L1 CA track finder with realistic STS clusterization

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In a realistic process of strip clusterization some loss of information inevitably occurs due to merging of clusters. A merged cluster is a group of strips, fired by more than one MC point. For Au+Au collisions at 25 AGeV simulated with `cbmroot` version Jun10, about 12% of hits are created from merged clusters (at least in one projection) and more than $\sim 50\%$ of tracks contain hits from merged clusters. This may affect the tracking performance and the present work considers this influence on L1 Cellular Automaton Track Finder (CA) [1].

The "removal procedure" of the CA, which removes from further consideration hits attached to found track candidates, does not allow tracks to have hits in common and thus by default does not take into account possible merging of the clusters. Therefore it is able to remove true hits together with fakes if the corresponding cluster (at least in one projection) has been included in some other track.

This particular source of loss in the track finding efficiency was considered in our talk [2]. To recover the efficiency without significantly increasing the clone and ghost rates we tried to optimize the removal procedure (in order to remove maximum of non-merged and minimum of merged clusters), using the information about: the total cluster charge, the mean charge of the clusters on the track, and the size of the cluster. The charge distributions significantly differ for single- and many-strip clusters, so we considered them separately. Figure 1 shows the dependence of the efficiency, the ghost and clone rates after the first step of the algorithm on the cut on the minimal cluster charge.

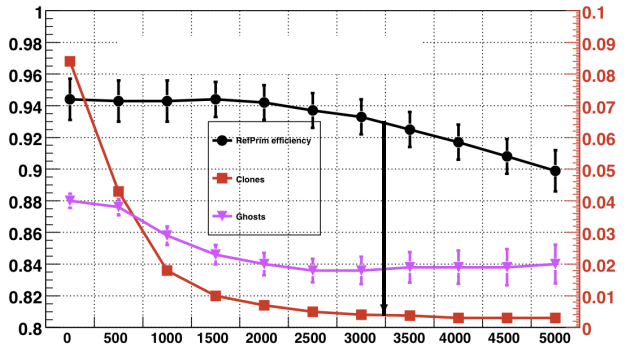

Figure 1: `RefPrim` efficiency (circles), clones (squares), ghosts (triangles) versus cut on the total cluster charge

We chose to cut on the minimal total cluster charge for many-strip clusters below 2500 to remove clusters with low charge which are more likely to be non-merged. The effect of the difference in charge distribution between merged and non-merged single-strip clusters is less pronounced.

Because the cluster charge depends on the type of the particle, its momentum and angles, one can expect to achieve some improvement by cutting on "normalized charge" obtained by dividing the charge of the cluster by mean$(\{c_i\})$, the mean value of cluster charges on the track. We have also studied different truncated mean definitions: mean$(\{c_i\} \setminus c_{\max})$, and mean$(\{c_i\} \setminus \{c_{\max}, c_{\min}\})$ to increase robustness. No significant difference could be found between the results obtained using the cut on total cluster charge or cutting on any of the studied normalized cluster charges.

Table 1: Comparison of CA performance with default and modified removal procedure

Track category	**Jun10**	**charge $<$ 2500**
	%	%
RefSet (> 1 GeV/c)	89.0	94.1
RefPrim	90.4	95.1
RefSec	80.2	87.8
All set	82.5	87.6
Extra set (< 1 GeV/c)	66.2	71.2
Clone	0.6	1.0
Ghost	3.4	3.3

As listed in Table 1 (taken from [2]), using the optimal cut on the total charge of many-strip clusters at the first step of the CA algorithm, it was possible to recover the tracking efficiency for the reference set of tracks to about 94% while keeping low clone and ghost rates.

It is necessary to underline that the amount of merged clusters significantly depends on the properties of the detector and on the digitization algorithm as well as the local track occupancy. So, it will be subject to keep step with the development of the detector design and changes in operational conditions. Due to the reported strong dependencies we have decided not to include the described modifications in the official release of the L1 CA. Nevertheless, the presented study may be used at a later phase of adjusting the tracking algorithm to the performance of the real detector.

References

[1] I. Kisel, Nucl. Instrum. Meth. **A 566** (2006) 85

[2] I. Rostovtseva *et al.*, *Status of L1 Track Finder*, 16th CBM collaboration meeting, Mamaia, Romania, 28 September 2010