

**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



### 1: Originated at PITZ

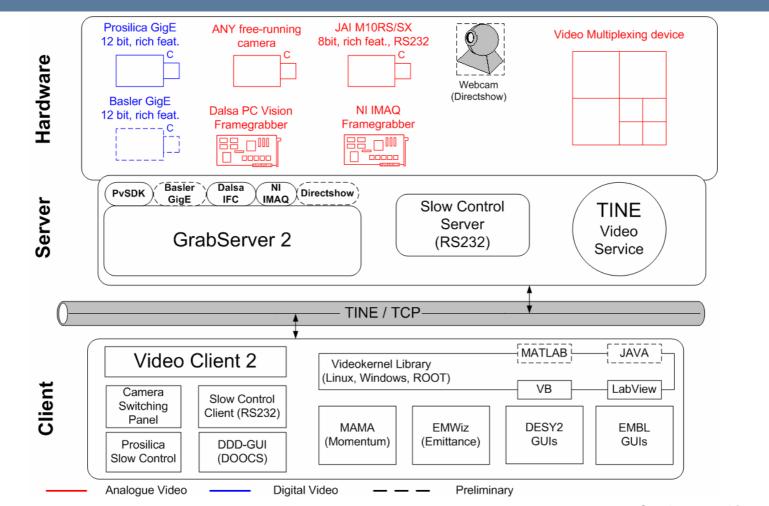
- Photo Injector
   Test Facility Zeuthen
  - test, condition and optimize sources of high brightness electron beams for future free electron lasers and linear colliders
  - goal: intense electronbeam with very small transverse emittance and reasonably small longitudinal emittance
  - goal is requirement 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 <u>FLASH</u>, the <u>European XFEL</u>, and the proposed <u>BESSY-FEL</u>."



### 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



### 2: Cameras



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

### PROSILICE Prosilica GE/GC series



(GE1350, GC1350)

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

2: Cameras

### Directshow implementation

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



A HELMHOLT

### • Basler GigE camera evaluation

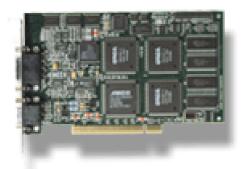
might be a Gigabit Ethernet-capable replacement for analogue JAI type





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)

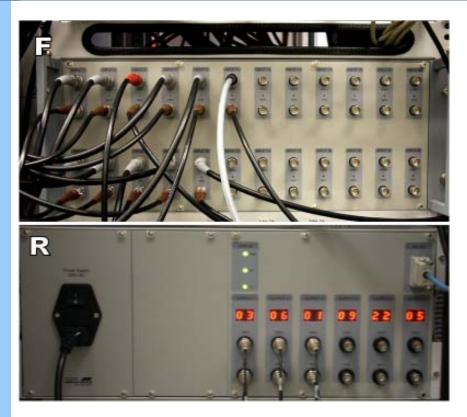
• NI IMAQ (PCI 1409/1410)



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



### 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



### 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

Framerate ( average ! ) Capture Heartbea 5.001329 Hz		Config Start Grabbi
Lossless connection status Client(s) connected on sockets TINE clients connected	Lossy connection status Enabled Client(s) connected on sockets	Stop Grabbi
	0x00000101 Orientation MIRRORHORIZ f [mV] 1000 Width [px] 768 Height [p	Scale 0.008300 x) 574 BPP 8
	0x11223366         Orientation         NORM           ef (mV)         1000         Width (px)         768         Height	Scale 1.000000 [px] 574 BPP 8
GrabServer Messages 10.01.2007 16:22:27 Successful initialized co 10.01.2007 16:22:27 GrabServer2 on ZNPPI 10.01.2007 16:22:27 Successful initialized TII 10.01.2007 16:22:27 Successful initialized So	TŻFG2 NE.	
10.01.2007 16:22:28 Grabbing started.		_



**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



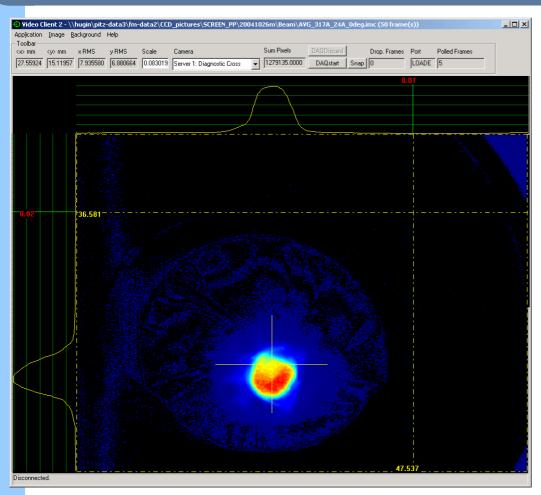
### **3: Camera Slow Control**

Com Setup			VideoCamServer
□       □	Advanced Com Setup	Port Configuration Port Configuration Redirect COM2 To: Zntspit20.ifh.de:3002 Port Settings Web Configu	Result 0f Operation 0 WriteCommand - recieved 117 Result 0f Operation 0 WriteCommand - recieved 153 Result 0f Operation 0 WriteCommand - recieved 153 Result 0f Operation 0 WriteCommand - recieved 217 Result 0f Operation 0 WriteCommand - recieved 251 Result 0f Operation 0 WriteCommand - recieved 151 High1.Scr1 High1.Scr3
Com8     Com18     Com28     Com9     Com19     Com29     Com30	Status: Connect	ed to zntspitz0.ifh.de:3002 over IP           Disconnect         Help         Save	Result Of Operation 0 WriteCommand - recieved 51 Result Of Operation 0 WriteCommand - recieved 0 Result Of Operation 0

- 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



### 3: Video Client 2



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



### 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



### **3: GUI supplements**

EDevice - LOW.Scr1(DDC) Devi	ice Name - LOW.Scr1(	(DDC)		
Shutter Speed : 1/60 sec.	Gain Level	Setup Level Channel 1 Channel 2 (MAXS) (160) (100)	Mhite Clip Level Channel 1 Channel 2	AGC Level Channel 1
Not Interlaced     Gain Control     Manual Gain     Rear Panel Gain     AGC Gain	<min> (215) 164 34 34</min>	▼ ▼ 100 <b>↓</b> 140 <b>↓</b>	▼ ▼ 166 ▼ 163 ▼	▼ 191 <b>↓</b>

**Prosilica Slow Control** 

# Slow Control Client (RS232)

🐂 Prosilica slow control - High1.Scr5 (f=160) (	0x20003405) on /PITZ/VIDMUX
Camera: High1.Scr5 (f=160)	
Shutter (10 to 100000 us)	Gain (0 to 25 a.u.)
Set 1000 us Set	Set 0 a.u. Set
Readback 5000 us	Readback 15 a.u.
Green: Readback directly from camera.	
	Close

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### 3: GUI supplements (2)

plexer				
neras connected to the Multiplexer		Output Servers connected to the Port Multiplexer	3	Free/ Locked
outport: (01) Virtual Cathode 1		1 ZNPPITZFG2	(01) Virtual Cal	hode 1 💌 F
outport: (03) Low.Scr1 (DDC) outport: (05) Disp1.Scr1		2 ZNPPITZFG4	(02) Virtual Cal	hode 2 💌 F
outport: (06) Low.Scr3 outport: (07) High1.Scr1 (EMSY) outport: (08) High1.Scr2 (PP)		3 ZNPPITZFG6	(06) Low.Scr3	F.
outport: (00) High1.Scr2 (FF) outport: (09) High1.Scr3 (Zoom) outport: (10) High1.Scr4		4 ZNPPITZFG1	(06) Low.Scr3	▼ <mark>F</mark>
outport: (11) High1.Scr5 outport: (12) High2.Scr1	D. MALE	5 Not assigned	_	
outport: (13) Disp2.Scr1 outport: (14) High2.Scr2		6 Not assigned	_	
		1		
cated Server(s) nera on dedicated Servers	Dedicated Server(s)			
nera on dedicated Servers w.Scr2 (DC) 12Bit -> PROSFG2 eakCam Laser -> ZNPPITZFG5	Dedicated Server(s)	StreakCam Laser	<ul> <li>▼</li> </ul>	
nera on dedicated Servers w.Scr2 (DC) 12Bit -> PROSFG2 eakCam Laser -> ZNPPITZFG5 tionall Port 0 -> ZNPPITZFG3 tionall Port 1 -> ZNPPITZFG3			- <u>-</u>	
nera on dedicated Servers w.Scr2 (DC) 12Bit -> PROSFG2 eakCam Laser -> ZNPPITZFG3 tionall Port 0 -> ZNPPITZFG3 tionall Port 1 -> ZNPPITZFG3	ZNPPITZFG5	Low.Scr2 (DC) 12Bit		
	ZNPPITZFG5 PROSFG2	Low.Scr2 (DC) 12Bit		
nera on dedicated Servers w.Scr2 (DC) 12Bit -> PROSFG2 eakCam Laser -> ZNPPITZFG3 tionall Port 0 -> ZNPPITZFG3 tionall Port 1 -> ZNPPITZFG3	ZNPPITZFG5 PROSFG2 ZNPPITZFG3	Low.Scr2 (DC) 12Bit		
nera on dedicated Servers w.Scr2 (DC) 12Bit -> PR0SF62 eakCam Laser -> ZNPPITZF65 titonall Port 0 -> ZNPPITZF63 titonall Port 1 -> ZNPPITZF63 titonall Port 2 -> ZNPPITZF63 titonall Port 3 -> ZNPPITZF63	ZNPPITZFG5 PROSFG2 ZNPPITZFG3 Not assigned	Low.Scr2 (DC) 12Bit		
Average Servers w.Scr2 (DC) 128it -> PR0SF62 eakCam Laser -> ZNPPITZF65 tionall Port 0 -> ZNPPITZF63 tionall Port 1 -> ZNPPITZF63 tionall Port 3 -> ZNPPITZF63	ZNPPITZFG5 PROSFG2 ZNPPITZFG3 Not assigned Not assigned	Low.Scr2 (DC) 12Bit		Refresh
nera on dedicated Servers w.Scr2 (DC) 12Bit -> PR0SFG2 eakCam Laser -> ZNPPITZFG3 tionall Port 0 -> ZNPPITZFG3 tionall Port 2 -> ZNPPITZFG3	ZNPPITZFG5 PROSFG2 ZNPPITZFG3 Not assigned Not assigned	Low.Scr2 (DC) 12Bit		Refresh

### Camera Switching Panel

(TINE Video Service interface at PITZ)



znppitzfg1

## **TINE Video System**

### 3: GUI supplements (3)

	stem status		?	
	mera mapping		s SVC.VIDMUX on ZNPPITZFG2)	
<mark>erver alive</mark> server	<pre>since: 11.01.2007 12:39 currently connected camera</pre>	<b>:36</b> via Multiplexer device		
NPPITZFG1	Low.Scr3	٢		
NPPITZFG2	Virtual Cathode 1	۲		
ROSFG2	Low.Scr2 (DC) 12Bit	0		
NPPITZFG4	Virtual Cathode 2	•		
NPPITZFG6	Low.Scr3	٢		
NPPITZFG5	StreakCam Laser	0		
	server status	d last stantum time		
server		d last startup time		
ZNPPITZFG1	vitalize O O O	Server alive since 1		
ZNPPITZFG2		Server alive since 1		
	vitalize 📀 😑 🔿	Server alive since 1	11.01.2007 12:49:19	
PROSEG2	chown hospuso it's a test corr			
	: shown because it's a test servitalize 💧 🔿 🔿	Server alive since 1		

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

CPU: 5% load D: 80% used system G.GRABSRV2 znppitzfg2 7% load U: D: 33% used system RG.GRABSRV2 RG. PROSGS2 SVC.VIDMUX znppitzfg4 U: 21% load 7% used D: system G.GRABSRV2 znppitzfg5 0% load D: 50% used system G.GRABSRV2 znppitzfg6 7% load CPU: HDD: 10% used system

PRG. GRABSRV2

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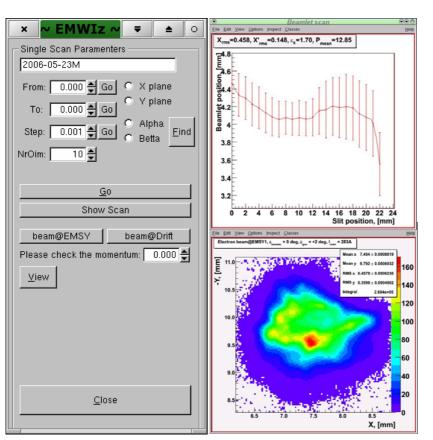
3: Videokernel Library

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

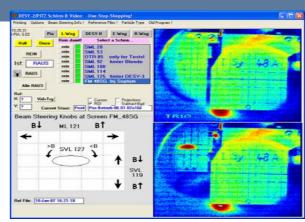
- Linux (32 and 64 bit), Win32, Root32, Root64
- adopted to Visual Basic, Labview
- heavily used at PITZ, EMBL, DESY-2



### **3: Videokernel Library Examples**



### **Emittance Measurement Wizard (PITZ)**



### DESY-2



**EMBL** 



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



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



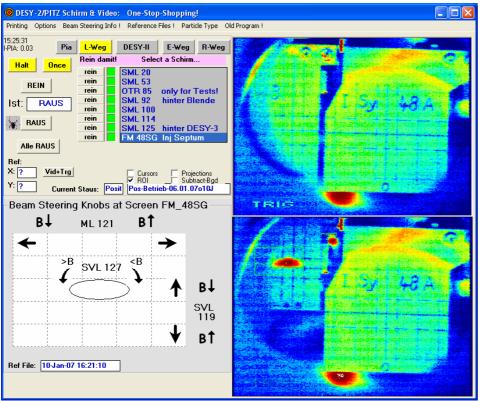
### 4: at EMBL



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



### 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



**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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## **TINE Video System**

# Live Presentation

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## **TINE Video System**

### Thank you for listening!

### Questions? Comments?

**Stefan Weiße**