About the Company

Hunan Mindvision Technology Co., Ltd. is a professional industrial camera supplier. Since its establishment, it has been dedicated to the research, development, production, and sales of industrial cameras.

The company boasts strong technical strength. It is a national high - tech enterprise, has passed the ISO90001 quality management system certification, and is one of the few industrial camera manufacturers in China that can provide both conventional industrial cameras with USB2.0/3.0, GigE, VGA/HDMI interfaces and intelligent cameras based on X86 and ARM platforms. Its software sophistication also leads other domestic manufacturers. The SDK supports Windows, Linux, ARM Linux, and Apple MAC OS systems. At the same time, we also undertake custom development services for various high - end, mid - end, and low - end cameras. The industrial cameras and modules customized by Mindvision have been widely used in scientific research, intelligent transportation, model aircraft, biology, medical treatment, non - standard automation, public security, and other fields.

We sincerely invite major automation manufacturers, vision software developers, lens manufacturers, and light source manufacturers to establish cooperative relationships, achieve win - win results together, and make positive contributions to promoting the independent development and progress of China's automation industry. Attitude determines everything, and details determine success or failure! Your satisfaction is our greatest pursuit!

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About this Manual

This manual is only for the guidance and instruction of related products. There may be differences between the manual and the actual products. Please refer to the actual products. Mindvision recommends that you use this manual under the guidance of professionals.

Contents

Chapter 1 Software Introduction

1.1 Product Description

This manual mainly focuses on the support and operation of USB cameras, Gigabit Ethernet area - scan cameras, and Gigabit Ethernet line - scan cameras by MindVision's PC - side demonstration software.

1.2 Overview of Functional Features

. Device list, device connection, acquisition, disconnection, and batch operations.

. Device preview and status parameters, software zooming, panning, photo - taking, and video - recording.

. Device property tree, including the properties and operations supported by the current device.

. Menu bar functions such as language switching, skin switching, IP configuration, firmware upgrade, and file settings.

1.3 Software Download

Download Address： https://www.mindvision.com.cn

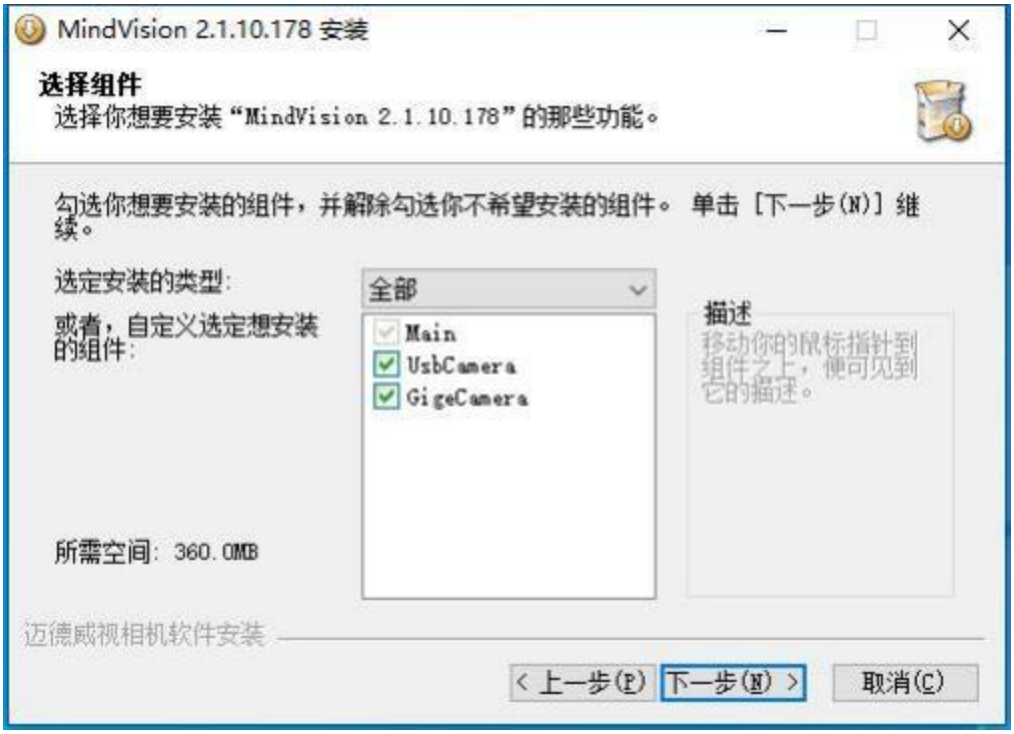
Chapter 2 Installation and Startup

2.1 Installation Steps

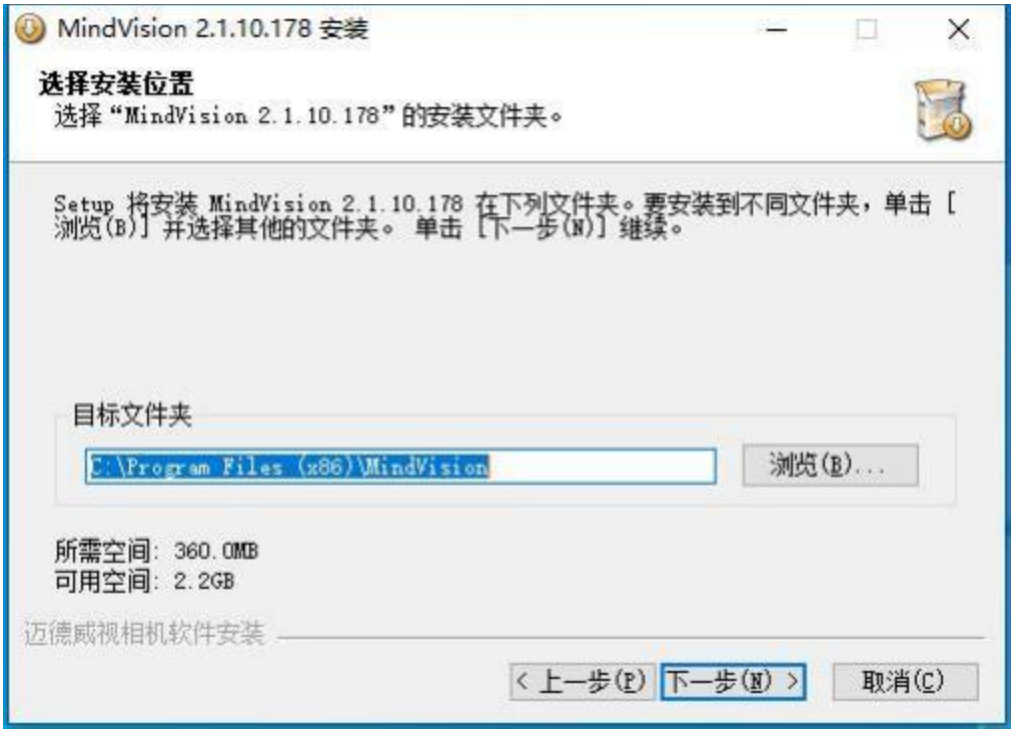
After downloading the software installation package, double - click to start the installation and select the SDK language.

After confirming the language, click "OK" to enter the installation interface.

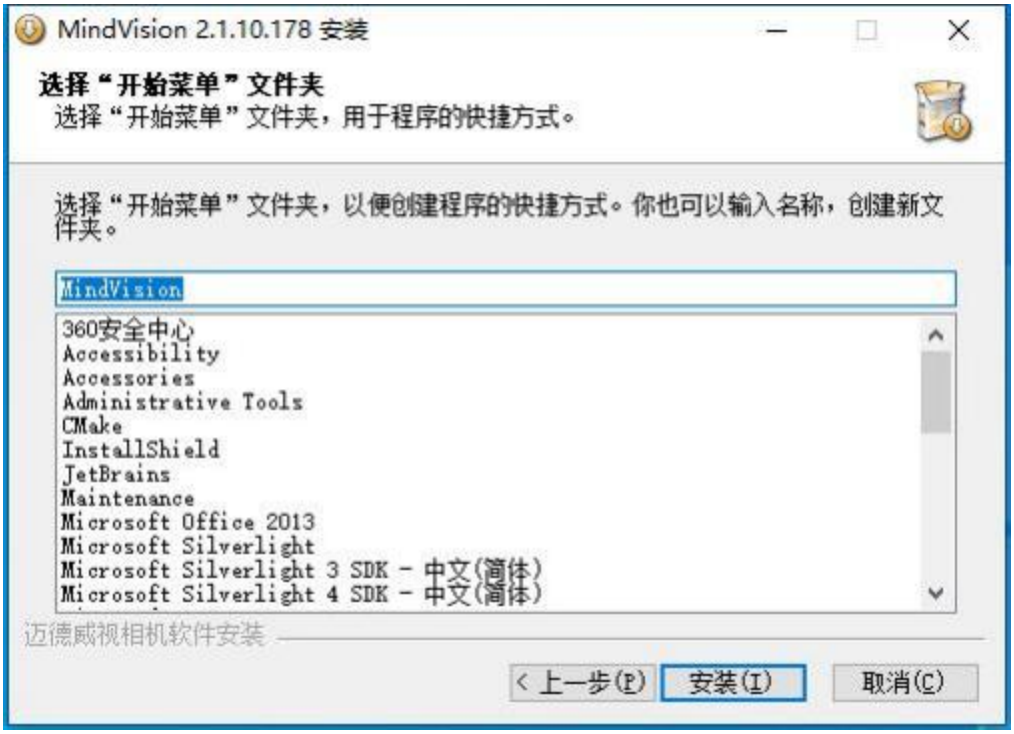
Click "Next" to enter the selection interface and check the device drivers you want to install.



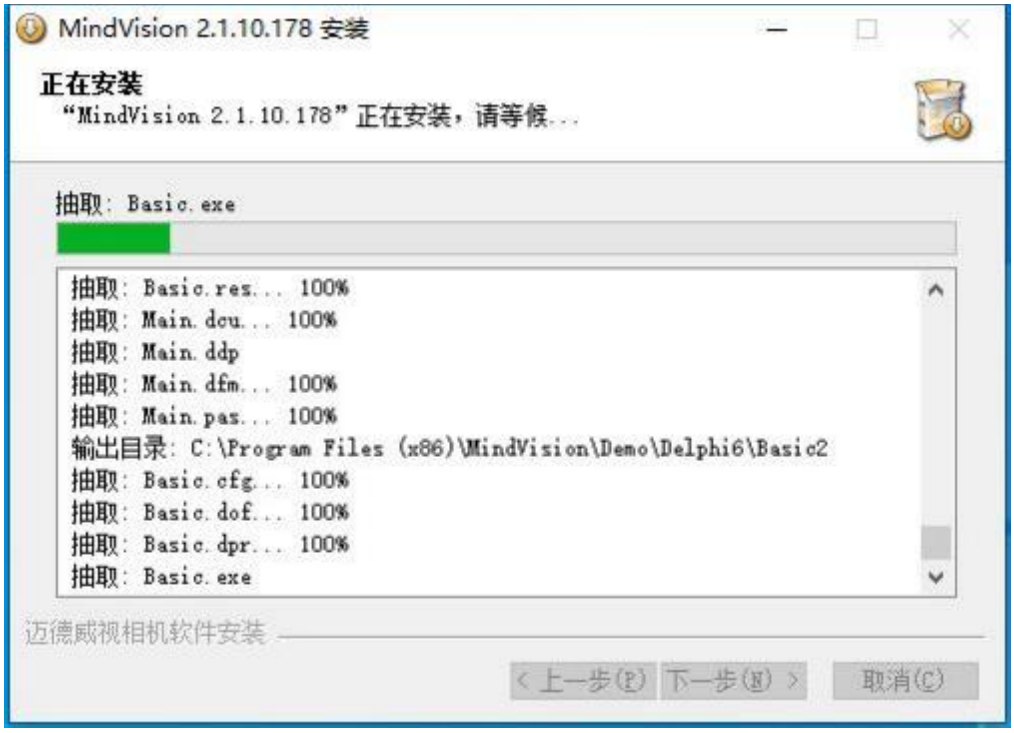
Click “Next” to enter the software installation directory selection interface.



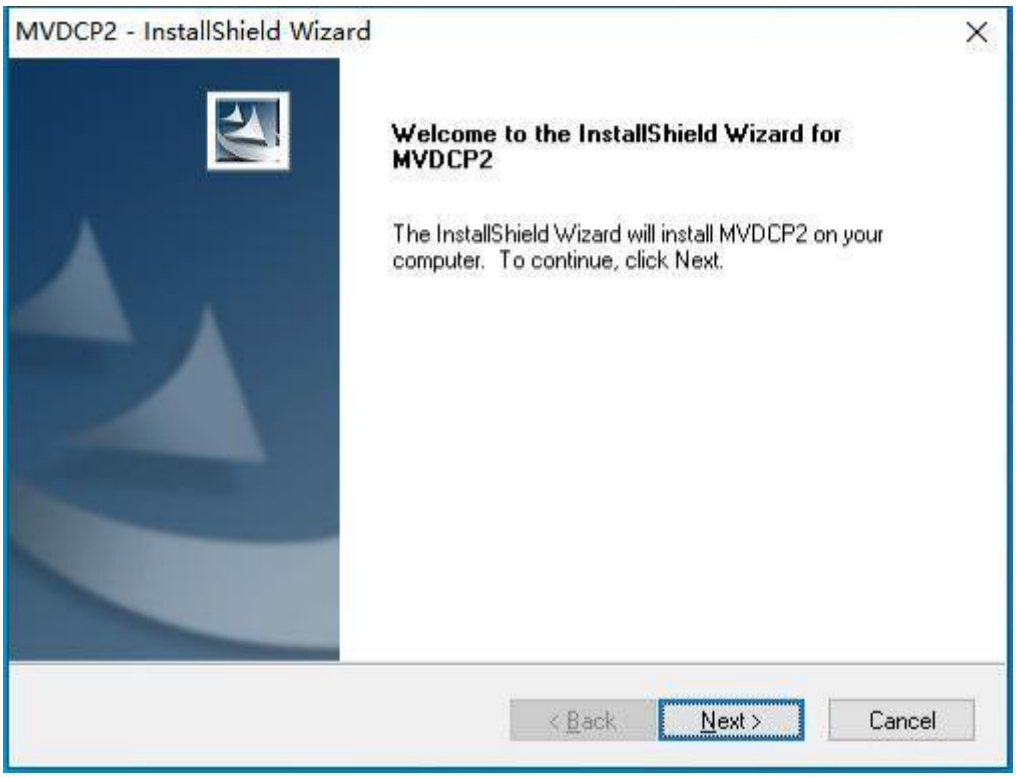
Click “Next” to enter the create shortcut interface.



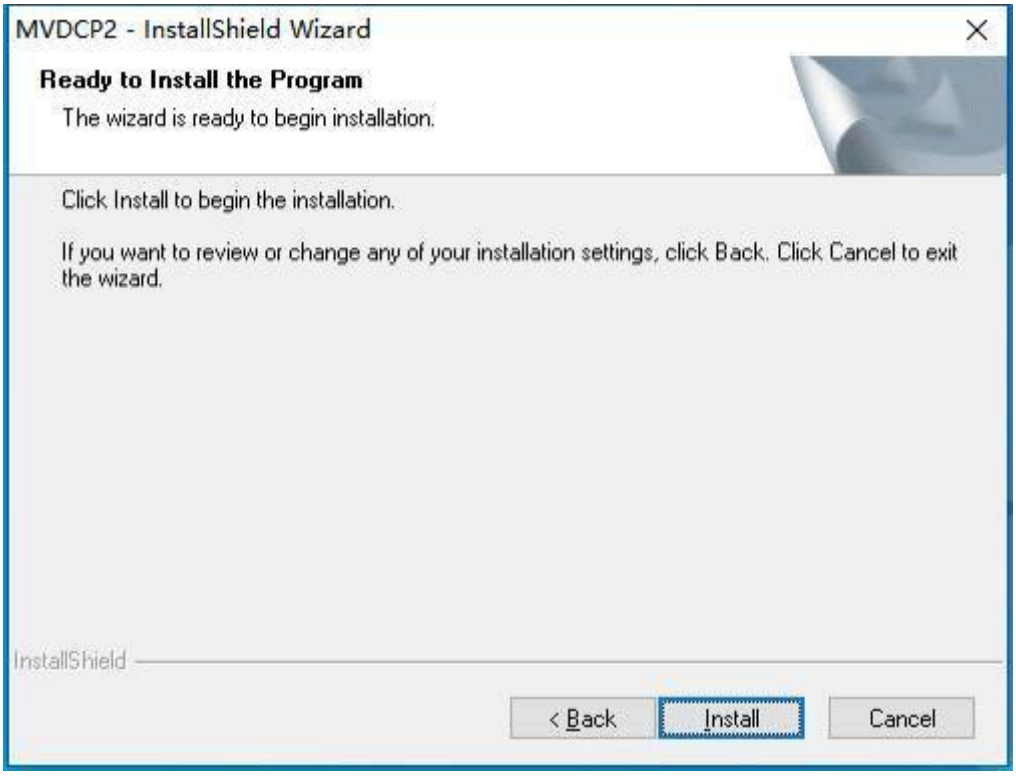
Click “Install” to start the installation. If there is a problem with signature verification during the installation process, it means that the signature verification of some system software has failed. Select to always install this software.



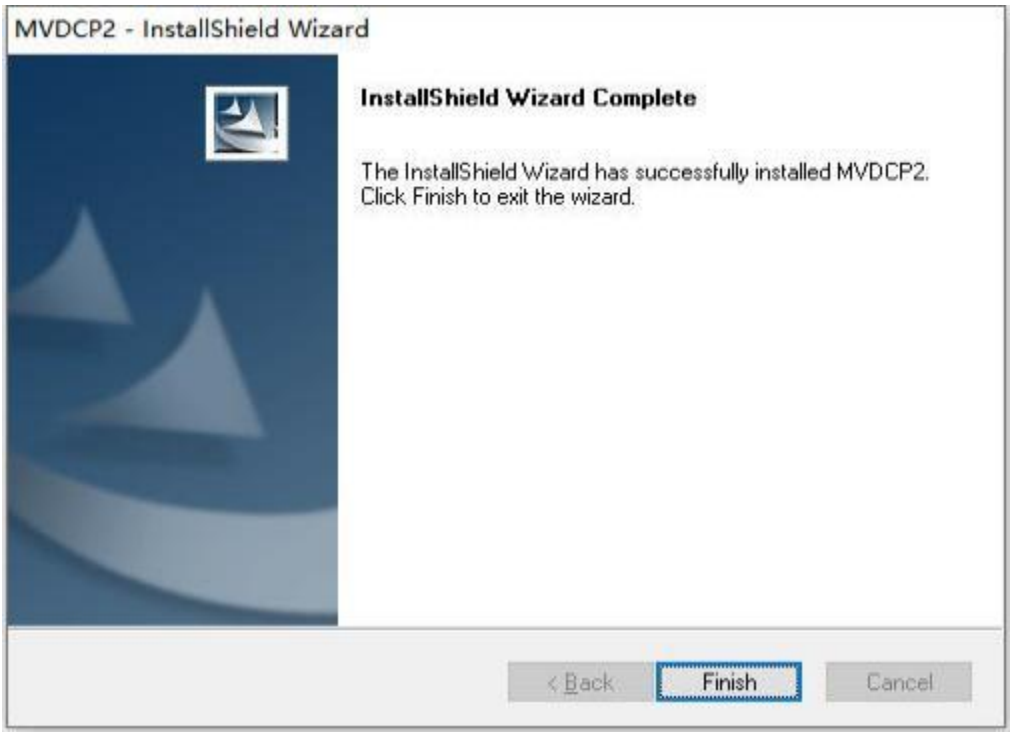
Click "Next" to enter the installation process of the new - version demonstration software.



Click "Install" to proceed with the installation.



Click "Finish" to complete the installation of the new - version demonstration software.



Complete the entire installation process.

2.2 Startup

Double - click the desktop shortcut to start the software.

Chapter 3 Introduction to Basic Functions

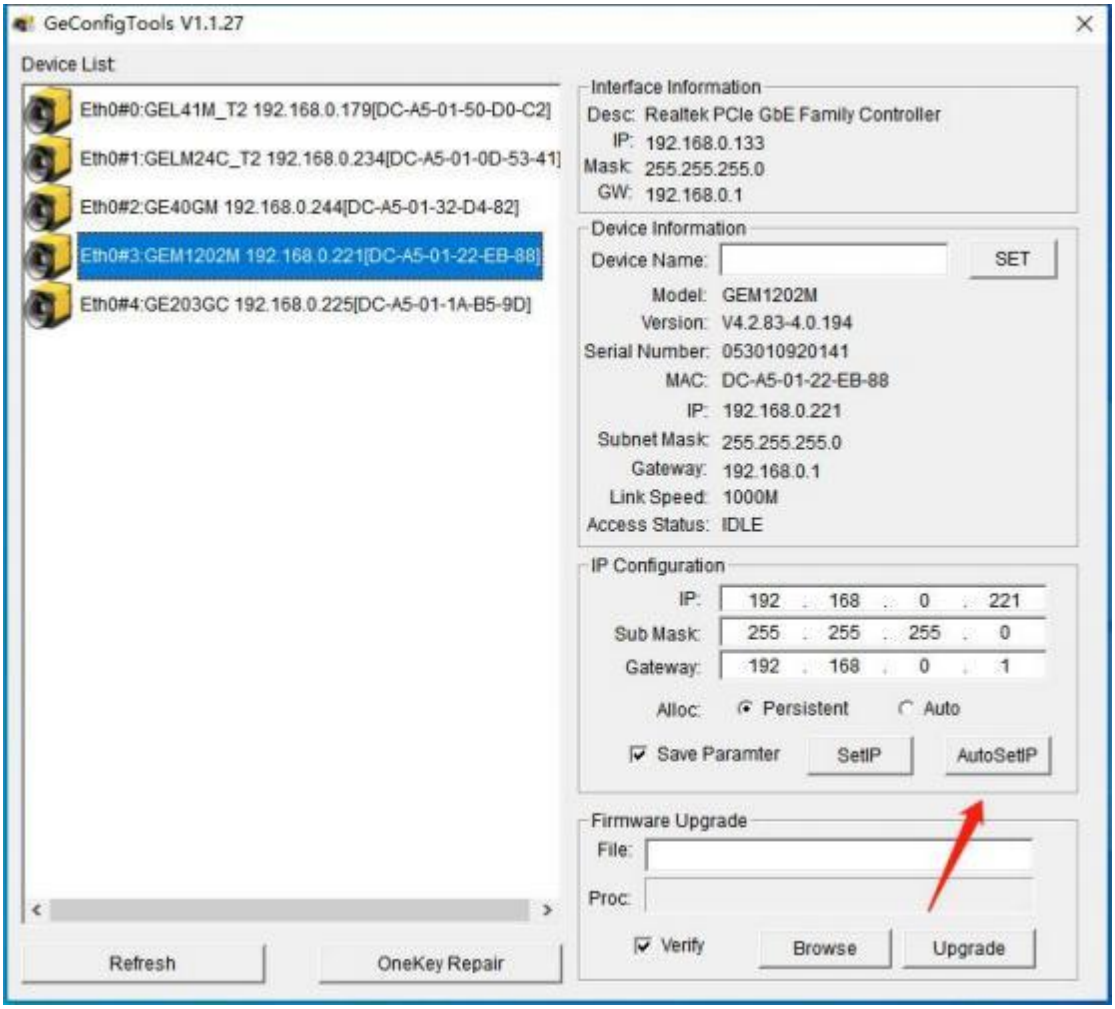
3.1 Introduction to the Basic Interface

The above is the main interface. The left side is the device list, the middle is the image preview window, the right side is the device property list, and the top contains a menu bar with some basic functions. Next, the functions of these four modules will be introduced one by one.

Chapter 4 Menu Bar

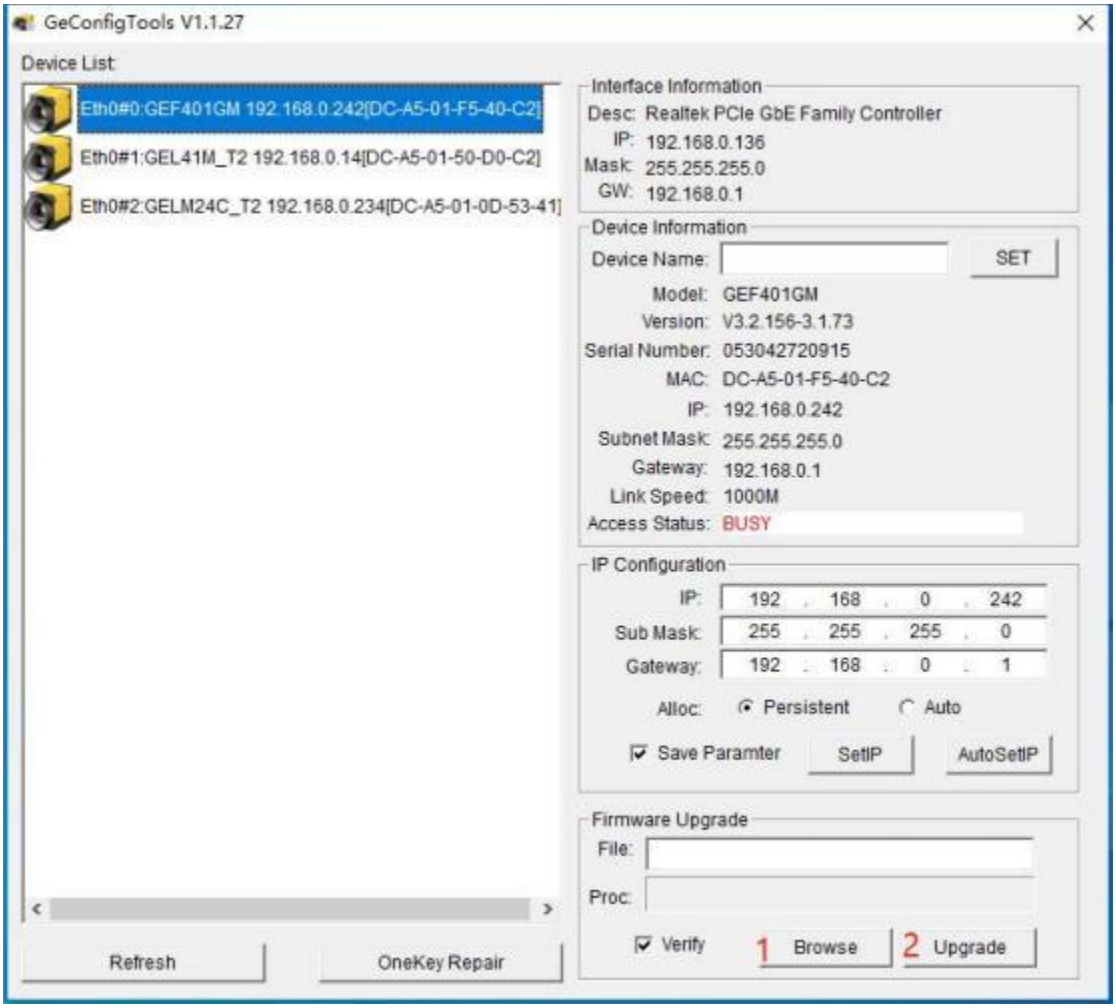
4.1 IP Configuration Tool

Tools - > IP Configuration Tool - > Enter the IP configuration tool for the network - port camera. Select any network - port camera in the left - side device list and click the "AutoSetIP" button for one - click IP setting. For more function introductions, please refer to "Gigabit Network Camera User Guide.pdf" in the software installation directory/Docmuent.



4.2 Firmware Upgrade

Tools - > Firmware Upgrade - > Enter the camera's firmware upgrade tool. Select any device in the left - side device list, click the button marked as 1 in the figure to select the firmware, and then click the button marked as 2 in the figure to perform the upgrade operation.



4.3 Language

Help - > Language. You can switch languages and view the currently used language. The software supports three languages: Chinese, English, and Traditional Chinese.

4.4 Color Theme

Help -> Color Theme. You can switch skins and view the currently used skin. The software supports two skins: black and white.

4.5 About

Help -> About. View the current software version.

4.6 Photo Settings

File -> Photo Settings -> The following interface will pop up. You can set the image format, naming prefix, and file storage path for taking photos. The "Capture" function is used to render the current frame of the image on the interface for display but not for saving. Click the "Save" button to save the image to a file.

4.7 Video Recording Settings

File -> Video Recording Settings -> The video recording settings interface will pop up. You can set the video quality, compression method, and save path for video recording.

Chapter 5 Device List

5.1 Camera Connection

After the software is opened, it will automatically enumerate all currently connectable USB cameras and Gigabit Ethernet cameras on the left side. Select any camera and double - click or click the button shown in the figure to connect to the camera.

5.2 Camera Disconnection

Select the connected camera and click the button shown in the figure to disconnect the camera.

5.3 Camera Preview

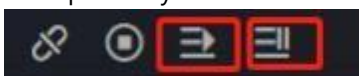
Select the connected camera and click the button shown in the figure to start the acquisition of this camera and display the preview image in the central area. You can also right - click to start the preview or click the acquisition button in the central area to start the camera preview.

5.4 Stop Acquisition

Select the camera that is currently previewing and click the button shown in the figure to stop the acquisition of the camera, so that the preview will no longer be refreshed. You can also right - click to stop the acquisition or click the stop - acquisition button in the central area to stop the camera's acquisition.

5.5 Batch Operations

The two buttons shown in the figure can be used to stop/start the acquisition of all connected cameras in the list respectively.



5.6 Device Information Viewing

Select any camera, and you can view the device information of the camera in the lower - left corner, as shown in the figure.

Chapter 6 Property List

6.1 Device Control

This property is used to view the information of the current device, including firmware information, serial number, nickname, etc.

6.2 Image Format Control

This property is used to set the camera's resolution, rotation, mirroring, Binning mode, and pixel format.

6.2.1 Resolution and ROI

The camera defaults to displaying images at the maximum resolution. Usually, a camera has multiple common resolutions. When the user is interested in a certain part of the image, the camera can be set with ROI to output the image of the region of interest.

Setting ROI can reduce the data transmission bandwidth and, to a certain extent, increase the frame rate. As shown in the figure, the width, height, and offset of the ROI can be set.

6.2.2 Binning Mode

The Binning function can combine multiple adjacent pixels into one pixel, reducing the resolution while increasing the image brightness. Currently, area - scan cameras support four Binning modes, namely:

- SUM22: Combine pixels according to the 22 rule and take their sum value;
- SUM44: Combine pixels according to the 44 rule and take their sum value;
- AVG22: Combine pixels according to the 22 rule and take their average value;
- AVG44: Combine pixels according to the 44 rule and take their average value;

For line - scan cameras, software Binning can be performed through the right - click menu of the video preview window. The specific operations are detailed in Chapter 8.

6.2.3 Mirroring

Mirroring is divided into horizontal mirroring and vertical mirroring. It can be processed on software or supported by underlying hardware. The principles of the two types of mirroring are as follows:

- Horizontal mirroring: The camera image is flipped left - to - right;
- Vertical mirroring: The camera image is flipped up - to - down.

6.3 Acquisition Control

This property is used to view and set the camera's acquisition mode, frame rate, frame - rate mode, etc.

6.4 Exposure Control

This property is used to view and set the camera's exposure mode, brightness, exposure time, anti - flicker frequency, etc.

6.4.1 Brightness

The camera brightness is the reference brightness for adjusting the image in single - automatic or continuous - automatic exposure and gain modes. If the camera is in manual exposure mode, the brightness parameter is invalid.

After setting the brightness, the camera will automatically adjust the exposure time or analog gain to make the image brightness reach the target brightness. The larger the brightness setting, the brighter the image will be adjusted in the automatic exposure or automatic gain mode. The smaller the brightness setting, the darker the image will be adjusted in the automatic exposure or automatic gain mode.

6.5 Trigger Control

This property is used to view and set the camera's trigger mode and flashlight mode.

6.5.1 Trigger Mode

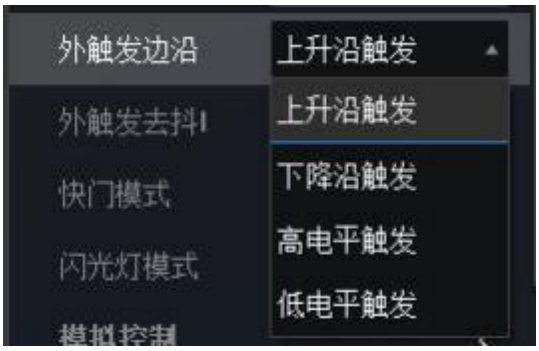
The trigger modes are divided into three types: continuous trigger, software trigger, and hardware trigger, as follows:

- Continuous trigger: The camera continuously acquires images at the frame rate, which is the default mode;
- Software trigger: The camera triggers an acquisition action by receiving a command sent by the upper - layer software;
- Hardware trigger: External devices are connected to the camera through the camera's I/O interface. The external device sends a trigger signal to the camera for image acquisition. For hardware trigger, parameters such as the number of triggered images, trigger delay, trigger interval, external trigger edge, external trigger debounce time, and flashlight mode can be set.

6.5.2 Trigger Method

Edge - trigger mode. You can select the rising edge or the falling edge as the trigger condition on the interface. When a valid trigger signal is received at the trigger terminal, the camera starts to acquire a frame of image and transmit it to the host. Each valid edge corresponds to one trigger, and only one frame of image is output. Before the acquisition of the previous frame of image is completed, repeated trigger signals will be ignored. For example, if the camera's exposure time is set to 10 milliseconds and the valid trigger signal is set to rising - edge trigger, then within 10 milliseconds, even if there are multiple rising - edge signals, only one frame of image will be triggered.

Level - trigger mode. You can select high - level or low - level as the trigger condition on the interface. When a trigger signal is at a valid level, the camera starts to acquire a frame of image and transmit it to the host. After the acquisition of this frame is completed, if the signal is still at a valid level, the camera starts to acquire the next frame of image and transmit it to the host until the trigger signal becomes an invalid level.

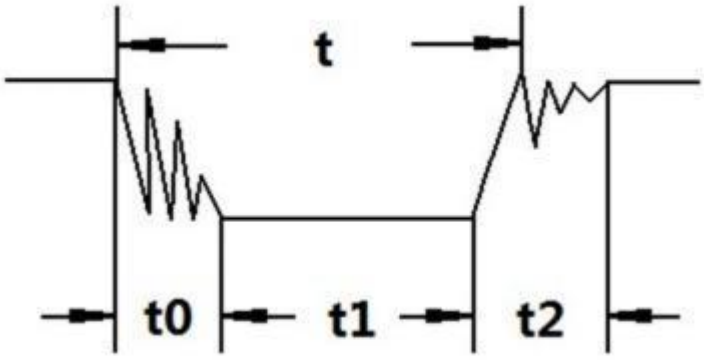


6.5.3 Trigger Delay

Trigger delay means that after the external trigger signal is generated, the camera does not start exposure immediately but starts exposure after a certain delay. When the delay is set to 0, it means no delay.

6.5.4 External Trigger Debounce Time

When a mechanical switch is connected to the external trigger terminal TRIG_IN, the jitter of the contacts may cause false triggering. The camera has a hardware filter circuit, and the debounce time can be set to filter out the jitter, such as the jitter at t0 and t2 in the following figure:



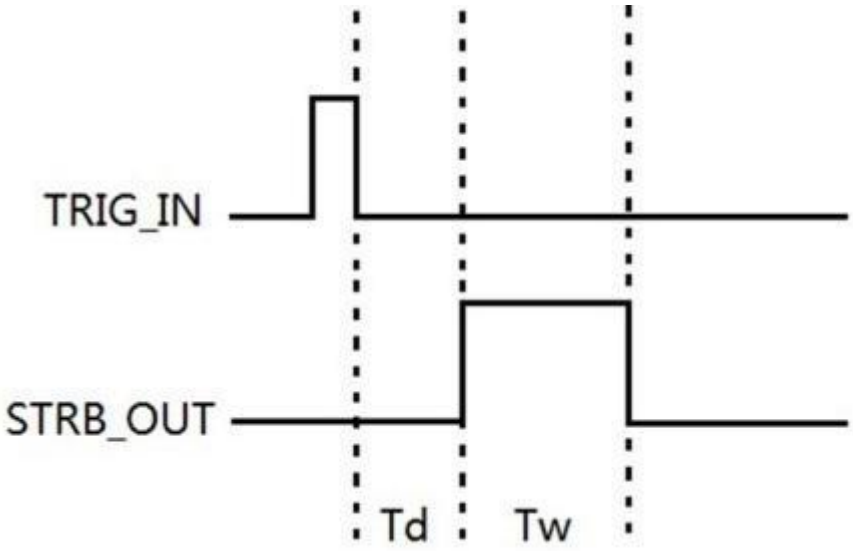
When an electronic switch is connected, there is no need for debouncing, and the debounce time can be set to 0.

6.5.5 Flashlight

The flashlight signal is an output signal, corresponding to the output IO port with index 0. In the automatic mode, the flashlight is synchronized with the exposure. When the sensor starts to expose, the flashlight turns on, and when the sensor finishes the exposure, the flashlight turns off. This mode is used by default. In the semi - automatic mode, the timing of the flashlight is completely controlled by software programming. It requires setting the delay and width. When an external signal is generated, the flashlight signal starts to

output for one cycle. The timing is shown in the following figure (assuming that both the trigger and the flashlight output are high - active):

Td is the delay, and Tw is the pulse width.



6.6 Analog Control

This property is used to view and set the analog gain for manual exposure, sharpness, LUT user lookup table, noise reduction, etc.

6.6.1 LUT User Lookup Table

The LUT lookup table is a grayscale curve. Through the setting of the LUT, users can stretch, highlight, etc. the grayscale range of interest. It can be generated in three ways: dynamic generation, custom definition, and camera presets. The specific situations of these three methods are introduced as follows:

- Dynamic generation: The default LUT curve of the camera can be adjusted by gamma value and contrast;
- Camera presets: Several LUT curves built - in the camera;
- Custom definition: User - defined mapping curves.

6.6.2 Sharpening

The camera has a sharpening function that can adjust the sharpness of the image edges. The sharpness parameter is set to 0 by default and is not enabled.

6.6.3 2D Noise Reduction

Some cameras support noise reduction. Enabling 2D noise reduction can achieve the effects of maintaining edges and smooth noise reduction, improve the signal - to - noise ratio of the image, and further enhance the imaging quality of the image.

6.6.4 3D Noise Reduction

Similar to the principle of 2D noise reduction, 3D noise reduction samples and calculates multiple frames of images at different times from the image frame queue, and the operation speed is relatively slow.

6.6.5 Algorithm - based Noise Reduction

It is a solution to improve the signal - to - noise ratio using software algorithms. Currently, it supports three algorithms: Gauss, Bilateral, and A3.

6.7 Color Conversion Control

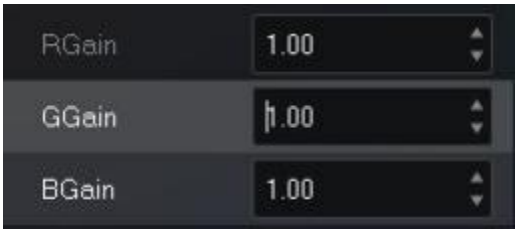
This property mainly involves image color correction and conversion, including white balance, ISP version selection, saturation, Raw2RGB algorithm, etc.

6.7.1 ISP Version

ISP stands for Image Signal Processing. The camera integrates several sets of image signal processing engines, which vary among different camera versions.

6.7.2 White Balance

Color correction is performed according to different light source illumination conditions. By adjusting the R, G, and B components in the image, the white area can always remain white under different color temperatures. It also supports regional white balance. Users can click the "Set White Balance Window" to pop up the following interface to set the reference area.



6.7.3 Saturation

Saturation refers to adjusting the vividness of the image color in a color camera to make the image more full, vivid, and closer to the real object. The smaller the set value, the duller the image looks; the larger the set value, the more vivid and full - colored the image looks.

6.7.4 Raw2RGB Algorithm

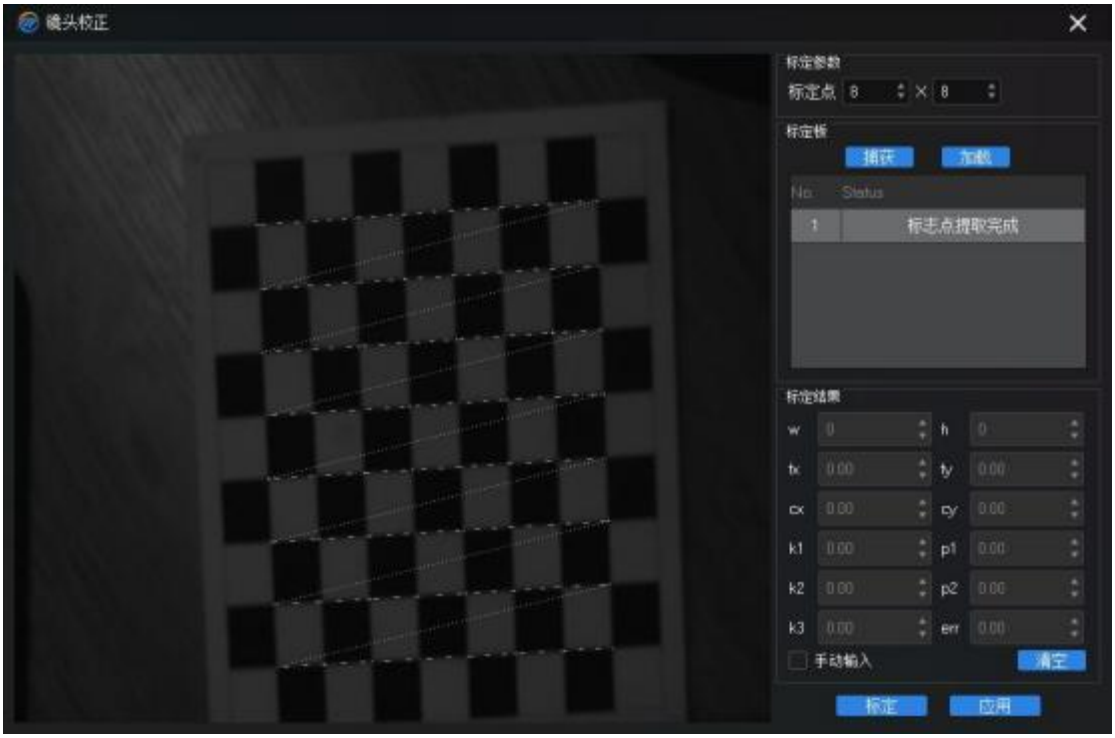
It is a set of algorithms that convert the original image data in RAW format to RGB format, and it supports multiple algorithms.

6.8 Shadow Correction

This property contains various image correction algorithms. The algorithms supported by area - scan cameras and line - scan cameras are different, and they will be introduced one by one below.

6.8.1 Lens Distortion Correction

Due to deviations in the manufacturing process accuracy of the camera lens, distortion may occur, resulting in image distortion. This algorithm is used to restore and correct the distorted part to a certain extent. Click the "Edit" button in Shadow Correction -> Lens Distortion Correction to pop up the following dialog box for specific correction operations.



A black - and - white calibration plate needs to be prepared and placed completely within the camera's field of view. If there is a complete calibration plate image, it can be directly loaded. After clicking "Capture" or loading, the software will calculate and display the set of fiducial points. Then, click the "Calibrate" button to calculate the calibration result, which is finally applied to the camera's imaging screen.

6.8.2 Color Spot Correction

That is, dead pixel correction. In a digital camera, a dead pixel refers to a photosensitive component unit that cannot correctly capture light. If there are dead pixels in the photosensitive element, it will directly cause imaging defects. The software corrects the dead pixels in the image through algorithms. Click the "Edit" button in Shadow Correction -> Color Spot Correction to pop up the following dialog box for specific correction operations.

When entering the dialog box, an image will be automatically taken and displayed. If the color spot correction is enabled and the camera has built - in color spots, they will be automatically recognized and presented on the image. At this time, the "Camera Color Spots" text box will count the number of built - in color spots of the camera; if the above conditions are not met, the number is 0.

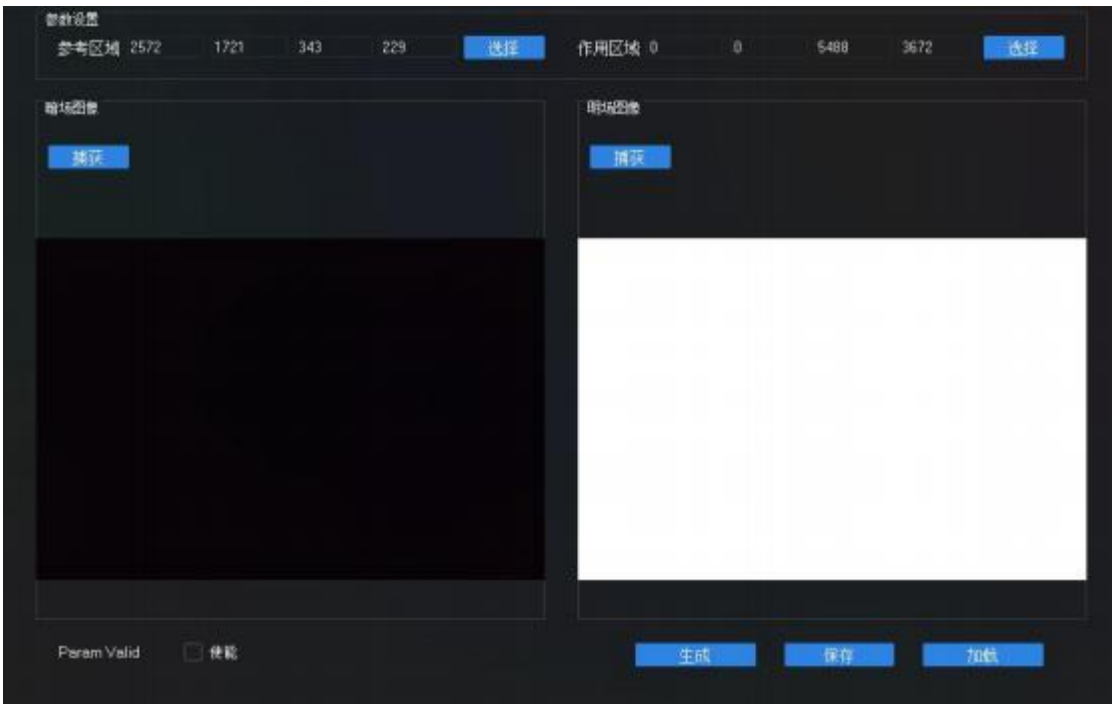
Click the "Dead Pixels" and "Color Spots" buttons shown in the figure to analyze the dead pixels of the camera. Color spots, that is, bright spots, refer to pixels that are much brighter than their surroundings, and dead pixels refer to pixels that are much darker than their surroundings.

Click the "Apply" button to display the dead pixels analyzed this time on the camera preview image. This only takes effect for the current camera on - off operation and will become invalid when the camera is restarted.

Click "Save to Camera" to make it take effect permanently, but it will affect the camera startup time.

6.8.3 Flat - Field Correction

For area - scan cameras, flat - field correction, also known as fixed - background noise correction, is caused by various factors such as uneven illumination, inconsistent responses between the center and the edge of the lens, and inconsistent responses of each pixel of the imaging device. The software algorithm calculates and corrects the bright - field and dark - field images. Click the "Edit" button in Shadow Correction -> Flat - Field Correction to pop up the following dialog box for specific operations.



First, cover the lens with an occluder and take a dark - field image. Then, take a bright - field image against a white paper or a pure white object. Then, click the "Generate" button to calculate the set of correction parameters. When the "Param valid" prompt appears, check the "Enable" box to make the calculated parameters take effect on the camera preview image.

6.9 Digital IO Control

This property is used to view the electrical characteristics and line status of the I/O and set the line mode.

6.9.1 Line Mode

Item	Power Supply Access Limit
Trigger Input TRIG	Voltage 5 - 24 V
Flashlight STRB	Maximum Current Less than 50 mA
General Input IO	Voltage 5 - 24 V
General Output IO	Maximum Current Less than 50 mA

6.9.2 Line Status

General output port. The output status has high - level/low - level (high - level indicates conduction, and low - level indicates disconnection), which is controlled by software. It is flexible but has a low speed and is not suitable for applications that require very precise delay and high - speed operation. General input port. The software calls the API once, and the hardware captures the status of the interface once. It is a non - continuous reading mode and does not support interrupt response. It is suitable for medium - and low - speed acquisition input.

6.10 User Set Control

The software has preset a set of parameter sets for loading the values of each property in the property list. Switching different user sets loads different parameter sets.

6.11 GigEVision Control

This property is mainly used to view and set the network - related properties of Gigabit Ethernet cameras, including packet size, heartbeat packet, IP address, gateway, etc.

Chapter 7 Image Preview and Status

7.1 Preview Toolbar

- Zoom in the image with software
- Zoom out the image with software
- Display the image in an adaptive way or according to the original image ratio
- Start or stop acquisition
- Take a photo and save it to the file location specified in Menu Bar -> Photo Settings
- Record a video and save it to the file location specified in Menu Bar -> Video Recording Settings

7.2 Status Bar

- View the current resolution of the camera
- View the current software image zoom ratio
- View the camera acquisition frame rate
- View the camera preview frame rate
- Total number of acquired frames statistics
- Number of dropped frames of the network - port camera
- Number of retransmissions after frame dropping of the network - port camera
- Pixel coordinates
- RGB value at the current pixel coordinates
- YUV value at the current pixel coordinates
- Packet size of the network - port camera
- Camera temperature

Chapter 8 Unique Functions of Line - Scan Cameras

8.1 Row Rearrangement

This function is usually used in conjunction with high - speed light sources to achieve time - sharing stroboscopic functions. For example, if the light source is set with three brightness levels, after the camera scans one row, the light source switches to another brightness level. As a result, on the overall captured image, every three rows form a group with different brightness levels. Through the camera's "3 - row rearrangement" function, rows with the same brightness can be grouped together for convenient processing. For example, before rearrangement, it is 123456789, and after rearrangement, it becomes 147258369.

It can be operated through the right - click menu of the video preview window - > Row Rearrangement, as shown in the figure:

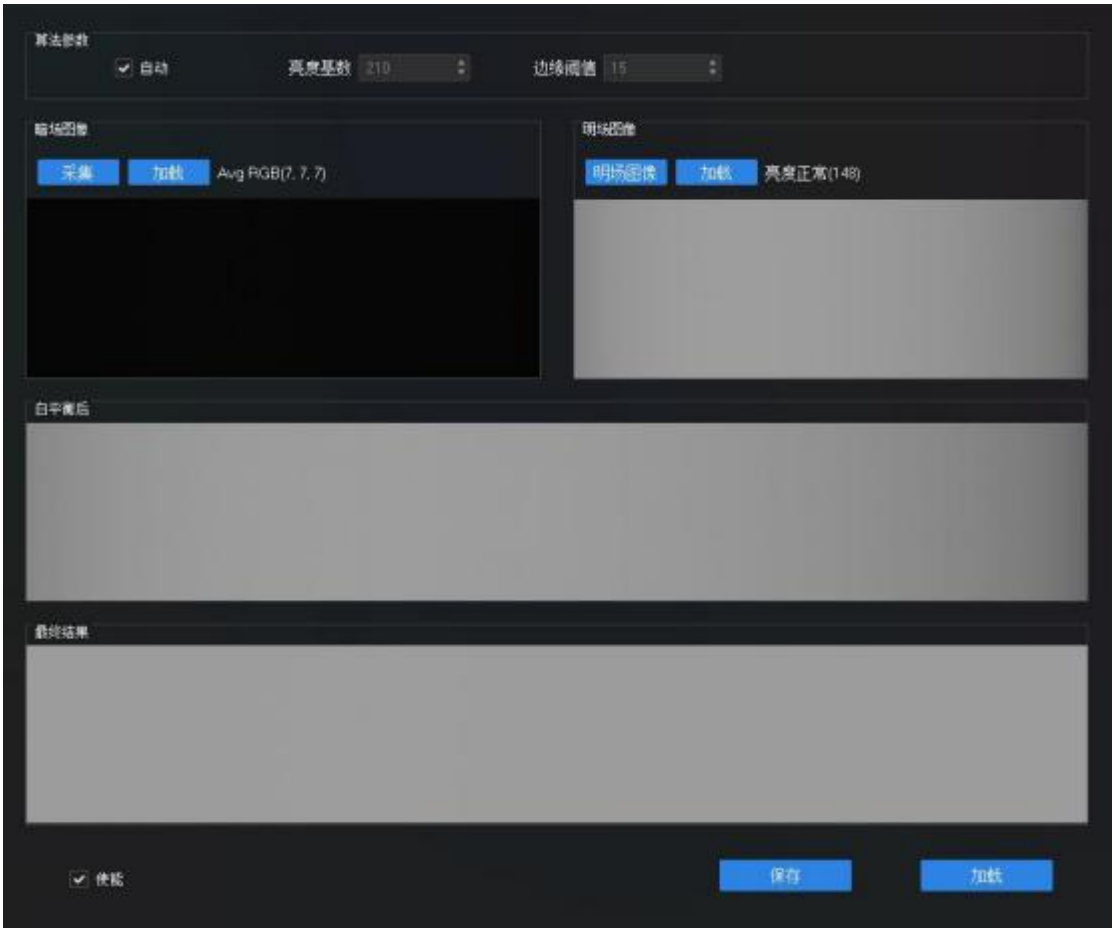
8.2 Software Binning

The Binning function of line - scan cameras is similar in principle to that of area - scan cameras, which is to combine several adjacent pixels into one pixel. However, the sampling rules are different. Line - scan cameras perform sampling and recombination by rows or columns.

It can be operated through the right - click menu of the video preview window - > Software Binning, as shown in the figure:

8.3 One - Click Flat - Field White Balance

This function performs white balance while doing flat - field correction to correct the distortion of the image. Click the "Edit" button on the right side of Attribute List -> Shadow Correction -> One - Click Flat - Field White Balance to pop up the following dialog box for operation:



First, capture a dark - field image, calculate the image average value, adjust the exposure time, and then capture a bright - field image while performing white balance and FPN (Fixed Pattern Noise) calculation to obtain the calculation results. Click the "Save" button to save the results to a file. Check the "Enable" option to apply the calculation results to the camera and display them in the preview window. The image will change significantly compared to before, and there will be no obvious stripes.

8.4 Termination Frame

Line - scan cameras have frame trigger and row trigger modes. Frame trigger means that the camera starts to acquire a frame of image after receiving an external trigger signal, while row trigger means that the camera starts to acquire one or several rows of images after receiving an external trigger signal. If the current camera is in the row - trigger mode, assuming the resolution is 4096*512, and the height of the object being photographed by the current camera only requires 256 rows, the termination frame function can be manually set to start outputting the decoded image after 256 rows are acquired. The specific operations are as follows:

1.First, adjust the trigger condition to row trigger. Select row trigger in the Trigger Control - > Trigger Mode of the property tree.

2.Then, manually adjust the number of rows you need through the trigger board, or the camera just meets the row - number limit condition.

3.Right - click on the video preview area - > Click Termination Frame.

8.5 Automatic Black Level Correction

There is dark current in the circuit of the sensor. Dark current, also known as zero - illumination current, refers to the current flowing in light - receiving components such as solar cells, photodiodes, photoconductive elements, and phototubes in the absence of light irradiation. It is generally caused by internal defects of the device. Dark current is mainly generated during the process of converting light signals into analog signals by photodiodes in the CMOS chip. The photodiodes are interfered by factors such as temperature and voltage stability, resulting in an output level that is not necessarily stable at 0 in the fully - black state. The instability of the signal can cause color deviation in some images. Artificially fixing the value in the fully - black state to the black - level value is largely to ensure the stability of the signal and to ensure consistent image performance.

It can be operated through the right - click menu of the video preview window - >

Automatic Black Level Correction.

8.6 Encoder Counter Reset

An encoder is a commonly used electronic device that converts input analog or digital signals into a specific coding form. Encoder reset means resetting the encoder counter to zero.

8.7 Multiple Exposures

Photosensitive sensors with a low dynamic range may exhibit underexposure or overexposure. To compensate for these defects, software algorithms are used to artificially change parameters such as the exposure time and Gamma value of different rows of the line - scan camera image, and dynamically form a CCD control waveform. Specific operations can be carried out through the dialog box popped up by Attribute Tree -> Exposure Control -> Multiple Exposures.

Version Update Record

Date	Remarks
2023.09.15	User Manual for Demonstration Software
2023.09.27	Added Branch Functions for Line - Scan Cameras