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A software and computing prototype for CMS Muon System alignment

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Abstract. A precise alignment of Muon System is one of the requirements to fulfill the CMS expected performance to cover its physics program. A first prototype of the software and computing tools to achieve this goal has been successfully tested during the CSA06, Computing, Software and Analysis Challenge in 2006. Data was exported from Tier-0 to Tier-1 and Tier-2, where the alignment software was run. Re-reconstruction with new geometry files was also performed at remote sites. Performance and validation of the software has also been tested on cosmic data, taken during the MTCC in 2006.

1. Introduction

Since the early stages of design and development, it was well understood that a precise knowledge of the position of the different elements of CMS (Compact Muon Solenoid at LHC) Muon Spectrometer was necessary. To achieve this goal, different hardware, software and computing solutions were developed. We discuss in this article the present situation of the later two, covering diferent issues: the calculation of alignment constants from data, and implementation of the constants obtained by this or other methods into the track reconstruction, and the workflow and dataflow in a grid environment, including remote access to the alignment database. The existing tools were tested during two major challenges in 2006 for CMS, the CSA06 (Computing, Software and Analysis Challenge, described in [1]) and the MTCC06 (Magnet Test and Cosmic Challenge, where a fraction of the detector was operated taking cosmic data [2]).

2. Workflow at CSA06

As part of the general CSA06 challenge, the Muon System Offline Alignment was tested, emulating at smaller scale the expected situation during the real data taking, starting in 2008. After data processing at CERN a new stream known as ALCARECO was produced, selecting the muon track information relevant for alignment, reducing the size of the sample by two orders of magnitude. This data was then transferred to the Tier-2 where the analysis was to be performed. Full samples were also transferred for validation jobs. In all the cases the CMS schema for data transfers was followed.

Different type of jobs were run at the Tier-2 as the data arrived. Initially basic magnitudes were plotted, checking the quality of the data. Then, alignment jobs were executed using

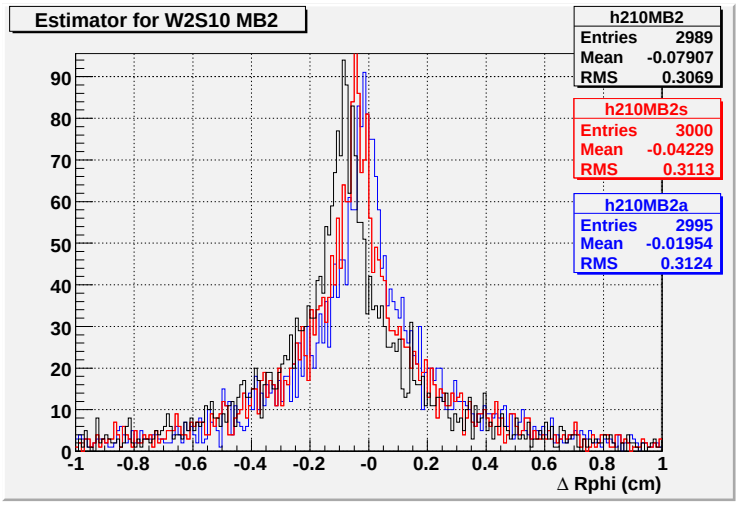

Figure 5. Estimator for the displacement of chambers in the most sensitive coordinate for one of the chambers instrumented in the MTCC. The black histogram shows the estimator when no correction is applied and the red and blue ones when corrections from photogrammetry and track alignment respectively are applied

7. Conclusions

An alignment exercise for the Muon System of CMS was developed and tested successfully during CSA06, at a scale corresponding to roughly 25% of that expected for the real data taking, confirming a correct performance of software and computing resources. The full dataflow was completed in about 24 hours, starting with the alignment and calibration stream availability at Tier-0, followed by data transfers to corresponding Tier-1 and Tier-2, and first prompt analysis and plots at Tier-2. Efficient access to remote databases was also tested, allowing the alignment algorithms to handle alignment constants from the official condition database at CERN without any significant delay.

The performance of a simplified version of the alignment algorithm was validated with simulated data (CSA06). It has also been validated in the MTCC, at a smaller scale, but with real data and realistic data-taking conditions.

Results showed that a significative improvement of muon reconstruction was achieved. A new improved version of the algorithm is now under development and will be tested during CSA07.

References

[1] The CMS Collaboration, *CMS Computing, Software and Analysis Challenge in 2006 (CSA06) Summary*, CMS NOTE 2007/006, LHCC-G-128, CERN/LHCC 2007-010
[2] The CMS Collaboration, *The CMS Magnet Test and Cosmic Challenge (MTCC Phase I and II) Operational Experience and Lessons Learnt*, CMS NOTE 2007/005
[3] *http://lcg.web.cern.ch/LCG/*
[4] José Hernández et al., *Exercising CMS dataflows and workflows in computing challenges at the Spanish Tier-1 and Tier-2 sites*, presented in these proceedings
[5] Lana Abadie et al., *DPM Status and Next Steps*, presented in these proceedings
[6] Lee Lueking et al., *CMS Conditions Data Access using FroNTier*, presented in these proceedings
[7] Lassi Tuura et al., *Scaling CMS data transfer system for LHC start-up*, presented in these proceedings.
[8] Volker Blobel and Claus Kleinwort, *A new method for the high-precision alignment of track detectors*, Proc. of Conf. on Advanced Statistical Techniques in Particle Physics, Durham, 2002