Contribution ID: **11**   Type: **not specified**

Clustering Cosmic Muon and Neutrino Interactions in MicroBooNE using a Deep Convolutional Neural Network

Friday, 19 June 2020 10:45 (15 minutes)

We have developed an incarnation of Mask-RCNN based on Facebook's 'Detectron' framework. Our implementation of this network, sMask-RCNN (Sparse Mask-RCNN), is trained to look at wire signal readout images from the MicroBooNE time projection chamber, and output a variable number of objects within the image. Each object is classified between either coming from a neutrino interaction, or a cosmic muon, given a bounding box, and an individual segmentation mask. sMask-RCNN has been modified from the original 'Detectron' structure to include a Sparse Convolution ResNet for speed. However in order to benefit from the feature-finding ability of pretrained versions of dense ResNet, we translate dense ResNet weights trained on ImageNet into our sparse version. While sMask-RCNN is designed for cosmic finding within the MicroBooNE detector, the network could be adjusted in the future to identify different interaction types and different detectors. The network may further be useful to other networks employed in MicroBooNE and Liquid Argon TPC (LArTPC) particle physics by providing a sparse ResNet trained to find interaction features. Code has been made available at: https://github.com/NuTufts/Detectron.pytorch

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Session Classification: Day 2: Morning