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Critical evaluation of discriminator networks for assessing simulation.

The FTX Software (SFT) group develops calorimeter simulation for future high granularity detectors. In particular, this group is interested in fast and accurate reproduction of full scale calorimeter simulations using Machine Learning (ML) techniques. When such a tool is put into production, the output is reconstructed by an armoury of equally complex algorithms, both classical and ML based. New and improved reconstruction algorithms will continue to be developed long after a stable release of the simulation is available. Our real objective is to ensure that the output of reconstruction is as similar as possible between the full simulation, and our fast reproduction. Given that these reconstruction algorithms don't yet exist, evaluating the accuracy of a fast simulation is a non-trivial task.

Known physically significant distributions are normally compared, and the fast simulation deemed acceptable if these distributions are reproduced. However a second approach is also popular; a discriminator network. The discriminator network is trained to distinguish between the output of the full simulation and the fast reproduction. The better the discriminator performs, the worse the fast reproduction is. This metric is likely to be sensitive to correlations and features that are not directly tested by hand picked variables, however, little is known about the limitations and potential biases of this approach. The "no free lunch theorem" tells us these sensitivities will change according to the design of the discriminator network.

In this project, we aim to understand the limitations of the discriminator network approach to evaluating the accuracy of a fast simulation. Complexity and design of the discriminator will be varied in order to establish the boundaries of the approach.

Group

SFT - FTX - DESY

Project Category

B5. Computing

Special Qualifications

Experience in python

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