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New Angles on Fast Calorimeter Shower Simulation

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The simulation requirements of experiments in high energy physics place major demands on the available computing resources. These simulation pressures are projected to increase further at the upcoming high luminosity phase of the LHC and for future colliders. An additional challenge arises from the significantly higher granularity present in future detectors, which increases the physical accuracy required of a surrogate simulator. Machine learning methods based on deep generative models have the potential to provide simulation tools that could help to alleviate these computational pressures.

While significant progress has been made on the development of generative models for the simulation of showers in highly granular calorimeters, key challenges have yet to be addressed. In particular, these simulators must be able to provide an appropriate detector response for particles incident at various positions and under different angles. This contribution will present progress on these requirements by generalising the performant Bounded Information Bottleneck Autoencoder (BIB-AE) architecture to multi-parameter conditioning scenarios. Particular focus will be given to the high degree of physics fidelity achieved after interfacing with state-of-the-art reconstruction algorithms. Additionally, progress on the integration of these surrogate simulators into full simulation chains will be discussed. These advances represent key steps towards benchmarking the performance of such simulators on full physics events.

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