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Advanced Northern Tracks Selection using a Graph Convolutional Neural Network for the IceCube Neutrino Observatory

The IceCube Neutrino Observatory is a cubic-kilometer detector located in the Antarctic ice at the geographic South Pole. It reads out over 5,000 photomultiplier tubes (PMTs) to detect Cherenkov light produced by secondary particles, enabling IceCube to identify both atmospheric and astrophysical neutrinos. One of the main challenges in this effort is effectively distinguishing between muons induced by neutrinos and those generated by cosmic-ray air showers. To address this challenge, the Advanced Northern Tracks Selection (ANTS) employs a graph convolutional neural network. This network is designed to utilize both the sensor data and the geometric arrangement of the detector's PMTs. By representing each module as a node in a graph and extracting features from each module, the network can capture and integrate both local and global features. This work details the implementation of the network architecture and highlights the improvements in background rejection efficiency compared to existing methods for selecting muon tracks.

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