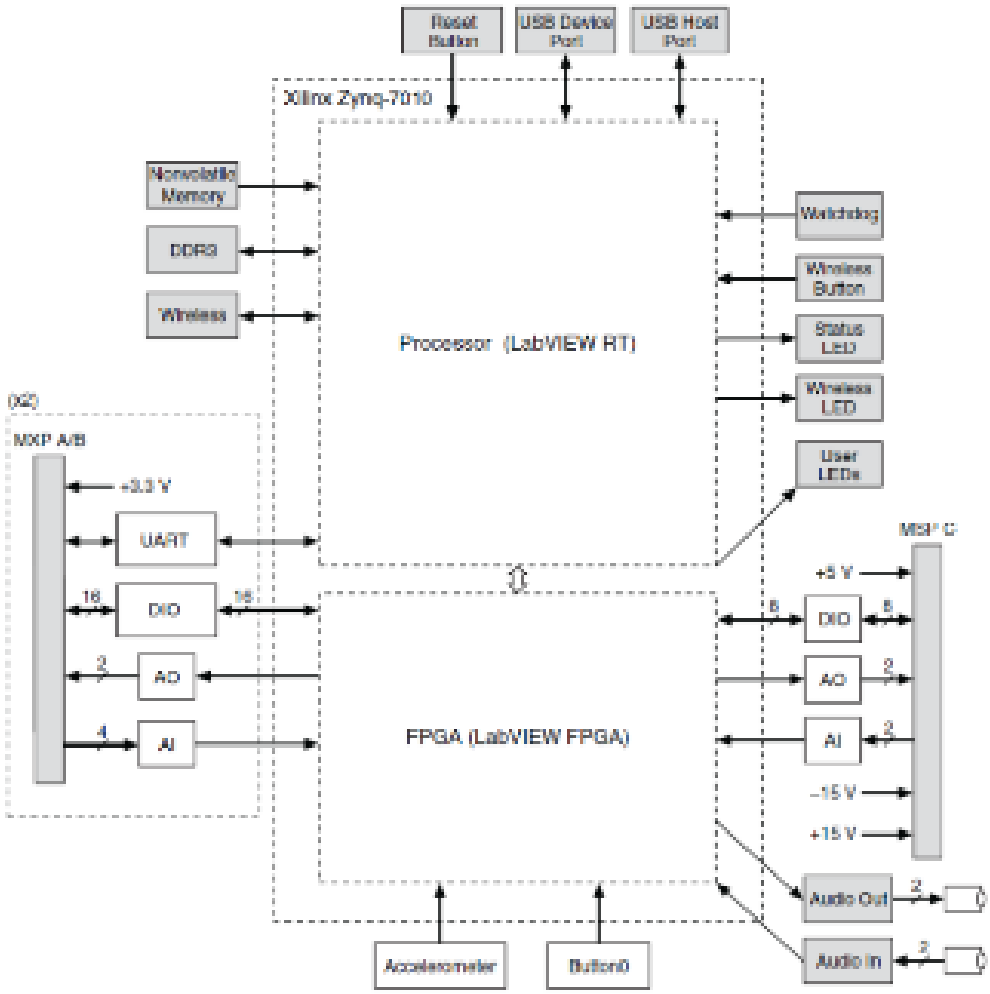
Hardware of the NI MyRIO



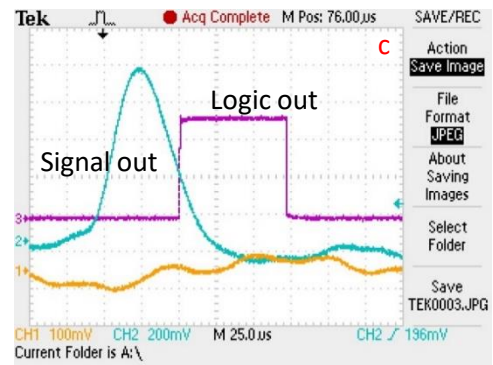
NATIONAL INSTRUMENTS CORP.

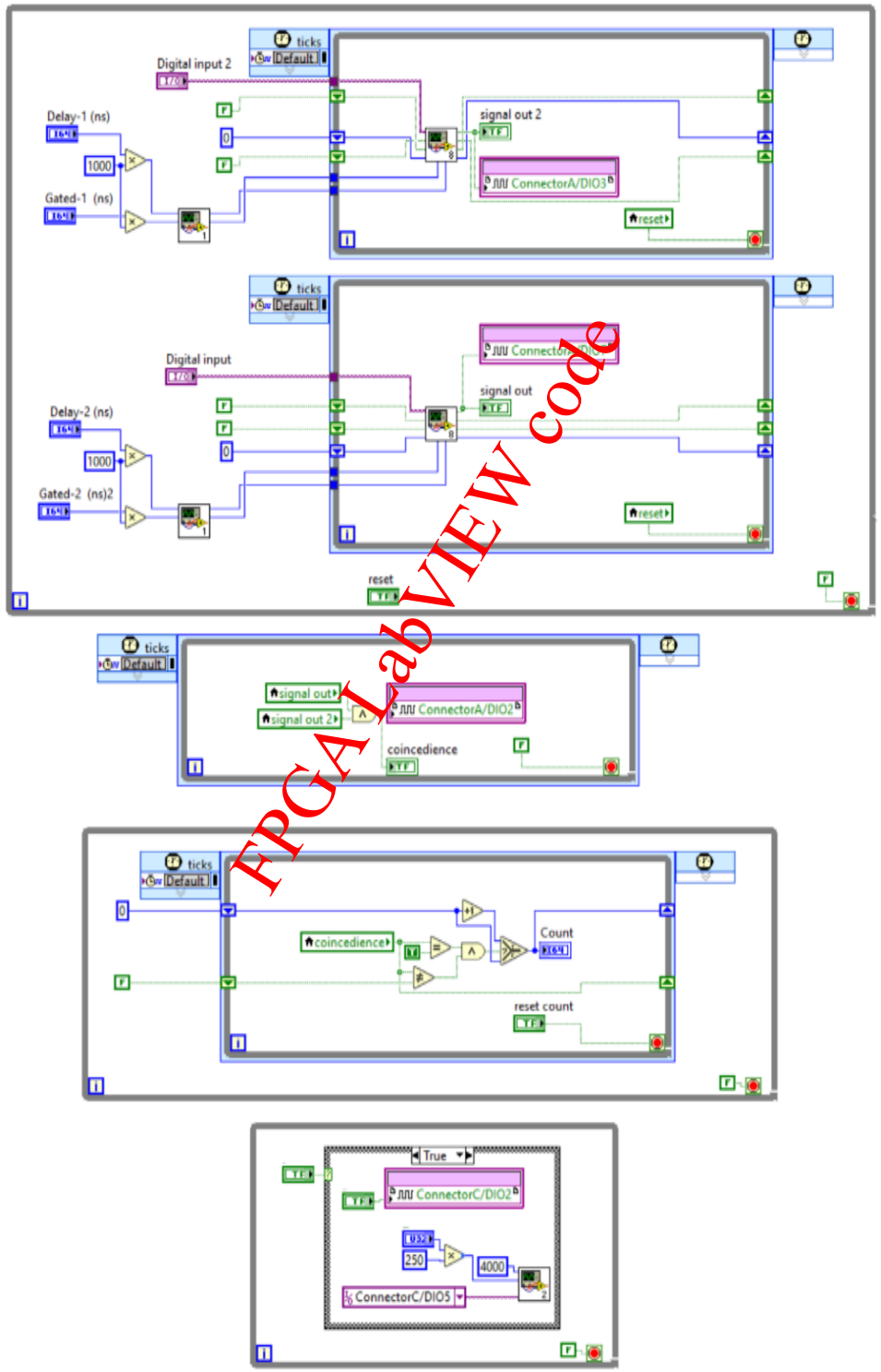
NI MyRIO hardware electronic:

- Field-Programmable Gate Array (FPGA), ARM Cortex-A9 processor,
- Clock: 40 MHz
- 6 Analog input: 500kSpS (Sampling rate)/ 0->5V in range.
- DIO: 20+.
- USB/wireless connectivity with a host computer.
- LabVIEW codes, developed on the LabVIEW™ platform.

Pulse Height Analysis → Energy spectrum measurement *with Scintillation detector*

Gate/Delay Module
Coin. Module
Counter Module
Rotation Module
→ Gamma-gamma angular distribution measurement *with scintillation detectors*





Development of FPGA-Based Nuclear Electronics using NI MyRIO Hardware for Small-Scale Radiation Detector Systems

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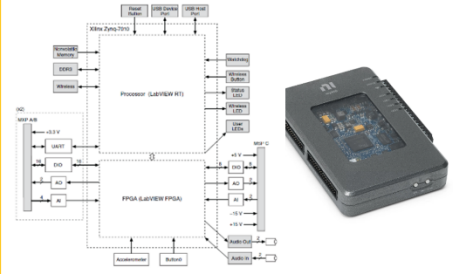
Introduction

This work presents advancements in a coincidence electronics and a Pulse Height Analyzer (PHA) utilizing commercial FPGA-based (Field-Programmable Gate Array) hardware for radiation scintillation detectors.

- The FPGA-based coincidence electronics performance is assessed through an experimental setup for the gamma-gamma angular distribution of a Na-22 radioisotope source.

- The FPGA-based PHA undergoes testing with a NaI(Tl) detector, with a subsequent comparison of energy resolution against a commercial EASY-MCA 2K from AMETEK Inc.

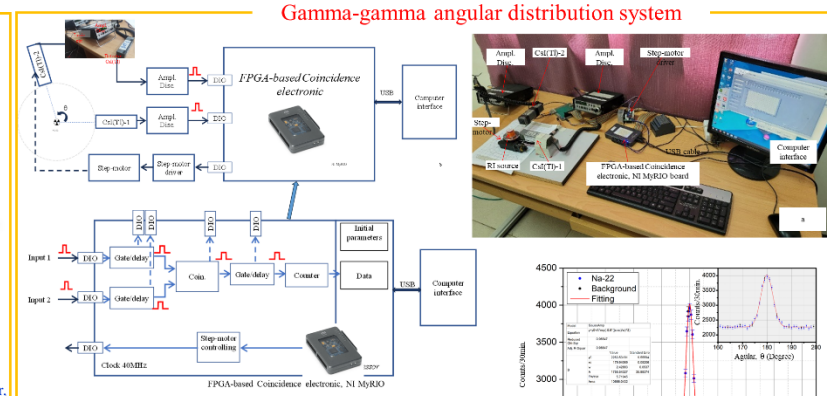
Hardware of the NI MyRIO [1]



NI MyRIO [1]:

- Field-Programmable Gate Array (FPGA), ARM Cortex-A9 processor,
- Analog input (AI), digital input and output (DIO),
- USB/wireless connectivity with a host computer.
- LabVIEW codes, developed on the LabVIEW™ platform [2].

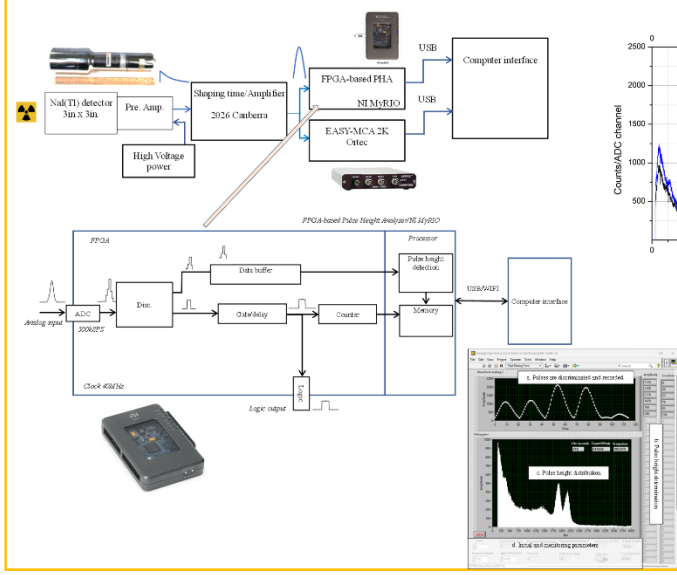
Gamma-gamma angular distribution system

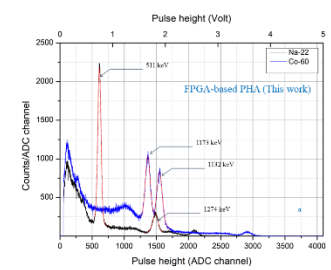


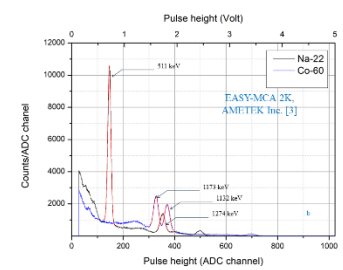
Initial parameters:

(1) Positions of CsI(Tl)-1 relative to CsI(Tl)-2, including start and finish rotation angles; (2) Step rotation angle; and (3) Duration per step rotation angle.

FPGA-BASED PULSE HEIGHT ANALAYER







RI sources	Energy (keV)	Energy resolution (%) FPGA-based PHA (This work)	Energy resolution (%) EASY-MCA 2K, AMETEK Inc. [3]
Na-22	511	10.4 ± 0.1	10.4 ± 0.1
	1274	7,0 ± 0.1	6.8 ± 0.1
Co-60	1173	6.9 ± 0.1	7.1 ± 0.1
	1332	6.6 ± 0.1	6.7 ± 0.1

Conclusions

- The system's automation potential, incorporating angular rotation via a step motor, coincidence counting, and spectrum saving, is demonstrated.
- FPGA-based PHA for NaI(Tl) detector exhibits commendable performance in comparison to the commercial EASY-MCA 2K from AMETEK Inc.

References

[1] NI MyRIO-1900, National Instruments Corp., [Online] https://www.ni.com/
[2] NI LabVIEW software, National Instruments Corp., [Online] http://www.ni.com/labview/
[3] EASY-MCA 2K, AMETEK Inc., [Online] https://www.ortec-online.com/

Acknowledge

We thank Prof. Masaharu Nomachi, Osaka University, Japan in supporting CsI(Tl) scintillator detectors. Gratitude is also expressed to Dr. Martin Grossmann Handschin of the Paul Scherrer Institute, Switzerland, for Na-22 source.

This work was funded by Vietnam National University, Ho Chi Minh City under Grant number B2022-18-01