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The HEP.TrkX Project: deep neural networks for HL-LHC online and offline tracking

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Charged particle reconstruction in dense environments, such as the detectors of the High Luminosity Large Hadron Collider (HL-LHC) is a challenging pattern recognition problem. Traditional tracking algorithms, such as the combinatorial Kalman Filter, have been used with great success in HEP experiments for years. However, these state-of-the-art techniques are inherently sequential and scale quadratically or worse with increased detector occupancy. The HEP.TrkX project is a pilot project with the aim to identify and develop cross-experiment solutions based on machine learning algorithms for track reconstruction. Machine learning algorithms bring a lot of potential to this problem thanks to their capability to model complex non-linear data dependencies, to learn effective representations of high-dimensional data through training, and to parallelize easily on high-throughput architectures such as FPGAs or GPUs. In this talk we will discuss the evolution and performance of our recurrent (LSTM) and convolutional neural networks moving from basic 2D models to more complex models and the challenges of scaling up to realistic dimensionality/sparsity.

Authors: ANDERSON, Dustin James (California Institute of Technology (US)); CALAFIURA, Paolo (Lawrence Berkeley National Lab. (US)); CERATI, Giuseppe (Fermi National Accelerator Lab. (US)); FARRELL, Steven Andrew (Lawrence Berkeley National Lab. (US)); GRAY, Lindsey (Fermi National Accelerator Lab. (US)); KOWALKOWSKI, Jim (Fermilab); MUDIGONDA, Mayur (Lawrence Berkeley National Laboratory); Mr PRABHAT (Lawrence Berkeley National Laboratory); SPENTZOURIS, Panagiotis (Fermilab); SPIROPULU, Maria (California Institute of Technology (US)); TSARIS, Aristeidis (Fermilab); Dr VLIMANT, Jean-Roch (California Institute of Technology (US)); ZHENG, Stephan (California Institute of Technology)

Presenter: TSARIS, Aristeidis (Fermilab)

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