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AI-Assisted Design of the ECCE Tracking System at the Electron Ion Collider

The Electron-Ion Collider (EIC) is a cutting-edge accelerator experiment, which will be uniquely poised to address questions related to the origin of mass and spin of the nucleon and the emergent properties of dense systems of gluons. Detector design and R&D are currently ongoing for proposed experiments at the EIC that will be realized approximately 10 years from now. These experiments will be the first to leverage Artificial Intelligence (AI) during the design phase. Optimizing the design of its tracking system is of crucial importance for the EIC Comprehensive Chromodynamics Experiment (ECCE), which has proposed a detector design based on a 1.5T solenoid. The optimization is an essential part of the R&D process and ECCE included in its structure a working group dedicated to AI-based applications for the detector design. In this talk we describe our study in AI-assisted detector design using full simulations based on Geant4. Our approach manages a complex optimization in a multidimensional design space driven by multiple objectives that encode the detector performance, while satisfying mechanical constraints. In this contribution, we describe our end-to-end strategy and compare different approaches for multi-objective optimization, with a description of tools developed to get knowledge and insights from our studies. Finally, we show the results of the AI-assisted tracking system in ECCE and discuss future prospects for additional studies.

Submitted on behalf of a Collaboration?

Yes

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