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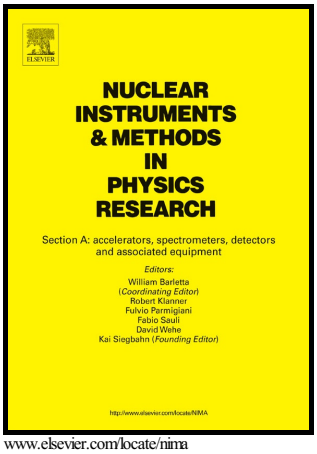

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Experimental validation of improved 3D SBP positioning algorithm in PET applications using UW Phase II Board

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Abstract

Continuous scintillator-based detectors have been considered as a competitive and cheaper approach than highly pixelated discrete crystal positron emission tomography (PET) detectors, despite the need for algorithms to estimate 3D gamma interaction position. In this work, we report on the implementation of a positioning algorithm to estimate the 3D interaction position in a continuous crystal PET detector using a Field Programmable Gate Array (FPGA). The evaluated method is the Statistics-Based Processing (SBP) technique that requires light response function and event position characterization. An algorithm has been implemented using the Verilog language and evaluated using a data acquisition board that contains an Altera Stratix III FPGA. The 3D SBP algorithm was previously successfully implemented on a Stratix II FPGA using simulated data and a different module design. In this work, improvements were made to the FPGA coding of the 3D positioning algorithm, reducing the total memory usage to around 34%. Further the algorithm was evaluated using experimental data from a continuous miniature crystal element (cMiCE) detector module. Using our new implementation, average FWHM (Full Width at Half Maximum) for the whole block is 1.71 $\pm$ 1 mm, 1.70 $\pm$ 1 mm and 1.632 $\pm$ 5 mm for x, y and z directions, respectively. Using a pipelined architecture, the FPGA is able to process 245,000 events per second for interactions inside of the central area of the detector that represents 64% of the total block area. The weighted average of the event rate by regional area (corner, border and central regions) is