



<b>Product Name</b>	GAOTek Rolling Shutter HD Machine Vision
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## Chapter 1 Software Introduction

### **1.1 Product description**

This manual mainly involves the support and operation of GAOTek PC-side demonstration software for USB cameras, Gigabit Ethernet port area scan cameras, and Gigabit Ethernet port line scan cameras.





## **1.2 Overview of functional features**

- Device list and device connection, collection, disconnection, and batch operations
- Device preview and status parameters, software zoom and pan, take photos, and video
- Device attribute tree, including attributes and operations supported by the current device
- Menu bar language switching, skin switching, IP configuration, firmware upgrade, file settings

## **1.3 Software download**

Download address:

## **Chapter 2 Installation and Startup**

### **2.1 Installation steps**

- After the software installation package is downloaded, double-click to enter the installation and select the SDK language.



- After the language is confirmed, select "OK" to enter the installation interface
- Click "Next step" to enter the selection interface and check the device driver that needs to be installed.
- Click "Next step" to enter the software installation directory selection.
- Click "Next step" to enter the shortcut creation interface
- Click "Installation" to enter the installation. If there is a problem that the signature cannot be verified during the installation process, and the signature verification of individual system software fails, choose to always install this software.
- Click "Next" to enter the new version of the demo software installation process
- Click "Install" to install.
- Click "Finish" to complete the installation of the new version of the demo software.
- Complete the entire installation process

### **Overview of functional features**

- Device list and device connection, collection, disconnection, and batch operations
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- Device attribute tree, including attributes and operations supported by the current device
- Menu bar language switching, skin switching, IP configuration, firmware upgrade, file settings

## **2.2 Startup**

Double-click the desktop shortcut to launch the software

## **Chapter 3 Basic Function Introduction**

### **3.1 Basic interface introduction**



The above interface is the main interface, with a device list on the left, a screen preview window in the middle, a device attribute list on the right, and a menu bar with some basic functions at the top. Next, the functions will be introduced one by one based on these four modules.

## Chapter 4 Menu Bar

### **4.1 IP configuration tool**

Tools->IP Configuration Tool->Enter the IP configuration tool of the network port camera, select any network port camera in the device list on the left, and click the "AutoSetIP" button to perform one-click IP settings. For more function introduction, please refer to the software installation directory/Document/"Gigabit Network Camera User Guide.pdf".

### **4.2 Firmware upgrade**

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

### **4.3 Language**

Help->Language can switch languages and display 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 display the currently used skin. The software supports black and white skins.

### **4.5 About**



Help->About, check the current software version.

#### **4.6 Photo settings**

File->Photography Settings->The following interface pops up to set the captured image format, naming prefix, and file storage path. "Capture" is used to render the current frame of image to the interface and display it without saving it. Click "Save"" button will be saved to the file.

#### **4.7 Recording settings**

File->Recording Settings->The recording setting interface pops up to set the video quality, compression method, and save path during recording.

## **Chapter 5 List of equipment**

### **5.1 Camera connection**

After the software is opened, all currently connectable USB cameras and Gigabit Ethernet cameras will be automatically enumerated on the left. Select any camera and double-click or click the icon button to connect to the camera.

### **5.2 Camera disconnection**

Select a connected camera and click the icon button to disconnect the camera.

### **5.3 Camera preview**





the

Select the connected camera, click the icon button to start the camera's acquisition and display the preview image in the central area, or right-click to start the preview, or click the acquisition button in the central area to start the camera's preview.



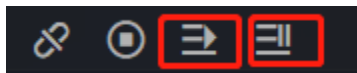
#### 5.4 Stop collection

Select the camera being previewed and click the icon button to stop the camera's collection so that the preview will no longer be refreshed. You can also right-click to stop collection, or click the stop collection button in the center area to stop the camera's collection



#### 5.5 Batch operations

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



#### 5.6 View device information

Select any camera to view the camera's device information in the lower left corner, as shown in the figure.

## Chapter 6 Property List

### 6.1 Device control



This attribute is used to view the current device information, 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 displays images at the maximum resolution by default, and usually a camera has multiple common resolutions. When the user is interested in a certain part of the image, the camera can set the ROI to output the image of the area of interest. Setting the ROI can reduce the transmission data bandwidth and increase the frame rate to a certain extent. As shown in the figure, the width, height and offset of the ROI can be set.

### 6.2.2 Binning mode

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

- SUM2\*2 combines pixels according to the 2\*2 rule and takes their sum;
- SUM4\*4 combines pixels according to the 4\*4 rule and takes their sum;
- AVG2\*2 merges pixels according to the 2\*2 rule and takes the average value;
- AVG4\*4 merges pixels according to the 4\*4 rule and takes the average value;

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

### 6.2.3 Mirroring

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

- Horizontal mirroring flips the camera image left and right;
- Vertical mirroring flips the camera image up and down.



## 6.3 Collection 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

Camera brightness is the reference brightness when adjusting images in one automatic or continuous automatic exposure and gain modes. If the camera is exposed manually, 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 automatic exposure or automatic gain mode. The smaller the brightness setting, the darker the image will be adjusted in automatic exposure or automatic gain mode.

## 6.5 Trigger control

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

### 6.5.1 Trigger mode

There are three trigger modes: continuous trigger, software trigger, and hardware trigger. The details are as follows:



- Continuous triggering means that the camera continuously collects images according to the frame rate, which is the default mode;
- Software triggering means that the camera sends a command through the upper-layer software to trigger a collection action;
- Hardware triggering: The external device is connected to the camera through the camera I/O interface, and the external device sends a trigger signal to the camera to capture images. The hardware trigger can set the number of trigger images, trigger delay, trigger interval, external trigger edge, and external trigger removal. Bounce time, strobe mode, etc.

### 6.5.2 Triggering method

Edge triggered mode. You can select the upper edge or lower edge as the trigger condition on the interface. When the trigger terminal receives a valid trigger signal, the camera starts to collect a frame of images and transmits it to the host. Each valid edge corresponds to a trigger, and only one frame of image is output. Before the last frame of image acquisition is completed, repeated trigger signals will be ignored.

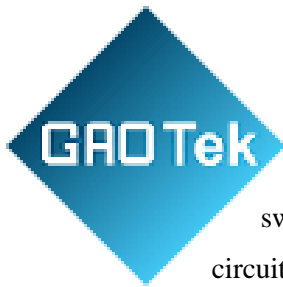
For example, if the camera's exposure time is set to 10 milliseconds and the effective trigger signal is set to rising edge trigger, then within 10 milliseconds, even if there are multiple rising edge signals, only one frame of image will be triggered.

Level triggered 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 collect a frame of image and transmits it to the host. After the frame collection is completed, if the signal is still at a valid level, the camera starts to collect the next frame of image and transmits it to the host until the trigger signal changes to an inactive level.

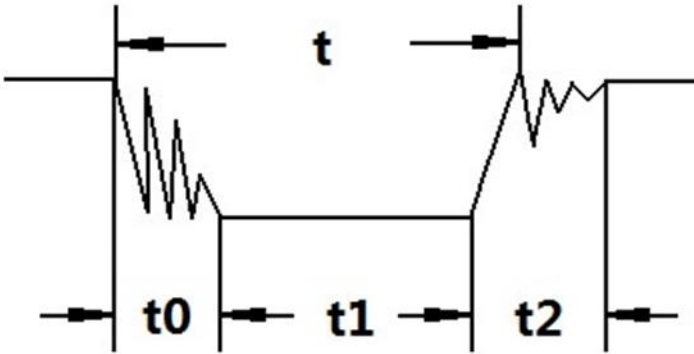
### 6.5.3 Trigger delay

Trigger delay means that when the external trigger signal is generated, the camera does not start exposure immediately, but delays for a certain period of time before starting exposure. When the delay is set to 0, it means there is no delay.

### 6.5.4 External trigger debounce time



When the external trigger terminal TRIG\_IN is connected to a mechanical switch, false triggering may occur due to contact jitter. There is a hardware filter circuit in the camera, and the debounce time can be set to filter out the jitter, as shown in the figure below for  $t_0$  and  $t_2$  jitter:



When connecting an electronic switch, debounce is not required and the debounce time can be set to 0.

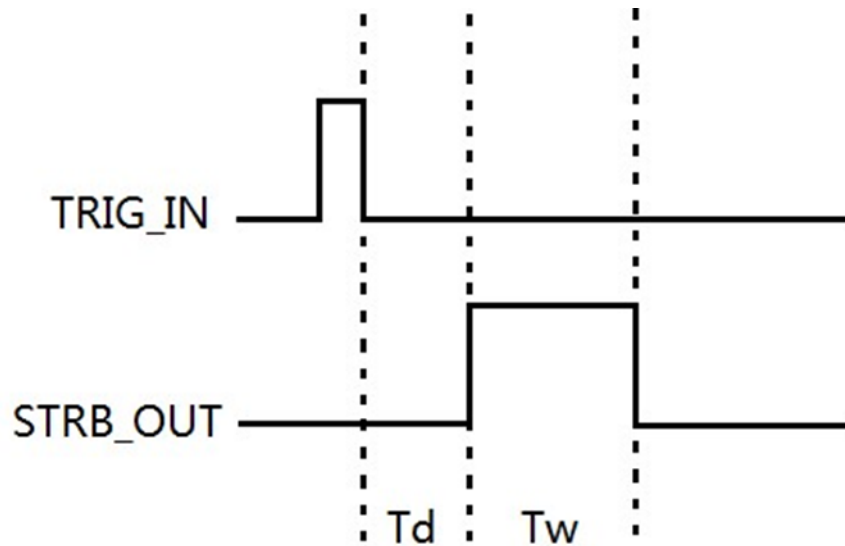
### 6.5.5 Strobe

The strobe signal is an output signal, corresponding to the output IO port with index 0.

In automatic mode, the strobe is synchronized with the exposure. When the sensor starts to expose, the strobe turns on. When the sensor ends the exposure, the strobe turns off. This mode is used by default.

In semi-automatic mode, the strobe timing is completely controlled by software programming, which requires setting the delay and width.

When an external signal is generated, the strobe signal begins to output for one cycle, and the timing is as shown below (assuming that both the trigger and strobe output are active high):



Td is the delay and Tw is the pulse width.

## 6.6 Analog control

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

### 6.6.1 LUT user lookup table

A LUT lookup table is a grayscale curve. Through the settings of LUT, users can stretch and highlight the grayscale range of interest. It supports three methods of dynamic generation, customization, and camera preset. The details of these three methods are introduced below:

Dynamically generate the camera's default LUT curve, which can be adjusted by gamma value and contrast; Camera presets include several LUT curves built into the camera; Custom user-defined mapping curve.

### 6.6.2 Sharpening



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

### **6.6.3 2D noise reduction**

Some cameras support noise reduction. Turning on 2D noise reduction can achieve the effect of maintaining edges, reducing noise and smoothing, improving the signal-to-noise ratio of the image, and further improving the imaging quality of the image.

### **6.6.4 3D noise reduction**

The principle is similar to 2D noise reduction, but multiple frames of images at different times are collected from the image frame queue for sampling calculation, and the calculation speed is slower.

### **6.6.5 Algorithm noise reduction**

A solution that uses software algorithms to improve the signal-to-noise ratio. Currently, it supports Gauss, Bilateral, and A3 algorithms.

## **6.7 Color conversion control**

This attribute 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, and different camera versions have different versions.



### 6.7.2 White balance

Color correction based on different light source lighting conditions. You can adjust the R, G, and B components in the image so that the white area remains white at different color temperatures.



It also supports regional white balance. Users can click "Set White Balance Window" to pop up the following interface to set the area to be referenced.

### 6.7.3 Saturation

Saturation refers to adjusting the brightness of the image color under a color camera to make the image more full, gorgeous and close to the real thing. The smaller the value you set, the darker the image will look; the larger the value you set, the richer and more colorful the image will look.

### 6.7.4 Raw2RGB algorithm

A collection of algorithms that convert original image data RAW into RGB format, supporting multiple algorithms.

## 6.8 Shadow Correction

This attribute contains various image correction algorithms. The algorithms supported by area array cameras and line array cameras are different. Let's introduce them one by one below.

### 6.8.1 Lens distortion correction

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





You need to prepare a black and white calibration plate and place it completely within the camera screen. If you already have a complete picture of the calibration plate, you can also directly load the image. After clicking "Capture" or loading, the software will calculate the set of landmark points and display the result. Come out, and then click the "Calibrate" button to calculate the calibration result, and finally apply it to the camera's imaging screen.

### **6.8.2 Color point correction**

It means dead pixel correction. In digital cameras, dead pixels refer to the photosensitive component unit that cannot capture light correctly. If the photosensitive component has dead pixels, it will directly cause imaging defects. The software uses algorithms to correct bad pixels on the image. Click the Shadow Correction->Color Point Correction "Edit" button 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 color point correction is enabled and the camera's own color points are automatically recognized and presented on the image, the "Camera Color Points" text box will count the number of camera's own color points; if the above conditions are not met, is 0.

Click the "Dead Pixels" and "Colored Pixels" buttons in the icon to analyze the camera's dead pixels. Colored pixels are bright spots that are much brighter than the surrounding pixels, and bad pixels are those that are much darker than the surrounding pixels. point.

Click the "Apply" button to display the bad pixels analyzed in this analysis on the camera preview image. It only works for this camera switch and will not work if you restart the camera.

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

### **6.8.3 Flat field correction**

For area array cameras, flat field correction is also called fixed background noise correction. It is caused by various reasons such as uneven illumination, inconsistent response between the center of the lens and the edge of the lens, and inconsistent response of each pixel of the imaging device. The bright and dark field images are calculated through software algorithms. and correct. Click the Shadow Correction->Flat Field Correction "Edit" button to pop up the following dialog box for specific operations.



First cover the lens with an occlusion, take a dark field image, then take a bright field image against white paper or a pure white object, and then click the "Generate" button to calculate the correction parameter set. When Param valid appears When prompted, check the "Enable" box to enable the calculated parameters to affect the camera preview image.

## 6.9 Digital IO control

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

### 6.9.1 Line mode

Project	Access power restrictions
Trigger input TRIG	Voltage 5~24V
Strobe STRB	Maximum current is less than 50 mA
Normal input IO	Voltage 5~24V
Normal output IO	Maximum current is less than 50 mA



## **6.9.2 Line status**

Ordinary output port. The output status has high level/low level (high level means on, low level means off), which is controlled by software. It is flexible but not very fast, so it is not suitable for applications that require very precise delay and high speed.

Ordinary input port. The software calls the API once, and the hardware captures the interface status once. In non-continuous reading mode, interrupt response is not supported. Suitable for medium and low speed acquisition input.

## **6.10 User set control**

The software presets a batch of parameter sets for loading the values of each attribute in the attribute list, and switches different user sets to load different parameter sets.

## **6.11 GigE Vision control**

This attribute is mainly used to view and set Gigabit network card camera network-related attributes, including data packet size, heartbeat packet, IP address, gateway, etc.

## **Chapter 7 Image Preview and Status**



### 7.1 Preview toolbar

- Software to enlarge image
- Software to reduce image
- Display images adaptively or in original image proportions
- Start or stop collection
- Take a picture and save it to the file location specified in the menu bar->Photo settings
- Record a video and save it to the file location specified in the menu bar->Video Settings

### 7.2 Status bar

- Check the current resolution of the camera
- Check the current software zoom image ratio
- View camera acquisition frame rate
- View camera preview frame rate
- Statistics of the total number of frames collected
- The number of frames dropped by the network port camera
- Number of network port camera retransmissions after frame loss
- Pixel coordinates
- RGB value at current pixel coordinates
- YUV value at current pixel coordinates
- Network port camera data packet size
- Camera temperature

## Chapter 8 Unique Functions of Line Scan Cameras

### 8.1 Row rearrangement



This function is usually used with high-speed light sources to achieve time-sharing stroboscopic function. For example, the light source is set to three brightness levels. After the camera scans a line, the light source switches to another brightness. In this way, each group of 3 lines in the overall imaged picture has different brightness. Through the camera's "3-row rearrangement" function, rows with the same brightness can be put together for easy processing. For example: 123456789 before rearrangement, 147258369 after rearrangement. It can be operated through the video preview window->right-click menu->row rearrangement.

## **8.2 Software Binning**

The Binning function of line scan cameras is similar in principle to the Binning function of area scan cameras. They both merge adjacent pixels into one pixel, but the sampling rules are different. Sampling and reorganization are performed by rows or columns.

It can be operated through the video preview window->right-click menu->software Binning.

## **8.3 One-click flat white balance**

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

First collect a dark field image, calculate the image mean, adjust the exposure time, then collect a bright field image and perform white balance and FPN calculations at the same time to obtain the calculation results. Clicking the "Save" button will save the results to a file. Checking "Enable" will apply the calculation results to the camera and present them in the preview window. The image has changed a lot compared to before, and there are no longer obvious stripes.