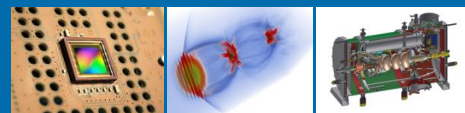


The Common Data Acquisition Platform in the Helmholtz Association

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Various German Helmholtz centers started in 2014 to develop a **modular data acquisition platform**. This platform integrates generic hardware components like the multi-purpose HGF-AMC Hardware or the UFO smart camera framework, adding user value with Linux drivers and board support packages. Technically the scope comprises **FPGA-modules, frontend-electronics-interfaces, FPGA-microcontrollers plus software and high-performance data transmission** to computing servers. The core idea is a generic and component-based approach, satisfying specific requirements of different experiments.

Adopting New Crate Standards

The HGF-AMC is an example of a versatile MTCA.4 FPGA board.

Features:

- Powerful digital processing
- Interface experiment-specific inputs via rear transition module (analog, ...)
- 4x 10 Gbit/s Ethernet readout links

Applications:

- Dark matter searches
- Ultrasound computer tomography

Custom Analog Front-end

Analog electronics often defines the quality of the system. Interface to standard and non-standard electronics (high-frequencies, low noise, extreme ambient conditions, ...)

UFO – A Smart Camera Platform

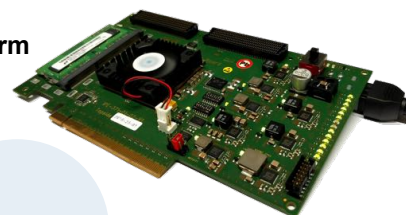
Toolbox to turn custom detectors in scientific cameras.

Features:

- Compact readout board
- FMC front-end interface
- PCIe link with up to 6GB/s throughput

Applications:

- Phase-Contrast-Tomography



"High-Flex" readout board



Smart camera for phase contrast X-ray tomography by Helmholtz-Zentrum Geesthacht and KIT.

Results

- Shorter development times for DAQ systems
- Maintenance and quality improves
- Double work is avoided

Example:

KALYPSO, a system using electro-optical modulation for monitoring of electron beams with **femto-second** time resolution.

Modules used:

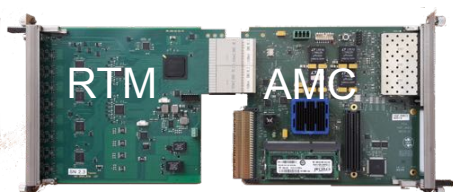
- Custom front-end board
- UFO smart camera platform
- Online data evaluation by GPU

Effort: only about 1-2 FTE in ~1 year

In operation at 3 facilities: KIT, HZDR, DESY



Analog front-end for KALYPSO with a 256 pixel line sensor.



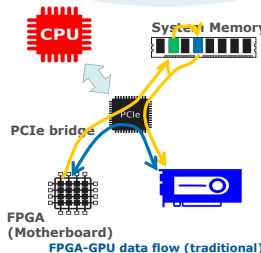
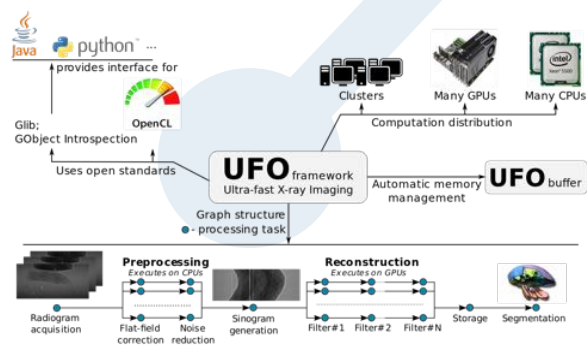
HGF-AMC and rear module for EDELWEISS

Rapid Development of FPGA and Microprocessor Firmware

To cope with complex technologies libraries, building blocks and reference designs for common platforms enable re-use and reduce the required effort.

Integration of "GPU Computing"

Integration of powerful parallel processing hardware is essential for modern DAQ systems. GPUs are rather compact and offer enormous performance that can be used for scientific computing. The UFO parallel processing framework simplifies programming and re-use of algorithms.



Example of fast communication by GPUdirect.

Transfer of "Big Data"

High-throughput readout links are essential for heterogeneous FPGA-GPU systems.

Protocols and technologies:

- Ethernet
- PCI Express
- Infiniband
- RDMA (e.g. GPUdirect)
- ...

Partners in the Helmholtz Programme "Matter and Technologies":

