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White Rabbit Time Synchronization for Radiation Detector Readout Electronics

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As radiation detector arrays in nuclear physics applications become larger and physically more separated, the time synchronization and trigger distribution between many channels of detector readout electronics becomes more challenging. Clocks and triggers are traditionally distributed through dedicated cabling, but newer methods such as the IEEE 1588 Precision Time Protocol and White Rabbit allow clock synchronization through the exchange of timing messages over Ethernet.

Consequently, we report here the use of White Rabbit in a new detector readout module, the Pixie-Net XL. The White Rabbit core, data capture from multiple digitizing channels, and subsequent pulse processing for pulse height and constant fraction timing are implemented in a Kintex 7 FPGA. The detector data records include White Rabbit time stamps and are transmitted to storage through the White Rabbit core's gigabit Ethernet data path or a slower diagnostic/control link using an embedded Zynq processor. The performance is characterized by time-of-flight style measurements with radiation from coincident gamma emitters and by time correlation of high energy background events from cosmic showers in detectors separated by longer distances. Software for the Zynq controller can implement "software triggering", for example to limit recording of data to events where a minimum number of channels from multiple modules detect radiation at the same time.

Minioral

Yes

IEEE Member

Yes

Are you a student?

No

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