Digital System for Signal Processing from a Position-Sensitive Detector Based on a Digitizer with Open FPGA

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Signal preprocessing plays an important role in the interpretation of experimental data obtained with different types of neutron detectors. Since in most experiments information is collected digitally, FPGAs are increasingly used for signal processing as part of the data acquisition system. For this purpose, it is convenient to use a digitizer, an electronic device that continuously receives analog pulses passing through an analog input signal conditioning stage, performs analog-to-digital conversion using fast ADCs, and stores the digitized samples as event data in digital memory, from which they can be read by a host computer via fast communication interfaces (USB, VMEbus, Optical Link, Ethernet). To accelerate and facilitate the development of firmware for such devices, Nuclear Instruments in cooperation with CAEN has developed Sci-Compiler software, which instead of standard VHDL/Verilog programming languages uses a set of ready-made libraries for further code generation.

The main stages of creating custom firmware for a digitizer with Open FPGA are presented. The algorithms of high-level IP library blocks are discussed in detail and three methods of signal processing of a gas one-dimensional position-sensitive detector with a resistive filament are compared. Figure 1 shows the main blocks of the project comparing the three methods - QDC, MCA HP and PSD. The first results obtained using a neutron source are also presented.

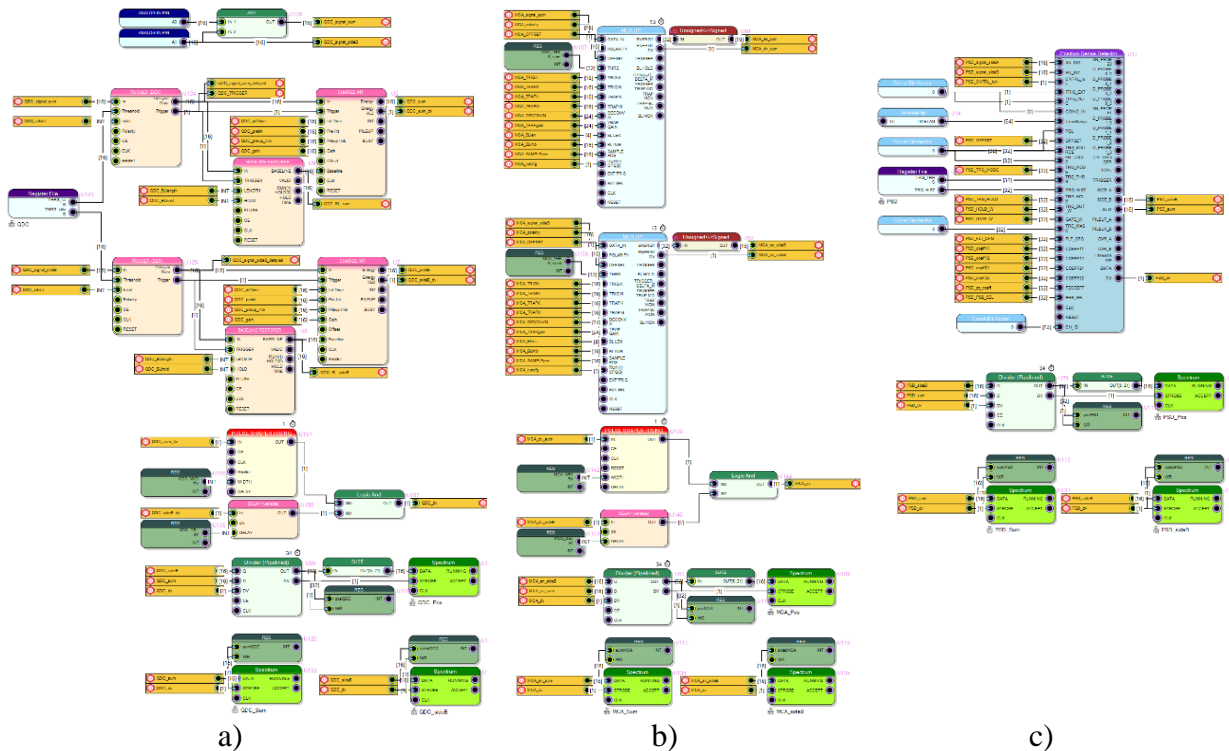a)   b)   c)

Figure 1: Graphical diagram of the three detector data processing methods in the Sci-Compiler project a) QDC, b) MCA HP and c) PSD.