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Study of using machine learning for level 1 trigger decision in JUNO experiment

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The Jiangmen Underground Neutrino observatory (JUNO) is a neutrino medium baseline experiment in construction in China, with the main goal to determine the neutrino mass hierarchy. A large liquid scintillator (LS) volume will detect the antineutrinos issued from nuclear reactors. The LS detector is instrumented by around 20000 large photomultiplier tubes. The JUNO electronics readout system consists of two parts: (i) the underwater front-end electronics system and after 100-meter-long Ethernet cables, (ii) the back-end electronics system. Hit information from each PMT will be collected to a center trigger unit for level one trigger decision, current algorithm is vertex fitting.
Since neural networks even with only one hidden layer are capable of approximating any Borel measurable function, it is interesting to study the performance of a machine learning method for the level 1 trigger decision. We treat trigger decision as a classification problem, and train a Multi-Layer Perceptron (MLP) model to distinguish from background the events with an energy higher than a certain threshold, using JUNO software datasets which include 10K physics events with noise and 10K pure noise events. For events with energy higher than 50 KeV, we can achieve an accuracy higher than 99%. We managed to fit the trained model into a Kintex 7 FPGA. We will present the technical details of the neural network implementation and training, as well as its performance when applied to real hardware.

Minioral

Yes

IEEE Member

No

Are you a student?

No

Author: Dr YANG, yifan (iihe)

Co-authors: CLERBAUX, Barbara (Universite Libre de Bruxelles (BE)); Dr XU, Yu

Presenter: Dr YANG, yifan (iihe)

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