Development of an online calibration framework for ALICE

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The time projection chamber (TPC) is the main tracking and particle identification device of the ALICE detector [1]. Its working principle is the ionization of gas by traversing charged particles, and the acceleration of the freed electrons to readout chambers, where they are multiplied and an electrical signal is produced. Before the produced data can be used for reconstruction, it has to be calibrated to compensate for changes in physical conditions, as the drifting velocity or the gain factor. Currently, calibration of the data is done offline, after storing the raw data to disk. The result of the calibration is then stored in a special database, which can be used later in reconstruction.

For run 3 of data taking, starting after the long shutdown 2 of the LHC, which is foreseen for the year 2018, major upgrades of the TPC and of other parts of the ALICE detector are planned in order to cope with higher luminosities which will be delivered [2]. By replacing the current readout chambers of the TPC witch Gas Electron Multipliers (GEMs), it will be possible to operate in a continuous readout mode [3]. The produced data will increase by a significant factor, which means that a reduction in data volume before storage of about a factor 20 will be necessary. For an efficient data size reduction (e.g. removal of detector hits which cannot be associated to particle tracks), the data has to be calibrated, this means the calibration process has to be moved to the ALICE online data taking chain after the readout of the detector data, i.e. to the ALICE High Level Trigger (HLT) [4].

In order to transfer the calibration procedure to the online environment, a special framework has been developed. On the one hand, functionality to handle the data in the online environment has been implemented. Furthermore, the online environment makes it necessary that calibration procedures are finished in a certain amount of time according to the interaction rate, i.e. within some milliseconds per collision. For this reason, new data structures were developed, which possess a "flat" memory layout, which makes them easier to serialize and stream in memory between different processes, compared to the existing data structures, which have a rather complex memory structure and are hence not suited for use in an online environment.

For backward compatibility and to be able to compare the performance of the two approaches, it was made sure that the same calibration procedures can be run both in the existing offline and the new online environment without code changes. It is foreseen to use the LHC run 2 to test the newly developed framework in terms of its physics performance and use the obtained experience for run 3, when online calibration will be mandatory.

Figure 1 shows the data flow for both the online and the offline calibration. Tests have been conducted on the performance of the conversion of input data from the detectors to the new and the old data format. It could be demonstrated that the new data format needs significantly less time to be produced than the old one. Currently investigations are ongoing on how the performance of the calibration tasks changes when using the new data formats compared to the old ones.

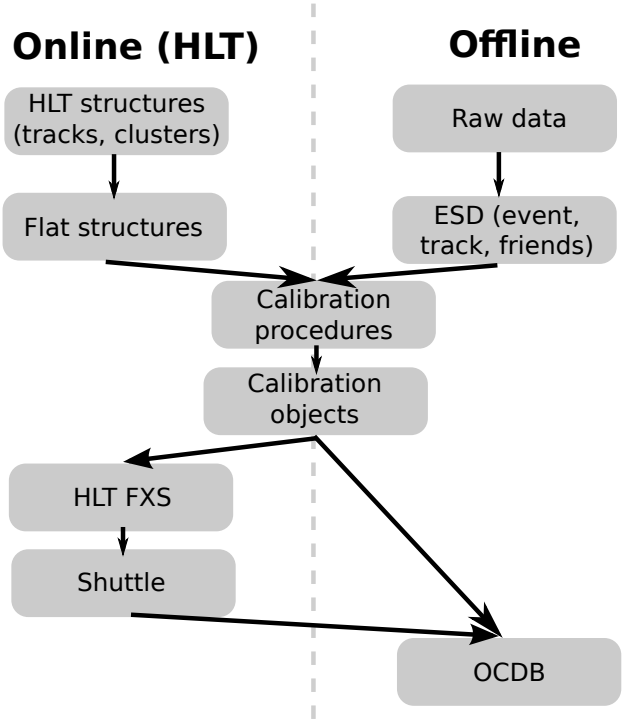

Figure 1: ALICE TPC calibration procedure in online and offline environment.

References

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