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Atmospheric neutrino reconstruction in the DUNE experiment using Machine Learning

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The Deep Underground Neutrino Experiment (DUNE) is a cutting-edge international neutrino experiment under construction now in US, which uses Liquid Argon Time Projection Chambers (LArTPCs) as its main detector technology for particle identification on the far site in the SURF facility in South Dakota. The far detector (FD) modules will be able to detect longbeam neutrinos (generated by a source at the near site in FNAL) but also neutrinos from natural sources (like solar and cosmic rays). In this work, I am focusing on atmospheric neutrinos, created in Earth's atmosphere by cosmic rays interactions. In order to determine the moving direction of an atmospheric neutrino, identifying its interaction vertex in the LArTPC is an essential first step. This allows it to determine the distance the neutrino traveled before interacting, and hence make it possible to calculate its oscillation probability. I will present the performance of the reconstruction algorithm for the interaction vertex of such neutrinos in the DUNE FD LArTPCs. Using a simulated sample of atmospheric neutrinos, I will show the present performance (resolutions and reconstruction efficiency) of vertex reconstruction in DUNE's FD. I will also present my work on identifying failure points and improving the algorithm using deep learning techniques. Further development prospects will also be discussed.

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