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OpenCL implementation of an adaptive disruption predictor based on a probabilistic Venn classifier

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The ability and flexibility of the Open Computing Language (OpenCL) for task parallelization in heterogeneous computing platforms (FPGA, CPU, GPU) represent a remarkable advantage when designing advanced data acquisition and processing systems. This work shows a specific implementation of an adaptive probabilistic disruption predictor for fusion devices. This implementation uses OpenCL as base technology for the design cycle. The system was realized in two different platforms. The first one is an FPGA-based architecture that comprises a Cyclone V SoC in a DE1SoC development board. The second one is a GPU-based architecture that contains an AMDFireProW4300 inserted into a computer running Scientific Linux as Operating System. This contribution presents the methodology, the hardware/software system architecture, and the implementation results in both hardware platforms. The work is focused on the critical aspects involved in the design of these intelligent data acquisition and processing systems with OpenCL. When dealing with this technology, it is essential to be aware of aspects such as the significant differences in the design flow concept between FPGA and GPU implementations, or how to select the part of the algorithm that is better to be executed in each platform, which is not an easy task. The work addresses aspects such as how to optimize the pipelines in the FPGA implementation or how to arrange the work items in the GPU implementation to obtain the best performance. The test results show that it is possible to achieve prediction times shorter than 500 us with both solutions.

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