Local strategy of tracking with TrackNETv2 on the BES-III CGEM inner detector

Anastasia Nikolskaya, **Pavel Goncharov**
Saint Petersburg State University, **Dubna State University**

Motivation

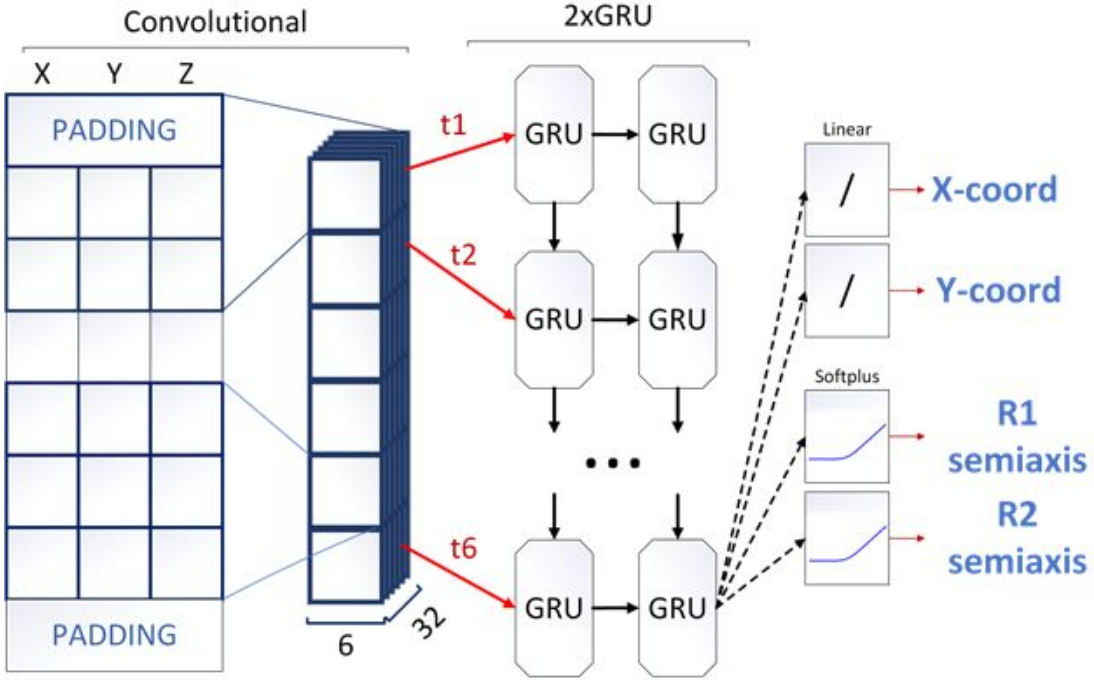
- Despite the fact that GNN approach demonstrate promising results it is a bit overkill for the detector with 3 stations
- Kalman filter is accurate but less scalable and has several well-known drawbacks: initialization and transport matrix calculation

We want:

- a more scalable approach in terms of parallel calculations
- reduce efforts to the initialization and seeds extrapolation

TrackNETv2

Model Architecture



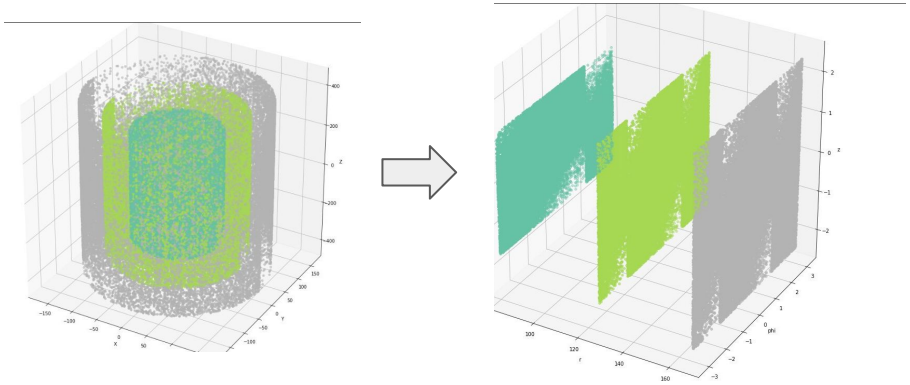
- works like learnable version of the Kalman filter
- for the starting part of a track it predicts an elliptical area at the next station where to search for the continuation
- if there is no continuation the candidate track is thrown away

Results (BM@N experiment, NICA):

- 12K tracks/sec on Intel Core i3-4005U @1.70 Ghz
- 96% of tracks were reconstructed without any mistake

TrackNETv2 adaptation to the BES-III CGEM

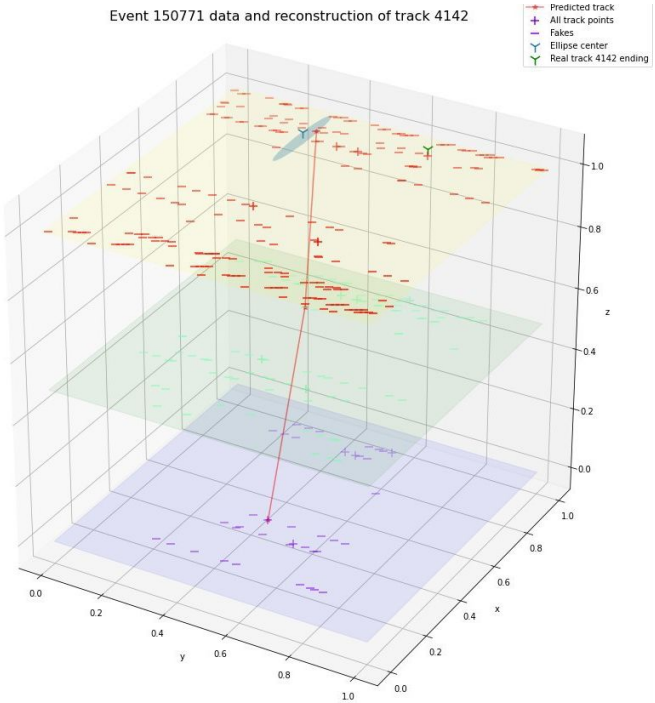
- TrackNETv2 works with sequential data and for each hit we define a z+1 coordinate of the next detectors station where to search for the continuation
- so go to cylindrical coordinates $r = \sqrt{x^2 + y^2},\ \varphi = arctan2\,(y, x)\,, z = z$



- setup tracknet coords as following: phi -> x, z -> y, r -> z

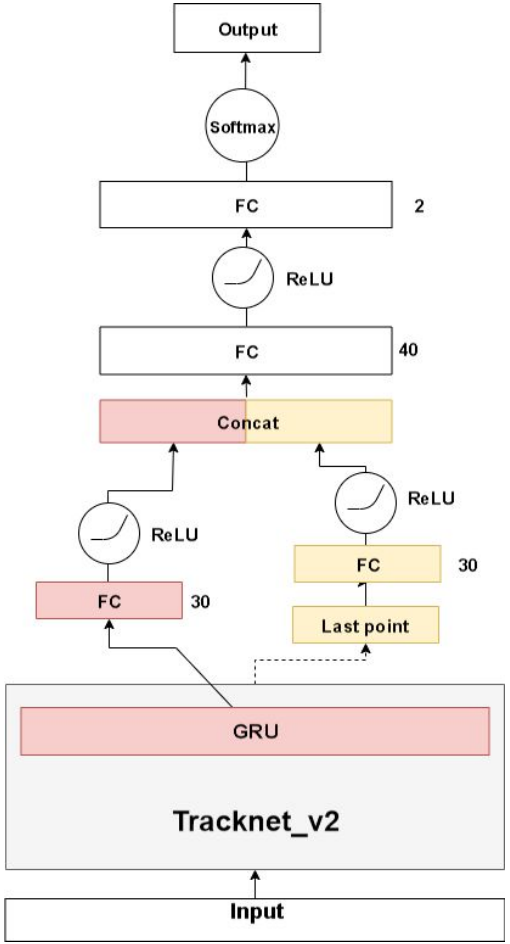
TrackNETv2 adaptation to the BES-III CGEM

- since the number of stations is too small the TrackNETv2 reconstructs many fake tracks
- the model has too little data on the global picture of the event
- recall ~0.99 (lose 1% of true tracks)
- precision 0.07 (93% of reconstructed are fakes)



TrackNETv2.1

The solution is to train a separate classifier which will distinguish between true tracks predicted by TrackNETv2 from fake tracks



Preliminary results

- Recall (percent of the found real tracks)
  - 94.14%
- Precision (percent of the found true tracks interpreted as true tracks)
  - 77.11%
- Speed (still in progress...)

Outlook

- We successfully adapted TrackNETv2 model developed for the fix target experiment BM@N to the BESIII CGEM detector
- Recall of the original model itself is very high ~0.99, but the precision is low due to the small number of stations
- We developed a small classifier to filter out most of the ghosts
- In further investigation we will cut the number of ghosts more
- Parallel C++ implementation of the algorithm is coming soon

Local strategy of tracking with TrackNETv2 on the BES-III CGEM inner detector

Anastasia Nikolskaya, **Pavel Goncharov**
Saint Petersburg State University, **Dubna State University**