Contribution ID: **20** Type: **poster**

Smart Pixels: A Machine Learning Approach Towards Data Reduction in Next-Generation Particle Detectors

Monday 14 October 2024 18:15 (13 minutes)

Pixel detectors are highly valuable for their precise measurement of charged particle trajectories. However, next-generation detectors will demand even smaller pixel sizes, resulting in extremely high data rates surpassing those at the HL-LHC. This necessitates a "smart"approach for processing incoming data, significantly reducing the data volume for a detector's trigger system to select interesting events. As charged particles pass through an array of pixel sensors, they leave behind clusters of deposited charge. The shape of these charge clusters can be useful, especially when fed into customized neural networks, which can extract the physical properties of the charged particle. These weights and biases of these neural networks can then be later implemented on-chip onto ASICs for installation at future pixel detectors.

We propose a "feature regression network", which uses TensorFlow and QKeras and takes as an input the 2-D shape of the charge clusters at different slices of time. These inputs are passed through a convolutional network and dense network to regress 14 quantities. As a result, we can predict the position (x, y), incidence angle (cot alpha, cot beta), and their covariance matrix. This customized model has been trained and evaluated on 7 different sets of pixel pitches (varying in x, y, and thickness) placed in a 13x21 pixel array, where their performance is analyzed through residual and pull study.

Author: JIANG, David (Univ. Illinois at Urbana Champaign (US))

Co-authors: GANDRAKOTA, Abhijith (Fermi National Accelerator Lab. (US)); BEAN, Alice (The University of Kansas (US)); BADEA, Anthony (University of Chicago (US)); DAS, Arghya Ranjan; PARPILLON, Benjamin (Fermi National Accelerator Lab. (US)); SYAL, Chinar (Fermi National Accelerator Lab. (US)); MILLS, Corrinne (University of Illinois at Chicago (US)); WEN, Dahai (Nanjing Normal University (CN)); SHEKAR, Danush (University of Illinois at Chicago (US)); BERRY, Douglas Ryan (Fermi National Accelerator Lab. (US)); HOWARD, Eliza Claire (University of Chicago (US)); FAHIM, Farah (Fermi National Accelerator Lab. (US)); Ms PRADHAN, Gauri; DI GUGLIELMO, Giuseppe (Fermilab); DICKINSON, Jennet Elizabeth (Cornell University (US)); Ms YOO, Jieun (UIC); HIRSCHAUER, Jim (Fermi National Accelerator Lab. (US)); DI PETRILLO, Karri Folan (University of Chicago); GRAY, Lindsey (Fermi National Accelerator Lab. (US)); VALENTIN, Manuel; NEUBAUER, Mark (Univ. Illinois at Urbana Champaign (US)); LIU, Miaoyuan (Purdue University (US)); WADUD, Mohammad Abrar (University of Illinois at Chicago (US)); SWARTZ, Morris (Johns Hopkins University (US)); TRAN, Nhan (Fermi National Accelerator Lab. (US)); MAKSIMOVIC, Petar (Johns Hopkins University (US)); KOVACH-FUENTES, Rachel Elizabeth (University of Chicago (US)); LIPTON, Ronald (Fermi National Accelerator Lab. (US)); KULKARNI, Shruti R (Oak Ridge National Laboratory)

Presenter: JIANG, David (Univ. Illinois at Urbana Champaign (US))

Session Classification: Poster Session / Reception