

Deep Learning based Energy Reconstruction and Event Generation for the CALICE AHCAL

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The CALICE collaboration is developing high-granular calorimeters for the application of particle flow reconstruction to calorimetry in future linear collider experiments. An engineering prototype for an analogue hadron calorimeter (AHCAL) was assembled by the CALICE collaboration. Events measured by the AHCAL include 5-dimensional information in 22k channels: the 3D location, energy and timing of each hit are recorded. Pion test beam runs and a Monte Carlo simulation of the test beam setup are used to determine the energy resolution of the AHCAL. An improvement over the energy resolution obtained with standard reconstruction can be achieved by employing supervised machine learning approaches.

Deep neural networks can be used to reconstruct the event energy from the full 5D calorimeter image. Multiple architectures are presented and compared to traditional approaches. Using locally connected layers with cell-wise hit energy weighting shows promising results for shower leakage compensation. Convolutional networks improve energy resolution but suffer from overfitting at the phase space boundaries. Combined approaches and networks incorporating 5D information are discussed and practical lessons learned for regression tasks are presented. Beyond regression, we also show recent progress in interpreting the latent space of Variational Autoencoders for the generation of hadronic showers.

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Session Classification: Experimental methods