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Letter to the Editor

AN INTELLIGENT CONTROLLER FOR DATA ACQUISITION FROM STREAMER TUBE CALORIMETERS

Gian Mario BILEI [1], Orlando CIAFFONI [2], Maria Lorenza FERRER [2] and Luciano TRASATTI [2]

[1] *Department of Physics, University of Perugia, Italy; associato ai Laboratori Nazionali di Frascati, CP 13, 00044, Frascati (Roma), Italy*
[2] *INFN Laboratori Nazionali di Frascati, CP 13, 00044, Frascati (Roma), Italy*

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We have built an intelligent controller for acquisition and pre-elaboration of data coming from the read-out electronics of streamer tube calorimeters. Its main features are very short acquisition time and low costs.

Streamer tubes [1] are steadily growing in popularity in the field of high energy physics. In these experiments (see for example the Mont Blanc nucleon decay [2] or the proposed Gran Sasso monopole experiment) the signals coming from the read-out strips must be discriminated, shaped and loaded into a chain of shift registers.

The data are then read out serially by a dedicated controller. It performs clustering and data transfer to the host computer.

We have built a controller [3] which uses a microprocessor (Texas Instruments TMS 9995) to control the acquisition. The main features of this controller are:
a) very short acquisition time, and
b) low costs.

After triggering, data are transferred in parallel from several shift registers chains to an internal RAM without any processing.

When the transfer is completed, the apparatus can go back to the data acquisition mode to minimize the dead time. The data stored in memory are then processed (clustering etc) by the controller. Results of the elaboration are then transferred to the host computer where they are recorded on tape. The link to the host computer will be performed using an ETHERNET local area network.

The prototype for the read-out of the LeCroy Model 4200 [4] and SGS cards [5] has been built and tested using the microcomputer CANDI2 (the system is designed in the National Laboratory of Frascati) [6–14].

A standard CANDI2 CPU board has been used, and a wire-wrap interface card has been built to interface the processor to a number of read-out channels (this number can easily be adjusted). The final system will be built on a single card (CAMAC or EUROCARD) removing from the CANDI2 CPU board some unnecessary items and adding the interface chips.

The main characteristics of this controller are:

1. Read-out clock: 1 MHz.

2. Data are read in parallel from several (4–8) shift register chains. The full information from 4 read-out channels (e.g. 4 wire planes in the Mont Blanc experiment) is stored in a time slightly longer than the shift time (1 μs/4 channels).

3. The preprocessing (clustering etc) is carried out after the apparatus is back in the data acquisition mode. The dead time is thus minimized because, if a second event happens while the preprocessing is being carried on, an interrupt to the CPU stops the elaboration and stores the second event in RAM (in the usual CANDI2 configuration, 80 events fit into the RAM space). After servicing the interrupt the CPU continues the elaboration of the first event.

4. The transfer of preprocessed data to the host computer takes place while the apparatus is in the data acquisition mode.

5. The read-out time is independent of the event configuration.

6. It is possible to test the shift register chain of the read-out electronics injecting data at the beginning of the chain and reading them out at the end.

To have an exact idea about the acquisition time we make an example. To read the whole Mont Blanc apparatus (134 planes of streamer tubes and 608 strips per plane) it takes:

0.75 ms if every controller is able to read 4 planes,

1.30 ms for controllers that read 8 planes.

Note that this is the total dead time, while in the existing systems the data transfer time to the host computer must be added.

The prototype has been tested using a plane of 32 streamer tubes and one LeCroy read-out card (model 4200 card, the same used in the Mont Blanc experiment). We have collected with success data from cosmic rays

and from electrons coming from a radioactive source (^{90}Sr).

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