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Partition Pooling for Convolutional Graph Network Applications in Particle Physics

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Convolutional Graph Networks (CGN) can be used for effective parameter estimations and event classification based on sensor-level data. However, if applied to the static sensor arrangement of modern particle detectors, the CGN performance can be limited by the considerable number of sensors. A scheme analogous to conventional pooling on images that uses graph partitioning to create pooling kernels is presented. With partition pooling, successful image recognition architectures can be adopted to graph neural network applications in particle physics. These architectures often rely on dimensionality reduction via pooling, which also helps to reduce computational costs. The latter allows for deeper networks and more extensive hyperparameter optimizations. A CGN, including partition pooling, is compared with a similar network without pooling performing vertex reconstructions in an idealized neutrino detector. The pooling improves the performance and makes the network less susceptible to overfitting. Due to the lower computational resource requirements, it is feasible to construct a deeper network, which further improves the performance.

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