Error Mitigation Methods in Track Reconstruction of ICARUS

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Introduction
Liquid Argon Time Projection Chambers (LAr-TPCs) are a common and powerful detector for neutrino interactions. Charged particle interactions ionize the liquid Argon, whereafter the electrons, under influence of an electric field, drift toward the three wire planes. Reconstruction takes the resultant signal, and after checking for agreement between all three planes, creates a 3D space point. These points are then passed to Pandora[1], a pattern recognition software for reconstruction used in several LArTPCs, and then reconstructed particles are fit under a track or shower hypothesis. Track losses can be created when computational noise reduction methods in the pre-Pandora stage incorrectly remove valid hits, which effects the whole line of reconstruction. With this study we hope to identify and address some threads of improvement for error mitigation pre-Pandora as well as post-Pandora.

Results & Conclusion
In the Two-hit and Hit-recovery datasets there was noted a slight improvement in the RTL of reconstructed muons, attributable to an improvement in the ±50 to ±90 bin of ThetaXZ. It remains to be seen why these muons receive a boon from the mitigation methods implemented. Additionally, after analysis in LArSoft, it was found that ~5% of events result in zero cluster hits, and that another ~5% of events misidentify track hits as showers- a potential source for improved metrics. A population of split tracks was also found, with a recommendation that these could bare improving from “Track Gluing.”

Next Steps- Track Gluing
A potential way to recover tracks is to use what’s already there. Tracks that have lost hits due to noise or improper noise reduction can be separated into two (or three, four, etc.) distinct tracks incorrectly. Similar work[2] was previously done by Michael Vayninger for muons crossing cryostats, and we can continue his work for muons within the same cryostat. We can correctly regroup and “glue” these muon tracks together by cutting for several variables on the characteristics of these split tracks. To the right there are a few variables which have already been explored and show promising results for gluing together split muon tracks.

Acknowledgements
Many thanks to my supervisor, Dr. Bruce Howard. Without his guidance, none of the work seen above would be possible. I find myself a more competent and lively physicist because of his time, patience, and wisdom.

[1] https://github.com/PandoraPF