Contribution ID: **37** Type: **not specified**

CaloMan: Fast generation of calorimeter showers with density estimation on learned manifolds

Wednesday 2 November 2022 15:40 (20 minutes)

The efficient simulation of particle propagation and interaction within the detectors of the Large Hadron Collider is of primary importance for precision measurements and new physics searches. The most computationally expensive simulations involve calorimeter showers, which will become ever more costly and high-dimensional as the Large Hadron Collider moves into its High Luminosity era. Advances in deep generative modelling have opened the possibility of creating models that can generate realistic calorimeter showers orders of magnitude more quickly than physics-based simulation. Deep generative models have recently made stunning advances in modelling high-dimensional data like images and audio, however, the high-dimensional nature of calorimeter data belies the relative simplicity of the underlying physical laws which govern shower processes. In machine learning this relates to the manifold hypothesis which states that high-dimensional data is supported on low dimensional manifolds. We propose modelling calorimeter showers by first learning their manifold structure, then estimating the distribution of data on the manifold. Learning manifold structure reduces the dimensionality of the data, which enables fast training and generation. For our proof of concept, we model the datasets provided by the Fast Calorimeter Simulation Challenge 2022.

Primary authors: Dr CATERINI, Anthony (Layer 6 AI); ROSS, Brendan (Layer 6 AI); Dr LOAIZA-GANEM, Gabriel (Layer 6 AI); Dr REYES-GONZÁLEZ, Humberto (University of Genoa); CRESSWELL, Jesse (Layer 6 AI); Dr LETIZIA, Marco

Presenter: CRESSWELL, Jesse (Layer 6 AI)

Session Classification: Generative Models – Detector Level