LCLS camera system

Upgrade proposal

Abstract

This is a design document for the camera system proposed for LCLS injector laser. The system consists of a Dell Linux server with up to 7 cameras. EPICS *areaDetector* support is used to control the cameras. Image acquisition, processing and data transfer as well as use of multiple cameras attached to the same host computer were studied at XTA. At first only the laser room cameras (3 in total) will be replaced. If the system proves itself, then also the cameras in the injector vault will be replaced (additional 3).

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Document Revision History

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1 INTRODUCTION

For the LCLS II a new camera system was proposed [RD1]. The system was successfully tested at XTA test facility.

Camera system uses gigE Prosilica cameras [RD2] and areaDetector [RD3] for software control. The system includes up to 7 cameras connected to the same server. All data processing is done on the server where different areaDetector plugins are used. The plugins enable full control of image acquisition and processing.

In the proposed setup, the system will be configured in the same way as the existing system, giving the same image size (659 x 493) and network traffic. Image saving to disk will be initially disabled. There will be no user interface allowing the users to change network traffic. The network traffic will even be reduced by using MPEG servers to compress the data streams.

1.1 References

[RD1]   areaDetector usability study.

[RD2]   Prosilica cameras.

[RD3]   areaDetector.

[RD4]   Ffmpeg areaDetector plugin.

2 COMPARISON TO THE EXISTING SOLUTION

Table 1: Comparison of the proposed and existing solution.

Function	Proposed solution	Existing
Max resolution	656x492 (12bit, 16bit data transfer)	648x484 (8bit)
Max frame rate	88 Hz@ full image size, 120 Hz@	120 Hz
Operation rate	10 Hz (5 Hz image transfer)	10 Hz
# cameras per server	7, if only acquiring data and frame loss around 1% is acceptable.	1 per CPU
ROI	ROI can be set in the camera and during processing.	Not available
Binning	Binning can be set in the camera and during processing	Not available
External/internal trigger	Free run, external trigger and fixed rate are supported.	External trigger only
Variable image frame rate	Any frame rate can be selected.	Not available
Variable processing frame rate	Processing rate for individual plugins can be specified.	There is no configurable processing.
Background subtraction	Image or constant background subtraction is supported.	Not available
Image analysis	Flat field normalization, scale and offset, Low/High clipping, recursive filter, statistics, average XY, centroid XY, cursor XY, threshold XY, histogram.	Not available
Configurable image analysis	Individual analysis functions can be turned on/off and update rate can be set.	Not available
Saving images	TIFF and JPEG	Not available
Monitoring tools	Asyn support with dropped frame monitoring	Not available
Support	Module used by many. Mark Rivers provides support in 24h.	

3 LCLS I LASER ROOM SETUP

In the LCLS injector laser room three cameras will be connected to one camera server. Their image size is 656x492, which is the same as in the original system. Since the cameras are 12 bit (16 bit transfer) not 8 bit as was the case in the original system, the image transfer rate should not exceed 5 Hz making the new system compliant with the existing network/computing infrastructure.

Since the image processing is done on the server, images can be acquired and processed at higher rates. This is important for feedback loops where averaging is used and higher sampling means a more responsive system.

The network traffic for displaying images can be reduced by a factor of 10 using the MPEG plugin (section **Error! Reference source not found.**). The image traffic can further be reduced by using ROI, binning, or owering JPEG quality. This additional functionality will be enabled in future upgrades.

At the moment there are no plans to save images to disk. If this is required, the same data traffic as for image viewing will be present. The functionality will not be enabled before it is cleared with the network/computing group.

In the testing phase, which will last approximately a month, all features will be available over the user interface to allow system tuning. After the test period the settings will be fixed and options will be removed from the user interface. At all times the network traffic will be kept at the same level as in the original system.