User Interfaces Development of Imaging Diagnostic Devices for the Taiwan Photon Source

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Abstract

The imaging diagnostics devices, includes screen monitor (SM), streak camera (SC), and intensified CCD (ICCD) are used and its user interfaces are plan to develop for the TPS project. Control of these applications is centered around EPICS IOC. The windows OS based system, such as SC and ICCD, are controlled respectively through the Matlab (combined with LabCA module) and LabVIEW (combined with DSC module) tools and share the data as EPICS PVs. The main user interfaces and data analysis are constructed by Matlab GUIDE toolbox.

Devices Control Framework

Screen Monitor/OTR

- For the TPS beam diagnostic application distributed in Linac, LTB, BTS, booster, and storage ring, the screen monitor is responsible for the beam profile acquisition from YAG:Ce/OTR screens and used to analysis to find the beam characteristic data.

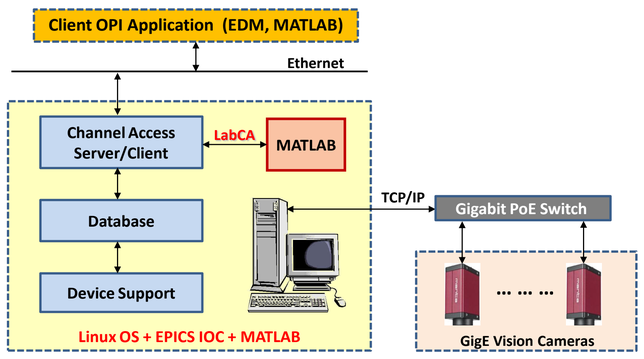

Fig 1 . Infrastructures for the screen monitor CCD camera.

- The optical system contains screen, lens, and lighting system. The PoE CCD camera with Gigabit Ethernet interface (GigE Vision) will be a standard image acquisition device. The CCD timing trigger clock is locked with TPS injection system, which is produced from a local timing IOC (EVR).
- The Linux OS plus EPICS IOC infrastructure is employed for the screen monitor CCD camera.

Intensified CCD

- An Intensified CCD camera (PI-MAX3 1024i) is used to make transverse measurements of the beam. The gate width of 0.2 ns allows a head-on image of a single bunch to be capture in order to analyse the shape and stability of the bunch structure of the beam.
- Since the intensified CCD camera is controlled through the LabVIEW under Windows OS, the LabVIEW Datalogging and Supervisory Control module [5] was used to create the PVs or communicate to PVs through the Server and Client I/O server functions.

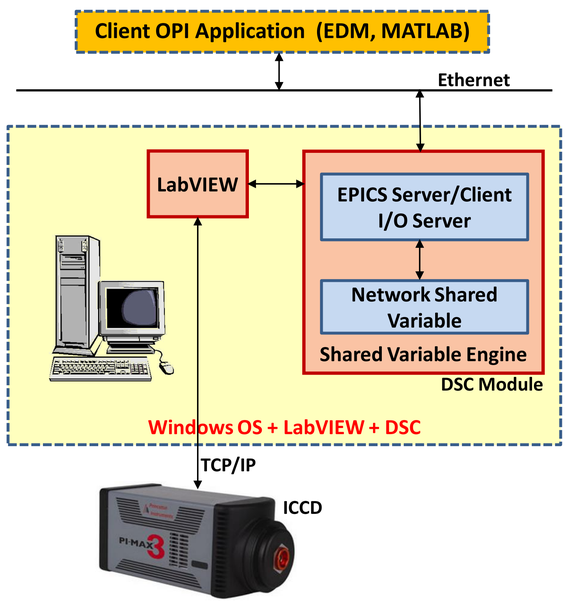

Fig 2 . Infrastructures for the Intensified CCD camera.

Streak Camera

- A new dual sweep streak camera (C10910) with one fast, one slow and two frequency of synchroscan sweep unit is used to perform temporal/longitudinal beam measurements at TPS.
- The beam motion in the longitudinal direction (phase information) could be observed by using the synchroscan unit (operate at 125/250 MHz).

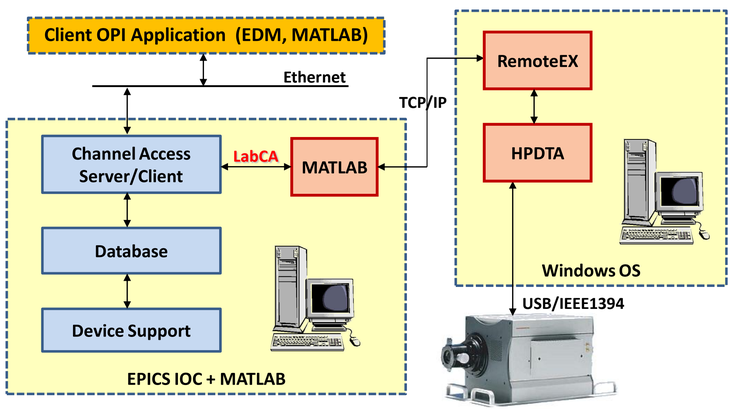

Fig 3 . Infrastructures for the streak camera.

- By using the fast single sweep unit triggered by the orbit clock, the single shot bunch length, which is the function of beam current, can be measured in picoseconds resolution.
- By using the slow sweep unit it is possible to look at the stability of the beam over several milliseconds. The dual time-based unit allow the streak camera to be operated in dual sweep mode.
- There are many other experiments that can be done such as bunch length measurements with different bunch current and RF gap voltage, synchrotron phase investigation, and instability observations, etc.

User Interfaces Development

EDM Camera Control Panel

- Based on the areaDetector module (R1-9-1) which provides a general-purpose interface for area (2-D) detectors in EPICS, it is easy to construct a camera control panel by using the EDM tool.
- The screen monitor user interfaces for the TPS Linac, LTB, BR, BTS, and SR are shown in right figure, which can switch in between in one GUI.
- The camera parameters of exposure time and gain can be configured in this panel, the camera location also shown below. The trigger mode selection include that the Free-Run for simply monitor the image and Sync-In for synchronization of linac injection (3 Hz).
- This EDM panel only offer lunch the screen, control the CCD parameters and simple monitoring features but do not perform any calculations. The image analysis work is mainly performed by using Matlab GUI as shown in the below section.

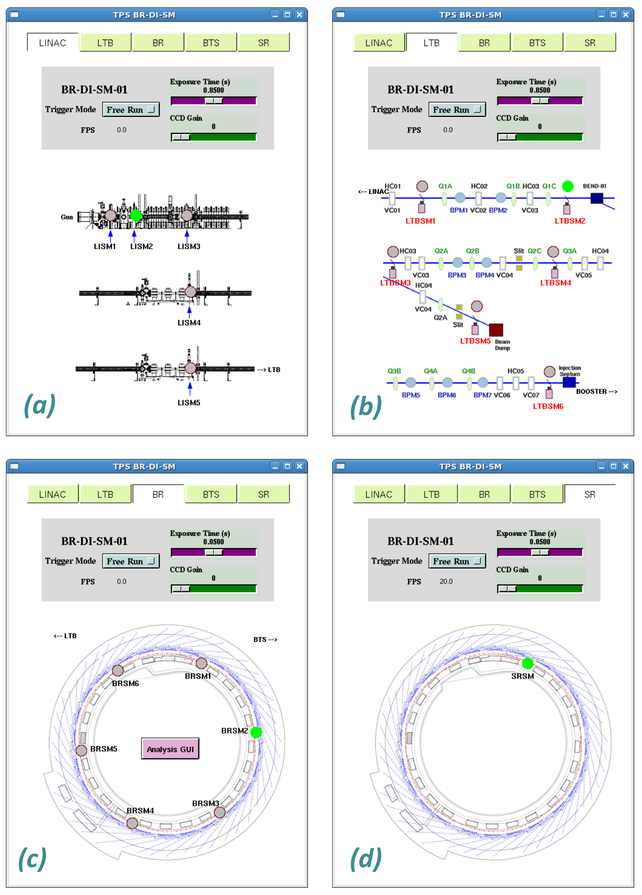

Fig 4 . The EDM camera control user interfaces for the screen monitor of (a) Linac, (b) LTB, (c) BR, and (d) SR. The top bar can switch in between in the five pages, and the cameras location shows in below.

Matlab GUI

- The image analysis work is mainly performed by using Matlab GUI. The GUI can run in multiple clients simultaneously and read the analysis results from EPICS IOC and display them in the window.
- The Matlab analysis program runs in IOC's PC as a background task which can do a complex analytical work to analyze the beam parameters. All the analyzed data will store into the EPICS IOC as PVs.

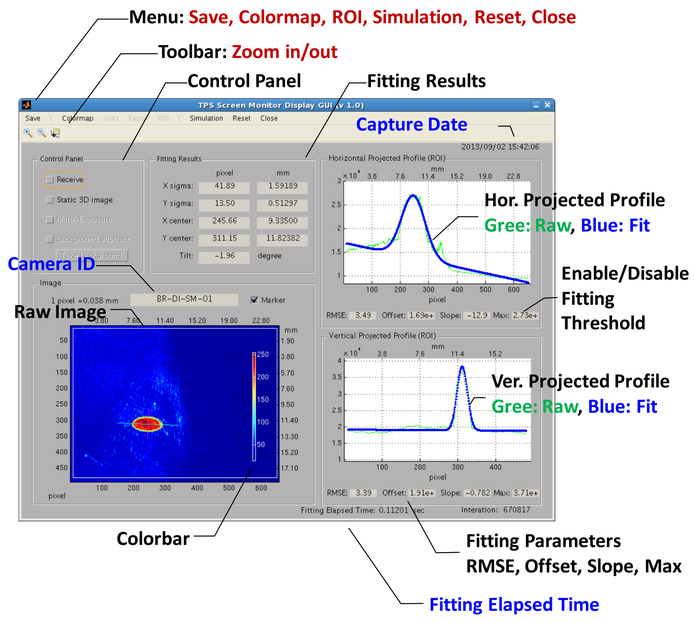

Fig 5. Matlab analysis display GUI for screen monitor.

Matlab Streak Image Data Analysis GUI (Offline)

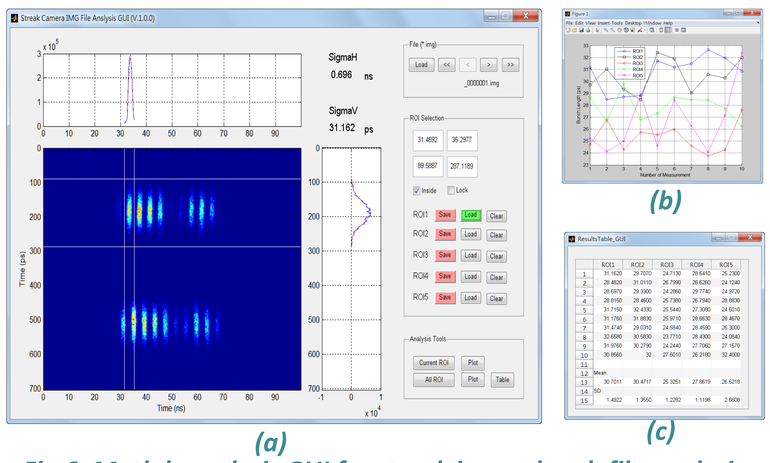

Fig 6. Matlab analysis GUI for streak image batch file analysis, (a) main page, (b) graph display, (c) table display.

- The offline streak image data analysis program was developed by the Matlab tool.
- Finding the bunch length for the specify ROI was implemented in this GUI, and the analysis results can be displayed in graph and table. It is helpful for batch file analysis.

LabVIEW GUI

- The LabVIEW GUI was developed for the gated ICCD control and display. It contained a EPICS IOC by using the LabVIEW Datalogging and Supervisory Control module which can create the PVs or communicate to PVs through the Server and Client I/O server functions.

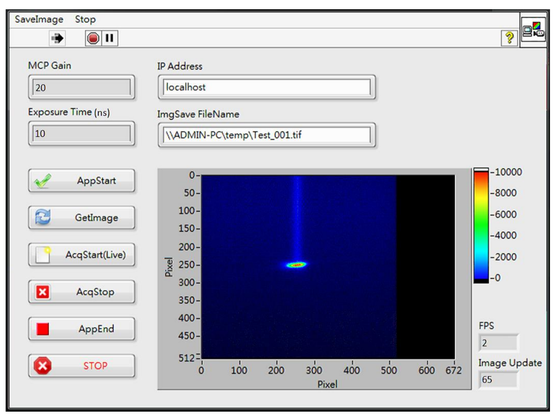

Fig 7. LabVIEW control/display GUI for ICCD.

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