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Reactor Neutrino Energy Reconstruction with Machine Learning Techniques for the JUNO Experiment

The Jiangmen Underground Neutrino Observatory (JUNO) is a neutrino experiment under construction with a broad physics program. The main goals of JUNO are the determination of the neutrino mass ordering and the high-precision measurement of neutrino oscillation properties with anti-neutrinos produced in commercial nuclear reactors. High-quality reconstruction of reactor neutrino energy is crucial for the success of the experiment.

The JUNO's central detector is equipped with photomultiplier tubes (PMTs) of two types: 17 612 20-inch PMTs and 25 600 3-inch PMTs. The central detector is designed to provide an energy resolution of 3% at 1 MeV. Compared to traditional reconstruction methods, Machine Learning (ML) is significantly faster for the detector with so many PMTs.

In this work, we study ML approaches for energy reconstruction from the signal coming from the PMT array and present fast models using aggregated features: a fully connected deep neural network and boosted decision trees. Consideration of the problem of the domain adaptation of a model trained on Monte Carlo data for real data will be also presented. The datasets for training and testing are generated with full simulation using the official JUNO software.

Collaboration / Activity

The JUNO collaboration

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