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A hybrid deep learning approach to vertexing

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In the transition to Run 3 in 2021, LHCb will undergo a major luminosity upgrade, going from 1.1 to 5.6 expected visible Primary Vertices (PVs) per event, and will adopt a purely software trigger. This has fueled increased interest in alternative highly-parallel and GPU friendly algorithms for tracking and reconstruction. We will present a novel prototype algorithm for vertexing in the LHCb upgrade conditions.

We use a custom kernel to transform the sparse 3D space of hits and tracks into a dense 1D dataset, and then apply Deep Learning techniques to find PV locations. By training networks on our kernels using several Convolutional Neural Network layers, we have achieved better than 90% efficiency with no more than 0.2 False Positives (FPs) per event. Beyond its physics performance, this algorithm also provides a rich collection of possibilities for visualization and study of 1D convolutional networks. We will discuss the design, performance, and future potential areas of improvement and study, such as possible ways to recover the full 3D vertex information.

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