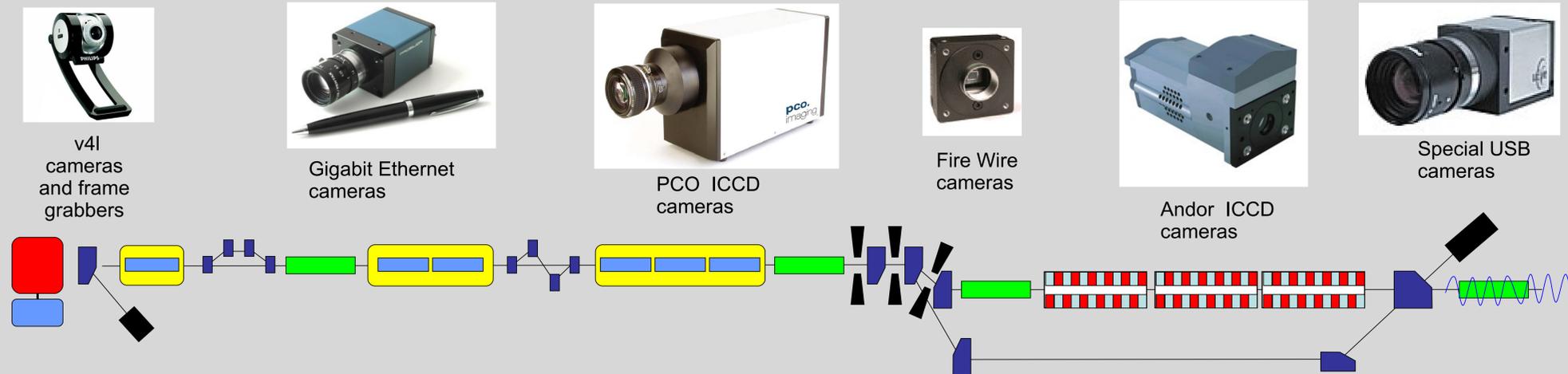


## Abstract

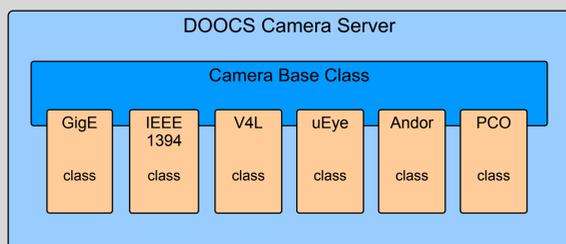
The Free Electron Laser in Hamburg (FLASH) [1] with its complex accelerator diagnostics and user experiments requires for both, the operation and the experiments, a lot of different cameras. A common interface for simple USB cameras, for fire wire cameras and for high resolution cameras with e.g. multiple "region of interest" was developed. This system integrates the various camera types in a transparent way into the FLASH control system DOOCS [2]. In addition the cameras are connected to a fast data acquisition system (DAQ) [3]. The DAQ provides the synchronization with other diagnostics data, online processing of the images and a long time archiving.

## Used Cameras at FLASH



## Introduction

The main design idea was to develop a common approach for different camera types and frame grabbers used in FLASH. A camera base class implements all common functions in C++. Any camera type or frame grabber has its own camera specific class which inherits from the base camera class. All camera common parameters (e.g. exposure, brightness, etc.) belong to the base class and therefore have the same DOOCS property name. The camera specific class for a particular camera type provides its additional features that do not exist in the base class.



- Calibrations, background subtraction, offsets
- Image pixel histogram calculation
- X & Y Spectra with calculations of
  - min, max, mean
  - sigma, centre of mass
 All values can be calculated in physical units.
- Software region of interest operations
  - three types of shape (ellipse, rectangle or cross)
  - rotated shapes
  - different visualisation modes
  - similar calculation as for X & Y spectra
- Software image flipping X/Y
- JPEG Images for presentation
- Central storage of all images via FLASH DAQ
- Hardware region of Interest, binning, loops,...

## Operating Example

UV Laser projection on a YAG crystal.  
The laser is used to release electrons out of the cathode at the FLASH gun.



## Camera PC



## Operating Experience

The first camera type was adopted in January 2006. Currently 6 different types of cameras and in total 60 cameras are in operation. The cameras are served by 16 camera servers running under Debian GNU/Linux [4] OS. Cameras and computers are sensible to radiation damage. Therefore the hardware is placed as far as possible away from the radiation source and is shielded with lead or concrete. The maximum cable length currently exploited for USB cameras with use of hubs is 17 meters, and for IEEE1394 cameras - 20 meters. We are forced to use remote controllable switches/hubs for the camera connections to be able to reset cameras by power cycling.

## References

- [1] Free Electron Laser in Hamburg <http://flash.desy.de/>
- [2] K. Rehlich et al, DOOCS: an Object Oriented Control System as the integrating part for the TTF Linac, Proceedings ICALEPCS '97, Beijing, China. Available: doocs.desy.de
- [3] K. Rehlich et al, DAQ: Multi-Processor based Fast Data Acquisition for a Free Electron Laser and Experiments, Proceedings of 15th IEEE NPSS Real Time Conference 2007, Fermilab, Batavia IL, USA
- [4] Debian GNU/Linux <http://www.debian.org/>