LIMA: Library for Image Acquisition
A worldwide Project for 2D detector Control

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Introduction

Goals:
- Provide common user functionality
- Separate hardware control from software tasks
- High throughput detectors
- Exploit hardware optimisations (Bin, RoI, Video)
- Software alternative when missing in hardware
- Fully multithreaded processing, event-based

LIMA:
- Library for IMage Acquisition
- Control system independent
- C++ & Python (2 and 3) , Linux & Windows 32/64

Current context:
- In production since 2010
- World-wide collaboration:
  - Synchrotrons, large facilities, R&D institutes
  - Detector manufacturers and support enterprises

General LIMA Layout

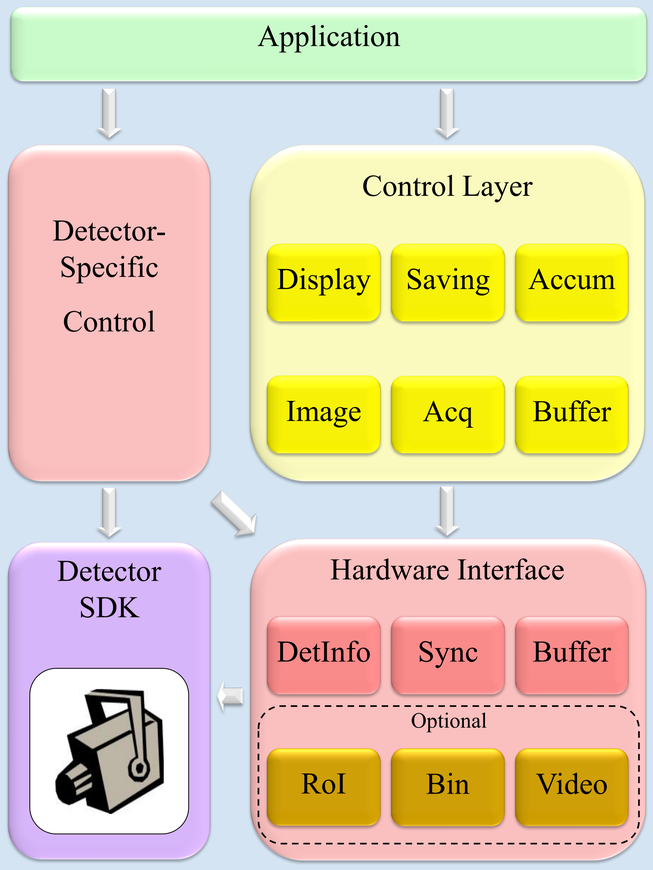
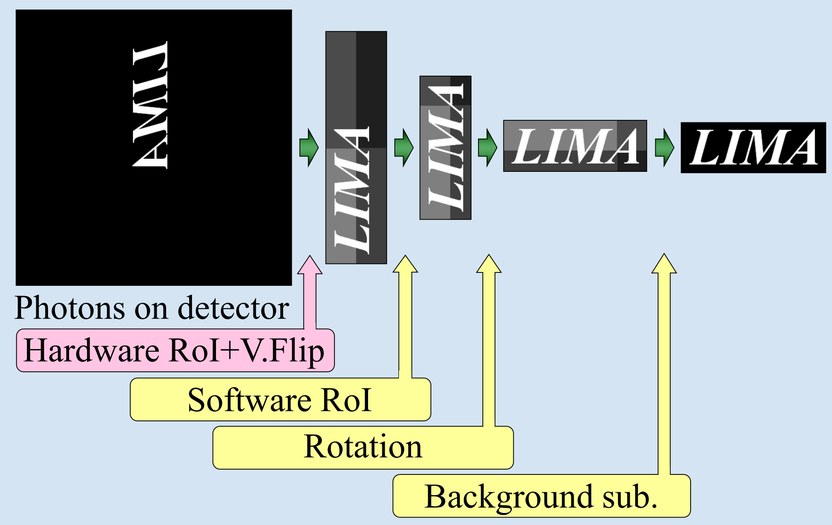


Image processing

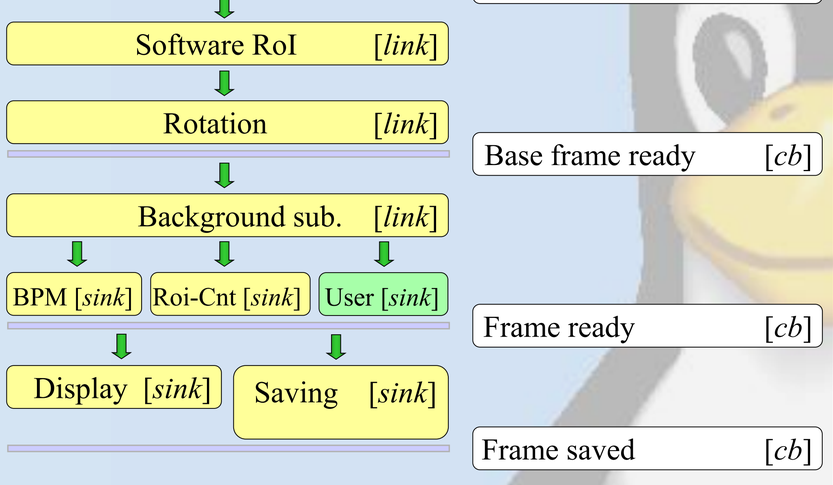
Geometric transformations
- Frame reconstruction
- Stripe concatenation
- Rotation, Flipping, Binning, Region-of-Interest

Basic Image processing
- Frame accumulation
- Background subtraction, flat-field correction



ProcessLib

Multi-threaded image processing framework:
- Pool of working threads: as many as # of CPU/cores
- Task execution end ⇨Notification callback [cb]
- *Link* tasks (sequential) & *Sink* tasks (parallel)
- User-defined tasks can be added to the chain



Supported Detectors

- ESRF Frelon & Maxipix
- Dectris Pilatus2&3, Eiger
- GigE: Basler, PointGrey, Prosilica, Ueye
- Rayonix, ADSC, MarCCD
- STFC: Hexitec, Ultra, Xh, Xspress3, Merlin
- PCO.Dmax, Edge, 2K, 4K
- Andor I-Kon, Zyla, Neo
- Hamamatsu Orca
- v4l2
- PerkinElmer, Dexela
- PSI Detector: Eiger 2M & 500K
- Lima Meta camera (4x Maxipix)
- Aviex, Pixirad, imXPAD

New Features

Hardware Layer:
- Native hardware Saving
- Reconstruction Capability
- Video enhancements

Control Layer:
- Configurations save/restore (libconfig, .ini file)
- RoI Counter :Arc-like shape integration
- Accumulation:
  - Saturation image mask (non-linearity detection)
  - Callback for over-exposure notification (EPS)
  - Offset subtraction for cumulative bckg correction
- Frame processing task in pure Python allowed
- New Peak-Finder task added
- Data Saving:
- Formats : HDF5, EDFconcat, EDFGZ, EDFLZ4
- Parallel frame saving: cope with // FS like GPFS

High Level Interface:
- Tango server emits events on image counters
- Python 3.6 and PyTango 9 compliant

Visualisation:
- Lima-GUI: local control or Tango server
- AtkPanel API via LiveViewer device

Roadmap

Visualisation:
- Flexible GUI layouts with Silx framework

High-performance Acquisitions:
- Global memory buffer management
  - Control both hardware and processing allocation
  - De-couple hardware and processing dynamics
- Include branches in frame processing chain
- Common API for different saving streams
- Multi-backend computer support
  - Each PC receives a full frame (frame dispatch)
  - Each PC receives all frames from a detector module (module dispatch)

Challenges

Saving:
- Increase in generated data bandwidth:
  - PCO Edge: 1 GByte/s
  - Dectris Pilatus 3 2M, PSI Eiger 500k: 2 GByte/s
  - Dectris Eiger 4M: 4 GByte/s
  - PSI Eiger 2M: 8 GByte/s
- GPFS over 10 Gbit/s Ethernet link: 1 GByte/s
  - Pilatus 3 2M: compression 2-3x ⇨ 700 MByte/s
- Central/shared server performance is not sustained when several BLs save data at maximum speed

Computing Performance:
- Backend computer requirements: CPU, RAM & I/O
- BIOS & OS tuning

Long-term Stability:
- CMake: platform versatility: Windows & Linux
- Continuous Integration: Travis-CI & Appveyor

Packing and Deployment:
- **BLISS**: Conda + Ansible + Supervisor

Conclusions

LIMA keeps its role controlling 2D detectors:
- In production since 2010
- New features added and new detectors integrated
- Active collaboration among synchrotrons, large facilities and detector manufacturers
- Roadmap envisage next generation of 2D detector control

Acknowledgements

Some hardware plug-ins have been contributed by F. Langlois, A. Noureddine, S. Cohen and X. Elattaoui from SOLEIL Synchrotron inside a collaboration framework on LIMA development. In the same way, G. Mant (STFC), M. T. Nuñez-Pardo-de-Vera (DESY) M. Blum (Rayonix), A. Parenti (XFEL), A. Lenz (FRM2), G. Jover(ALBA) have contributed in improving the library.