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Fast Simulation of Particle Physics Calorimeters

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Detector simulation is a key component of physics analysis and related activities in particle physics.In the upcoming High Luminosity LHC era, simulation will be required to use a smaller fraction of computing in order to satisfy resource constraints at the same time as experiments are being upgraded new with the new higher granularity detectors, which requires significantly more resources to simulate. This computing challenge motivates the use of generative machine learning models as fast surrogates to replace full physics-based simulators. We introduce CaloDiffusion, a new model which applies state-of-the-art diffusion models to simulate particle showers in calorimeters.

The simulations produced by CaloDiffusion are found to be nearly indistinguishable from those of full physics-based simulation, and can be generated up to 1000 times faster.

Focus areas

HEP

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