GI-MS46-P05 | AZIMUTHAL INTEGRATION AND CRYSTALLOGRAPHIC ALGORITHMS ON MALLEABLE HARDWARE

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Field-programmable gate arrays (FPGAs) present a sort of malleable computer hardware that is nowadays extensively used for readout of fast X-ray cameras or real-time applications controlling experiments. Contrary crystallographic analysis and data reduction codes on FPGAs are not common. Within this work the azimuthal integration (AZINT) of 2D-detector data for powder diffraction and small angle scattering is implemented on FPGAs. The project demonstrates possibilities of this type of compute accelerators for data analysis in crystallography and other photon or neutron sciences. Possible future applications include frame filtering, spot finding or diffraction features classification with machine learning. Contrary to existing solutions the FPGA implementation allows all the tasks of receiving and decoding the image stream and the AZINT computation itself to be handled on a single chip with fixed and low latency. The integrated patterns can be fitted in other parts of the configurable pipeline and provide a real-time feedback to the experiment. The solution can be integrated with compute infrastructures at large scale facilities or as a compact embedded device it can increase handling data capabilities from high throughput detectors in any lab. Azimuthal integration represents the first demonstration case of a project which aims for making FPGAs easily available for scientists with use of industrial standards as OpenCL as well as with free and open-source numeric algebra toolbox based on synchronous message exchange (SME). Initial benchmarks show that SME based implementation of a histogram computation, which is a basis for AZINT, can process 600 Gb/s of uncompressed data stream.