Multivariate Event Identification Study for a Liquid Argon Time Projection Chamber $\nu_\mu \rightarrow \nu_e$ Oscillation Experiment

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Abstract: Neutrinos are nearly massless fermions that come in three flavors (ν_e, ν_μ, and ν_τ). Several experiments have confirmed that neutrinos oscillate between flavors. These oscillations are governed by the unitary MNS mixing matrix, which specifies three mixing angles and one complex Charge-Parity (CP) violating phase. Studies of solar and atmospheric neutrino oscillations have measured two of those mixing angles, however, a study of $\nu_\mu \rightarrow \nu_e$ oscillations is necessary to give a better measurement of θ_{13}. Research and development is underway on a new generation of neutrino detectors using Liquid Argon Time Projection Chambers (LAr TPCs), which will be exposed to the NuMI beam at Fermilab in order to better measure θ_{13}, determine if CP violation can be studied with neutrino oscillations, and determine the mass hierarchy of the neutrino flavors. Current limits of θ_{13} show that the $\nu_\mu \rightarrow \nu_e$ oscillation probability will be low (< 7%), therefore, an efficient event classification scheme is necessary to pull the small charge current electron signal from the charge current muon and neutral current background. The success of different event classification schemes for neutrino detection by an LAr TPC using several distinguishing variables is explored in this study.