The Development of Detector Alignment Monitoring System for the ALICE ITS

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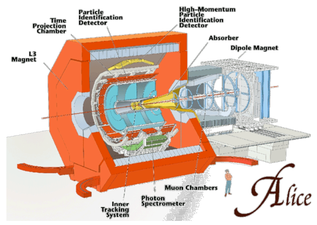
Abstract

A real-time detector alignment monitoring system has been developed by using commodity USB cameras, spherical mirrors, and laser beams introduced via a single mode fiber. An innovative control and online analysis software has been developed by using the OpenCV (Open Computer Vision) library and PVSS (Prozessvisualisierungs- und Steuerungssystem). This system is being installed in the ALICE detector to monitor the position of ALICE's Inner Tracking System subdetector. The operational principle and software implementation will be described.

Introduction

ALICE (A Large Ion Collider Experiment)



The ALICE detector

- One of the detectors at the Large Hadron Collider at CERN.
- Optimized for heavy ion collisions.

ITS (Inner Tracker System)

- Detector in ALICE which is nearest the interaction point.
- Six layers of silicon detectors.
- Designed to track particles with momenta less than 100 MeV/c.
- Designed to improve the angular and momentum resolution of higher than 100 MeV/c particles.

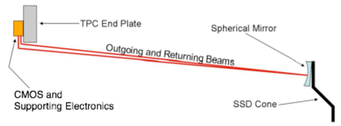
ITSAMS

(Inner Tracker System Alignment Monitoring System)

- ITSAMS monitors the position of the ITS with respect to the Time Projection Chamber (TPC)
- Insures no loss of continuity as particle tracks are fit across the boundary between the ITS and the TPC.

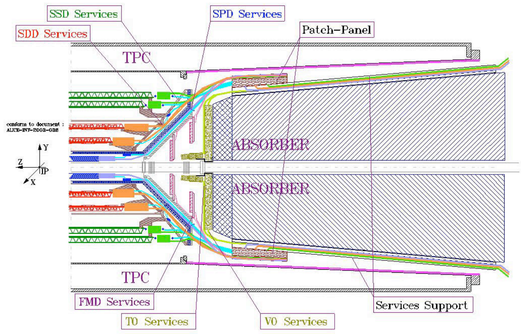
Hardware

- The system consists of four units. Each unit is comprised of a diode laser, a spherical mirror, and a camera.



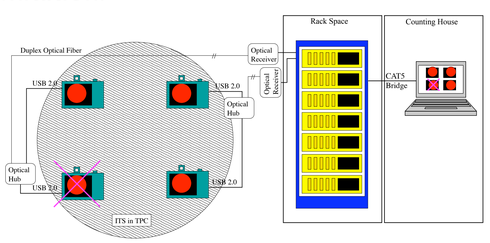
The conceptual diagram of the ITSAMS.

- The diode laser and the camera are mounted on the TPC end plate. The spherical mirror is mounted on the SSD cone.



A cross section view of the ITS, showing the layers of the ITS, the support cones, cabling and other services and other detectors.

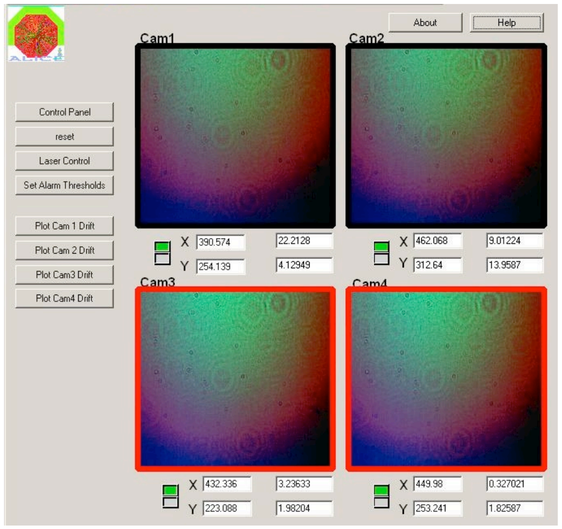
- High precision monitoring of the relative motion of various strategic points on and around the ITS.
- Inexpensive and physically small.
  - The cameras used are USB webcams (Rocketfish Model RF-NBCAM).
- The use of passive components on the ITS limits grounding and thermal issues.
- Requires power only at the TPC locations.
- Data is transmitted using USB 2.0 standard. USB-optical fiber Bridges are used to over come the transmission distance limitation.



A conceptual drawing of the data path for ITSAMS.

Software

- Image analysis software is written in C++, utilizing various functions in OpenCV
- Cross-platform (currently runs on Windows)
- Well-documented open source system makes it easier for users to write and update code.
- PVSS (Prozessvisualisierungs- und Steuerungssystem) is used for the graphical interface, archiving of data, and alarm.



A screenshot of the ITSAMS in PVSS.

Conclusion

- Webcam use provides a more cost effective solution than comparable systems currently available for alignment monitoring.
- Meets all the alignment monitoring requirements for the ALICE ITS.
- OpenCV provides a flexible software framework for the ITSAMS.

Acknowledgement

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