Machine Learning in High Energy Physics

Report of Contributions

https://indico.global/e/11098

Contribution ID: **2** Type: **not specified**

Finding exotic hadronic signatures at the LHC with artificial intelligence

Monday 12 September 2022 10:15 (1 hour)

The most powerful hadron collider in existence, the LHC, smashes bunches of protons at unprecedented energies and rates. The CMS detector takes snapshots of these collisions, in which we must accurately disentangle and reconstruct the particles and their origins in order to hypothesize about potential effects arising from new, yet undiscovered particles or forces. Some of the most intriguing new theories describing physics beyond the Standard Model predict signatures that are characterized by a large amount of hadronic activity - just as the Standard Model background processes predominant at hadron colliders. I will discuss how we can still identify such potential signals with the help of artificial intelligence, which turns out to not only be a facilitator, but actually an enabler of entirely new analysis strategies.

[40-45min + discussion]

Presenter: MAIER, Benedikt (CERN)

Session Classification: Seminars (morning)

Contribution ID: **3** Type: **not specified**

Normalizing Flows at the LHC — Preparing for the Future

Monday 12 September 2022 14:15 (1 hour)

LHC run 3 just started and in the years leading up to 2040, we will see a 20-fold increase in available data. This forthcoming dataset will have enormous potential for a deeper understanding of the Standard Model and possible physics beyond it.
In my talk, I will highlight how advancements in modern Machine Learning can help speed up crucial bottlenecks and open new avenues for model-agnostic searches of physics beyond the Standard Model. In particular, I will focus on Normalizing Flows (also known as invertible neural networks), which provide a versatile class of Machine Learning models that have seen many applications to high-energy physics. I will discuss how Normalizing Flows can be used to improve the unweighting efficiency in Monte Carlo event generation, speed up detector simulation, and how they can boost bump hunt searches for new physics.

[40-45min + discussion]

Presenter: Dr KRAUSE, Claudius (Rutgers University)

Session Classification: Seminars (afternoon)

Contribution ID: **9** Type: **not specified**

Statistically Learning the Next Standard Model from LHC Data

Monday 12 September 2022 09:00 (1 hour)

Despite the large amount of data generated by the LHC so far, searches for new physics have not yet provided any clear evidence of beyond the Standard Model (BSM) physics. Most of these experimental searches focus on exclusive channels, looking for excesses in specific final states. However, new physics could manifest as a dispersed signal over many channels. It therefore becomes increasingly relevant to attempt a more global approach to finding out where BSM physics may hide. To this end, we developed a novel statistical learning algorithm that is capable of identifying potential dispersed signals in the slew of published LHC analyses. Aiming to minimize theoretical bias, our approach is not constrained to a specific BSM scenario. Instead, the algorithm is tasked with building candidate "proto-models", precursor theories to the Next Standard Model, from small excesses in the data, while at the same time remaining consistent with negative results on new physics.

In this talk, we explain the concept as well as technical details of the statistical learning procedure. We also present proof of concept results obtained when running the algorithm over the SModelS database. A special emphasis will be put on all data scientific aspects of the approach.

[40-45min + discussion]

Presenter: WALTENBERGER, Wolfgang (Austrian Academy of Sciences (AT))

Session Classification: Seminars (morning)