Using Machine Learning to Scan Beyond Standard Model Parameter Spaces

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December 4, 2023

Abstract

When trying to test models of new physics against experimental results, the customary approach is to simply sample random points from the parameter space of the model, calculate their predicted values for the desired observables and compare them to experimental data. However, due to the typically large number of parameters in these models, this process is highly time consuming and inefficient. We propose a solution to this problem by adopting sampling algorithms which make use of Machine Learning methods in order to improve the efficiency of this validation task. The efficiency and exploratory capacity of these algorithms were tested using the parameter space of the cMSSM and pMSSM models and constrained experimentally by the Higgs mass and Dark Matter relic density. The results show a massive improvement in efficiency with only minor sacrifices in parameter space coverage.

A similar analysis was implemented for the scotogenic model, using an evolutionary multiobjective optimization algorithm, confronted against experimental constraints coming from the Higgs and neutrinos masses, lepton flavor violating decays, neutrino mixing and the anomalous magnetic moment of the muon.