SFT Group Meeting

Status Update #8

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PFO Selection

- Cut 1: ECal Cut
  - only allow ECal hits
- Cut 2: Geometry Cut
  - only allow barrel or endcap hits
- Cut 3: Shower Quality
  - $\frac{E \text{ deposit MC truth}}{E \text{ deposit whole shower}} \geq 90\%$
- Cut 4: Track Length
  - $1800\,\text{mm} \leq l \leq 8000\,\text{mm}$
- Cut 5: Track extrapolation cut
  - $d(\text{ECal, hit } 0) \leq 30\,\text{mm}$
- Cut 6: Momentum Cut
  - track $p \leq 10\,\text{GeV}$
- Cut 7: RMS90 Hit Outlier Rejection
  - *next slide*

PFO Selection - RMS90 Outlier Rejection #1

1. take list of shower hit times
2. apply:

```
def fit90(x):
    # remove zero entries that might come from zero padding the data
    x = x[x != 0]
    # in case the above mask on x yields x = []
    mean90 = 0
    rms90 = 0
    mean90_err = 0
    rms90_err = 0
    # ----------------------------------------
    x = np.sort(x)
    n10percent = int(round(len(x)*0.1))
    n90percent = len(x) - n10percent
    for i in range(n10percent):
        rms90_i = np.std(x[i:i+n90percent])
        if i == 0:
            rms90 = rms90_i
            mean90 = np.mean(x[i:i+n90percent])
            mean90_err = rms90/np.sqrt(n90percent)
            rms90_err = rms90/np.sqrt(2*n90percent)   # estimator in root
        elif i > 0 and rms90_i < rms90:
            rms90 = rms90_i
            mean90 = np.mean(x[i:i+n90percent])
            mean90_err = rms90/np.sqrt(n90percent)
            rms90_err = rms90/np.sqrt(2*n90percent)   # estimator in root
    # 1. the mean of the RMS90 interval
    # 2. the std of the RMS90 interval
    # 3. error on the mean
    # 4. error on the std
    return mean90, rms90, mean90_err, rms90_err
```

PFO Selection - RMS90 Outlier Rejection #2

3. interval in which the hit times must be in: $[0, \mu_{\text{RMS90}} + 1.28 \cdot \sigma_{\text{RMS90}}]$
4. remove this hit

Rotate Shower And Put Particle in a Box

- center the shower, i.e. subtract ECal surface hit point from each hit
- rotate the shower based on ECal barrel segment or FB endcap it hit ➡️ afterwards the showers all 'fly into the same hemisphere'
- do RMS90 outlier rejection:
  - get x, y, z distribution all the showers in the dataset
  - calculate $\mu_{\text{RMS90},i}$ and $\sigma_{\text{RMS90},i}$ for $i = x, y, z$
  - in x, y, z direction separately remove hits that do not lie in that box, here: two sided rejection: $[\mu_{\text{RMS90}} - 1.96 \cdot \sigma_{\text{RMS90}},\ \mu_{\text{RMS90}} + 1.95 \cdot \sigma_{\text{RMS90}}]$
- scale the box to [0,1] for input to the network

Rotate Shower And Put Particle in a Box

- network architecture + plots: next meeting
- put the EPiC encoder (thanks Anatolii!!!) into PointNet++ and
- implemented 'EPiC regression', i.e. EPiC encoder + MLP

Highlights - THANKS ANATOLII & PETER