Canadian Association of Physicists

Association canadienne des physiciens et physiciennes

Contribution ID: **35** Type: **Invited Speaker / Conférencier(ère) invité(e)**

Machine Learning and Multiclassifiers for Improved Measurements of 2-Lepton Final States in the Higgs to WW Decay Channel in High Energy Physics Analyses

Tuesday 9 June 2020 15:25 (15 minutes)

Multivariate analysis techniques have found widespread use in high energy physics for their ability to identify complex correlations and nonlinear behaviour within large, high-dimensional datasets. Machine learning (ML) is one such example whereby events of some known classification are input to a map with many free parameters. Determining the values of these free parameters which best recreate the known classification of the inputs at the map's output is the "learning"or "training"aspect of ML. In Large Hadron Collider (LHC) physics, ML may be used to filter rare processes such as Higgs boson decays from dominant background processes. The Higgs boson process we are interested in involves Higgs boson production in association with a vector boson V (VH) decaying to pairs of W bosons (HWW) in the 2-lepton final state. We have investigated the use of neural networks (NNs), a flavour of nonlinear ML, for classifying input events into six categories. NNs which classify events into more than two categories are referred to as multiclassifiers. Our categories include the signal process: VH(WW); competing Higgs processes: gluon-gluon fusion and vector boson fusion; and leading background processes: top quark production, Z boson production in association with jets, and diboson production. The training was performed using reconstructed ATLAS Run 2 Monte Carlo (MC) samples for the processes of interest. The inputs to the NN included kinematic variables based on leptons, jets, and missing transverse energy. At the level of the inputs, we verified that our MC samples accurately modelled the shape and normalization of data as well as the correlations between inputs. The output of our NN describing how likely an event is to be VH(WW) was used as a discriminant to build a measurement region for VH(WW) which maximized the statistical significance of discovery while protecting against statistical fluctuations. We have shown that the NN discriminant offers substantial improvements in the significance of the measurement over a traditional analysis relying on rectangular cuts on the same inputs. Our NN has yet to be deployed on LHC data, but it shows promising results for improving measurements in these difficult channels.

Author: BASSO, Matthew (University of Toronto)

Presenter: BASSO, Matthew (University of Toronto)

Session Classification: T-PPD-2 : Energy Frontier | Frontière d'energie

Track Classification: Particle Physics / Physique des particules (PPD)