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Fast simulation of the Zero Degree Calorimeter responses with generative neural networks

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Applying machine learning methods to high-energy physics simulations has recently emerged as a rapidly developing area. A prominent example is the Zero Degree Calorimeter (ZDC) simulation in the ALICE experiment at CERN, where substituting the traditional computationally extensive Monte Carlo methods with generative models radically reduces computation time. Although numerous studies have addressed the fast ZDC simulation, there remains significant potential for innovations. Recent developments in generative neural networks have enabled the creation of models capable of producing high-quality samples indistinguishable from real data. In this paper, we apply the latest advances to the simulation of the ZDC neutron detector and highlight the potential benefits and challenges. Our focus is on exploring novel architectures and state-of-the-art generative frameworks. We compare their performance against established methods, demonstrating competitive outcomes in speed and efficiency.

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