Contribution ID: **372** Type: **talk**

Particle Instance Identification Using a Sparse 3D Convolutional Neural Network

Wednesday, 14 July 2021 15:30 (15 minutes)

In recent years, deep learning has played an emerging role in event reconstruction for neutrino experiments using liquid argon TPCs (LArTPCs), a high-precision particle imaging technology. Several algorithms have been developed to infer the 3D location of charge depositions in the detector. Furthermore, the development of 2D pixel-readouts naturally provides 3D positions. Therefore, there is a growing need for reconstruction algorithms that work on 3D image data. We report on our effort to develop a 3D particle instance identifier based on an extension of the Mask Region-Convolutional Neural Network (Mask-RCNN). Mask-RCNN, originally an algorithm for 2D images, is widely used in computer vision problems and has three main goals: to identify the location of each object in an image using a bounding box, to classify an object in each bounding box, and to cluster each object by determining its pixel boundaries using a mask. Inspired by the conversion to 3D and our sparse dataset, we introduce a sparse bounding box proposal method that greatly reduces inefficiencies associated with box predictions in 3D. We also describe our future plans to continue development on the masking network to explore using this architecture for particle clustering.

Are you are a member of the APS Division of Particles and Fields?

Yes

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Session Classification: Computation, Machine Learning, and AI

Track Classification: Computation, Machine Learning, and AI