

NIDays Helsinki
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Examples of Optomized™ projects

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OptoFidelity Oy

Sisältö

- OptoFidelity Oy pikaesittely
 - Tyypillisen projektin elementit
 - OptoFidelityn projektiprosessi pähkinänkuoressa
- Case example: TVI Vision Tester Platform

OptoFidelity Oy

OptoFidelity Oy nopeuttaa asiakkaansa tuotekehitystä testausjärjestelmillä, OEM-platformeilla sekä erityisosaamisellaan.

Osaaminen:

- Konenäkö ja digitaalinen kuvantaminen
- Ohjelmisto- ja elektroniikkasuunnittelu
- Kone- ja prosessiautomaatio
- Vaativat mittaus- ja testausjärjestelmät

Vahvasti verkottunut teknologiayritys.

OptoFidelityn patentoitu IPR liittyy videon testaamiseen ja käyttäjäkokemuksen mittaamiseen laitteen näytöltä.



SONY



OptoFidelity Oy

Konenäkö- ja mittausteknologian asiantuntija

Automatisoidut mittaus- & testausjärjestelmät

- Elektroniikkateollisuus
- Testauslaboratoriot
- Tuotanto
- R&D yksiköt

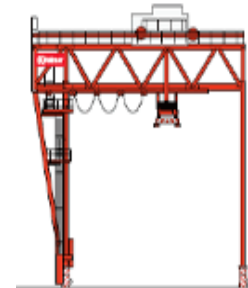
Kamerajärjestelmät vaativiin olosuhteisiin

- Liikkuvien työkoneitten valmistajat
- Koneenrakentajat
- EMC -laboratoriot

Tarjoamme:

Suunnittelupalveluja, OEM-moduuleja sekä testausjärjestelmien kokonaistoimituksia

Tuotteidemme ja palveluidemme avulla parannamme koneiden käytettävyyttä, turvallisuutta ja älykkyyttä



Automatisoidut testausjärjestelmät elektroniikkateollisuudelle

Toimintakenttä:

- Kameroiden testaus
- Näyttötekniikan testaus
- Videotekniikan testaus

Tietotaito:

- Optinen / kamerapohjainen mittaustekniikka
- Automaatio-osaaminen
- Elektroniikkasuunnittelu
- Ohjelmisto-osaaminen

Tuotteidemme ja palveluidemme avulla lyhennämme asiakkaidemme tuotekehitysprosessia

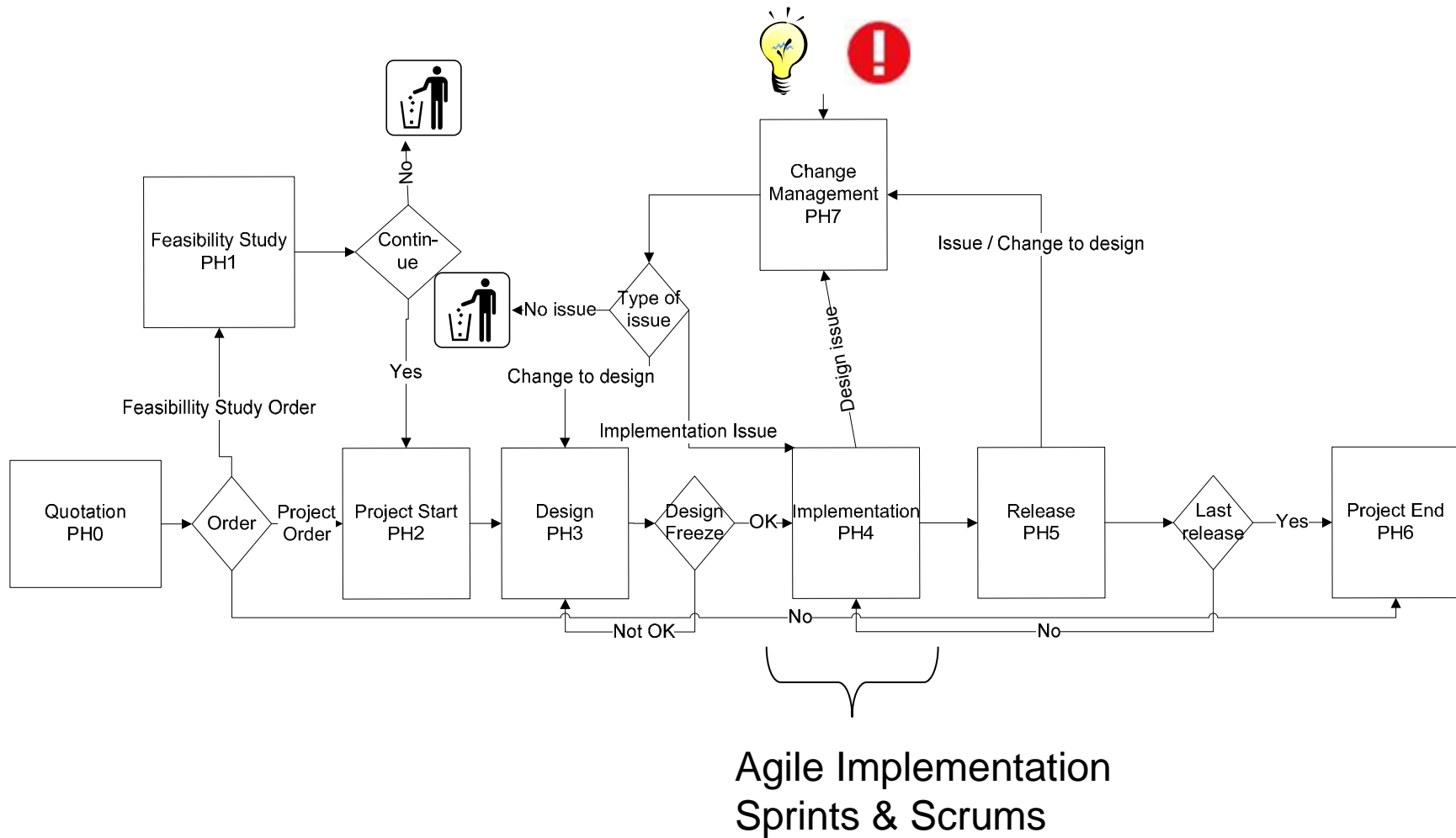


LabVIEW suunnittelu- ja testausplatformit

- 3 CLAD certified LabVIEW assistant suunnittelijaa
- 3 CLD certified LabVIEW suunnittelijaa
- OptoFidelity is NI's preferred multimedia test system partner
- Valmiit LabVIEW platformit
 - Näytöntarkastustyökalut
 - Videon laadunmittaustyökalut
 - Axis, Sony ja kameramonitorointialustat
 - Räätelöidyt liittynät LabVIEW maailmaan
- Myös muut työkalut: MS Visual Studio (C,C++,C#, arkkitehtuurisuunnittelu, tietokannat, NI TestStand, NI Vision Tools, Halcon, VisionPro, MatLab/Simulink...

Elements of a typical OptoFidelity's software project

- Typically test automation applications, including interfaces for PDM-systems
- SW/HW Engineering for companies R&D
- Projects contain Measurement / Automation challenge
 - Requires cross-scientific solutions
 - Mission is to speed up R&D with OptoFidelity's knowledge and Platforms



Case: Tester Platform application for TVI Vision Oy



The Camera Under Test

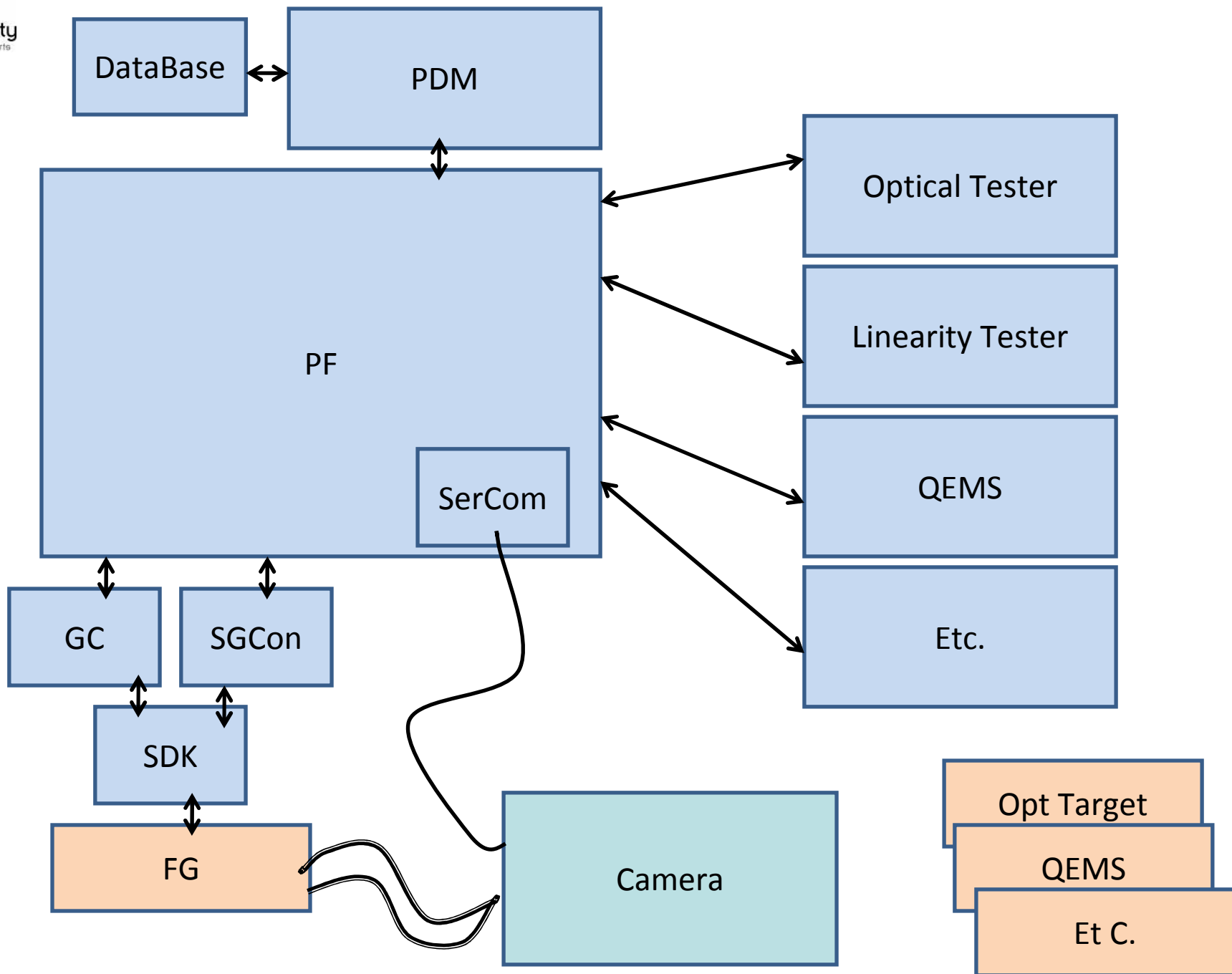
- TVI Vision Xiimus Line Scan Camera
- Prism-based 3CCD with up to 3x4096 pixels
- Camera Link / LVDS output
- Line rate up to 9500 lines/sec (4k model)
- Bit Depth 8, 10 or 12 bits
- R-GB-IR models available
- Programmable via RS-232 or CL-serial



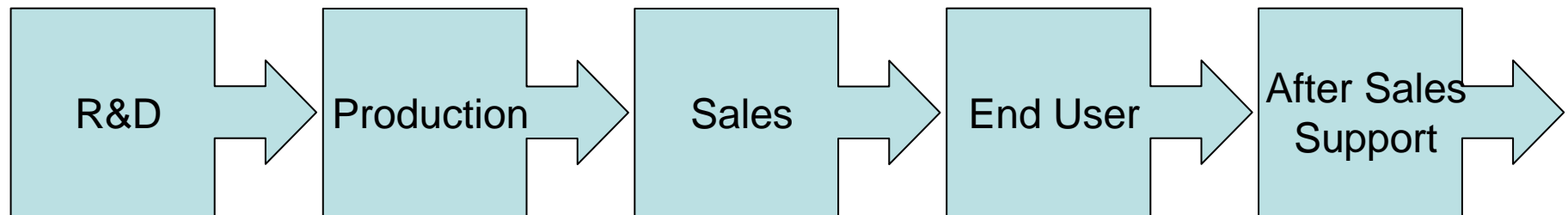
More information: www.tvivision.com

Why LabVIEW

- Extensive support for external devices
- Native Vision library
- Support for SQL databases
- Wide variety of Graph & Chart elements
- Ideal platform for testing & sharing ideas in agile manner



Tester Platform Usage



- R&D tool for solving various issues
- Quality control tool for manufacturing needs
- Production Tester for each step:
 - Preliminary tests
 - Final tests
 - Configuration
 - All steps controlled by PDM-system
- Sales uses the application for Pre-engineering, in Trade Fairs etc.
- End user uses the application for camera tuning

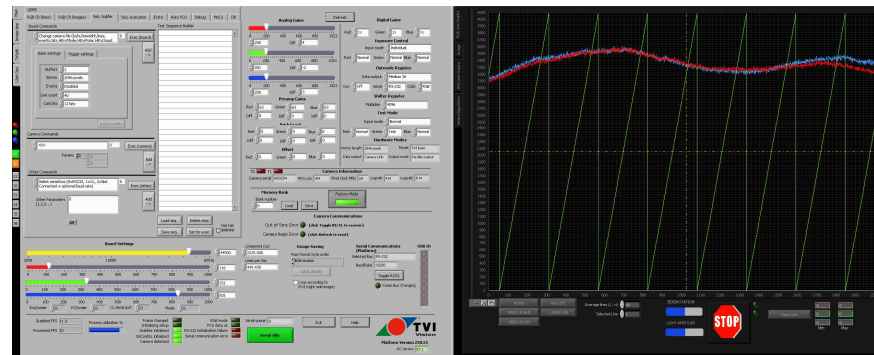
Tester Platform Functionality

- TVI Vision cameras configuration via RS-232 or Camera Link serial
- Grabbing parameters (line period, exposures etc.) control at nanosecond resolution
- Image capture at any bit-depth; LUT-operations for displaying data
- Visualization of the line data
- Averaging; Peak detection; Peak hold etc

Tester Platform Functionality, cont'd

- Wide variety of tests for functional, electrical and optical testing and verification
- Test sequencer for automating practically all the functions; camera, grabber, linear movement command & parameters, optical tests...
- Production Data Management interface for seamless integration and interaction with Production Process

Elements of TVI Vision Tester Platform



Main

Image disp

TrnSplit

12bit Ops

Ct

Sn

S1

S2

S3

S4

S5

S6

QEMS

RGB Ch (lines)RGB Ch (Images)Seq. builderSeq. executionExtraAuto PCUDebugMoCoDB

Board Commands

Test Sequence Builder

Change camera file (bufs,linewidth,lines,events,bits,HEncMode,HEncPolar,HEncInput,0)Exec (board)

Basic settingsTrigger settings

Buffers2Sensor2048 pixelsEventsDisabledLine count40Cam bits12 bits

Select camfile:

Camera Commands

<0>0Exec (camera)

Params000

Add-->

Other Commands

Select serial bus (0=RS232, 1=CL, 2=Not Connected + optional Baud rate)0Exec (other)

Other Parameters (1,2,3...)0

Add-->

Load seq.Delete stepSave seq.Set for execUse tab delimiter

Analog Gains

Refresh

02004006008001023

200Diff4

02004006008001023

200Diff-2

02004006008001023

200Diff3

Preamp Gains

Red63Green63Blue63

Diff0Diff0Diff0

Dark Level

Red0Green0Blue0

Diff0Diff0Diff0

Offset

Red0Green0Blue0

Digital Gains

Red1xGreen1xBlue1x

Exposure Control

Input modeIndividual

RedNormalGreenNormalBlueNormal

Outmode Register

Data outputMedium 36

CorrOffSerialRS-232ColorRGB

Shifter Register

Multiplier4096

Test Mode

Input modeNormal

RedNormalGreenTestBlueNormal

Hardware Modes

Vector length2048 pixelsModelTVI basic

Data outputCamera LinkOutput modeParallel output

Camera Information

T0T1

Camera serialA83204MCU s/wJ04Pixel clock MHz20Logic#1R18Logic#2D14

Memory Bank

Bank number0LoadSave

Factory Mode

Camera Communications

Out of Sync Error(click Toggle RS/CL to recover)

Camera Reply Error(click Refresh to reset)

Board Settings

20481000065536

01002003004005006007008009001000

116

01002003004005006007008009001000

331

01002003004005006007008009001000

831

EncDivider0PCDivider0CL serial port0Mode0

Grabbed FPS11.3Processed FPS10

Process utilization %

Frame changed

Initializing setup

Grabber initialized

SGConDLL initialized

Camera detected

8 bit mode

PCU data ok

Serial queue0

RS-232 initialization failure

Serial communication error

Serial Idle

Exit

Help

Image Saving

Raw format byte order

little-endian

SAVE IMAGE

Crop according to ROI (right side image)

Serial Communications (Platform)

Selected BusRS-232

BaudRate19200

Toggle RS/CL

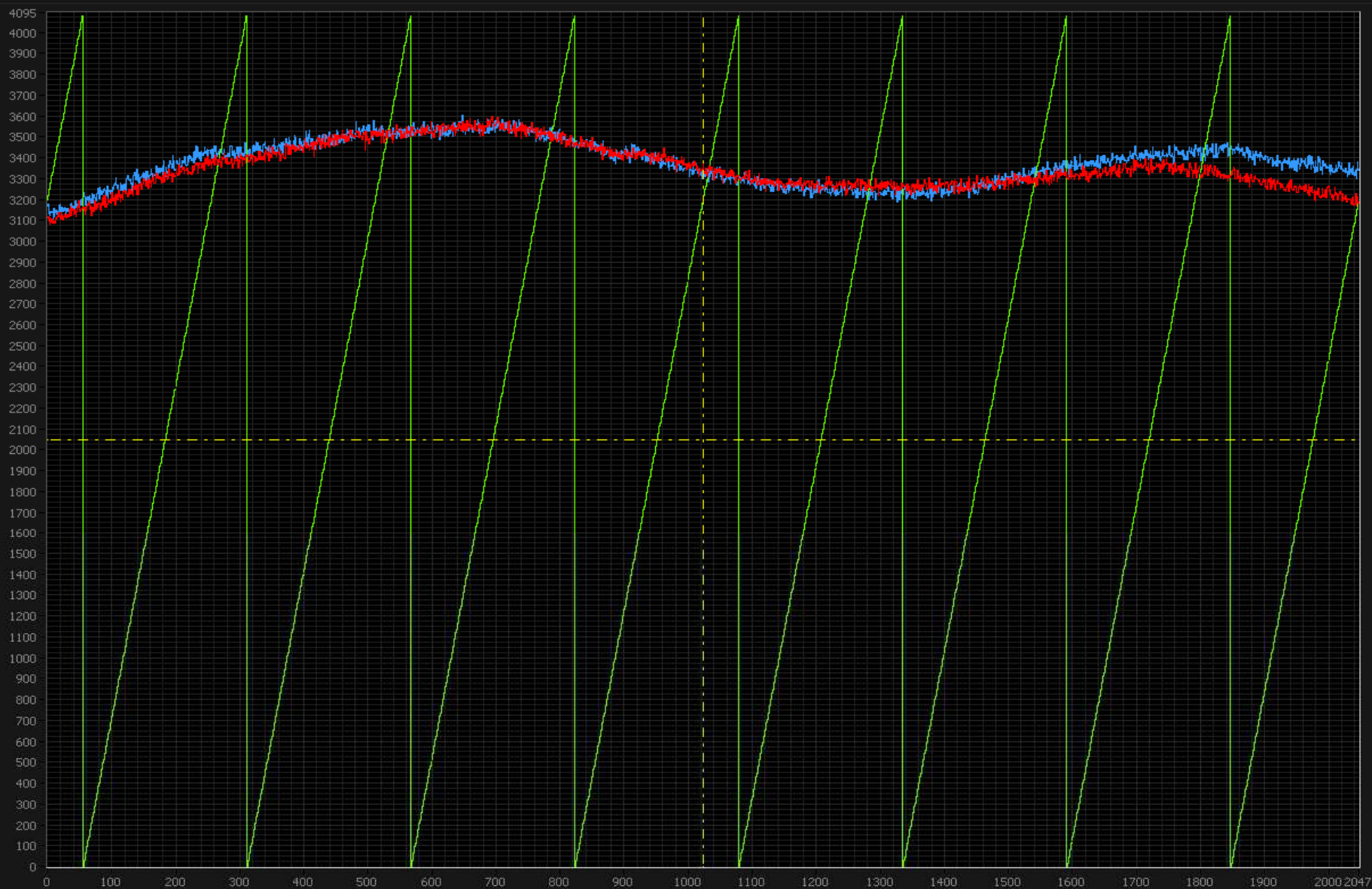
Comm Bus Changing

USB IO

TVI Vision

Platform Version 228.55

GC Version 17.1





NORM

RESET SCALE

UNDO ZOOM

AVG OFF

C.SPIKE ON

Average lines (1..n)

Selected Line

SIDE/ROTATION

LIGHT APERTURE

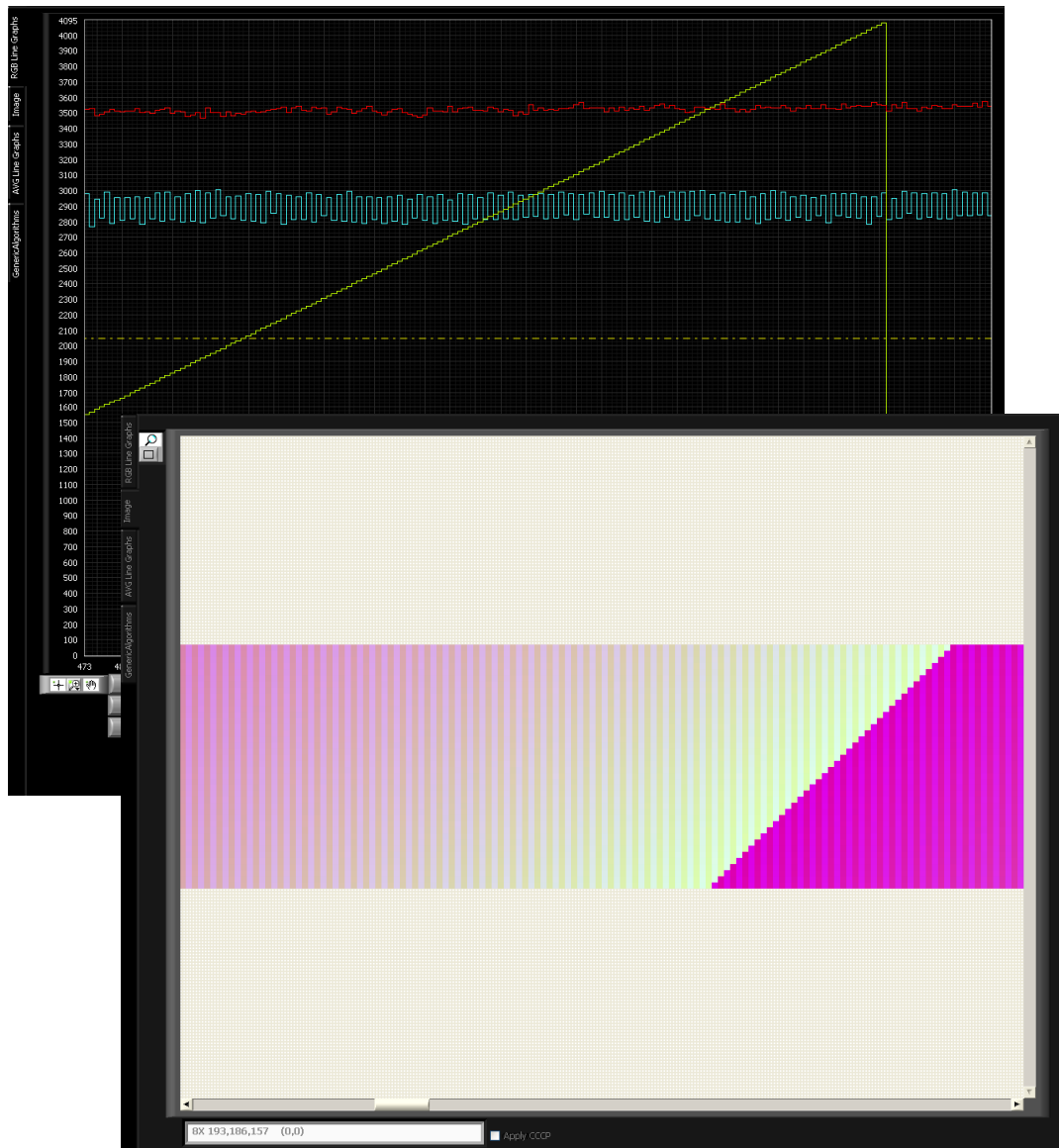


Peak hold

Min

Max

Line Graphs vs Image



Linear CCD
Sensor

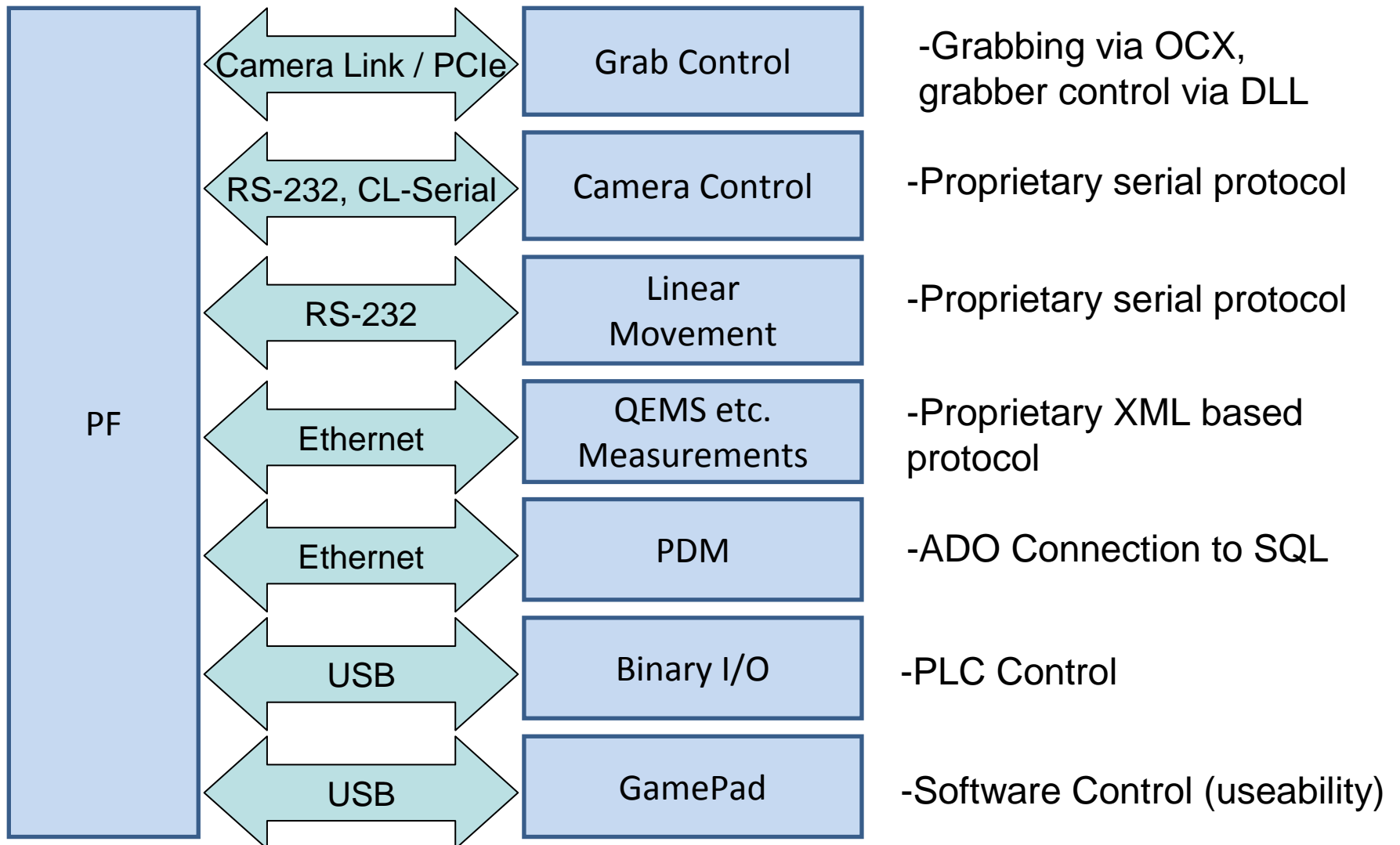
Lens



Architecture

- Event-driven UI
- Producer-Consumer type loops for data (image) acquisition
- Queue-controlled loops for
 - Camera control
 - Linear movement control
- Socket interfaces for
 - Separate camera/sensor characteristics measurement system
 - PDM system

Interfaces



Camera Configuration

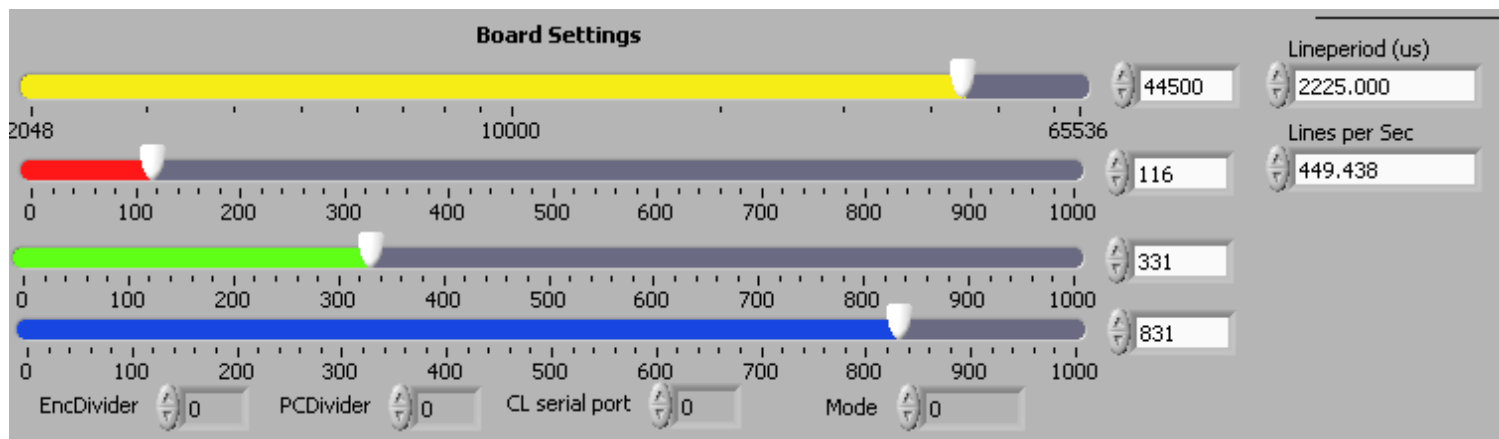
- Camera is configured via RS-232 or Camera Link Serial interface
- Separate Control VI was designed for this purpose
- Control VI contains features like
 - Swapping between RS/CL
 - Automatic recovery from error situations

The screenshot displays the OptoFidelity Camera Configuration software interface, which is organized into several functional sections:

- Analog Gains:** Features three horizontal sliders for Red, Green, and Blue channels, each ranging from 0 to 1023. Below each slider are input fields for the current value (e.g., 200) and a difference value (Diff).
- Digital Gains:** Includes three spinners for Red, Green, and Blue channels, each set to 1x.
- Exposure Control:** Contains an 'Input mode' dropdown set to 'Individual' and three spinners for Red, Green, and Blue channels, all set to 'Normal'.
- Outmode Register:** Includes a 'Data output' dropdown set to 'Medium 36', a 'Corr' dropdown set to 'Off', a 'Serial' dropdown set to 'RS-232', and a 'Color' dropdown set to 'RGB'.
- Shifter Register:** Features a 'Multiplier' spinner set to 4096.
- Test Mode:** Includes an 'Input mode' dropdown set to 'Normal' and three spinners for Red, Green, and Blue channels, all set to 'Normal'.
- Hardware Modes:** Includes a 'Vector length' field set to 2048 pixels, a 'Model' dropdown set to 'TVI basic', and a 'Data output' dropdown set to 'Camera Link'.
- Camera Information:** Displays various camera parameters including Camera serial (A83204), MCU s/w (304), Pixel clock MHz (20), Logic#1 (R18), and Logic#2 (D14).
- Memory Bank:** Includes a 'Bank number' spinner set to 0, 'Load' and 'Save' buttons, and a 'Factory Mode' button.
- Camera Communications:** Features two status indicators: 'Out of Sync Error' (green dot) and 'Camera Reply Error' (green dot), both with instructions on how to recover or reset.
- Image Saving:** Includes a 'Raw format byte order' dropdown set to 'little-endian', a 'SAVE IMAGE' button, and a checkbox for 'Crop according to ROI (right side image)'.
- Serial Communications (Platform):** Includes a 'Selected Bus' dropdown set to 'RS-232', a 'BaudRate' field set to 19200, and a 'Toggle RS/CL' button.
- USB IO:** Features a vertical status indicator with red and green LEDs.

Grabber Configuration

- Tester Platform supports currently two models from BitFlow
- Special firmware is needed to drive the grabber, in order to control timings (line rates, exposures) at nanosecond level
- Nanosecond level control is needed in order to carry out accurate sensitivity and linearity measurements

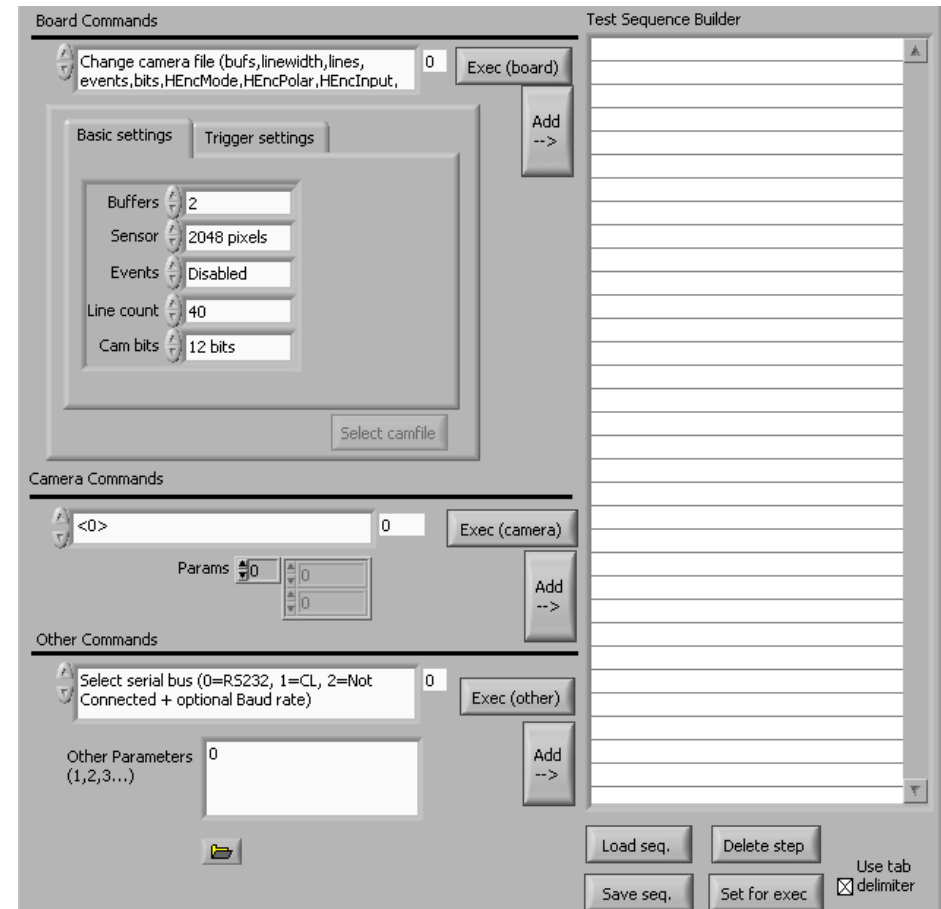


External Hardware Control

- I/O for flexible controls, e.g. PLC's
 - Usable for example in Trade Fairs, controlling various dynamic targets
- Linear movement
 - Needed in Optical Tester automation
- Gamepad
 - Adds usability for certain usage, where simultaneous adjusting of camera and target setup is required

Test Automation

- All controls can be added to sequencer list
 - Camera controls
 - Grabber controls
 - Linear movement commands (can contain macros)
 - Electrical and Optical tests
- Sequencer list items can be loaded from a file



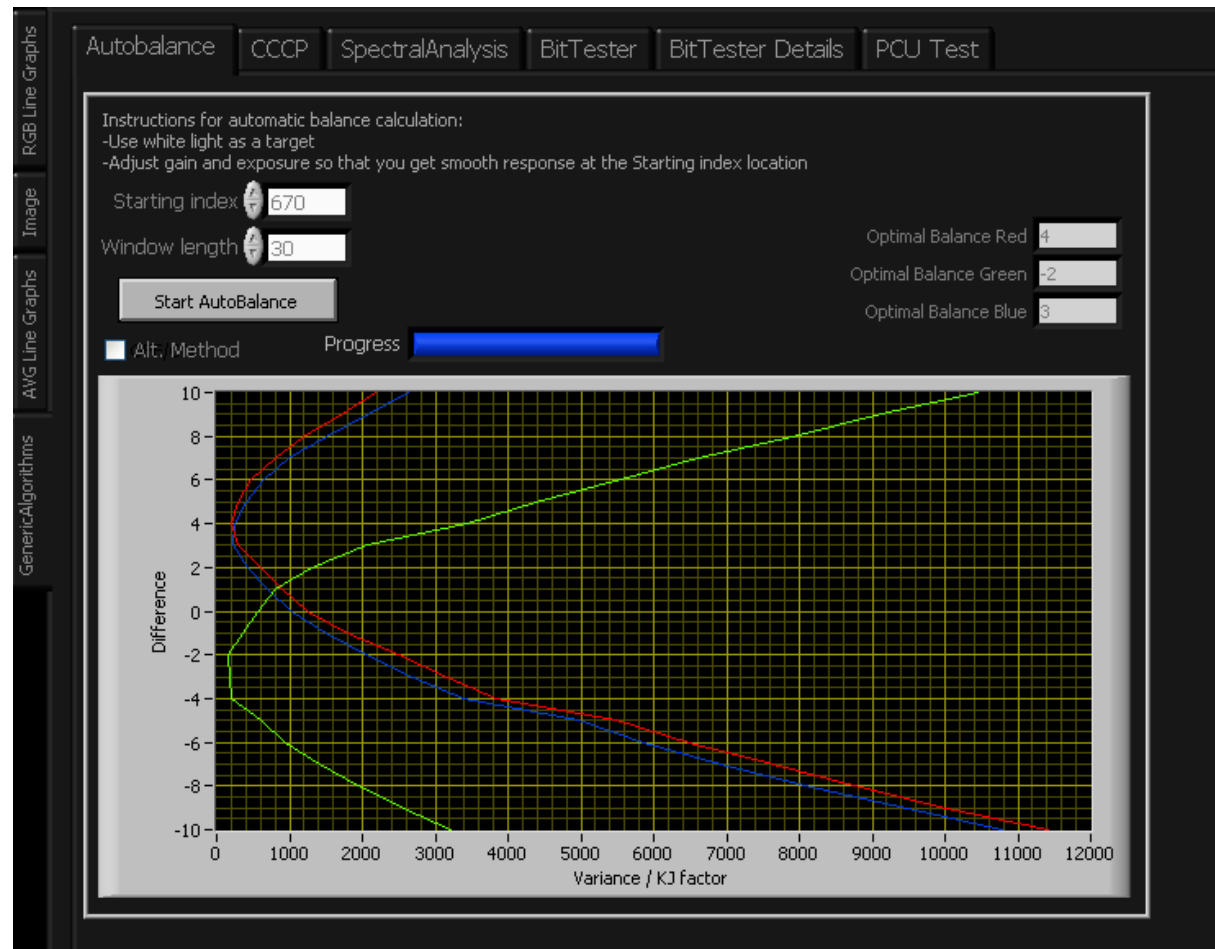
Sequencer

Electrical Tests

- Camera's electronics verification and characterisation at tap-level
- Signal path consistency verification
- FFT tests for revealing periodic phenomena
- Lots of mathematics, statistics

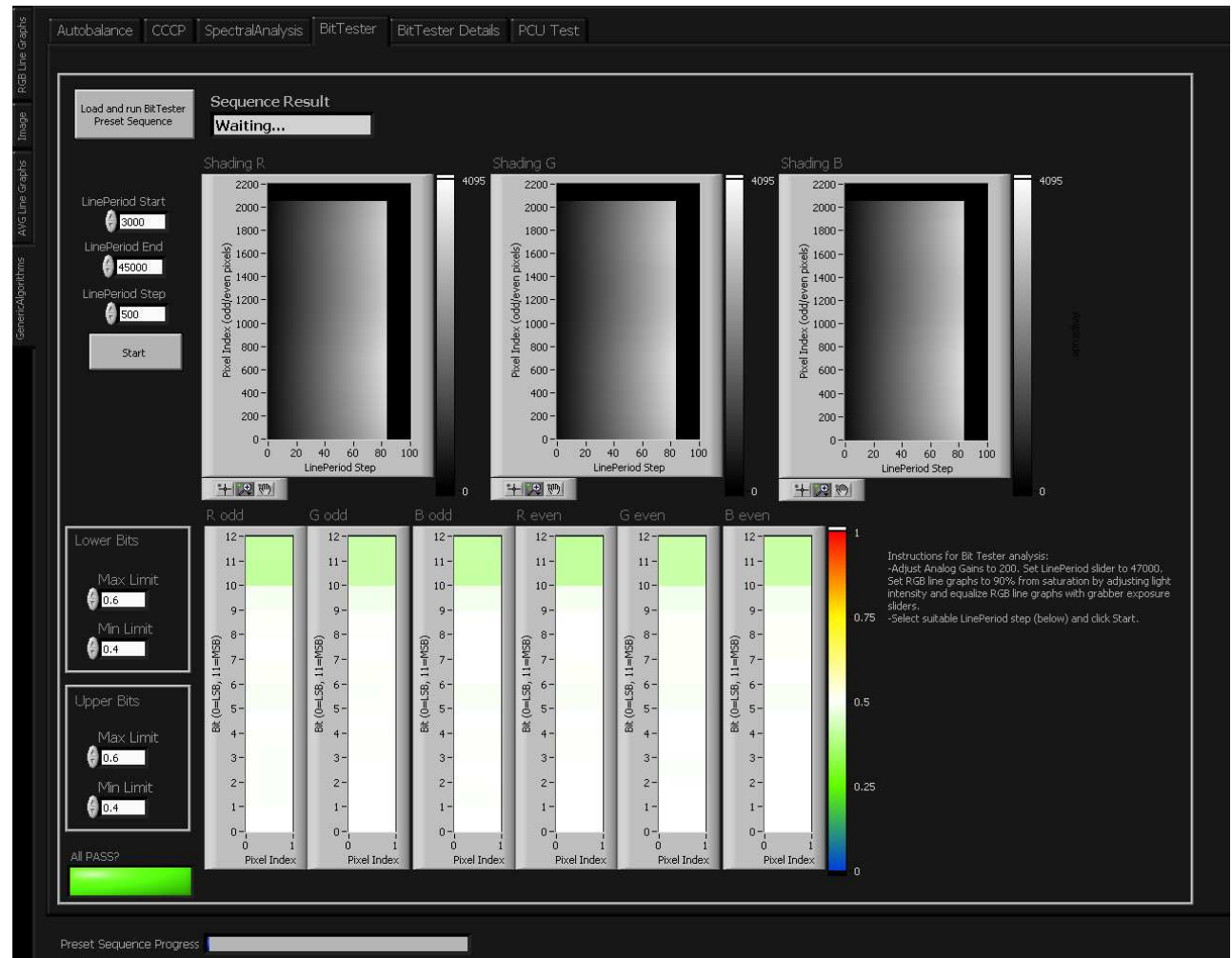
Generic Algorithms

- Generic Algorithms combine both Optical and Electrical testing
- Some of them use static or moving target
- Some of them require no target at all



Example - Bit Tester

- Simple white light target is required
- Software automatically adjusts Line rate to grab "shading" images
- Statistics is used to verify that there is no "stuck" bits



Example - AutoPCU

- Example of a helping tool for end-user
- Performs shading correction calculations at any bit depths
- Sends correction data to camera

Auto PCU reader

Save current image as Dark Reference ☒ Dark Reference saved

Save current image as Bright Reference ☒ Bright Reference saved

Dark reference statistics (Mean, Min, Max) of all pixel mean values

0.99804	0	8
2.70264	0	20
5.521	0	43

Bright reference statistics (Mean, Min, Max) of all pixel mean values

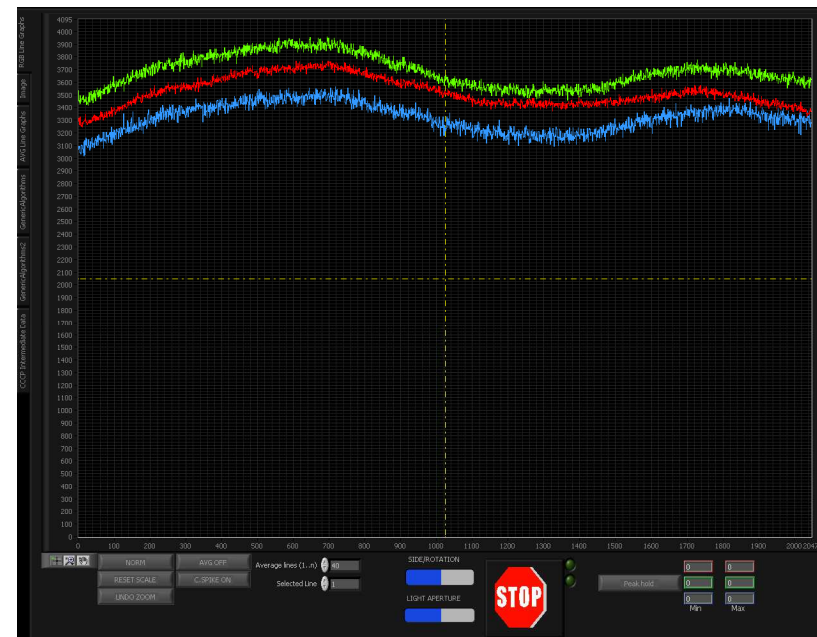
3522.18	3245	3776
3684.69	3424	3977
3320.69	3010	3568

Shifter Register Multiplier: 4096

Desired Bright level for R/G/B: 3850

Desired Dark level for R/G/B: 0

Calculate PCU values



AutoPCU – After correction



Optical Tests with Scientific equipment

- Linearity and Quantum Efficiency measurements according to EMVA-1288
- The goal of EMVA-1288 is to harmonize camera manufacturer's technical specifications concerning sensitivity, linearity etc.
- Especially QE standardization is a goal



How to compare sensors...

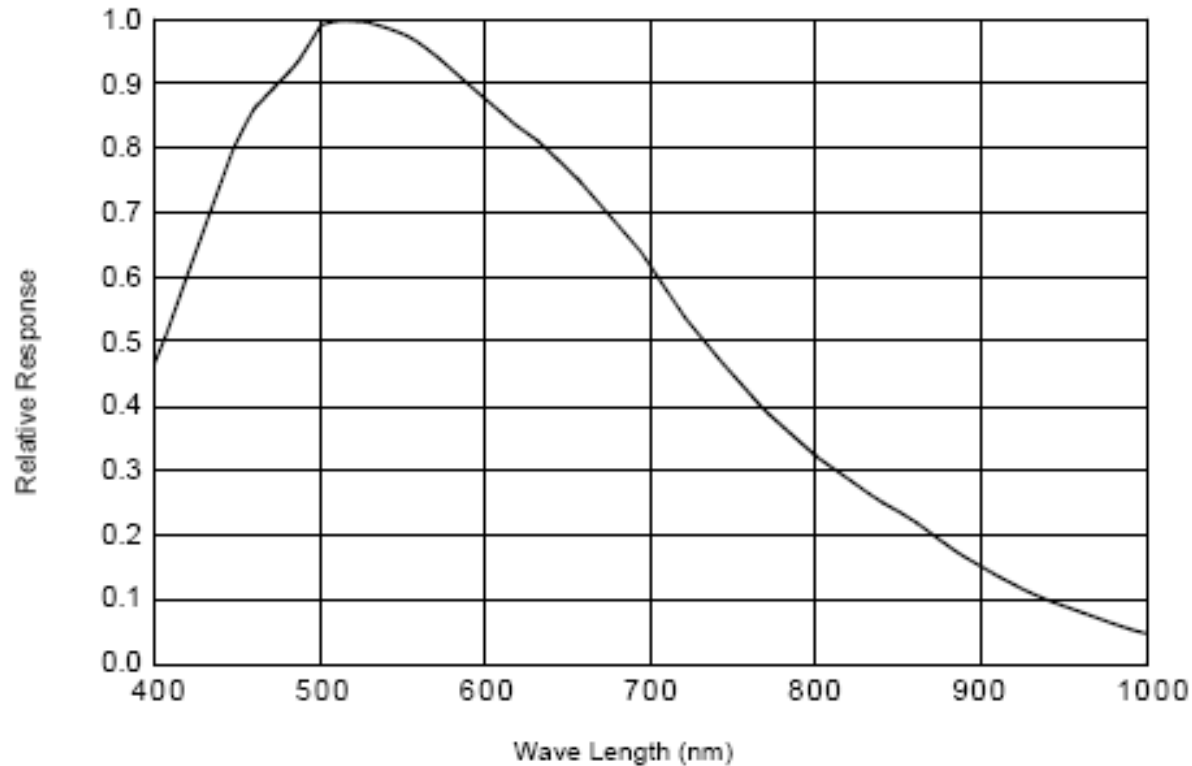


Fig. 5: piA2400-12gm Spectral Response

Relative response... How useful is that for comparing sensors' spectral sensitivity?

EMVA-1288 parameters

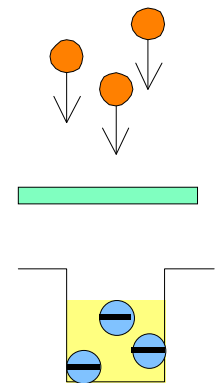
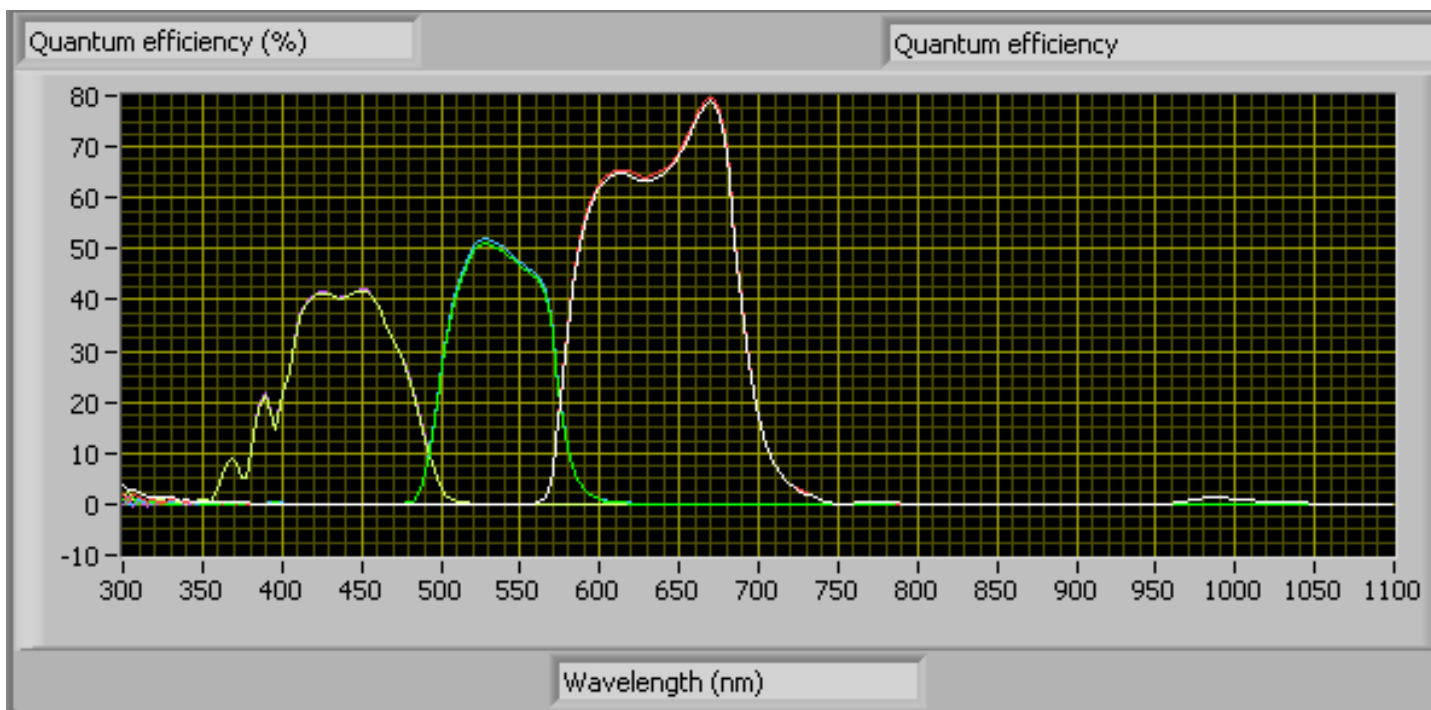
- Two modules:
 - "Module 1: Characterizing the Image Quality and Sensitivity of Machine Vision Cameras and Sensors"
 - "Module 2: Linearity and Linearity Error"
- Quantum Efficiency
- Dark noise, Dark current
- Saturation capacity
- Absolute sensitivity threshold
- SNR
- Dynamic range
- Linearity (Module 2)

More info:

[http://www.emva.org/files/standard1288/emva_1288_rela2.01_official.p
df](http://www.emva.org/files/standard1288/emva_1288_rela2.01_official.pdf)

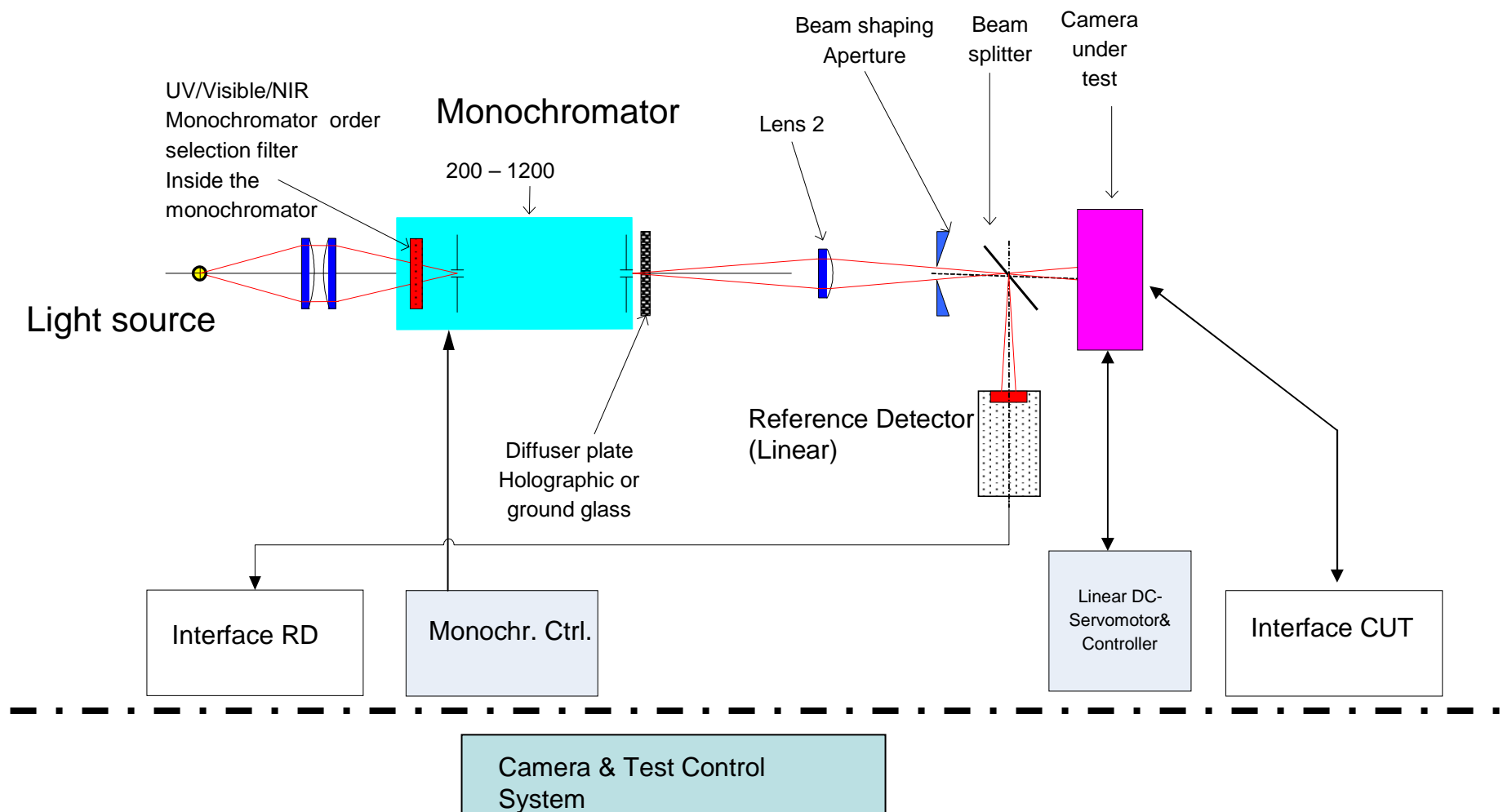
QE – Quantum Efficiency

- QE(wavelength) contains all data for spectral sensitivity
- Theoretical maximum = 1.0 (each photon releases electron)
- QE can be measured down to 2, 5 or 10 nm FWHM bandwidth (FWHM == Full Width at Half Maximum)



Quantum Efficiency Measurement System

- Built according to EMVA-1288 instructions



QEMS Integration

- Communication realized by Sockets
 - TCP-protocol, QEMS as Server (Listener)
 - Enables distributed system
- Communication protocol XML-based
 - Text-based communication works fine with Socket interface
 - XML-LabVIEW cluster conversions in both ends provide straightforward integration
 - Standardized TCP+XML enables also any 3rd party software to communicate with QEMS
 - Gen*Cam* style naming convention in camera parameters

PDM Integration

- Tester Platform reads and writes data from PDM-database (MS SQL Server)
 - Test Sequences for performing Initial and Final Tests
 - Configuration data for configuring Customer-specific cameras

The screenshot displays the OptoFidelity Tester Platform software interface. At the top, there are tabs for different functional areas: RGB Ch (lines), RGB Ch (images), Seq. builder, Seq. execution, Extra, Auto PCU, Debug, MoCo, and DB. The main window is divided into several sections:

- Database connection status:** Shows the UDL path (from INI) as %C:\kimmo\TVI-Tester\build-source\Database\%vitoj.udl. It indicates that the database connection is enabled and successfully opened, with a green status icon.
- Query parameters for Testing / Configuring:** Includes a field for Camera serial(db) set to A73911, an 'Update testing/configuration data' button, and checkboxes for 'Test Flow Control' (checked) and 'Maintenance Mode' (unchecked).
- Configuration information from Database:** This section contains a table for 'conf filename' and 'Firmware_data'. The 'conf filename' table lists 'Xiimus_nollapankki_base2 4.tvi' with 'conf data' values of 192, 193, 194, 195, and 196, all set to 0. The 'Firmware_data' table lists 'Fast', 'D14', 'Acex', 'R18', 'H8', 'J04', 'Laiteohjelma_kuvaus', 'Xiimus 40 MHz', and 'Parallel'. A 'Set configuration' button is located to the right of this section.
- Configuration Log:** A text area showing the progress of the configuration process, including 'Log started', 'Starting to write buffer...', '...buffer written.', 'Verifying buffer...', 'Buffer verify PASS', 'Writing banks...', and a list of memory addresses (2.3.4.5.6.7.8.9.10.11.12.13.14.15.16.17.18.19.20.21.22.23.24.25.26.27.28.29.30.31.32.33.34.35.36.37.38.39.40.41.42.43.44.45.46.47.48.49.50.51.52.53.54.55.56.57.58.59.60.).
- Configuration Status:** A green bar indicating 'Done - no errors'.
- Show Report & Update Database:** A button to generate a report and update the database.
- Operator name:** A field containing 'testaus'.
- Additional information:** A field for additional test details.
- Camera status:** A row of radio buttons for selecting the camera status: N/A, Koottu, Alkuteistattu, Vanhennettu, Lopputeistattu (selected), and Konfiguroitu.

Future Considerations

- Additional features
 - Linearity measurements with state of the art precision
 - New tester cases, easy to add
 - Various optical sub pixel level characterisation
 - XML based Camera Control
 - New drivers for new Frame Grabbers
- Extracting a subversion for camera control purposes only
- Converting the present 8.2.1 project into 8.6.1
 - Optimizing the application to Multi-Core –platform
 - Dedicating certain timed loops to individual Cores to ensure proper operation

What OptoFidelity offered

- Camera technology know-how
 - Needed in order to speak "same language" with the customer
- LabVIEW and Vision know-how
- Measurement & Automation technology, signal processing expertise
- Flexible working methods
 - Agile methods were needed especially in the first stages of the development

Kiitos!

Tervetuloa juttelemaan OptoFidelityn ständille.