A GPU-based Architecture for Real-Time Data Assessment at Synchrotron Experiments

S. Chilingaryan[1], M. Caselle[1], T. Farago[1], A. Kopmann[1], A. Mirone[2], T. dos Santos Rolo[1], U. Stevanovic[1], M. Vogelgesang[1]

[1]Karlsruhe Institute of Technology, Karlsruhe, Germany
[2] European Synchrotron Radiation Facility, Grenoble, France
E-mail: andreas.kopmann@kit.edu

X-ray tomography has been proven to be a valuable tool for understanding internal, otherwise invisible, mechanisms in biology, materials research and other fields. Detectors employed at modern synchrotrons are able to deliver images with high resolution and at high frame rates, generating up to several gigabytes per second. The ability to process this information in real-time and present to the users without long processing delays is extremely important for synchrotron operation. It will increase experiment throughput and enable image-based control of dynamical processes under study. We have developed a GPU-based platform for high-speed tomography optimized for continuous operation with streamed data [1]. Our system consists of a dedicated hardware platform, camera abstraction layer, pipelined parallel programming framework [2], and a high-speed implementation of tomographic reconstruction. Using only a single GPU server we are able to handle the full throughput of the CameraLink interface with 850 MB/s.

References

[1] S. Chilingaryan, A. Mirone, A. Hammersley, C. Ferrero, L. Helfen, A. Kopmann, T. dos Santos Rolo, P. Vagovic, A GPU-Based Architecture for Real-Time Data Assessment at Synchrotron Experiments, IEEE Trans. Nuclear Science, 58, 4, 1447-1455 (2011) doi: 10.1109/TNS.2011.2141686.

[2] M. Vogelgesang, T. dos Santos Rolo, S. Chilingaryan, A. Kopmann, UFO: A Scalable GPU-based Image Processing Framework for On-line Monitoring, IEEE 14th International Conference on High Performance Computing and Communication & 2012 IEEE 9th International Conference on Embedded Software and Systems (HPCC-ICESS), 824-829 (2012) doi: 10.1109/HPCC.2012.116