Contribution ID: **24** Type: **Plenary**

Can AI (help to) design a HEP experiment?

The design of tracking detectors for high energy physics is an extremely complicated problem. A variety of orthogonal inputs have to be taken into account: the available detector volume, technology, environment, stability, budgetary constraints and - last but not least - the physics performance. Several of these components involve careful evaluation (partly using simulation studies, partly other estimation techniques), while at the same time would allow for different configurations and realisations. Finding the best compromise in such a multidimensional space is challenging at least.

We present a first attempt of using reinforcement learning to design a tracking detector; reinforcement learning is a type of machine learning where an agent learns to interact with an environment and performs actions to maximise a reward function. In the presented study, the environment describes the detector setup, while the agent is first tasked to place detector modules inside layer structures without volume overlapping. The initial reward function is designed such that a maximal geometrical coverage of the phase space is achieved. Subsequently, the predicted detector configuration is evaluated for physics performance via a fast track simulation, followed by truth track finding and track fitting (based on the ACTS toolkit). In a next step, the complexity is increased by allowing the agent to modify a growing number of environment parameters, such as the number, dimensions, type and positioning of layers, and their detection technology. Dedicated care has been taken that any action by the agent reflects a realistic change of detector parameters, which are designed to stay within physically constraint envelopes. Geant4 simulation has been used to validate intermediate layout configurations during the optimisation process. Finally we present plans to connect this pipeline to reconstruction modules and make the reconstruction algorithms part of the detector design process.

Consider for young scientist forum (Student or postdoc speaker)

No

Second most appropriate track (if necessary)

Techniques developed beyond high-energy physics

Primary authors: AMROUCHE, Sabrina (Université de Geneve (CH)); SALZBURGER, Andreas (CERN); CALACE, Noemi (CERN)

Presenters: AMROUCHE, Sabrina (Université de Geneve (CH)); SALZBURGER, Andreas (CERN)

Session Classification: Recording sessions