User Manual

Xeneth v2.6

ENG-2013-UMN004-R001

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Xenics nv is committed to a policy of continuous development for which we reserve the right to make changes and improvements on any of the products described in this manual without prior notice.

Revision History

Issue	Issue date	Changes	Modified by

Change Details

This table lists all changes of this issue compared to the previous released one.

Chapter/Section	Changes	Modified by

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List of Abbreviations

ADC	Analog Digital Convertor
BPR	Bad Pixel Correction
CL	Camera Link
CXP	CoaXPress
DDE	Dynamic Data Exchange
DHCP	Dynamic Host Configuration Protocol
GEV	GigE Vision
IP	Internet Protocol
LUT	Lookup Table
LWIR	Long- Waved InfraRed
MCT	Mercury Cadmium Tellurium
MWIR	Middle-Waved InfraRed
NIC	Network Interface Controller
NIR	Near InfraRed
NUC	Non-Uniformity Correction
OEM	Original Equipment Manufacturer
SDK	Software Development Kit
SWIR	Short-Waved InfraRed
TCP	Transmission Control Protocol
UI	User Interface
UTP	Unshielded Twisted Pair
VIS	Visible
URL	Uniform Resource Locator
XNP	Xenics Network Protocol
XSP	Xenics Serial Protocol

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1. Introduction

Before being able to start the camera, the Xeneth imaging suite and its graphical user interface must be installed, so that the data coming from a wide variety of Xenics detectors and cameras can be easily operated on and analyzed.

Target group: This technical manual is written for professional users.

Please read this manual thoroughly before installing Xeneth!

1.1. Manual Overview

This section provides a chapter overview:

- Chapter 1 (this chapter) gives an overview of the conventions used in this manual (styles and symbols), the safety warnings, conformity information about Xenics cameras and the contact information.
- Chapter 2 lists the minimum system requirements.
- Chapter 3 describes the Xeneth installation and removal.
- Chapter 4 describes the camera connection.
- Chapter 5 contains the use of the Xeneth menus and tabs, image processing, troubleshooting, some scripting samples and an introduction to the SDK.
- Chapter 6 collects references to several features concerning thermography.

1.2. Conventions Used in This Manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

The styles used in this manual are:

- **Bold**: used for highlighting important things
- `Courier New`: used for code listings and output.
- *Italics*: used for UI elements, modes and fields.

The symbols used in this manual:

Note: This symbol highlights important information.

Warning: This symbol highlights important instructions. These instructions must be followed to avoid malfunctions!

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1.3. Safety Warnings

The following safety warnings must be followed:

Supply voltage polarity: Use the correct polarity of the 12 V supply voltage.

Warranty: The warranty becomes void in case of unauthorized tampering or any manipulations not approved by the manufacturer.

Electrostatic discharge: The camera contains sensitive electronic components which can be destroyed by means of electrostatic discharge. Use sufficient grounding to minimize the risk of damage.

For camera models with Camera Link interface first connect CL camera and grabber with Camera Link data cable, and afterwards supply power to the CL camera.

Environmental conditions: Operate the camera in dry and dust free environment.

Regarding the signal quality of the camera it is an advantage to operate the camera under constant ambient air temperature (~20 °C).

Beneath or above ambient temperature a sufficient heating or cooling may be necessary.

Warm-up Period: Depending on the prevailing environmental conditions, some time might pass after the camera start, until the image quality reaches its optimum.

1.4. Contact Information

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- **Distributors worldwide**

  Xenics is a European based provider of infrared imaging products and has representatives and distributor locations around the world to service our many customers.

  Please visit our website for more contact details:
  www.xenics.com

2. Prerequisites

2.1. System Requirements

In order to run Xeneth, the minimum system requirements are:

- Windows XP (32 bit, SP3 minimal), Vista (32/64 bit, SP2 minimal), Windows 7, 8 and 10 (32/64 bit)
- 2 GB RAM or more
- **Gigabit** Ethernet network interface for GigE Vision cameras
- **100 Mb** Ethernet network interface for cameras using the proprietary Xenics network protocol.
- **USB 2.0** Hi-Speed ports for cameras with a USB interface
- A frame grabber compatible with Xeneth for cameras with a Camera Link™ interface:
    - **National Instruments**
        - NI PCI-1428 (http://sine.ni.com/nips/cds/view/p/lang/en/nid/208265)
        - NI PCIe-1429 (http://sine.ni.com/nips/cds/view/p/lang/en/nid/14518)
        - NI PCIe-1433 (http://sine.ni.com/nips/cds/view/p/lang/en/nid/208913)
    - **Euresys GRABLINK™ Series**
        - http://www.euresys.com/Products/grablink/GrablinkSeries.asp
    - **ImperX FrameLink™ Series**
        - VCE-CLEX01 (http://imperx.com/frame-grabbers/vce-clex01/)
        - VCE-CLEX02 (http://imperx.com/frame-grabbers/vce-clex02/)
- Any other Camera Link™ frame grabber that supports serial communication via the standard CLALLSERIAL interface can be used to set up a command and control session.
- USB Memory stick for installation
- Display resolution of 1024x768 or higher (1920x1080 preferred)
- High speed storage. For instance the Cheetah CL camera (640x512, 16 bit, 400Hz) can produce in excess of 245 MB/s.
- CPU that supports the SSE2 instruction set.

2.2. Applications

Xeneth can be used in the following applications:

- SWIR/VISNIR/MWIR/LWIR imaging
- Thermography
- High speed imaging & recording
- Real-time analysis/monitoring of thermal/infrared processes
- Post processing of thermal/infrared processes

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3. Installation

3.1. Installation Sequence

It is a good practice to first uninstall a previous Xeneth version when installing a new one.

When using Camera Link cameras, it is also necessary to pre-install the frame grabber before installing Xeneth!

Follow the next installation sequence to avoid problems:

1. Uninstall a previous Xeneth version
2. First install the frame grabber drivers when using a frame grabber for Camera Link cameras (see chap. 3.3.2).
3. Install Xeneth (see chap. 3.2) and mark the frame grabber checkbox (Figure 3-4).
4. Install the Xeneth.

3.2. Xeneth Installation

When installing the software, Figure 3-1 shows the language selection dialog box to choose the user interface language.

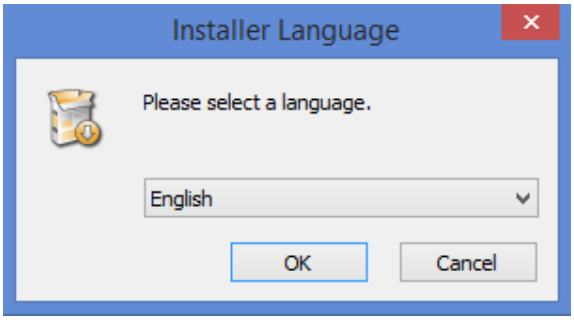

Figure 3-1 Language selection

The *Language → Welcome* page provides information about the SW version being installed as shown in Figure 3-2.

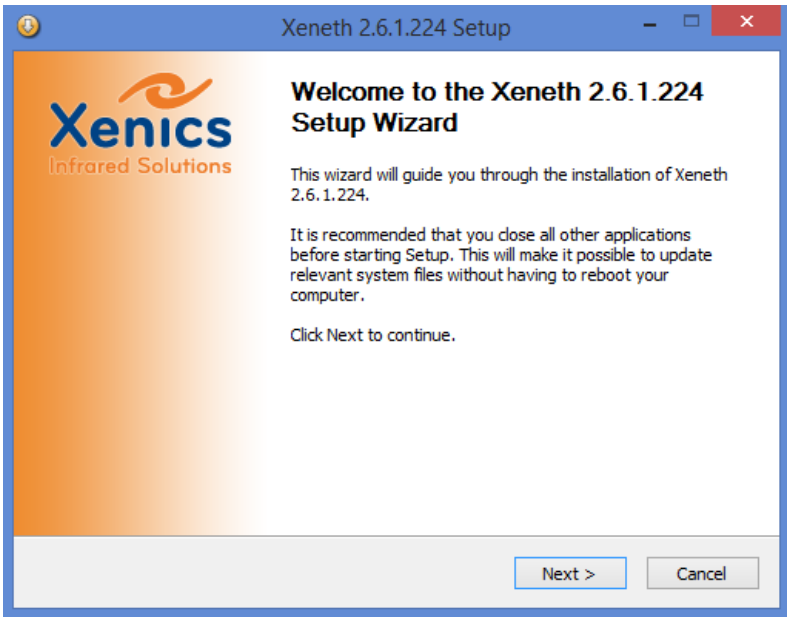

Figure 3-2 Xeneth Setup wizard

When clicking 'Next' the *Language* → *Welcome* → *License* page is shown (see Figure 3-3).

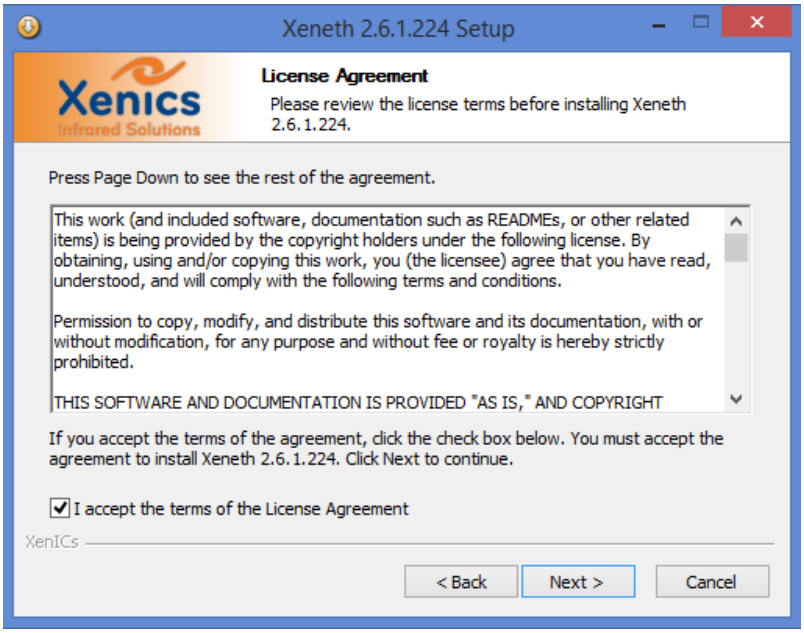

Figure 3-3 License agreement page

The license page contains the copyright notice and copyright notices about the software components used.
Proceed by checking the 'I accept the terms in the License Agreement' checkbox. When clicking 'Next' the *Language → Welcome → License → Components* page is shown (see Figure 3-4).

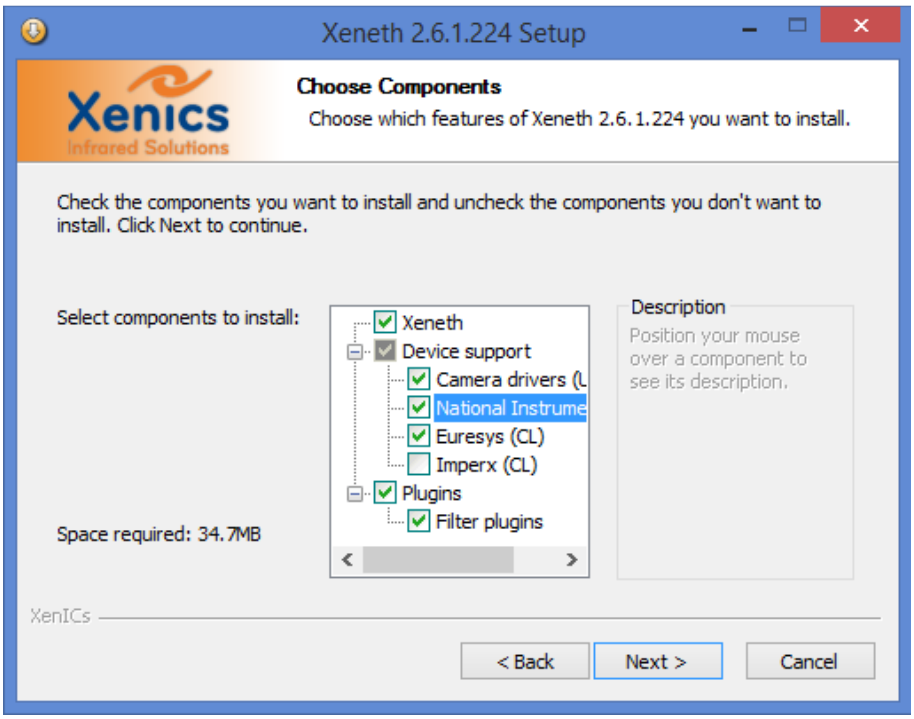

Figure 3-4 Components selection page

As shown in Figure 3-4, the 'Device support' category may be necessary for acquisition over third party drivers or cards, such as Camera Link™ frame grabbers.

3.3. Device Support

The device support sub category contains items that may be necessary to get access using third party drivers or cards.

The following two device support categories exist:

3.3.1. Camera Drivers (USB)

The USB driver must be installed to support the Xeva line of cameras. The first time the camera is plugged – in new hardware will be detected, recognized and installed.

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3.3.2. Camera Link™

The options from the following sub categories can be selected to install the desired frame grabber plug-in for frame grabbers that are natively supported by our software. The available plug-ins are used for grabbing the frames from the acquisition board and do provide an interface to the board-specific settings.

To enable serial communication over the Camera Link™ serial lines to the camera, Xeneth makes use of the clallserial.dll specification from the Camera Link™ standard API. This is a wrapper to other brand specific DLLs that comply with the clserxxx.dll naming convention and API definition. A dedicated clserxxx.dll should be shipped with all Camera Link™ compatible brands and should be located where the value of CLSERIALPATH points to. To obtain this value look in the HKLM registry under the key “SOFTWARE\Cameralink”.

The binary clallserial.dll is always installed with Xeneth and enables the user to use command and control with *any* brand that complies with the standard clserxxx.dll API specification.

When a frame grabber is used for which Xeneth does not provide a plugin, always make sure the frame grabber specific clserxxx.dll resides at the correct path!

When Device Support for an integrated frame grabber is selected, the installer adds a copy of the corresponding clserxxx.dll to the root installation folder and updates the key CLSERIALPATH. Note that this could interfere with other software applications.

3.3.2.1. National Instruments (Camera Link)

Select this option (see Figure 3-4) to install the National Instruments frame grabber plug-in for use in combination with our Camera Link™ enabled cameras.

This option also installs the .ICD files that contain the camera and board specific configurations into the camera files path of NI. The path is obtained from NIIMAQPATH in the HKLM registry, location “SOFTWARE\National Instruments\NI-IMAQ for Windows 95/NT”.

A copy of *clsernat.dll* is placed in the root installation folder of Xeneth and CLSERIALPATH is updated.

The National Instruments Image Acquisition installation procedure must be completed before installing the Xeneth software. The installation CD and installation manual is **provided by National Instruments** together with the frame grabber card.

3.3.2.2. Euresys (Camera Link)

Select this option (see Figure 3-4) to install the Euresys frame grabber plug-in to use the GRABLINK™ series acquisition boards in combination with our Camera Link™ enabled cameras.

This option installs the .cam files that contain the camera specific configurations into the camera files path of Euresys. The path is obtained from CAMERAS in the HKLM registry, location “SOFTWARE\Euresys\MultiCam\Parameters”.

A copy of *clseremc.dll* is placed in the root installation folder of Xeneth and CLSERIALPATH is updated.

The Euresys MultiCam studio installation procedure must be completed before installing the Xeneth software. The installation manual is **provided by Euresys** together with the frame grabber card. The software needs to be **downloaded** from www.euresys.com > DOWNLOAD.

3.3.2.3. IMPERX (Camera Link)

Select this option (see Figure 3-4) to install the IMPERX frame grabber plug-in to use the FrameLink series acquisition boards in combination with our Camera Link™ enabled cameras.

This option installs the .cxf files that contain the camera specific configurations into the GrabberFiles folder of Xeneth.

A copy of *clseripx.dll* is placed in the root installation folder of Xeneth and CLSERIALPATH is update.

The IMPERX installation procedure must be completed before installing the Xeneth software. The installation manual and software is **provided by IMPERX** together with the frame grabber card.

If the IMPERX installer is not installed using the default installation directory the Xeneth GUI application is unable to find the required IMPERX SDK runtime DLLs. When Xeneth is installed with the IMPERX option checked a configurable path property is appended in Application Settings → Frame

grabber options named *Imperx SDK path* to allow the user to configure a custom path. (See chap 5.2.3.) Make sure to set this path to the correct location taking into account the version of Xeneth (32 or 64 bit) installed.

3.4. Plug-ins and Scripts

The Plug-ins & Scripts category contains additional filters/scripts that are used to perform a number of image processing tasks.
Select the required components, and click 'Next'.

The *Language → Welcome → License → Components → Install location* page is shown in Figure 3-5.

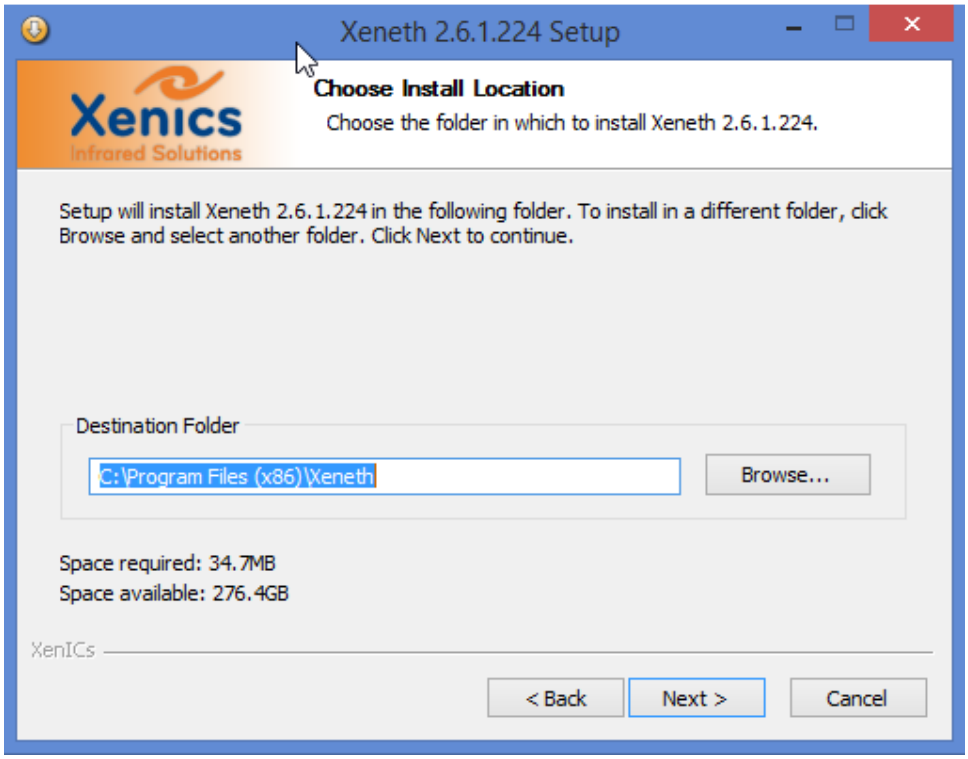

Figure 3-5 Install location page

Choose the location in which Xeneth must be installed.

Choose the installation location, and when clicking 'Next', the *Language → Welcome → License → Components → Install location → Start menu* page is shown (see Figure 3-6).

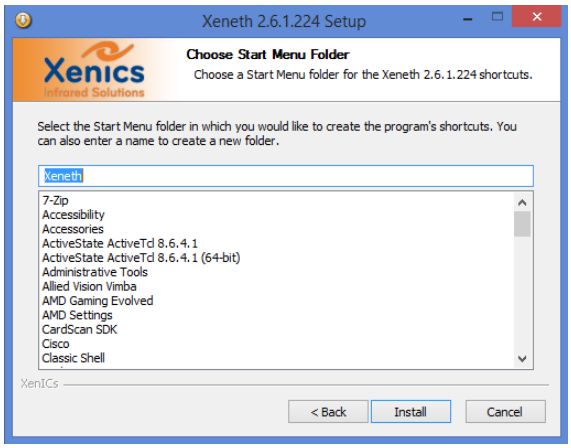

Figure 3-6 Start menu page

This page determines the Xeneth location in the start menu.
Choose the start menu folder, and when clicking 'Next', the *Language* → *Welcome* → *License* → *Components* → *Install location* → *Start menu* → *Install* page is shown (see Figure 3-7).

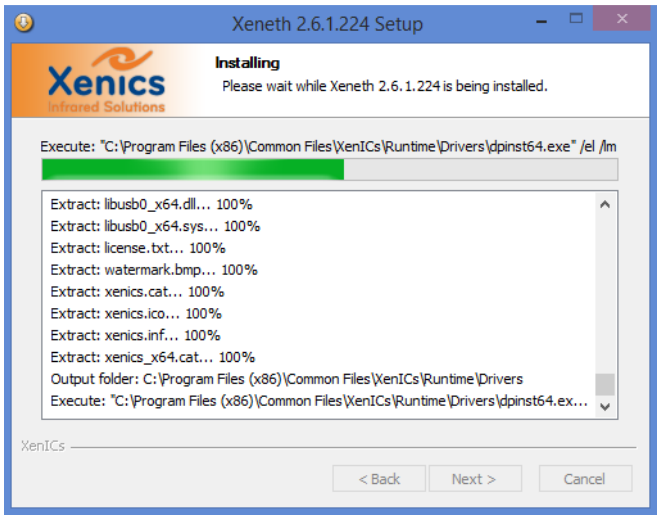

Figure 3-7 Installation page

During installation, when the USB drivers were selected to install, an additional dialog will pop up as shown in Figure 3-8.

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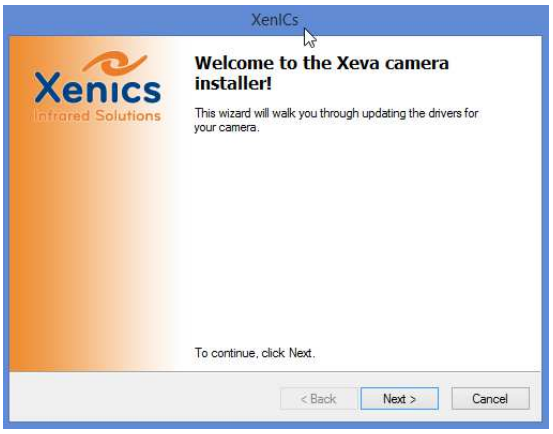

Figure 3-8 USB driver installation page

When clicking ‘Next’, Figure 3-9 is shown.

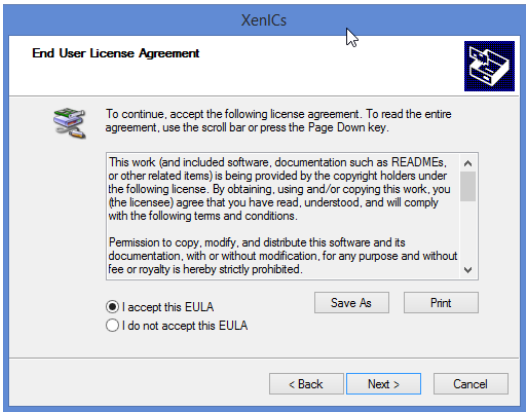

Figure 3-9 End user license agreement page

Proceed by accepting the end user license agreement and click ‘Next’.

The USB driver is installed at this point, as shown in Figure 3-10.

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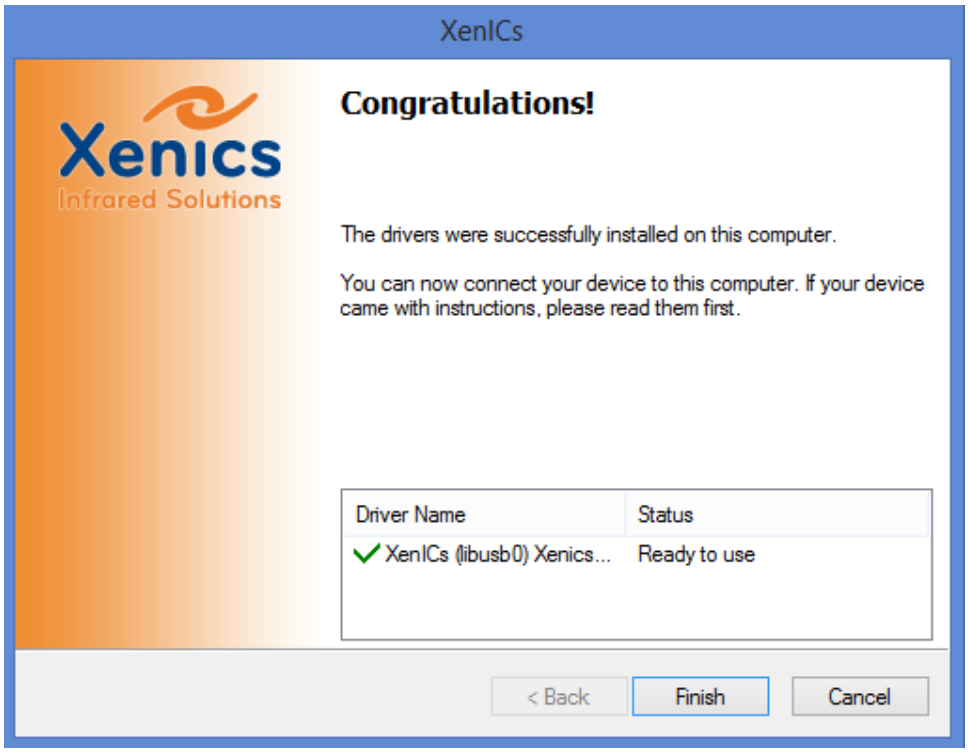

Figure 3-10 Installation end page

Click ‘Finish’ to proceed with the rest of the installation.

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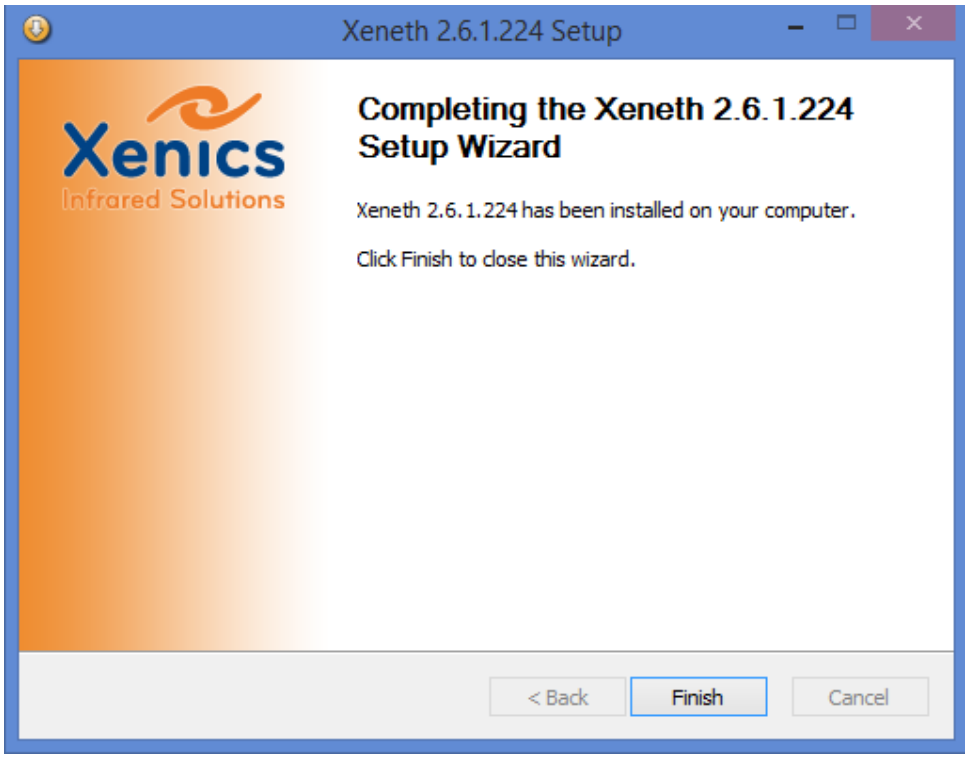

Figure 3-11 Finish installation

Find the Xeneth shortcut (

) on the windows desktop. Double click it to start the application.

3.5. Xeneth Documentation

After the Xeneth installation, the Xeneth User Manual can be found in the following Xeneth installer folder and in the Help tab within Xeneth:

- C:\Program Files\Xeneth
  (64 bit Xeneth installed on a 64 bit operating system or 32 bit Xeneth installed on a 32 bit operating system).
- C:\Program Files (x86)\Xeneth
  (32 bit Xeneth installed on a 64 bit operating system).

3.6. Uninstall

When selecting the Xeneth uninstall option, Figure 3-12 is shown.

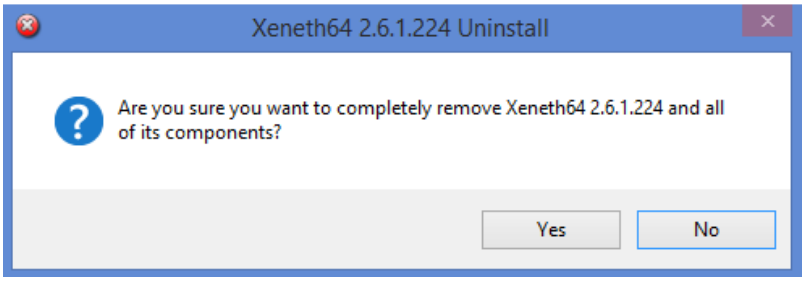

Figure 3-12 Xeneth uninstall

Click 'Yes' to remove the Xeneth software. Afterwards the uninstaller will prompt whether or not the data stored in the "C:\program files\xeneth\Calibrations" is discarded (see Figure 3-13).

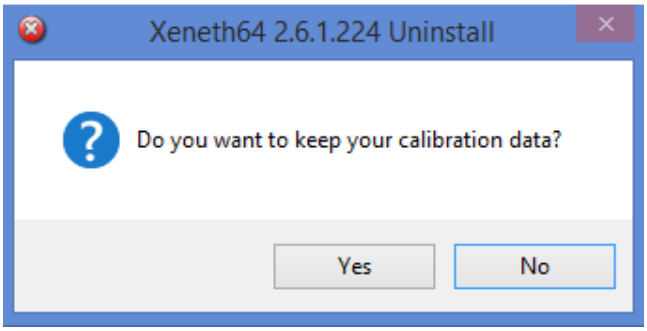

Figure 3-13 Xeneth uninstall – Calibration data

Click 'Yes' to keep the data.

The following figure is shown afterwards:

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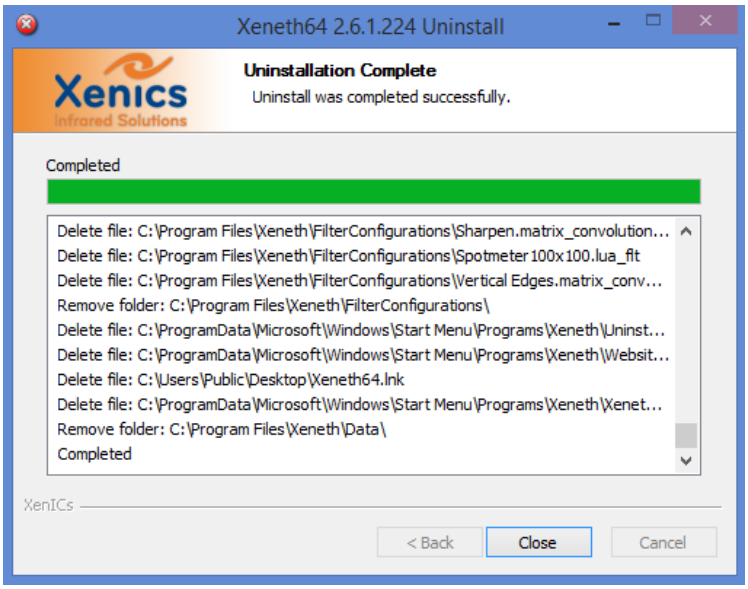

Figure 3-14 Xeneth uninstall – Close

When clicking the ‘Close’ button, the uninstaller will proceed to remove the Xeneth software and its API.

4. Getting Started

4.1. Connecting the Camera using USB

Connect the camera to its power supply, and proceed to connect the camera's USB port to the PC using the Xenics cable.
When any new hardware detected dialogs from windows pops up, refer to chap. 3 Installation. It is possible that the USB driver was not installed, or the proper procedure was not followed.

4.2. Connecting the Camera using GigE

Connect the camera to its power supply, and proceed by connecting the camera's Ethernet connection to the local network (Cat 5e or better).

Alternatively, it is possible to connect the camera directly to the PC, but keep in mind that if the PC has a 100mbit NIC, a crossed UTP cable must be used instead of a regular UTP cable.

Please keep in mind that an Ethernet network is being built. If the camera in question does not have Zero Configuration support, a DHCP server must be available, so that the camera can be assigned an IP address.

When the camera is located on a different subnet it is still possible to connect to the device by assigning a new IP address using the Force IP procedure defined by the GigE Vision standard. For more information on how to enable this feature refer to chap. 5.2.1.4.

4.3. Connecting the Camera using Camera Link

If a compatible Camera Link™ card is available and the camera has a Camera Link port available, connect the Camera Link cables at this point.

Keep in mind that for cameras with multiple Camera Link outputs, great care has to be taken as to which cable to be plugged into which slot. Always pay attention to the Base/Medium designations on both the camera housing and the grabber.

Not all cameras allow commands to be sent over Camera Link. These cameras must be used in combination with an additional connection (e.g.

USB) for command and control.

5. In Depth

5.1. Connection Setup – Manual

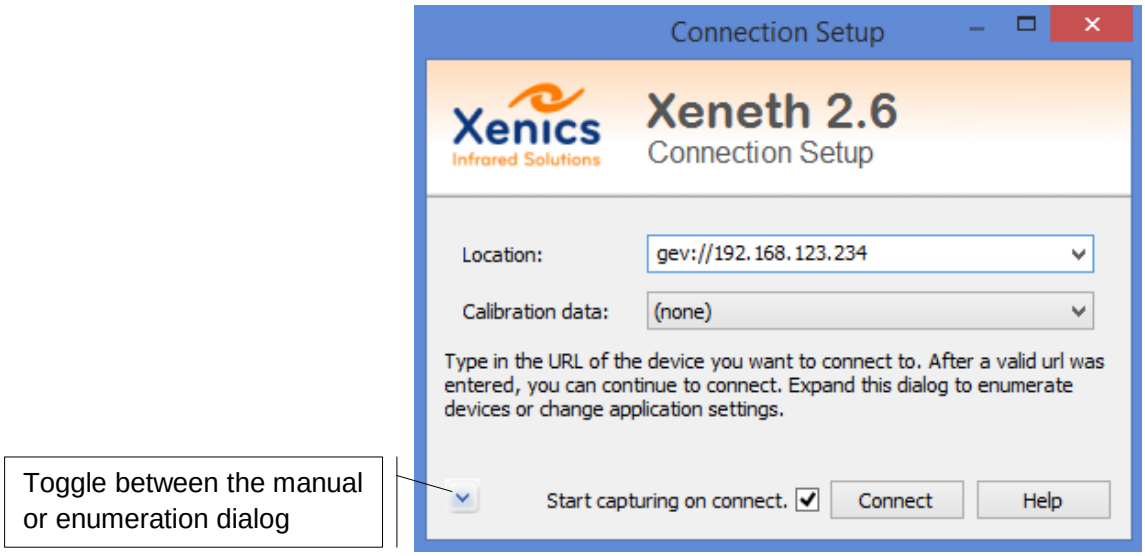

Figure 5-1 Connection setup

Using the manual connection dialog it is possible to immediately type in the URL of the camera the user wishes to establish a connection with in the *location* text box. Currently GigE Vision and the Xenics Network and Serial Protocols are URL enabled. These are explained in depth in chap. 5.1.1 on Uniform resource locator (URL). A history of ten URLs is kept and can be accessed using the drop-down arrow.

After entering a valid URL any calibration pack can be selected using the *Calibration data* drop-down list. Make sure to select the correct pack for the type of camera. If the calibration pack was not loaded correctly it will be reported in the status area. We refer to chap.5.3 for the location of this field.

When a valid location and optional calibration pack was entered a connection can be established using the *Connect*-button, the *help*-button is used to open this manual.

If you want to immediately start capturing when the connection was successfully instantiated make sure to check the *"Start capturing on connect"*-checkbox.

When this checkbox is unchecked, press the  start capturing button to start acquiring images, even when playing back an XVI movie.

Using the expansion button the enumeration dialog is shown. More information on the enumeration dialog is handled in chap.5.2.

5.1.1. Uniform Resource Locator (URL)

All URLs follow a common scheme using the format
protocol-name : [//] **location** [/] [? **query-string**]

protocol-name is a 3 to 4 character abbreviation used to identify the protocol to use.

location is the unique location identifier compatible with the protocol domain.

query-string is an optional part of the URL which allows the user to pass some extra configuration options in special cases. The format is **key=value**.

Parts inside the **square braces** [] are optional and can be omitted while still holding a valid URL.

Protocol	Protocol - name	Location	Remark
Xenics serial protocol	xsp	COM0 … COM255	Via PC serial port
Xenics serial protocol	xsp	CL0 … CL255	Via Camera Link serial port
Xenics network protocol	xnp	ipv4 ethernet address	
GigE Vision	gev	ipv4 ethernet address	

Table 5-1 URL scheme

Key	Value	xsp	xnp	gev	Remark
fg	none	X	X	X	Connect the camera for command and control.
nif	0 … 255	X	X		Select a Camera Link interface.
forceip	{Ipv4; Ipv4; Ipv4}			X	See force IP in chap 5.2.1.4. See example below.
bitsize	8, 16, camera	X	X	X	Applicable to cameras that have selectable bit depth.

camfile	File path	X			Suggest an alternative camera file to the frame grabber.

Table 5-2 URL scheme – Query string

Examples:

- “gev://10.0.0.1” opens a connection to a GigE Vision camera with IP address 10.0.0.1 for command and control and image grabbing.
- “gev://192.168.1.12?fg=none” opens a connection to a GigE Vision camera with IP address 192.168.1.12 for command and control only.
- “xnp://10.0.0.1” opens a connection to a Xenics network camera with IP address 10.0.0.1 for command and control and image grabbing.
- “xnp://192.168.1.12?fg=none” opens a connection to a Xenics network camera with IP address 192.168.1.12 for command and control only.
- “xnp://192.168.1.12?nif=CL0” opens a connection to a Xenics network camera with IP address 192.168.1.12 for command and control and image grabbing over the first detected Camera Link channel.
- "xsp://COM1" opens a connection to the serial COM port. Since COM ports do not support any frame grabbing this session will start as command and control only.
- "xsp://CL1" opens a connection to a Camera Link camera. Because Camera Link channels support image grabbing this will open a session for both command and control and image acquisition.
- gev://192.168.2.100?forceip={192.168.1.100;255.255.255.0;192.168.1.1}. Open a connection to a camera and force it to change its IP address to
    - 192.168.1.100 is the imposed IP address
    - 255.255.255.0 is the imposed network mask
    - 192.168.1.1 is the imposed local gateway.

5.2. Connection Setup – Enumeration

The connection setup dialog is divided into several tabs. The *Enumerate devices* and *Enumeration settings*- tabs can be used to configure options specific to device enumeration. The *Application settings*-tab allows configuring features specific to the graphical user interface. The following paragraphs provide an overview followed by an in depth description of the different components and settings.

5.2.1. Enumerate Devices

The *device list* with sort option for sorting the list items based on transport, name or serial number. The item is prefixed with a status icon. A green icon indicates the device is available, red means the device is busy and a black icon indicates that the device is unavailable. When the mouse is hovering over an individual item a tooltip is shown with the basic device information.

The device information holds camera specific details of the selected camera. This section is split into several tabs to enable protocol specific options.

Toggle between the manual or enumeration dialog

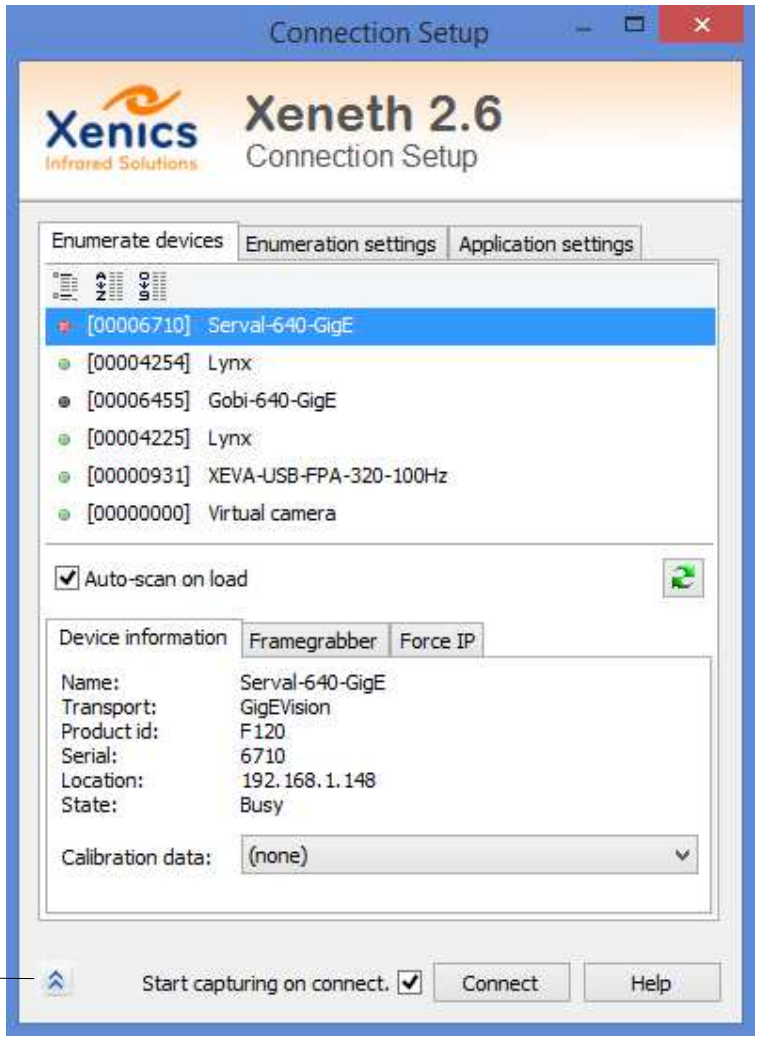

Figure 5-2 Enumerate devices

5.2.1.1. Device List

This component holds a list of all the devices found during the enumeration procedure. A tool tip containing basic information about a device can be obtained by placing the mouse above one of the items.

The items in the device list are formatted such that the user can instantly identify the camera by serial number and model name. The status icon immediately tells the user if he

is able to connect the device. A camera can have three device states: Available , Busy or Unreachable . The unreachable state is only shown for GigE Vision cameras when the *Ignore subnet mask*-option is set to True in the *Enumeration settings*-tab. When the user encounters a device in this state, the Force IP procedure has to be performed first before a connection can be established (see chap. 5.2.1.4.).

The device list is also sortable by using one of the sort buttons above the device items.

- Sort the list alphabetically in ascending order using the transport name.
- Sort the list alphabetically in ascending order using the device name.
- Sort the list numerically in ascending order using the serial number.

When the *Auto-scan on load* box is checked this dialog will be displayed when the application is started and cameras are enumerated automatically. When unchecked the manual connection dialog will be shown on startup.

Use the *"Refresh"*-button ( ) located at the bottom right of this section to update the list of devices.

When a camera is selected clicking the item in the list the *device information*-section is instantly updated.

In case the camera cannot be found in this list, refer to chap. 0 Troubleshooting Camera Detection Problems.

5.2.1.2. Device Information

These fields hold camera specific information. Based on this the user can determine what the camera's model specifications is, what its native protocol is, what its state is and where it is located. A calibration pack can be selected using the *Calibration data* drop-down list. Make sure to select the correct pack for your camera. If the calibration pack was not loaded correctly, this will be reported in the status area (see chap 5.5).

5.2.1.3. Frame Grabber

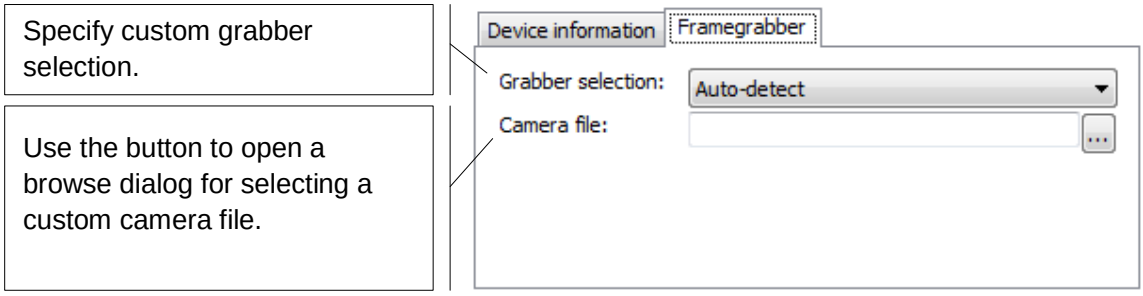

Figure 5-3 Frame grabber

Grabber selection allows the user to select the video stream of the camera.

Auto-detect

By default Xeneth will choose the command and control channel to stream the data. If the command and control channel is not Camera Link, the user needs to select a camera Link port (*CL0, CL1, CL2* or *CL3*).

Command and control

The application will open no *X-View* window, only the *Settings* panel will be presented to the user to enable control of the camera.

CL0, CL1, CL2 or *CL4*

When the command and control channel is different from the streaming channel, the user has to enter which Camera Link interface needs to be used. When only one Camera Link interface is available it is most likely named CL0.

Camera file is used to select a custom, manufacturer specific formatted, camera file. These camera files can be created and tested with various manufacturer specific tools. If the file works in these environments they can be used in Xeneth. An absolute path should be supplied to the camera file. Use the "…" button to open a browse dialog.

5.2.1.4. Force IP

Enter a valid IP address, a netmask and the gateway to be sent with the Force IP packet to enforce the camera in a new configuration. Note that this new configuration is valid until the camera is power cycled.

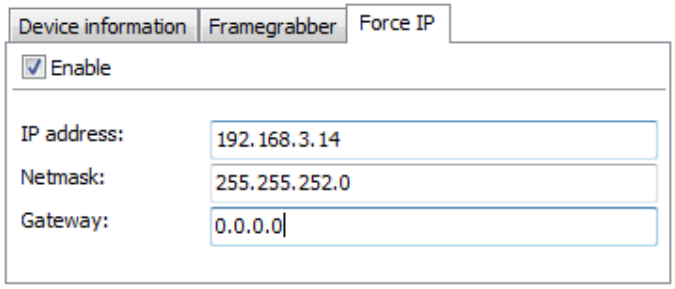

Figure 5-4 Force IP

The GigE Vision protocol has defined a procedure to recover the camera from an invalid IP configuration. To enable Xeneth for enumerating devices that are not using the same network configuration as the user make sure to set the Enumeration Settings → Protocol specific settings → GigE Vision → Ignore subnet mask option to True.

After this option is set, the cameras discovered on a different network will be marked with the Unreachable ● state. To force a new IP address, make sure to check the "*Enable*"-checkbox in the Force IP tab and enter a new valid IP configuration. This new setting will only be retained until the camera has been power cycled again. It is therefore advised to configure the IP settings of the camera once the session has been opened such that a new persistent IP address is assigned or the camera will get a new address through DHCP after the next power cycle.

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5.2.2. Enumeration Settings

Enable protocols allows the user to specify individual protocols to be enabled or disabled. This is useful to speed up enumeration by specifying just the protocol of the devices the user wants to discover.

Using the p*rotocol specific settings* the user is able to configure details of the enumeration procedure for specific protocols. For GigE Vision, *Ignore subnet mask* allows to enumerate devices located on a different subnet. For serial the user is able to set the port ranges that will be used during enumeration.

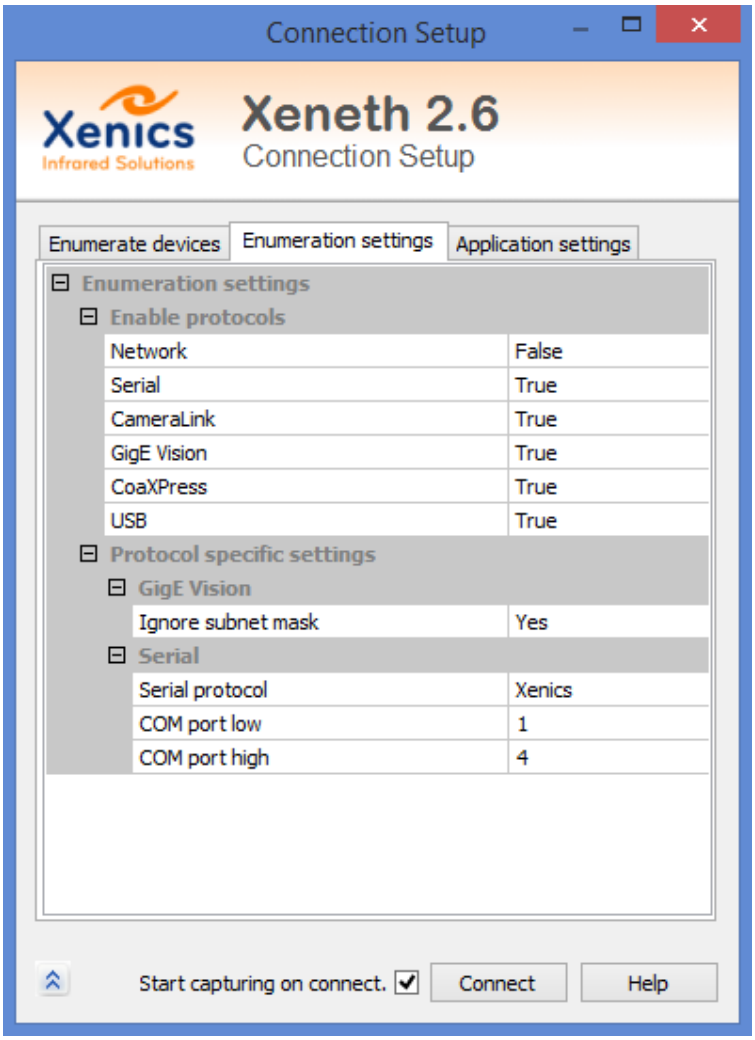

Figure 5-5 Enumeration settings

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5.2.3. Application Settings

Set extra camera options relevant to the GUI application.

Configure options only relevant to the GUI application and interface.

Path to frame grabber files for Imperx

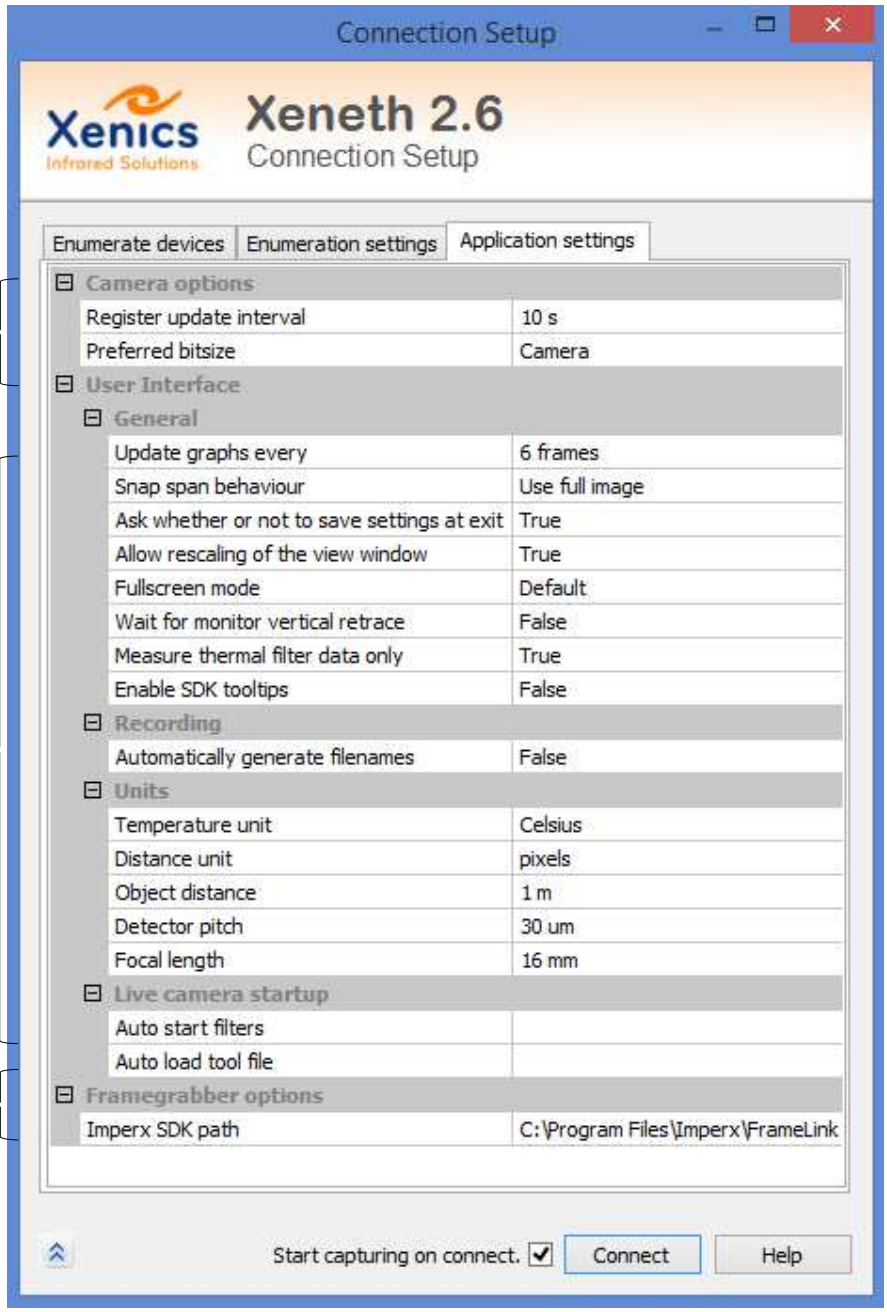

Figure 5-6 Application settings

5.2.3.1. Camera Options

- Register update interval – Controls the time interval in which the register update cursor moves between readable camera registers.
- Preferred bitsize – This option allows overriding the camera's default bit size. This is only relevant for some cameras which allow variable pixel sizes.

5.2.3.2. User Interface Options

Explanation of the *General* parameter fields in the user interface:

- Update graphs every n frames – Controls when the user interface will redraw the different graphs (Histogram, Graph, Timegraph).
- Snap span behaviour – Determines the histogram that is taken into account when the scale is snapped automatically ().
- Ask whether or not to save settings – When true, the application will prompt to save default settings for the camera type attached.
- Allow rescaling of the view window – When true, it causes the main view to be stretched up to touch the window's edges.

i When set to false, it may give performance gains when the video card does not have hardware acceleration for Stretched Blitting.

- Fullscreen mode – When the user goes into full screen, the camera image can be shown in 3 different modes.
  - Default: Image is scaled to the first boundary. The borders are filled with a checkers pattern and the toolbar is visible.
  - Scale: Image is scaled to the first boundary. The borders are filled with black and the toolbar will be hidden.
  - Crop: The image is scaled such that no borders are shown. In this case part of the image can fall outside the visible area. The toolbar is hidden.

i Images are always centered, unless manual panning of the image was performed. To leave fullscreen mode, use the escape button. The fullscreen-button from the toolbar can also be used if the toolbar is visible.

- Wait for monitor vertical retrace – When set to true, it forces the software to wait for the monitors vertical blanking interval before drawing frames.

i When undesirable image tearing occurs when operating Xeneth, this should be activated. However do note, that this could consume quite some CPU cycles due to the way this is implemented in Windows.

- Measure thermal filter data only – When true, the effect of image enhancement filters is ignored while converting pixel data into temperatures. See chap. 5.9.14 and chap 6.4.1.
- Enable SDK tooltips – The features shown in the Settings tab (chap. 5.9.11) are available for developers integrating the Xeneth SDK. When this option is activated the correct programming names are shown in a tooltip.

Explanation of the *Recording* parameters:

- Automatically generate filenames – When true the user is not prompted to give a new file name every time a movie is recorded (chap.5.9.13).

Explanation of the *Units* parameter fields in the user interface:

- Default temperature unit – The unit at which thermal information is displayed: (Celsius, Kelvin, Fahrenheit).
- Distance unit – The distance unit that is used in the UI (pixels, m ,mm, inches, feet).
- Object distance – The distance to the target for unit conversion
- Detector pitch – Square pixel size in µm
- Focal length – The focal length of the lens

Explanation of the *Live camera startup* parameter fields in the user interface:

- Auto start filters – Comma separated list of image filters that automatically will be loaded in the Image processing tab (chap.5.9.14): e.g. *Matrix, AutoExposure.*
- Auto load tool file – The on-screen selections (tools) file to load at startup.

5.2.3.3. Frame Grabber Options

- IMPERX SDK path – This option is only visible when support for IMPERX (Camera Link) was selected during installation (chap. 3.3.2.3). When a path different from the default installation path is selected, Xeneth needs this information to find the IMPERX SDK runtime DLLs.

5.3. User Interface Overview

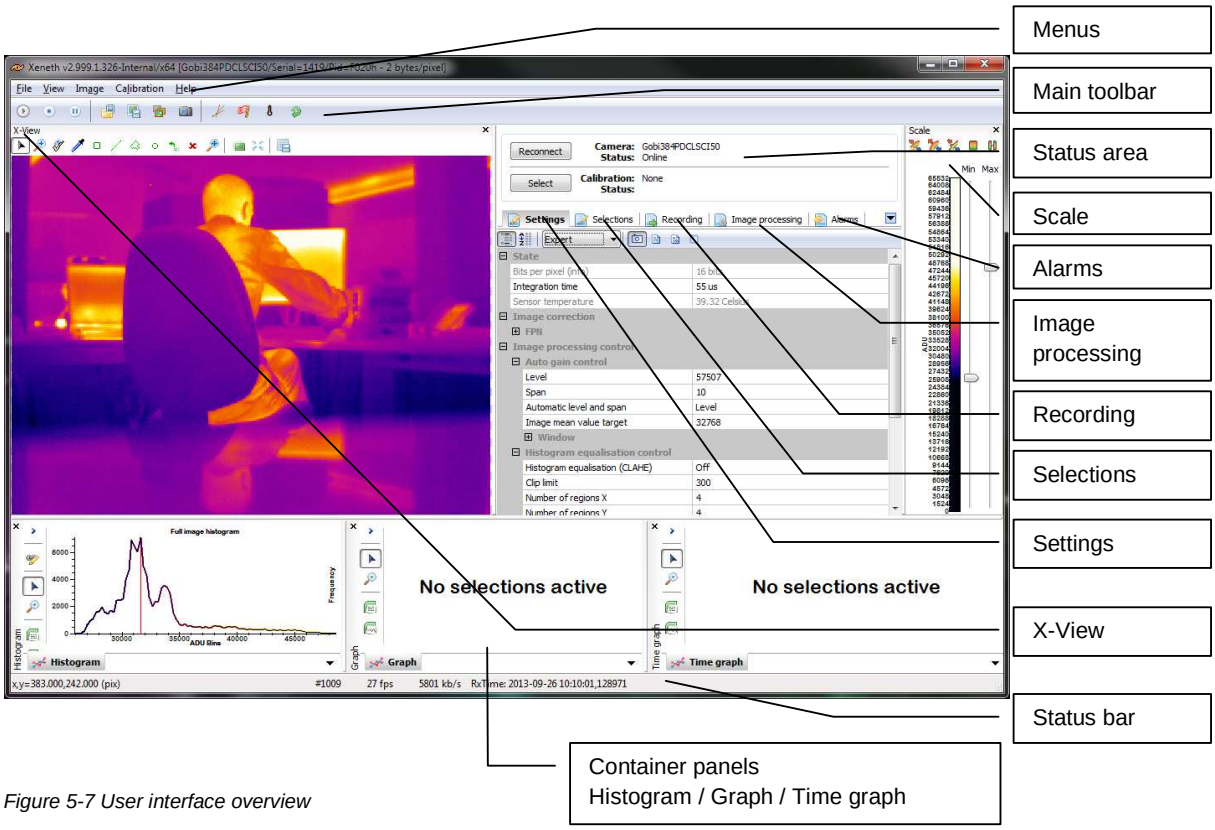

Figure 5-7 User interface overview

The Xeneth user interface consists of a number of key elements, such as the menu bar at the top of the screen. This is followed by the toolbar underneath it, which contains quick access to some of the key functionality such as starting the acquisition, pausing output, loading/saving images and activating corrections. The remaining user interface is divided into containers that support reorganization of the interface elements, which are called the container panels and tabs. The (Settings, Selections, Graph, etc.) tabs can be dragged from one container panel to another, which allows the reorganization of the user interface to match the available task.

5.4. Reorganizing the User Interface

It is possible to drag the Settings, Image processing, Graph, Histogram and Selections tabs from the main container (between the display and the scale) to any of the three containers below. It is also possible to re-arrange the containers by left-clicking and dragging ( ) their title bars to drop them somewhere else in the user interface (see Figure 5-8).

If a particular container is no longer necessary, it is possible to close it by clicking the (×) button next to its title bar.

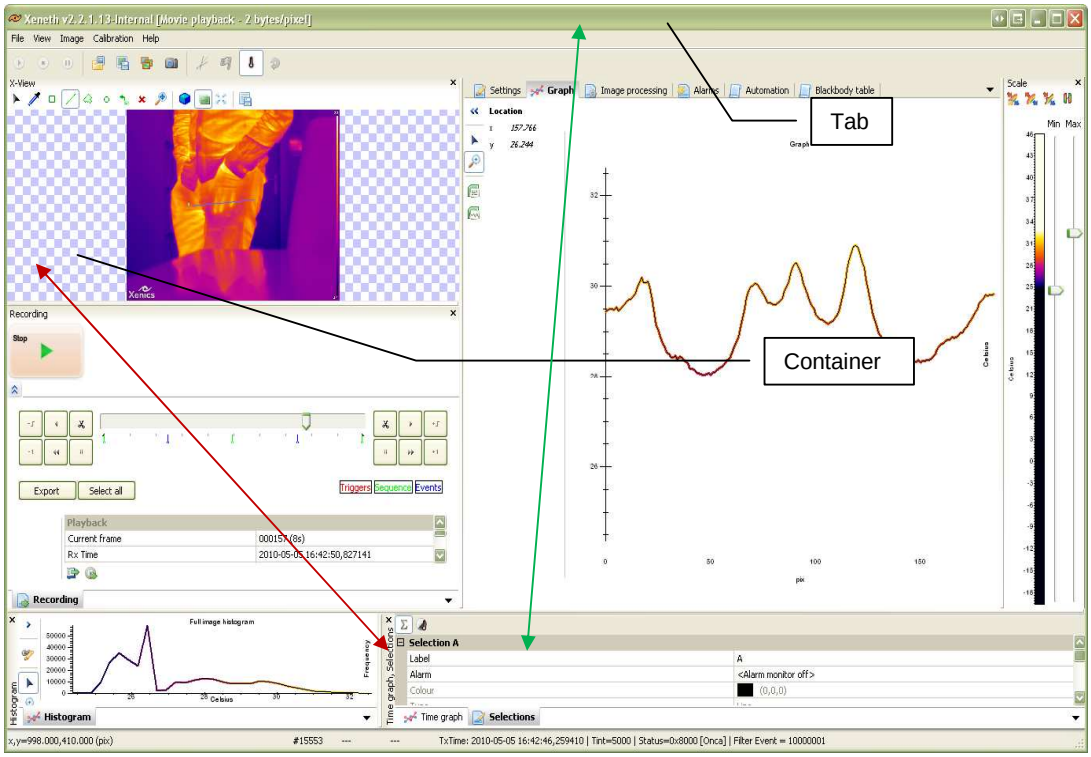

Figure 5-8 Reorganizing the user interface

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5.4.1. Rearranging Containers

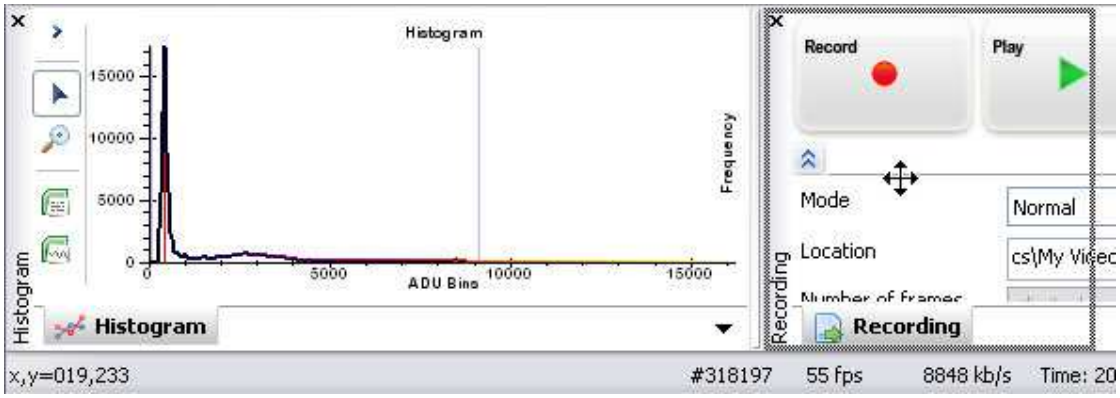

Figure 5-9 Rearranging containers

To move a container, position the mouse on the name of the window to drag. The mouse cursor will change to two orthogonal double arrows.

Keep the left mouse button pressed. Whilst doing this it is possible to drag the window. Release the left mouse button to drop the window in its new location (which is indicated by dotted lines while you are dragging).

Special keyboard modifier: While dragging, and when keeping the 'CTRL' key pressed, it is possible to decouple the container from the main application, and thus make it free floating.

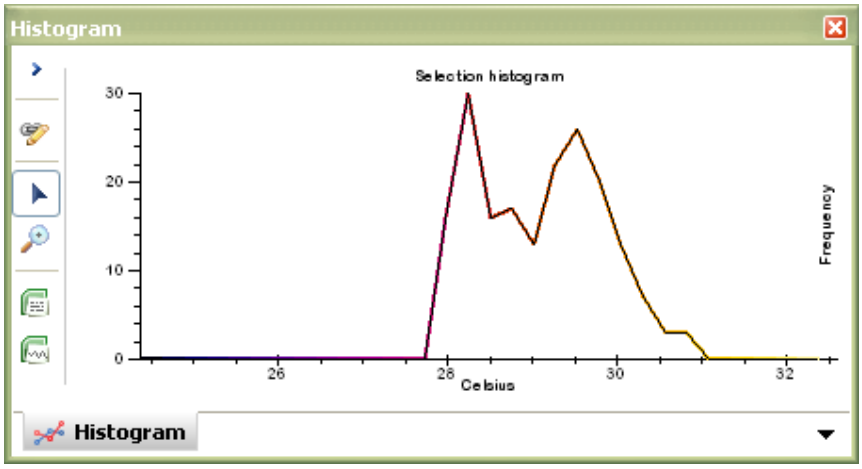

Figure 5-10 Histogram container

i It is possible to easily restore the default layout of these containers by clicking F12, or going to the *View* menu and choosing *Restore Defaults*.

5.4.2. Resizing Containers

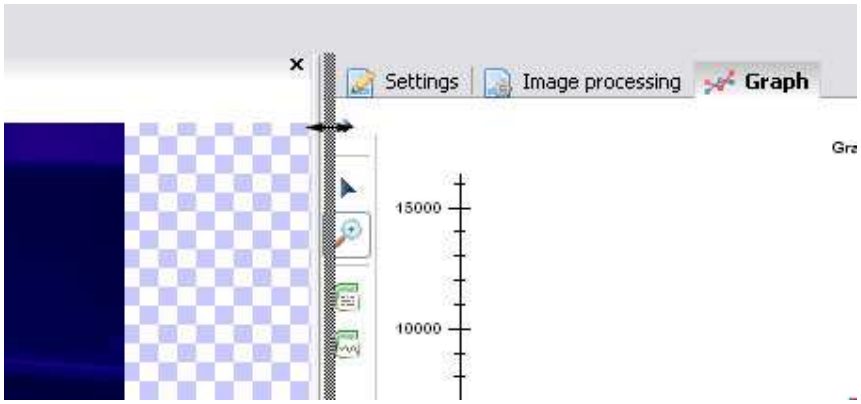

Figure 5-11 Resizing containers

To resize containers, select the raised area between two containers, and wait for the cursor to change to a double arrow cursor. Now, left-click and drag to change the ratio between the two window's sizes.

5.4.3. Closing/Reopening Containers

Close a container window by pressing the (×) next to its title.

Figure 5-12 Closing a container

When a container must be reopened that was closed earlier, go to the *View* menu, and click the container that must reappear.

5.4.4. Dragging Tabs

Dragging tabs is quite simple and is a powerful way to get a quick overview of the interesting data.

Left-click and keep the mouse button pressed to see the drag and drop cursor appearing (see Figure 5-13).

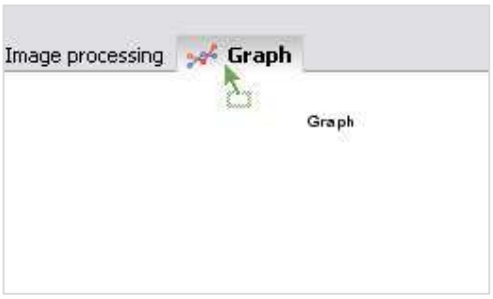

Figure 5-13 Dragging tabs – Keep left mouse button pressed

Now move the mouse to another container window and release the left mouse button (see Figure 5-14).

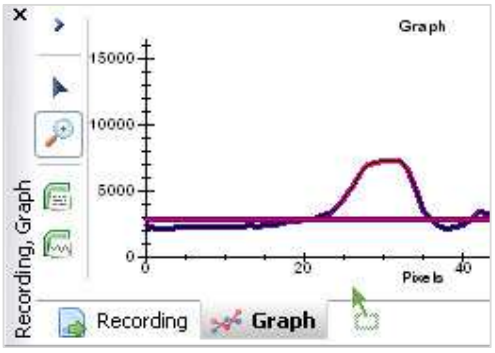

Figure 5-14 Dragging tabs – Release left mouse button

5.4.5. Enabling/Disabling Tabs

The selection of tabs from the main view can be customized through the *View* menu (chap. 5.8.2).

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5.5. The Status Area

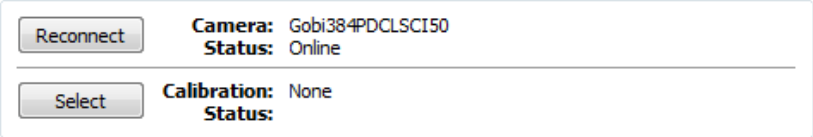

Figure 5-15 Status area

The status area (see Figure 5-15) shows the current camera's name and connection status (*Online* or *Offline*). The *Reconnect* button allows to disconnect from the current camera and to return to the connection dialog to reconnect or to select a different camera.

In addition, the status area shows the currently loaded calibration and its type (i.e. NUC, TrueThermal, InGaAs thermal, etc.), as well as any errors that occurred when trying to load the calibration. The 'Select' button allows selecting a calibration.

5.6. The Title Band

Figure 5-16 Title band

Explanation from left to right:

- Xeneth vMaj.Min.Beta.Build Basic/Radiometry/Advanced – The Xeneth type installed.
- Gobi-640-GigE – The camera type.
- Serial=<x> –The decimal serial number that can be found on the back plate of the camera.
- Pid=<hex>h –The product identifie.
- 16 bits/pixel – The size of an individual pixel.

5.7. Main Toolbar

Figure 5-17 Main toolbar

Explanation from left to right:

Parameter	Explanation	Xeneth version
Start capture ( )	Starts acquiring video data from the camera system.	All
Stop capture ( )	Stops acquiring video data from the camera system.	All
Pause ( )	Causes the software to freeze the output for as long as this button is active.	All
Load image ( )	Loads and displays an image from disk.	Advanced, Radiometry
Save image ( )	Save the current output to disk.	All
Save sequence ( )	Starts the sequence recorder (chap. 5.8.3.3 Save Sequence).	Advanced, Radiometry
Save snapshots ( )	Arms the snapshot recorder (chap. 5.8.3.4 Save Snapshots).	Advanced, Radiometry
Non Uniformity Correction (NUC) ( )	Starts correcting sensor output. (chap. 5.9.14.2). The NUC that is applied is part of the calibration pack that is selected via the *Select* button in the status area (chap.5.5)	Advanced, Radiometry
Thermography ( )	Starts thermal conversion (chap. 5.9.14.8 and chap. 6).	
Restore ( )	Restores the camera settings in effect during the creation of the active calibration pack.	Advanced, Radiometry
Show web interface ( )	When the camera has a web interface, it can be opened here.	

Table 5-3 Main toolbar parameters

5.8. Menus

5.8.1. The File Menu

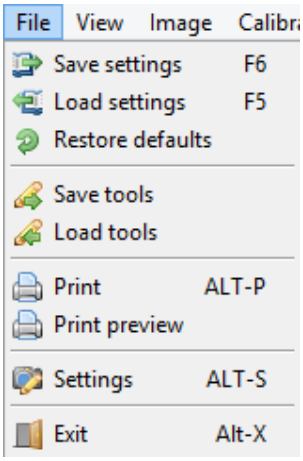

Figure 5-18 File menu

Top-down explanation of the file menu:

- Save settings ( ) – Store the current camera configuration to a file.
- Load settings ( ) – Restore the camera configuration from a file.
- Restore defaults ( ) – Restore the camera settings to the settings of the active calibration pack.
- Save tools ( ) – Save the current selections to disk.
- Load tools ( ) – Restore selections from a file.
- Print ( ) – Print the current image to any printer (this includes the temperature scale in thermography mode).
- Print preview ( ) – Essentially the same as “Print” but it is possible to inspect the image first.
- Settings ( ) – Open the settings dialog.
- Exit ( ) – Close the application.

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5.8.2. The View Menu

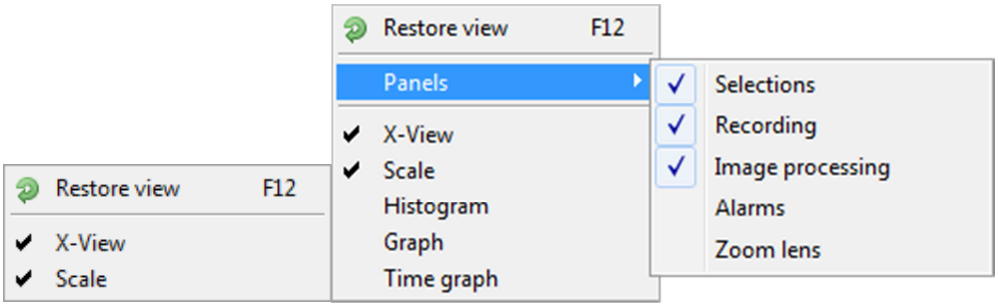

Figure 5-19 View menu – basic,advanced,radiometric

The view menu makes it possible to hide/restore the different containers available in Xeneth.

- Restore view – Restores the factory default layout of the different containers, and reset all panels to default activation and ordering (F12)
- Panels – Select which panels to show or hide in the interface
- X-View – The main view window
- Histogram – Container window
- Graph – Container window
- Time graph – Container window.
- Scale – Window for scale.

5.8.3. The Image Menu

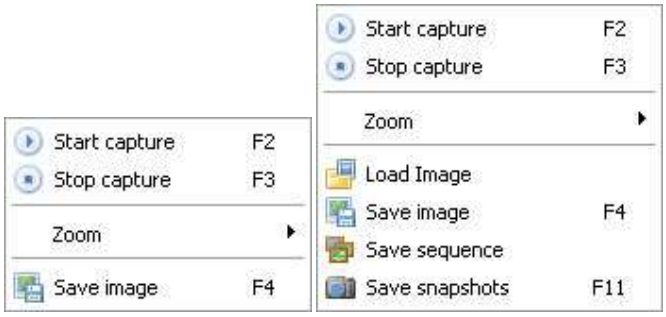

Figure 5-20 Image menu – basic, advanced, radiometric

- Start capture – Starts capturing data from the camera.
- Stop capture – Stops capturing data from the camera.
- Zoom – The available zoom settings (100% -> 400%) are subset of all zoom positions that can obtained via the Main tool bar (chap. 5.7).

5.8.3.1. Load Image

Xeneth offers some live image processing using external images.

After pressing the load image button ( ) the Windows open file dialog box is shown (see Figure 5-21).

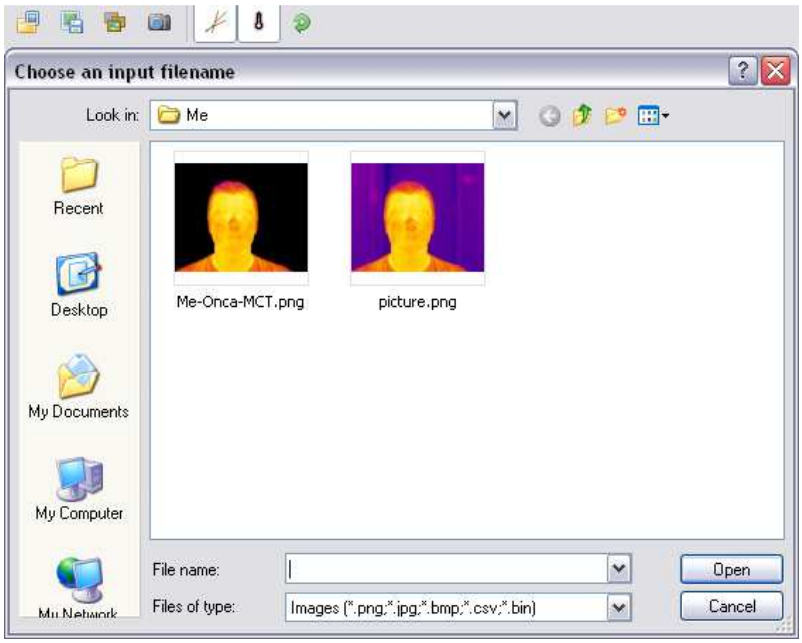

Figure 5-21 Open file dialog box

After selecting the image to load, several options for using the image are shown in the Image Processing tab (see Figure 5-22). If the Image Processing tab is missing, enable it through the *View* menu (chap. 5.8.2).

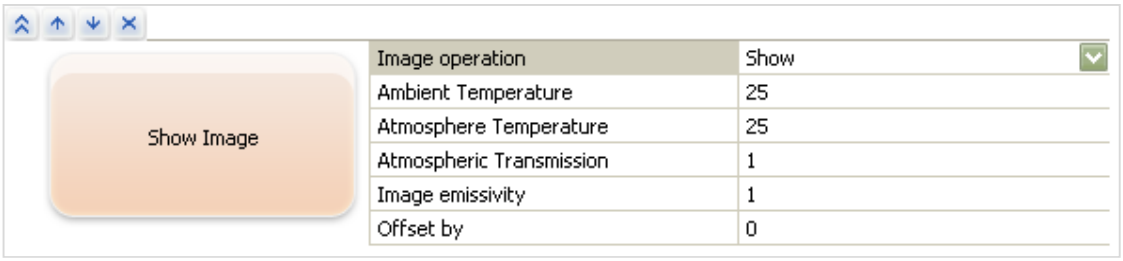

Figure 5-22 Show image options

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Explanation of the show image options:

- Image operation:
  - Show – Display the image.
  - Add – Add the image to current camera output.
  - Subtract – Subtract the image from the current camera output.
- Ambient Temperature
  - Available for thermal images (xpng) only – Set the ambient temperature near the object in the image.
- Atmosphere Temperature
  - Available for thermal images (xpng) only – Set the atmosphere temperature.
- Atmospheric Transmission
  - Available for thermal images (xpng) only – Set the atmospheric transmission.
- Image emissivity
  - Available for thermal images (xpng) only – Change the global emissivity of the source image.
- Offset by
  - Shift the input image (thermal / non thermal) by set value (degrees / digital unit).

Unload the image by removing the filter (Click ).

5.8.3.2. Save Image

After clicking the 'Save Image' button ( ) the following save dialog is shown:

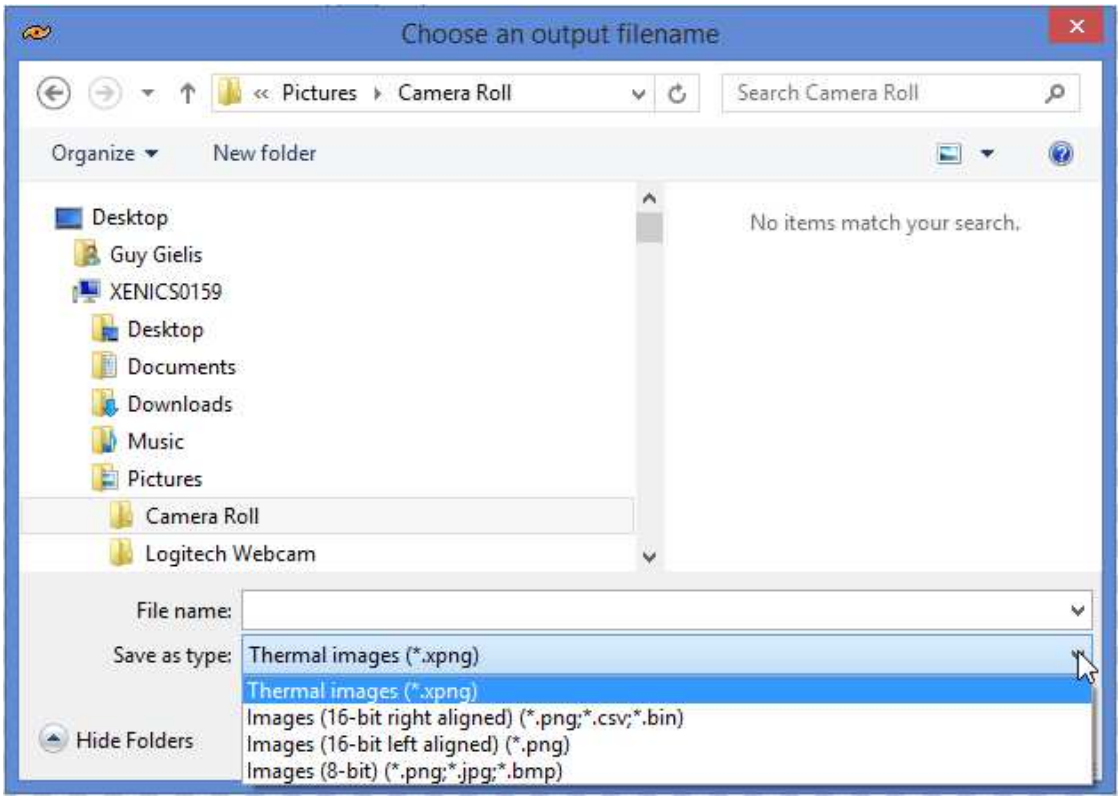


Figure 5-23 Save image dialog box

The following file formats are available:

- XPNG – An extension to the PNG image format which keeps track of thermal calibration information.
- PNG – This is the standard for storing 16 bit data, is lossless and supported by most imaging applications.
- CSV – Comma separated values. Compliant with Microsoft Excel.
- BIN – Raw binary, outputs a raw stream of 16 bit values.
- BMP – This format supports pseudo color output (8 bit).
- JPG – This format supports pseudo color output (8 bit).

Color

Color information will not be saved in a file format that has no (8 bit) RGB pixel data. This implies that overlay information that is added by some image processing filters could be lost. Moreover, the color profile defined by the scale and its sliders (see 5.9.12 Scale) is ignored.

Alignment

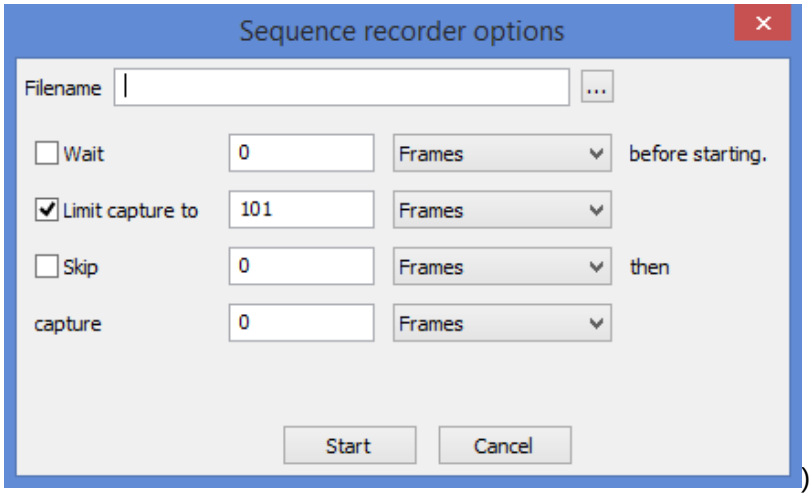
For cameras with pixels consisting of 12 or 14 bit (and hence having values going up to 4095 and 16383) a choice must be made on where to put these bits within a 16 bit word.

- Right aligned – The digital counts are stored as their actual values (0-4095 / 0-16383)
- Left aligned – The digital counts are shifted to the left so that white is always 65535.

After a filename has been chosen and the save button was hit, the image will be saved to disk.

i The software will also freeze the current output from the camera while being in this dialog box.

5.8.3.3. Save Sequence

After clicking the *Save Sequence* button ( ) the *Sequence recorder options* dialog box is shown (see 

). The same file types are available as during a regular image save.

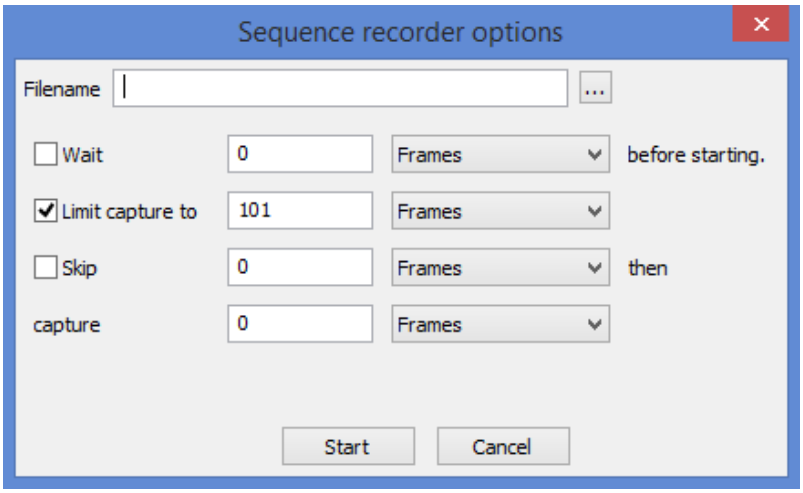


Figure 5-24: Sequence recorder options dialog box.

At the top of the dialog it is possible to choose a filename, and file types that are used while recording a sequence of images. The following counter is automatically appended to the filename:

<your filename>_<counter>.<ext>.

The control part in this dialog box operates as follows:

- Wait – Makes it possible to specify a delay in time or in frames before starting acquisition.
- Limit capture to – Specifies the maximum number of frames/time within which to:
    - Skip – Skip n frames/wait n time units and then
    - Capture – Record n frames/n time units.

5.8.3.4. Save Snapshots

The save snapshot button ( ) is used to make a series of quick shots.

When clicking the button a file save dialogue is shown:

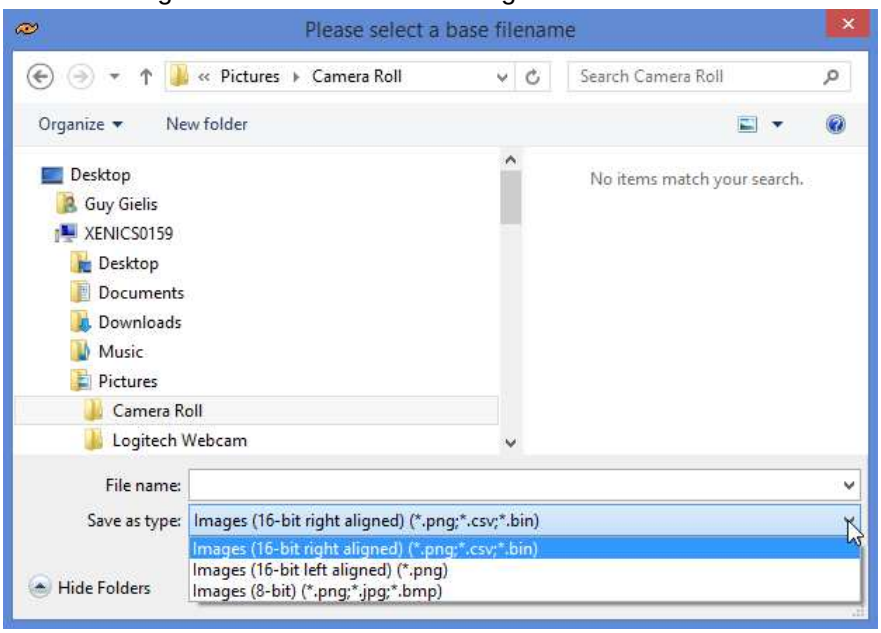


Figure 5-25 Save snapshots dialog box

The button ( ) becomes armed after which it has the following functionalities.

- Left mouse click – Saves <yourname>_<counter>.<ext> to disk
- Right mouse click – Disarms the save snapshot button ( ).

i When saving snapshots it is not possible to store files in a .xpng format.

5.8.3.5. png Versus xpng File Format

To store an image in a xpng format, it is needed that a thermal calibration pack is loaded and the thermal filter is active. In that case thermal information is stored as metadata in the file. This allows the user to reinterpret the data in the image by adjusting the emissivity of the displayed objects and the ambient temperature of the scenery.

Notice that also the effect of other image filters is neglected when saving the xpng. Again, the reason for this is to allow thermal analysis in post processing.

If a png file is saved, the result is an image after all active image processing filters are applied.

Having in mind that a side effect of the thermal filter is mapping the image to an image that linear in temperature, it is possible to measure temperatures on a png file as well. A necessary condition is that no other image filters are active when saving.

In that case you can derive the temperature from the pixel value. Indeed, the lowest pixel value (i.e value 0) corresponds to the lower bound of the temperature range, while the highest pixel value coincides with the upper bound of the temperature range. All other temperatures can be obtained by linear interpolation.

5.8.4. The Calibration Menu

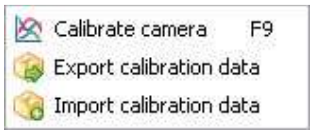


Figure 5-26 Calibration menu

Explanation of the menu items in Figure 5-26:

- Calibrate camera – Launches the *Calibration wizard* shown in Figure 5-27.
- Export calibration data – Exports the current calibration pack to another location in the file system.
- Import calibration data – Copies and activates a calibration pack located in a folder different from to Xeneth Calibrations folder.

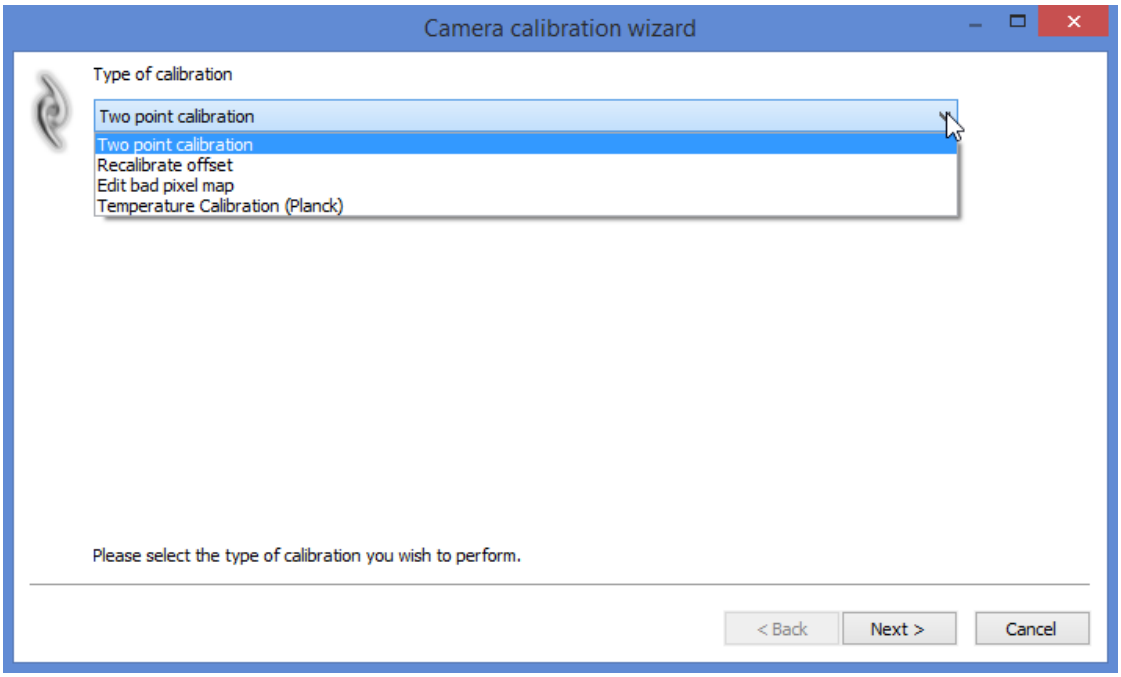


Figure 5-27 Camera calibration wizard

The following calibration types can be selected (see Figure 5-27):

- Two point calibration – Perform a full NUC including bad pixel definition
- Recalibrate offset to compensate for integration time – Modify the offset part of the current NUC.
- Edit bad pixel map – Manually add/remove bad pixel markings from the current calibration pack.
- Temperature calibration (InGaAs) – Allows to correct an active InGaAs thermal calibration.
- Temperature calibration (Planck) – Given knowledge on the spectral behavior of the sensor, this wizard allows to make a temperature calibration for cooled cameras.

5.8.4.1. Two Point Calibration

Two point calibrations (NUC creation) consist of two stages, each of which has its own set of tools to classify bad pixels.

The aim is

- to adjust the offsets and slopes of the individual pixels in the array to obtain a uniform response and to find deviating pixels,

- to detect deviating pixels that need to be replaced.

Tools

To make a two point calibration for a camera with NIR/SWIR detector you need a set up in which a uniform dark and light image can be generated.

In case of a MWIR or LWIR camera a uniform and cold image is required. The best results are obtained when using a professional flat field black body.

Prerequisites

To make a proper calibration it is important that the data collected are representative for the context in which the camera will be used. At least the camera should be in a thermal equilibrium. For cooled cameras this implies that the cooling is switched on and the sensor temperature is at the desired level. For uncooled cameras the sensor and case temperature should have reached their steady state. Depending on the type of camera you deal with this could take up to 30 minutes.

Data: dark/cold image

In a first step of the calibration a dark/cold uniform image is needed. Preferably the image is as dark/cold as possible, yet all of the responsive pixels should have a strictly positive value.

The minimal requirement is that all responsive pixels do have a value lower than 50% of the digital range of the camera.

In case a TrueNUC calibration (see below) is made, it is needed that for none of the integration times in the selected range (responsive) pixels are clipped at zero or have a value in excess of 50%.

When the dark/cold image is not absolutely dark/cold the parameter *Keep offset level* should be selected (Figure 5-32 Two point calibration – Bad pixel criteria and post processing) in order to be able observing signals lower than the presented dark/cold image. This will be always be the case for thermal cameras.

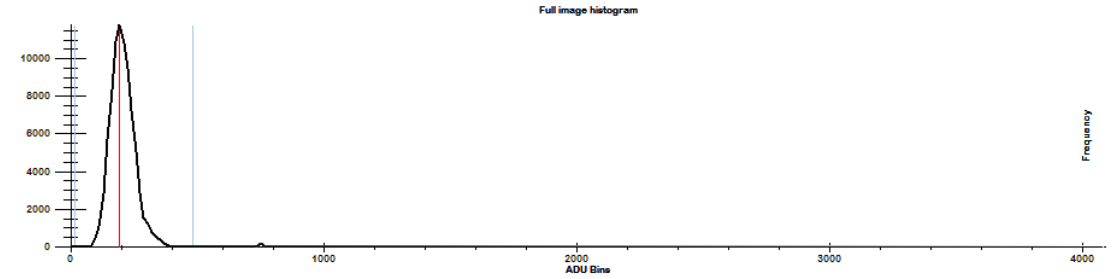


Figure 5-28 Histogram dark image - example 1

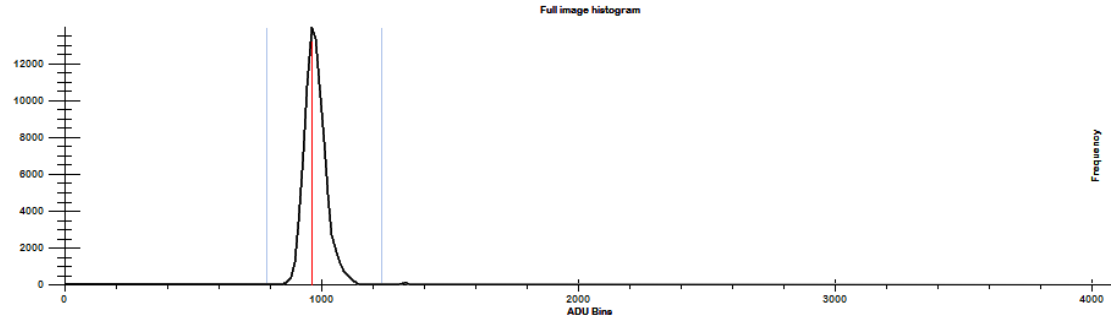


Figure 5-29 Histogram dark image - example 2

Data: light/warm image

In the second step of the calibration a grey/warm uniform image is needed. This image should be substantially higher (at least 30% of the digital range) then the dark/cold image. However, it is important that none of the responsive pixels is clipped at the maximum level.

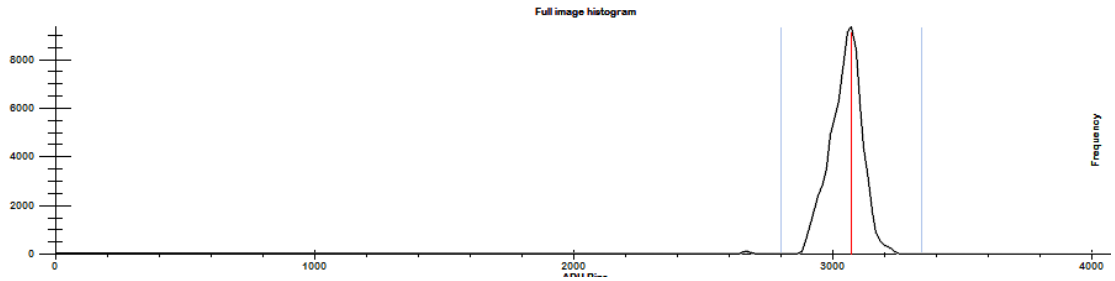


Figure 5-30 Histogram light image

Calibration wizard: step 1

A dark/cold uniform image is required.

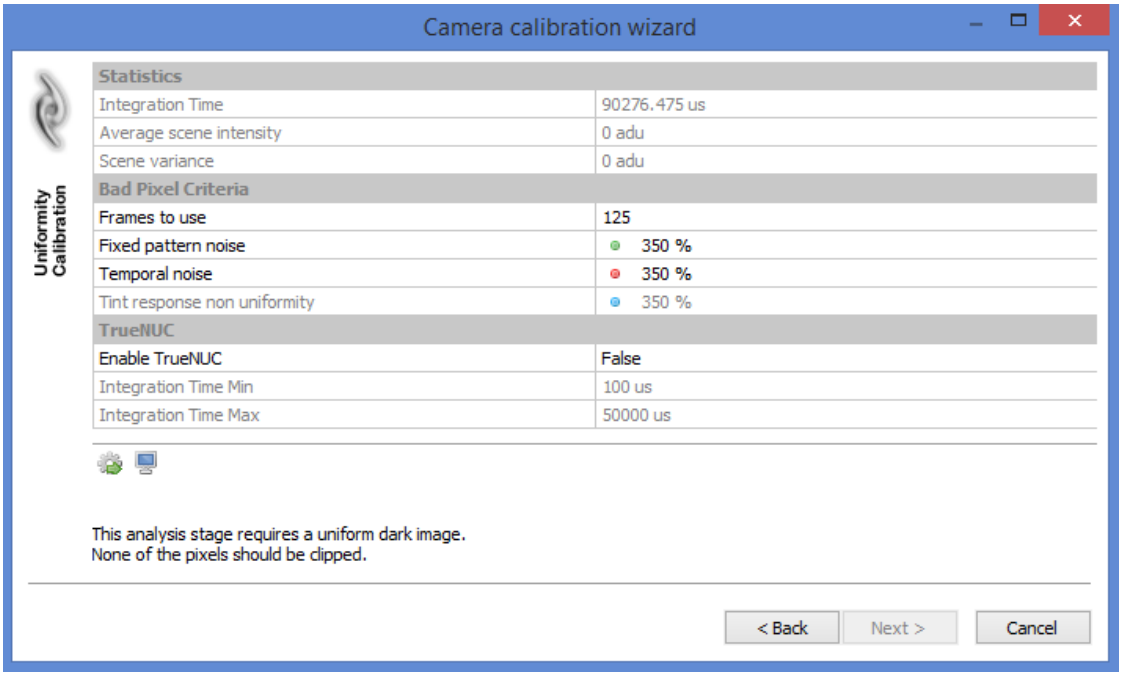


Figure 5-31 Two point calibration – True NUC and bad pixel criteria

Explanation of Figure 5-31:

Bad Pixel criteria:

- Frames to use – The number of frames to be used in the analysis.
- Fixed pattern noise – Defines a threshold to decide which pixels need to be replaced based on their deviating response.
- Temporal noise – Defines a threshold to decide which pixels need to be replaced based on their deviating noise.
- Tint response non uniformity – Defines a threshold to decide which pixels need to be replaced based on their deviating dependency on the integration time. The value is only taken into account when the *Enable TrueNUC* is set to *true*.

TrueNUC:

A TrueNUC calibration is valid for a range of integration times. When this option is not selected the generated calibration pack comes with a fixed integration time.

For optimal image quality select a NUC calibration.

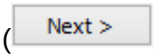
- Enable TrueNUC
  - False: a single integration time NUC calibration is made.
  - Linear: the integration time dependency is modelled by a linear function.
  - Polynomial: the integration time dependency is modelled by a higher order polynomial curve. Depending of the size of the sensor, this option can last for more than 30 minutes. Only select it when you have very good reasons to do so.
- Results – This part of the dialog only pops up after a first analysis is made and shows the amount of pixels that are marked for replacement.

After having entered all parameters push the analysis button () and wait for the result.

During the fittings step of a TrueNUC calibration an abort icon pops up () which can be used to stop the calculations immediately.

Pixels that are marked as outliers will be colored according to the criteria you have entered.

If you notice that the criteria you have imposed are too restrictive or too relaxed, they can be modified and the analysis can be redone by hitting the analysis button () once more.

Use the Next button () to go to the second step of the analysis.

Calibration wizard: step 2

A grey/warm uniform image is required.

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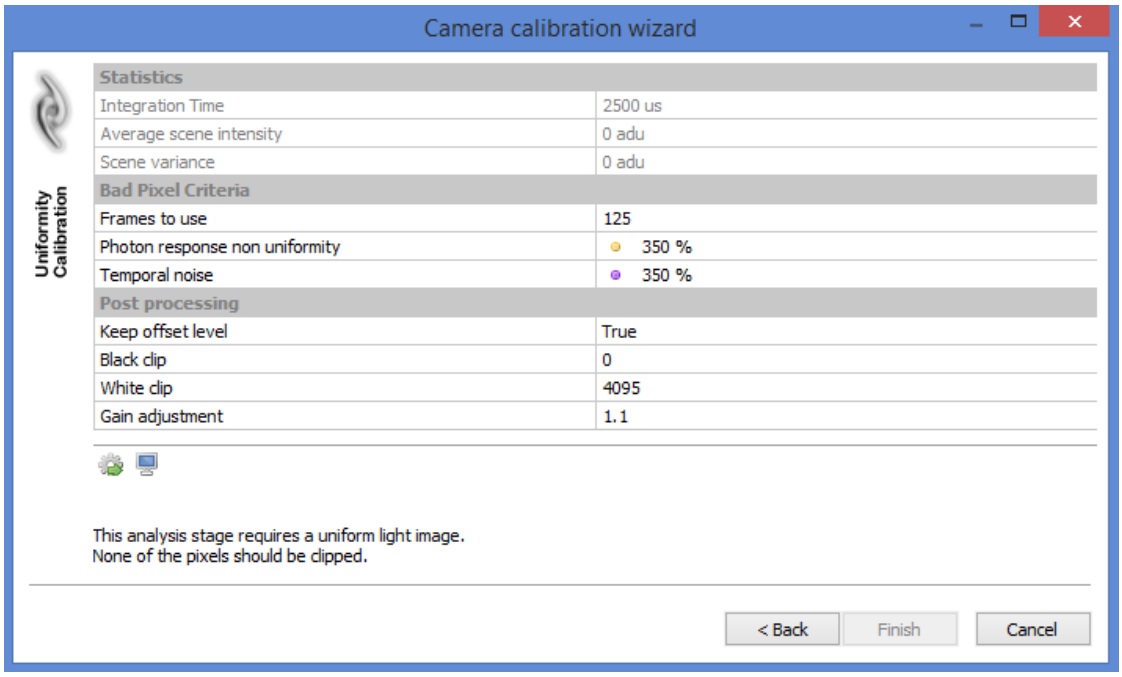

Figure 5-32 Two point calibration – Bad pixel criteria and post processing

Explanation of Figure 5-32:

Bad Pixel criteria:

- Frames to use – The number of frames to be used in the analysis.
- Photon response non uniformity – Defines a threshold to decide which pixels need to be replaced based on their deviating response.
- Temporal noise – Defines a threshold to decide which pixels need to be replaced based on their deviating noise.

Post processing

- Keep offset level – When false, applying the resulting calibration will lower the image value depending on the dark/cold data used during calibration. It is typically used to remove the dark current of the sensor. This option should always be true for thermal cameras.
- Black clip – Pixel values lower than this value will be clipped onto this value.
- White clip – Pixel values higher than this value will be clipped onto this value.
- Gain adjustment – Multiplication factor applied to each pixel. It is typically used to make sure that pixels do not saturate at a value lower than the maximum digital value displayed.

After having entered all parameters push the analysis button ( ) and wait for the result.

Pixels that are marked as outliers will be colored according to the criteria you have entered.

If you notice that the criteria you have imposed are too restrictive or too relaxed, they can be modified and the analysis can be redone by hitting the analysis button ( ) once more.

Use the Finish button (Finish) and save the calibration.

After the software has finished writing the NUC data to disk, click the enable image correction button ( ) to see the result as shown in Figure 5-33 and Figure 5-34.

Figure 5-33 Uncorrected image

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Figure 5-34 Corrected image

5.8.4.2. Recalibrate Offset

This option becomes available when a calibration pack is selected.

It allows correcting the offset in a NUC calibration.

When a pack is not loaded, but not activated – *Status: Inactive* – it is possible to change the camera settings in the package as well.

As a side effect the bad pixel map will be adapted according to the settings in the recalibration procedure.

MCT/InSb – provided that the camera has a shutter available, the software will propose using this MCT/InSb option to perform the offset recalibration.

5.8.4.3. Edit Bad Pixel Map

This option becomes available when a calibration pack is selected. It is advised to activate the software filter before the bad pixel editor is opened.

The bad pixel map editor allows to mark/unmark bad pixels as assigned by the criteria during the two point calibration process.

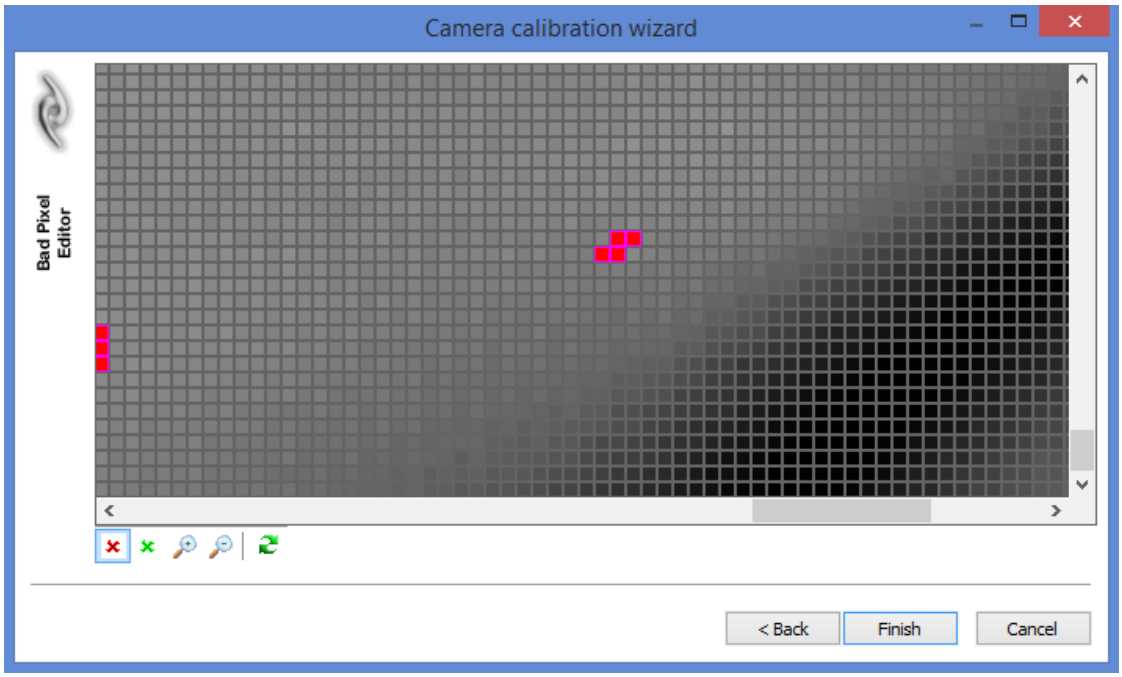

Figure 5-35 Edit the bad pixel map

Explanation of Figure 5-35:

The red X button marks a new bad pixel for replacement (see Figure 5-37). Notice that in case the Software correction filter is activated the marking will be applied immediately to the live image in the *XView* pane.

The green X button un-marks the bad pixel as shown in Figure 5-36.

Increase magnification level

Decrease magnification level

Update the image in the bad pixel editor from the live camera output

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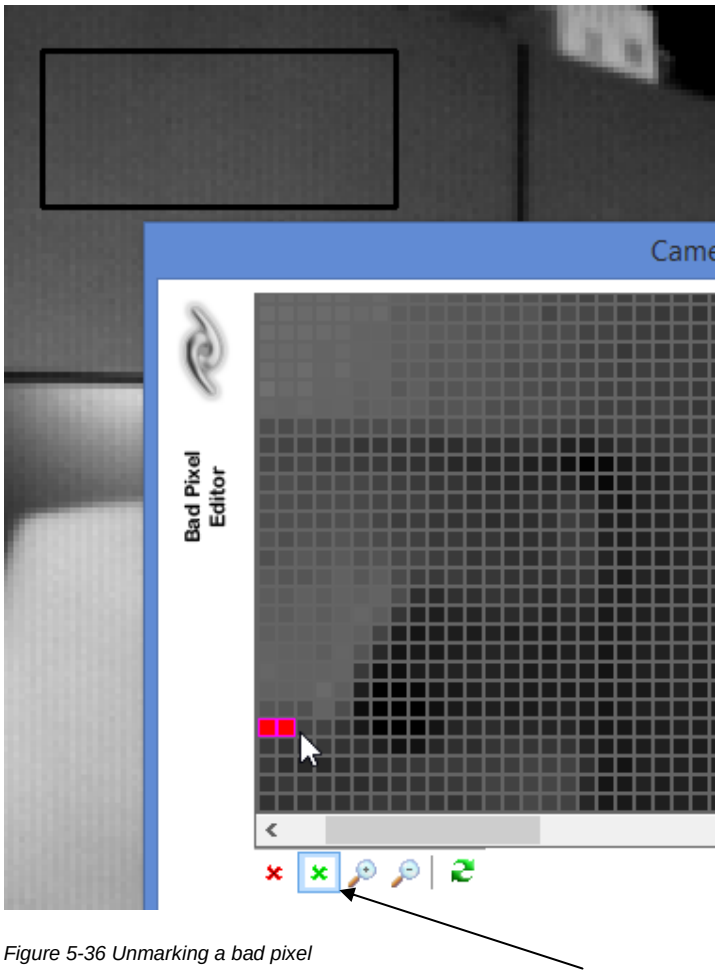

Figure 5-36 Unmarking a bad pixel

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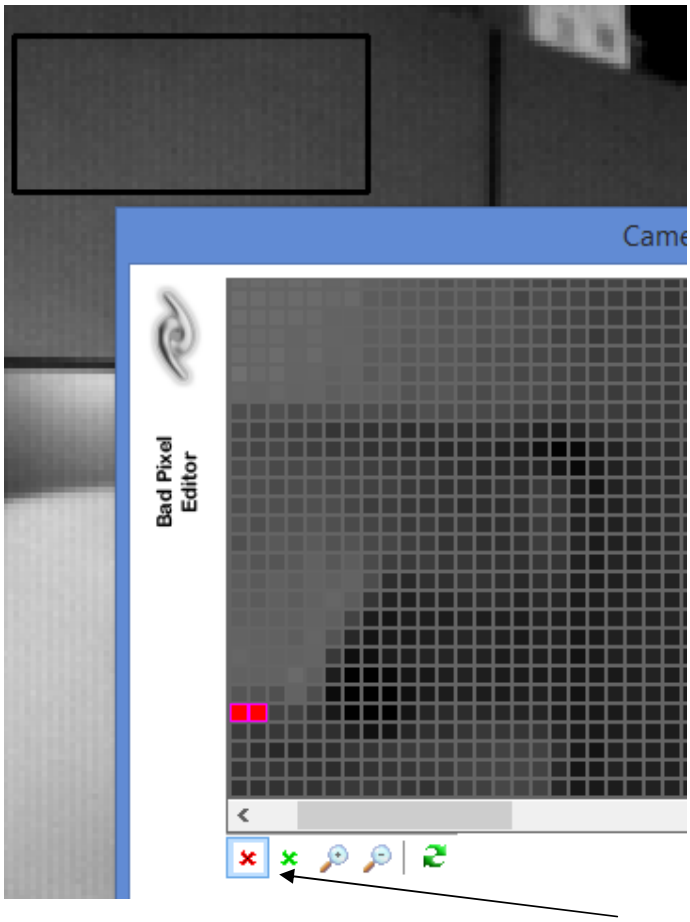

Figure 5-37 Marking a bad pixel

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5.8.4.4. Temperature Calibration (Planck)

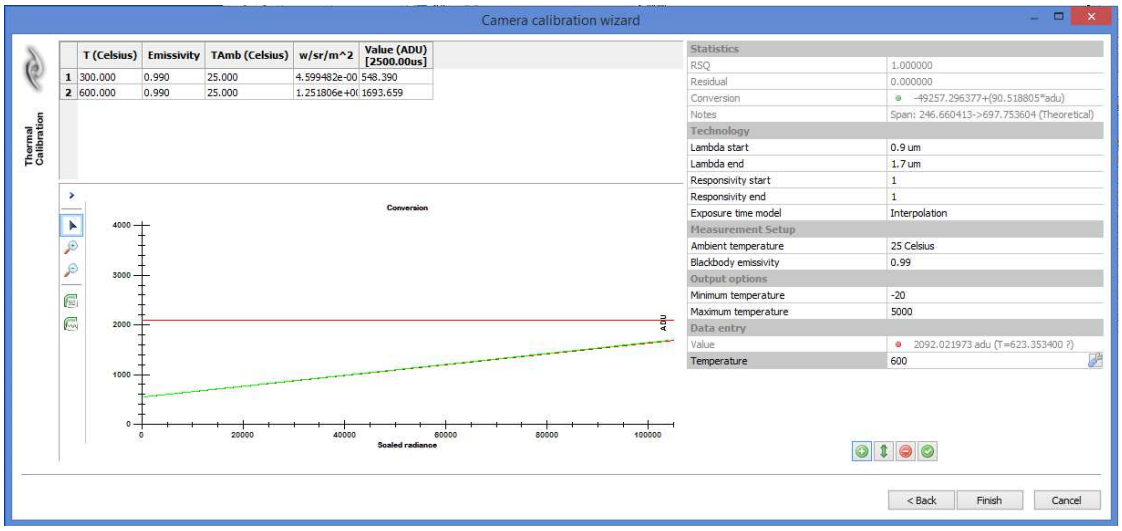

Figure 5-38 Temperature calibration (Planck)

The Planck-based thermal calibration wizard allows making a first order thermal calibration for cooled cameras. It assumes that the response of the camera is linearly dependent on the detected black body (Planck) radiation.

The user needs to enter a series of measurements in the wizard shown in Figure 5-39. For each measurement the camera has to be put in front of a black body at known temperature. Next, the () button must be clicked. When all data is entered, click Finish.

Note: No accuracy is guaranteed.

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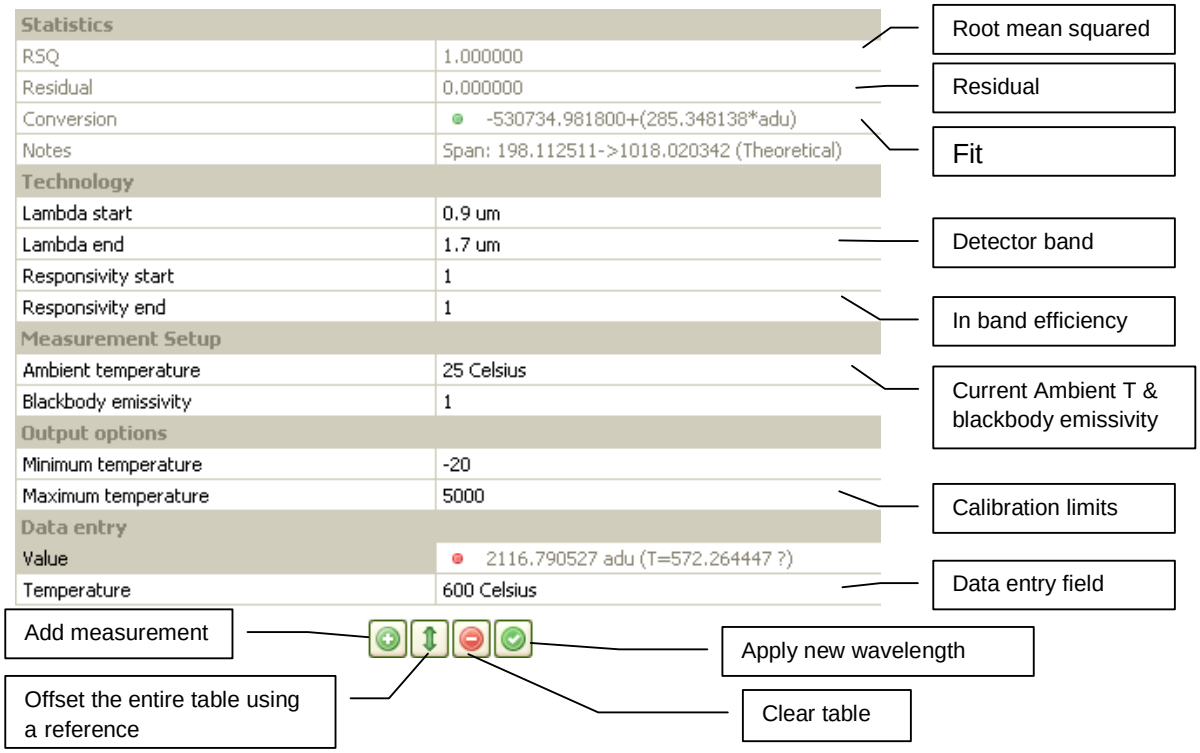

Figure 5-39 Temperature calibration (Planck) – Parameters

5.8.4.5. Temperature Calibration (InGaAs)

This part of the calibration wizard allows updating (recalibrating) a specific kind of calibration pack applicable to some NIR or SWIR cameras. The item can only be selected when such a camera is connected and the corresponding calibration data is selected.

Before the wizard is started, a selection should be made containing an object of which the emissivity and the temperature is known. This temperature and emissivity should be put down in the wizard together with the iris opening (f-number) applied on the lens.

This procedure can be applied when for some reason or another the camera needs to be used with a diaphragm that is different from the one used during calibration. This – however - should be done with care and Xenics no longer guarantees full accuracy.

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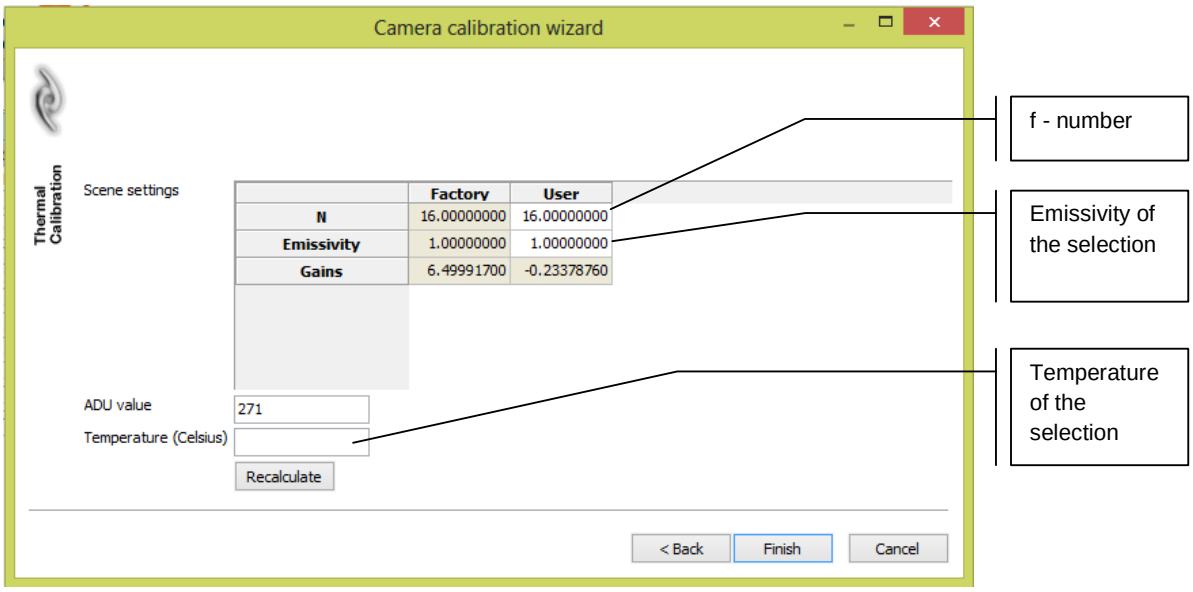

Figure 5-40 Thermal calibration (InGaAs)

5.8.5. The Help Menu

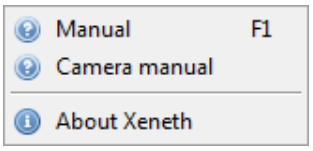

Figure 5-41 Help menu

Explanation of Figure 5-41:

- Manual – This document.
- Camera manual – This provides a brief explanation of the available camera features together with the programming name as can be used when building an application using the Xeneth software development kit (SDK).
- About Xeneth – Version and system information.

5.9. Tabs and Containers

5.9.1. X-View

Figure 5-42 The X-view

The tools that can be found in the toolbar above the main display can be used to manipulate selections, zoom in or out, save line profiles/areas/points and expand the view to a full screen state.

5.9.2. X-View Tools

Figure 5-43 The X-view tools

Explanation of Figure 5-43 from left to right:

- Neutral, arrow cursor ( ) – Allows to change the endpoints of selections drawn earlier.

  Special keyboard modifier: CTRL – Allows you to pan (move) ( ) a selection to a new location.
  When resizing an existing selection, notice the points highlighted in green when you hover over them. As soon as being in this highlighted region, it is possible to move a single endpoint, or pan both points depending on whether or not you are using the keyboard modifier.
- Select the window of interest region ( ) – Allows to drag one, or multiple rectangular windows of interest (depending on camera support) as shown in Figure 5-44.

  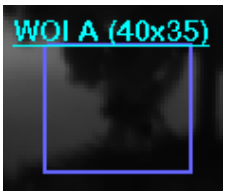

  Figure 5-44 Window of interest

  To create a window of interest: keep the left-hand mouse button pressed and drag a rectangular area that contains the region.

  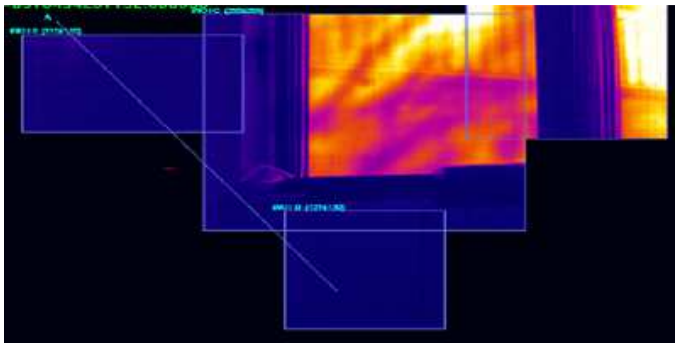

  Figure 5-45 Multiple windows of interest

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- Reset window of interest ( ) – Restores the maximum region that can be read out.
- Apply window of interest region ( ) – Sends the coordinates of the window of interest to the camera sensor, thus reducing the number of pixels that need to be read from the sensor.

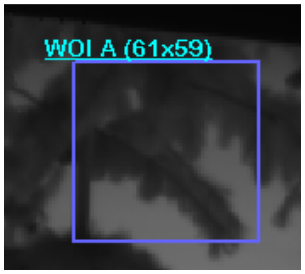

Figure 5-46 Applying the window of interest

- Pixel picker ( ) – Read the pixel of a single pixel.

Figure 5-47 Pixel picker

To create a point selection, click the left-hand mouse button on a pixel of interest.

- Rectangular area selection ( ) – Collect statistics of a rectangular area.

Figure 5-48 Rectangular area selection

To create a rectangular selection keep the left-hand mouse button pressed and drag a rectangular area that contains the region.

- Polygon area selection ( ) – Collect statistics in an area described by a closed set of scattered points.

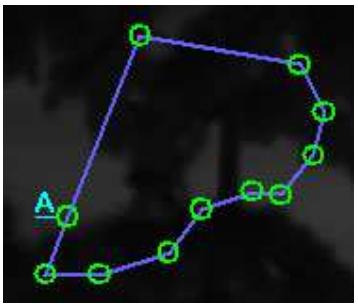

Figure 5-49 Polygon area selection

To create a polygon area, keep the left-hand mouse button pressed and drag out the first polygon segment. By releasing and pressing the left mouse button again a new segment will be created. The polygon can be closed by clicking on the starting vertex.

- Elliptical selection ( ) – Collect statistics of an elliptic selection.

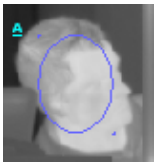

Figure 5-50 Elliptical selection

To create an elliptic selection keep the left-hand mouse button pressed and drag a rectangular area that contains the ellipse.

- Line profile selection ( ) – Collect the statistics of a line selection.

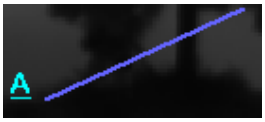

Figure 5-51 Line profile selection

To create a line selection click the left-hand mouse button, drag out, and release the left-hand mouse button at the end point.

- Remove selection ( ) – Remove an individual selection by moving the mouse cursor to one of its control points and left clicking.
  It is also possible to remove all selections by right clicking in the viewer and selecting

Clear all selections.

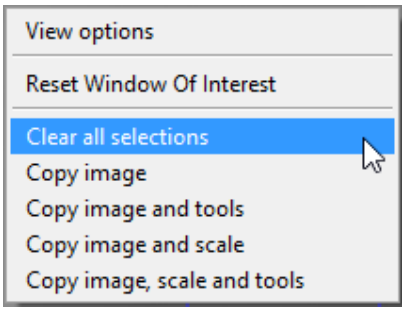

Figure 5-52 Clear all selections

- Software zoom ( ) – Allows the mouse's scroll wheel to zoom and left click dragging to pan (scroll) ( ) the display.
  Alternatively the image menu has a zoom feature that does not require the presence of a scroll wheel. (See chap. 5.8.3.)
- Reset software zoom ( ) – Completely zooms out the main view.
- Save tool output ( ) – Allows to write the selection pixel values of a number of consecutive images into a CSV file.
  The format is as follows:
  ToolA data<newline>
  ToolB data<newline>…
- Toggle overlays ( ) – Allows to turn on and off the RGBA overlay (temperature scales, bad pixel highlight, etc.).
- Fullscreen ( ) – Maximizes the X-View to cover the entire monitor area. The full screen mode can be configured in the application settings (See chap. 5.2.3.2): both the background and the selection can be adapted.

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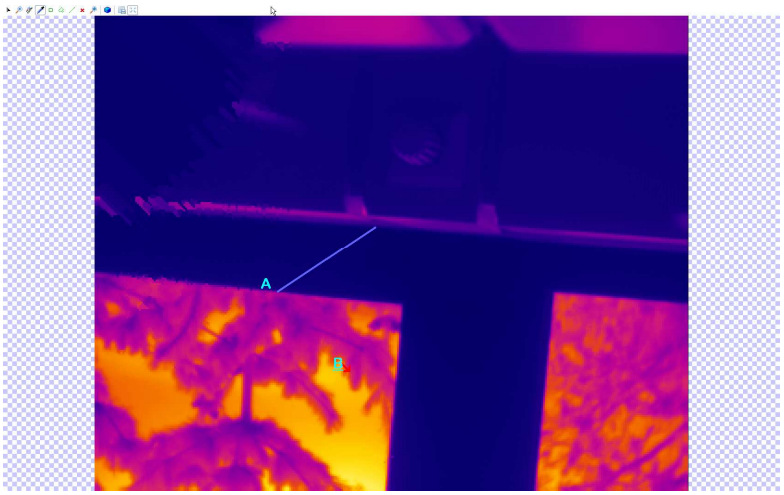

Figure 5-53 Full screen view

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5.9.3. Selections Tab

The selections (Selections) made using the *X-view* tools can be found here. If the Selections tab is missing, enable it through the *View* menu (chap. 5.8.2).

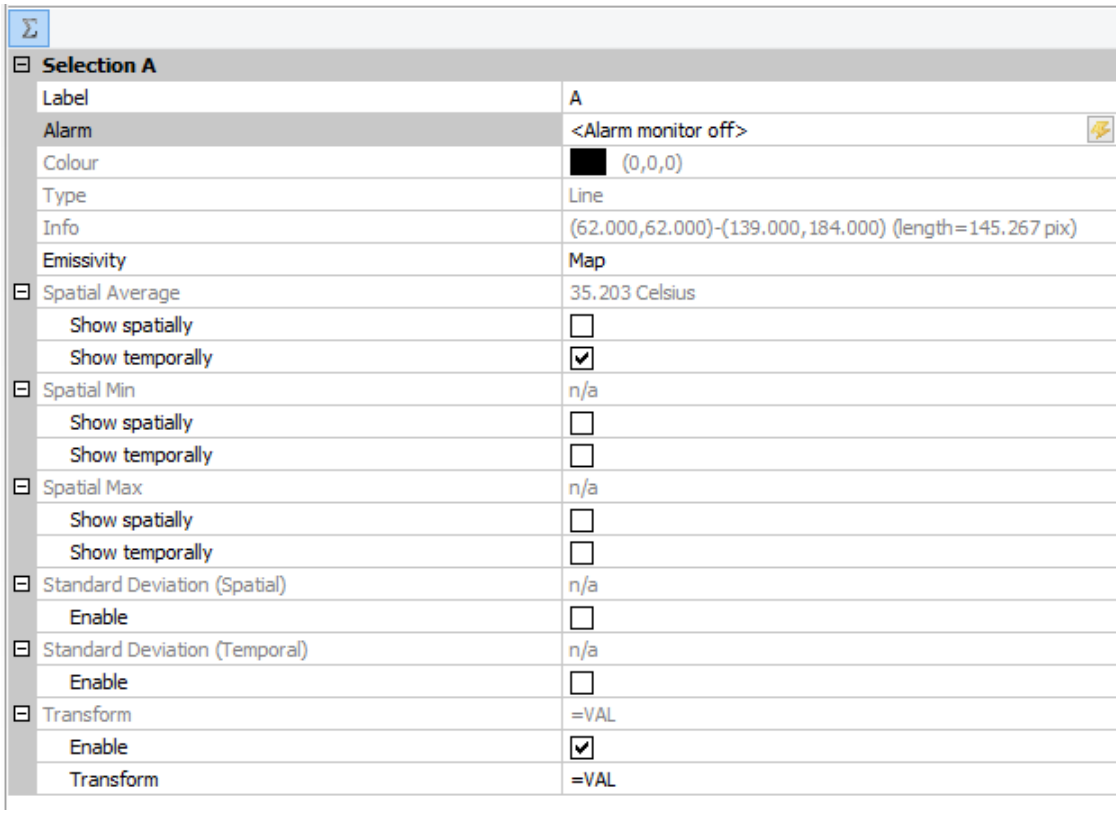

Figure 5-54 X-view tools selections

Explanation of Figure 5-54:

- Label – Allows changing the name of a selection to something more meaningful.
- Alarm – Allows monitoring and generating an event based on several selection statistics.

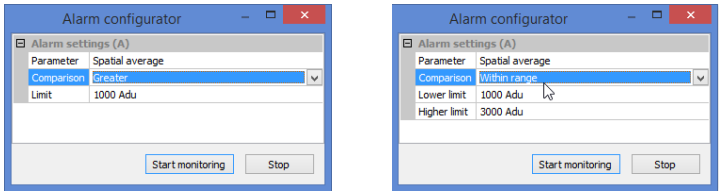

Figure 5-55 Alarm configurator

When clicking ‘Start monitoring’, the monitor/event generator will start, when hitting ‘Stop’, it stops.

- Emissivity – When changing this parameter the ratio between an objects’ emission and reflectance changes. Default a uniform pixel emissivity map of value one is used. This map can be changed in the *Settings Tab – Thermography* (see chap. 5.9.11.2). The map can be overruled in any selection by defining a local emissivity between 0 and 1.

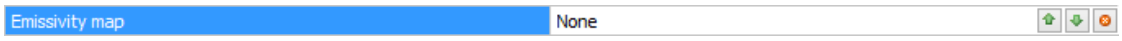

Figure 5-56 Selecting emissivity

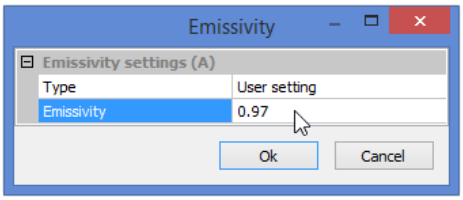

Figure 5-57 Emissivity settings

> **i** Please do not forget to specify an Ambient Temperature in the Thermography tab (chap.5.9.11.3).

- Colour – The colour Xeneth automatically attributes to the selection.
- Type – The selection type, being Line, Point or Area.
- Info – The control points that determines the selection.
- Show spatially – Controls whether or not to calculate and draw the statistic on the ‘Graph’ (Graph).
- Show temporally – Controls whether or not to plot out the statistics in time on the ‘Time graph’ (Time graph).
- Spatial average – The average value of the pixels in a selection.
- Spatial minimum – The smallest pixel value in a selection.
- Spatial maximum – The largest pixel value in a selection.

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- Standard deviation (spatial) – The standard deviation of the pixels in a selection.
- Standard deviation (temporal) – The standard deviation of a sequence of average values of the selection.

  i Standard deviation (temporal) is calculated using the frames displayed in chap. 5.9.7 Time Graph Tab. It is possible to change the number of points it is calculated over by editing the X-Axis parameters of the time graph.

- Transform – Arbitrary execution of mathematical formulae that can be used to compare selections with one another.

Figure 5-58 Transform selections

Click the star next to the Transform property for a quick help on this subject.

5.9.4. Selections Tab and Real-time Transformations

This feature is used to do (simple) real-time calculations on values retrieved when using the different image tools at your disposal.

The formula parser in Xeneth is capable of handling the following operators:

- + : Add
- - : Subtract
- * : Multiply
- / : Divide.

The formula parser handles the following variable:

- VAL:
  - For a line selection, VAL is an array containing the pixel value for each pixel.
  - For an area, VAL is a number that equals the average value over all the pixels.

The formula parser handles the following formulae:

- AVG(A), MIN(B), MAX(C) in which A is the first selection, B the second and so on.

This can also be quite useful in combination with the recording option (chap. 5.9.13 Recording Tab), e.g. when starting the recording or raising an alarm based on the difference in temperature in a scene.

Example:

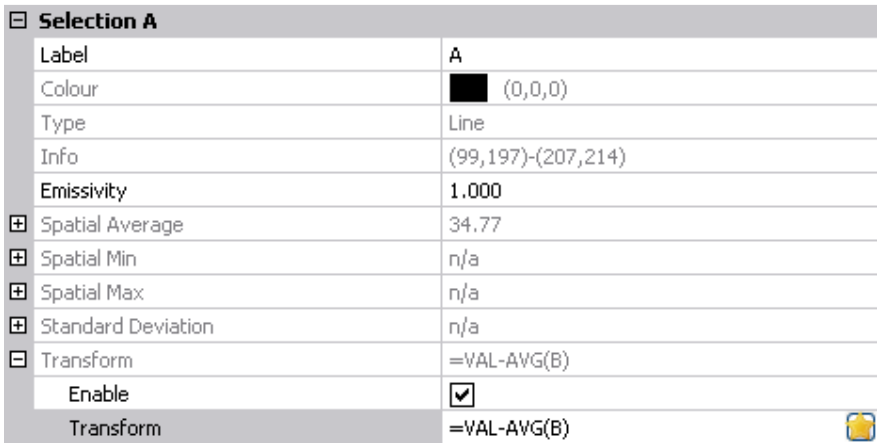

Figure 5-59 Transform feature – Example

In this example the per selection transform feature is used to subtract a reference (the average value of all points in selection B, 50 in this example) from the current selection's data points.

Transform	=VAL
Enable	☐
Transform	=VAL-AVG(B)

Figure 5-60 Entering transform formula

In Figure 5-60, the formula is entered, but not yet activated.

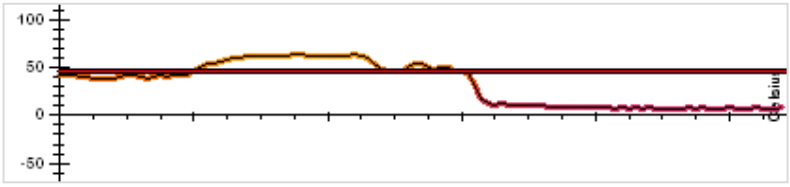

Figure 5-61 Graph without activating the formula

Transform	=VAL-AVG(B)
Enable	☑
Transform	=VAL-AVG(B)

Figure 5-62 Activating transform formula

When checking the checkbox, the formula becomes active (see Figure 5-62).

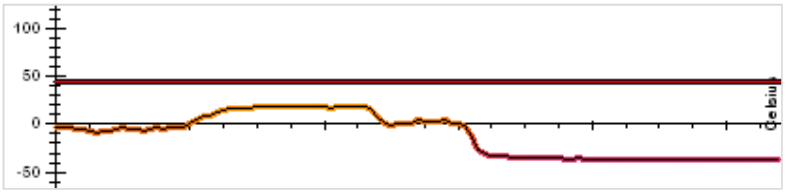

Figure 5-63 Graph with activated formula

The average of selection B is subtracted in real-time from all points in selection A (as shown on Figure 5-63).

5.9.5. Histogram Tab

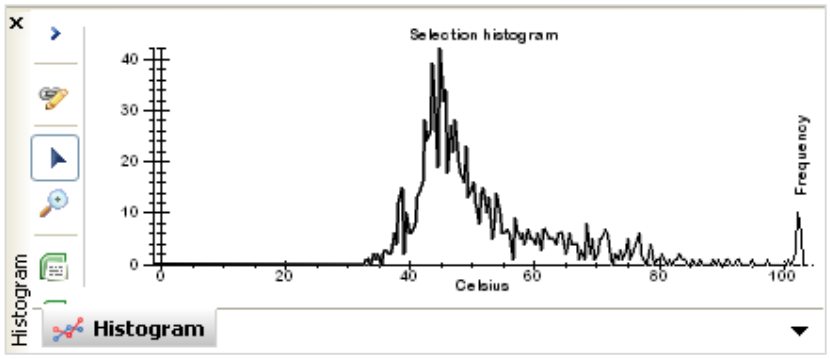

Figure 5-64 Histogram

The histogram (Histogram) shows the distribution of pixels (Frequency) for a given "ADU count" or Temperature value per image.

5.9.5.1. Zoom in

The following two ways exist to zoom in on the histogram:

1. Using the mouse:

   To zoom in, use the zoom icon in the toolbar next to the graph, click the left-hand mouse button, **drag** out, and release the left-hand mouse button at the end of the region of interest.

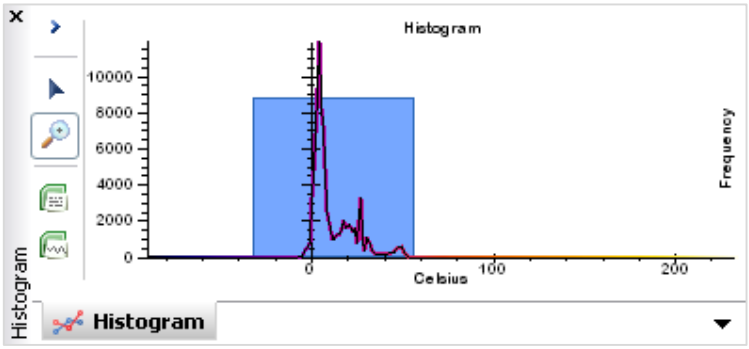

Figure 5-65 Histogram – Zoom in

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2. Manually setting the axis scales:

   The second way of zooming in on a graph is by manually adjusting the Axis. Click the right-hand mouse button on the graph to get the ‘Graphs options’ menu (see Figure 5-66), and select either ‘Format X-Axis’ or ‘Format Y-Axis’.

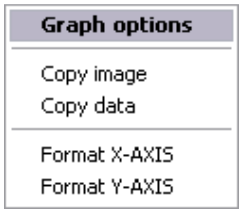

Figure 5-66 Histogram – Graph options menu

When a click and drag based zoom was performed before, the auto tick boxes in the format axis dialog are already unchecked (see Figure 5-67).

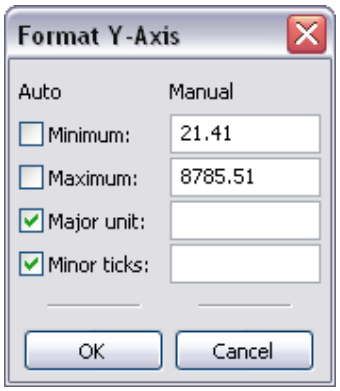

Figure 5-67 Graph options menu – Y-axis format

To manually enter any values it is sufficient to uncheck the check boxes, and enter the value. The major unit and minor ticks settings refer to the interspacing between axis labels and the ticks in between them (as shown in Figure 5-68).

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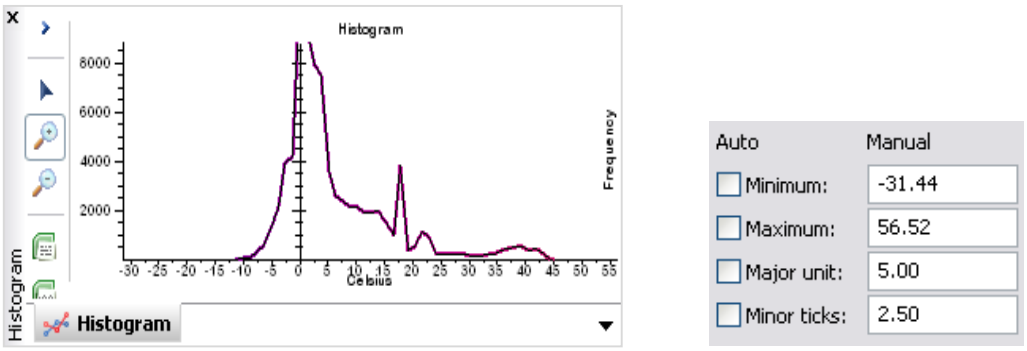

Figure 5-68 X-axis format – Example

5.9.5.2. Zoom out

Click the Zoom Out button ( ) to reset the zoom level.

i Please note that this does not reset the Major / Minor tick settings. To reset the tick settings, re-enable their Auto checkbox.

5.9.5.3. Copy Data

To copy data to Microsoft Excel and other applications select *Copy data* or *Copy image* depending on whether either a bitmap representation or decimal values are required. It is also possible to get a live update in some applications (notably via DDE). See chap. 5.9.8 DDE Hot Linking.

More information about how to copy images to third party applications can be found in chap. 5.9.9 Copying Images to Third-party Applications.

5.9.5.4. Inspecting Values

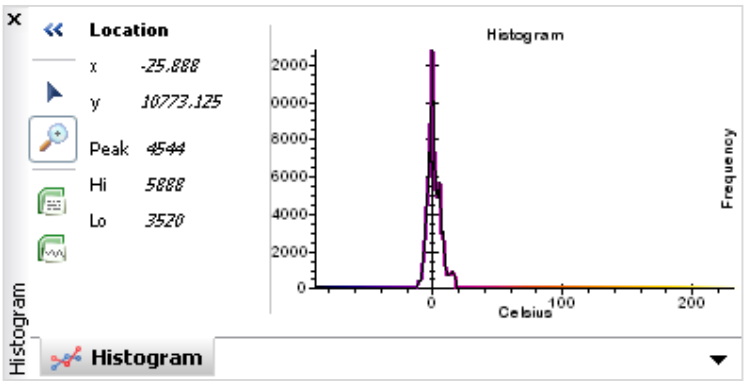

Figure 5-69 Histogram – Graph values

Clicking the "<<" on the top left corner shows the live statistics section of the graph in which the mouse cursor coordinates translated to graph coordinates can be found.
This makes it easy to quickly inspect the amount of pixels at a provided value/temperature.

5.9.6. Graph Tab

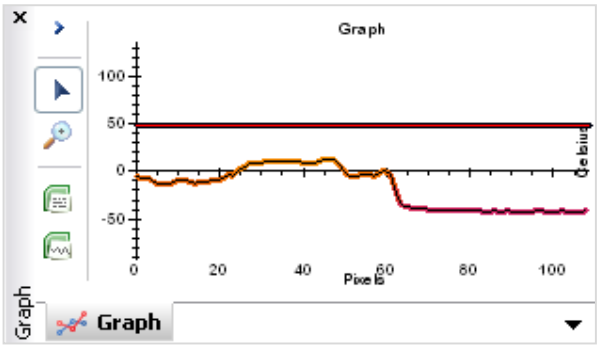

Figure 5-70 Graph tab

For a line selection the value of each pixel is displayed. For an area selection, the average value over all pixels in the selection is displayed.

This tab supports hot linking data via DDE (Paste as link via Microsoft Excel), zooming, copying images, and value inspection. (See chap. 5.9.5 for more details.)

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5.9.7. Time Graph Tab

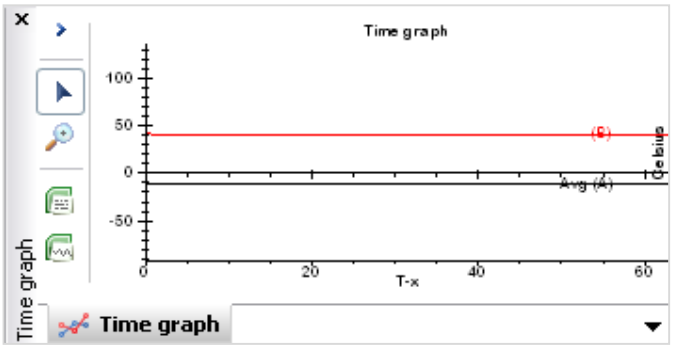

Figure 5-71 Time graph tab

For the time graph the following two distinct modes of operation exist:

- Min/Max/Avg Mode
- Pixel History.

5.9.7.1. Min/Max/Avg Mode

This mode displays statistics on selections (Statistics can be chosen in chap. 5.9.3 Selections Tab) and behaves the same as the other graphs.

i The number of points shown in the time graph can be changed by rescaling the X-Axis. The more points that are selected on the X-Axis, the longer the History Xeneth will track. This will eventually (for a large number of points/selections) reduce the speed of the application.

i The temporal standard deviation computed in the *Selections* tab is calculated for an amount of images that is equal to the amount the length of the x – axis.

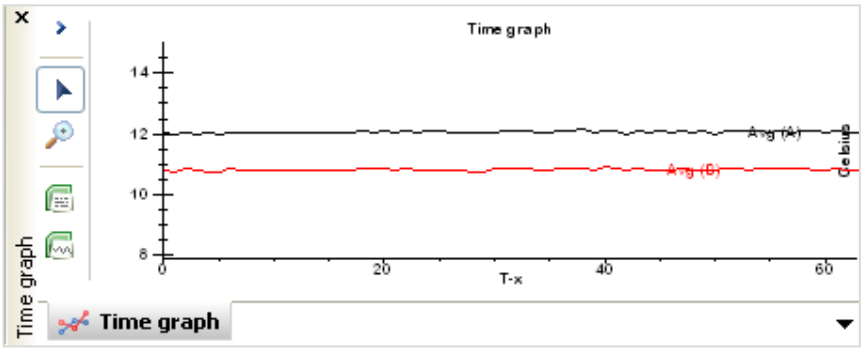

Figure 5-72 Time graph

5.9.7.2. Pixel History

This second mode displays a trace of the default selection's pixels in time (scrolling upward, 256 rows), which is mainly useful for line scan cameras.

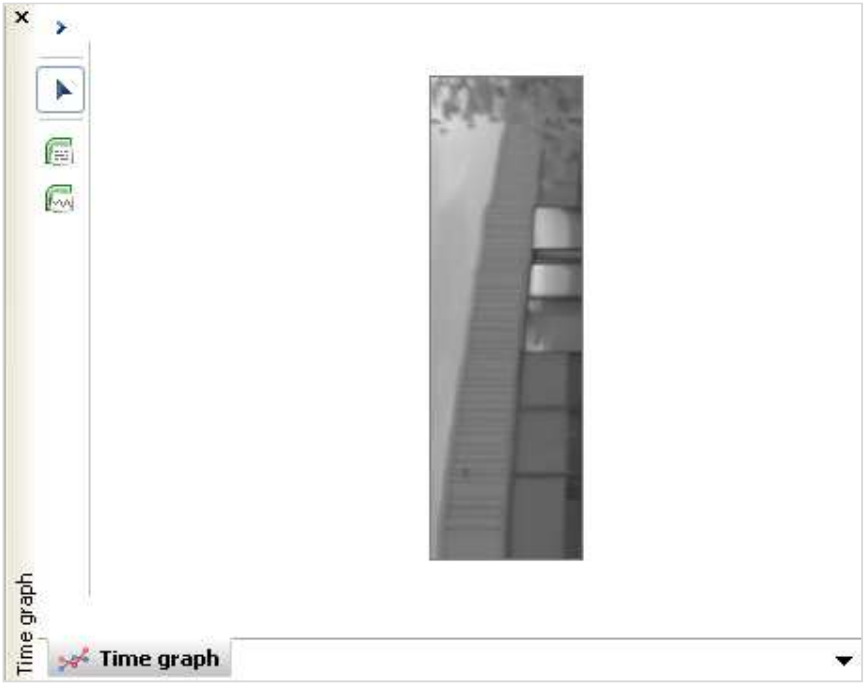

Figure 5-73 Time graph – Trace of default selection

The Time Graph behaves like all other graphs with respect to DDE hot linking/zooming/copying images etc.

5.9.8. DDE Hot Linking

DDE hot linking is a technique used in Microsoft Windows that enables applications to share data. In Xeneth this is used to enable live transfer of data from the different graph windows to for instance Microsoft Excel.

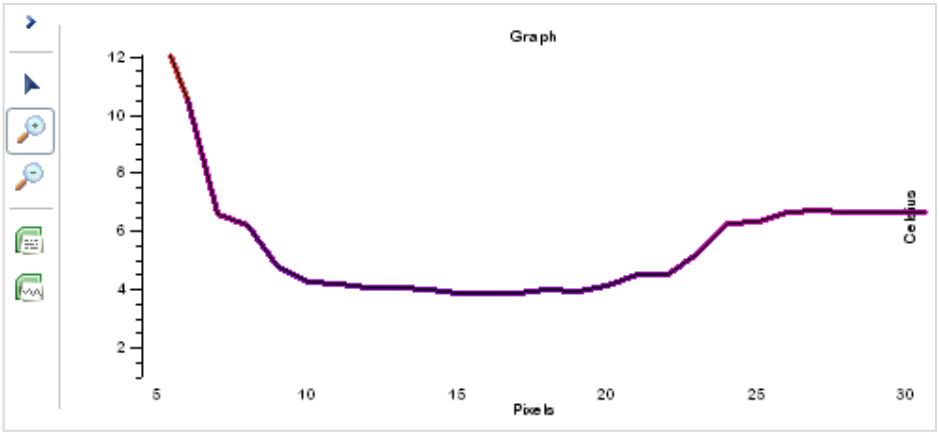

Figure 5-74 DDE hot linking – Graph

Start by clicking the ( ) copy data icon, or right-click the graph, and select 'Copy data'. Open Excel and select the 'Paste special' or 'Paste link' option in the Home tab menu as shown in Figure 5-75.

Figure 5-75 Excel paste options

After the paste operation completes, a live link exists to the data of Xeneth's highlighted selection (see Figure 5-76).

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	A	B
1	Point	Temperature (e=1.0)
2	0	14.83
3	1	15.63
4	2	15.25
5	3	13.62
6	4	12.78
7	5	12.46
8	6	10.35
9	7	6.26
10	8	5.93
11	9	4.36
12	10	3.89
13	11	3.79
14	12	3.63
15	13	3.63

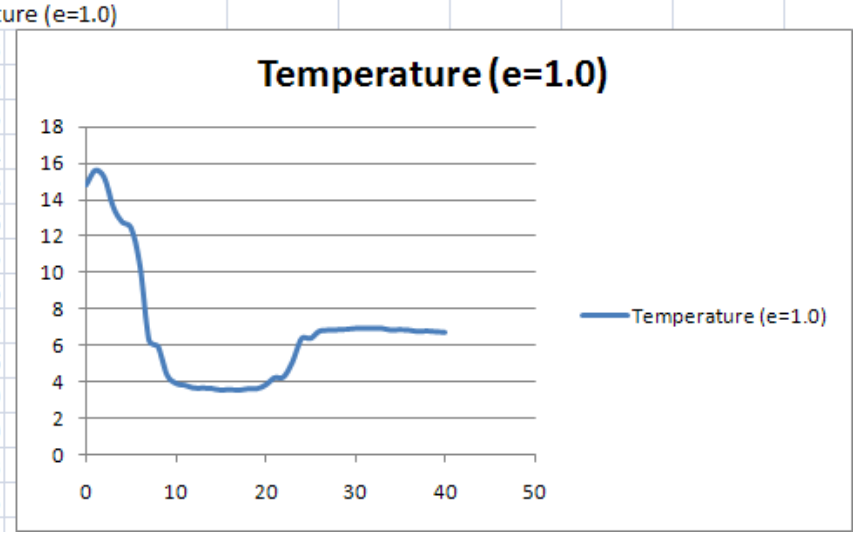

Figure 5-76 Data in excel

5.9.9. Copying Images to Third-party Applications

Figure 5-77 Copy image

Right-click the view window and select one of the following options as shown in Figure 5-77:

- Copy image – The image as currently shown is copied to the windows clipboard.
- Copy image and scale – The image and the temperature bar are copied

- Copy image, scale and tools – The image with all active selections and the temperature bar are copied.

Figure 5-78 and Figure 5-79 are an example of an image copied from the main display, and the graph belonging to it.

Figure 5-78 Image with temperature bar

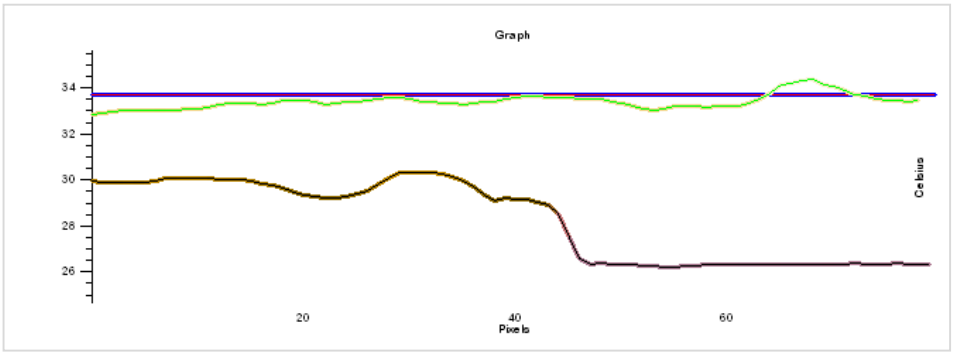

Figure 5-79 Graph belonging to the image above

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5.9.10. Copying Data to Third-party Applications

See also chap. 5.9.8 DDE Hot Linking and select the normal paste operation, or click CTRL-V in the third-party application.

5.9.11. Settings Tab

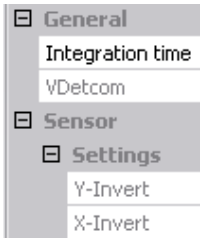
Aside from chap. 5.5 The Status Area, this Settings tab (

) contains the entire set of camera and application settings pertaining to the imaging scene.

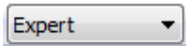
Figure 5-80 Settings tab icons

Explanation of the icons from left to right:

-  - Category view – Organizes the camera settings in logical categories



-  - Alphabetic view – Alphabetically sorts all camera settings

- 

- Property visibility level – Select which properties to show
-  – Camera settings - General
-  – Camera settings - Application
-  – Camera settings - System
-  – Camera settings - Storage
-  – Camera settings - Thermography
-  – Frame grabber settings
- – GigE Vision settings

-  – Thermography parameters (only visible when thermal calibration pack is loaded).

5.9.11.1. Settings Tab – Camera

The camera specific settings are distributed over different categories – General, Application, System, Storage and Thermography. The content depends on the available camera features and the implementation thereof.

For each camera an overview of the available features is available. This can be obtained by right clicking on one the features and select “Show property settings” (see Figure 5-81) or via the help menu (chap. 5.8.5). This document also contains the programming names to be used when the camera is implemented in a custom application using the Xeneth software SDK.

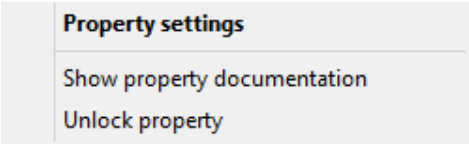


Figure 5-81 Camera properties settings tab

If in the application settings (chap. 5.2.3.2) the option Enable SDK tooltips is activated the programming names and values are shown in a tooltip as well.

5.9.11.2. Settings Tab – Frame grabber settings

When a Camera Link camera is connected via one of the Xeneth integrated Camera Link frame grabbers, the parameters to configure the frame grabber are listed here. Typical settings are:

- Frame count – Defines the amount of buffers the frame grabber software sets apart for grabbing.
- Mode – Defines the buffer management.
    - Preview: The frame grabber is suggested to use its buffers as ring buffer. The latest image is always stored even if the previous image at that location is not yet read out by the application.
    - Synchronous burst: All buffers are filled only once. Capturing is halted afterwards. All images are read from the buffer.
    - Synchronous bursts: Continuous loop of synchronous bursts. A new series of images is captured as soon as the application did read all the available images.

- Timeout – The maximal time that the frame grabber is waiting before it returns.

5.9.11.3. Settings Tab – GigE Vision

- Packet delay – The delay (in timestamp counter units) between consecutive data packages on the stream channel.
- Packet size – The size of data packages (in bytes) on the stream channel.
- Retry count – The maximal number of times Xeneth retries to set a control register when no acknowledge is received.
- ACK timeout – The time Xeneth waits for an acknowledge after a control register is set.
- Pass frames with lost packages – When false, frames with missing parts are dropped.
- Use packet resend – When active, the Xeneth will ask the camera to resend a package that is missed.
- Frame drops – The number of frames that are lost since start of capture.
- Packet drops – The number of packages that are not received by Xeneth.

5.9.11.4. Settings Tab – Thermography

The following features can be found here:

- Ambient temperature
- Emissivity map
- Atmosphere temperature
- Atmosphere transmission
- Window temperature
- Window reflected temperature
- Window transmission
- Window reflection
- Optics f number

In the Selections tab (see chap. 5.9.3) you can define a per selection emissivity. This emissivity will be combined with the above parameters to compute temperatures based on the model described in chap.6.3.

To compute the value of the atmosphere transmission as a function of the distance, the dialog under the blue wrench icon ( ) can be used. (See Figure 5-82 Transmission calculator.)

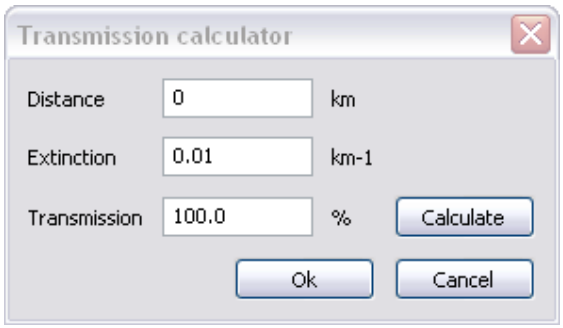


Figure 5-82 Transmission calculator

Emissivity map

Figure 5-83 Emissivity map

The emissivity map defines the default emissivity values in a selection.

Explanation of the icons:

- Set an emissivity map (.xepng) / Convert a thermal frame to an emissivity map (providing that an object was heated to a known temperature)
- Save an emissivity map (.xepng)

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Clear the actively loaded emissivity map.

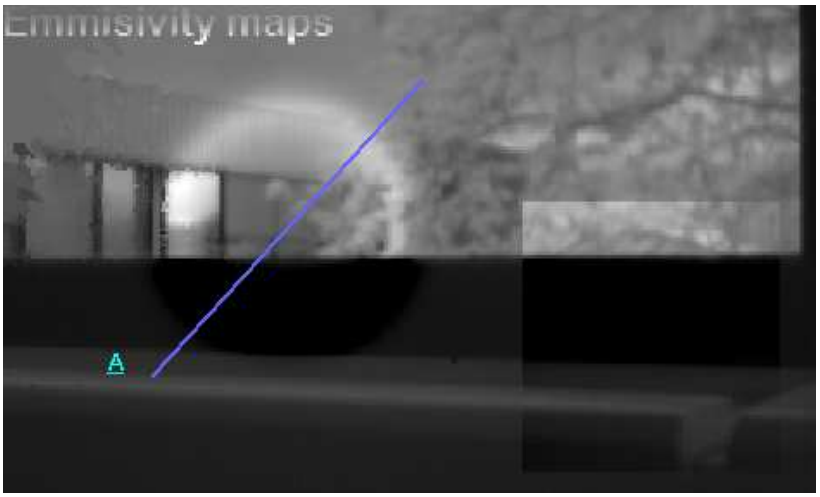

Figure 5-84 Emissivity maps example

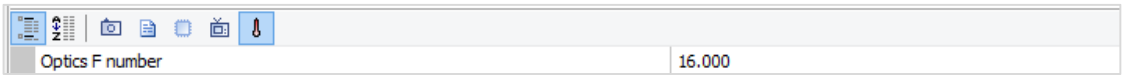

Figure 5-85 InGaAs thermography settings

For InGaAs thermography there is an additional parameter (see Figure 5-85):

- Optics F number – Can be read on the lens, usually spans from 1.4 to 16

5.9.12. Scale

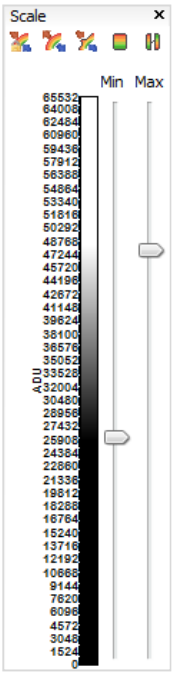

Figure 5-86 Scale

The *Scale* (Scale) allows to focus on the adu or temperature range of interest in the *X-View* pane by moving the min and max sliders.

Top icon description:

Lock – Locks the span (temperature/adu range), in effect moving either slider causes the fixed thermal window to slide.

Restore full range – Resets the span to the full span the camera is able to image.

Snap span to histogram – Sets the range to match the image histogram.

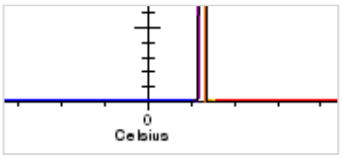

Figure 5-87 Scale – Snapped span

Select color map – Allows the selection of a different color map to apply to the image.

Invert palette – Inverts the active palette.

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5.9.13. Recording Tab

5.9.13.1. Recording

If the Recording tab is missing, enable it through the “View” menu (chap. 5.8.2).

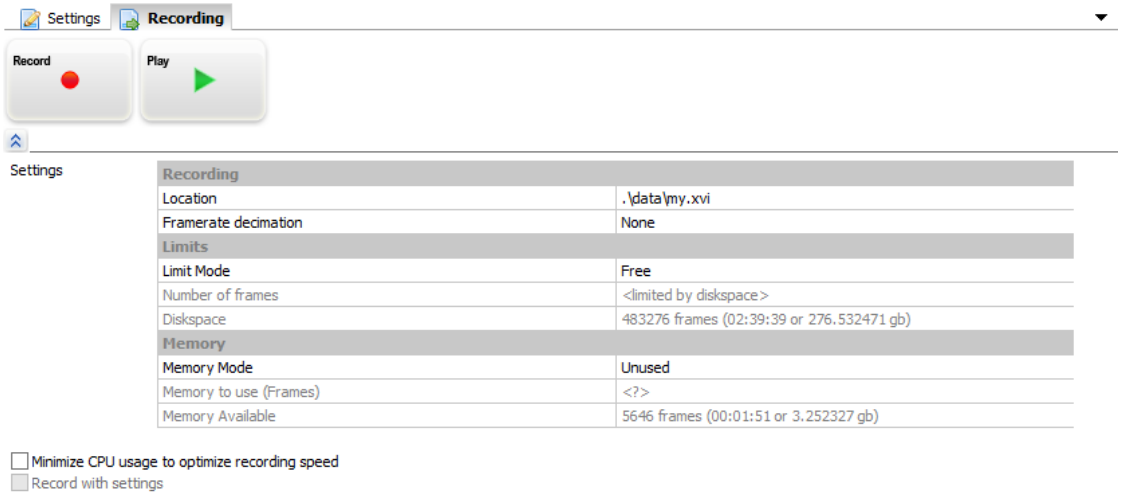


Figure 5-88 Recording tab

Explanation of the settings:

- Location – The file to save the movie in, be it XVI (raw 16 bit) or AVI (raw 8 bit)
- Framerate decimation – Frames are skipped during recording.
- Limit mode – When selecting *Limit* the maximal amount of frames that can be stored is set in *Number of frames*. Otherwise the size of the movie is limited by the available disk space.
  Number of frames – When setting the *Limit Mode* to *Limit* the maximal amount of frames that can be captured is set here.
- Diskspace – Available space on the drive *Location* refers to.
- Memory mode – Pre-triggering/buffering
- Minimize CPU usage to optimize recording speed – Attempt to save some CPU cycles by simplifying the interface.
- Record with settings – Allows to
  - include user comments in the movie,
  - select camera settings that only will be applied during recording.

5.9.13.2. Recording using Settings

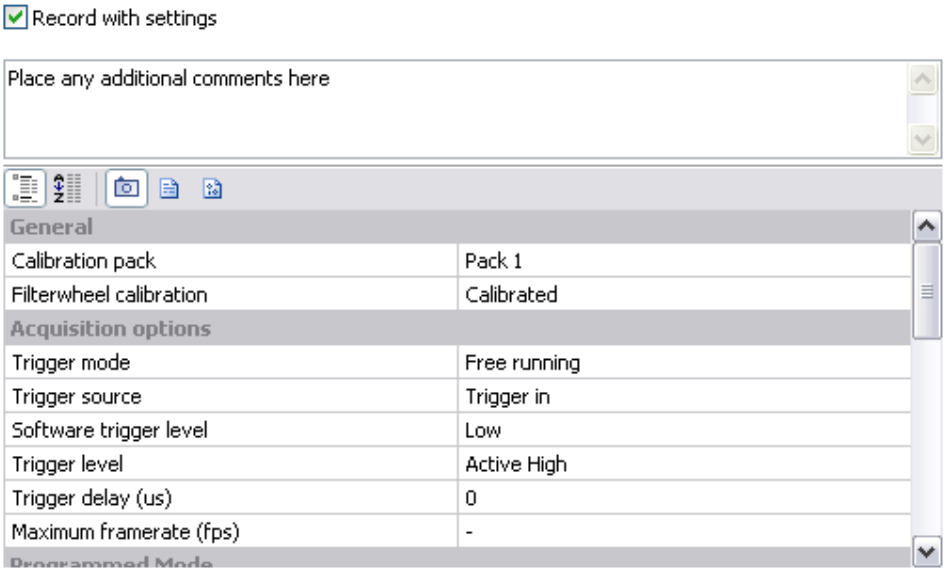


Figure 5-89 Record with settings

The settings in this pane will be activated when the recording is started.
This can for instance be used to configure triggering.

5.9.13.3. Recording Memory Modes

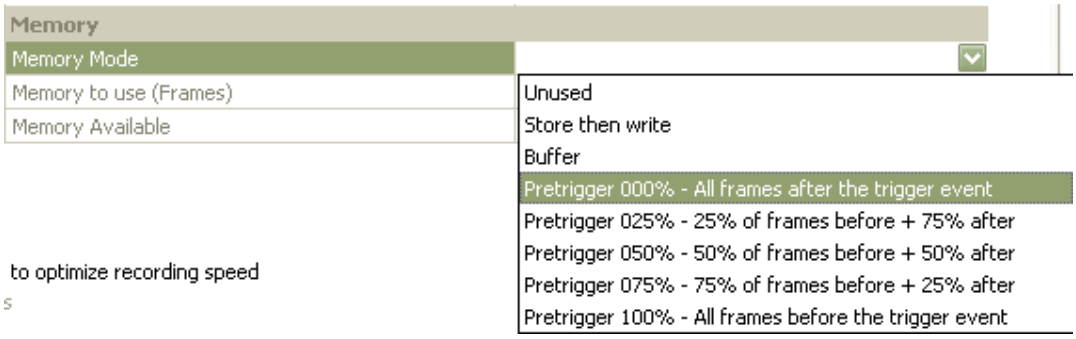


Figure 5-90 Record memory modes

Explanation of the parameters (see Figure 5-90):

- Unused – Off
- Store then write – First save the recording to the PC memory and afterwards write to disk.
- Buffer – Record to PC memory in a rotating buffer, write to disk when the CPU has time available.

- Pre-triggering – Explained in chap. 5.9.13.4.

5.9.13.4. Recording – Pre-triggering

Memory	
Memory Mode	Pretrigger 050% - 50% of frames before + 50% af
Trigger Source	Any
Auto re-arm	True
Memory to use (Frames)	500
Memory Available	13685 frames (00:03:17 or 2.140308 gb)

Figure 5-91 Recording – Pre-triggering

Pre-triggering makes it possible to get information before and after a trigger event. The trigger sources include camera trigger signals, and image triggering results.

5.9.13.5. Recording and calibration packs

When a (NUC) calibration pack is loaded and the software correction filter is not activated while recording an XVI movie, uncorrected images are stored and the name of the calibration pack is added to the file as meta – data.

In this case the mentioned calibration pack can be used to correct the data from the movie during playback.

When a (NUC) calibration pack is loaded and the software correction filter is activated while recording an XVI movie, corrected images are stored and the name of the calibration pack is added to the file as meta – data.

In this case it is not possible to revert to uncorrected data during playback.

When a calibration pack containing temperature calibration data is loaded and the thermal filter is activated while a movie is recorded a ADU to temperature lookup table is stored in the XVI file.

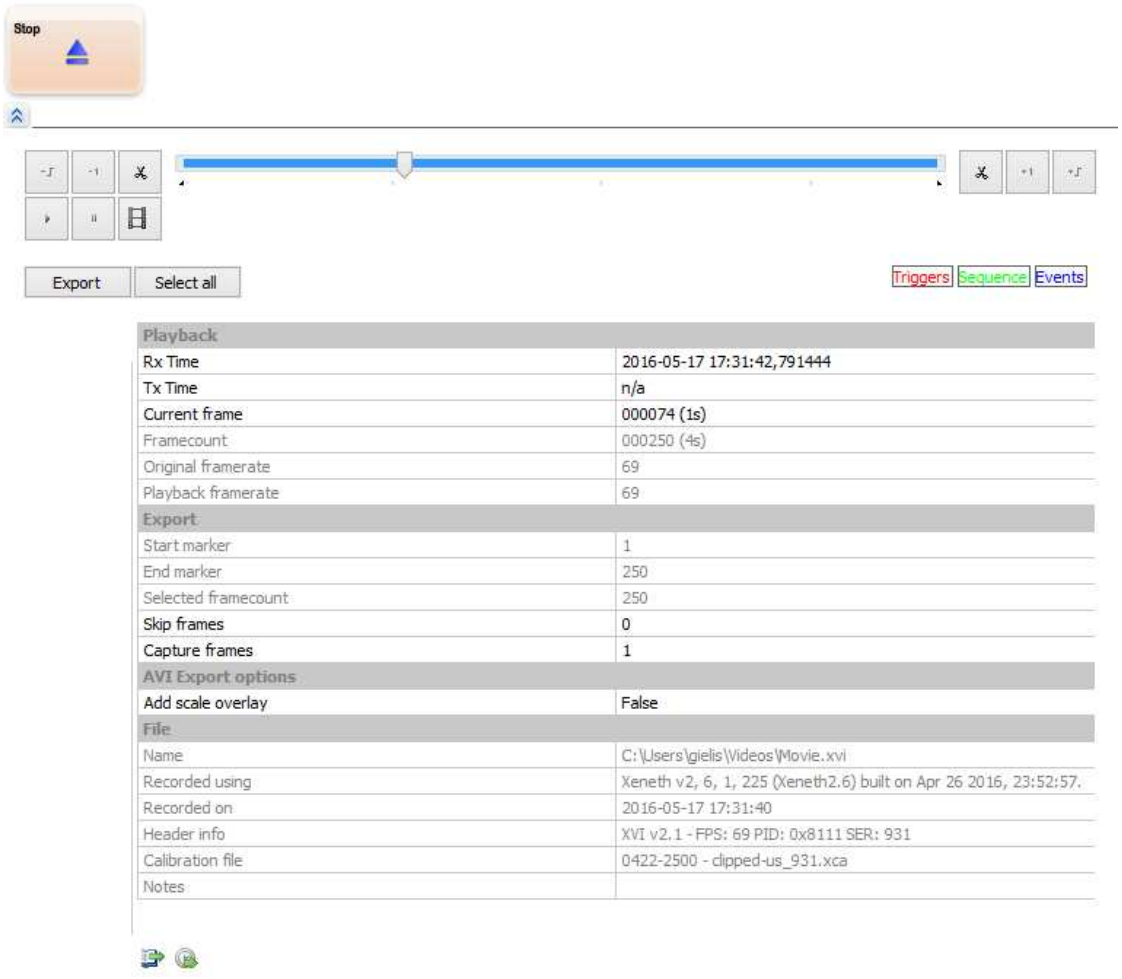
In this case it is possible to make a temperature analysis of the recorded data – even without the original calibration pack. Moreover it is possible to use selections and apply all radiometric corrections. (See chap. 6.2 to chap. 6.4.)

5.9.13.6. Playback overview

Figure 5-92 Playback button

This button makes it possible to play back an existing recording from disk. Notice that a second instance of Xeneth will be started in which the virtual camera is connected. When Xeneth was started with the virtual camera, no new instance will be launched.

After the video is loaded the Recording tab contains the following elements (see Figure 5-93):



Playback	
Rx Time	2016-05-17 17:31:42,791444
Tx Time	n/a
Current frame	000074 (1s)
Framecount	000250 (4s)
Original framerate	69
Playback framerate	69
Export	
Start marker	1
End marker	250
Selected framecount	250
Skip frames	0
Capture frames	1
AVI Export options	
Add scale overlay	False
File	
Name	C:\Users\gielis\Videos\Movie.xvi
Recorded using	Xeneth v2, 6, 1, 225 (Xeneth2.6) built on Apr 26 2016, 23:52:57.
Recorded on	2016-05-17 17:31:40
Header info	XVI v2.1 - FPS: 69 PID: 0x8111 SER: 931
Calibration file	0422-2500 - clipped-us_931.xca
Notes	

Figure 5-93 Playback a recording from disk

Overview of the playback control buttons (see Figure 5-93):

 Go to previous (trigger) event.

 Step back one frame.

 Set export range initial frame.

 Start playback.

 Pause playback.

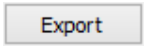
 Apply modified frame rate.

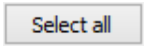
 During playback this cursor shows the current location. Alternatively, the cursor can be used as a slider to select the preferred location in the movie. In this case the recorder will be paused immediately.

 Set export range final frame.

 Step forward by one frame.

 Go to next (trigger) event.

 Export a selected range to disk.

 Select all frames for export.

Explanation of the Playback settings:

- Rx Time – The time at which the image is received by the software.
- Tx Time – The time at which the image is transferred by the camera. It is not available on all cameras.

- Current frame – Frame counter. When the movie is halted, the value is editable and can be used to steer the cursor.
- Frame count – The total amount of frames in the movie.
- Original frame rate – The frame rate at which images are captured. Expressed in frames per second.
- Playback frame rate – When the *Adjust playback framerate* button is activated () the *Original frame* is overruled by the *Playback frame rate*. This allows for instance to show the movie in slow motion.

Explanation of the export settings:

- Start Marker – The initial frame of the exported data.
- End marker – The final frame of the exported data.
- Selected frame count – The size of the range.
- Skip frames – Between every set of size defined by *Capture frames* that is exported an amount of frames equal to *Skip frames* is skipped.
- Skip frames – Between every set of size defined by *Capture frames* that is exported an amount of frames equal to *Skip frames* is skipped.

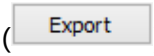
Explanation of the AVI export settings:

- Add scale overlay – Add a copy of the Scale (See chap 5.9.12 Scale) to every frame.

Explanation of the file information:

- Name – File path
- Recorded using – Xeneth version that was used for recording.
- Recorded on – Recording date and time
- Header info – XVI header info
- Calibration file – The calibration file that was active during recording.
- Notes – User notes as defined in the “Record with settings” panel. See chap. 5.9.13.2 Recording using Settings.

5.9.13.7. Playback export

The (

) button allows to export a part of an XVI movie to another XVI movie, a AVI movie or to a set of separate images.

Selecting the frames that end up in the exported data can be done as follows:

1. Select the initial frame by placing the slider ( ) at the desired location and click on the left scissor button ( ).
2. Select the final frame by placing the slider ( ) at the desired location and click on the right scissor button ( ).
3. The selected range is colored bleu:

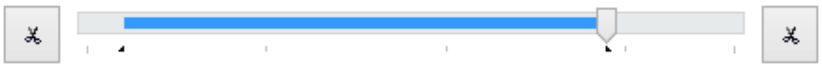


Figure 5-94 Selected range.

4. The (Select all) button can be used to clear the selection of the range and set it to its default range.
5. Define a subset of the selected range by changing the values for *Skip frames* and *Capture frame.* Between every set of size defined by *Capture frames* that is exported an amount of frames equal to *Skip frames* is skipped.

After the Export button is clicked a file selection window will pop up in which a file format and a file name can be selected. In case an image format is chosen, each frame will be saved in a separate image in which the frame number is added to the selected file name.

5.9.13.8. Playback camera settings

When an XVI movie is recorded the active camera settings are stored as well. During playback these settings can be consulted via the ( ) icon.

This feature requires that Microsoft WordPad is installed on your computer.

5.9.13.9. Time graph synchronization

In case a movie is loaded, a selection is made in the X-View pane (see chap. 5.9.3 Selections Tab) and the Time graph (see chap. 5.9.7 Time Graph Tab) is open, it is possible to display the evolution of the selection throughout the movie. This is can be achieved by clicking the ( ) icon.

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5.9.14. Image Processing Tab

If the Image Processing tab is missing, enable it through the *View* menu (chap. 5.8.2).

Adding filters to the image processing (Image processing) chain is accomplished by pressing the *Add Filter* button at the bottom of the Image Processing tab ( ).

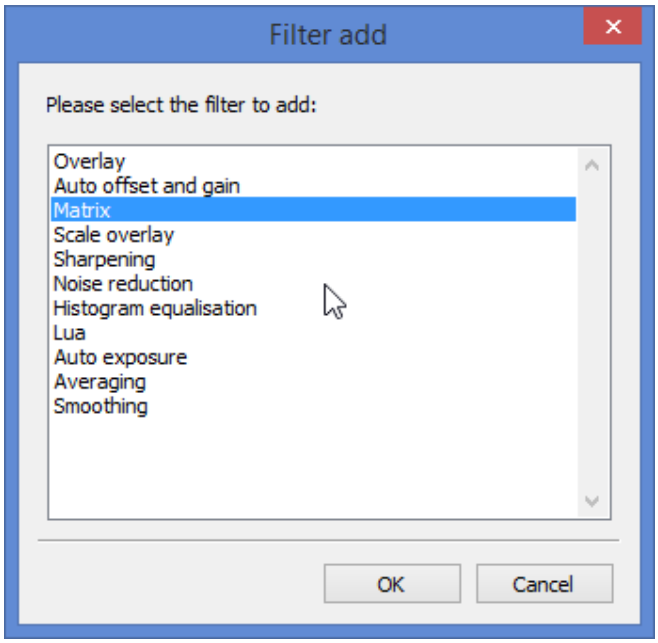

Figure 5-95 Image processing – Add filter

5.9.14.1. Filter documentation

By right clicking on the property pane of an image filter a selection pane will pop up that allows displaying extra information of the filter.

Figure 5-96 Show property documentation of a filter.

The documentation explains the different settings for the filter. Moreover, it contains the corresponding programming names to be used in combination with the Xeneth software

development kit (SDK) and in the *Auto start filters* setting of the Application settings (See chap. 5.2.3.2 User Interface Options.).

5.9.14.2. Image Processing – Software correction

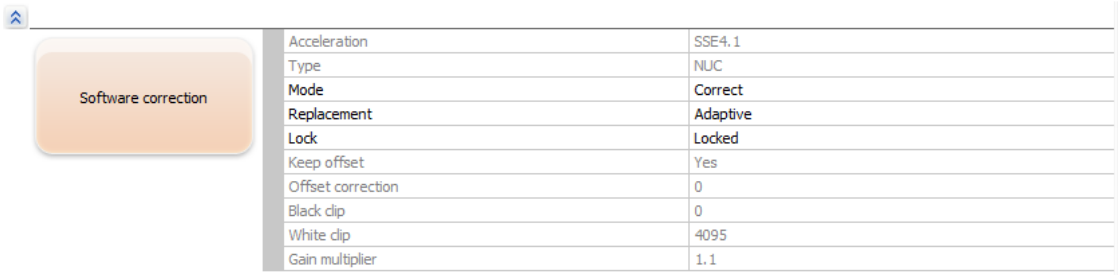

Figure 5-97 Image processing – Software correction

Parameter	Values	Description
Mode		
	Correct	The correction is applied.
	Show offset	Displays the dark image of the calibration pack.
	Show gain	Displays the applied gain values of the calibration pack.
	Pass	No correction is applied.
Replacement		
	Adaptive	The optimal value is derived from all the neighboring pixels
	Vertical	The upper or the lower pixel is copied.
	Vertical interpolation	The value is derived from interpolation of the pixels in the same column.
	Horizontal	The left or right pixel is copied.
	Horizontal interpolation	The value is derived from interpolation of the pixels in the same row.
Lock		
	Locked	For thermal calibrations, the lock should always be on.
	Unlocked	When unlocked the offset and gain multiplier parameters can be adapted.
Keep offset		
	No	The dark calibration image is subtracted from the image. This is the preferred option for non thermal cameras.
	Yes	The overall camera signal is kept at the same level. This is the preferred option for thermal cameras.
Offset correction		The dark calibration image is shifted before it is applied. In this way the user can avoid that the dark calibration image is the lowest possible signal when “Keep offset” is “No”.
Black clip	Between 0 and White clip -1	Output values lower than the black clips are clipped onto the black clip.
White clip	Between Black clip + 1 and maximal pixel	Output values higher than the white clip are clipped onto the white clip.

	value	
Gain multiplier		An overall gain is multiplied to all the pixels.

Table 5-4 Software correction parameters

5.9.14.3. Image Processing – Auto Exposure

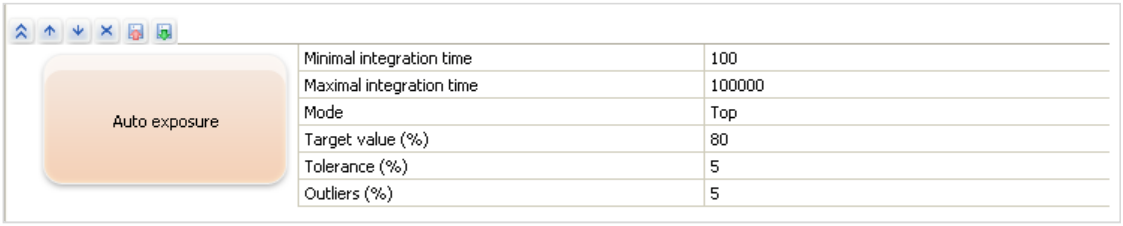

Figure 5-98 Image processing – Auto exposure

This filter continuously adapts the integration time based on the scene. It should only be used together with a TrueNUC calibration pack.

Parameter	Values	Description
Minimal integration time		The minimum and maximum integration time is limited by minimum and maximum integration time defined in the TrueNUC calibration pack.
Maximal integration time		
Mode	Top	The top of the image histogram is steered towards the Target value.
	Average	The mean of the image histogram is steered to the Target value.
Target value (%)		The preferred histogram top (average) defined as percentage of the maximal digital output value of the camera.
Tolerance (%)		As long as the histogram top (average) did not change more than this value, the integration time is kept stable.
Outliers (%)		The extreme values of the image histogram are not taken into account when searching a suitable integration time.

Table 5-5 Auto exposure parameters

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5.9.14.4. Image Processing – Sharpening

Figure 5-99 Sharpening filter

Sharpen all features in the scene. This filter has no adjustable parameters.

5.9.14.5. Image Processing – Auto offset and gain

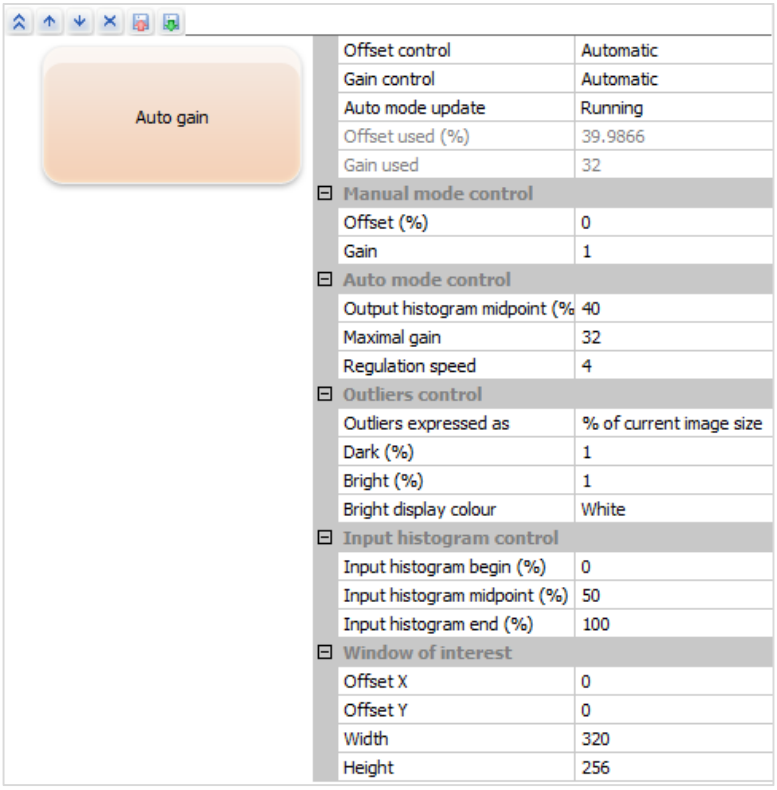

Figure 5-100 Auto offset and gain filter

Improve the representation of the usable information in the image by automatically shifting and spreading the actual pixel values in the image over the entire available range.

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Parameter	Values	Description
Offset control	Automatic; Manual	Select automatic or manual offset control.
Gain control	Automatic; Manual	Select automatic or manual gain control.
Auto mode update	Running; Stopped	Allow the filter to change offset and gain in auto mode.
Offset used (%)	(read only)	Shows the currently applied offset level (% of ADU range).
Gain used	(read only)	Shows the currently applied gain factor.
Offset (%)	-99.9% to 99.9%	Use this offset (% of ADU range) if in manual offset mode.
Gain	1 to 256	Use this gain factor if in manual gain mode.
Output histogram midpoint (%)	0.1% to 99.9%	Target level for the histogram midpoint if in auto offset mode.
Maximal gain	1 to 256	Maximal applied gain factor if in auto gain mode
Regulation speed	0 to 9	Select how quickly changes in scene result in changes in filter parameters. Higher numbers result in slower adjustment.
Outliers expressed as	% of image size; % of maximal intensity	Select how 'Dark' and 'Bright' settings are interpreted.
Dark (%)	0% to 100%	Percentage of dark pixels to ignore in the histogram. If the mode is 'intensity', this is absolute % of the ADU range.
Bright (%)	0% to 100%	Percentage of bright pixels to ignore in the histogram. If the mode is 'intensity', this is absolute % of the ADU range
Bright display colour	White; Black	Force the colour of bright pixels. If set to 'white', outliers remain unaffected.
Input histogram begin (%)	0% to 'midpoint'	After clipping outliers, set the beginning of the input histogram to this % of the resulting histogram span.
Input histogram midpoint (%)	'begin' to 'end'	Same for midpoint.
Input histogram end (%)	'midpoint' to 100%	Same for end.
Offset X	0 to sensor width – 1	X coordinate of the top-left corner of the window of interest
Offset Y	0 to sensor height – 1	Y coordinate of the top-left corner of the window of interest
Width	1 to sensor width	Width of the window of interest.
Height	1 to sensor height	Height of the window of interest.

Table 5-6 Auto offset and gain filter parameters

5.9.14.6. Image Processing – Histogram equalisation

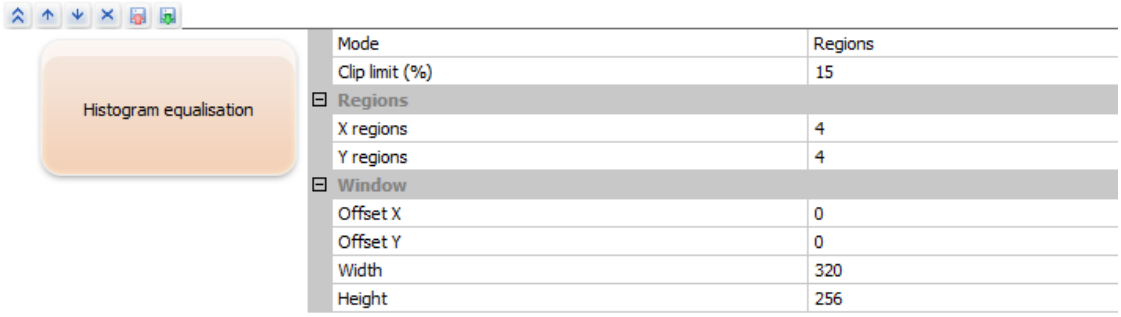

Figure 5-101 Histogram equalisation filter

Improve the representation of the usable information in the image by dividing the image into regions and redistributing the actual pixel values in the region over the entire available

range. Alternatively, the image can be adjusted based on only input information from 1 specific window of interest. In this mode, no subdivision into regions will take place.

Parameter	Values	Description
Mode	Regions; Window	Select full-frame sub regions or single window of interest.
Clip limit (%)	0 to 100%	Limit the amount of redistribution of pixels to equalize the histogram.
X regions	1 to 8	Divide the image in the defined amount of columns.
Y regions	1 to 8	Divide the image in the defined amount of rows.
Offset X	0 to sensor width - 1	X coordinate of top-left pixel of window of interest.
Offset Y	0 to sensor height - 1	Y coordinate of top-left pixel of window of interest.
Width	1 to sensor width	Width of window of interest.
Height	1 to sensor height	Height of window of interest.

Table 5-7 Histogram equalisation filter parameters

5.9.14.7. Image Processing – Noise reduction

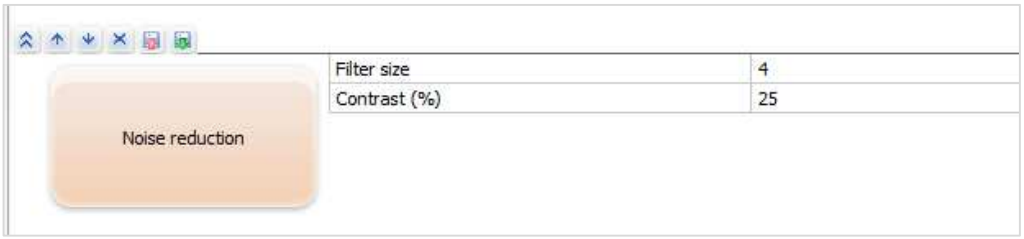

Figure 5-102 Noise reduction filter

Reduce noise in uniform regions of the frame while preserving edges.

Parameter	Values	Description
Filter size	1 to 8	Set the range of pixels used to filter the noise.
Contrast (%)	0 to 100%	Set the contrast level the filter will use to determine the noise and the edges.

Table 5-8 Noise reduction filter parameters

5.9.14.8. Image Processing – Thermography

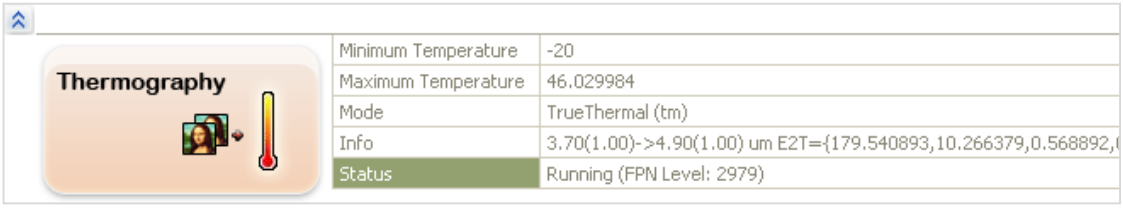

Figure 5-103 Image processing –Thermography

This pane is purely informational; it shows the thermal range available and the type of thermal conversion.
And, in case of an error it displays an error message in its status field.

5.9.14.9. Image Processing – Image averaging

Figure 5-104 Image processing – Image averaging

The image averaging filter makes it possible to reduce the visible noise by averaging a configurable number of frames.

5.9.14.10. Image Processing – Scale Overlay

Figure 5-105 Image processing – Scale overlay

Figure 5-106 Image processing – Thermal scale

The scale overlay filter makes it possible to show an in-view thermal scale (see Figure 5-106).

5.9.14.11. Image Processing – Overlay

Figure 5-107 Image processing – Overlay

The overlay filter makes it possible to display a logo (for promotional purposes) in any of the image corners, and in the center.

5.9.14.12. Image Processing – Matrix

Figure 5-108 Image processing – Matrix

5.9.14.13. Image Processing – Lua - Iso Gradient

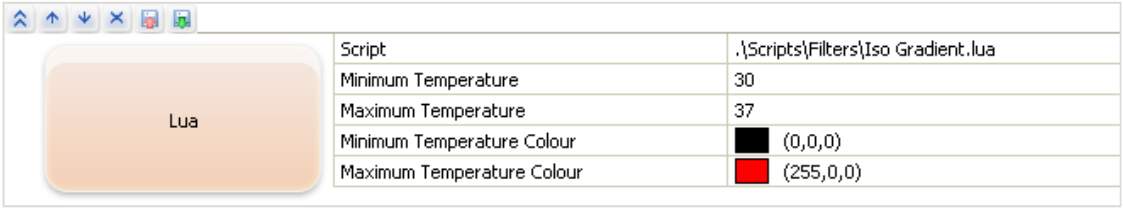

Figure 5-109 Image processing – Lua - Iso gradient

Figure 5-110 Lua – Iso gradient example

The general purpose scriptable Lua filter with the Iso Gradient example loaded (see Figure 5-110).
This filter also emits an image triggering event when a scene possesses elements that match the configured thermal interval.

5.9.14.14. Image Processing – Lua - Spot Meter

Figure 5-111 Image processing – Lua - Spot meter

Figure 5-112 Spot meter overlay example

This spot meter overlay example is nice for third party thermographic applications.

5.9.14.15. Image Processing – Lua - Crosshairs

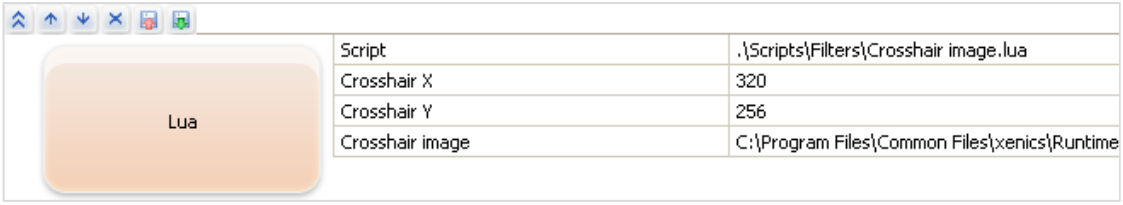

Figure 5-113 Image processing – Lua - Crosshairs

Figure 5-114 Image processing – Lua - Crosshair example

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5.9.14.16. Image Processing – Lua - Custom Filter

The general purpose of the Lua filter is to load custom scripts. Chap. 5.11 General Purpose Image Filter – Scripting describes the way to write and load these scripts.

5.9.14.17. Image Processing – Recording/Playback

When a movie is recorded or shown, the recorder or player icon (see Figure 5-115) is shown in the Image Processing tab:

Figure 5-115 Image processing – Recorder/player icon

The movie is recorded in a 16 bit XVI file format, which is the Xenics proprietary file format. We refer to the documentation included in the Software Development Kit for a detailed description of the format.

The filters in the Image Processing tab that are active during recording are stored in the file, without being applied to the data. This allows the user to (re)analyze the frames afterwards, which can be very useful, e.g. if the thermal filter is applied to measure temperatures in a scene, but – at that time - do not have correct information on the emissivity of the objects and the ambient temperature.

i Nothing is recorded when the filter parameters are changed during recording or when filters are (de)activated. Only their initial state will be captured in the XVI.

i The main exception is the non-uniformity correction (NUC): when a NUC is applied during recording, corrected images are stored and it will not be possible to switch off the NUC when showing the recorded movie. When no NUC is applied, it is possible to activate one while the movie is being played.

5.9.14.18. Image Processing – Record AVI

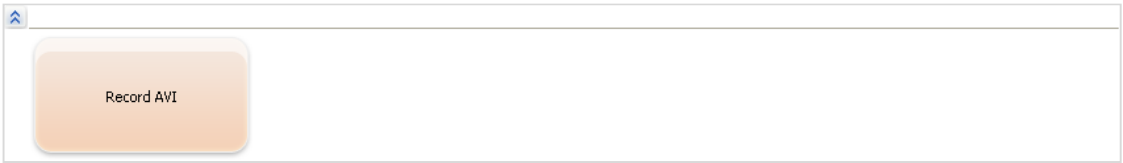

Figure 5-116 Image processing – Record AVI icon

The movie is recorded in the 8 bit AVI format, in which case the activated filters in the Image Processing tab are applied to the recorded data. In this way a “What You See Is What You Get” movie can be shared with third party viewers. The disadvantage is that it is no longer possible to analyze the data afterwards.

5.9.14.19. Image Processing – XVI Player

Figure 5-117 Image processing – XVI player icon

When an XVI movie is started, all filters that were active at the start of the recording will be activated again. Moreover, also the parameters applied to these filters are remembered. Afterwards the user is free to change these parameters, deactivate filters or switch on new filters as necessary for the required analyses to perform.

When a NUC was applied during recording it cannot be switched off. The NUC that was loaded is shown in the ‘Calibration’ item in the Recording tab. When it was applied, the ‘[Data is corrected]’ message is shown, if not ‘[Data is not corrected]’ is shown. In the latter case, it is possible to activate any NUC.

5.9.14.20. Image Processing – Filter Priorities/Management

For filters, not managed by Xeneth, the order in which filters operate on the image data can be changed by using the following buttons:

Figure 5-118 Image processing – Filter management

Explanation from left to right:

- Collapse filter settings
- Move filter up
- Move filter down
- Remove filter from the filter stack
- Save active filter settings to disk
- Load active filter settings from disk as shown in Figure 5-119.

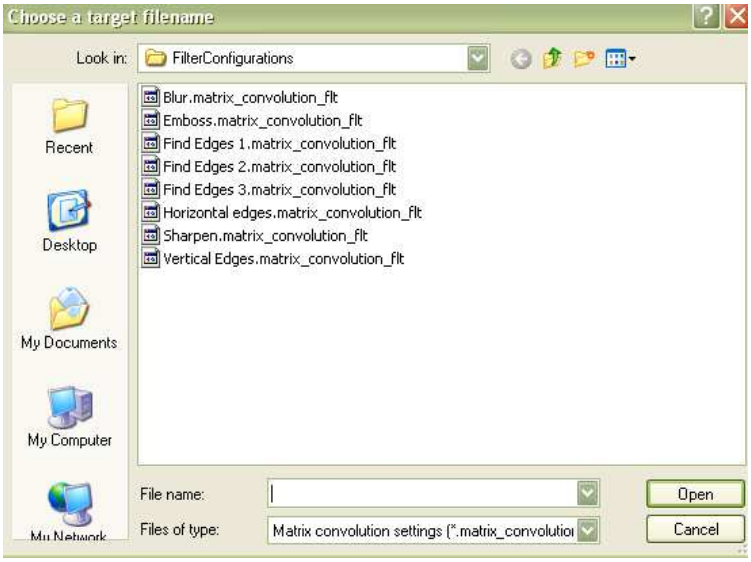

Figure 5-119 Load active filter settings from disk

Filters can also be temporarily switched off, by pressing the filter icon (see Figure 5-120):

Figure 5-120 Disable filter

Filters can also be temporarily switched on, by pressing the filter icon (see Figure 5-121):

Figure 5-121 Enable filter

5.9.15. Alarms

If the Alarms tab is missing, enable it through the “View” menu (chap. 5.8.2).

Using the alarms pane, it is possible to receive audible/programmatic responses to image filter / selection threshold events (See also chap. 5.9.3 Selections Tab and chap. 5.9.14 Image Processing Tab).

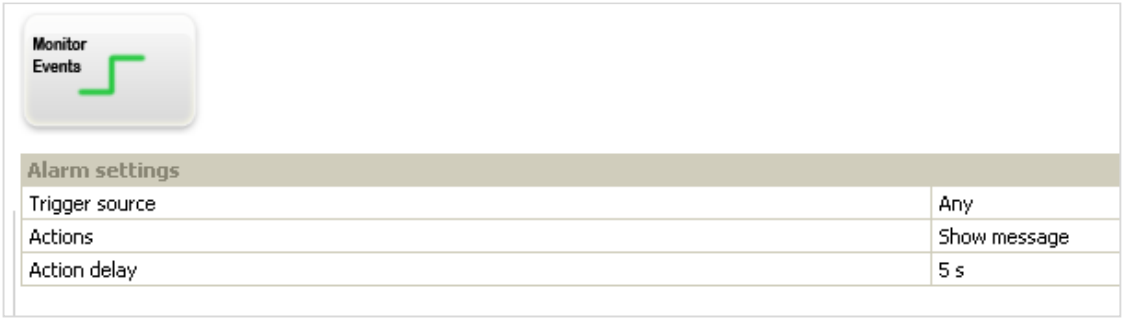

Figure 5-122 Alarm settings

Explanation of Figure 5-122:

Parameter	Parameter options	Description
Trigger source		
	Any	Responds to all events.
	Events – Image processing	Responds to events generate by an image filter.
	Events – Selection alarms	Responds to selection events only.
Actions		
	Start external program	Spawn, and wait for an external process to terminate
	Play sound	Play a .wav file
	Show message	Display a dialog box
Action delay		Bars the event response from being executed faster than every <x>s.

Table 5-9 Alarm parameters

5.9.16. Zoom Lens

If the Zoom lens tab is missing, enable it through the “View” menu (chap. 5.8.2).

The zoom lens pane provides control for a connected, motorized zoom lens. On connection, the panel will display the current zoom and focus positions of the lens on the sliders.

Basic connection status information is presented in the ‘Status’ field (‘Disconnected’ and ‘Connected on port: xxx’). The name field shows the protocol used with the currently connected lens.

The zoom and focus position of the connected lens can be adjusted by moving the respective sliders.

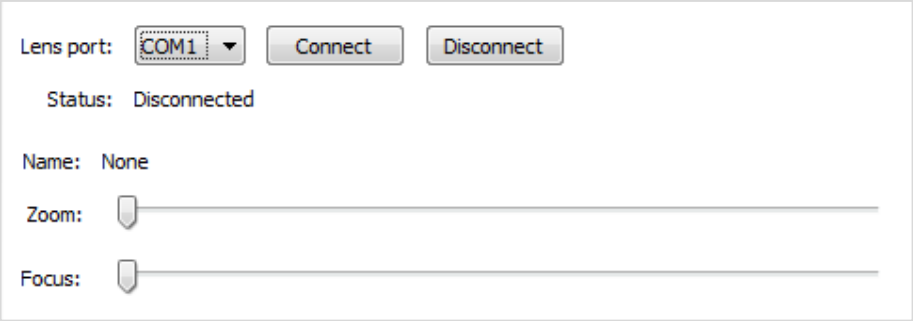

Figure 5-123 Zoom lens pane

Zoom lenses compatible with the Ophir U3 and IRZoom protocols are supported.

5.9.17. Status Bar

Figure 5-124 Status bar

Explanation of Figure 5-124:

Parameter	Description
#14980	Current frame number
49 fps	Effective data rate achieved over the current frame transport (usb/ether/…).
31061 kb/s	Number of kilobytes / second (fps * w * h * pixelsize / 1024).
Time:	The time the frame was taken with microsecond accuracy (this is also available during movie playback).

Table 5-10 Status bar parameters

5.10.Troubleshooting

The issues listed in this section focus on problems that may occur when working with the Xeneth software. Make sure to also check out the camera specific user manuals to learn about potential problems for your camera.

5.10.1. Troubleshooting Camera Detection Problems

5.10.1.1. Ethernet Cameras

This section handles the absence of a zero configuration networking support.

If the camera does not have zero configuration support (http://en.wikipedia.org/wiki/Zeroconf), and it must be plugged into a network without a DHCP server (http://en.wikipedia.org/wiki/Dhcp), it is necessary to manually assign an IP address to both the computer and the camera (refer to the per camera documentation).

After having set a fixed address e.g. 192.168.0.2 on your camera, proceed to:

Figure 5-125 Select network

Select 'Local area connection 1' and right-click to select its properties (as shown in Figure 5-126).

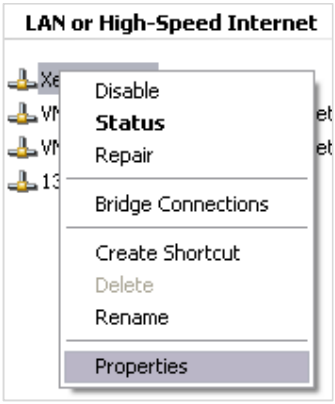

Figure 5-126 Select network properties

Figure 5-127 Select network properties – TCP/IP

Select 'Internet Protocol (TCP/IP)' and click the 'Properties' button (as shown in Figure 5-127).

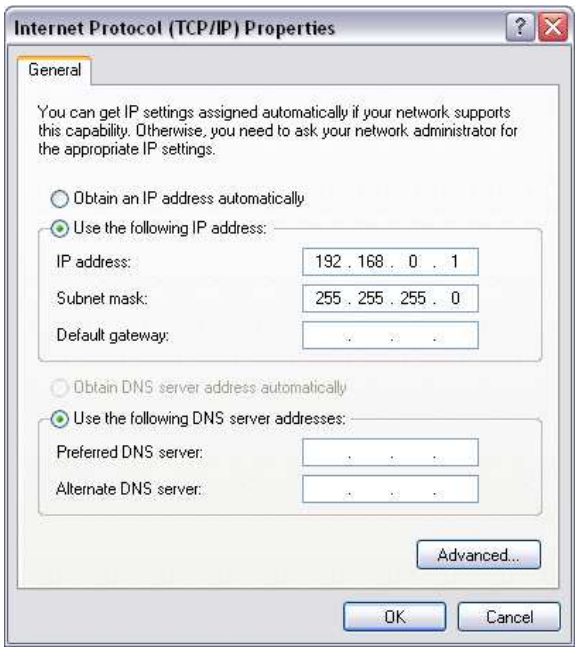

Figure 5-128 TCP/IP properties

The address in the 'IP address' field (in Figure 5-128) is not the same as the one assigned to the camera (camera = 192.168.0.2 in the example).

The subnet mask is correct.
For every field in the IP address that is different between camera and the PC put a 0 in the subnet mask instead of a 255.

5.10.1.2. GigE Vision Cameras

When a GigE Vision camera does not appear in the enumeration list it could be that its persistent IP address does not belong to the local sub network. These cameras can be recovered by the “Ignore subnet” settings of the camera enumeration settings (see chap. 5.2.2) and the Force IP mechanism for GigE Vision cameras (see chap. 5.2.1.4).

5.10.1.3. USB Cameras

When any new hardware detected dialogs from Windows pops up during operation of the camera (this sometimes happens when it is plugged into a different USB port), guide Windows through the process of re-discovering the driver (see Figure 5-129, Figure 5-130 and Figure 5-131).

Figure 5-129 USB camera – Windows connection

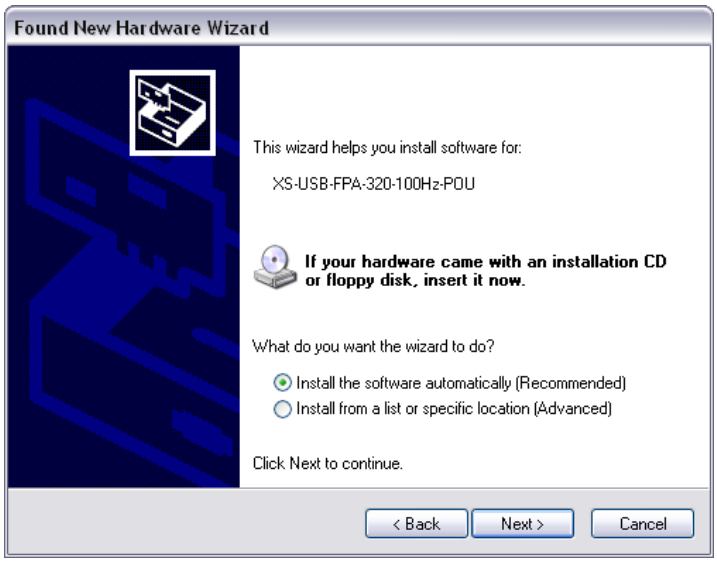

Figure 5-130 USB camera – Select automatic installation

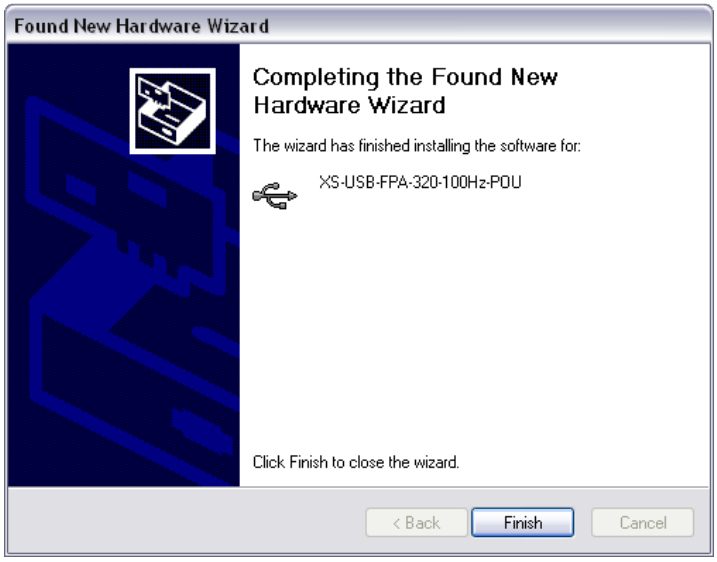

Figure 5-131 USB camera – Driver installation completed

If these steps did not resolve the issue, refer back to chap. 3.3.1 Camera Drivers (USB).

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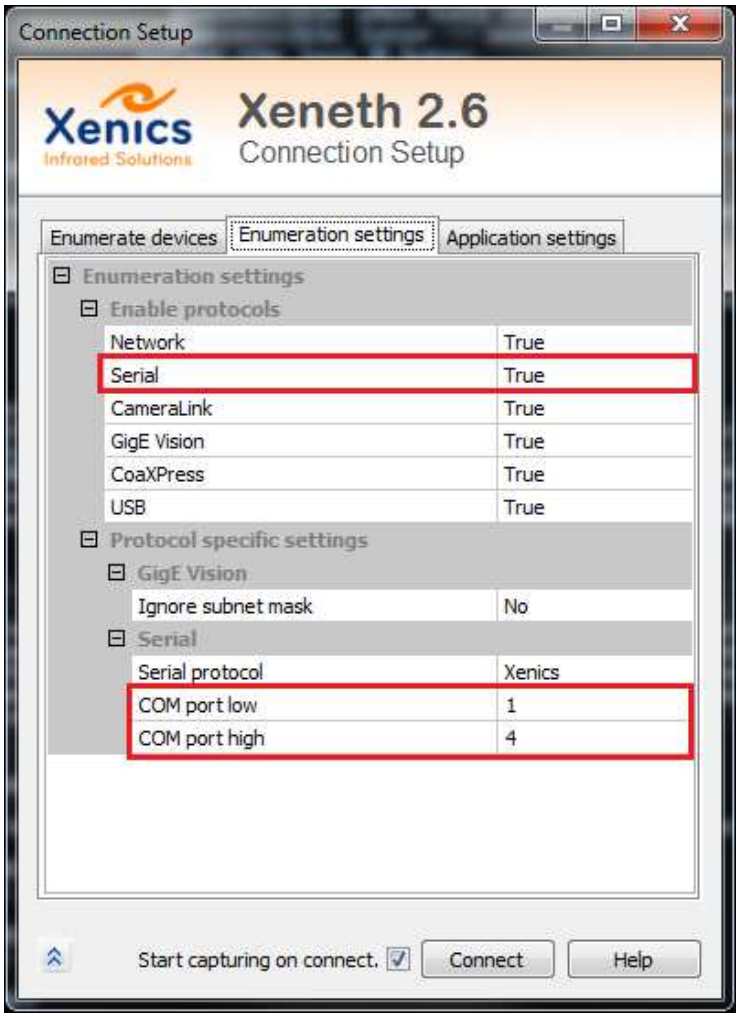
5.10.1.4. Serial cameras

Always make sure the correct cables are used and all connections are properly plugged into the designated connectors. Refer to the camera user manual to learn how to set up the connection. When a camera connected using the correct serial cable cannot be detected it is possible that the configured range of serial ports to look for is not valid. By default Xeneth will only scan ports from COM1 up to, and including, COM4. Usually the serial port will have an identifier assigned by the operating system within this range. It is possible to extend this range if the assigned port exceeds the default range. The *COM port low* and *COM port high* values can be found on the *Enumeration settings* - tab in the *Connection Setup* -dialog. Moreover, make sure the protocol is enabled by setting the "Enumeration settings → Enable protocols → Serial"-setting to "True".



5.10.2. Troubleshooting Frame Rate Performance Problems

5.10.2.1. Register Polling

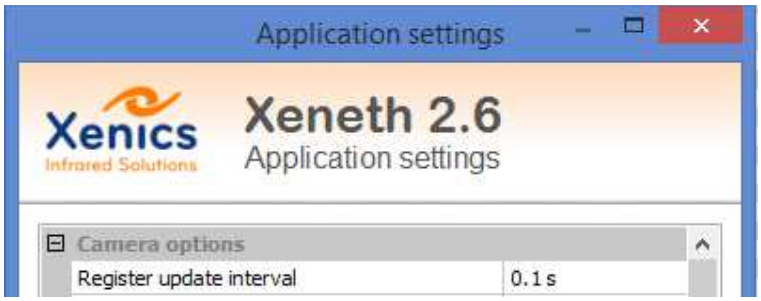


Figure 5-132 Register update

Register polling (see Figure 5-132) impacts the frame rate on network cameras where the bandwidth requirements are already quite big (e.g. 117 fps 640x512).
Reducing/disabling the register read interval makes it possible to achieve better a performance.

5.10.2.2. Graph Updates / Resizing the View

Changing the *Update graphs very x frames* in the application setting (chap. 5.2.3) to a higher value and disabling the resizing of the view window reduces the CPU load.

5.10.3. Troubleshooting Recording Rate Problems

When encountering a drop in frame rate while recording in Xeneth closely examine your hard drives sustained write speed.

When the Task Manager of your PC indicates that Xeneth is constantly running at 100% CPU load, it may be worthwhile to flag the *Minimize CPU usage to optimize recording speed* tick box in the disk recorder (see Figure 5-133 and Figure 5-134). This causes the GUI to revert to a minimal state avoiding any unnecessary drawing operations.

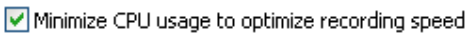


Figure 5-133 Disk recorder option

.

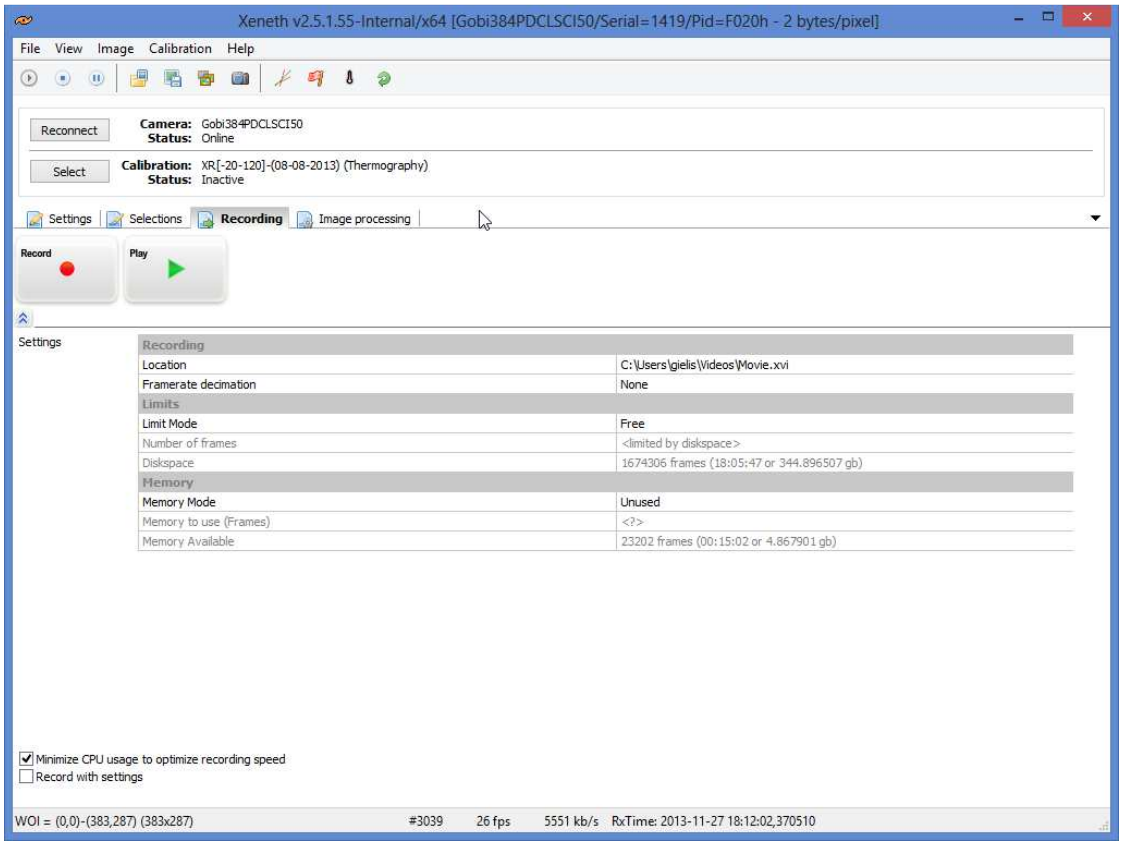


Figure 5-134 Recording tab

5.11.General Purpose Image Filter – Scripting

5.11.1. Setup and Tools

Chap. 5.9.14.16 did introduce the general purpose Lua image filter. Xeneth allows users to write custom scripts that can be loaded in this filter. After the installation, the Xeneth scripts are put in the 'C:\Program Files\Xeneth\Scripts\Filters' directory, which is the default location for the filter to start looking for scripts. It is possible to put the scripts anywhere else on the computer as well.

Lua (http://www.lua.org) is the used scripting language. It is a small, well documented and easy to learn programming language. Other nice tools that can help the development are the editor Notepad++ (http://notepad-plus-plus.org) that provides syntax highlighting and

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DebugView (http://technet.microsoft.com/en-us/sysinternals/bb896647.aspx) for capturing the Lua error messages.

5.11.2. Tutorial

5.11.2.1. Start

Add the Tutorial.lua file in the 'C:\Program Files\Xeneth\Scripts\Filters' directory and open this file in your editor.

5.11.2.2. Objects

Xeneth provides the following three base objects:

- XCamera() to inquire the camera properties
- XSensorImage() to edit the frame data and the frame overlay
- XOverlayImage() to load an external image to the overlay of a frame.

5.11.2.3. Events

There are several events that are raised while Xeneth processes the frames of the camera. Defining a filter means that the script assigns the desired image manipulation to each of the events.

The events that are available are:

- OnFrame(): Image manipulation must be done here
- OnDrawOverlay(): Image overlay manipulation must be performed
- OnProcessedFrame(): This step follows after that all the activated filters did process a frame. The main goal of this step is doing statistics on the image.
- OnUpdateSpan(): This event is raised whenever a user changes the Scale (See selection on Scale)
- OnUpdateTint(): This event is used when the integration time of the camera is adapted
- OnSerialise(): This event is used to update the user interface of the filter to its internal settings
- OnParameterUpdate (): This event warns the filter logic that the user did change some parameters.

5.11.2.4. Sample 1: Write Information to DebugView

The following code (Figure 5-135) writes information to the DebugView.

```
1
2  MyCamera = XCamera()
3  MyImage = XSensorImage()
4  MyOverlay = XOverlayImage("C:\\TEMP\\overlayImage.png")
5
6  cameraWidth                                = MyCamera:GetWidth()
7  cameraHeight                               = MyCamera:GetHeight()
8  cameraMaximalPixelValue                    = MyCamera:GetMaxValue()
9  minimumTemperature, maximumTemperature     = MyCamera:GetThermalInterval()
10
11
12 print("Camera width  = ".. cameraWidth)
13 print("Camera height = ".. cameraHeight)
14 print("Maximal pixel value = "..cameraMaximalPixelValue)
15 print("Camera output range = ["..minimumTemperature..","..maximumTemperature.."]")
```

Figure 5-135 Sample 1 – Information to DebugView code

The output of the 'GetThermalInterval()' call depends on the loaded thermal calibration pack. Notice that a Lua construct is used, in which a function is able to return multiple values.

5.11.2.5. Sample 2: Add Image to Overlay

The following code adds an image to the overlay. The image is located in 'C:\\TEMP\\overlayImage.png' directory.

```
1
2  MyCamera = XCamera()
3  MyImage = XSensorImage()
4  MyOverlay = XOverlayImage("C:\\TEMP\\overlayImage.png")
5
6  cameraWidth                                = MyCamera:GetWidth()
7  cameraHeight                               = MyCamera:GetHeight()
8
9  imageStartX = cameraWidth/5
10 imageStartY = cameraHeight/5
11
12 function OnDrawOverlay()
13     MyImage:DrawOverlayImage(MyOverlay, 0, 0, 110, 85, imageStartX, imageStartY)
14 end
```

Figure 5-136 Sample 2 – Add image to overlay code

When e.g. the image is the Xenics logo, the result is shown in Figure 5-137.

Figure 5-137 Sample 2 – Add image to overlay

5.11.2.6. Sample 3: Add Line to Overlay

The following code (see Figure 5-138) adds a line to the overlay.

```
1
2   MyCamera = XCamera()
3   MyImage = XSensorImage()
4   MyOverlay = XOverlayImage("C:\\TEMP\\overlayImage.png")
5
6   cameraWidth      = MyCamera:GetWidth()
7   cameraHeight     = MyCamera:GetHeight()
8
9   function OnDrawOverlay()
10      local line = {}
11      for i = 0, cameraWidth - 1 do
12          line[6*i + 1] = i
13          line[6*i + 2] = cameraHeight - 10
14          line[6*i + 3] = 255
15          line[6*i + 4] = 0
16          line[6*i + 5] = 0
17          line[6*i + 6] = 255
18      end
19
20      MyImage:SetOverlayPixels(line)
21  end
```

Figure 5-138 Sample 3 – Add line to overlay code

The SetOverlayPixels() function takes a Lua table as argument. This table contains consecutively the x and y coordinates and the red, green, blue and alpha color component of the points that needs to be drawn. In this example a red line is placed at the bottom of the image (see fig).

i The starting index of a Lua table is 1 and not 0.

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Figure 5-139 Sample 3 – Add line to overlay

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5.11.2.7. Sample 4: Change Frame Data

The following code (see Figure 5-140) changes the frame data.

```
MyCamera = XCamera()
MyImage = XSensorImage()
MyOverlay = XOverlayImage("C:\\TEMP\\overlayImage.png")

cameraWidth                                 = MyCamera:GetWidth()
cameraHeight                                = MyCamera:GetHeight()
cameraMaximalPixelValue                     = MyCamera:GetMaxValue()

function OnFrame()
    leftRight = { 1, 1, cameraWidth - 2, cameraHeight - 2 }
    leftRightValue = MyImage:GetPixels(leftRight)

    centerX = cameraWidth/2 - 1
    centerY = cameraHeight/2 - 1


    local whiteCenter = {}
    for i = 0, 2 do
        for j = 0, 2 do
            whiteCenter[ 3*(i + 3*j) + 1]  = centerX + i
            whiteCenter[ 3*(i + 3*j) + 2]  = centerY + j
            whiteCenter[ 3*(i + 3*j) + 3]  = cameraMaximalPixelValue
        end
    end

    if leftRightValue[1] > leftRightValue[2] then
        MyImage:SetPixels(whiteCenter)
    end
end
```

Figure 5-140 Sample 4 – Change frame data code

The XCamera:GetPixels() function takes a Lua table as argument containing all the pixels of which the frame values must be known. The first entry is the x coordinate of the first pixel, the second entry is its y coordinate, followed by the x coordinate of the next pixel and so on. The call returns a table with the corresponding pixel values.

The XCamera:SetPixels() function makes a table of the form {x1_coord, y1_coord, value1, x2_coord, ...}.

The code edits the central pixels in a frame.

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5.11.2.8. Sample 5: Activate Trigger

When changing the above sample (Figure 5-140) in the following way (see Figure 5-141), a trigger bit is set in the frame's footer.

```
25
26      if leftRightValue[1] > leftRightValue[2] then
27          MyImage:SetReference("trigger")
28      end
```

Figure 5-141 Sample 5 – Activate trigger code

When this filter runs while the Xeneth event monitor is activated (Alarms), an alarm will be triggered (see Figure 5-142) when the top left corner of the image is warmer than the bottom right one.

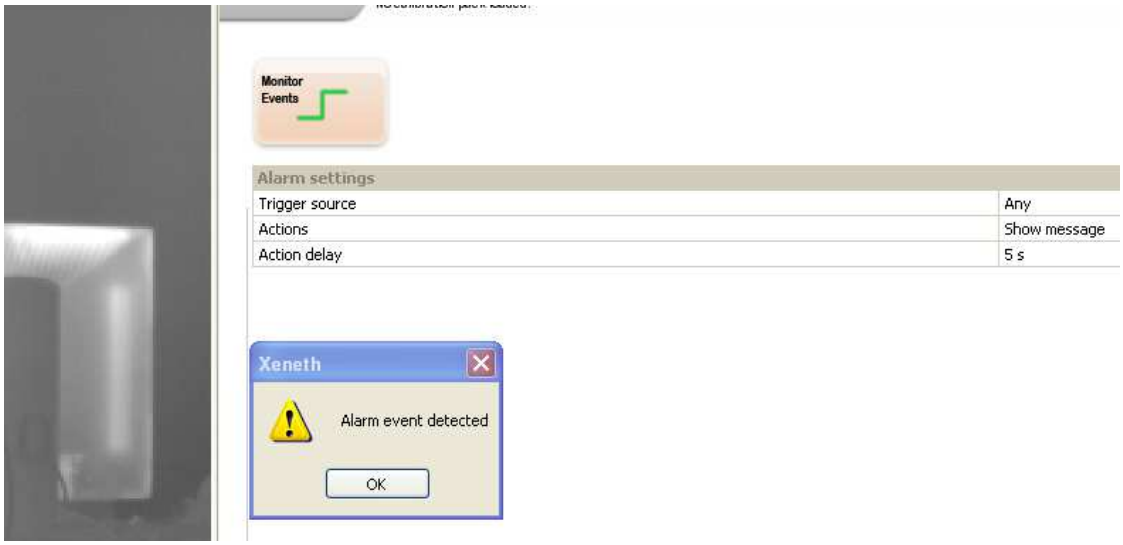

Figure 5-142 Sample 5 – Alarm is triggered

5.11.2.9. Sample 6: Define User Interface

To define a working user interface both the 'OnParameterUpdate' and 'OnSerialise' calls need to be defined. The resulting user interface will be a parameter grid.

To extend the code in sample 2 in such way that the user is able to define the overlay image location, the following sample can be used (see Figure 5-143).

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```
MyCamera = XCamera()
MyImage = XSensorImage()
MyOverlay = XOverlayImage("C:\\TEMP\\overlayImage.png")


imageStartX     = 10
imageStartY     = 10

function OnDrawOverlay()
    MyImage:DrawOverlayImage(MyOverlay, 0, 0, 110, 85, imageStartX, imageStartY)
end


function OnParameterUpdate (name, value)
    if name == "StartX" then
        imageStartX = value
    end

end

function OnSerialise()
 State = [[<StartX type='int' label='Image start x' range='' editable='1'>]]..imageStartX..[[</StartX>]]
 return State
end
```

Figure 5-143 Sample 6 – Define overlay image location code

This results in the interface of fig.

Figure 5-144 Sample 6 – New interface created

The arguments of ‘OnParameterUpdate’ event are the name of the updated parameter and its new value.

The ‘Onserialize’ event is used to define the user interface via a series of xml nodes. Each node has a name (StartX), a value (imageStartX) and the following series of attributes:

- Type: possible values are: ‘int’, ‘float’, ‘bool’, ‘colour’, ‘enum’
- Label: the name that will be displayed
- Range: for an enum, this is a list of names that will be shown in a drop-down list
- Editable: 0 or 1.

The double brackets “[[” and “]]” are te Lua syntax for literal strings.

The following sample (Figure 5-145, Figure 5-146 and Figure 5-147) exploits more of the interface facilities:

```
MyCamera = XCamera()
MyImage = XSensorImage()
MyOverlay = XOverlayImage("C:\\TEMP\\overlayImage.png")

cameraWidth                         = MyCamera:GetWidth()
cameraHeight                        = MyCamera:GetHeight()
cameraMaximalPixelValue             = MyCamera:GetMaxValue()


lineR                               = 255
lineG                               = 0
lineB                               = 0
imageStartX                         = 10
imageStartY                         = 10
centerValue                         = "Black"
drawLine                            = false

function OnFrame()
    leftRight = { 1, 1, cameraWidth - 2, cameraHeight - 2 }
    leftRightValue = MyImage:GetPixels(leftRight)

    centerX = cameraWidth/2 - 1
    centerY = cameraHeight/2 - 1

    centerPixelValue = 0
    if centerValue == "White" then
        centerPixelValue = cameraMaximalPixelValue
    end
    local whiteCenter = {}
    for i = 0, 2 do
        for j = 0, 2 do
            local index = 3*(i + 3*j)
            whiteCenter[ 3*(i + 3*j) + 1]  = centerX + i
            whiteCenter[ 3*(i + 3*j) + 2]  = centerY + j
            whiteCenter[ 3*(i + 3*j) + 3]  = centerPixelValue
        end
    end

    if leftRightValue[1] > leftRightValue[2] then
        MyImage:SetPixels(whiteCenter)
    end

end
```

Figure 5-145 Sample interface facilities – Code part 1

```
function OnParameterUpdate(name, value)
    if name == "StartX" then
        imageStartX = value
    elseif name == "CenterValue" then
        centerValue = value
    elseif name == "DrawLine" then
        drawLine = false
        if value == "true" then
            drawLine = true
        end
    elseif name == "LineColour" then
        lineR,lineG,lineB = ToRGB(value)
    elseif name == "CenterValue" then
        centerValue = value
    end


end

function OnSerialise()
    State = [[<StartX type='int'        label='Image start x' range=''        editable='1'>]]..
                imageStartX..[[</StartX>]]..
            [[<StartY type='int'        label='Image start y' range=''        editable='0'>]]..
                imageStartY..[[</StartY>]]..
            [[<DrawLine type='bool'     label='Draw line'     range=''        editable='1'>]]..
                tostring(drawLine)..[[</DrawLine>]]..
            [[<LineColour type='colour' label='Line Colour'   range=''        editable='1'>]]..
                string.format("rgb(%d,%d,%d)",lineR, lineG, lineB)..[[</LineColour>]]..
            [[<CenterValue type='enum'  label='Center Value'  range='Black,White' editable='1'>]]..
            centerValue..[[</CenterValue>]]
    return State
end
```

Figure 5-146 Sample interface facilities – Code part 2

```
function ToRGB(RGBString)

    strStart = RGBString:find("%(")
    strEnd   = RGBString:find("%,", strStart + 1)
    local R = tonumber( RGBString:sub(strStart + 1, strEnd -1) )

    strStart = strEnd
    strEnd   = RGBString:find("%,", strStart + 1 )
    local G = tonumber( RGBString:sub(strStart + 1, strEnd -1 ) )

    strStart = strEnd
    strEnd   = RGBString:find("%)", strStart + 1 )
    local B = tonumber( RGBString:sub(strStart + 1, strEnd - 1 ) )

    return R,G,B
end
```

Figure 5-147 Sample interface facilities – Code part 3

This code results in the following interface:

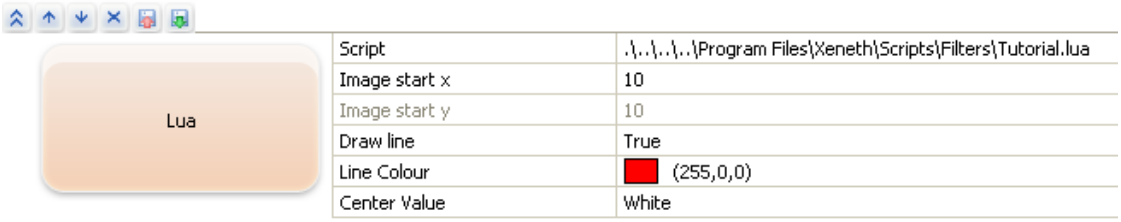

Figure 5-148 Sample interface facilities – Interface result

To conclude, Xeneth provides an embedded rgb(r,g,b) function that allows to replace the ToRGB function of Figure 5-147 by the following construct of Figure 5-149.

```
119 function ToRGB(RGBString)
120     return loadstring("return "..RGBString)()
121 end
122
```

Figure 5-149 Embedded RGB function used

5.11.3. Reference Manual

The following functions are available:

XCamera:XCamera

Description: Parameterless constructor

XCamera:GetWidth

Return Returns the width of the displayed frame. When a window of interest is selected, this can be smaller than the pixel width of the camera.

XCamera:GetHeight

Return Returns the height of the displayed frame. When a window of interest is selected this can be smaller than the pixel height of the camera.

XCamera:GetMaxValue

Return: Returns the maximal pixel value of the camera.

XCamera:GetThermalInterval

Return When the thermal filter is loaded, this call returns both the lowest and the highest value from the calibration pack. When no calibration pack is active the return values are 0 and XCamera:GetMaxValue.

XSensorImage:XSensorImage

Description: Parameterless constructor

XSensorImage:SetPixels

Description Allows to override a set of pixels in the frame data.

Parameters A Lua table of the form {x_1, y_1, v_1, x_2, y_2, v_2, …, x_n, y_n, v_n} contain the x and y coordinates of the n pixels that will be modified, together with the new value of these pixels.

XSensorImage:SetOverlayPixels

Description Allows to add coloured information (RGBA) to the overlay layer of each frame.

Parameters A Lua table of the form {x_1, y_1, r_1, g_1, b_1, a_1, x_2, y_2, r_2, …, x_n, y_n, r_n, g_n, b_n, a_n} contain the x and the y coordinates of the n pixels where we want to change the overlay of, together with their new RGBA colour coordinates.

XSensorImage:GetPixels

Description Allows to retrieve the frame data from a set of pixels.

Parameters A Lua table of the form {x_1, y_1, x_2, y_2, …, x_n, y_n} containing the x and y coordinates of the n pixels of interest.

Return Returns a Lua table of the form {v_1, v_2, …, v_n}.

XSensorImage:GradientTransfer

Description Allows to define a global colouring scheme on the frame overlay by relating a colour gradient to a range of pixel values. The colour scheme is defined by its extremal points. Intermediate points are interpolated.

Parameters
1. Lowest pixel value in the (inclusive) interval of interest
2. Highest pixel value in the (inclusive) interval of interest
3. Red colour coordinate assigned to the lowest pixel value
4. Green colour coordinate assigned to the lowest pixel value
5. Blue colour coordinate assigned to the lowest pixel value
6. Alpha colour coordinate assigned to the lowest pixel value
7. Red colour coordinate assigned to the highest pixel value
8. Green colour coordinate assigned to the highest pixel value
9. Blue colour coordinate assigned to the highest value
10. Alpha colour coordinate assigned to the highest pixel value.

Return Returns the number of coloured pixels, i.e. the number of pixels in the selected output interval.

XSensorImage:SetReference

Description Tags a frame by setting a trigger flag in the footer.

Parameters
1. The string “trigger”
2. 28-bit filter specific data.

XSensorImage:DrawOverlayImage

Description Allows to copy an image into the overlay of a frame.

Parameters
1. x coordinate of the first pixel selected from the image
2. y coordinate of the first pixel selected from the image
3. width of the selection
4. height of the selection
5. x coordinate of the target location
6. y coordinate of the target location.

XOverlayImage: XOverlayImage

Description Defines an image object that can be placed at the overlay of a frame.

Parameters String that contains the path to the image’s location.

XOverlayImage:GetWidth

Return: Returns the width of the image.

XOverlayImage:GetHeight

Return: Returns the height of the image.

5.12. Software Development Kit

5.12.1. Installation

Aside from installing the runtime (Xeneth.dll and dependencies), the option exists of installing the available libraries & headers, documentation and samples as shown in Figure 5-150.

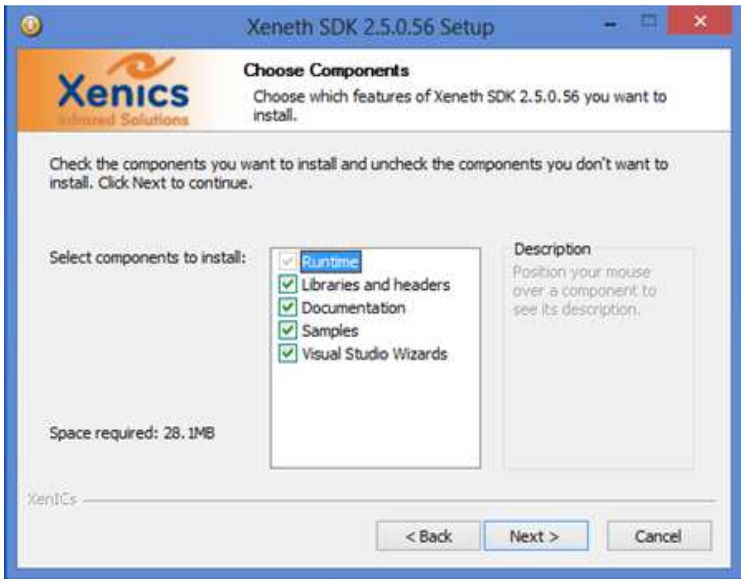

Figure 5-150 SDK installation setup

If a new application is being developed based on this SDK, check all the options!
By default only the runtime is installed, which will eventually be bundled in the application's installer.

5.12.2. Documentation

A shortcut to the API documentation will become available in the start menu (see Figure 5-151):

Figure 5-151 SDK documentation

Select the ‘X-Api-Help’ to open the Xeneth.dll programming reference, or alternatively, navigate to the ‘C:\Program Files\Xeneth\Sdk\Help’ to find ‘xeneth-sdk-chm’. The document collects the information on the programming interface and Xenics file formats. It also tells where to find samples and binaries(.dll, .o), libraries(.lib) and header (.h) files.

6. Thermography

In this chapter we briefly overview of the thermography features in Xeneth. Most of the topics that will be discussed are already dealt with at other places of this manual and will not be described in detail. The aim is rather to put all these features in the context of thermography.

To take advantage of the thermal capabilities of the software, you need the Radiometric version of Xeneth and your camera needs to be calibrated. This means that you received either a calibration pack as a so called .xca file or you own a camera that has temperature calibration data onboard.

6.1. Select Calibration Data

When your camera is shipped with a calibration pack (.xca), the pack will be installed automatically during the installation of Xeneth. After Xeneth is started and when the camera is selected in the list of cameras, the calibration pack will be shown in the “Calibration data” drop down list.

When this is not the case, the calibration file can be imported via the Calibration menu (see chap. 5.8.4) or put manually in the calibration folder. The default path of this folder is C:\Program Files (x86)\Xeneth\Calibrations or C:\Program Files\Xeneth\Calibrations.

For cameras that have calibration data onboard, you should select the item “(Camera memory)” in the same drop down list.

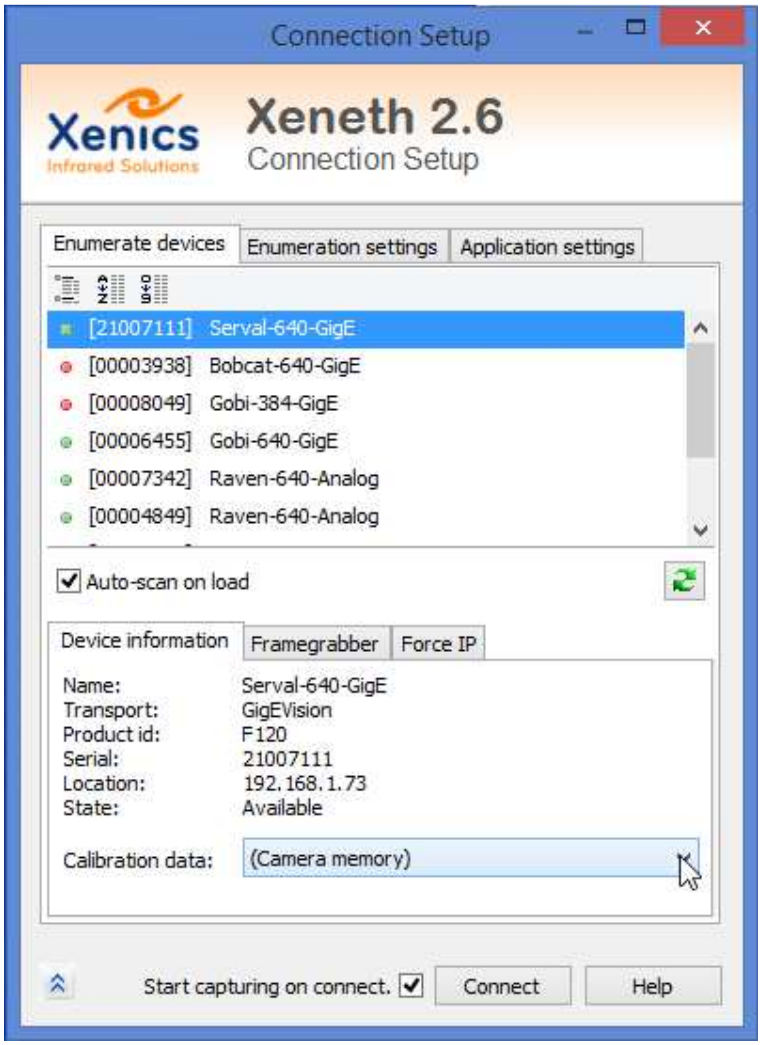

Figure 6-1 Select thermal calibration pack.

To activate the calibration, use the button in the main tool bar. (See chap. 5.7)

When the calibration pack loaded contains valid temperature calibration data for the current camera or when the temperature calibration data is stored on the camera a ( ) icon will appear on top of the thermography settings tab. (See chap. 5.9.11.3 Settings Tab – GigE Vision

- Packet delay – The delay (in timestamp counter units) between consecutive data packages on the stream channel.
- Packet size – The size of data packages (in bytes) on the stream channel.
- Retry count – The maximal number of times Xeneth retries to set a control register when no acknowledge is received.
- ACK timeout – The time Xeneth waits for an acknowledge after a control register is set.
- Pass frames with lost packages – When false, frames with missing parts are dropped.
- Use packet resend – When active, the Xeneth will ask the camera to resend a package that is missed.
- Frame drops – The number of frames that are lost since start of capture.
- Packet drops – The number of packages that are not received by Xeneth.

Settings Tab – Thermography).

Figure 6-2 Image filter temperature settings.

6.2. Software Settings

The thermography settings tab (, see chap. 5.9.11.3) collects features that are applied in the Thermography software filter.

- Ambient temperature – Overall ambient temperature of the scene (T_{amb}).
- Emissivity map – Per pixel emissivity values (ε).
- Atmosphere temperature – The temperature of the medium between the scene and the observer (T_{atm}).

- Atmospheric transmission – The transmission factor of the medium between the scene and the observer (τ).
- Window temperature – The temperature of a window in front of the camera (T_{win}).
- Window reflected temperature – The temperature reflected at an intermediate window and observed by the camera ($T_{win\,refl}$).
- Window transmission – The transmission factor of the window (ζ).
- Window reflection – The reflection factor on the window (ρ).

6.3. Radiometry

The radiance that is observed by a camera when it is pointed to an object is affected by the following components:

- the energy radiated by the object,
- the energy from the environment reflected on the object,
- the energy radiated by the atmosphere between the object and the camera,
- the energy absorbed by the atmosphere between the object and the camera,
- the energy radiated / absorbed / reflected by a window between the object and the camera.

By combining these elements the observed irradiation ($W_{Observed}$) by a camera that looks to an object of temperature (T) can be approximated by:

$$W_{Observed} = W_{Object} + W_{Relflected\ on\ object} + W_{Atmosphere} + W_{Window} + W_{Reflected\ on\ window},$$

where

$$W_{Object} = \varepsilon * \tau * \zeta * W_{BB}(T_{obj})$$

$$W_{Relflected\ on\ object} = (1 - \varepsilon) * \tau * \zeta * W_{BB}(T_{amb})$$

$$W_{Atmosphere} = (1 - \tau) * \zeta * W_{BB}(T_{atm})$$

$$W_{Window} = (1 - \zeta - \rho) * W_{BB}(T_{win})$$

$$W_{Reflected\ on\ window} = \rho * W_{BB}(T_{win\,refl})$$

in which

- $W_{BB}(T)$ is the radiated energy of a perfect black body at temperature T,
- T_{obj} is the temperature of the object.

All other symbols are as defined above.

6.4. Temperature Readings

As soon as a thermal calibration is activated, temperatures can be read at different places:

- The scale (chap. 5.9.12) reflects the selected thermal range.
- When a calibration pack is activated in software, the statistics describing a selection are expressed in temperature (chap 5.9.3).
- The Histogram (chap.5.9.5), Graph (chap. 5.9.6) and Time Graph (chap.5.9.7) are expressed in temperatures.
- XPNG images can be saved (chap.5.8.3 and chap. 5.8.3.5).

Temperatures can be read in degrees of Celsius, Kelvin and Fahrenheit. This can be selected in the Application settings (chap. 5.2.3.2).

6.4.1. Temperature Readings and Image Filters

When an image filter is activated (chap 5.9.14), it affects the image and hence the temperature reading. This could be the desired behavior – for instance when the filter reduces noise - but this is not always the case. Indeed, by applying filters that alter the histogram all thermal information could be lost.

In the Application settings (chap. 5.2.3.2), you can find the item “Measure thermal filter data only” which determines whether thermal information is extracted immediately after the thermal filter or only after all image filters are applied.

6.4.1.1. Loading Thermal Images

When thermal images (.xpng) are loaded (see chap. 5.8.3.1), the *Show Image* filter is activated and the image is shown on top of the live image. In this case it is very likely that you want to read temperatures after the filter. This implies that *Measure thermal filter data only* should be put to *False*.

6.5. Thermal data in XVI movies

When an XVI movie is recorded while a temperature calibration is loaded and the thermography software filter is activated, calibration data are stored in the XVI as meta-data.

When playing back this movie the calibration data can be applied.

Start Xeneth, select the *Virtual camera* and select as *Calibration data* (none).

Select and start the movie.

Click ( ) to activate the thermography filter.

Figure 6-3 Movie thermal data

6.6. Onboard Settings

For cameras that have a temperature calibration onboard, the features listed under the ( ) tab are camera settings. This means that the values you enter here are passed to the camera that makes the needed computations. Which features are available is camera depended.

Typical settings are:

- Minimal temperature - the lowest temperature that can be measured,
- Maximal temperature – the highest temperature that can be measured,
- Selection minimal temperature – the minimal temperature as selected by the user,
- Selection maximal temperature – the maximal temperature as selected by the user,
- Emissivity – the overall emissivity of the scene,
- Ambient temperature – the overall ambient temperature of the scene.

We refer to the camera manual for more details.

In case those cameras are used in Xeneth the camera settings that you find here are mastered by the software and need not to be modified. Use the thermography settings tab instead. (See chap. 5.9.11.3 and chap.6.2.)

6.6.1. Serval

The Serval family of cameras could contain several sets of correction data (for instance to be used for different lenses) and temperature calibration data.

A temperature calibration can be activated as follows:

1. Select the onboard calibration data (See chap. 6.1.).
2. Go to the *Settings* tab > Camera > Image correction control > Source control > Source and select one of the items *Calibration 1* to *Calibration 2*.
   If the selected source does contain temperature calibration data then
   - the feature Camera( ) > Image correction control > Source control > Thermography enable will have the value *On*,
   - the feature Thermal( ) > Thermography > Temperature control > Minimal temperature and Thermal > Thermography > Temperature control > Maximal temperature do contain the minimal and the maximal calibrated temperatures.
3. Click on the icon  (See Figure 6-2 Image filter temperature settings.) to activate the software image filter that converts the camera output to temperatures.
4. Read temperatures as described in chap.6.4.

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