X-VIEW2 SOFTWARE

User's Manual

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Warning

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Change record

Rev	Date issued	Description of change
1.0	2015-11-12	Release
1.1	2015-11-20	Add section 2.3 and chapter 4.
1.2	2016-01-21	Add section 2.4, 3.14 and 3.15 and Figure 2-6; Update Figure 3-4.
1.3	2016-05-03	Add async external line trigger mode; Add pingx function to section 2.3.
1.4	2016-09-08	Add section 4.5; Revise Figure 3-12, 3-22 and 3-39.
1.5	2017-05-23	Change all the "Reset" to "Set" in UI and in the text information. Update Figure 3-3, 3-5, 3-21, 3-22, 3-23, 3-25, 3-26, 3-27, 3-28, 3-47 and 3-48; Add figure 4-2.
1.6	2017-08-21	Add section 4.6; add operation mode summary.

Terms, definitions and abbreviations

Abbreviation	Definition
ACK	The acknowledgement sent from an X-GCU after getting a command from the computer.
CAT-5e/6	Category 5/6 cable.
DM	The front-end Detector Module which is composed of X-DFE and X-Ray cards.
DMID	The index of DMs; the first DM of the first X-GCU channel is marked as DM1, the following DMs are marked by the order.
HEX	Hexadecimal.
Hi/Lo trigger	The high energy and low energy external line trigger generated by dual- energy LCS system.
IP	Internet Protocol address.
LED	Light-Emitting Diode.
MAC	Media Access Control address.
UDP	User Datagram Protocol.
X-DEF	The front end control unit of the detector which reads the signal from analog front-end, digitizes the signals and sends back the image data to the X-GCU.
X-GCU	Giga-bit control unit board of the detector which reads the image data from numbers of X-DFEs and sends the data to the system host computer.
X-GCU_CL	Giga-bit Control Unit Board, Camera Link version.
X-GCU_EX	Giga-bit Control Unit Board, Extra version.
X-GCU_STD	Giga-bit Control Unit Board, Standard version.
X-LIB	Software library to support the X-GCU.

1. INTRODUCTION

1.1. Scope and overview

This document contains the instructions necessary for the installation, initialization and use of the X-View2 application software.

Detection Technology Plc has released the next generation detector electronics read out platform in 2015. The new platform provides a universal solution for all the applications in a simplified and faster way.

The X-View2 application software is designed for the new electronic read out platform, which is based on the X-LIB library. You can refer to the "DS0000087 Programmer's Manual of X-LIB Software Library" for the use of the X-LIB library.

1.2. Hardware and software requirements

The X-View2 is a cross platform application software, which supports Windows7/8.1/10 (32/64-bits) and Ubuntu 14.04/16.04(32/64-bits).

The X-View2 functions with one or more X-GCU boards. For the single X-GCU system, the system configuration is as shown in the table1-1.

Table 1-1. Single X-GCU system configuration

Device	**Configuration**
Processor	Intel 4 cores/8 threads 3.0GHz
Memory	4G
Display card	Independent GPU
Monitor	Resolution 1024*768
OS	Window7/8.1/10(32/64-bits) Ubuntu14.04/16.04(32/64-bits)
Network adapter	1Gbps
Frame grabber (Optional, only for Win7)	Xcelera-CL PX4 Dual

For the multi-X-GCU system, the system configuration is as in the following table.

Table 1-2.Multi-X-GCU system configuration

Device	**Configuration**
Processor	Intel 4 cores/8 threads 3.0GHz
Memory	8G
Display card	Independent GPU
Monitor	Resolution 1024*768

Device	Configuration
OS	Window7/8.1/10(64-bits) Ubuntu14.04/16.04(64-bits)
Network adapters	1/10Gbps
Frame grabber (Optional, only for Win7)	Xcelera-CL PX4 Dual
Switch(Optional)	10Gbps

Note: The above configurations are minimum requirements; users may be required for more advanced hardware configurations according to the real applications.

1.3. Working mode

Since the X-GCU can be configured in a gigabit Ethernet mode or camera link mode, the X-View2 can also function in the two modes.

In the gigabit Ethernet mode, the basic communication protocol is UDP. There are two logical channels between the X-View2 and X-GCU: a command channel and an image channel. The command channel is in charge of sending and receiving commands. The image channel is for getting image data from the X-GCU.

In the camera link mode, the basic communication protocol is a camera link and an RS232. There are also two logical channels between the X-View2 and X-GCU: a command channel and an image channel. The command channel is based on the RS232 protocol. The image channel is based on the camera link protocol.

2. INSTALLING AND CONFIGURING X-VIEW2 SOFTWARE

2.1. Installing software of Windows system

For the Windows user, please follow the installation steps below.

1) Open the X-View2 installation package.

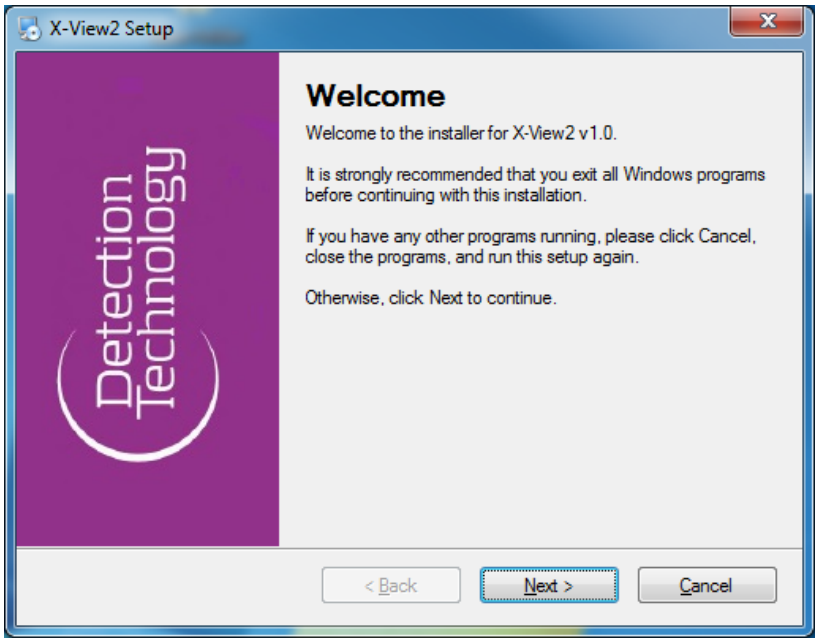


Figure 2-1. Welcome screen

2) Agree the license.

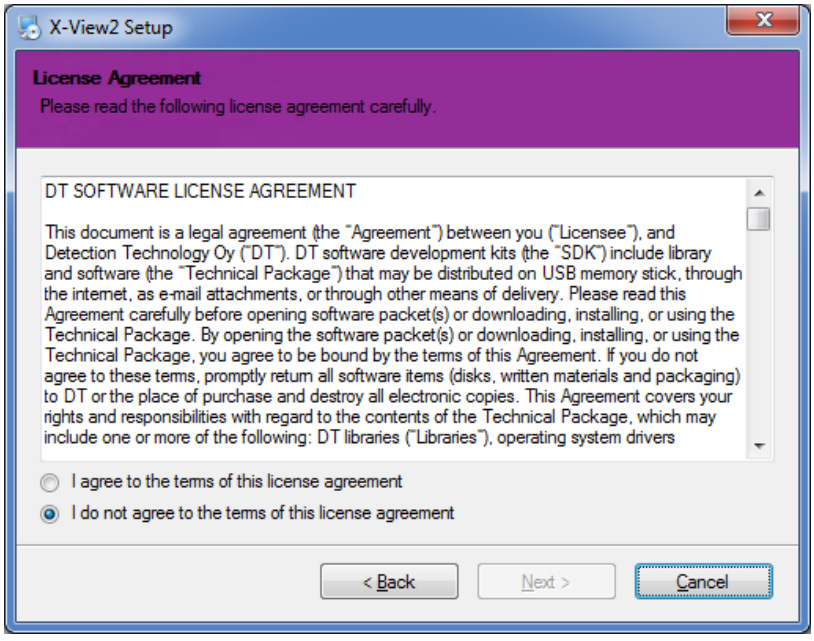


Figure 2-2. License screen

3) Choose the directory to install the software.

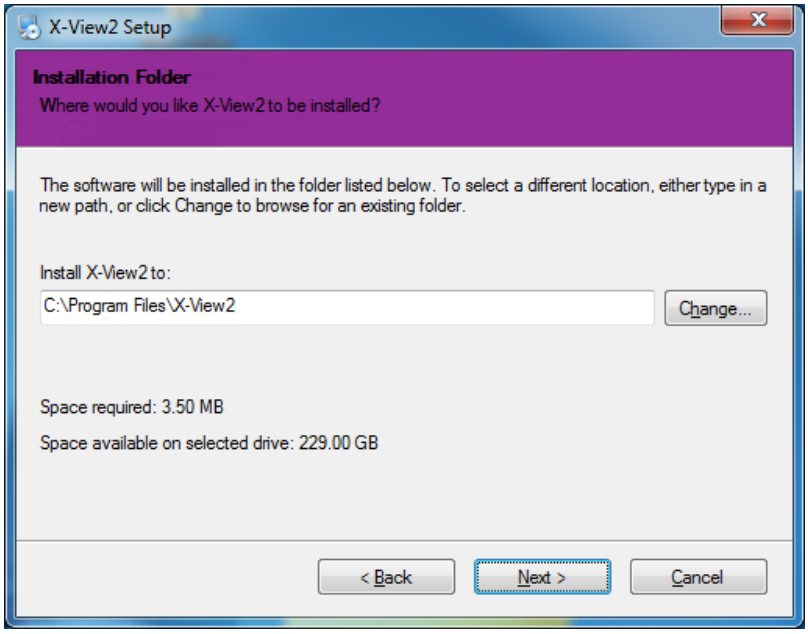


Figure 2-3. Choosing installing directory

4) Complete the installation.

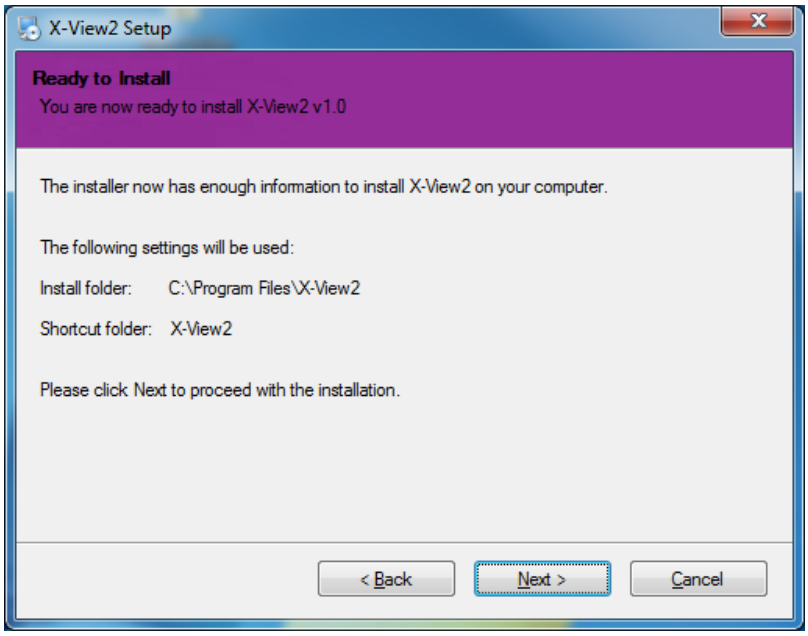


Figure 2-4. Installation screen

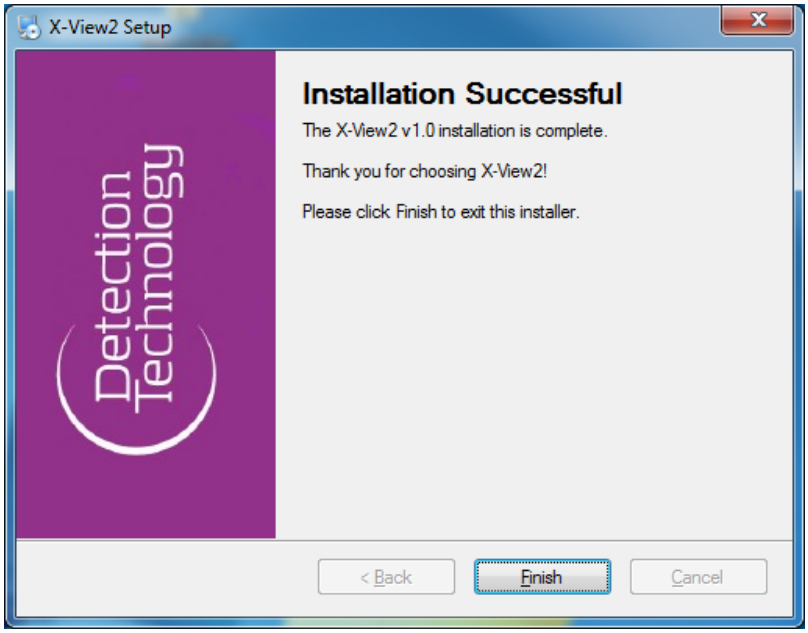


Figure 2-5. Completing screen

2.2. Installing software of Ubuntu system

You need to enter root account and input "chmod +x ./X-View2_ubuntu_xx.bin" command. Then you should input "./X-View2_ubuntu_xx.bin" command to install the software. After that, you can switch to user account.

X-View2 software is installed in directory "/opt/xview2_xx". You should enter "/opt/xview2_xx/bin" directory and input "./X-View2" command to start the application.

The SDK is installed in directory "/opt/xview2_xx/X-LIBSDK", which includes the demo code and SDK user's manual.

2.3. Network configuration

If you are using the Ethernet type detector, you should connect the computer and the detector with a CAT-5e/6 cable directly or through a gigabit switch. You should give a fixed IP address to the network adapter that connects with the detector, such as "192.168.1.XXX". If the detector's IP address is not in the same subnet with the network adapter, you must set the detector's IP address in the setup page (Please refer to the section 3.1).

If you are using multi-adapters to connect more than one detector, you must give the network adapters different subnet addresses, such as "192.168.1.XXX" and "192.168.2.XXX". You must set the detector's IP address to be the same subnet of the connected network adapter.

When you start the software for the first time, you have to allow it to pass the firewall as following figure shown.

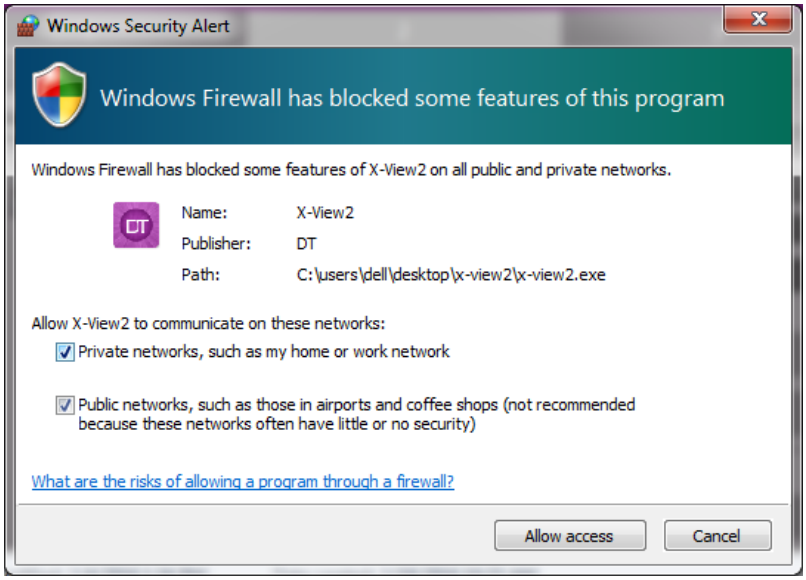


Figure 2-6. Firewall configuration

For Windows system, you can use command "pingx" to check the connection status between PC and detector.

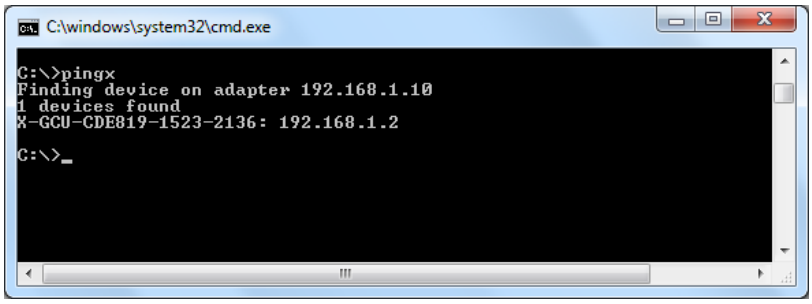


Figure 2-7. pingx command window

2.4. Camera link grabber setup and configuration

If you are using the camera link type detector, you have to make sure that you have installed the camera link frame grabber "Xcelera-CL PX4 Dual" in the computer. For single X-GCU system, you should connect the camera link cable to connector 1 as following figure shown.

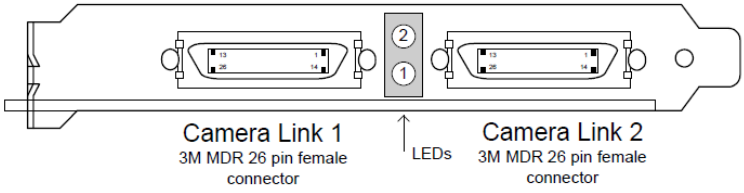


Figure 2-8. "Xcelera-CL PX4 Dual" card

You need to install the Sapera LT SDK first and then install the Xcelera-CL PX4 card driver. After finishing the installation, you should choose start -> program -> Teledyne DALSA ->Sapera LT->Sapera configuration. Then you have to set the requested buffer size to 64 Mbytes as shown in Figure 2-9 and map the COM port number.

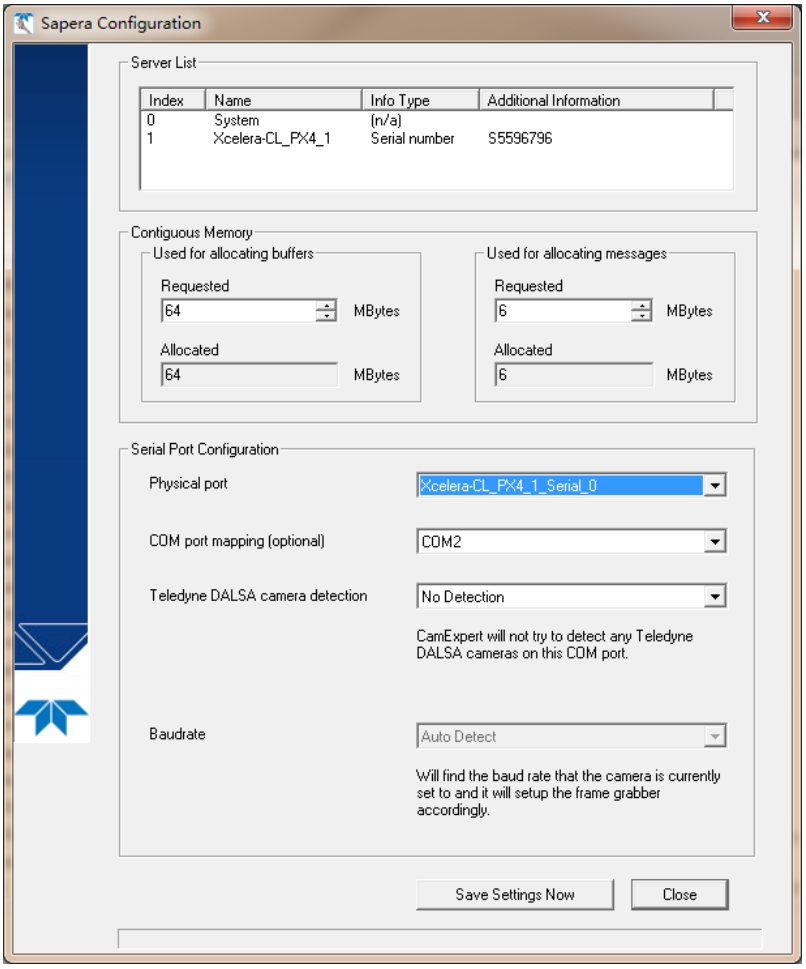


Figure 2-9. Sapera Configuration

3. X-VIEW2 FUNCTIONS

3.1. Setup page

After you open the software, the welcome screen will show in the center of the window as in the following figure. You should make sure you have the detector powered on and connected with the computer. After this has been done, you can click "Connect to detectors". If you just want to open static image, you should click "If you don't want to use detectors, skip the setup".

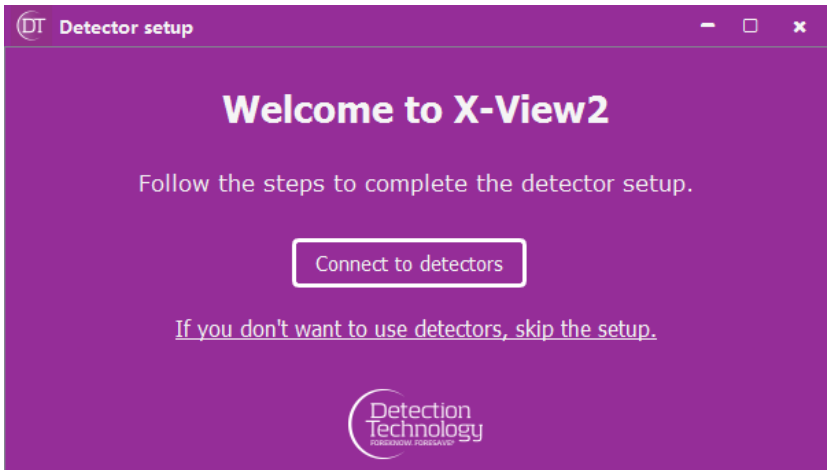


Figure 3-1. Welcome screen

You can enter setup pages after clicking "Connect to detectors" as shown below.

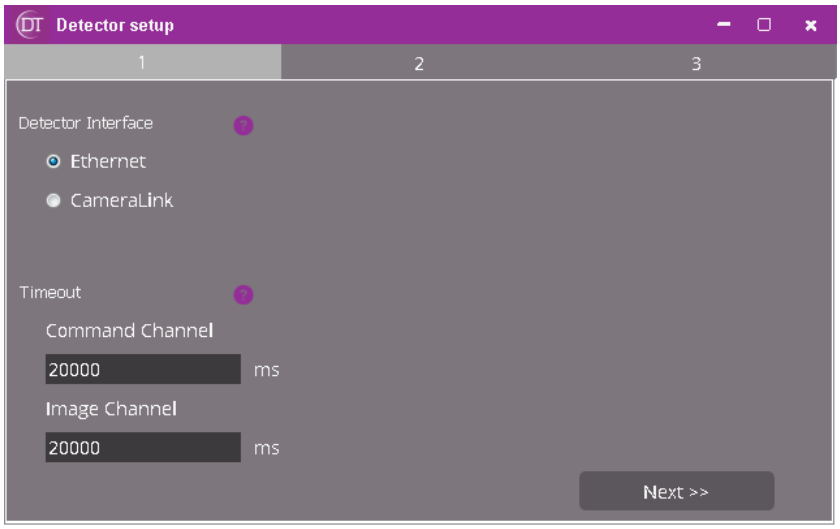


Figure 3-2. Detector setup page

The first setup page contains the following items.

Item	Description
Detector Interface	You should choose the physical connection type with the Ethernet or camera link. If your detector is of camera link interface, you have to set the serial port number that you mapped before by "Sapera configuration".
Command Channel Timeout	It is the waiting time after sending a command. It will show command timeout error if the ACK does not arrive within the period. The unit is ms with the default value 20000. The range is 12000 to 2000000. The default value is 20000.
Image Channel Timeout	It is the waiting time while grabbing image. It will show image timeout error if no image data arrives within the period. The unit is ms with the default value 20000. The range is from 0 to 2000000. If it is 0, the grabbing thread will block and wait for the data without reporting any error.

If you are using Ethernet connection, you can click the "Next" button to enter the second page as shown in the figure 3-3. Otherwise, you will enter the third page as in the figure 3-4.

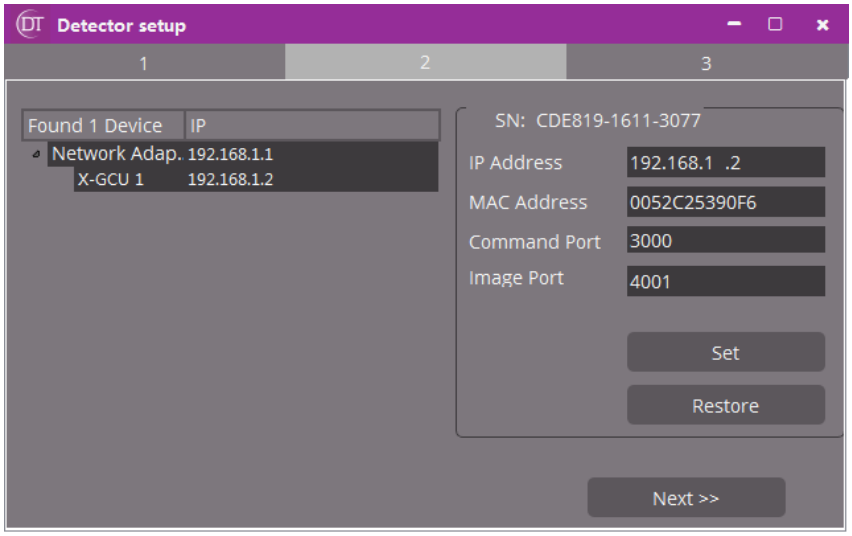


Figure 3-3. Ethernet setup page

On the left of the Ethernet setup page, you can find the tree of Ethernet adapters that connect with detectors. If you click the specific detector, you can check the detector network settings on the right side of the page.

Item	Description
IP Address	It is the X-GCU IP address that should be in the same subnet with the connected adapter. If not, you must change it and click the "Set" button. The default X-GCU IP address is "192.168.1.2".
MAC Address	It is the read only X-GCU MAC address.
Command Port	It is the command channel port number with the default value 3000. You can change it and click the "Set" button.
Image Port	It is the image channel port number with the default value 4001. You can change it and click the "Set" button.
Set	You can set the IP and port number by clicking this button.
Restore	You can restore the default IP and port number by clicking this button.

After finishing the network settings, you can click the "Next" button to enter the last setup page as shown in the figure 3-4.

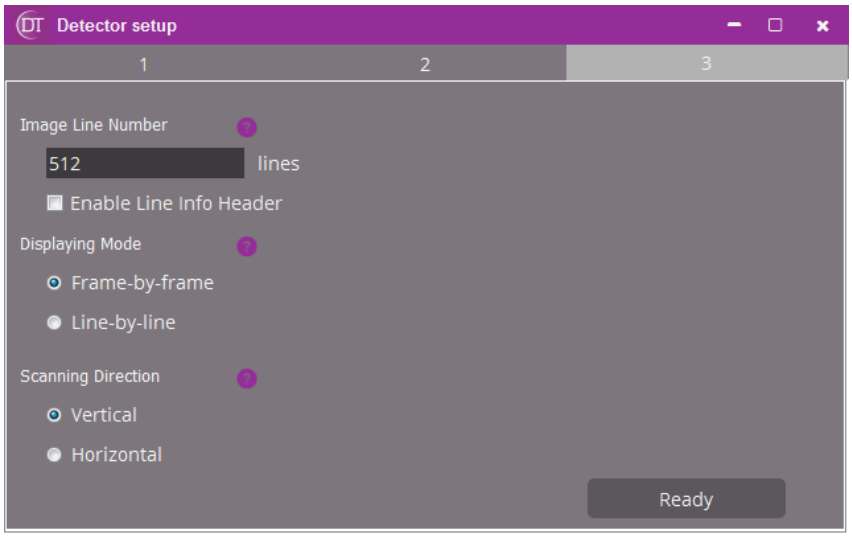


Figure 3-4. Last setup page

You can set the following items here.

Item	Description
Image Line Number	It is the number of lines in one frame, which should be a multiple of 32 lines and not less than 32 lines. The default is 512 lines
Enable Line Info Header	If enable line info header, there will be an extra 8-bytes header on front of each line. The content of the header is line id(2 bytes), line stamp(4 bytes), energy flag(1 byte) and DFE number flag(1 byte).
Displaying Mode	It defines the grabbing or refreshing style. You can choose the "Frame-by-frame" mode that refreshes every frame or "Line-by-line" mode that refreshes every 32 lines. The default is the "Frame" mode. Please note that the LCS detector can only support "Frame-by-frame mode.
Scanning Direction	It defines the displaying directions. "Vertical" direction displays the frame as the scanning direction is vertical. "Horizontal" direction displays the frame as the scanning direction is horizontal. The default is "Vertical". Please note that "Direction" must be "Vertical" if you are using dual-energy detector. The LCS detector can only support "Vertical" direction.
Dual Row LCS Mode	It's only available for dual-row LCS detector, which folds or unfolds row A and row B data.
Dual Row LCS Direction	It's only available for dual-row LCS detector. When row A and row B are folded, it defines which row is on the top.

After you finish all the settings, you will enter the main software interface.

3.2. Interface outline

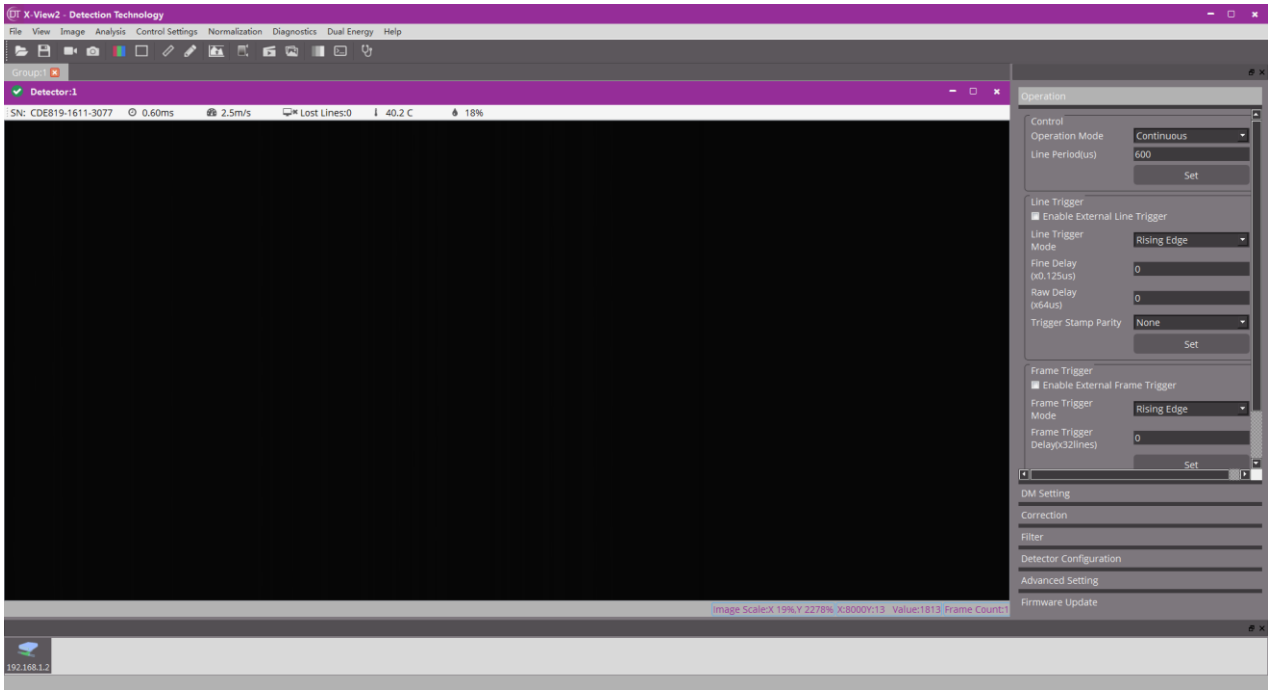


Figure 3-5. Main software interface

The main interface of the X-View2 is shown in the figure 3-5. There are four areas in the main interface: a menu bar on the top, a tool bar below the menu bar, an image window in the middle and a detector enumerating bar on the bottom.

The menu bar contains all the functions of the X-View2 software. If one item of the "Control Setting" menu is chosen, there will be a controlling dialog that docks on the right of the main interface.

The toolbar contains the most used functions of the X-View2, such as grabbing and saving image.

The image window is in charge of displaying images. It has an info bar on the top, which shows the basic information read from the detector. And on the bottom, there is a status bar which shows the status of the grabbed image.

The detector navigating bar shows the detectors that are connected with the computer. If there is more than one detector in the system, the user can switch between them to choose the targeted detector for control.

3.3. Toolbar components

The toolbar which contains 15 buttons is shown in the following figure. The following section describes the function of each button.

Figure 3-6. Toolbar

Button	Function	Description
	Open image file	You can open a static image file with this function. It supports the image format of a ".bmp" of an 8-bit bitmap, a ".tif" of a 16-bit TIFF file and "a .txt" of an ASCII format image. This function is only available when the current image window is free and not occupied by other images.
	Save image file	You can save the current image with this function. The image format could be a ".bmp" of an 8-bit bitmap, a ".tif" of a 16-bit TIFF file and a ".txt" of an ASCII format image.
	Grab/stop images	You can grab images continuously or stop grabbing them with this function.
	Snap an image	You can snap one image by clicking this function once.
	Enable/disable pseudo color	You can enable or disable the pseudo color mode with this function.
	Choose region of interest	You can click this button and move the mouse by left-clicking to choose the region of interest of an image. After that, you can right-click the mouse and the mouse menu will pop up.

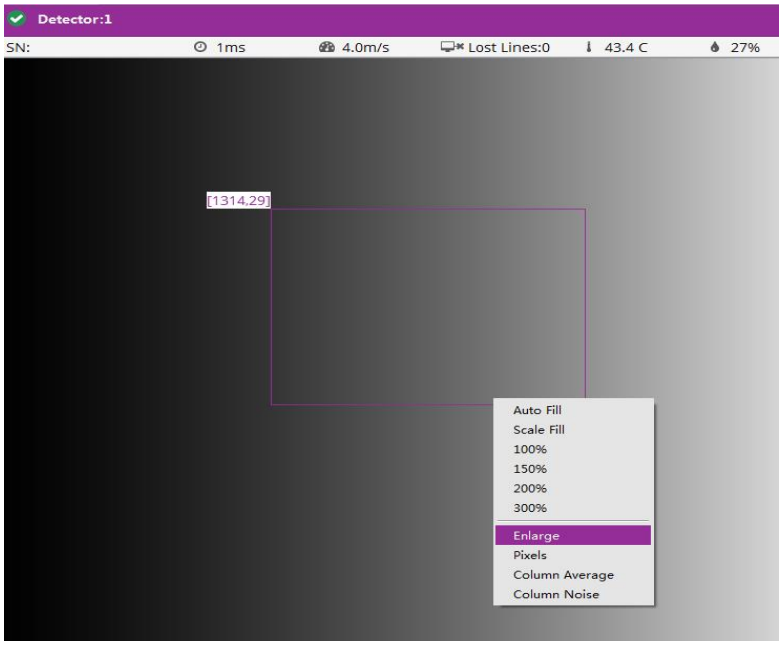
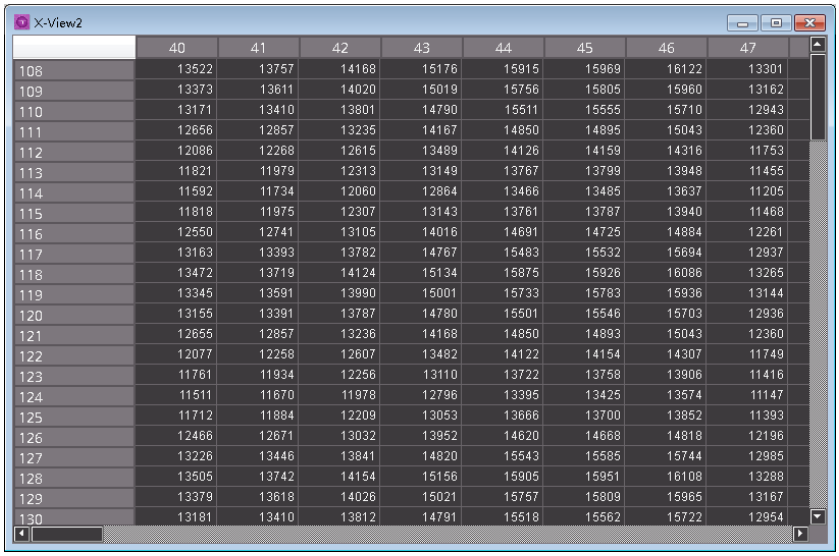


Figure 3-7. ROI and right-click menu

The "ROI" item "Enlarge" is for zooming in the ROI to full window. You can check the pixel value of the ROI by clicking the "Pixels" item as shown in the figure 3–8. You can also get the column average and noise analysis of the ROI.



	40	41	42	43	44	45	46	47
108	13522	13757	14168	15176	15915	15969	16122	13301
109	13373	13611	14020	15019	15756	15805	15960	13162
110	13171	13410	13801	14790	15511	15555	15710	12943
111	12656	12857	13235	14167	14850	14895	15043	12360
112	12086	12268	12615	13489	14126	14159	14316	11753
113	11821	11979	12313	13149	13767	13799	13948	11455
114	11592	11734	12060	12864	13466	13485	13637	11205
115	11818	11975	12307	13143	13761	13787	13940	11468
116	12550	12741	13105	14016	14691	14725	14884	12261
117	13163	13393	13782	14767	15483	15532	15694	12937
118	13472	13719	14124	15134	15875	15926	16086	13265
119	13345	13591	13990	15001	15733	15783	15936	13144
120	13155	13391	13787	14780	15501	15546	15703	12936
121	12655	12857	13236	14168	14850	14893	15043	12360
122	12077	12258	12607	13482	14122	14154	14307	11749
123	11761	11934	12256	13110	13722	13758	13906	11416
124	11511	11670	11978	12796	13395	13425	13574	11147
125	11712	11884	12209	13053	13666	13700	13852	11393
126	12466	12671	13032	13952	14620	14668	14818	12196
127	13226	13446	13841	14820	15543	15585	15744	12985
128	13505	13742	14154	15156	15905	15951	16108	13288
129	13379	13618	14026	15021	15757	15809	15965	13167
130	13181	13410	13812	14791	15518	15562	15722	12954

Figure 3-8. Pixel value checking table

Button	Function	Description
	Measure distance	You can click this button and move the mouse by left-clicking to draw a line on the image. At the same time, it shows the coordinates and distance of the two ending points as shown in the figure 3–9.

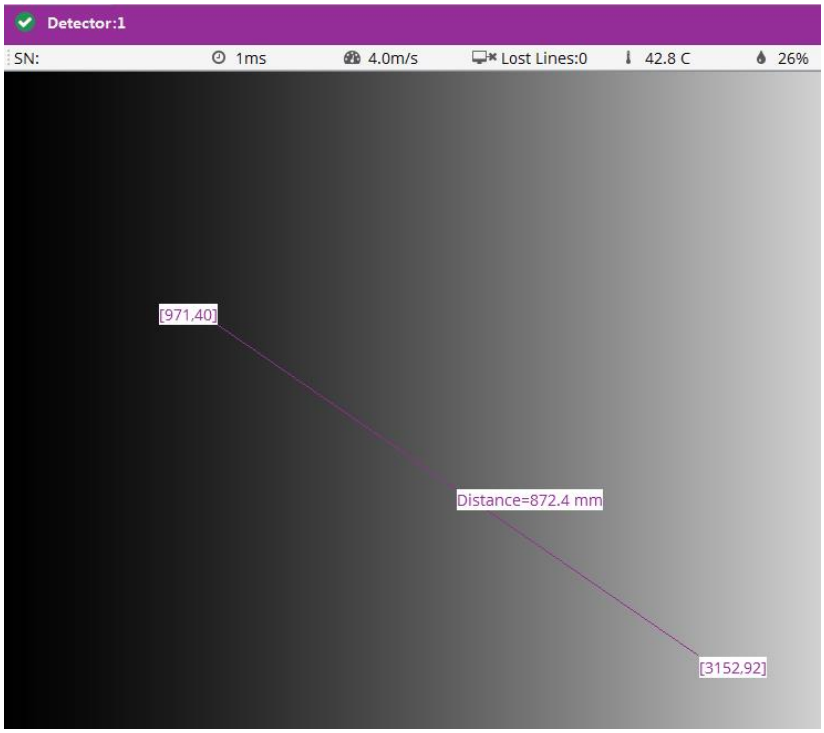


Figure 3-9. Distance measuring function

Button	Function	Description
	Point marker	You can click this button and mark point on the image by left-clicking the mouse.
	Normalization	It is the same function as the normalization menu.
	Map into an 8-bit gray image	You can click this button and adjust the mapping window to map the raw image data into an 8-bit gray image for displaying.

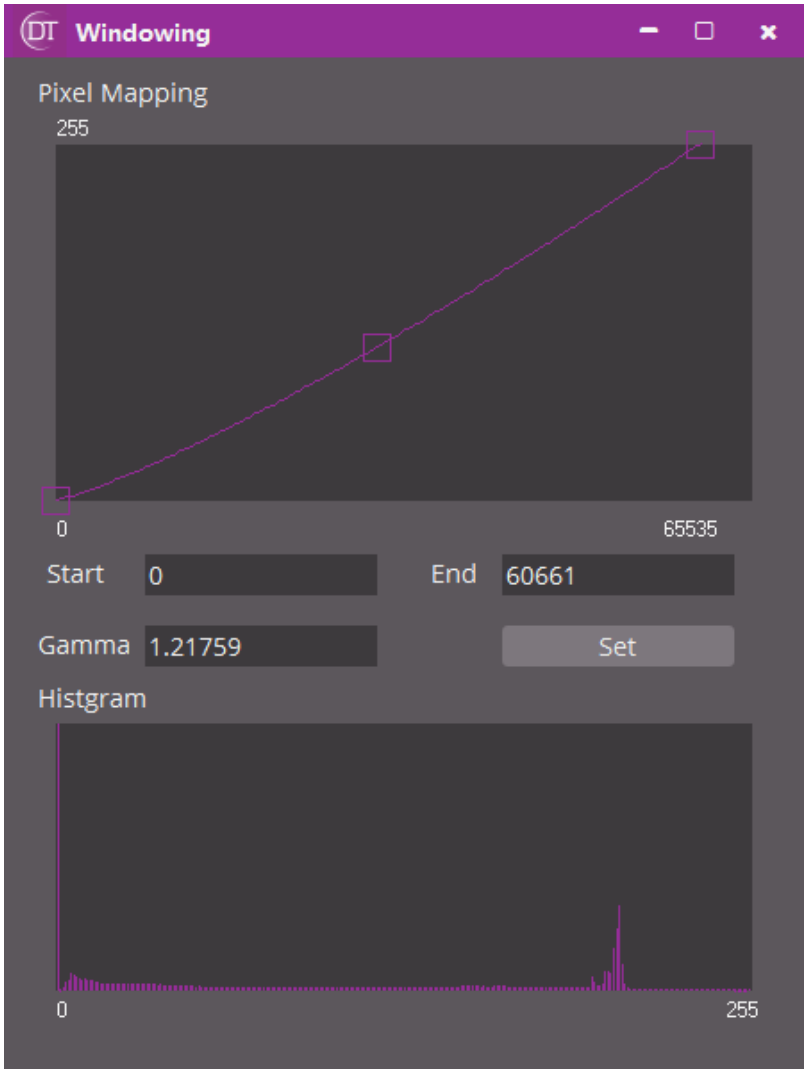


Figure 3-10. Pixel mapping function

As figure 3–10 shows, the upper window represents the mapping function. Moving the purple block will change the mapping parameters. The lower window displays the histogram of the mapped 8-bit image.

Only the pixels that have an intensity which is between the "Start" and "End" parameters will be mapped into an 8-bit value. Pixels that have a lower value than the "Start" parameter will be set to 0 and those which have a value higher than the "End" parameter will be set to 255. These two parameters and "Gamma" can be changed by dragging the purple blocks or by setting in the text box.

Button	Function	Description
	Enable/disable video saving mode	You can enable the video saving mode with this function and then click "Grab" to save the frame stream as an ".avi" file.
	Enable/disable continuous image saving mode	You can enable continuous image saving mode with this function and then click "Grab" to save the frame stream as images.
	Enable/disable data pattern mode	You can enable the data pattern mode of the X-GCU with this function. If it is enabled, the image will be faked data generated by the X-GCU.
	Send ASCII command to detector	You can open command sending dialog with this function. As figure 3–11 shows, the window serves as a debugging tool by sending an ASCII command string to detector directly. You can refer to the section 6.3 of the "Programmer's Manual of X-LIB Software Library" for the command list.

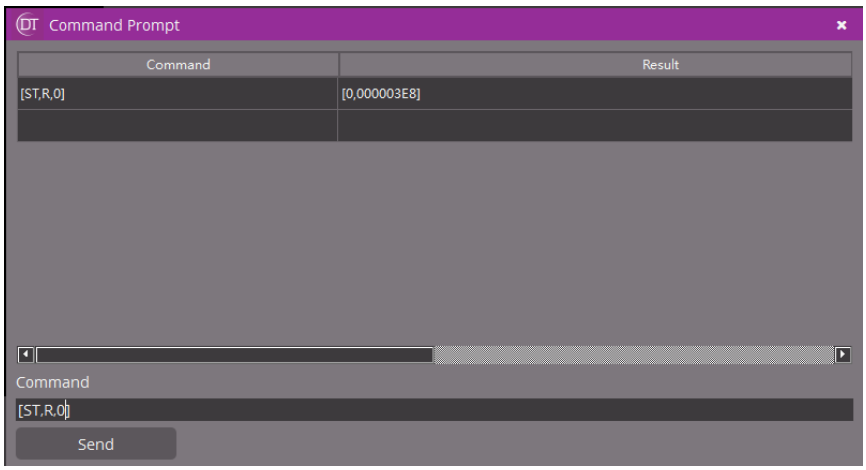


Figure 3-11. Command prompt

Button	Function	Description
	Automatically diagnose	If there is anything wrong with the detector, you can process the troubleshooting operation. You should follow the troubleshooting steps and get a report and three images after finalizing the steps. You can send all the materials to the Detection Technology Plc for further analysis.

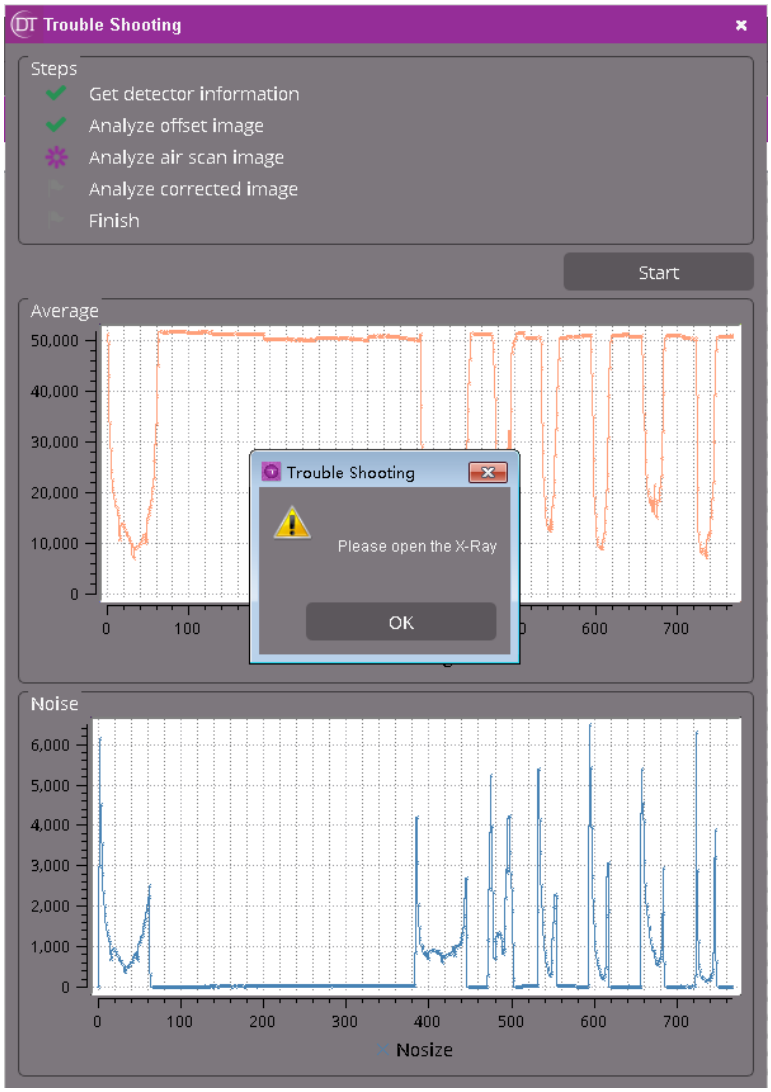


Figure 3-12. Troubleshooting panel

3.4. File menu components

The file menu is shown in the following figure.

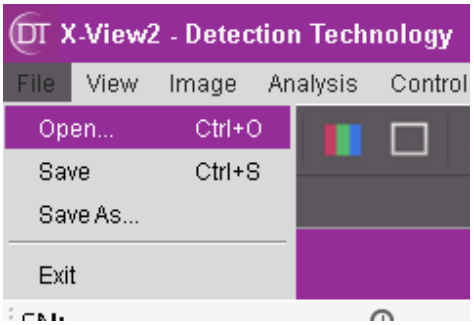


Figure 3-13. File menu

Component	Description
Open	You can open a static image with this function.
Save	You can save the current image as a file with this function.
Save as	You can resave current image with this function.
Exit	You can exit the program with this function.

3.5. View menu components

The view menu is shown in the following figure.

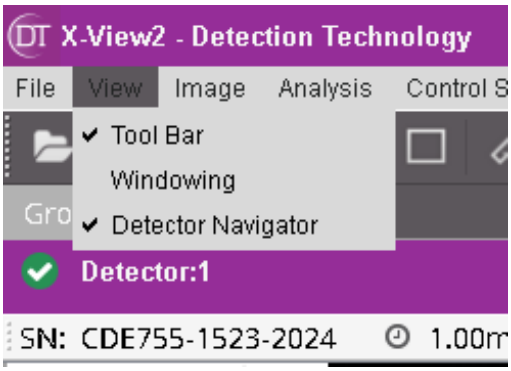


Figure 3-14. View menu

Component	Description
Tool Bar	You can enable/disable the toolbar with this function.
Windowing	It is the same function as the 10th button of the toolbar.
Detector navigator	You can enable/disable the detector navigating bar.

3.6. Image menu components

The image menu is shown in the following figure.

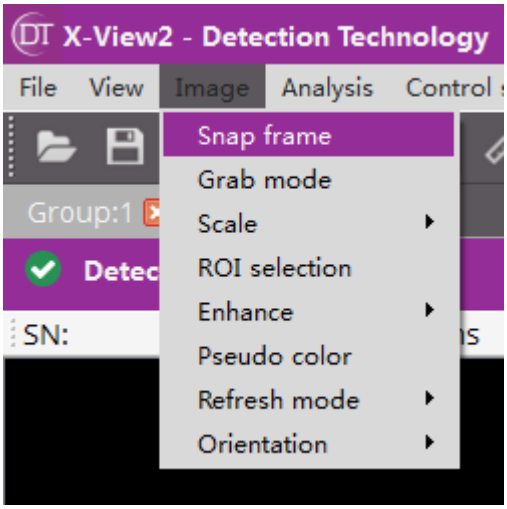


Figure 3-15. Image menu

Component	Description
Snap frame	It is the same function as the 4th button of the toolbar.
Grab mode	It is the same function as the 3rd button of the toolbar.
Scale	You can zoom in the image to different scale. "Auto file" is to scale the image fully to the window. "Scale fill" is to scale the image to the window without altering the original scale.

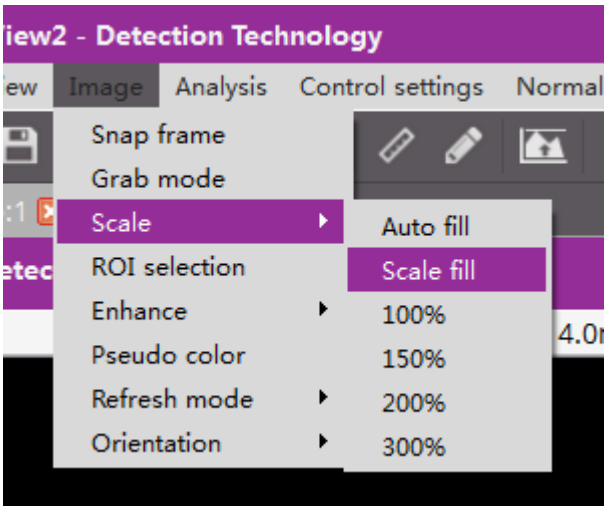


Figure 3-16. Scale menu

Component	Description
ROI selection	It is the same function as the 6th button of the toolbar.
Enhance	You can enhance the static image by three means: histogram enhancement, median filter and sharpening enhancement.
Scale	You can zoom in the image to different scales. "Auto file" is to scale the image fully to the window. "Scale fill" is to scale the image to the window without altering the original scale.

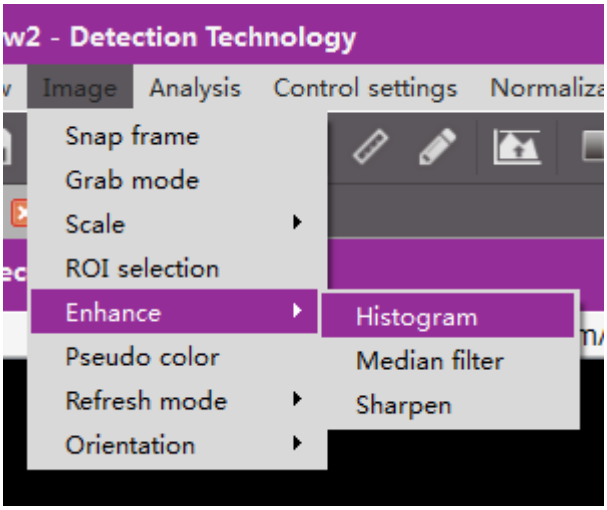


Figure 3-17. Enhance menu

Component	Description
Pseudo color	It is the same function as the 5th button of the toolbar.
Refresh mode	You can read the current status of refreshing mode with this function.
Orientation	You can read the current status of orientation.

3.7. Analysis menu components

The analysis menu is shown in the following figure.

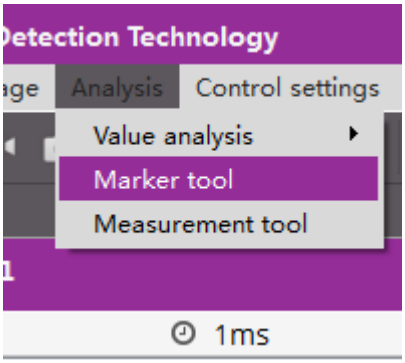


Figure 3-18. Analysis menu

Component	Description
Value analysis	There are two categories of value analysis: a row and column. For both of them, there are five selections: "minimum", "maximum", "average", "noise" and "selected line". Figure 3–19 and 3-20 are the pixel analyzing panels.

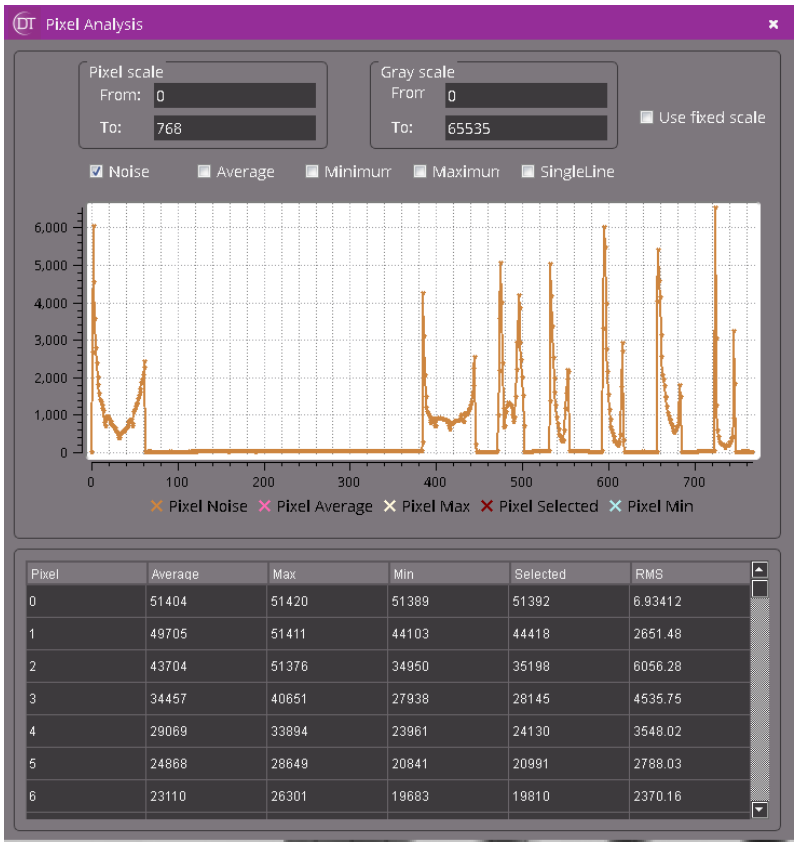


Figure 3-19. Pixel noise analysis

Figure 3-20. Pixel noise and average

Component	Description
Marker tool	It is the same function as the 8th button of the toolbar.
Measurement tool	It is the same function as the 7th button of the toolbar.

3.8. Control setting menu components

The control setting menu is shown in the figure 3-21.

3.8.1. Operation

You can set the operational parameters in the "Operation" panel.

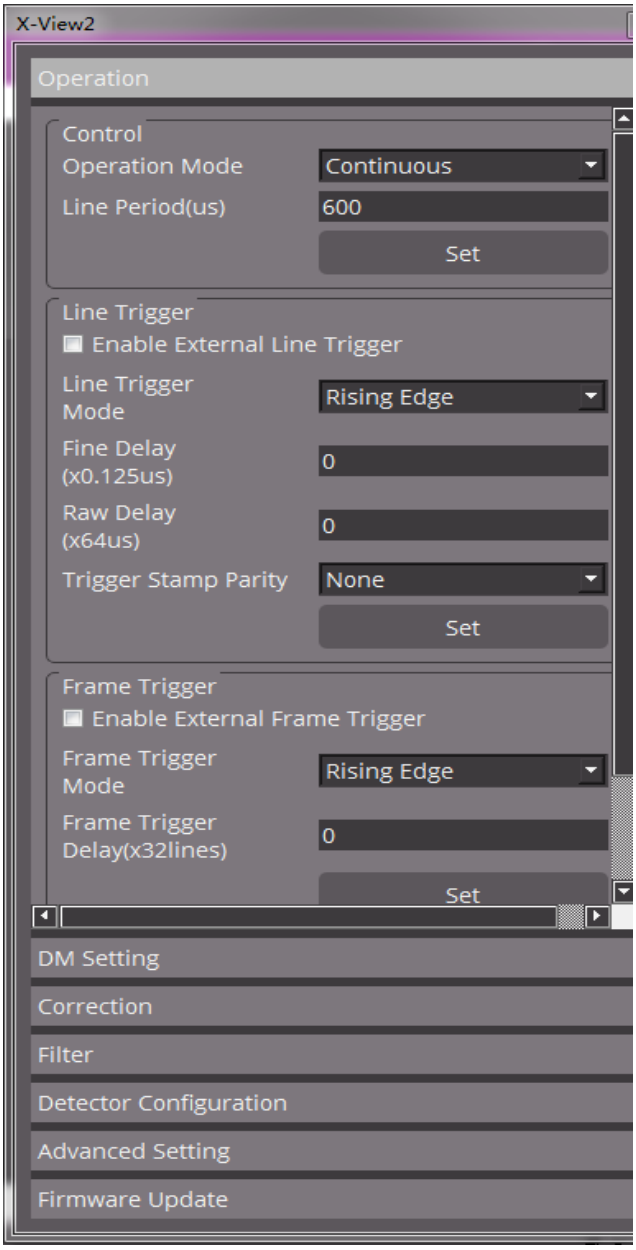


Figure 3-21. Control setting panel

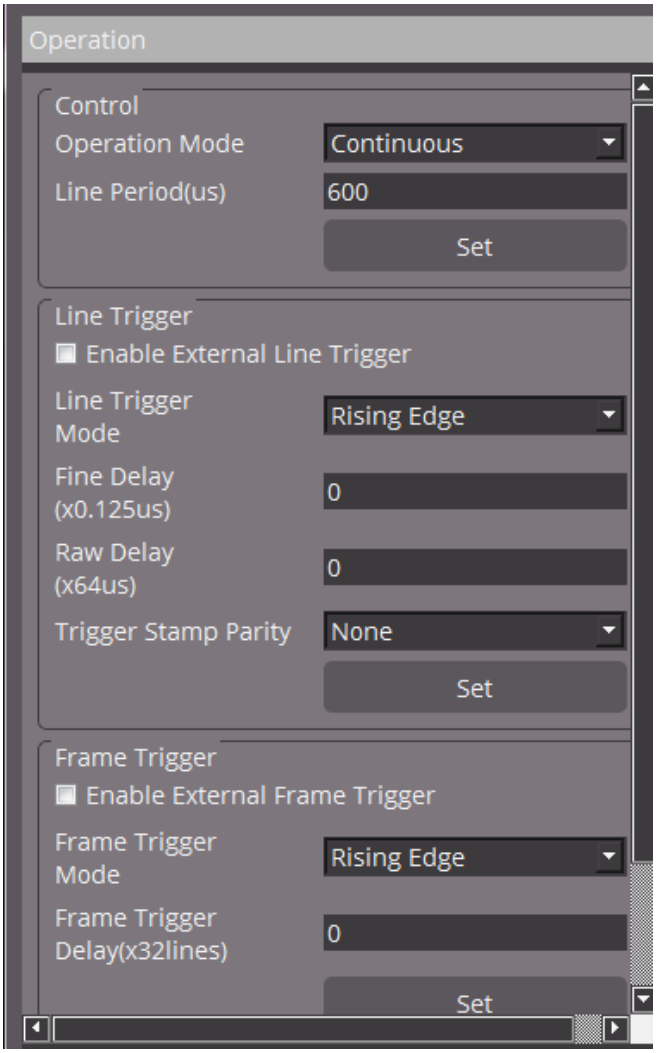


Figure 3-22. Operation panel

The items of the “Operation” panel are as the following.

Item	Description
Operation Mode	You can set the operational mode as "Continuous", "Non-continuous", "Constant integration time" and "Non-continuous with Hi/Lo trigger".
Integration Time	You can set the integration time value for continuous operational mode, which unit is us. The formula for calculating integration time is: Integration time = S/(V*SDD/SOD) 'S' is the pixel size; 'V' is the speed of conveyor; 'SDD' is the distance from X-ray source to the detector; 'SOD' is the distance from X-ray source to the object.
Non Int Time	You can set the Integration time in Non-continuous mode and in Constant mode, which unit is us.
Enable External Line Trigger	You should enable this check if you are using the external line trigger.
Line Trigger Mode	You should set the trigger mode according to your trigger generator by this item, which is "Raising Edge", "Falling Edge", "Sync Trigger Stamp" or "Async Trigger Stamp"
Fine Delay	You can set the delay precisely from the start of the external trigger to the start of the integration period in non-continuous mode, which step is 0.125us.
Raw Delay	You can set the delay roughly from the start of the external trigger to the start of the integration period in non-continuous mode, which step is 64us.
Trigger Stamp Parity	You can set trigger stamp parity mode while you are using line trigger stamp mode.
Enable External Frame Trigger	You should enable this check if you are using the external frame trigger.
Frame Trigger Mode	You should set the trigger mode according to your trigger generator by this item, which is "Raising Edge" or "Falling Edge".
Frame Trigger Delay	You can set the delay from the start of external frame trigger to the start of scanning, which step is 32 lines.
Enable LED	You can enable/disable the LED of the X-GCU and X-DFE with this check.

The following table is operation mode summary of X-Scan detector.

Operation mode	Integration time (Tint)	Line rate	Description
Continuous Integration time mode -With internal trigger (no external trigger)	Software input, value will not change.	1/Tint	Standard and default factory mode. In this mode new integration period starts immediately after the previous period. Select this mode in applications where the object moving speed is stable under continuous X-ray flux. Disadvantage is that if the conveyor speed is not stable, then the scanned object geometry may be distorted and shape can be abnormal, unless compensated in the application software.
Continuous Integration time mode - With External trigger	Trigger period is defined by external signal	1/Trigger period	The integration period starts immediately after Receiving the external trigger. The whole interval between two triggers is used for signal integration. Select this mode in the application where the object movement speed is changing under continuous X-ray flux and synchronization with conveyor belt or other trigger source is required. Disadvantage is that brightness of the image will change with external signal period. Longer period (=slower speed) results to brighter image, unless system is re-calibrated.
Non-continuous mode - With External trigger	Software input, value will not change after input. Typically Tint is much shorter than trigger period.	1/Trigger period	This mode is used in applications where the start and stop timing of signal integration needs to be very precisely synchronized to the X-ray pulse. Typically such system uses Linear Accelerator or Betatron as the radiation source. Benefit is that only radiation This mode should be selected only when the X-ray flux can be synchronized with the trigger. Otherwise useful object information may be lost due to mismatching or insufficient integration period.
Constant Integration time mode - With External trigger	Software input, value will not change after input. Typically Tint is near to same as trigger period.	1/Trigger period	In this mode signal integration starts at external trigger. Integration stops after constant time, which is defined by software input. Thus integration time remains the same regardless of external trigger period. This enables constant image brightness even if trigger period changes. Such change may occur eg due to variable object speed. Disadvantage is that part of X-ray flux may not be integrated when the object speed is clearly slower than corresponding trigger period.

Note: In all modes, the Tint should not exceed the absolute integration time range defined in Table of "General specification".

In order to get the un-deformed raw image, the line rate should match the object scan speed in real application and the geometrical magnification need to be taken into account with below formula. SDD: Source Detector Distance; SOD: Source Object Distance.

$$LineRate = \frac{ObjectScanSpeed}{PixelPitch} * \frac{SDD}{SOD}$$

3.8.2. DM setting

You can set the gain values and test pattern mode of each DM in the "DM Setting" panel as shown in the figure 3–23. You can click a specific DM index item and apply its settings to all the DMs.

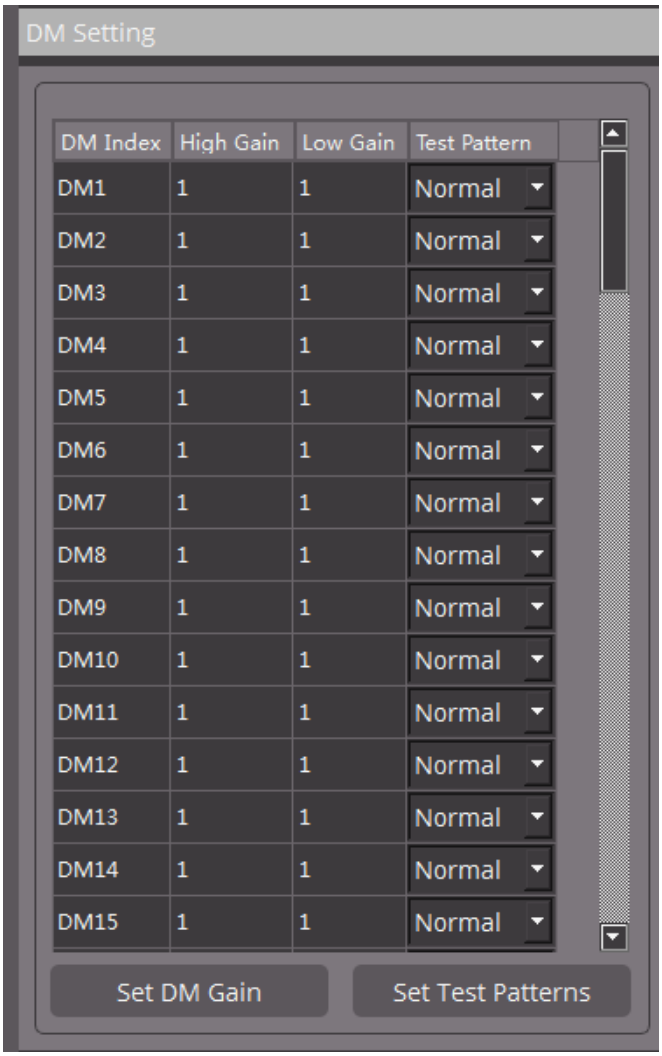


Figure 3-23. DM setting panel

3.8.3. Correction

For non-LCS detector, you can set the correct status in the "Correction" panel as shown in the figure 3–24. For LCS detector, the "Correction" panel is shown in the figure 3-25.

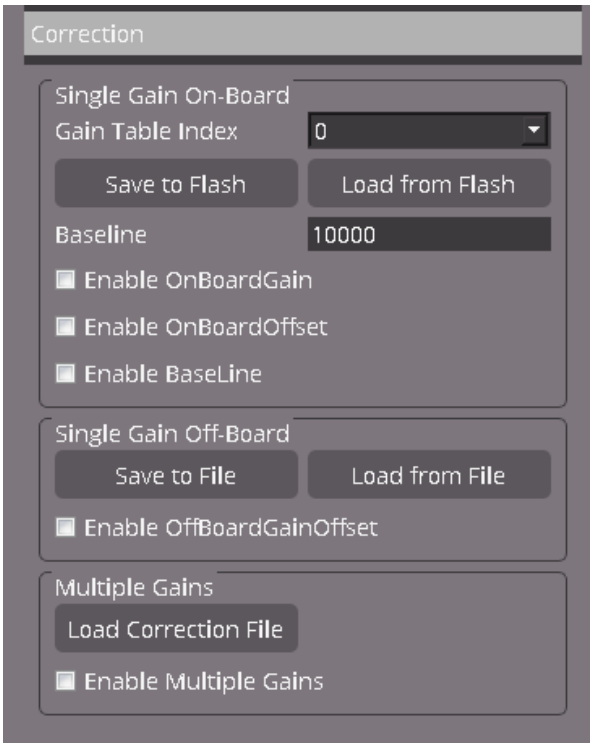


Figure 3-24. Correction setting panel for non-LCS detector

There are three correcting methods except for LCS detector. For single gain on-board correcting method, you can save the corrected parameters into the flash of the X-GCU board and the correction is done by the firmware. For single gain off-board correcting method, you can save the corrected parameters into disk, and the correction is done by the computer by enabling off-board gain offset. For multiple gain correcting method, it saves the corrected parameters into disk by the normalization process, and the multiple gain correction is done by the computer.

Component	Description
Flash Index	You can set 4 different groups of one point correcting parameters into the flash. So the index range is 0~3.
Save to Flash	After one point normalization, you can save the gain and offset parameters into the flash of the X-GCU board.
Load from Flash	You can load the previously saved parameter for one point correction without normalization.
Baseline	You can set the baseline value and the data value will be raised if the baseline correction is enabled.
Enable On-board Gain Correct	You can enable or disable the one point gain correcting function with this check.
Enable On-board Offset Correct	You can enable or disable the one point offset correcting function with this check.
Enable Baseline Correct	You can enable or disable the baseline correcting function with this check.
Save to File	After one point normalization, you can save the gain and offset parameters into the computer disk.
Load from File	You can load the previously saved parameter for one point correction from disk without normalization.
Enable Off-board gain offset	You can enable or disable the off-board gain offset correcting function with this check.
Enable Three Point Correct	You can enable or disable the three point correcting function with this check after three point normalization.
Load Parameters	You can load the previously saved three point correcting parameters from the computer and enable the function without normalization.

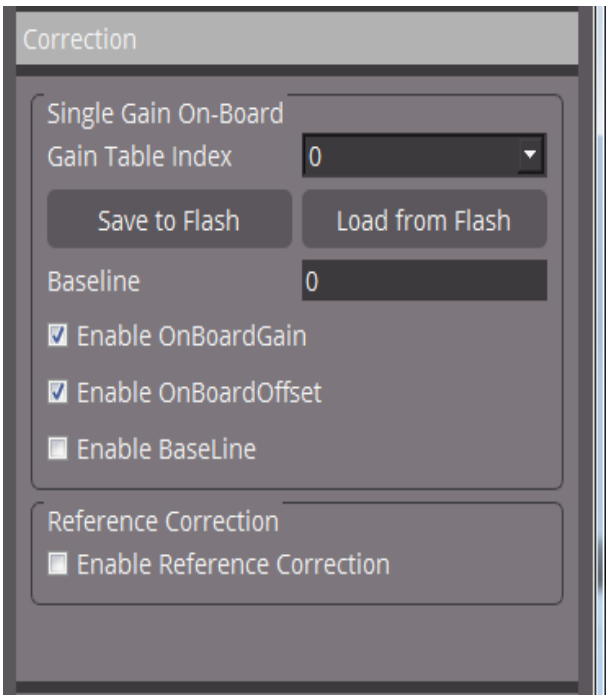


Figure 3-25. Correction setting panel for LCS detector

There are three correcting methods for LCS detector: on-line offset correction, single gain off-board correction and reference correction.

Component	Description
On-line Offset Correction	You can set the on line average filter with the size of 1line, 2 lines, 4 lines or 8 lines, and enable the on-line offset correcting function.
Save to File	After one point normalization, you can save the gain parameters into the computer disk.
Load from File	You can load the previously saved parameter for one point correction from disk without normalization.
Enable Off-board gain offset	You can enable or disable the off-board gain offset correcting function with this check.
Enable Reference Correction	You can enable or disable the reference correcting function with this check.

3.8.4. Filter

You can set the filtering function in the "Filter" panel as shown in the following figure.

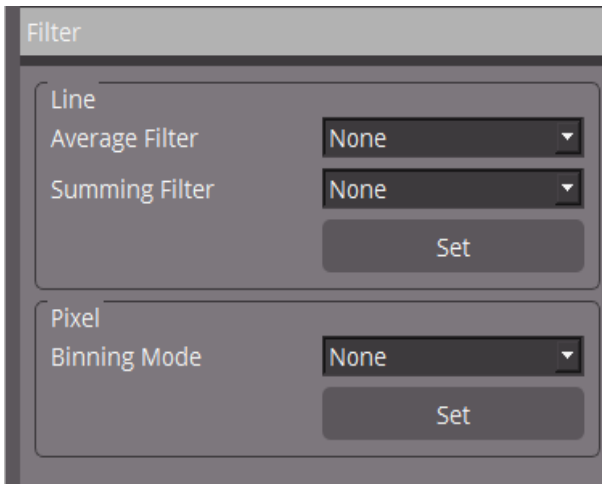


Figure 3–26. Filter setting panel

Component	Description
Average Filter	You can set the average filter size to average the corresponding lines inside the X-GCU board. The averaged result is sent as one line to the computer. The dual-energy one line LCS detector and the dual-lines LCS detector don't support this function.
Summing Filter	You can set the summing filter size to sum up the corresponding line inside the X-GCU board and the summing result is sent as one line to the computer. The dual-energy one line LCS detector and the dual-lines LCS detector don't support this function.
Binning Mode	You can set the binning mode to average or sum up two or four nearby pixels into one pixel value, so the pixel number will be a half or a quarter of the original number. The dual-energy one line LCS detector and the dual-lines LCS detector don't support this function.

3.8.5. Detector configuration

You can read the property of the detector and set the card number of each channel in this panel.

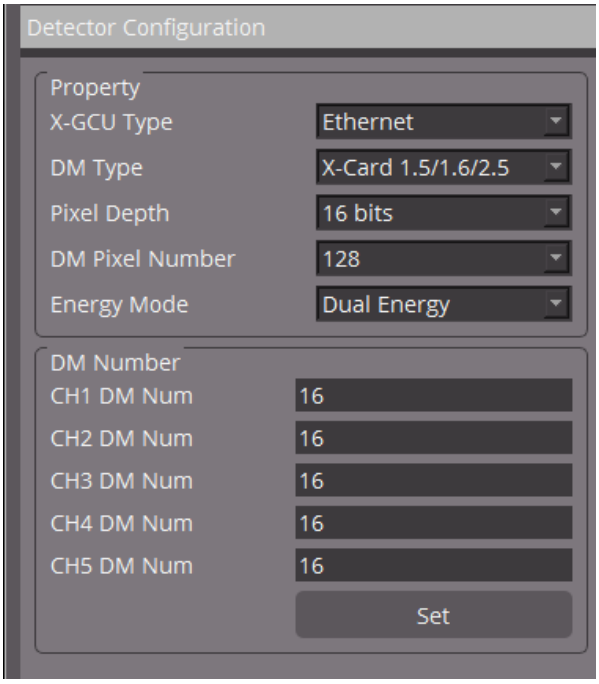


Figure 3–27. Configuration panel

3.8.6. Advanced setting

You can correct bad pixels and set video saving function in the "Advanced Setting" panel.

Component	Description
Bad Pixel Correction	You can enter 5 bad pixel positions at most and it will correct the bad positions. If the position value is -1, it will do nothing.
Continuous saving, Up Limit of Frame Number	You can set the how many frames you want to save by continuous image saving function. The total lasting time and the total size of saved images will be calculated by the frame number.
Interval (Frames)	You can set the saving intervals by saving one image per how many frames. The interval time will be calculated accordingly.
Video saving, Up Limit of Frame Number	You can set the how many frames you want to save by video saving function. The total lasting time and the total size of saved video will be calculated by the frame number.
Playing Rates	You can set the playing rates of the saved video.

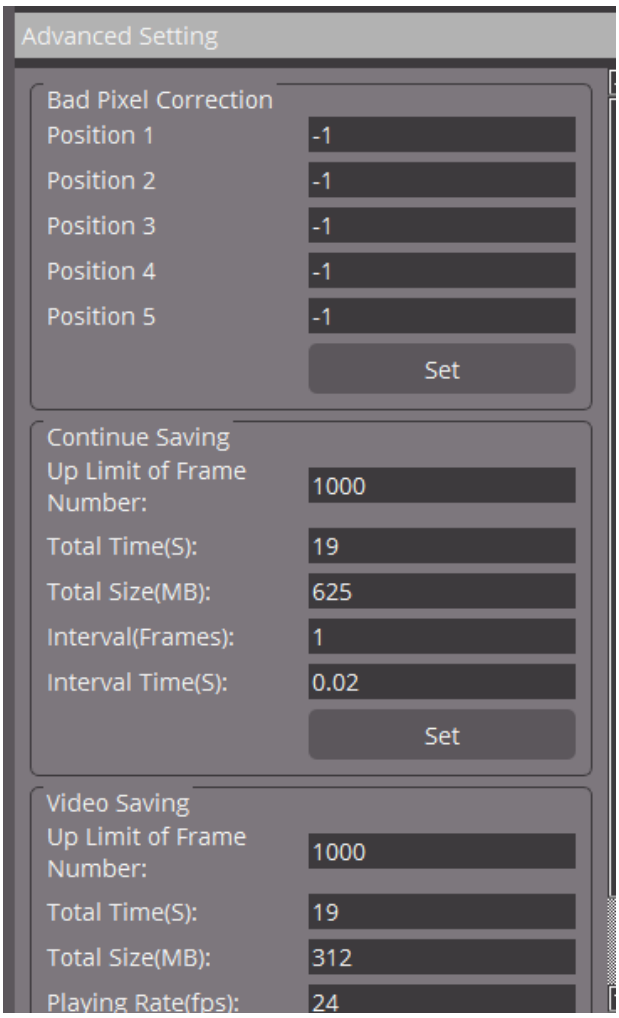


Figure 3–28. Advanced Setting panel

3.8.7. Firmware update

The "Firmware Update" panel is for upgrading the firmware of the X-GCU and X-DEF. Please make sure you get the permission and firmware files from Detection Technology Plc before using this function.

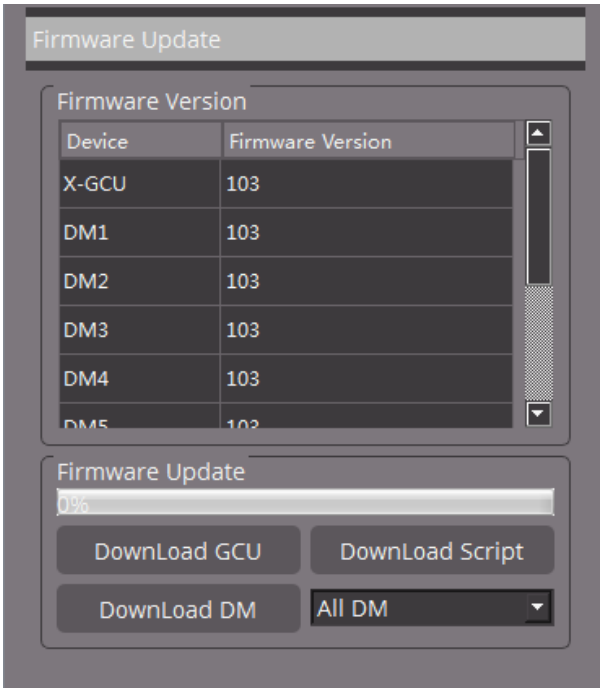


Figure 3-29. Firmware update panel

The correct upgrading process is downloading the X-GCU firmware and DM firmware first and then the script.

Before upgrading the DM, you can choose to update all DMs or a specific one.

3.9. Normalization menu components

The normalization menu has only one function for non-LCS detector. For LCS detector, there is one more function of reference correction.

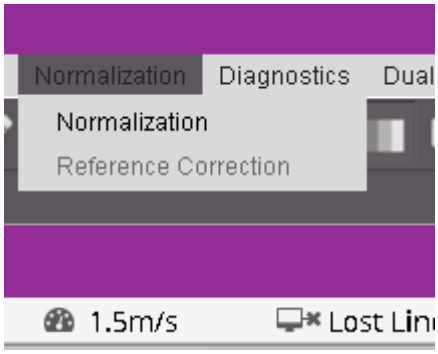


Figure 3-30. Normalization menu

Component	Description
Normalization	You can calculate the gain and offset parameters with the normalization process.

The interface of normalization dialog is composed of several pages; the first page is for checking the settings as shown in the figure 3-31 for non-LCS detector.

Figure 3-32 shows the first page for LCS detector. The on-line offset correction is enabled automatically.

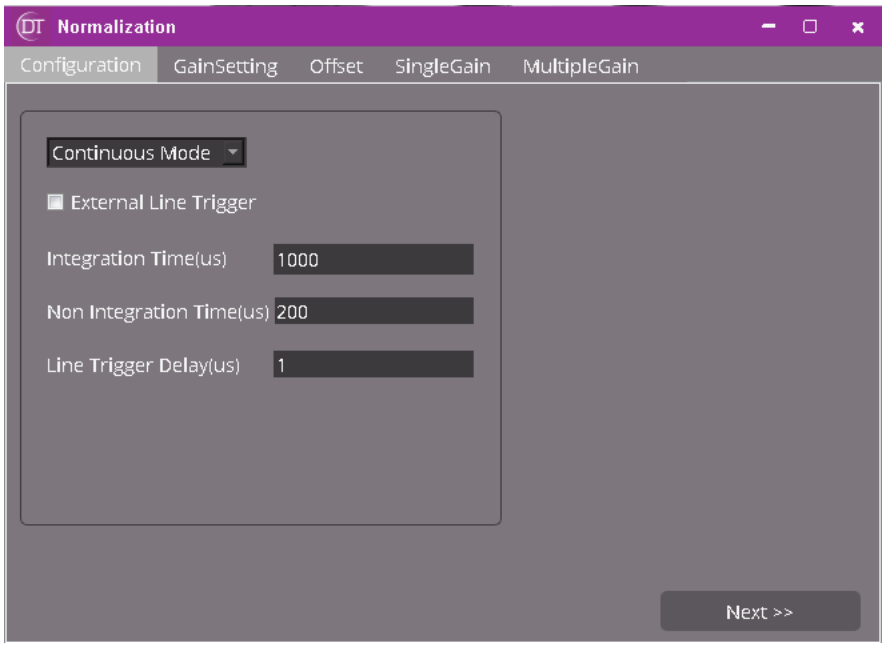


Figure 3–31. First normalization page

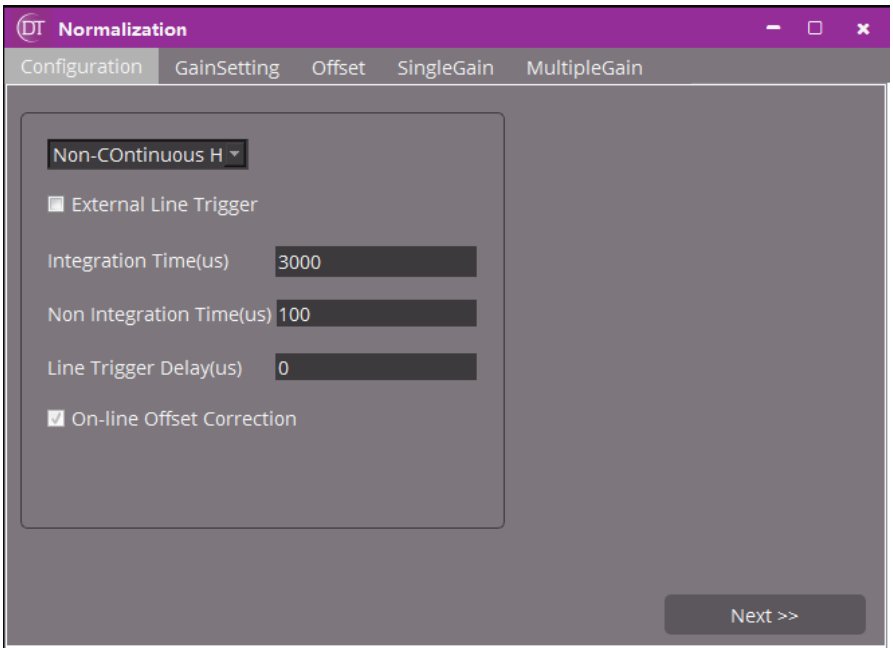


Figure 3–32. First normalization page for LCS detector

If the settings are correct, you can then click the "Next" button to enter the next page as the figure 3-33 shows. You can choose the normalization method of "Single Gain Normalization" or "Multiple Gain Normalization". The LCS detector doesn't support "Multiple Gain Normalization". With the single gain method, the mapping curve is linear and you can save the normalizing parameters into the flash of the X-GCU to let hardware and firmware do the

correction in real time. With the multiple gain method, you can make a nonlinear mapping curve of three segments, but you can only save the normalizing parameters in the disk and do the correction by the computer.

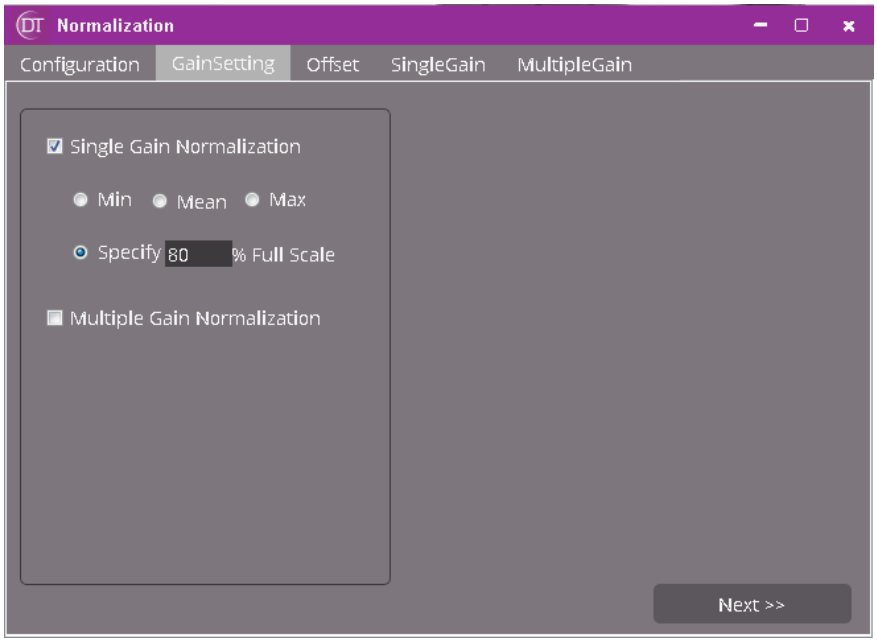


Figure 3-33. Normalization method selection page

You click the "Next" button to enter offset calculation page as shown in figure 3–34. For LCS detector, since the on-line offset correction is enabled, so there is no offset calculation process. You should turn off the X-Ray according to the instruction on the left. You can check the average curve before and after offset correction on the right.

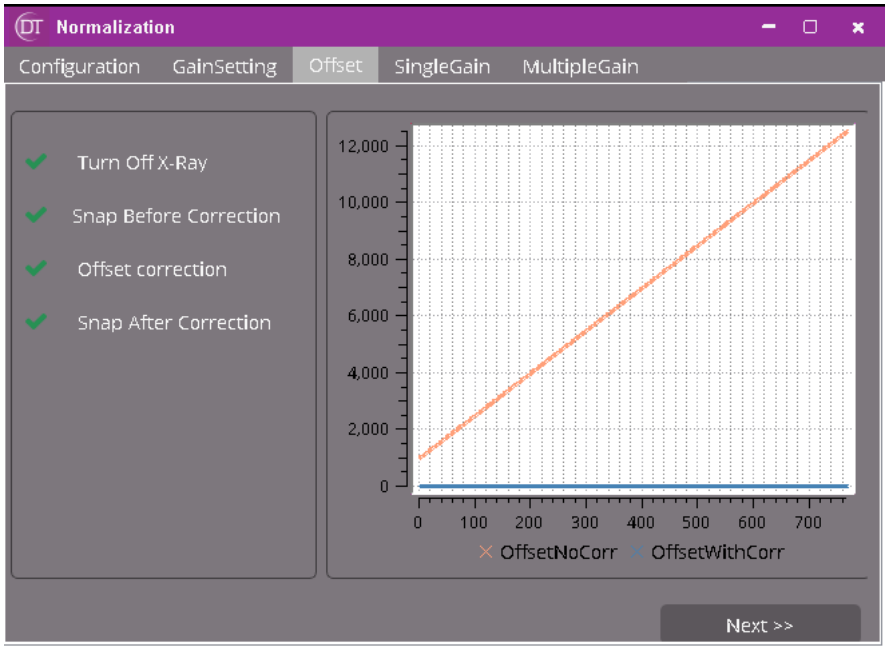


Figure 3-34. Offset calculating page

After the offset calculation, you can select "Next" to enter the next page. If you chose the "Single gain" method earlier, you will enter the "SingleGain" page as shown in the figure 3–

35. You should turn on the X-ray and follow each step on the left as the average curve before and after correction shows on the right.

Figure 3–35. "Single gain" method page

After gain calculation, the single gain normalization is finished. You can enter the control setting panel of correction to save the correcting parameters into the flash of the detector. Next time when cycling power to the detector, you can load the saved parameters from the detector flash without doing the normalization again.

If you chose the "Multiple gain" method earlier, you will enter the "Multiple gain" page as shown in the following figure. You can process the multiple gain normalization step by step.

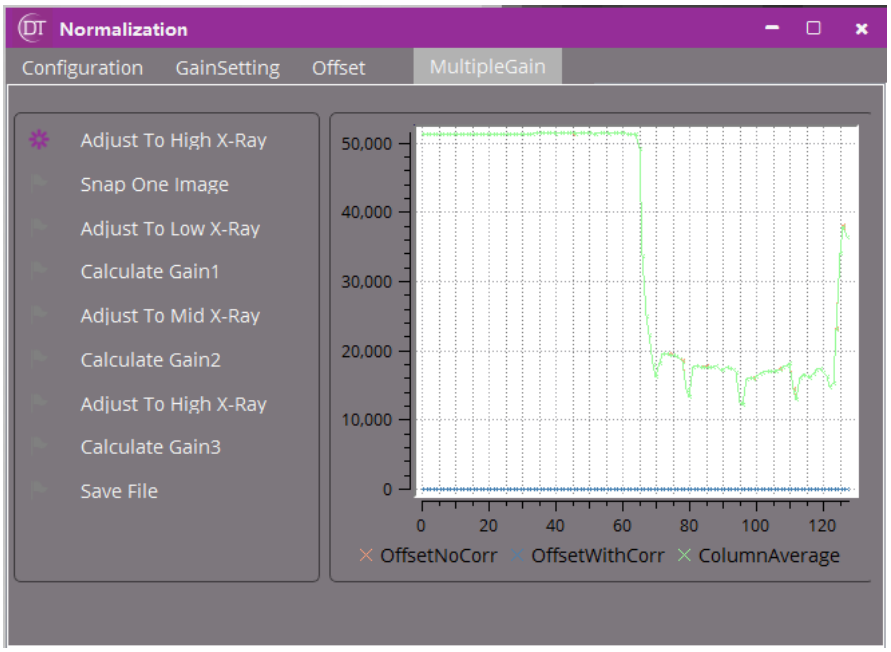


Figure 3–36. "Multiple gain" method page

First, you need to adjust the X-ray to the highest volume, and it will give you three suggested responding curves on the right map, which represent the low, middle and high X-ray volume response. Then you should follow each step; adjust the X-ray to the low, middle and high volume whether or not according to the suggested values. You also need to enter the target correcting values for each X-ray volume.

After finishing the whole process, the correcting parameters are saved to the computer disk. Next time when you restart the software, you can load the saved parameters from the computer disk without doing the normalization again.

Component	Description
Reference Correction	For LCS detector, you can do reference correction to correct the abnormal line data.

The following figure shows the reference correction page. The correcting method will keep several pixels at the end of each line for reference, which are not corrected. You can set the referenced pixel number as 8, 16 and 32 or 64. Then you can click the "Reference Correction" button to go through the process step by step.

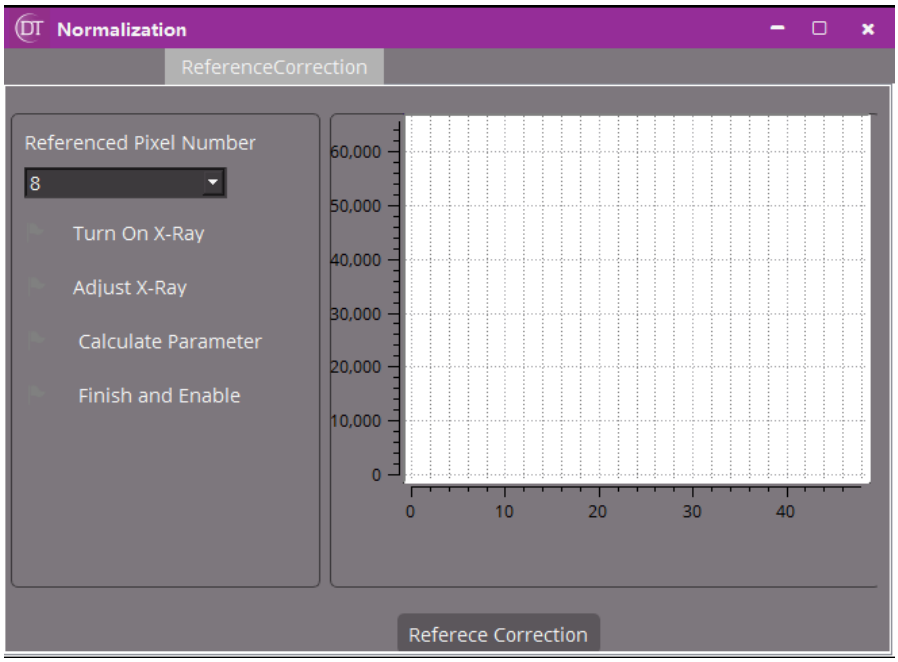


Figure 3-37. Reference correction page

3.10. Diagnostics menu components

The diagnostics menu is shown in the figure 3-38.

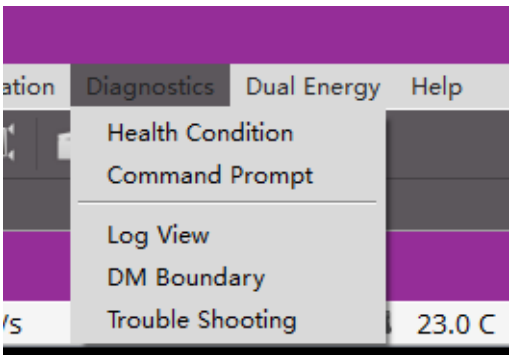


Figure 3–38. Diagnostics menu

Component	Description
Health condition	You can check the voltage, temperature and humidity of the X-GCU and each DM with this function. Please note that the X-GCU only has four voltage sensors. For the X-GCU_STD, it does not have a humidity sensor, the humidity value is always 0. The correct voltage values of the X-GCU should be as following: v1: 24V±10% (power 24V) 12V±10% (power 12V); v2: 3.3V±5%; v3: 2.5V±5%; v4: 1.1V±5%. The correct voltage values of the DM should be as following: v1: 2.5V±5%; v2: 24V±10% (power 24V) 12V±10% (power 12V); v3: 5.2V±5%; v4: 1.2V±5%; v5: 5V±5%; v6: 3.3V±5%; v7: 4.096V±5%.

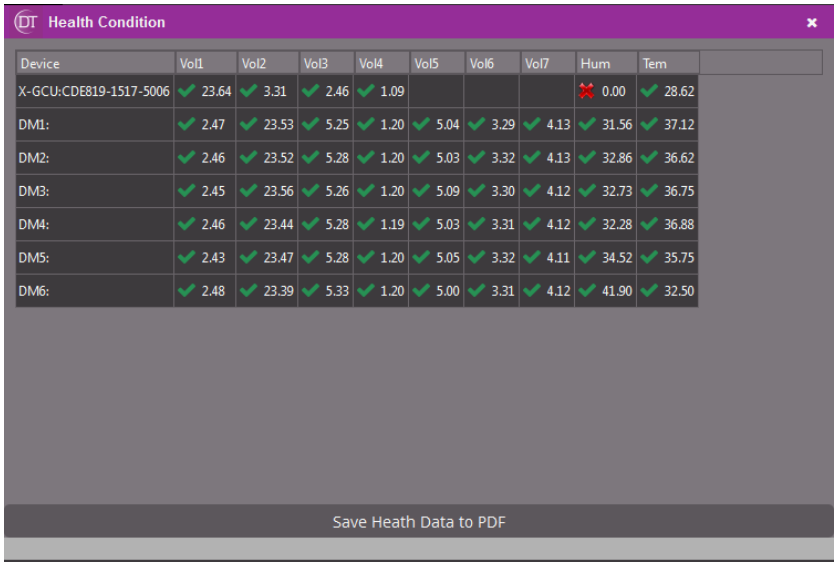


Figure 3-39. Health condition panel

Component	Description
Command Prompt	It is the same function as the 14th button.
Log View	You can check the log file by this function.
Boundary Display	You can check the boundary of each X-Card by this function.
Troubleshooting	It is the same function as the 15th button.

3.11. Dual energy menu components

You can enter the dual-energy process panel with this function.

You should choose the ROI of low energy part first with the 6th button. Click the "Dual Energy Process" menu to enter the dual-energy process panel as in the following figure.

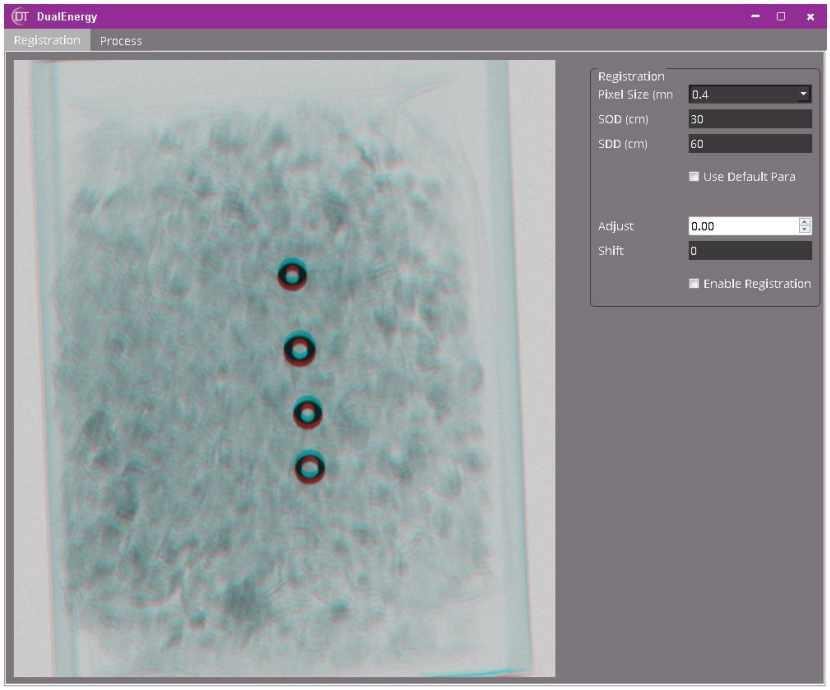


Figure 3-40. Image before registration

The “Registration” page shows the colorful image that is combined by low and high energy part. Non-registered raw image is colorful; the low part is red and the high is blue. After registration, the combined image should be gray.

Figure 3-41. Image after registration

You can adjust the registration settings to get the image registered.

Component	Description
Pixel Size	You should choose the correct pixel size of your detector.
SOD	You should enter the distance between the X-ray source and the object here.
SDD	You should enter the distance between the X-ray source and the detector here.
Use Default Para	You can load the registration parameter from the detector and apply it.
Adjust	If the default parameter is not precise, you can adjust this item manually to get the image registered.
Shift	It shows the real shifted distance of the high energy part, which is calculated by the above parameters. It is read only.
Enable Registration	After you get the correctly registered colorful image, you can apply the method to the raw image by checking this item.

After the registration process, you can enter the "Process" page as shown in the figure 3–42.

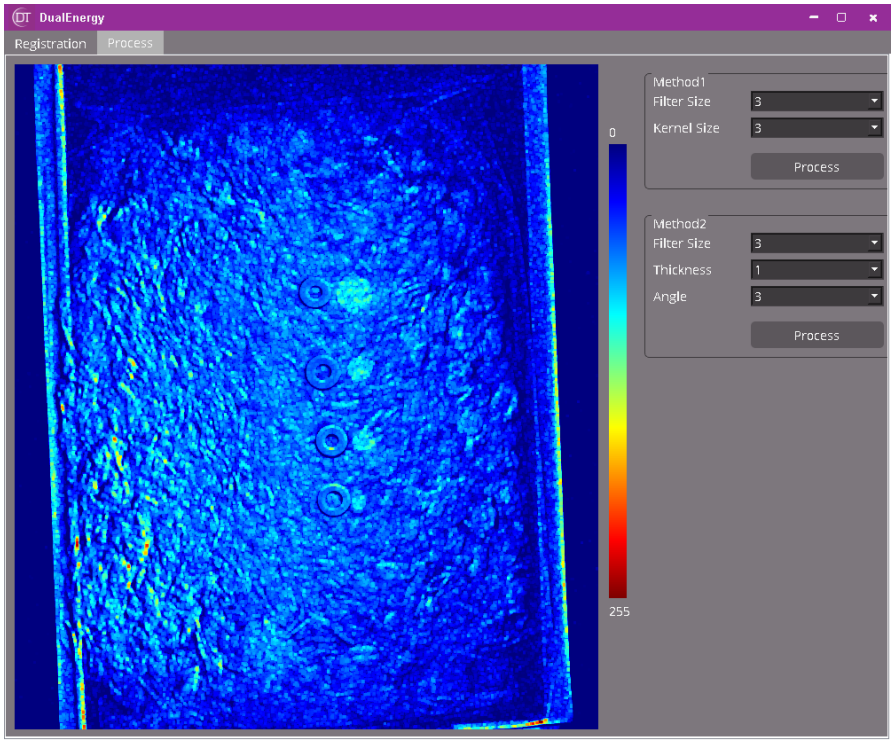


Figure 3–42. Result image processed by Method1

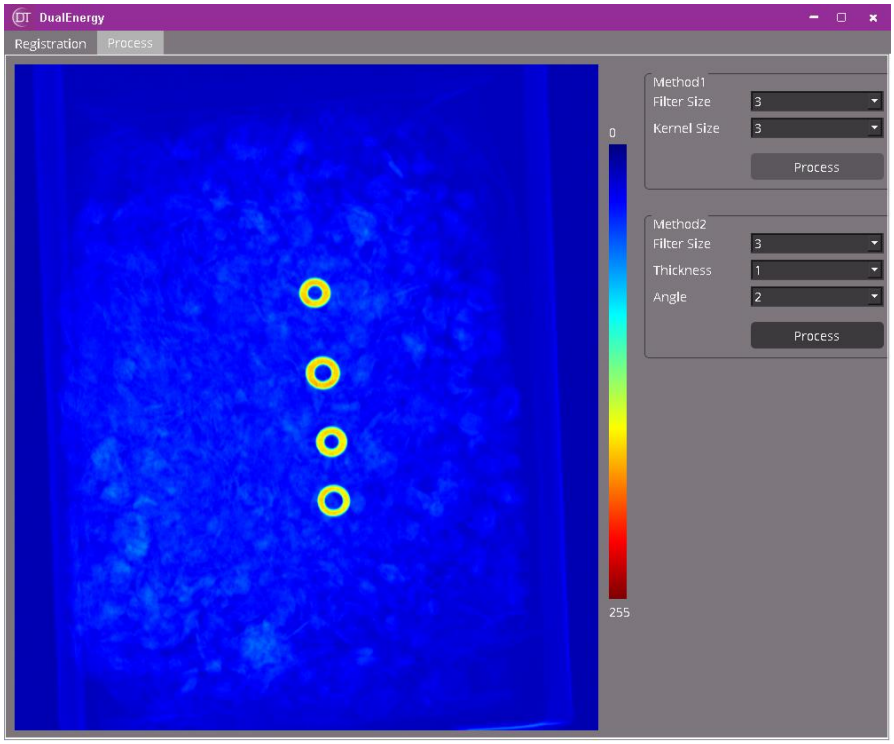


Figure 3-43. Result image processed by Method2

There are two dual-energy combination methods that adopt two different algorithms. You can adjust the following parameters to get the best result. The processed result is an 8-bits pseudo-color image. Method 1 is mainly based on the calculation of effect Z number. Method 2 is based on the contrast between low and high energy parts.

Parameters	**Description**
Filter Size of method1	You can set the pre-processed filter size of method 1. The bigger it is, the less the noise is.
Kernel Size	You can set the after-processed kernel size of method 1. The bigger it is, the less the noise is and the fuzzier the result is.
Filter Size of method2	You can set the pre-processed filter size of method 2. The bigger it is, the less the noise is.
Thickness	You can set the thickness compensation of method2. The bigger it is, the less the result value is.
Angle	You can adjust this parameter to get the best contrast of different matters.

3.12. Help menu components

You can get the software version and open the user's manual by using the "Help" manual.

3.13. Image window

The image window is composed of an info bar, a displaying window and a status bar as shown in the following figure.

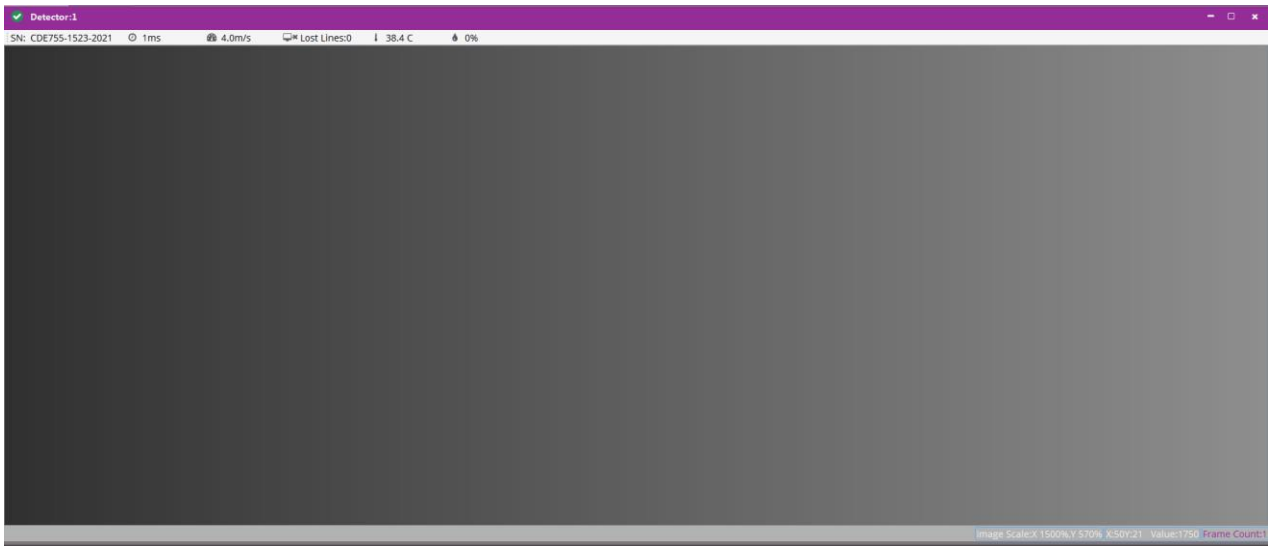


Figure 3-44. Image window

Component	Description
Info bar	You can find some necessary information on the info bar in real time. From left to right of the bar the items are the X-GCU serial number, integration time and speed, lost lines, XGCU temperature and X-GCU humidity.

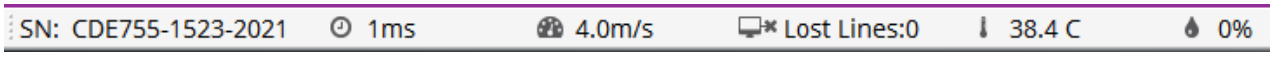


Figure 3-45. Info bar

Component	Description
Displaying window	The gray or pseudo color image is shown in the center of the image window.
Status bar	You can find the status bar on the right on bottom of the window as shown in the figure 3-46. From the left to right of the bar, the items are an image scale, coordinate and pixel value of current mouse point and frame count.

Figure 3-46. Status bar

3.14. Ethernet multi-view

X-View2 can work with 12 Ethernet non-LCS detectors at most by multi-network adapters or switch. You need to give each X-GCU a unique IP, command port number and image port number as following figure. You can choose each X-GCU item on the left and change the IP and port number on the right, then click "Set" button.

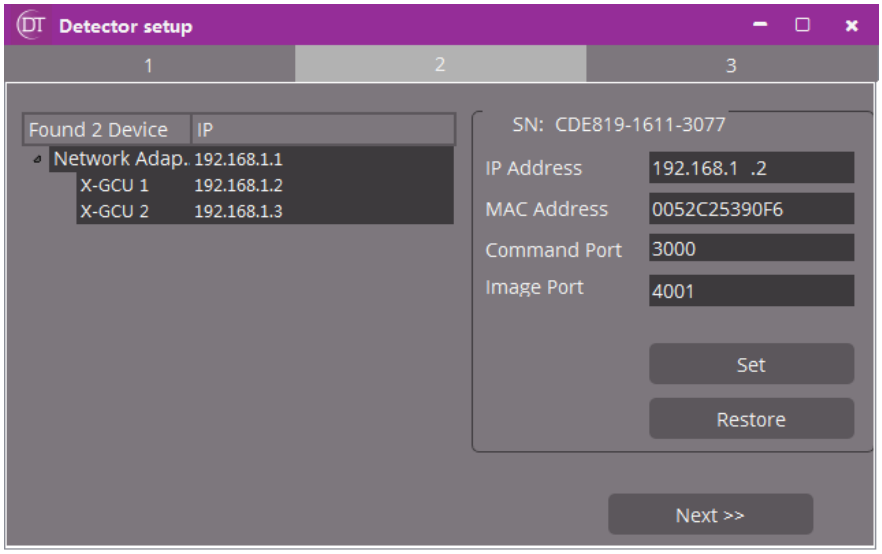


Figure 3-47. Muti-view setup

The detector navigating bar shows the detectors that are connected with the computer. You can switch between them to choose the targeted detector for control by clicking the flag. The command control will aim to the detector you chose.

Figure 3-48. Navigating bar

The image data from each detector will be synchronized and combined into one frame which is grouped following the order of IP address of each detector. You have to synchronize each detector by giving them the same integration time or by external line trigger. You can't do normalization with multi-view mode, so you have to normalize each detector in single-view mode.

3.15. Camera link multi-view

X-View2 can work with 2 camera link non-LCS detectors at most. You have to map a unique COM port number for each channel of the frame grabber card according to section 2.4. Make sure the COM port is continuous such as "COM2" and "COM3". In the setup page, you should choose 2 channels and set the smaller COM port number as following figure.

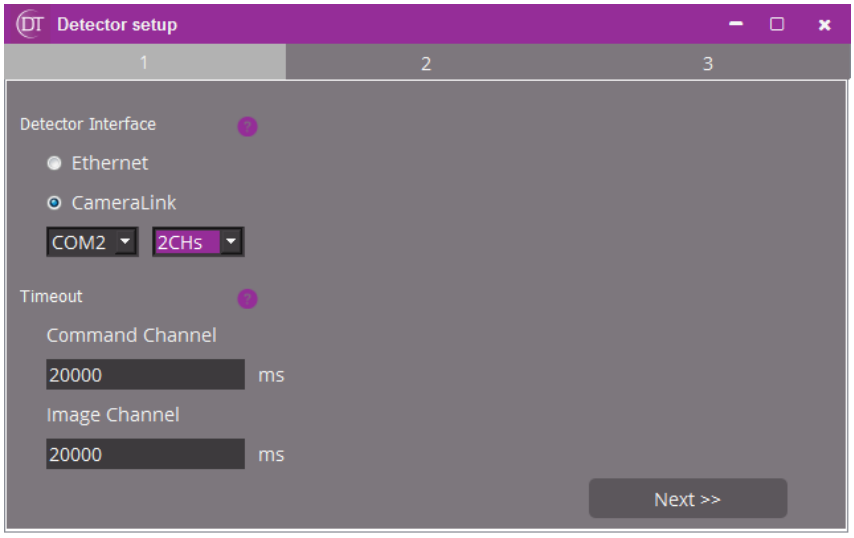


Figure 3-49. Camera link setup

The detector navigating bar shows the detectors that are connected with the computer. You can switch between them to choose the targeted detector for control by clicking the flag. The command control will aim to the detector you chose.

The image data from each detector will be synchronized and combined into one frame. You have to synchronize each detector by giving them the same integration time or by external line trigger. You can't do normalization with multi-view mode, so you have to normalize each detector in single-view mode.

4. TROUBLESHOOTING

The following sections describe several abnormal cases and the corresponding trouble shooting methods.

4.1. Error messages

The following table shows the error messages you may encounter during operating the software and the troubleshooting methods.

Error message	Troubleshooting
XSystem object's socket receives timeout.	Check the detector power and the Ethernet cable.
XSystem object fails to allocate resource.	Check the operating system memory.
XSystem or Xcommand object gets error format ASCII command.	Check the input command format.
XSystem or Xcommand object gets non-defined ASCII command.	Check the input command.
Xcommand object's socket receives timeout.	Check the detector power and the Ethernet cable.
Xcommand object receives error code.	Check the cable of X-DFE.
Xcommand object fails to allocate resource.	Check the operating system memory.
XAcquisition object's socket fails to bind IP and port.	Check whether the image port is occupied by other application.
XAcquisition object's socket receives timeout.	Check if the fire wall is blocking the software or if the detector power is off, or if the Ethernet cable is dropped or external trigger if off.
XAcquisition object fails to allocate resource.	Check the operating system memory.
XAcquisition grabbing engine fails to start grabbing.	Restart the software.
XAcquisition grabbing engine stops abnormally.	Check if the fire wall is blocking the software or if the detector power is off, or if the Ethernet cable is dropped

Error message	Troubleshooting
	or external trigger if off.
XAcquisition parsing engine fails to start.	Restart the software.
XAcquisition parsing engine stops abnormally.	Restart the software.
XframeTransfer object fails to start.	Restart the software.
XframeTransfer object stops abnormally.	Restart the software.
XmultiTransfer object fails to allocate resource.	Check the operating system memory.
Xcommand fails to get heartbeat packet.	Check the detector power and Ethernet cable.
Xcommand fails to start heartbeat thread.	Restart the software.
Xcommand stops heartbeat thread abnormally.	Restart the software.
X-GCU's voltage is out of range.	Power off the detector and check the hardware.
XAcquisition object grabbing engine works abnormally.	Restart the software.

4.2. Bad image quality

The detector has to be calibrated again. If the X-ray strength changes, the old offset and gain values are not available anymore.

4.3. Wrong configurations

If the configuration information read from X-GCU and X-DEF is not correct, you need to ask for correct script from DT and download the correct script.

4.4. Bad image quality even after normalization

Problem	Troubleshooting
Clear vertical stripes are seen in the image.	The imaging has been performed at x-ray energy different from the energy used for the normalization. Renormalize at the correct x-ray settings.
	The maximum x-ray energy (tube voltage) is too low. The x-ray intensity (tube current) is too low. Use higher x-ray energy/intensity and renormalize.
	There are some objects or structural parts between the x-ray source and the detector that prevents a uniform calibration exposure. Remove the objects or fix the system geometry and do normalization.
	The detector and the x-ray beam are misaligned. Adjust the detector and/or x-ray source position to achieve uniform x-ray coverage.
Vertical stripes and/or black edge areas are visible in the image.	The distance between the X-ray source and the detector is too small or the aperture angle of x-ray source beam is too small to expose the whole detector. Move the detector or the source to achieve a uniform exposure.
	The detector is not aligned with the x-ray source properly. Move the detector or the source to align the x-ray beam with the detector window.
	There are some objects or structural parts between the x-ray source and the detector preventing the x-rays from fully exposing the edge channels. Move the detector or source to align the x-ray beam with the detector window.

4.5. Packet/line lost

Make sure using cat-5e or above Ethernet cable and using Gigabit switch if needed. Turning the network adapter property as following figure could help to eliminate packet/line lost. Changes "Receive Buffers" to the maximum number.

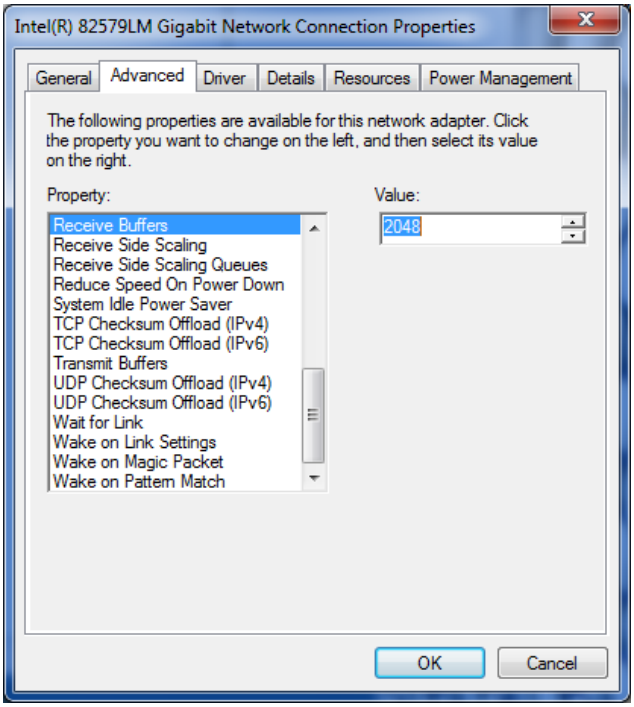


Figure 4-1. Turning network adapter

Make sure the power plan of operating system is in high performance mode as figure 4-2 shows.

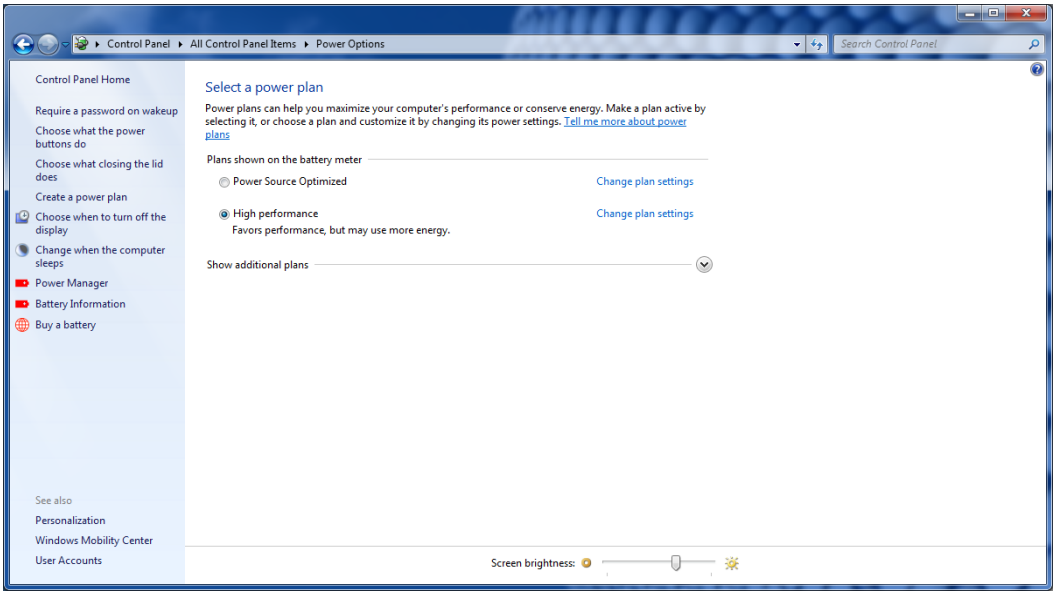


Figure 4-2. Setting power plan

4.6. Unstable Communication

If there are more than one network adapters installed in the computer and the communication with detector is not stable, you should check and make sure different subnet IP addresses are given to different network adapters.