 1ms/shower for dataset with about 500 dimensions, and the chi2 difference of energy compared to GEANT4 is less than 0.01. We also demonstrate the flexibility for this latent generative design which can adapt to a variety of encoder/decoder architectures and scale up to larger dataset with more than 40000 dimensions with generation time scaling better than O(N).

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