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Online Event Reconstruction in IceCube Using Deep Learning Techniques

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The IceCube Neutrino Observatory is a Cherenkov detector deep in the Antarctic ice. Due to limited computational resources and the high data rate, only simplified reconstructions restricted to a small subset of data can be run on-site at the South Pole. However, in order to perform online analyses and to issue real-time alerts, fast and powerful reconstructions are desired.

Recent advances, especially in image recognition, have shown the capabilities of deep learning. Deep neural networks can be extremely powerful and their usage is computationally inexpensive once the networks are trained. These characteristics make a deep learning-based reconstruction an excellent candidate for the application on-site at the South Pole. In contrast to image recognition tasks, the reconstruction in IceCube poses additional challenges as the data is four-dimensional, highly variable in length, and distributed on an imperfect triangular grid.

A deep learning-based reconstruction method is presented which can significantly increase the reconstruction accuracy while reducing the runtime in comparison to standard reconstruction methods in IceCube.

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