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A Machine Learning Method for calorimeter signal processing in sPHENIX

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The sPHENIX experiment at RHIC requires substantial computing power for its complex reconstruction algorithms. One class of these algorithms is tasked with processing signals collected from the sPHENIX calorimeter subsystems, in order to extract signal features such as the amplitude, timing of the peak and the pedestal. These values, calculated for each channel, form the basis of event reconstruction in the calorimeter. The baseline technique used for signal feature extraction is fitting the signal waveforms in individual calorimeter channels with a parametrized function which optimally represents the signal shape. Due to the large channel count in the sPHENIX calorimeters, such fitting procedure may consume a non-trivial fraction of the total reconstruction time in a given event. To solve this problem, an alternative technique is being explored, based on a Machine Learning algorithm utilizing a Neural Network, in which the training data sample is produced using the traditional fitting technique. Initial results demonstrate an order of magnitude improvement in speed of signal processing while preserving acceptable level of accuracy. A prototype of a Keras/TensorFlow-based inference application has been created, to be deployed on the worker nodes running sPHENIX event reconstruction software. Comparison with the standard fitting technique has been performed. We present our experience with the design and implementation of the ML-based algorithm for the sPHENIX calorimeter signal processing.

Significance

The material to be presented describes the first application of ML technology to processing signals produced in a RHIC experiment calorimeter, with a substantial performance gain. The software is optionally packaged as a microservice, which increases modularity and creates flexibility of integration with other applications.

References

Experiment context, if any

This research is done in the context of the sPHENIX experiment at RHIC. The abstract has been reviewed and approved by sPHENIX publication board.

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