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Online Data Compression in the ALICE O2 facility

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The ALICE Collaboration and the ALICE O^2 project have carried out detailed studies for a new online computing facility planned to be deployed for Run 3 of the Large Hadron Collider (LHC) at CERN. Some of the main aspects of the data handling concept are partial reconstruction of raw data organized in so called time frames, and based on that information reduction of the data rate without significant loss in the physics information.

A production solution for data compression is running for the ALICE Time Projection Chamber (TPC) in the ALICE High Level Trigger online system since 2011. The solution is based on reconstruction of space points from raw data. These so called clusters are the input for reconstruction of particle trajectories by the tracking algorithm. Clusters are stored instead of raw data after a transformation of required parameters into an optimized format and subsequent lossless data compression techniques. With this approach, a reduction of 4.4 has been achieved on average.

For Run 3, a significantly higher reduction is required. Several options are under study for cluster data to be stored. As the first group of options, alternative lossless techniques like e.g. arithmetic coding have been investigated.

Furthermore, theoretical studies had shown a significant potential of compressed data formats for clusters relative to the particle trajectory they belong to. In the present scheme, cluster parameters are stored in uncalibrated detector format while the track as reference for residual calculation is described in Cartesian space. This results into higher entropy of the parameter residuals and smaller data reduction. The track reconstruction scheme of the O^2 system will allow for storing calibrated clusters. The distribution of residuals has a smaller entropy and is better suited for data compression. A further contribution is expected from adaptive precision for individual cluster parameters based on reconstructed particle trajectories.

As one major difference in the mode of operation, the increase in the flux of particles leads to larger accumulation of space charge in the detector volume and significant distortions of cluster positions relative to the physical particle trajectory. The influence of the space charge distortions to the data compression is under study.

Though data compression is being studied for the TPC as premier use case, concept and code development is kept open to be applied to other detectors as well.

In this contribution we report on general concepts of data compression in ALICE O^2 and recent results for all different options under study.

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Secondary Keyword (Optional)

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Primary Keyword (Mandatory)

Data processing workflows and frameworks/pipelines

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