Fast processing of Jungfrau detector data

Jonas Schenke[1,2], Florian Warg[1,2], Anna Bergamaschi[3], Martin Brückner[3],
Michael Bussmann[1], Carlos Lopez-Cuenza[3], Aldo Mozzanica[3],
Sophie Redford[3], Bernd Schmitt[3], Heide Meißner[1]

[1]*HZDR*
[2]*TU Dresden*
[3]*PSI*

Abstract
...text...

Keywords: Photon pixel detector, fast data processing, GPU programming, Alpaka...

1 Introduction

Increasing data rates during FEL experiments require dedicated detectors as well as advanced methods for fast data processing

Jungfrau detector ([2], [3], [4]): pixel detector with gain switching scheme for large range of photon rates (single pixel to photon bunches)

online data conversion: calculate energy and number of photons from detector response for each pixel using continuously updated pedestal maps

Find clusters

Hardware-independent computation

Different numbers of modules, parallel processing

GPU / Alpaka: [1]: portable, parallel and scalable code

Related work

...

In the following, we describe ....

2 Methods

2.1 Abilities and applications of the Jungfrau Detector (PSI)

...

2.2 Data processing algorithm (PSI)

conversion from detector data to energy and number of photons

summation of frames

clustering (reference?)

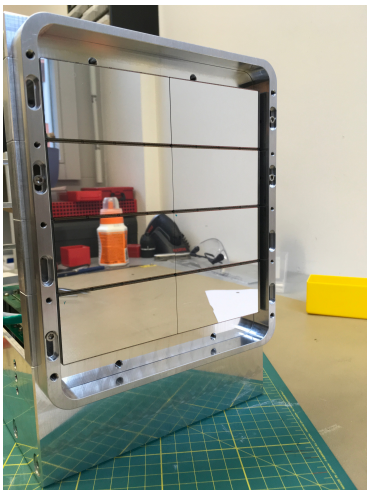

Figure 1: Jungfrau detector

2.3 Alpaka implementation of fast data processing (Jonas, Florian)

2.4 Benchmark tests (Jonas, Florian)

Design, objectives, and evaluation of tests

3 Results

3.1 Achieved improvements (Jonas)

Results of tests of software parts on various computing hardware using suitable Alpaka backends

Where are the bottlenecks

Available capacity on GPUs

Best system

3.2 Experiences from practical application of improved code (PSI)

Application results

4 Conclusions and Outlook

Is presented method applicable / useful for other detectors, e.g. AGIPD?

calculation on FPGAs in the future

5 Acknowledges

Thanks to Alpaka developers.....

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654220 (EUCALL).

References

[1] A. Matthes et al. “Tuning and Optimization for a Variety of Many-Core Architectures Without Changing a Single Line of Implementation Code Using the Alpaka Library”. In: *High Performance Computing*. Ed. by Julian M. Kunkel et al. Cham: Springer International Publishing, 2017, pp. 496–514. ISBN: 978-3-319-67630-2.

[2] A. Mozzanica et al. “The JUNGFRAU Detector for Applications at Synchrotron Light Sources and XFELs”. In: *Synchrotron Radiation News* 31.6 (2018), pp. 16–20.

[3] S. Redford et al. “First full dynamic range calibration of the JUNGFRAU photon detector”. In: *Journal of Instrumentation* 13.01 (2018), pp. C01027–C01027.

[4] S. Redford et al. “Operation and performance of the JUNGFRAU photon detector during first FEL and synchrotron experiments”. In: *Journal of Instrumentation* 13.11 (2018), pp. C11006–C11006.