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Image acquisition and GPU processing application using IRIO technology and FlexRIO devices

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The large amount of data generated by image diagnostics used in big physics experiments requires an efficient use of hardware technologies in real time data acquisition and processing applications. In order to get the best performance of the hardware, it is necessary to provide the hardware and software tools that enable a fast and easy way to deployment these kind of solutions. IRIO technology allows an easy development of advanced data acquisition applications and their integration in EPICS using National Instruments Reconfigurable Input/Output (RIO) FPGA-based cards. Using IRIO software tools, it is possible to minimize the development time to build specific application for different hardware configurations. IRIO uses the open source version of NI-RIO Linux device driver supporting direct DMA access from FlexRIO devices to NVIDIA GPUs. For the development of image processing applications the hardware platform selected has been implemented using a FlexRIO device with a cameralink adapter module and a NVIDIA Kepler architecture GPU. With the help of IRIO tools the user have to focus the development exclusively in the implementation of the FPGA application for the FlexRIO device using LabVIEW/FPGA and the GPU algorithm using NVIDIA CUDA tools. Additionally IRIO provides the EPICS integration for these applications using the software model developed by ITER and Cosylab that simplifies the development of EPICS device support by mean of Nominal Device Support approach. This is a set of libraries with C++ classes simplifying the development of these device supports.
To demonstrate the full development cycle an algorithm for image compression based on JPEG2000 standard has been evaluated and tested using a hardware configuration with the same elements defined in the ITER fast controllers hardware catalog. This image standard allows high compression ratios, with or without losses, and can include additional metadata information related to the image. In addition, it allows to define regions of interest (ROI) in which it is possible to work with the maximum detail and execute a specific processing algorithm. All these arguments makes this standard a very interesting option for image-based diagnostic in physics experiments. These software tools has been tested in ITER CCS (Codac Core System).

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