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Generative machine learning for fast silicon detector simulation

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Simulation of physics processes and detector response is a vital part of high energy physics research but also representing a large fraction of computing cost. Generative machine learning is successfully complementing full (standard, Geant4-based) simulation as part of fast simulation setups improving the performance compared to classical approaches.

A lot of attention has been given to calorimeters being the slowest part of the full simulation, but their speed becomes comparable with silicon semiconductor detectors when fast simulation is used. This makes silicon detectors the next candidate to make faster, especially with the growing number of channels in future detectors.

This work studies the use of transformer architectures for fast silicon tracking detector simulation. The OpenDataDetector is used as a benchmark detector. Physics performance is estimated comparing reconstructed tracks using the ACTS tracking framework between full simulation and machine learning one.

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