Real-Time Processing of pnCCD Images Using GPUs

F. Alghabi[1], U. Schipper[1], S. Send[2], A. Abboud[2], N. Pashniak[2], U. Pietsch[2] and A. Kolb[1]

[1] Institute for Vision and Graphics, University of Siegen
[2] Solid State Physics, University of Siegen

E-mail: farhoosh.alghabi@uni-siegen.de

Development of new detector concepts for applications with synchrotron radiation is highly demanding. One of these new concepts is the pnCCD which is an energy-dispersive CCD with fast read-out. However, the increase of dimensionality and the high acquisition rate of the detector, yielding a large amount of data, require new concepts for data processing. In recent years, the area of high-performance computing has witnessed a significant increase in the computational power delivered to the user. This has been realized through the use of massively parallel processors bundled in today many-core GPUs. Notably, the field of image processing, i.e. processing of sequences of image-like data, has proven to be very adequate for GPU processing due to its parallel nature.

In our work we designed and implemented a software framework which utilizes multiple GPUs for processing pnCCD sensor data. The long-term goal is to achieve data processing and visual analysis in near real-time, i.e. close to the acquisition rates of the pnCCD sensor. The major characteristics of the framework include automatic load distribution and user friendly parallelization with good scalability. Recently, we have focused on the integration of processing modules for the correction of the pnCCD images [1] into our framework. In the very close future, we will integrate further processing modules for the online analysis of pnCCD sensor data.

The correction implemented here consists of four consecutive steps. First, dark-frame correction is applied. Then ‘zero’ pixels are eliminated. This is followed by gain correction and finally CTE correction is applied. The images are uncompressed and each one is comprised of 128 by 128 2-byte pixels. The experiments are carried out on a workstation equipped with 4 NVIDIA Tesla C2050 GPUs. In the experiments each pnCCD image is corrected in an average period of 0.146 ms by our framework. The required time increases to an average of 0.476 ms for each image when they are transferred over Gigabit Ethernet.

References

[1] R. Andritschke, G. Hartner, R. Hartmann, N. Meidinger, L. Strüder, "Data Analysis for Characterizing pnCCDs", In Proc. of Nuclear Science Symposium Conference, pp. 2166-2172, 2008.