A NEW CLUSTER FINDER FOR THE ALICE MUON ARM FOR RUN3

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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.

- The current code while slow, runs well and is deemed to be accurate, so is the benchmark to beat.
- The stability of algorithm for clusters close together, is critical. The current algorithm is very good and stable.

LEGACY ALGORITHM

The current algorithm is a heavily modified Maximum Likelihood Expectation Maximisation (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 mathieson fit[2]. If there are more than 3 seeds for a precluster, the precluster is then split.
The breakdown of where the reconstruction spends its time is shown below as a percentage of total time:

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

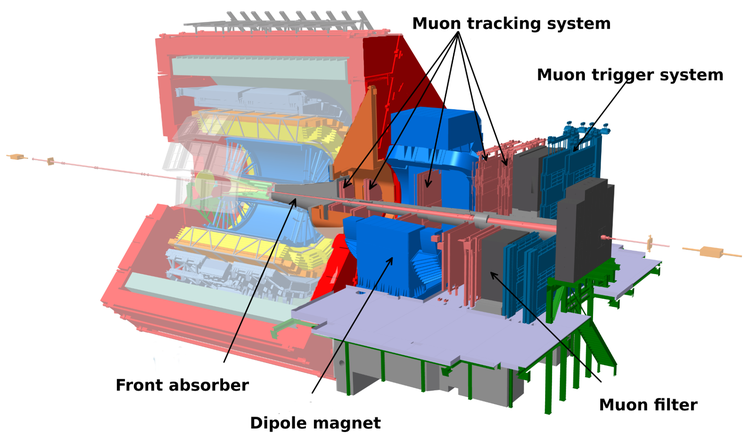
RADIAL BASIS FUNCTIONS

Radial Basis Function (RBF) Neural Networks, is a type of 3 layer feed-forward neural network.
A radial basis function is as the name implies a radially symetric function, in our case we used a Mathieson fit[2] due to the nature of the detector being cathode pad chambers, with 2 chathode pads with anode wires in-between seperated by 3.25mm anode to cathode. A weighted mean subtractive clustering was applied to get the centers to put into the RBF for learning.

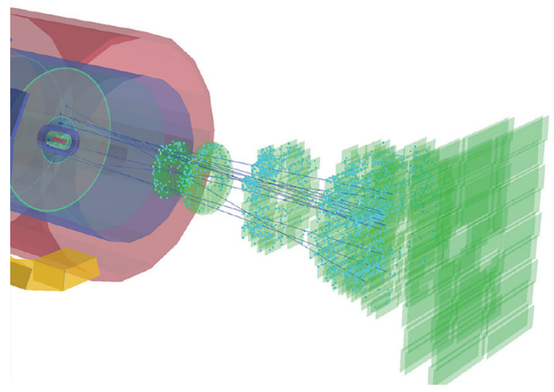
REFERENCES

[1] Internalnote: ALICE-INT-2003-006 ALICE Internal Note Feb 19 2003
[2] Mathieson, E. NIMA270 (1988) 602-603

MUON DETECTOR AND CLUSTERS



ALICE apparatus with muon arm highlighted



An example splash event showing the resolved tracks

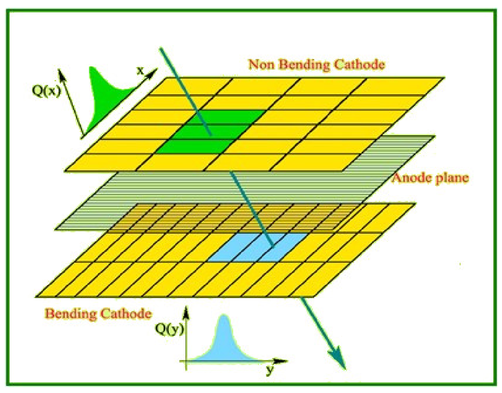
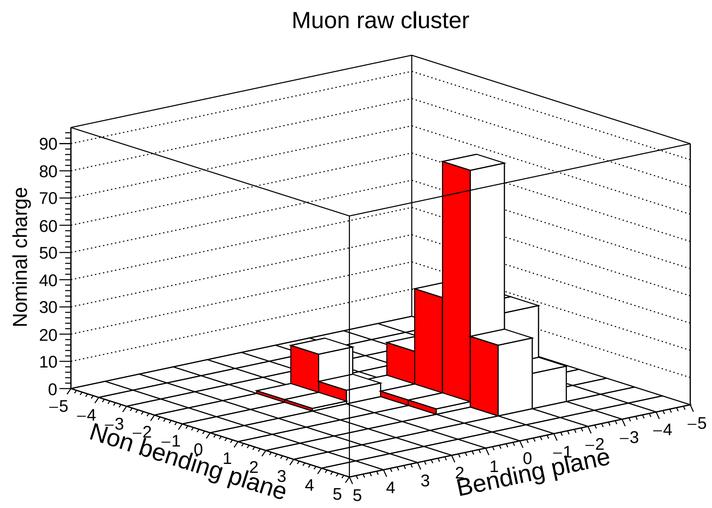


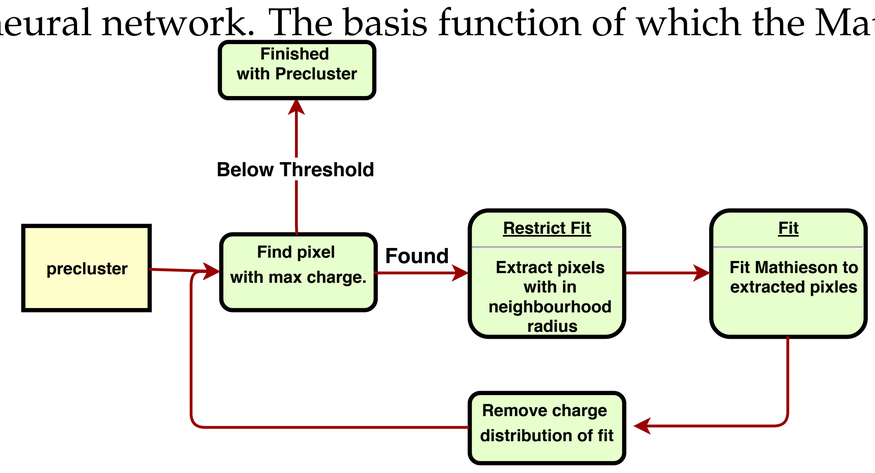
Diagram showing the bending and nonbending planes



An example raw anode plane cluster, showing overlap

ALGORITHM

Fortunately given we have a functioning algorithm already and a large data set already, we have a lot of training data and test data. The bending plane and non bending plane detectors are still combined into a pixelated anode. This pixelated anode is then sent through the RBF neural network. The basis function of which the Mathieson fit.



The weighted mean substractive clustering is used in the training set. The neural network is then trained via : Apply the weighted mean subsctractive algoritm to samples, compute the hidden units in the RBF network, cmpute the weights between the outer and hidden layers and then test. Graph of efficiency for current and new algoritm for pbpb11 and pp16.
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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.

SOURCE CODE

The source code resides on a private branch of AliRoot, the current ALICE software framework, on github.