Contribution ID: **568** Contribution code: **contribution ID 568** Type: **Poster**

Deep learning particle identification in LHCb RICH

The use of Ring Imaging Cherenkov detectors (RICH) offers a powerful technique for identifying the particle species in particle physics. These detectors produce 2D images formed by rings of individual photons superimposed on a background of photon rings from other particles.

The RICH particle identification (PID) is essential to the LHCb experiment at CERN. While the current PID algorithm has performed well during LHC data-taking periods between 2010 to 2018, its complexity poses a challenge for LHCb computing infrastructure upgrades towards multi-core architectures. The high particle multiplicity environment of future LHC runs strongly motivates shifting towards high-throughput computing for the online event reconstruction.

In this contribution, we introduce a convolutional neural network (CNN) approach to particle identification in LHCb RICH. The CNN takes binary input images from the two RICH detectors to classify particle species. The input images are polar-transformed sub-sections of the RICH photon-detection planes. The model is hyperparameter-optimised and trained on classification accuracy with simulated collision data for the upcoming LHC operation starting in 2022. The PID performance of the CNN is comparable to the conventional algorithm, and its simplicity renders it suitable for fast online reconstruction through parallel processing.

We show that under conditions of reduced combinatorial background, as expected from the introduction of timing resolution to the RICH detectors in future upgrades, the network achieves a particle identification performance close to 100 %, with simultaneous misclassification of the most prevalent particle species approaching 0 %.

Significance

The presented work will show the first application of a neural network approach for ring-imaging particle identification in the CERN LHCb experiment and has the potential to being expanded to similar detector applications. It represents an essential contribution to the future software pipeline of the experiment and an evolution away from computing intensive CPU algorithms towards high-throughput processing technologies.

References

Speaker time zone

No preference

Author: BLAGO, Michele Piero (CERN)

Presenter: BLAGO, Michele Piero (CERN)

Session Classification: Posters: Broccoli

Track Classification: Track 2: Data Analysis - Algorithms and Tools