Contribution ID: **171** Type: **Oral**

Affine Parametric Neural Networks for High-Energy Physics

Monday, 24 October 2022 14:50 (20 minutes)

Signal-background classification is a central problem in High-Energy Physics (HEP), that plays a major role for the discovery of new fundamental particles. The recent Parametric Neural Network (pNN) is able to leverage multiple signal mass hypotheses as an additional input feature to effectively replace a whole set of individual neural classifiers, each providing (in principle) the best response for the corresponding mass hypothesis. In this work we aim at deepening the understanding of pNNs in light of real-world usage. We discovered several peculiarities of parametric networks, providing intuition, metrics, and guidelines to them. We further propose the affine parametrization scheme, resulting in a new parameterized architecture: the affine parametric neural network (AffinePNN); along with many other generally applicable improvements, like the balanced training procedure, and the background's mass distribution. Finally, we extensively and empirically evaluate our models on the HEPMASS dataset, along its imbalanced version (HEPMASS-IMB) provided by us, to further validate our approach. Presented results are in terms of the impact of the proposed design decisions, classification performance, and interpolation capability.

Significance

Parametric neural networks can be generally applied to any signal-background classification task, they are experiment agnostic. This means that such method can be applied, in principle, to any analysis and any particle decay. The important aspect of our work is that with the improvements we propose, pNNs are now ready for being employed in a real analysis. In general, we address several aspects of the original pNN method (http://arxiv.org/abs/1601.07913 - which were not addressed by the authors) that are usually a source of confusion across the community.

References

CMS ML Forum (last talk): https://indico.cern.ch/event/1099308/

Experiment context, if any

Primary author: ANZALONE, Luca (Universita e INFN, Bologna (IT))

Co-authors: Prof. BONACORSI, Daniele (University of Bologna / INFN); Dr DIOTALEVI, Tommaso (Universita e INFN, Bologna (IT))

Presenter: ANZALONE, Luca (Universita e INFN, Bologna (IT))

Session Classification: Track 2: Data Analysis - Algorithms and Tools

Track Classification: Track 2: Data Analysis - Algorithms and Tools