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The adaptation of a deep learning model to locating primary vertices in the ATLAS experiment

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Over the past several years, a deep learning model based on convolutional neural networks has been developed to find proton-proton collision points (also known as primary vertices, or PVs) in Run 3 LHCb data. By converting the three-dimensional space of particle hits and tracks into a one-dimensional kernel density estimator (KDE) along the direction of the beamline and using the KDE as an input feature into a neural network, the model has achieved an efficiency of 98% with a low false positive rate. The success of this method motivates its extension to other experiments, including ATLAS. Although LHCb is a forward spectrometer and ATLAS is a central detector, ATLAS has the necessary characteristics to compute KDEs analogous to the LHCb detector. While the ATLAS detector will benefit from higher precision, the expected number of visible PVs per event will be approximately 10 times that for LHCb, resulting in only slightly altered KDEs. The KDE and a few related input features are fed into the same neural network architectures used to achieve the results for LHCb. We present the development of the input feature and initial results across different network architectures. The results serve as a proof-of-principle that a deep neural network can achieve high efficiency and low false positive rates for finding vertices in ATLAS data.

Significance

The work presented will demonstrate that deep neural network architecture designed to find primary vertices in LHCb data also works for ATLAS and CMS data, which come from central detectors rather than a forward detector.

References

https://arxiv.org/abs/2103.04962

Experiment context, if any

ATLAS, CMS, LHCb

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