# WDOOCS::FIREWIRE CAMERAS SUPPORT FOR DOOCS

V.Kocharyan, YerPhI, Yerevan, Armenia
K. Rehlich, DESY, Hamburg, Germany

## Abstract

The porting SUN RPC communication protocol to Windows based PCs permits data exchange between Windows and UNIX platforms [1]. Middle and low level Windows PC based servers at the TTF VUV-FEL control system as well as UNIX based DOOCS servers allow controlling different devices. Since the last year several image transfer devices like FireWire IEEE1394 and USB cameras have been integrated into the control system. All servers exploit WDOOCS server library. DOOCS Data Display (DDD) client tool has been extended by new image mapping classes. They support different image formats coming from image transfer DOOCS servers.

## INTRODUCTION

The Optical Diagnostic System on the TTF VUV-FEL consists of 30 Optical Transition Radiation stations along the linear accelerator providing beam profile, emittance and energy/energy spread measurement [2]. The ODC control system is based on Windows XP and developed with LabVIEW™, which has powerful image acquisition, processing and analysis library IMAQ. DOOCS image server has been embedded into LABVIEW VIs and provides image and data transmission over the network supporting the DOOCS communication protocol.

Since last year several experiments on the TTF VUV-FEL are equipped with FireWire CCD digital cameras that run a Windows operating system. WDOOCS based cameras server was written to integrate them into the
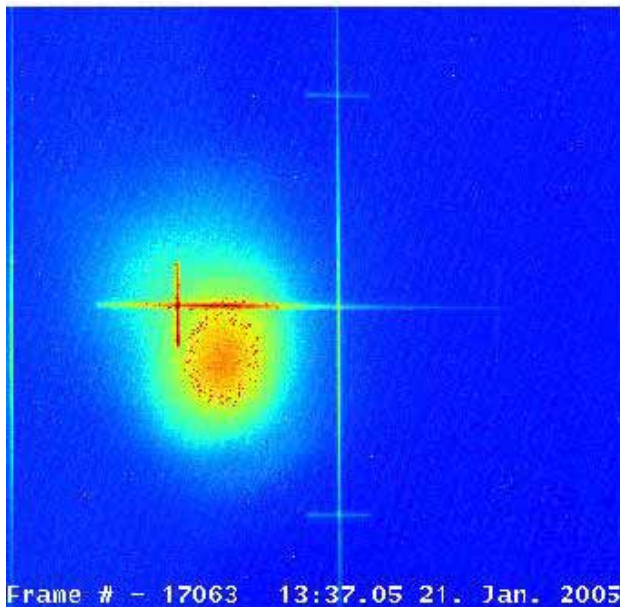
control system. The first photon beam 32nm wavelength of the SASE lasing has been recorded on Ce:Yag crystal by photon diagnostic camera. The photon beam image analysis was done by using the MATLAB external functions connection to the cameras server.

## DDD'S IMAGE CLASSES

The standard graphical editor DOOCS Data Display (DDD) [3] developed to display and control the TTF VUV-FEL equipment has been extended to allow the mapping of images. The image sources are different; they simply can be static or dynamic rewritable picture files (animation) or DOOCS image transfer servers. In the current implementation image mapping classes are provided to show RGB, B/W and TIFF uncompressed image formats as well as the JPEG format. Some of the image transfer servers make the JPEG compression before sending the image. On the other hand DDD simply allows creating TIFF, JPEG or PS format image files, sending DDD component snapshot to an e-logbook or a printer by a simple menu field select on mouse click. The grayscale images provide pseudo colour map. The DDD image mapping C++ classes exploited X library methods.
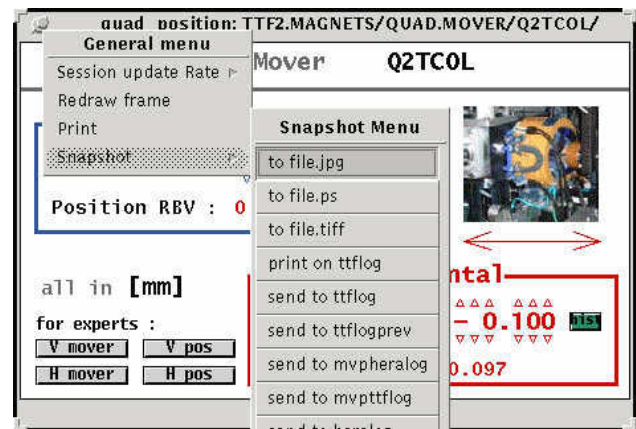


Figure 2: DDD component snapshot.

## LABVIEW IMAGE SERVER

The Optical Diagnostic Control System (ODCS) is INFN-LNF (Italy) [4] collaboration contribution for the VUV-FEL linear accelerator. It is based on LabVIEW™ and running on Windows XP Personal Computers. The interface with the DOOCS control system was accomplished via WDOOCS based server. The server has been implemented as a dynamic linked library that allows embedding it in a LabVIEW's vi. The server reads data structure (cluster) from the vi and transfers it to the corresponding DOOCS server properties. The read cluster



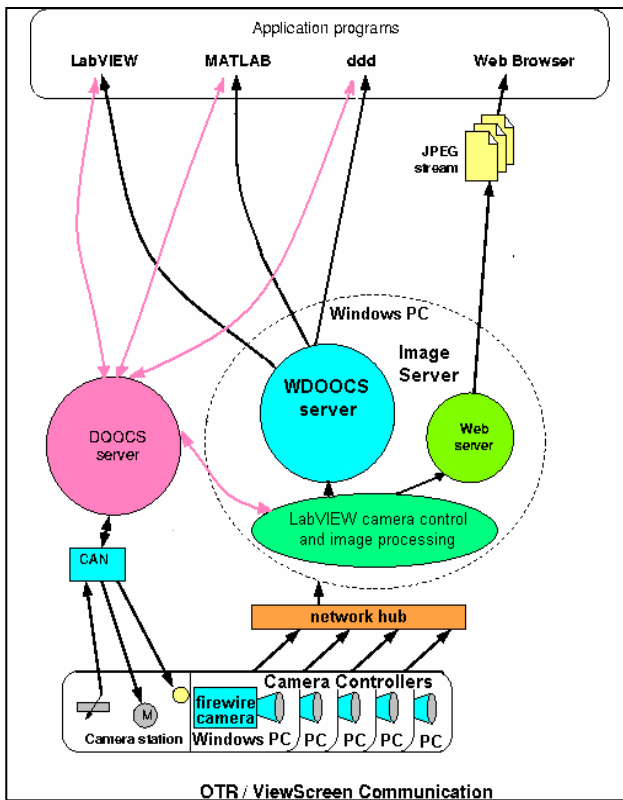Figure 1: The first SASE lasing photon beam image.

Figure 3: WDOOCS server location in ODCS.

includes images bitmap coming from active camera and stored background image. Additionally the server transmits the following information: optic setting, camera parameters (mode, shutter, brightness and gain), bunch profile and Gaussian profile values $\mu$ and $\sigma$.
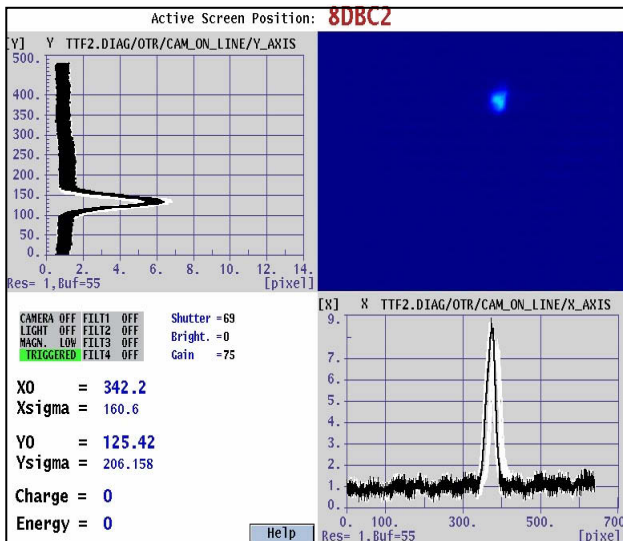


Figure 4: ODCS DDD component.

The possibility to change the ODCS settings over DOOCS connection will be done by LabVIEW mailbox writing and executing commands which will come from the server.

## FIREWIRE CAMERAS SERVER

The DOOCS cameras server employs the BASLER SDK library which easily allows setting camera parameters and acquiring images. The Basler BCAM 1394 Driver supports the DCAM standard and works with many other cameras that follow the IEEE1394 Trade Association's Digital Cameras Specification. It has been tested with Basler, iBoot, iWire, and Point Grey Research cameras. The DOOCS camera server is a multithreaded server and uses DCAM driver exception feature during the hardware access. In case of exception the server indicates an error in a corresponding property. The server provides images from several cameras simultaneously. Every camera is presented as a server location. The number of the cameras is configured by the DOOCS server's configuration file. The real number of camera locations depends on the number of actually connected ones, which is detected during the server initialization. All cameras are sorted by serial numbers independently of the used ports. The server update procedure is checking the connected cameras and reinitialized cameras after their on-the-fly reconnection. The server supports image transmission via net in three modes: grab, continuous shot and trigger. The server also provides a TCP channel for image transmission, which is configured by user (host name, port and transmission rate). This channel allows inserting images into DAQ data stream as well as into LABVIEW or MATLAB image processing software.
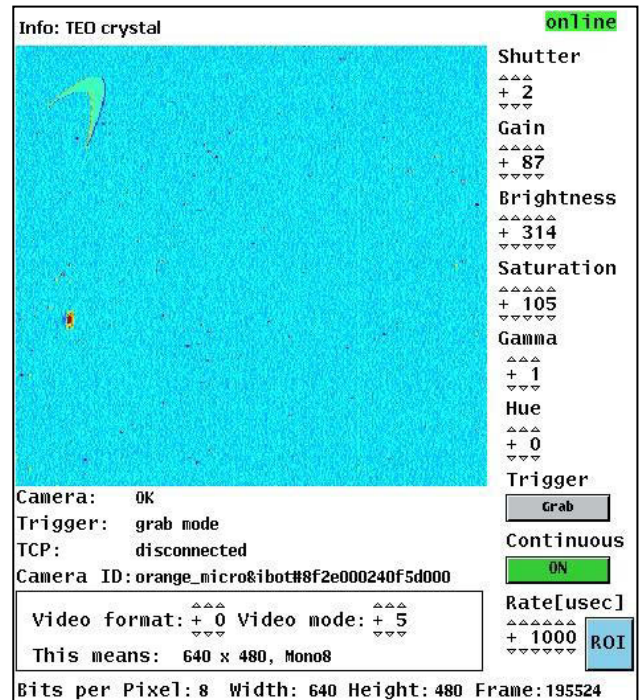


Figure 5: FireWire cameras server DDD component.

The DOOCS FireWire cameras server provides information about connected camera, allows to change video mode and video format, to adjust cameras settings like shutter, brightness, saturation, gain and gamma if

they are supported by a camera. Additionally the server transmits region of interest (ROI) of the image. The size
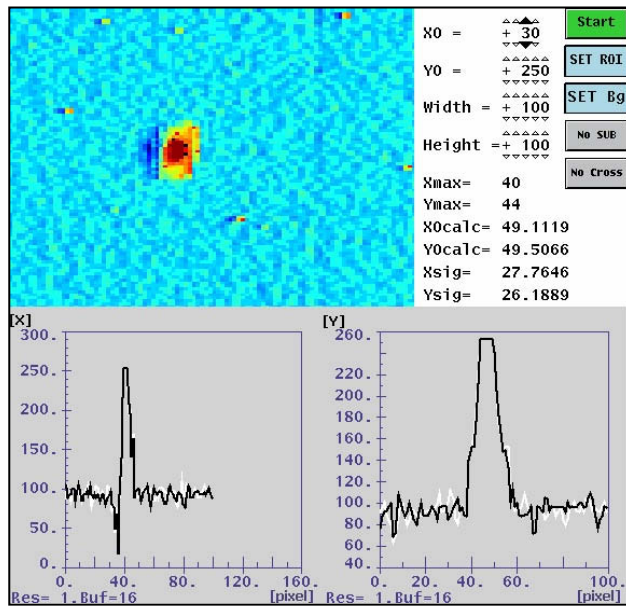


Figure 6: Image ROI DDD component.

of the image ROI can be selected by a user. The coordinate of the image core (first maximum value) are found within the ROI and can be shown (if desired) as a small cross in the image. Relative to this point simples calculations of centre of mass and RMS values for Gaussian profile are performed. The image denoise procedure is done by "setting some image as background–subtracting this background" algorithm. The image X and Y profiles are transmitted from the server.

## CONCLUSION

Since September 2004 the FireWire cameras servers are used for the following experiments:
1. Synchrotron radiation optical beam line.
2. TEO - Time Electro-Optics.
3. EOS Electro-Optic Samples.
4. Photon diagnostic.

The server installs in 2GHz PentiumIV compact industrial computer with the WindowsXP operating system. The image acquisition is synchronized by external trigger pulses from the linear accelerator timer system. The Basler 301f digital cameras hardware trigger port is connected with the timing unit. The FireWire Web cameras are applied in case when the synchronization isn't necessary. We are going to use MS DirectX SDK to increase the possible camera models.

## REFERENCES

[1] V.Kocharyan, K.Rehlich. "WDOOCS:: Porting DOOCS to Windows PC", PCaPAC 2005, Hayama, Japan.

[2] L.Catani, G.Di Pirro "A Beam Image Server for TTF2", PCaPAC 2002.

[3] K.Rehlich, "An Object-Oriented Data Display for the TESLA Test Facility", Proceedings ICALEPCS '97, Beijing China.

[4] L.Catani, et.al."A Large distributed digital camera system for accelerator beam diagnostics" , PCaPAC 2005, Hayama, Japan.