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Reconstruction Techniques in IceCube using Convolutional and Generative Neural Networks

A key challenge to the success of high-energy physics experiments such as IceCube is the reliable and accurate reconstruction of events. In IceCube, further challenges arise as the detector is situated at the geographic South Pole where resources are limited. However, to perform real-time analyses and to issue alerts to telescopes around the world, powerful reconstruction methods are desired. This results in a dilemma as performance is often paired with computational complexity. But even for offline reconstructions, the computational complexity of the most advanced maximum-likelihood-methods can render these intractable and hence limit the physics potential.

Machine learning-based methods might help to alleviate these complications. 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 approach an excellent candidate for the application in IceCube.

A reconstruction method using convolutional neural networks is presented which can significantly increase the reconstruction accuracy while reducing the runtime in comparison to standard reconstruction methods in IceCube. In addition, first results are discussed for future developments based on generative networks.

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