A Modular Data Acquisition System for Reconstruction of Radiation Dose Spatial Distribution in Radiotherapy Treatment Planning

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Introduction

The proposed Data Acquisition (DAQ) is the part of the project which aims to build a reconfigurable detector for the measurement of radiation dose spatial distribution. It is an extremely important field of study since cancer is one of the deadliest diseases worldwide, accounting for nearly ten million deaths in 2020 [1]. For more general overview of the project see the contribution by Maciej Kopec. A reconfigurable detector for measuring the spatial distribution of radiation dose for applications in the preparation of individual patient treatment plans.

Results and Discussion

Hardware

- 64 readout channels per slice generating < 50 Mbit/s data stream
- 8 slices per crate synchronized with Precision Time Protocol (PTP)
- Virtually unlimited scalability possibilities through crate stacking
- MAROC3A front-end readout Application Specific Integrated Circuit (ASIC) [2] allowing simultaneous readout of photon counting and energy

Firmware

- Based on eXtensible FPGA Control Platform (XFCP) [3]
- Functional parts of readout ASIC mapped and accessible via UDP/IP outward
- Submodules working in parallel to ensure collection of analog and photon counting data upstreams

Software

- Proxy Nodes maintain communication with mirrored firmware functional blocks [4]
- Each Proxy Node is implemented as Python thread
- Collected data (register states and continuous streams) are broadcasted to consumer widgets

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References