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Machine Learning Tools for the IceCube-Gen2 Optical Array

Neural networks (NNs) have a great potential for future neutrino telescopes such as IceCube-Gen2, the planned high-energy extension of the IceCube observatory. IceCube-Gen2 will feature new optical sensors with multiple photomultiplier tubes (PMTs) designed to provide omnidirectional sensitivity. Neural networks excel at handling high-dimensional problems and can naturally incorporate the increased complexity of these new sensors. Additionally, their fast inference time makes them promising candidates for handling the high event rates expected from IceCube-Gen2. This contribution presents potential applications of neural networks in the IceCube-Gen2 in-ice optical array. First, we introduce a method to simulate the IceCube-Gen2 optical modules'photon acceptance using a NN that leverages the modules'inherent symmetries. Secondly, we present the status of neutrino NN–based reconstruction efforts, including the adaptation of a novel IceCube technique that combines normalizing flows with transformer NNs. Finally, we describe current progress in noise cleaning applications based on node classification with graph neural networks (GNNs), a method that has already shown promising results for the forthcoming low-energy extension, IceCube-Upgrade.

Collaboration(s)

IceCube-Gen2

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