Development of software tools for the prototype readout chains of the CBM Silicon Tracking System

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Development and characterization of detector prototypes requires powerful, flexible, and reliable software tools, such as data acquisition, slow control and on-line/off-line monitoring systems. The present STS prototype readout chain includes the n-XYTER 1.0 and STS-XYTER 1.0 front-end ASICs, the SysCore versions 2 and 3 (SCV2, SCV3) readout boards, and the FLIB interface board [3]. Whereas the FLIB-based data acquisition system is covered in [4], the present report covers the controls and monitoring tools for the front-end ASICs and readout boards, as well as the USB-based readout system.

Controls

A control server library, which provides a high-level interface to various CBMNet [2] devices, such as the front-end ASICs and the SCV2 and SCV3 readout boards, has been developed. Having in mind its usage for the final experiment, the control server enables sending command sequences to a large numbers of CBMNet slaves in parallel.

Client libraries with device-specific macro commands were also developed. For the systems, based on SCV2s and n-XYTERs, these commands include transactions over the I^2C interface (which is needed for n-XYTER configuration), as well as over the SPI interface (which is used for controlling the ADC). Additionally, the possibilities to switch n-XYTER between the self-triggering and externally-triggered operation modes was provided. A possibility to configure the AUX block of the SCV2 was provided as well. For the systems, based on the STS-XYTER ASIC and SCV3 readout boards, only simple configuration scripts with hard-coded default settings are currently available.

In future it is planned to connect the data acquisition system to the control libraries. This will enable to receive the feedback from the system immediately after changing a setting, and to use this information for taking decisions on further adjustments. Thus, for example automatic trimming of the thresholds will be possible. This will also simplify performing various parameter scans and calibrations.

Both the server and the client libraries are provided together with the dictionaries for the CERN ROOT interpreter. This enables to use the ROOT interpreter as convenient environment for interactive system configuration.

On-line and off-line monitoring

The development of the on-line/off-line monitoring tools is still in progress. Unpackers for the n-XYTER and STS-XYTER raw data were implemented in CbmRoot [5]. For the STS-XYTER, basic checks of the self-consistency of the data is performed. Thus, it is checked whether the epoch numbers within an individual epoch message are consistent, and whether the epoch messages from each data link are coming in the right sequence. For the hit messages the bit parity check is performed. Also the correctness of the detector transport message (DTM) number is checked at the stage of microslice unpacking.

An analysis library, evaluating the hit rates per channel, hit amplitude distributions, total data rate, etc. was implemented. It is a simple, but essential system diagnostic tool.

Particular care was taken to optimize the code for high performance, in order to achieve maximum analysis throughput.

USB-based readout for SCV3 and STS-XYTER 1.0

Along with the FLIB-based data acquisition system, a data acquisition system operating over USB has been developed. This enables external R&D groups to quickly deploy the SCV3-based setups, and operate them without the need of using the FLIB board. Same control and on-line analysis tools can be used with systems, read out over USB. Transporting up to 27 MB/s of data was achieved, and it is limited by the USB bus.

References

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