CUPID: New System for Scintillating Screen based Diagnostics

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Introduction

A new, fully FAIR-conformal system for standard scintillating screen based beam diagnostics was developed at GSI. To cover a wide range of foreseen applications, a new technical solution was required for diagnostics upgrade between the Experimental Storage Ring (ESR) and Cave A as a precursor to the upcoming FAIR High Energy Beam Transport lines. The newly developed system (Figure 1), including digital image acquisition, remote controllable optical system and mechanical design, was set up and commissioned without beam during the 2013 shut-down.

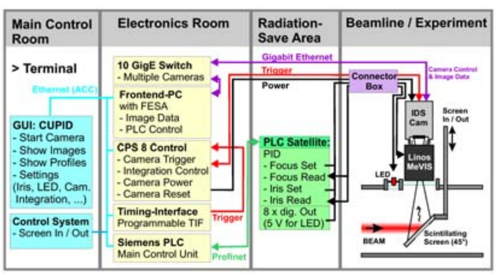

Figure 1: CUPID: overview of electronic devices and communication scheme.

CUPID System Layout

CUPID (Control Unit for Profile and Image Data) is based on the Front-End Software Architecture (FESA) [1] to control beam diagnostic devices. The FESA class for the digital GigE camera (IDS uEye UI-5240SE-M, radiation resistant CMOS type) acquires the images and preprocesses the optical data as required by the geometry of the setup (rotation, stretching). It calculates the projections and the intensity histogram and converts pixel number into a position in millimeters, which results in absolute beam position and width. The performance of the system reached more than 15 frames per second with one connected client. To avoid network overload, the front-end computer processing the camera images is equipped with two network cards: one for the standard accelerator network and one for the direct connection to the GigE cameras via a local 10 GBit network switch. If desired, the raw image data can be written to a file for offline analysis. Additionally, dedicated FESA classes access industrial Programmable Logic Controllers (PLCs) for a reliable slow control solution. A Siemens PLC (main unit and satellites) handles control of lens focus and iris motors (LINOS MeVis-Cm 16), read and set by a PID controller (FM355C). PLC digital outputs (SM322) switch the LED to illuminate the P43 target (ProxiVision) for calibration issues. Camera control, timing, as well as power supply and reset options for up to eight digital cameras are realized by the in-house developed Camera Power Supply controller CPS8.

Operating Features

The use of the FESA framework results in a clear separation between the data acquisition part and the graphical user interface (GUI) part. CUPID includes two parts: a) data acquisition and control using FESA and b) Java based analysis and display tools (see Figure 2). In the main control room, the user can select and start the camera in freerun or triggered mode, adjust the camera and iris settings as required for commissioning, alignment and transversal beam profile measurements. The GUI client displays the processed image, the horizontal and vertical intensity profiles as well as the intensity histogram. The display is automatically updated whenever the FESA class delivers new image data. If only profiles are needed, the image display can be disabled to reduce network load. CUPID is the first fully digital, FAIR control system compliant readout of scintillating screens for beam diagnostics.

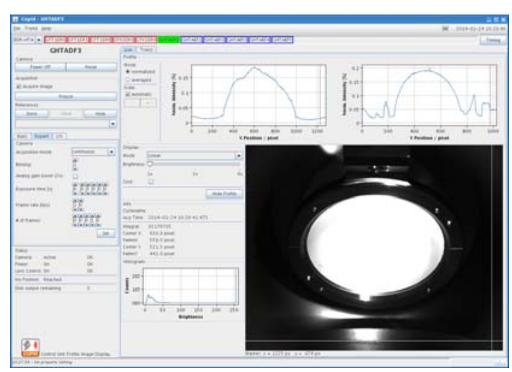

Figure 2: CUPID GUI with an image as well as horizontal and vertical profiles of a scintillating screen.

References

[1] R. Haseitl et al., “Development of FESA-based Data Acquisition and Control for FAIR”, DIPAC 2010