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Development and commissioning of the ALICE pixel detector control system

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The Silicon Pixel Detector (SPD) is the section of the ALICE Inner
Tracking System closest to the interaction point. In order to operate the detector in a safe way, a control system was developed in the framework of PVSS which allows monitoring a large number of parameters such as temperatures, currents, etc.
The control system of the SPD implements interlock features to protect the detector against overheating and prevents operating it in case of malfunctions. The nearly 50000 parameters required to fully configure the detector are stored in a database which implements an automatic version of the configuration file after a new calibration run has been carried out. Several user interface panels were developed to allow also non-expert shifters to operate the detector easily and safely.
This contribution provides a detailed description of the features and commissioning of the SPD control system.

Summary

The ALICE Silicon Pixel Detector (SPD) corresponds to the two innermost layers of the ALICE central tracking system and it is the closest detector to the interaction point. The SPD is made of hybrid silicon pixels and contains 9.8 M read-out channels. It is composed of 120 half staves (HS) mounted on 10 carbon fibre supporting sectors. Each half stave is made of two ladders, a Multi Chip Module and an aluminium-polyimide multilayer bus. Each ladder consists of 5 front-end chips bump bonded to a 200 microns thick silicon sensor. The MCM constitutes the on-detector electronics and performs operations such as triggering, clock distributions, data multiplexing, etc. The multilayer bus provides the communication between the MCM and the front-end chips. The communication between the MCM and the off-detector electronics (Routers) is assured by three single-mode optical fiber links.
The SPD low voltage power supply system is based on 20 CAEN A3009 dc-dc converter modules housed in 4 CAEN Easy3000 crates located at about 40m from the detector. The sensor bias voltage is provided by CAEN A1519 modules housed in a CAEN SY1527 mainframe 100 m away from the detector. The SY1527 mainframe is the top level of the system that communicates via Ethernet (TCP/IP, OPC protocol) with the software layer of the Detector Control System (DCS)
The DCS plays a very important role in operating the SPD and fulfils very stringent requirements. In particular, it protects the detector against overheating that may occur in case of failures in the evaporative cooling system or malfunctioning in the system components. The ALICE Detector Control System, as well as all the LHC experiments, is supervised by a SCADA system (Supervisory Control and Data Acquisition) based on a software platform called PVSSII.
The aim of every control system is to supervise all the operations carried out in its structure and to react promptly in case of misbehaviours. The ALICE Control Coordination (ACC) team in collaboration with every detector foresaw a series of constrains to integrate the control system of each sub-detector into a unique ALICE detector control system. The detector control system (DCS) of the SPD was designed according to such requirements. Standard components were mainly used to reduce maintenance efforts and, in few cases, dedicated components were developed for specific and innovative tasks. The DCS of the SPD has been developed to fully operate the detector and its system components, including the configuration of the front-end electronics.
PVSSII provides the link between the hardware components and the control logic units which are supervised by the Finite State Machine (FSM). The latter connects the defined logical states of the detector components and sends macroinstructions (i.e.: Go Off, Go Ready, etc) via PVSS: a macroinstruction is a sequence of operations addressed to the hardware. The correct sequence of actions is checked and possible errors are detected. The FSM has also the task of providing the Alice DCS with information regarding the status of the SPD (i.e.: Ready for data-taking, calibrating, etc.).
PVSS is designed for slow control applications and it is not suitable for direct control of fast front-end electronics. More than 50000 parameters (DAC) are required to configure the SPD front-end electronics. For this

reason a dedicated Front-End Device (FED) driver was build to interface the PVSS layer with the SPD electronics. The FED receives macroinstructions and autonomously operates the front-end/off-detector electronics. A direct connection reads and saves all the required parameters in the configuration Oracle database (CDB).
The DCS of SPD is a distributed system composed of 4 PVSSII sub-projects which run in 4 PCs (3 working nodes and 1 operator node). The working nodes, accessible only to expert users, are the computers used to control the detector. The User Interface (UI) is installed in the operator node where all users can login.
The UI is the graphic interface tool that allows users to monitor and manage the detector in a safe way.
This contribution will provide an overview of the DCS of the SPD, with particular emphasis on the functionalities that improved the system automation level. The solution adopted to connect PVSSII to the configuration database will also be presented.
The SPD detector control system is installed and used for the detector commissioning and operation. The DCS performances will also be discussed.

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