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CaloPointFlow - Generating Calorimeter Showers as Point Clouds

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In particle physics, precise simulations are necessary to enable scientific progress. However, accurate simulations of the interaction processes in calorimeters are complex and computationally very expensive, demanding a large fraction of the available computing resources in particle physics at present. Various generative models have been proposed to reduce this computational cost. Usually, these models interpret calorimeter showers as 3D images in which each active cell of the detector is represented as a voxel. This approach becomes difficult for high-granularity calorimeters due to the larger sparsity of the data.

In this study, we use this sparseness to our advantage and interpret the calorimeter showers as point clouds. More precisely, we consider each hit as part of a hit distribution depending on a global latent calorimeter shower distribution.

Our model is based on PointFlow (Yang et al. 2019) and consists of a permutation invariant encoder and two normalizing flows. One flow models the global latent calorimeter shower distribution. The other flow models the distribution of individual hits conditioned on the calorimeter shower distribution.

We present first results, they are shown and compared with state-of-the-art voxel methods.

Significance

First model to generate calorimeter showers as point clouds.

References

Experiment context, if any

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