WC & WbLS reconstruction

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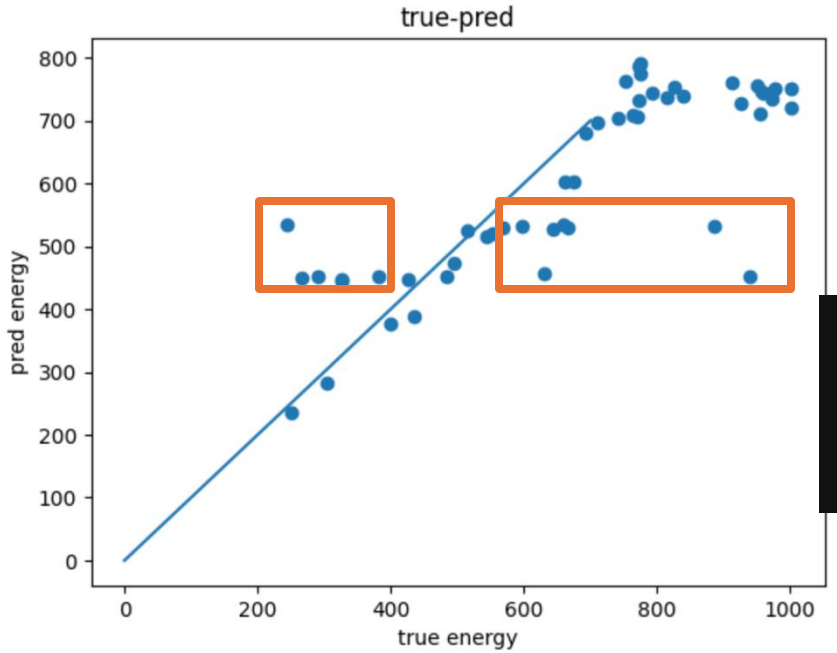
WC reconstruction pipeline

Full-reconstruction full_optimization_demo.ipynb

Test with the MC from WCSim (first 50 events only)

/sdf/data/neutrino/deperio/wcprod/pgun/wcsim_beam_mu-_uniform_mom.h5

Normalized the Charge, seed the initial vertex close to the true



Some of the optimization failed – Need to explore why….

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Starting gradient descent optimization...
Step 1/3000: Loss = 2.725986e+04, LR = 0.500000, Energy = 450.50 MeV, Pos = [19.50, 1368.26, -405.26], Dir = [-0.25, -0.94, -0.25]
Step 101/3000: Loss = 1.538024e+04, LR = 0.500000, Energy = 496.31 MeV, Pos = [16.85, 1337.25, -402.41], Dir = [-0.05, -1.00, 0.01]
Step 201/3000: Loss = 1.379265e+04, LR = 0.500000, Energy = 534.40 MeV, Pos = [9.68, 1326.09, -404.67], Dir = [-0.05, -1.00, 0.00]
Step 298: Reducing learning rate to 0.250000
Step 301/3000: Loss = nan, LR = 0.250000, Energy = nan MeV, Pos = [nan, nan, nan], Dir = [nan, nan, nan]
Step 398: Reducing learning rate to 0.125000
Step 401/3000: Loss = nan, LR = 0.125000, Energy = nan MeV, Pos = [nan, nan, nan], Dir = [nan, nan, nan]
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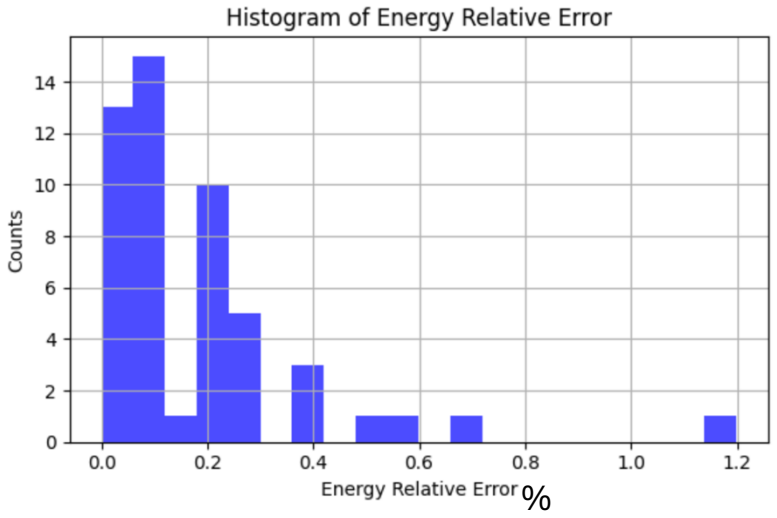
resolution



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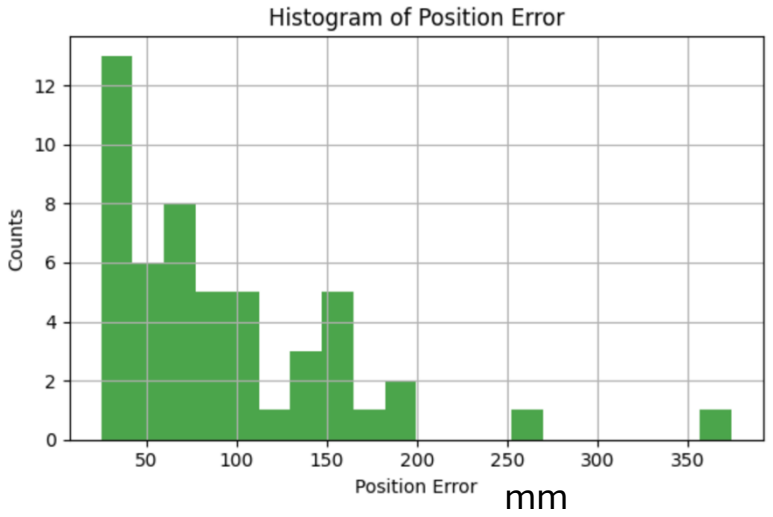
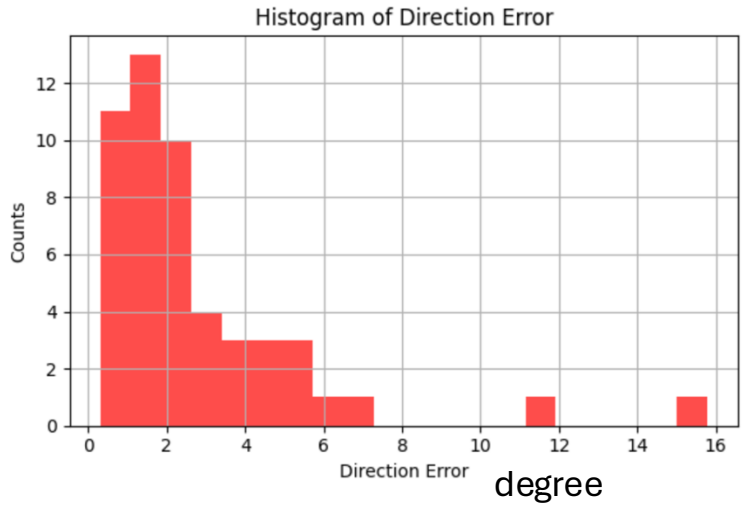


mm



degree

Summary

- Full reconstruction pipeline
  - The pipeline (kind of) works with some WCSim MC, still need to be improved
  - Will check if the nan comes from the edge of the detector
  - Need to explore the reason why some of the fit failed – loss surface etc

- Explore ML method for WbLS reconstruction
  - Start with WC low energy (~10 MeV) events, Prepare the MC for the ML tool this week

  PID, energy, vertex, directions

  PMT charge & time

  - Will train with the ML tool: https://github.com/ViniciusMikuni/OmniLearn/tree/main?tab=readme-ov-file
  - Will move on to high energy WC & WbLS