Contribution ID: **387** Type: **presentation**

The HEP.TrkX project. Approaching Charged Particle Tracking at the HL-LHC with Deep Learning, for Online and Offline Processing

Thursday 12 July 2018 14:00 (15 minutes)

In the horizon of the High Luminosity Large Hadron Collider phase (HL-LHC), each proton bunch crossing will bring up to 200 simultaneous proton collisions. Performing the charged particle trajectory reconstruction in such dense environment will be computationally challenging because of the nature of the traditional algorithms used. The common combinatorial Kalman Filter state-of-the-art approach is highly successful in reconstructing high quality tracks but scales worse than quadratically with event density, leading to unmanageable computation requirements for the HL-LHC. As an alternative to other approaches to overcome this challenge, we propose novel methods employing deep learning, with inspiration from image and sequence processing. While training such models is a computationally intensive task that can be performed offline, the inference is potentially fast and can be implemented in highly parallel processing units such as FPGA or GPU. We present several models for performing pattern recognition, end-to-end track parameter estimation and tree-search track following. The methods explore multiple ways of performing the association of hits in appropriate groups, with the assumption of a tracklet seed or not. Our methods utilize neural networks of various architecture, including image-based model exploiting the power of convolutional layers, recurrent cells such as long short term memory to process sequences of hits and graph-based models that overcome sparsity. We report on the introduction of physics prior in the formalism of the neural net training, with the goal to accelerate and improve convergence. We present performances, scaling and comparison of these methods applied on realistic simulation datasets.

Authors: ANDERSON, Dustin James (California Institute of Technology (US)); Dr VLIMANT, Jean-Roch (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, James (Fermi National Accelerator Lab. (US)); SPENTZOURIS, Panagiotis (Fermilab); SPIROPULU, Maria (California Institute of Technology (US)); TSARIS, Aristeidis (Fermilab); MUDIGONDA, Mayur (Lawrence Berkeley National Laboratory); PRABHAT (Lawrence Berkeley National Laboratory); ZHENG, Stephan (California Institute of Technology)

Presenter: Dr VLIMANT, Jean-Roch (California Institute of Technology (US))

Session Classification: T6 - Machine learning and physics analysis

Track Classification: Track 6 –Machine learning and physics analysis