

CaloHadronic: a diffusion model for the generation of hadronic showers

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Simulating showers of particles in highly-granular calorimeters is a key frontier in the application of machine learning to particle physics. Achieving high accuracy and speed with generative machine learning models can enable them to augment traditional simulations and alleviate a major computing constraint. Recent developments have shown how diffusion based generative shower simulation approaches that do not rely on a fixed structure, but instead generate geometry-independent point clouds, are very efficient. We present a transformer-based extension to previous architectures which were developed for simulating electromagnetic showers in the highly granular electromagnetic calorimeter of the International Large Detector, ILD. The attention mechanism now allows us to generate complex hadronic showers with more pronounced substructure across both the electromagnetic and hadronic calorimeters. This is the first time that machine learning methods are used to holistically generate showers across the electromagnetic and hadronic calorimeter in highly granular imaging calorimeter systems. Improvements to this model will also be shortly presented.

Author: MOZZANICA, Martina (UNI/EXP (Uni Hamburg, Institut für Experimentalphysik))

Co-authors: KOROL, Anatolii (FTX (FTX Fachgruppe SFT)); GAEDE, Frank (FTX (FTX Fachgruppe SFT)); KASIECZKA, Gregor (Universität Hamburg); KRUEGER, Katja (DESY (FTX Fachgruppe DTA)); MCKEOWN, Peter (CERN); BUSS, Thorsten (Universität Hamburg)

Presenter: MOZZANICA, Martina (UNI/EXP (Uni Hamburg, Institut für Experimentalphysik))

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