TINE Video System

Talk Overview

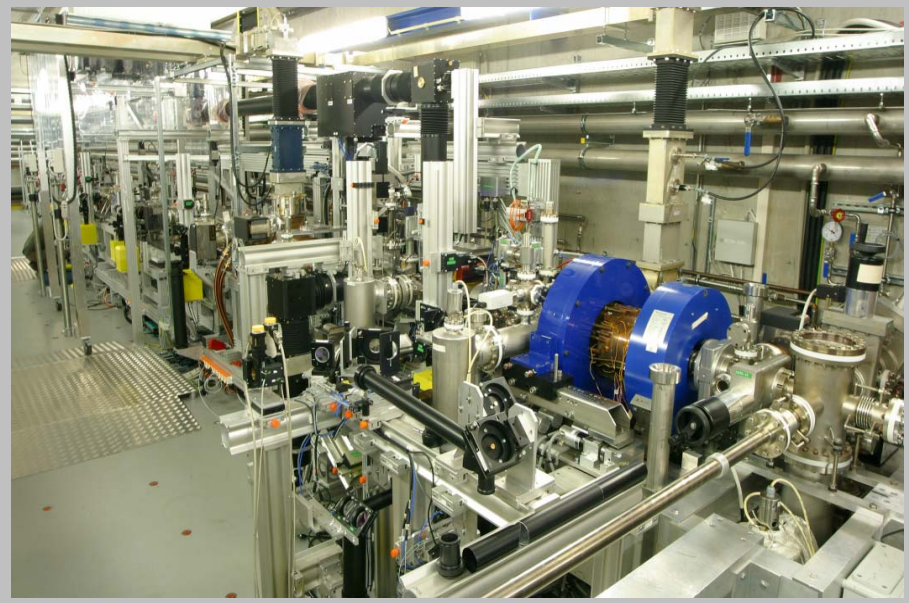
1. Introduction
2. Integrated/Supported Hardware
3. Software Overview/Components
4. Implementation Use Cases
    1. PITZ
    2. HERA-e, DESY-2
    3. EMBL
5. Current Fields of Activity
6. Live Presentation

Stefan Weiße

TINE Video System

1: Originated at PITZ

- **P**hoto **I**njector
  Test Facility **Z**euthen
  - test, condition and optimize sources of high brightness electron beams for future free electron lasers and linear colliders
  - goal: intense electron-beam with very small transverse emittance and reasonably small longitudinal emittance
  - goal is requirement for FEL operation



"The challenge of PITZ is the production of such beams with very high quality by applying the most advanced techniques in combination with key parameters of projects based on TESLA technology like the FLASH, the European XFEL, and the proposed BESSY-FEL."

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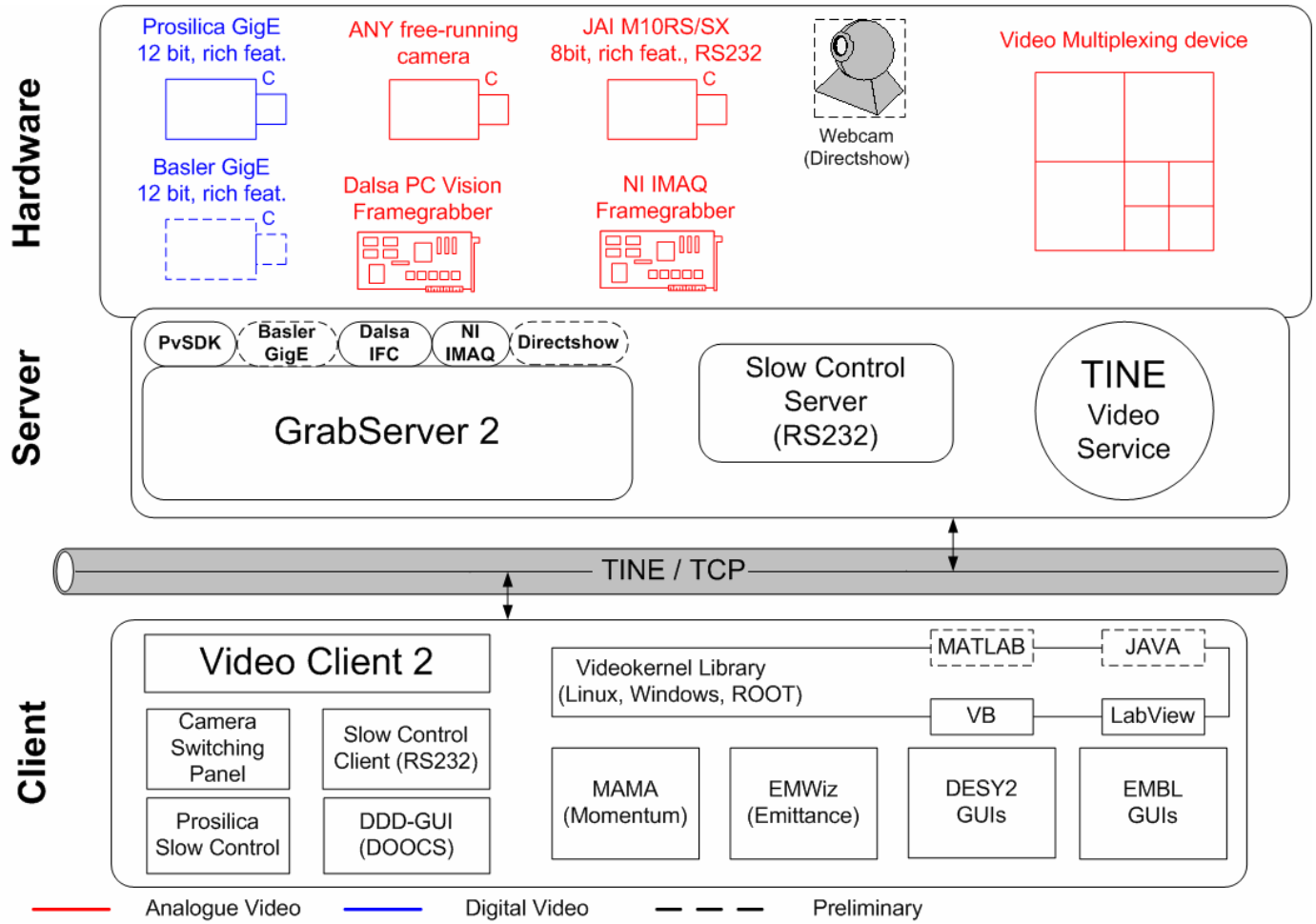
1: Overview



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1: Key Points

- core system: MS Windows-based set of software
- additional multi-platform interface library for user-written clients
- TINE used as control system backend

- constraints
  - triggered acquisition of 1 to 10 Hz (PITZ is a triggered facility)
  - do not lose any frame, if possible, be able to watch/store **every single shot without exception**
  - do not change original bit content of images (used for precise measurements)
  - be able to provide near-realtime performance (to watch behaviour of beam while changing experiment parameters)

- constraints are heavy tasks for any control system [protocol]
  - lossless-compressed frames are huge compared to lossy compression
  - high framerate demands good response times

- started at PITZ, evolved since 2002

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2: Cameras

JAI M10

RS (left)

SX (right)

analogue, progressive scan, 768x574, 8bpp, CCIR,
electronic shutter, precise gain, external trigger, RS232

PROSILICA

Prosilica GE/GC series

(GE1350, GC1350)

GigE digital, 1360x1024, binning, 12bpp,
electronic shutter, gain, external trigger

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2: Cameras

- Directshow implementation
  - use cheap webcams for checkout of TV system or monitoring tasks
  - be able to integrate more hardware easily

- Basler GigE camera evaluation
  - might be a Gigabit Ethernet-capable replacement for analogue JAI type

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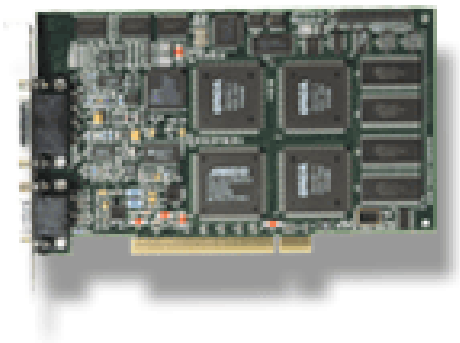
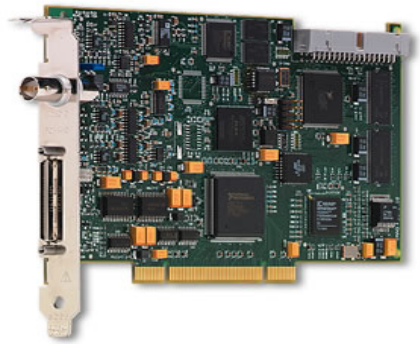
2: Framegrabber Cards

- Dalsa PCVision



- 4 video inputs (MUX)
- non-standard video
- 8 bit digitization
- used at PITZ, DESY-2
- stable Windows drivers (NT to XP)

- NI IMAQ (PCI 1409/1410)



- 4 video inputs (MUX)
- non-standard video
- 8/10 bit digitization
- used at EMBL
- NI Labview integration, raw C/C++ API provided

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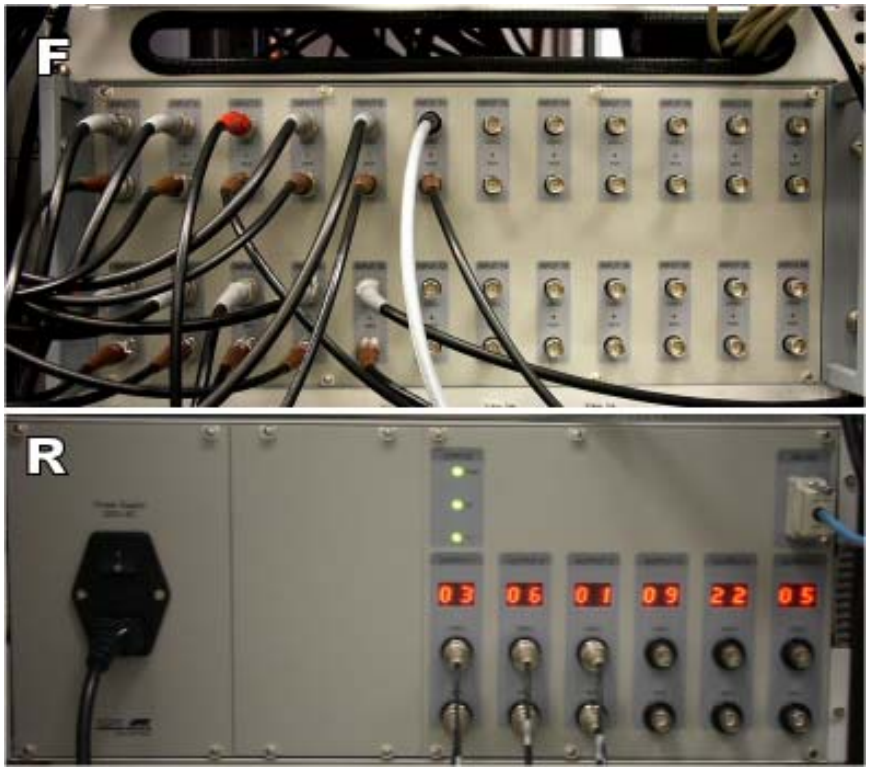
2: Analogue Video Multiplexing device



- 24 analogue video and trigger inputs
- 6 analogue video outputs
- video crossbar (RS232 control)
- supports non-standard video (triggered)
- developed and built at external company based on DESY specification

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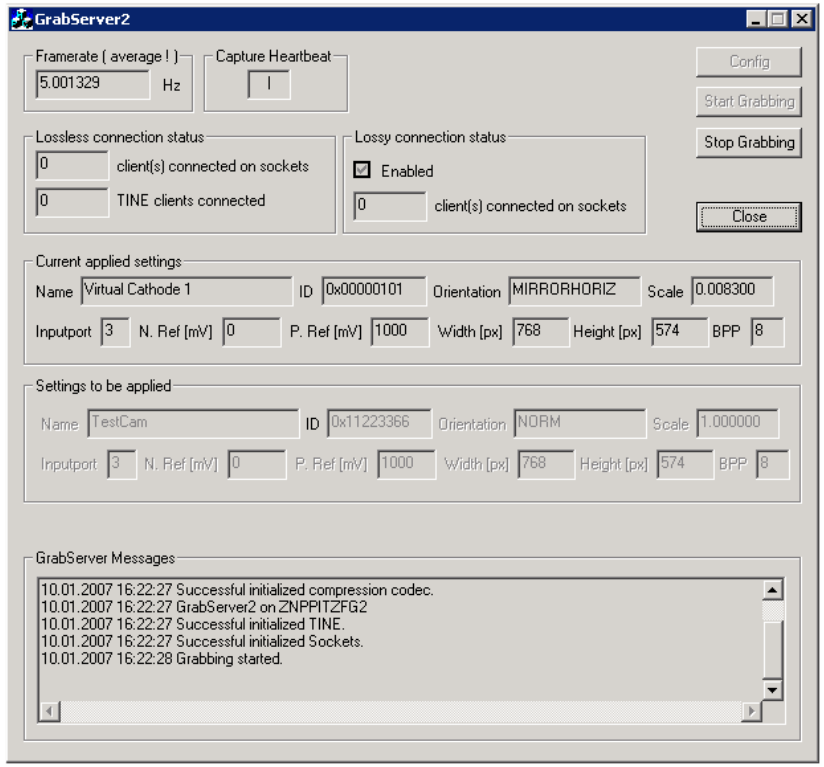
3: GrabServer 2

- input sources
  - analogue framegrabber support
  - Prosilica GigE camera support
  - Directshow support (in preparation)
  - Basler GigE support (experimental)
- orientation change
- destination video feeds for consumers
  - lossless video feed using TINE and raw TCP
  - JPEG images via dedicated TCP stream
  - Control System connections via TINE for control and diagnosis
- running on workstation-class PCs using Windows XP Professional



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3: TINE Video Service

"The goal is to have one server responsible for camera distribution and to keep all information required in one place. In fact, the configuration files located at the running directory of the service show almost any setting required from software side regarding the TINE Video system."

- keeps all settings in one place
- kind of naming lookup, registry
- controls providing of image streams
- ability to assign cameras to servers
- controls settings of intermediate devices

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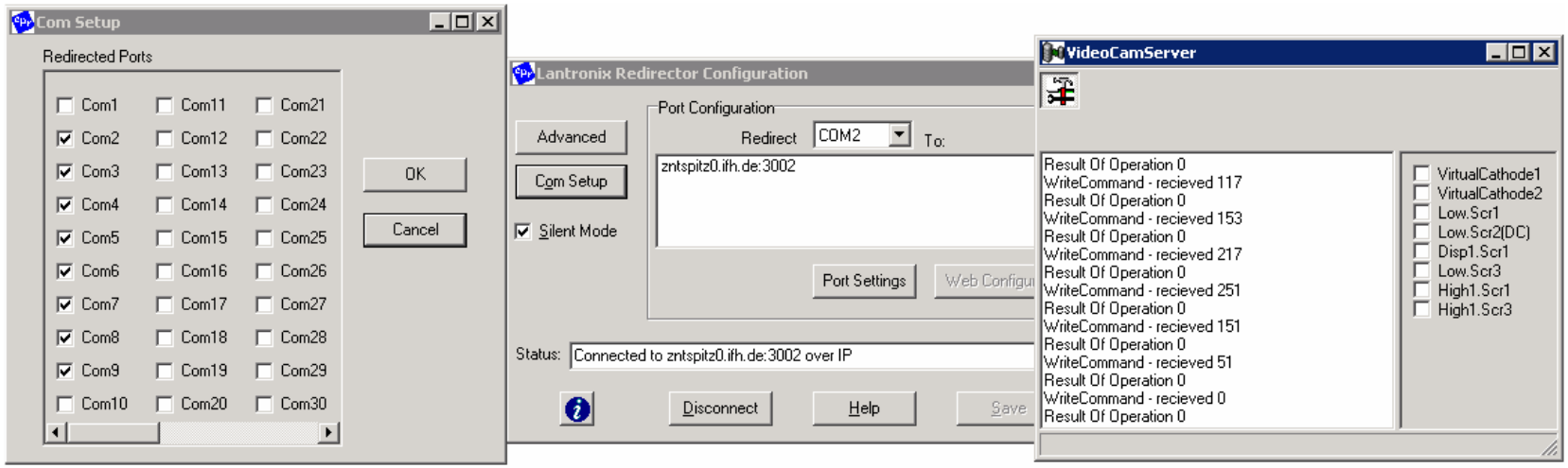
3: Camera Slow Control



- analogue cameras have dedicated RS232 slow control connection (gain, shutter speed, black level, white clip level, …)
- TINE-based software solution for remote slow control
- server controlling cameras connected at virtual or physical com-ports

- client panel running in control room

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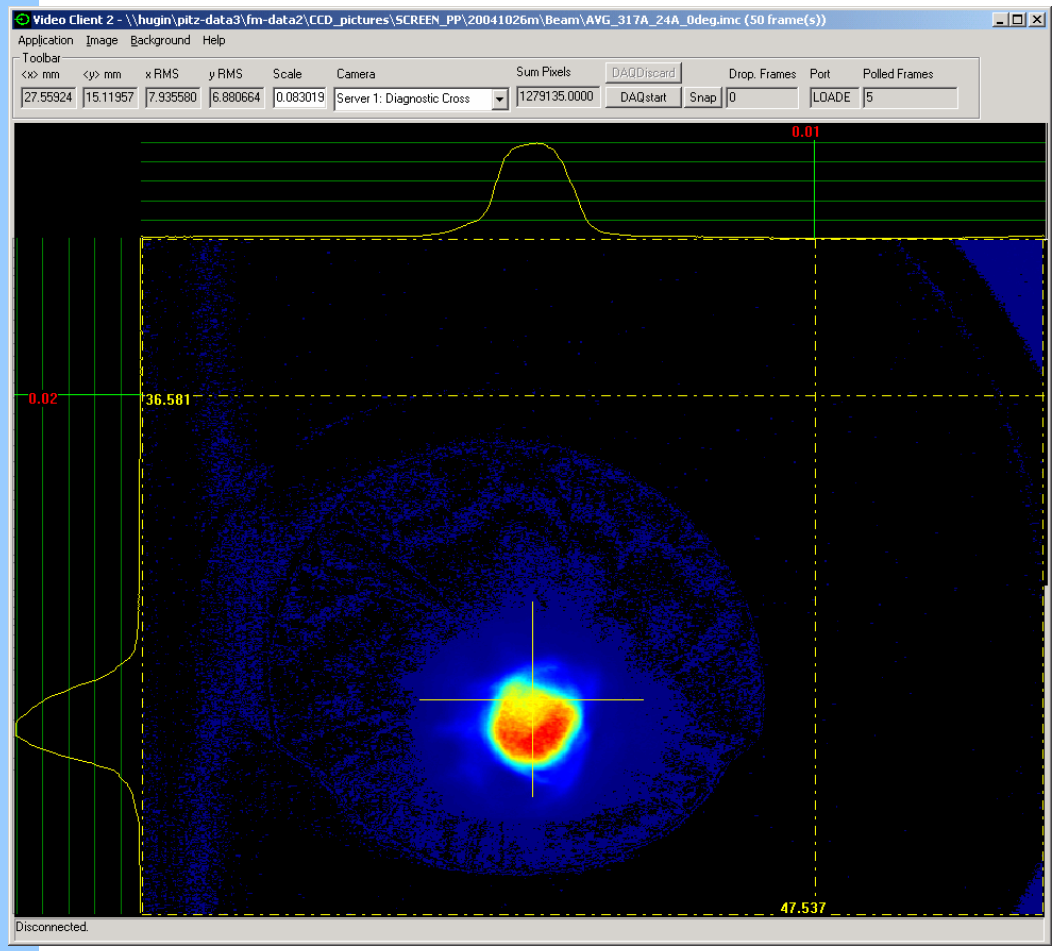
3: Video Client 2



- main client-side tool
- data taking
- live monitoring
- image analysis
- image correlation

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3: Video Client 2 (main Features)

- online and offline processing mode
- area of interest (rectangular, circular)
- drawing of X and Y projections
- scales to obtain results directly in millimetres (instead of pixels)
- multiple instances
- RDP support (to view from remote)
- live video (poll mode)
- loading and saving sets of video images and backgrounds to file (.imm, .imc, .bkg, .bkc, .bmp)
- printing of video images as well as the whole application window (electronic logbook or paper)
- background subtraction
- advanced background taking method (take multiple background and combining them into a single one)
- multiple algorithms for spot size and centre position finding (straightforward, Fourier, fitting (experimental))
- simple online DAQ function (calculated values, timestamp and important acquired experiment values (properties))
- semi-automatic data taking by controlling the laser shutter
- image enhancements like normalization, false colour modes, X-ray filtering to eliminate peaks)
- image preview on loading of files

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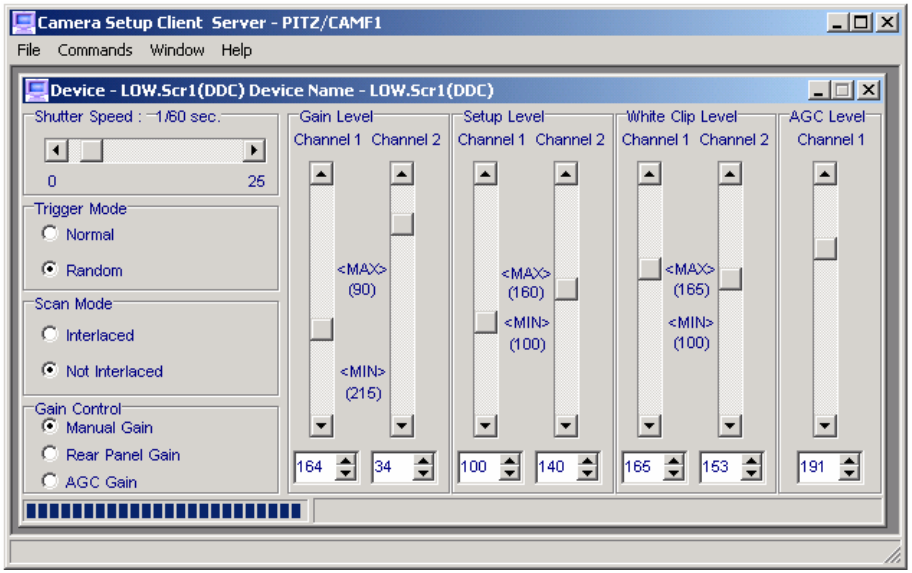
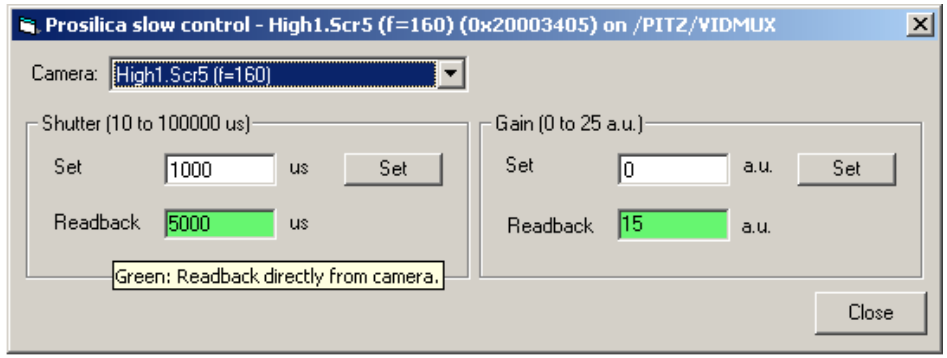
3: GUI supplements



Slow Control Client (RS232)



Prosilica Slow Control

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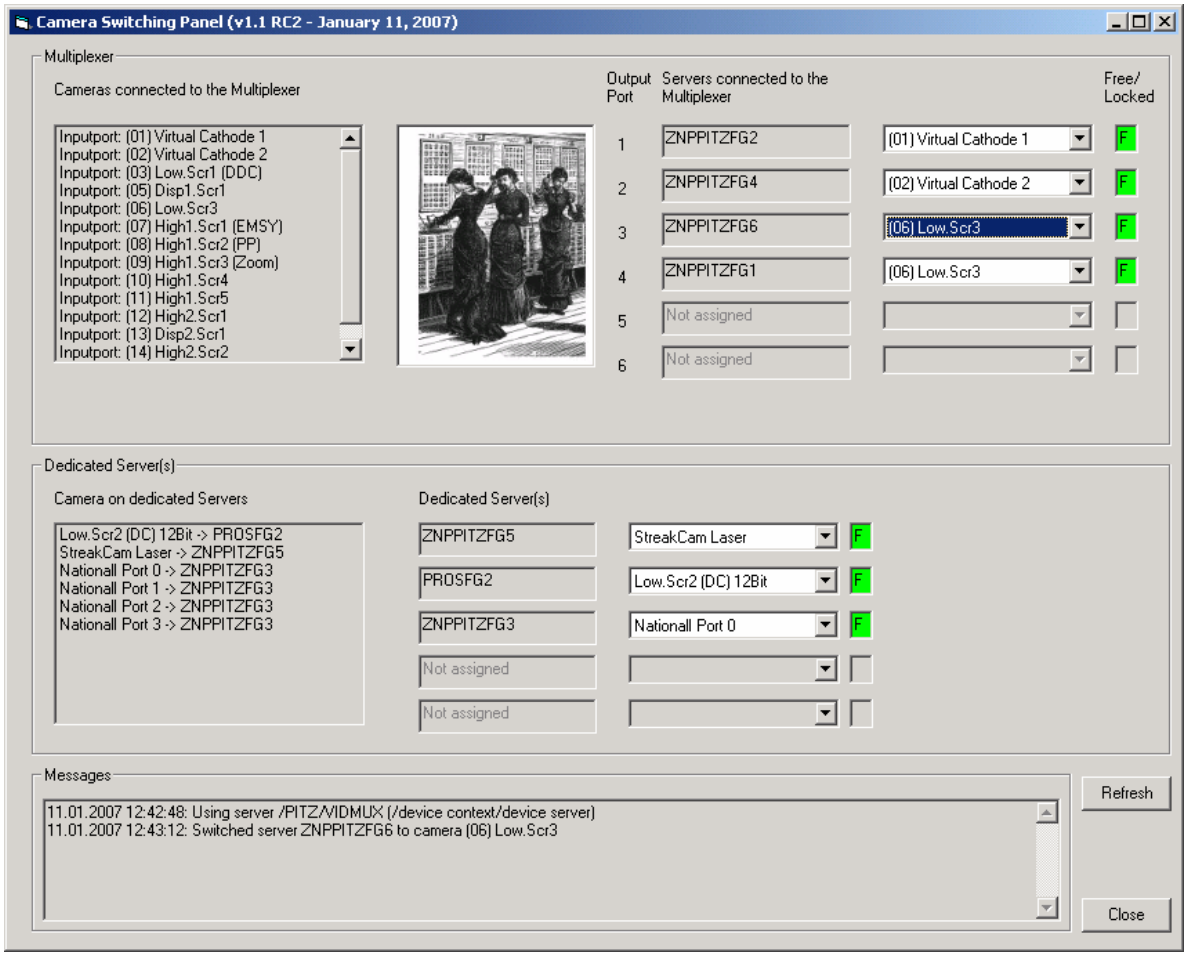
3: GUI supplements (2)



Camera Switching Panel

(TINE Video Service interface at PITZ)

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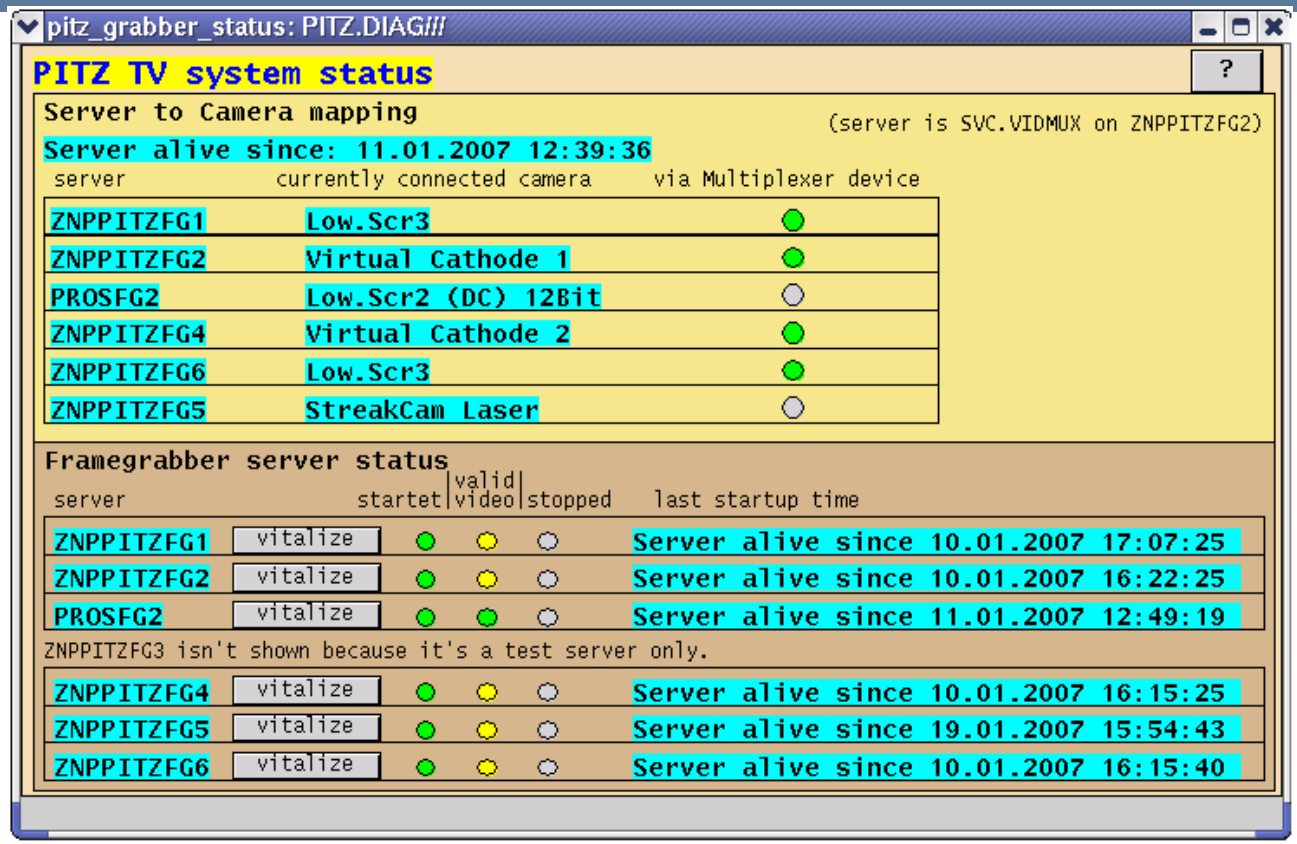
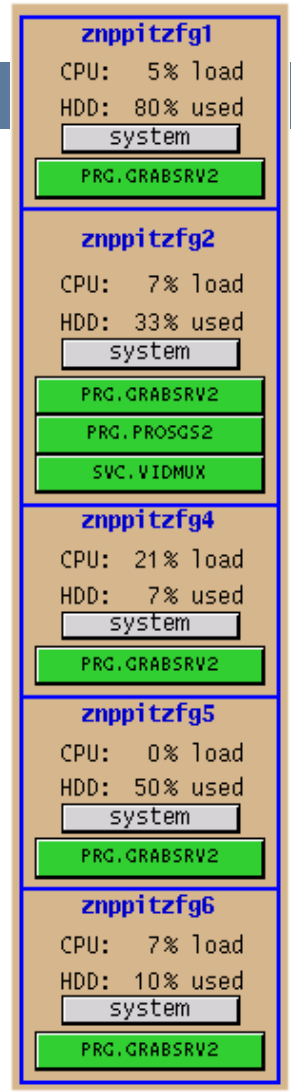
3: GUI supplements (3)





DDD-based GUI panels at PITZ
(status, overview and watchdog)

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3: Videokernel Library

- designed for users in order to interface the Video System
- ability to easily read/write supported image formats
- ability to acquire images for processing

- Linux (32 and 64 bit), Win32, Root32, Root64
- adopted to Visual Basic, Labview
- heavily used at PITZ, EMBL, DESY-2

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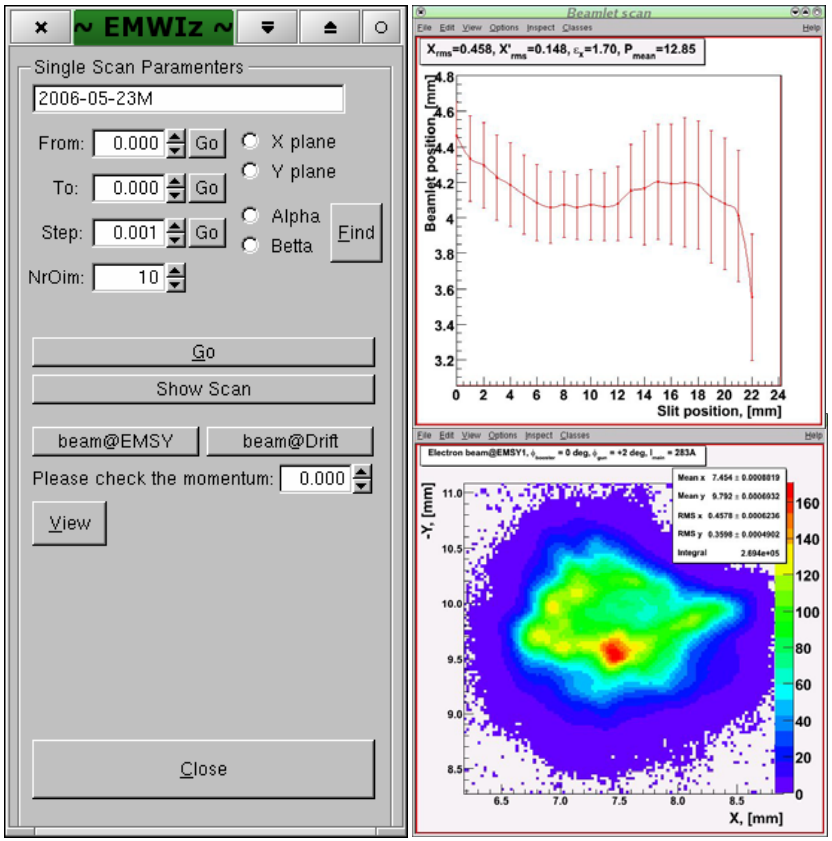
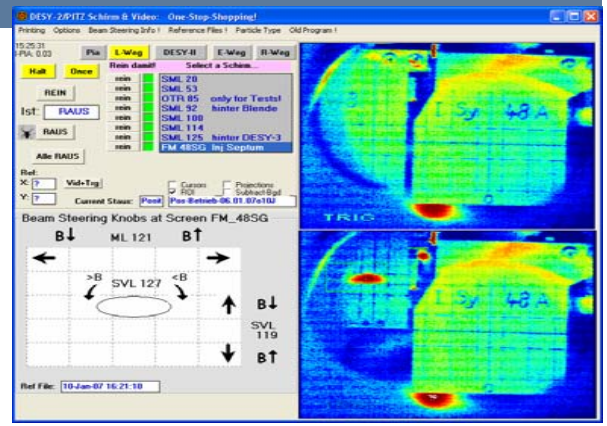
3: Videokernel Library Examples



Emittance Measurement Wizard (PITZ)



DESY-2

EMBL

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3: Highlight the TINE side

- loss-less, near real-time frame delivery using Multicasting (saving network bandwidth)
- asynchronous notification, event-based frame delivery (no polling necessary, if new frame is acquired it will be pushed out to connected clients automatically)
- seamless integration of shared memory data exchange makes it easy to run server and client on one host (no network loopback brake)
- Online DAQ: acquire certain other properties close to frame taking time (for correlations)
- interprocess communication between distinct parts of the Video System

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4: at PITZ

- heavy, widespread use
- Video is one of the most important diagnostic tools
- used for beam monitoring, beam size and position measurements, emittance measurements, momentum measurements, transverse laser profile measurements, beam correlation

- two fully supported camera solutions
  - analogue based JAI M10 RS / SX
  - digital Prosilica GE1350/GC1350

- integration of analogue video multiplexer device
- dedicated Gigabit Ethernet backbone for connecting GigE cameras to servers
- dedicated installation at laser source (laser, streak camera monitoring)
- five x86 workstation-class servers running Windows XP Professional

- one to three instances of Video Client 2 running at the same time
- dedicated measurement programs using Videokernel library
- slow control solution interfacing JAI M10 RS232 and Prosilica GigE

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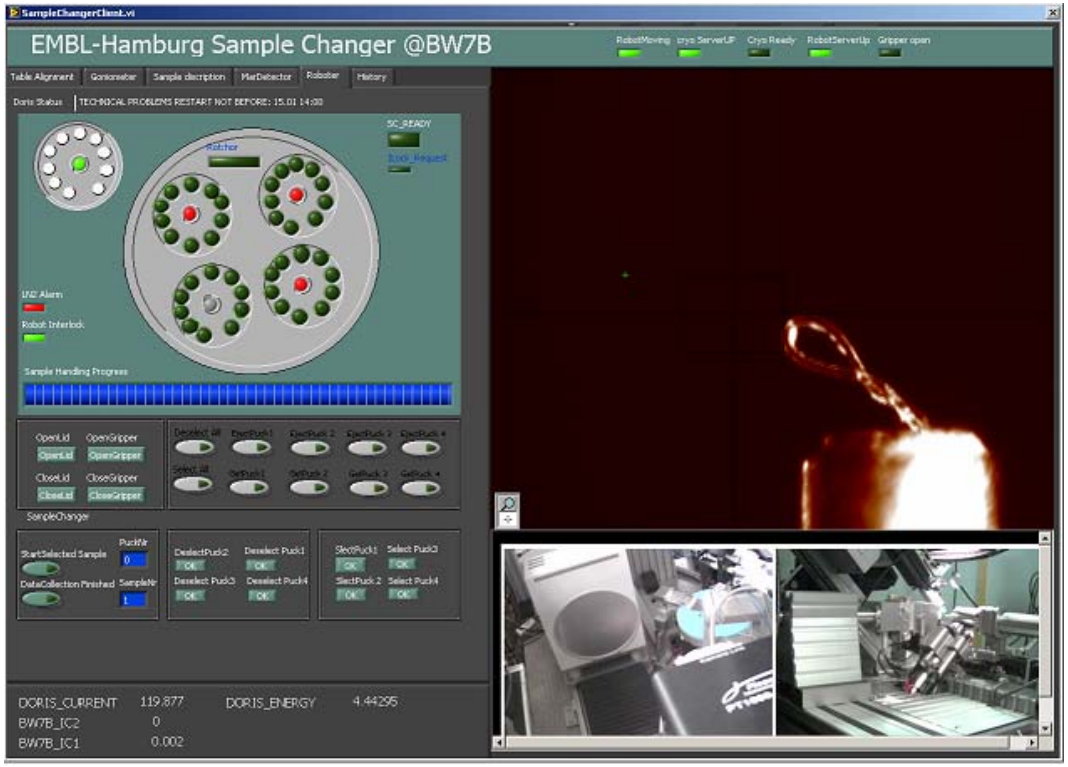
4: at EMBL



- live monitoring of robotics arm
- controlling of robotics arm
- uses Grabserver2 (analogue, NI IMAQ) and TINE Video Service
- uses Videokernel library Labview interface

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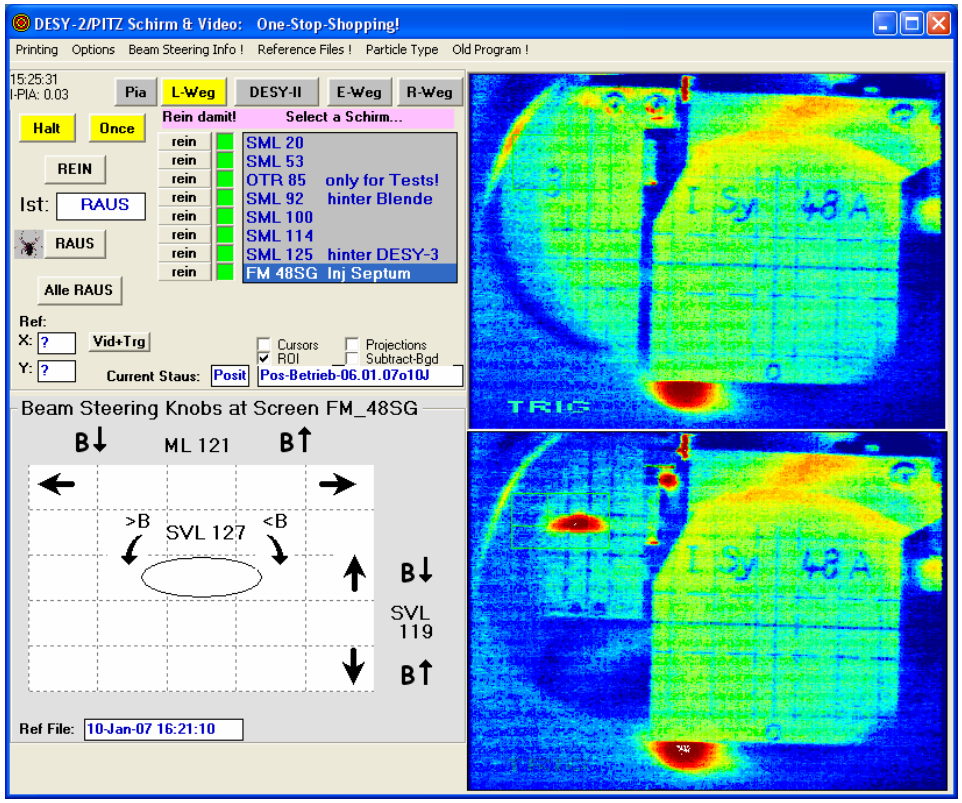
4: at DESY-2



- was used at HERA-e for synchrotron light monitoring
- used at DESY-2 Transport Line cameras
- uses GrabServer2 (analogue, PCVision) and TINE Video Service as backend
- uses Videokernel-based VB interface as base for dedicated clients

will be used in future for DORIS Synchrotron Light and PETRA 3 video applications

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5: Current Fields of Activity

- Transport Layer
- modernize image source interfaces
- rework aged slow control

- integration of Directshow interface
  - ability to integrate more hardware
  - e.g. cheap webcams for checkout of software and simple monitoring

- software integration of radiation hardened camera design by DLR
- DAQ integration (event counter and record on demand)
- create basic redistributable package and add to TINE website
- add new interfaces to Videokernel library (Matlab, JAVA)

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Live

Presentation

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Thank you for listening!

Questions? Comments?