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Deep learning solutions for 2D calorimetric cluster reconstruction at LHCb

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Calorimetric cluster reconstruction can be performed using deep learning solutions from real-time computer vision by casting the detector readout as a two-dimensional image. The increased luminosity expected of Run III poses unprecedented challenges to shower reconstruction at LHCb. This work seeks to perform shower identification and energy regression under such conditions through both convolutional neural networks (CNNs) and graph neural networks (GNNs). To this end, we designed a CNN-based network inspired by the You Only Look Once (YOLO) architecture, capable of regressing bounding boxes and the energy associated with shower deposits. The hybrid granularity of the calorimeter modules, however, requires regularization of the pixel grid through up-sampling and breaks the translational invariance assumed by CNNs. The second approach investigated in this work addresses this issue by leveraging the ability demonstrated by GNNs to learn arbitrary detector geometries without image preprocessing. In this talk, both algorithms are validated by employing a simulated dataset loosely inspired by the LHCb electromagnetic calorimeter. Finally, a set of preliminary results using the LHCb Run III simulations is presented.

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