New Cluster finder for MUONS

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Introduction

ALICE is moving to a new framework for Run3 merging offline and online software. The muon electronics will be triggerless. The muon reconstruction performance is too be sped up, for this to move online , and of course the algorithms need to rewritten or migrated into the new framework. The cluster finding takes up about 70% of the reconstruction time for the muon arm. The key points to solve.

1. The current code while slow, runs well and is deemed to be accurate, so is the benchmark.
2. The stability of algorithm for clusters close together, is critical. The current algorithm is very good and stable.
3. It is a deconvolution problem due to the number of clusters in close proximity and overlapping.

Current algorithm

The current algorithm is a heavily modified Maximum Likelihood Expectation Method (MLEM). It combines a bending and non-bending plane of cathodes into a pixelated anode plane. From there it has an iterative process to find the seeds for a matheson fit. If there are more than 3 seeds for a precluster, the precluster is then split. The split of work is show below :

Function	Time in %		
	pp '16	PbPb '11	15
Data Decoding	4	3	1
Data Filtering	2	2	1
PreClustering	10	10	10
Clustering	63	68	72
Tracking MCH	7	6	5
Tracking MID	6	6	6
Track match	8	5	5

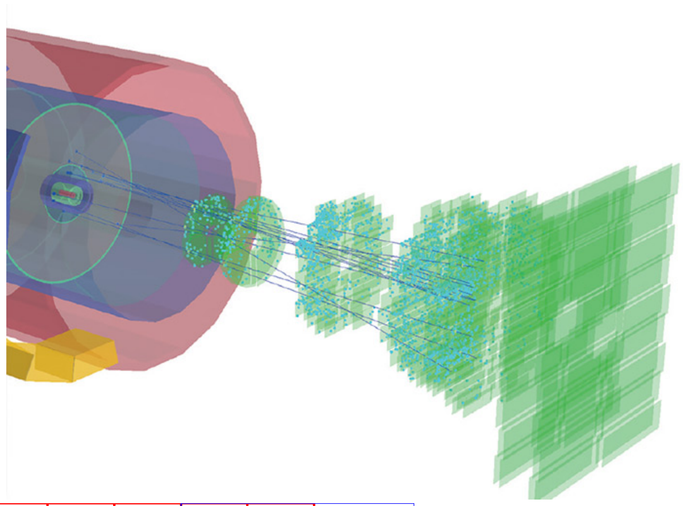
Radial Basis Functions

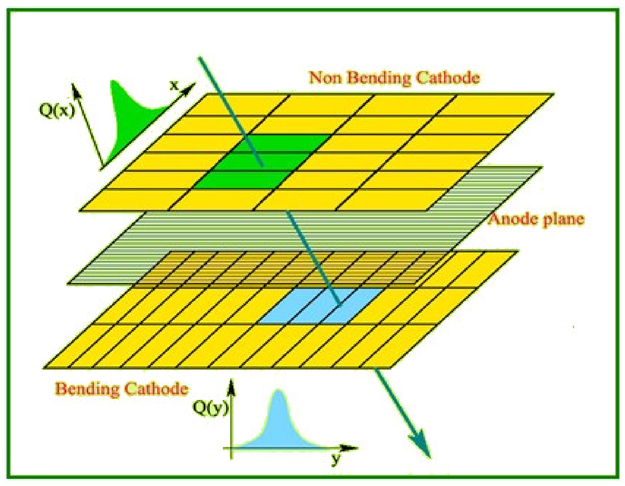
Radial Basis Function Neural Networks. These are a type of feed-forward neural network.
The RBF is a three layer neural network, one is free to implement as many hidden layers as you wish.
A radial basis function is as the name implies a radially symetric function.

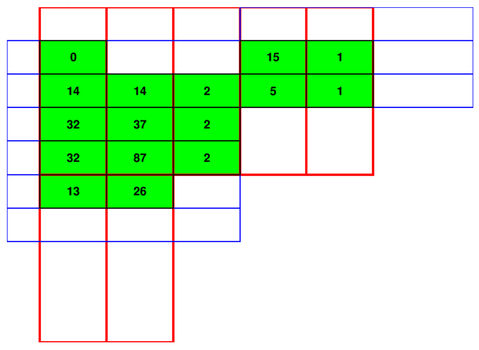
References

[1] Internalnote: ALICE-INT-2003-006 ALICE Internal Note Feb 19 2003

MUON detector and clusters







Above is an example cluster before unpacking. Above is a schematic of a muon pad showing the in-bending and out-of-bending pads

Algorithm

The bending plane and non bending plane detectors are still combined into a pixelated anode. This pixelated anode is the sent through the radial basis fuction network to determine the seeds for a matheson fit. Seeds that are too close are split up to limit the number of free parameters to keep the fitting stable. In the previous algorithm it was 3 clusters, we only got stability at 2.
1d PLOT example of splitting while keeping charge.
Graph of accepted vs rejected for current and new algoritm for pbpb11 and pp16.

Going forward

The algorithm is in the process currently of being migrated to run on nvidia gpu, and the new ALICE O2 framework. The choice of nvidia is due to being readily available but the openCL library will be used to be hardware agnostic.i

Comparisons of previously performed analysis is to be completed to compare physics results of this cluster finder with the previous one.

Source Code

The source code is at