Testing setup of IntPixel hybrid X-ray detector with on-chip and in-pixel artificial neural network

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ABSTRACT

We present a testing setup for a hybrid pixel array (HPAD) radiation detector with an on-chip and in-pixel Artificial Neural Network (ANN). The setup takes advantage of the IC design, which supports testing of it's individual blocks, and allows for full characterization of the IC as well as facilitates training of per-pixel ANN.

The setup is dedicated to testing of an "IntPixel" detector [1], [2]. The IntPixel integrated circuit (IC) was designed at AGH University of Krakow as a matrix of 8 x 8 square-shaped pixels, each 200 μm pitch. In every pixel, there is a charge-sensitive amplifier followed by a shaper, an analog-to-digital converter, and ANN.

The presented system design emphasize focusing on device-under-test rather than embedded system design itself. It consists of NI sbRIO 9609, an embedded and commercially available controller incorporated with an FPGA and microcontroller. It is connected to the power and bias distribution board, that also hosts a small daugherboard with the IntPixel ASIC. Along with basic IO operations, presented system provides fast data analysis and high data throughout. The testing IC is packaged and uses a socket allowing for quick exchange of individual units. We present details of our platform allowing for full characterization of all the IC's components including charge amplifier, ADC, discriminator and an ANN.

REFERENCES

[1]   A. Koziol *et al.*, "Semiconductor sensor readout integrated circuit with in-pixel artificial neural network for pulse amplitude measurement", IEEE Nuclear Science Symposium, Vancouver, Canada, 2023

[2]   A. Koziol *et al.*, "Artificial neural network on-chip and in-pixel implementation towards pulse amplitude measurement," *J. Instrum.*, vol. 18, no. 2, 2023, doi: 10.1088/1748-0221/18/02/C02048.