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Deep learning methods for noise filtering in the NA61/SHINE experiment

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The NA61/SHINE experiment is a prominent venture in high-energy physics, located at the SPS accelerator within CERN. Recently, the experiment's physics program underwent expansion, necessitating a comprehensive overhaul of its detector configuration. This upgrade is primarily geared towards augmenting the event flow rate, elevating it from 80Hz to 1kHz. This enhancement involves a substantial alteration of the read-out electronics in the core tracking detectors of NA61/SHINE, namely the Time-Projection-Chambers (TPCs). In light of the substantial surge in collected data, the deployment of an online noise filtering tool became imperative. Traditionally, this task has relied on the reconstruction of particle tracks and the subsequent removal of clusters that lack association with any discernible particle trajectory. However, it's important to acknowledge that this method consumes a noteworthy amount of time and computational resources.

In the year 2022, the initial dataset was collected through the utilization of the upgraded detector system. In relation to this data, a collection of deep learning models was developed, employing two distinct categories of neural networks: dense and convolutional networks (DNN, CNN).

Of utmost significance is the seamless integration of these trained models into the existing NA61/SHINE C++ software framework, utilizing the capabilities of the TensorFlow C++ library. Furthermore, to facilitate easier deployment, containerization using Docker was applied. This presentation aims to unveil the results attained through the application of these algorithms for noise reduction, encompassing training times for both CNN and DNN models, post-filtering data reconstruction duration, and the Receiver Operating Characteristic (ROC) analysis of the filtered data.

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