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Exploitation of Symmetries and Domain Knowledge in Deep Learning Architectures

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The field of deep learning has become increasingly important for particle physics experiments, yielding a multitude of advances, predominantly in event classification and reconstruction tasks. Many of these applications have been adopted from other domains. However, data in the field of physics are unique in the context of machine learning, insofar as their generation process and the laws and symmetries they abide by are usually well understood. Most commonly used deep learning architectures fail at utilizing this available domain knowledge.
In this contribution, the importance of utilizing domain knowledge is highlighted and a hybrid reconstruction method is introduced that combines the benefits of maximum-likelihood estimation with those of deep learning. Domain knowledge, such as invariances and detector characteristics, can easily be incorporated in this approach. Although applicable to any simulation based experiment, the hybrid method is illustrated by the example of event reconstruction in IceCube.

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Primary author: HUENNEFELD, Mirco (Universität Dortmund)

Co-author: COLLABORATION, IceCube

Presenter: HUENNEFELD, Mirco (Universität Dortmund)

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