GNNs for LUXE particle tracking

Status update

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Nontechnical Updates

Codebase is merged with the main LUXE QuantumComputing repository.

It is stored in branch gnn-tracking for now.

Graph production using more particles

Some statistics on the preselection. Dataset: 23-2-2022-1.25T-4.0_NS

- 10 graphs are produced from 10 events using 500 most energetic particles.

Total: True edges: 15000 Fake edges: 100361

Efficiency: 1.0000, Purity: 0.1300

- 10 graphs are produced from 10 events using 1000 most energetic particles.

Total: True edges: 30000 Fake edges: 326054

Efficiency: 1.0000, Purity: 0.0843

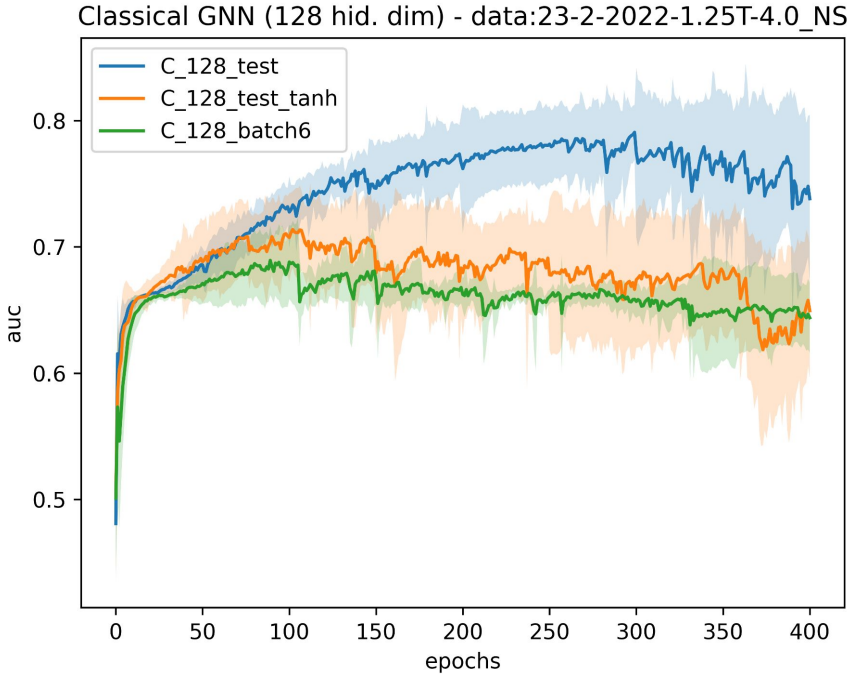
With more particles the purity decreases as expected (unfortunately).

Training results

I performed some experiments to see if we can improve the performance of the model.

The original model performed the best in the end, but we still lack performance. I'm not sure if this is only caused by lack of data.

Investigating ways to improve the performance.



Ideas for postprocessing

A case by case postprocessing method might be very time consuming to build and also execute. There are some suggestions from the literature, which uses already available algorithms.

arXiv:2007.00149 takes the connectivity matrix $J_{i,j}$ and uses $D_{i,j} = 1 - J_{i,j}$ to build a distance matrix. Then, they use DBSCAN algorithm to cluster each hits, such that each cluster is a track.