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Neural network based cluster creation in the ATLAS silicon Pixel Detector

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The read-out from individual pixels on planar semi-conductor sensors are grouped into clusters to reconstruct the location where a charged particle passed through the sensor. The resolution given by individual pixel sizes is significantly improved by using the information from the charge sharing between pixels. Such analog cluster creation techniques have been used by the ATLAS experiment for many years to obtain an excellent performance. However, in dense environments, such as those inside high-energy jets, clusters have an increased probability of merging the charge deposited by multiple particles. Recently, a neural network based algorithm which estimates both the cluster position and whether a cluster should be split has been developed for the ATLAS Pixel Detector. The algorithm significantly reduces ambiguities in the assignment of pixel detector measurement to tracks within jets and improves the position accuracy with respect to standard interpolation techniques by taking into account the 2-dimensional charge distribution. The implementation of the neural network, the training parameters and performance of the new clustering will be presented. Significant improvements of the track and vertex resolution obtained using this new method will be presented using Monte Carlo simulated data and compared to data recorded with the ATLAS detector will be given. The resulting improvements to both track reconstruction and the identification of jets containing b-quarks will be discussed.

Primary author: ANDREAZZA, Attilio (Università degli Studi e INFN Milano (IT))

Presenter: ANDREAZZA, Attilio (Università degli Studi e INFN Milano (IT))

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