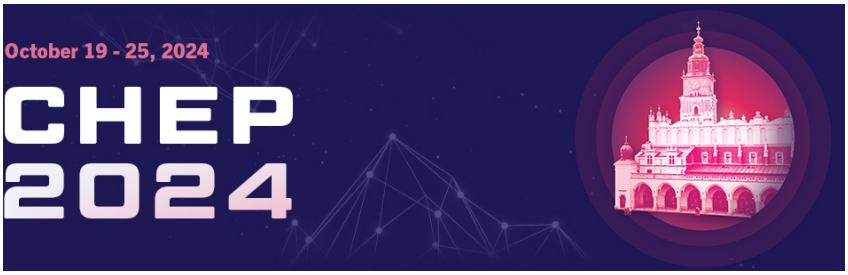

Contribution ID: **504** Type: **Talk**

Efficient Tracking Algorithm Evaluations through Multi-Level Reduced Simulations

Tuesday 22 October 2024 14:06 (18 minutes)

Subatomic particle track reconstruction (tracking) is a vital task in High-Energy Physics experiments. Tracking, in its current form, is exceptionally computationally challenging. Fielded solutions, relying on traditional algorithms, do not scale linearly and pose a major limitation for the HL-LHC era. Machine Learning (ML) assisted solutions are a promising answer.

Current ML model design practice is predominantly ad hoc. We aim for a methodology for automated search of model designs, consisting of complexity reduced descriptions of the main problem, forming a complexity spectrum. As the main pillar of such a method, we provide the REDuced VIrtual Detector (REDVID) as a complexity-aware detector model and particle collision event simulator. Through a multitude of configurable dimensions, REDVID is capable of simulations throughout the complexity spectrum. REDVID can also act as a simulation-in-the-loop, to both generate synthetic data efficiently and to simplify the challenge of ML model design evaluation. With REDVID, starting from the simplistic end of the complexity spectrum, lesser designs can be eliminated in a systematic fashion, early on. REDVID is not bound by real detector geometries and can be considered for simulations involving arbitrary detector designs.

As a simulation and a generative tool for ML-assisted solution design, REDVID is highly flexible, reusable and open-source. Reference data sets generated with REDVID are publicly available. Data generated using REDVID has enabled rapid development of multiple novel ML model designs, which is currently ongoing.

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