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A novel real-time radiation detector readout and acquisition system for PET

Thursday 14 June 2018 15:50 (15 minutes)

The objective of this study is to develop a real-time multi-channel detector readout and data acquisition system for a compact silicon photomultiplier based Positron Emission Tomography (PET) scanner for preclinical radiotherapy. Without using ASIC, the system consists of simple op-aps and FPGAs and apply novel 1-bit sigma-delta modulation (SDM) method to have most circuit functions of signal conditioning, ADC, TDC, and monitoring of noise and semiconductor photon sensor's status be performed by FPGA. We aim to provide ASIC-equivalent performance and compact size, but with advantages of much lower cost, easier to implement, more flexible to change the configuration and functionality by programming for different detector characteristics or operating needs, and capable to continuously monitor the signal and sensor status during the operation. Specifically, analog signals from silicon photomultipliers will be read out and processed by a detector-level board to provide digitized output signals containing detected energy, timing and positioning information; each board can read out two 32-channel detectors with one onboard low-cost FPGA; total 24 detector-level boards will be linked and synchronized with a system-level FPGA board for PET data acquisition that includes event selection, data transfer and system control, etc. Preliminary study based on a 16-ch prototype detector-level board has demonstrated the design feasibility and shown promising results of circuit signal performance and initial radiation detector measurement. A DAQ system with multiple detector-level boards for PET coincidence data acquisition and imaging study is under development and will be reported at the conference.

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Yes

Description

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