Contribution ID: **104**   Type: **Talk**

Constrained Optimization of Charged Particle Tracking with Multi-Agent Reinforcement Learning

Monday 9 June 2025 12:00 (25 minutes)

Detector optimisation requires reconstruction paradigms to be adaptable to changing geometries during the optimisation process, as well as to be differentiable if they should become part of a gradient-based optimisation pipeline. Reinforcement learning recently demonstrated immense success in modelling complex physics-driven systems, providing end-to-end trainable solutions by interacting with a simulated or real environment, maximizing a scalar reward signal. In this talk, we present a novel end-to-end optimizable multi-agent reinforcement learning approach with assignment constraints for reconstructing particle tracks in pixelated particle detectors, serving as a heuristic for a multidimensional assignment problem. We further highlight necessary components and modifications for efficient and stable optimisation under the high-combinatorial complexity of particle tracking.

Using simulated data, generated for a particle detector designed for proton imaging, we empirically demonstrate the effectiveness of our approach compared to multiple baseline algorithms. We provide additional insights into the optimisation landscape, highlighting the importance of the proposed architectural components for collaborative optimisation of particle tracks.

Author: KORTUS, Tobias (University of Kaiserslautern-Landau (RPTU))

Co-authors: KIESELER, Jan (KIT - Karlsruhe Institute of Technology (DE)); GAUGER, Nicolas; KEIDEL, Ralf (Fachhochschule Worms (DE))

Presenter: KORTUS, Tobias (University of Kaiserslautern-Landau (RPTU))

Session Classification: Applications in Particle Physics

Track Classification: Applications in Particle Physics