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# ML-based Correction to Accelerate Geant4 Calorimeter Simulations

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The Geant4 detector simulation, using full particle tracking (FullSim), is usually the most accurate detector simulation used in HEP but it is computationally expensive. The cost of FullSim is amplified in highly segmented calorimeters where large fraction of the computations are performed to track the shower's low-energy photons through the complex geometry. A method to limit the amount of these photons is in the form of Geant4's production energy thresholds. Increased computational speed can be achieved by high values of these thresholds, however reduction of the simulation accuracy occurs beyond a geometry specific value. We propose a post-hoc machine learning (ML) correction method for calorimeter cell energy depositions. The method is based on learning the density ratio between the reduced accuracy simulation and the nominal one to extract multi-dimensional weights using a binary classifier. We explore the method using an example calorimeter geometry from the International Large Detector project and showcase initial results. The use of ML to correct calorimeter cells allows for more efficient use of heterogeneous computing resources with FullSim running on the CPU while the ML algorithm applies the correction in an event-parallel fashion on GPUs.

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