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Alissa Remeza

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Determining DUNE Convolutional Neural Network Neutrino Identification Biases

The Deep Underground Neutrino Experiment (DUNE) is a collaborative next-generation neutrino experiment that utilizes liquid argon time projection chambers to detect neutrino interactions. DUNE is the present most advanced opportunity to understand the neutrino, which may resolve key universe questions. It applies a trained Convolutional Visual Network (CVN), a neural network utilizing image inputs, to classify neutrino event types. Images consist of three two-dimensional projections at different angles of a 3D interaction. The purpose of this study was to identify the factors, especially indicating erroneous or biased training, that influence the DUNE CVN predictions by evaluating the effect of modifications on network performance. The methodology involved modifying 800 network input images separated by interaction flavor and measuring neutrino properties to identify disproportionate biases toward any one property or based on event display factors. The results showed significantly worsened (5.5σ) performance for a 2D projection known as the collection plane for NuECC events and less accurate performance for high energy, inelastic, and deep inelastic scattering (DIS) interactions for both NuECC and NuMuCC events. These results suggest a NuECC overreliance on the collection plane as well as weakness in CVN DIS identification. Further training such as with higher energy events and induction plane views could improve future CVN performance.