EGP ML Workflow

10/30/2024

How can we improve detector RMS?

We have established that the detector backprojection RMS to existing features within the pyramid (Grand Chamber, Queen’s Chamber, King’s Chamber) is eclipsed by scattering in the concrete. We can try to use machine learning (ML) to improve RMS in spite of concrete scattering.

Options

At least 2 potential ways to use ML:

- Reconstruction algorithm
  - High reliance on ML, would largely substitute our current algorithm
  - Potentially more powerful
  - More training required
- Filtering secondaries/low energy muons
  - Lower reliance on ML, would only supplement our current algorithm
  - Less room for improvement
  - (Probably) less real training required

ML Workflow

- Develop simulation which mimics cosmic ray conditions (ignoring muons which wouldn't hit pyramid or detector)
  - Can choose to test in smaller G4Beamline environment first and see results, or start with Ralf's larger simulation off the bat
  - If in G4Beamline, could be too computationally intensive for my PC
- Develop model to train on ~80% of simulation data
  - Available parameters would be which detector cells were hit, how much energy deposited (in photoelectrons, with statistical smearing), and the time of collision (+- 1 ns)
  - G4Beamline provides us with knowledge about the particle type, particle momentum, and coordinates of collision, which we can hide from the model and use to compare results.
- Test model on remaining ~20% of simulation data
- Compare results
- Repeat with different loss/activation function(s) or width/depth of model if needed

Additional Goals

- Convert code to Python for ease of use
- Implement Pandas rather than clunky reading and writing to .txt files

Discussion/Questions