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Real Time Event Building for a Pixel Tracking Telescope Using an Advanced Mezzanine Card and MicroTCA

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We have designed an advanced test-beam facility including a pixel tracking telescope. In the data path between the telescope and a PC, a commercial MicroTCA crate houses an Advanced Mezzanine Card (AMC) which receives, buffers, and processes the data from the tracking telescope, transmitting complete assembled events to the PC in real-time. This approach makes possible rapid assessment of the data and alignment and improves the efficient use of the beam. Recent test beam results using this approach will be reported.

Summary

The Electronic Systems Engineering (ESE) Department of the Computing Sector at the Fermi National Accelerator Laboratory (FNAL) provides innovative solutions to the data acquisition and trigger system challenges faced by HEP. Emerging commercial standards like xTCA, which is driven by developments in the telecommunications industry, offer the promise of modular solutions that meet the requirements of high data volume HEP experiments. This paper reports on an approach designed to the MicroTCA standard to instrument a pixel tracking telescope to support pixel detector research and development.

ESE has developed a pixel tracking telescope based on the CMS Forward Pixel Detector modules. This telescope has been used for advanced pixel detector research as well as a facility available to users conducting tests at the Fermilab Test Beam Facility (FTBF). The data acquisition components of the telescope are multiple Compact And Programmable daTa Acquisition Node (CAPTAN) stations, developed by ESE. Previously, the telescope would push all of its data to a PC where the data was stored to disk. Then event building, geometrical alignment, and particle tracking were all done at a later time. To provide quick feedback on the data quality and alignment, the readout system has been further augmented to include a MicroTCA crate between the telescope and the PC. This crate hosts an AMC which receives, buffers, and processes the data, assembling complete events before transmission over Ethernet to the PC. The assembled events are received by software which can be run on Microsoft Windows or Linux operating systems.

At the heart of the AMC is an additional CAPTAN component which includes an FPGA in which the events are assembled. The AMC also includes a Module Management Controller (MMC) mezzanine card which negotiates the IPMI communications with the MicroTCA crate. Two Gigabit Ethernet ports are available on the front panel of the AMC and are used to establish communications from the CAPTAN stations of the telescope (for incoming data) and the PC (for merged events). With the addition of the MicroTCA crate, the event building can occur in real-time thus bypassing the need for the intermediate storage of the raw data. The PC receives only completed events for storage, and the analysis of the runs can begin with geometry inference, followed by track reconstruction.

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