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# Hyperparameter Optimization for Deep Learning Models Using High Performance Computing

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Clusters counting in a drift chamber represents the most promising breakthrough in particle identification (PID) techniques in particle physics experiments. In this paper, neural network models, such as the Long Short-Term Memory (LSTM) Model and Convolutional Neural Network (CNN) Model, are trained using various hyperparameters like loss functions, activation functions, different numbers of neurons, batch sizes, and varying numbers of epochs etc. These models are trained for a two-step reconstruction algorithm, which involves peak finding and clusterization. For the peak finding algorithm, a trained Long Short-Term Memory (LSTM) model is used to discriminate between ionization signals (primary and secondary peaks) and noise in the waveform, addressing a classification problem. Concurrently, a Convolutional Neural Network model is utilized to determine the number of primary ionization clusters based on the detected peaks, dealing with a regression problem. The trained models (LSTM and CNN) are applied to the simulations of particles traversing a gas mixture made of 90% Helium (He) and 10% Isobutane (C4H10) filling drift tubes with the same geometry as the ones used for the beam test at CERN in 2023 of the prototype of the IDEA detector for FCC. The simulation parameters included a cell size of 1.5 cm, a sampling rate of 1.2 GHz, a time window of 2000 ns, 5000 events, a number of ionization clusters with a mean value of 25.25, a number of electrons per cluster with a mean value of 1.468, and momentum of pi- meson particles ranging from 4 to 180GeV/c.

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