



UltraCut vision module

[Friendsess, Inc.](#)

# UltraCut Visual module user manual

Version: V 5 . 1

Based on UltraCut software version V 7.7

## Table of contents

|                                                                            |    |
|----------------------------------------------------------------------------|----|
| 1. Camera Configuration .....                                              | 2  |
| 1.1 Camera IP automatic configuration .....                                | 2  |
| 1.2 Enable NIC Jumbo Frame .....                                           | 3  |
| 1.3 Camera Installation Example — Hikvision .....                          | 4  |
| 1.4 Precautions .....                                                      | 8  |
| 2. Introduction to Visual Form Layout .....                                | 9  |
| 2.1 Visual positioning interface layout .....                              | 9  |
| 2.2 Visual calibration interface layout .....                              | 10 |
| 2.3 Setting page layout .....                                              | 11 |
| 3. Visual positioning, debugging and processing of the whole machine ..... | 12 |
| 3.1 Enter the visual function module and adjust the imaging effect .....   | 13 |
| 3.2 Camera Calibration .....                                               | 14 |
| 3.3 Area division and Mark point marking .....                             | 18 |
| 3.4 Visual positioning and processing .....                                | 20 |
| 4. Function bar introduction .....                                         | 23 |
| 4.1 Positioning settings .....                                             | 23 |
| 4.2 Identification settings .....                                          | 25 |
| 4.3 Camera settings .....                                                  | 26 |
| 4.4 Positioning results .....                                              | 27 |
| 4.5 Mouse positioning .....                                                | 28 |
| 4.6 Detection area .....                                                   | 28 |
| 4.7 Image evaluation .....                                                 | 29 |
| 4.8 Reconnecting the camera .....                                          | 30 |
| 4.9 Accessibility .....                                                    | 30 |
| 5. Other function description .....                                        | 34 |
| 5.1 Edit Template .....                                                    | 34 |
| 5.2 Mouse interaction function in image display area .....                 | 41 |
| 5.3 Manual recognition of Mark points .....                                | 42 |
| 5.4 Group template .....                                                   | 44 |
| 5.5 Multi-camera visual localization .....                                 | 45 |
| 5.5 The use of .....                                                       | 49 |
| 5.6 Machinable Mark graphics .....                                         | 53 |
| 5.7 Multi-camera supports multi-group processing .....                     | 54 |
| 5.8 Image autofocus .....                                                  | 55 |

# 1. camera configuration

The connection of the camera needs to install the camera driver and configure the ip address. This chapter will explain the automatic configuration process and manual configuration process of various models of cameras supported by Ultra Cut laser cutting parts .

- 1) At present , UltraCut supports six industrial cameras including Hikvision, Basler, Daheng, Dahua, Weishi, and Yingmeijing . Please install the drivers corresponding to each camera before preparing the network environment.
- 2) The network port connected to the camera must enable jumbo frame .

## 1.1 Camera ip automatic configuration

The IP configuration tool under the UltraCut platform configuration tool is used to automatically find and configure the camera IP address.

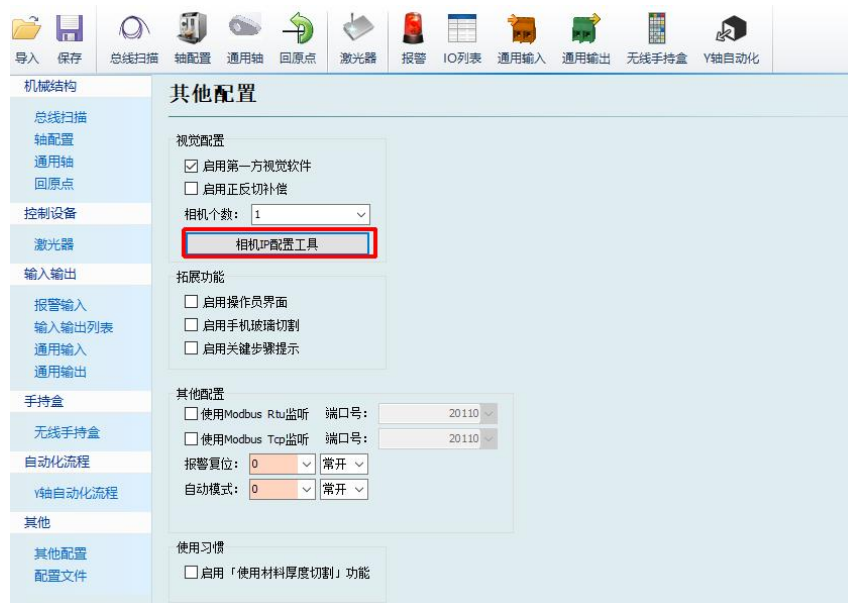
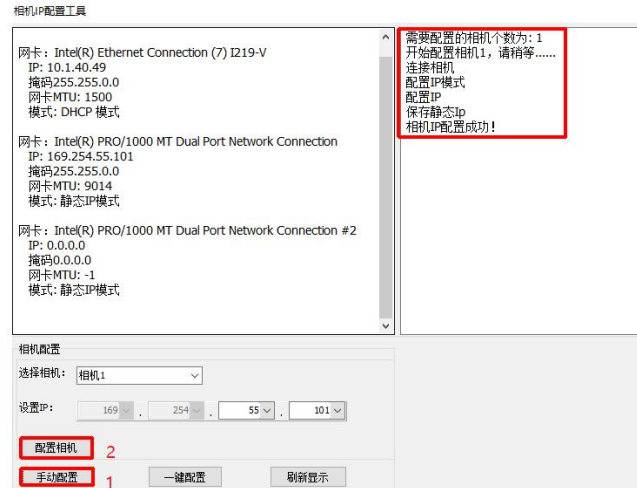


Figure 1 IP configuration tool entry

- 1) Open the software, you can choose manual configuration (manual) or one-key configuration (automatic);
  - ( 1) Manual configuration

You can flexibly configure the IP of a single camera. After configuration, if the information in the red box below appears, the configuration is successful!

(Each line of information is indispensable) as shown below:



picture 2 IP manual configuration operation

## ( 2) Automatic configuration

You can configure the IP of all cameras on the current host with one click, and the IP is automatically determined by the software



Figure 3 IP one-key configuration operation

## 1.2 Enable Jumbo Frames of NIC

- 1) Path: Control Panel\Network and Internet\Network Connections;
- 2) the local connection of the corresponding network card connected to the camera - select Properties;
- 3) Click Configure;

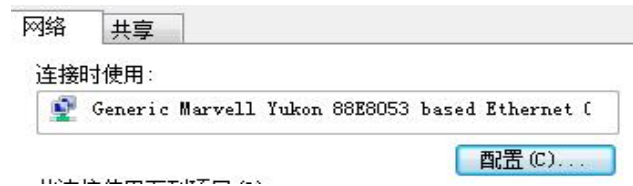


Figure 4 Enable jumbo frame configuration of network card

- 4) Select Advanced Options - Jumbo Packets (Large Data Packets, Jumbo Frames, Jumbo Frames, Jumbo Frames) - the value is 9K;

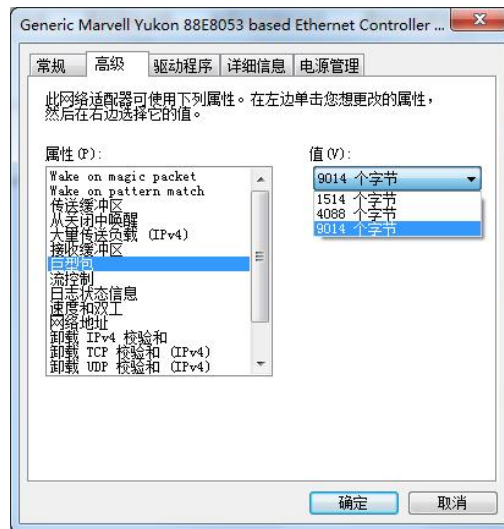


Figure 5 Enabling Jumbo Frames of the NIC

PS: The network card is recommended to use intel Pro/1000 series

- 5) After the setting is complete, click OK;

### 1.3 Camera Installation Example—Hikvision

- 1) Close the system firewall and install the client MVS\_STD\_2.3.1\_171129.exe ;



Figure 6 Hikvision client installation



Figure 7 Hikvision client installation

- 2) Enable NIC Jumbo Frames;
- 3) Set the network card IP;

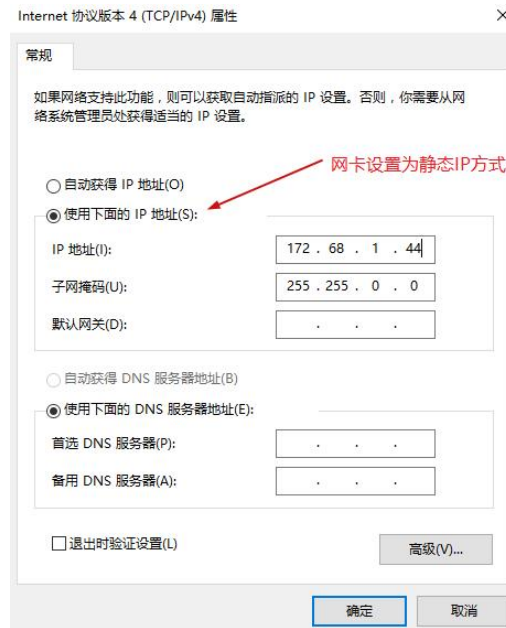
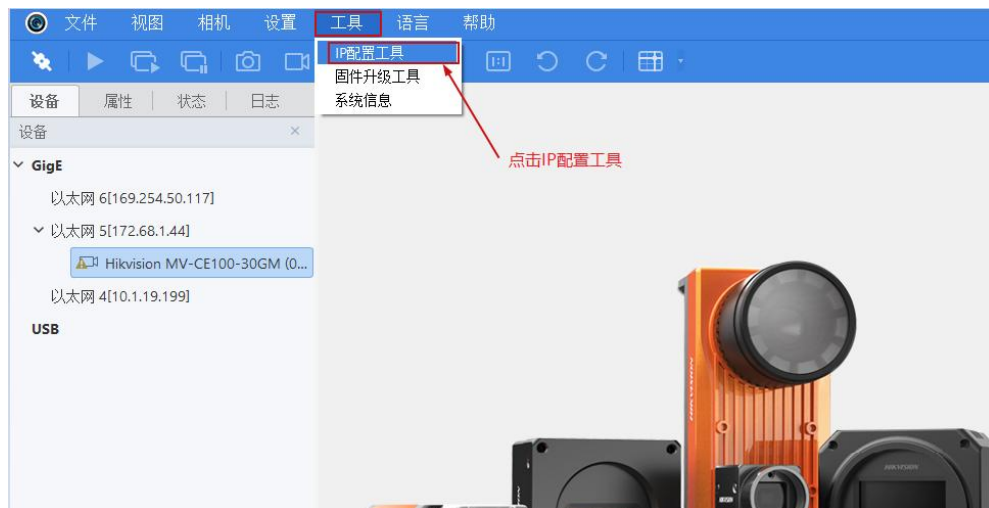
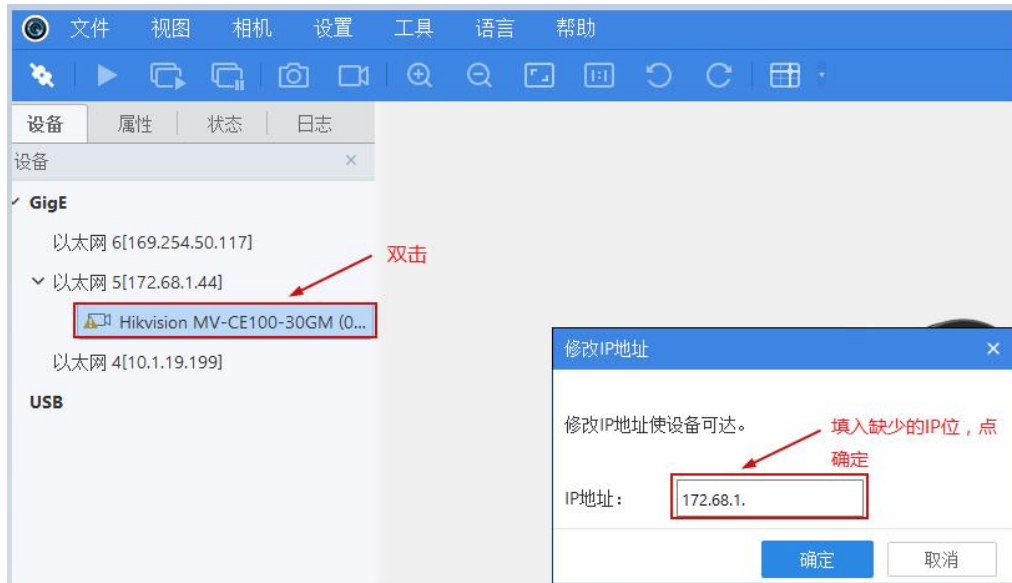


Figure 8 Set network card IP

- 4) you can also set the camera IP through the camera IP automatic configuration tool );





The screenshot shows the 'IP配置工具' (IP Configuration Tool) window. At the top, there's a table with columns: 型号名称 (Model Name), 设备用户ID (Device User ID), 序列号 (Serial Number), 物理地址 (Physical Address), 状态 (Status), IP配置 (IP Configuration), IP地址 (IP Address), and 子网掩码 (Subnet Mask). The table lists one device: MV-CE100-30GM with status '可用' (Available) and IP configuration '自动获取IP(DHCP)'. Below the table, a red arrow points to the '静态IP' (Static IP) option in the configuration panel, with a red text annotation: '选择静态IP, 除IP最后一位与网卡不同外, 其余均相同, 子网掩码与网卡的完全相同, 默认网关不用管' (Select static IP, except for the last digit of the IP which is different from the network card, the rest are the same, the subnet mask is the same as the network card, and the default gateway does not matter). The configuration panel shows the '静态IP' option selected, with fields for IP地址 (172.68.1.46), 子网掩码 (255.255.0.0), and 默认网关 (172.68.1.254). There are also radio buttons for '自动获取IP(DHCP)' and '自动获取IP(LLA)', and a '设备用户ID' field. A '保存' (Save) button is at the bottom. On the right, a summary panel shows the device details and the current configuration.

| 型号名称          | 设备用户ID | 序列号         | 物理地址              | 状态 | IP配置         | IP地址        | 子网掩码        |
|---------------|--------|-------------|-------------------|----|--------------|-------------|-------------|
| MV-CE100-30GM |        | 00C01341864 | C4:2F:90:F0:41:6B | 可用 | 自动获取IP(DHCP) | 172.68.1.23 | 255.255.0.0 |

选择静态IP, 除IP最后一位与网卡不同外, 其余均相同, 子网掩码与网卡的完全相同, 默认网关不用管

☒ 静态IP

IP地址: 172.68.1.46

子网掩码: 255.255.0.0

默认网关: 172.68.1.254

☐ 自动获取IP(DHCP)

☐ 自动获取IP(LLA)

设备用户ID:

保存

(00C01341864)

型号名称: MV-CE100-30GM

设备用户ID:

序列号: 00C01341864

物理地址: C4:2F:90:F0:41:6B

IP配置类型: 自动获取IP(DHCP)

IP地址: 172.68.1.23

子网掩码: 255.255.0.0

默认网关: 0.0.0.0

Figure 9 Setting Camera IP

## 1.4 Precautions \_ \_

- 1) After the IP configuration is correct, the UltraCut side cannot open the camera or reconnect to the camera.

**Reason 1:** There may be a network card on the host that is on the same network segment as the network card connected to the camera, or the host can access another camera through the network.

**Solution:** Disable other network cards first, leaving only the network card connected to the camera, then see if the camera can be connected correctly.

**Reason 2:** The firewall is not closed, and the driver is not installed correctly.

**Solution:** Uninstall the driver, close the firewall and reinstall the driver.

## 2. Introduction to Visual Forms Layout

### 2.1 Visual positioning interface layout

Visual positioning window :

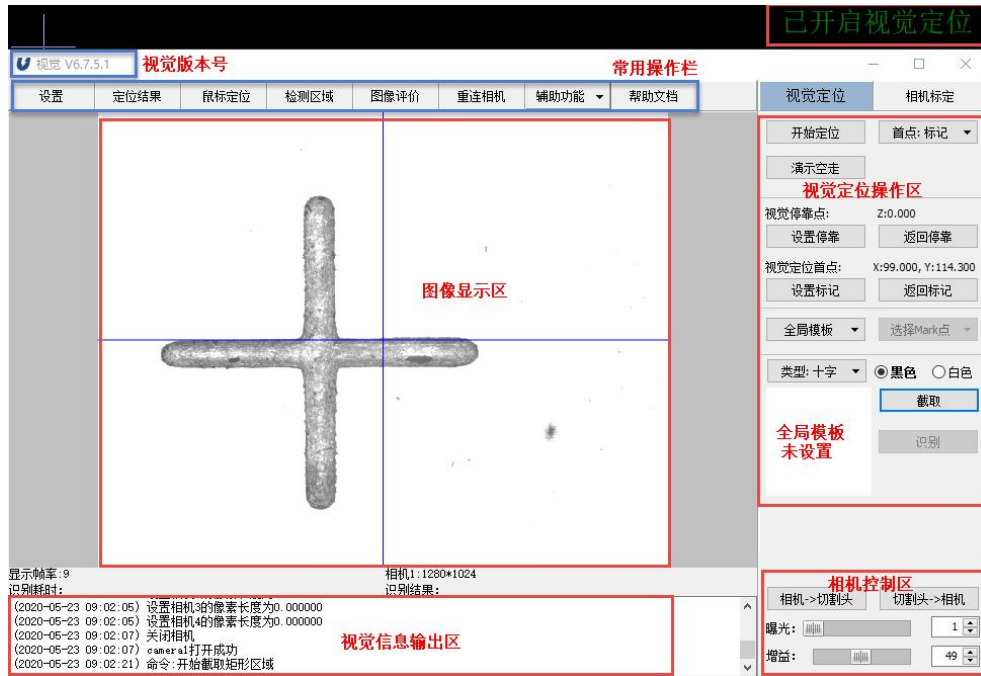


Figure 10 visual positioning window interface

As shown in the figure above, the visual positioning window interface is mainly divided into:

| visual positioning form                  |                                                                                                                                                                                                                                                          |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>title</b>                             | Show current visual version number                                                                                                                                                                                                                       |
| <b>Common Action Bar</b>                 | It mainly includes common operations related to vision : setting page, querying positioning results, enabling mouse positioning, enabling detection area, enabling image evaluation, reconnecting camera, auxiliary functions, and visual help documents |
| <b>image display area</b>                | Show camera screen                                                                                                                                                                                                                                       |
| <b>Template operation area</b>           | Display template library and current template, and intercept and edit template operations                                                                                                                                                                |
| <b>visual information output area</b>    | Status display and information output related to camera and algorithm                                                                                                                                                                                    |
| <b>camera control area</b>               | Set camera exposure value, gain value, and camera to cutting head and cutting head to camera motion                                                                                                                                                      |
| <b>Visual Positioning Operation Area</b> | Operations related to the visual positioning process , mainly including template setting, docking height setting and positioning                                                                                                                         |

Note:



- 1) When intercepting a template, you need to set the template type first, then select the characteristic color, click intercept, and then click identify;
- 2) The larger the exposure time value, the brighter the camera field of view, and the longer it takes for the camera to take pictures. It is recommended to control it below 20 ;
- 3) The larger the gain value, the brighter the camera field of view, and the more noisy the image, it is recommended to control it below 20 ;
- 4) If you want the camera field of view page to be concise, you can turn off the camera log, center crosshair, etc. in Settings->Camera Settings;

## 2.2 Visual calibration interface layout

### Visual calibration

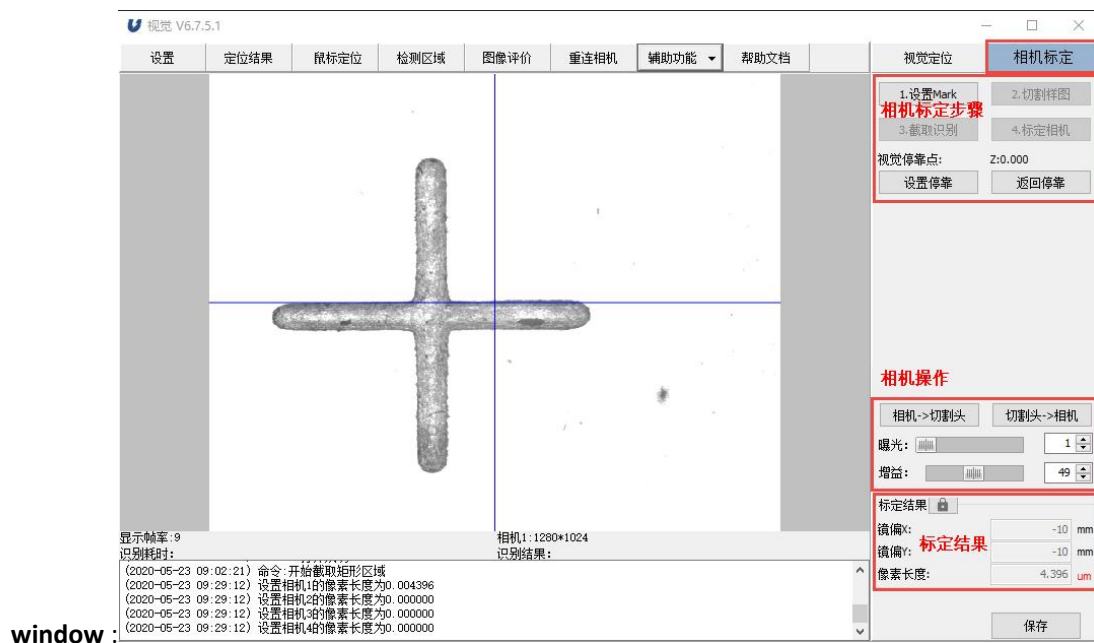


Figure 11 Visual Calibration Window Interface

| Vision Calibration Window |                                                                                                                          |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Camera operation steps    | Complete the camera calibration operation according to steps 1, 2, 3, and 4                                              |
| camera operation          | Adjust the camera exposure and gain to achieve a clear view. Camera and cutting head movement similar to specified steps |
| Calibration result        | Display the mirror polarity X, mirror polarity Y , and pixel length data after camera calibration                        |

## 2.3 set page layout

The settings are mainly divided into three parts, namely positioning settings, recognition settings and camera settings. Click the settings in the title bar of common operations to enter the settings page. At this time, the main visual window is hidden.

Positioning settings are mainly responsible for positioning-related parameter settings, which are divided into basic settings and advanced settings. As shown below:



Figure 12 positioning settings

Identification settings are mainly responsible for identifying related parameter settings, which are also divided into basic settings and advanced settings, as follows:



Figure 13 Recognition Settings

Camera settings are mainly responsible for camera brand, camera display and other settings, also divided into basic settings and advanced settings,



The page is shown as below:

设置

定位设置 识别设置 相机设置

基础设置

相机品牌: 海康威视

☒ 手动设置取图防抖延时: 防抖延时: 200ms

☒ 显示中心十字线 ☒ 显示相机日志

☒ 显示画面信息栏 ☒ 触发取图

☐ 实时显示模板缩略图

高级设置

帧率: 1 ☒ 模板绑定光照参数

选择工作相机号: ☒ 相机1 ☒ 相机2 ☒ 相机3 ☒ 相机4

☒ 降低分辨率: ☒ 原始分辨率1/2 ☐ 原始分辨率1/4

保存 取消

Figure 14 Camera settings

- 1) At present, it supports six industrial cameras including Hikvision, Basler, Daheng, Dahua, Weishi, and Yingmeijing . The virtual camera is used for testing, and it does not need to be concerned under normal circumstances ;
- 2) The display frame rate is generally set within 10 . When the setting is larger, it will take up more CPU ;

### 3. Machine vision positioning debugging processing

The overall debugging process of visual positioning and cutting is divided into "adjusting imaging effect", "camera calibration", " Mark point marking", "process setting", "visual positioning and processing".

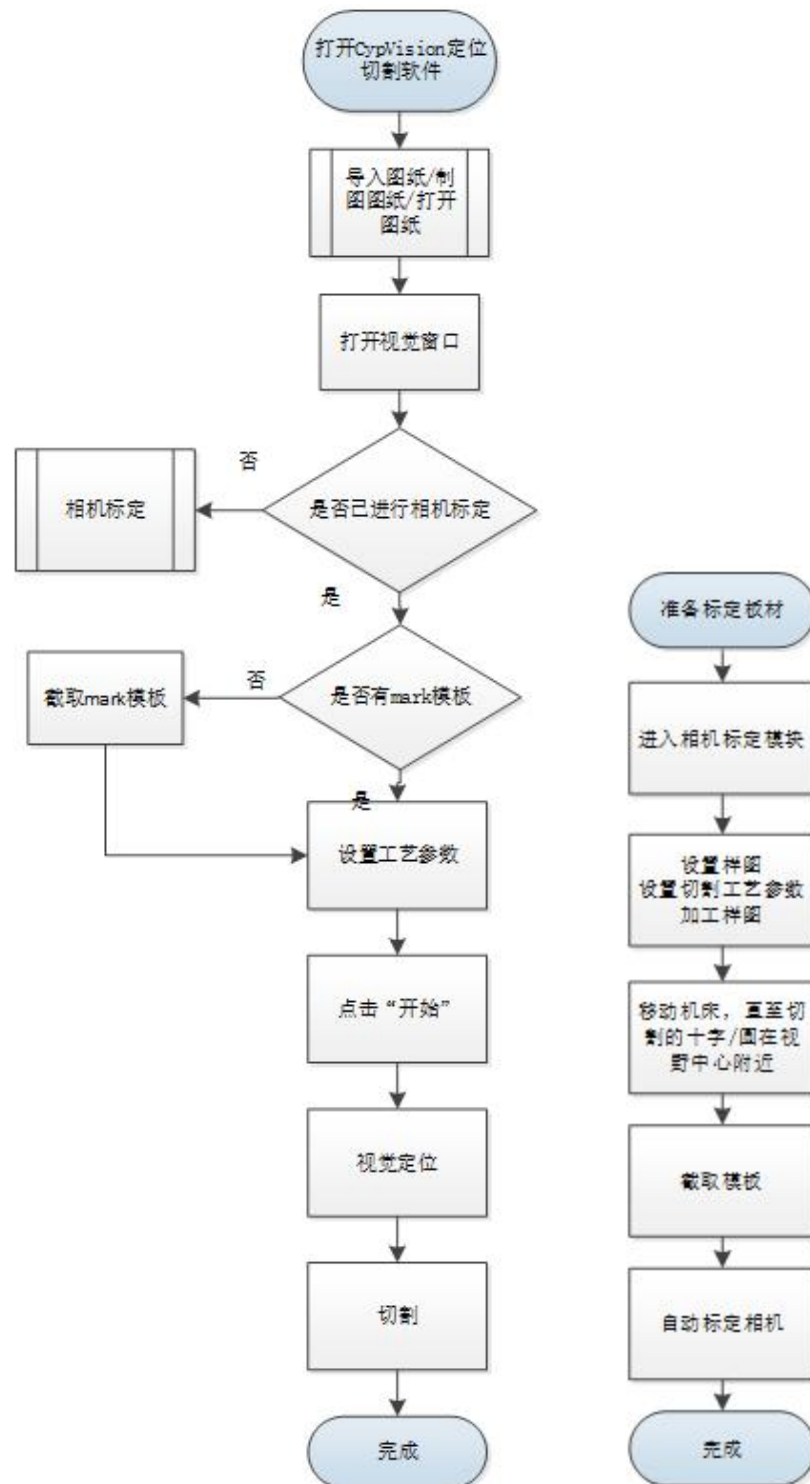


Figure 15 Overall flow chart of visual positioning and cutting

### 3.1 Enter the visual function module to adjust the imaging effect

in the main interface of UltraCut software---visual column.



Figure 16 Visual function entry

Note: Before the camera is debugged, it is necessary to ensure that the pulse equivalent of the machine tool and the number of pulses per revolution of the encoder are set correctly, and check the verticality of the machine tool. Firmly install the camera and lens, and ensure that the software and hardware of the vision module are installed correctly before entering the vision debugging process.

After installing the software and driver, open the UltraCut software and you can see the vision tool icon under the vision tab .

Click  to enter the visual positioning function interface, the software will give a prompt message to convert the coordinate system to the "workpiece coordinate system", click "OK" to officially enter the visual positioning processing interface, and when exiting the visual positioning module, it will also prompt whether to restore the coordinate system state before loading the visual positioning. Adjust the vertical height of the camera and the focal length of the lens, "light source", "exposure time", and "gain" until the image in the entire field of view is clear and the edges are sharp (as shown in the figure below). After the adjustment is completed, lock the lens magnification knob.

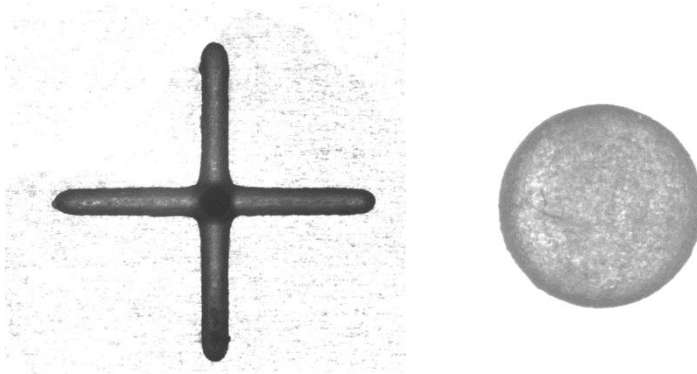


Figure 17 The effect of visual positioning within the field of view

### 3.2 \_ camera calibration

The purpose of calibrating the camera is to automatically measure the pixel length (the length corresponding to one pixel) and measure the deviation between the camera field of view center and the beam center of laser processing. After the camera is calibrated, it can ensure that the coordinate system of visual positioning is consistent with the processing coordinate system of the laser beam.



mirror offset data corresponding to a single pixel.

It needs to be emphasized again that the stability of camera calibration will greatly affect the accuracy and stability of subsequent positioning and processing . It is recommended that end users perform camera calibration once a day if conditions permit.

Steps:

- 1) **The machine tool returns to the origin once to establish a correct mechanical coordinate system** . Adjust the magnification of the lens and the brightness of the light source, and adjust the position of the cutting head to the clearest field of view to ensure that the edges of the collected graphics are clear and the background noise is less. At the same time, adjust the exposure value and gain of the camera to ensure clear imaging.
- 2) **Click "Camera Calibration" to enter the calibration interface.**

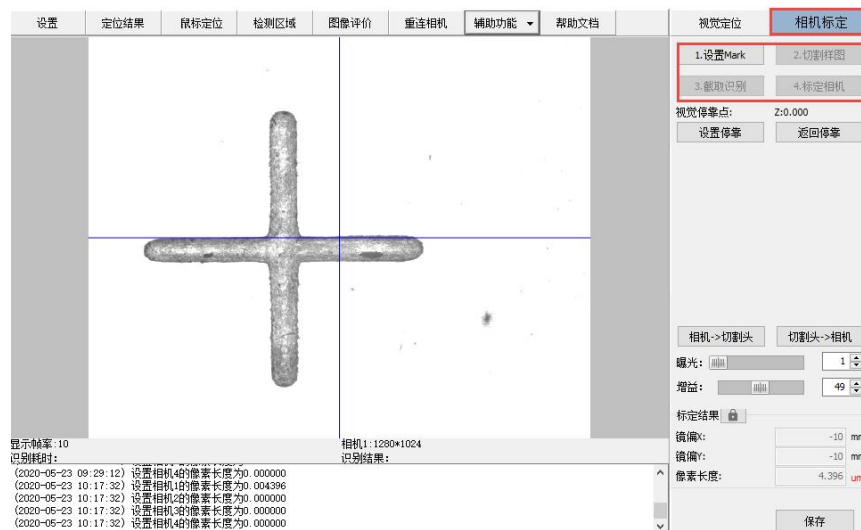


Figure 18 Camera calibration process

Click to set it as a visual stop (if the camera will change in height with the z-axis controlled by the height controller ; if the camera is fixed at a constant height, there is no need to set a visual stop), as shown in the figure below.



Figure 19 Setting Visual Stops

- 3) **"Set the sample"** , select the type of Mark point (cross / circle), set the length of the Mark point , select the processing process information, and set the appropriate speed in the corresponding sample process page to ensure that the "ten" or "circle"



is processed with better precision, no burrs, consistent width and width of vertical and horizontal slits, and no uneven heat radiation area.



Figure 20 Setting sample diagram

- 4) **Click "cutting sample" in the appropriate area** , and the machine tool will process the selected sample (cross/circle). If the trajectory is not clear enough, move to other areas to adjust the process before processing. After the processing is completed, move the machine tool so that the processing effect of the just-processed sample image (cross/circle) is clearly displayed within the camera's field of view .

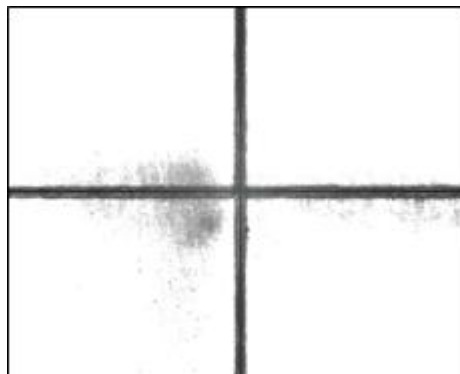


Figure 21 "Cutting sample" field of view effect

- 5) **Intercept identification.** First select the characteristic color, black/white, and then click Capture, use the left mouse button to select the previously processed "ten" in the field of view of the camera , capture it as a Mark template, and then click "Identify" to check whether the Mark point can be recognized. If the recognition is successful, "Cross Score: xx " will be displayed. If the recognition fails, it will display "detecte failed". If it is not recognized, please check the brightness of the light source, exposure time and gain, and capture the Mark again until the template can be found successfully.

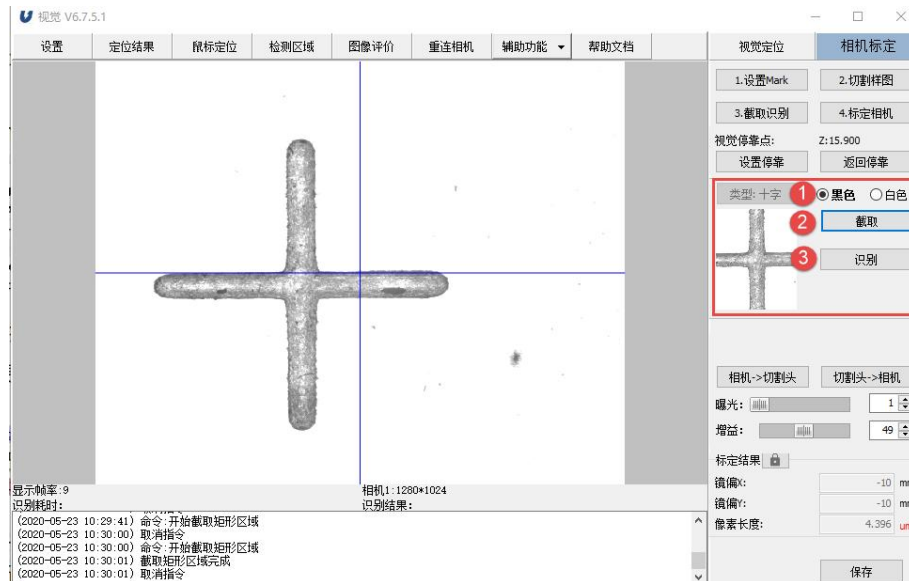


Figure 22 interception and recognition template

- 6) Click "Calibrate Camera", the machine tool will move within a small range of 10mm and automatically calibrate the camera. ( Please ensure that the relative position of the plate has not changed before calibration , otherwise it will affect the final calibration accuracy)
- 7) After the calibration is successful, it will automatically fill in the X and Y offsets of the "mirror deflection" of the camera relative to the cutting head. And the accuracy "pixel length" corresponding to 1 pixel is displayed below this parameter, and the general pixel length ranges from 5-10 $\mu$ m .
- 8) Simple inspection of calibration accuracy and positioning accuracy: Find a blank position and shoot the laser, and then use the "Camera->Cutting Head" function to visually check that the center position of the camera coincides with the point of the shooting.
- 9) Strict inspection of calibration accuracy and positioning accuracy:
  - ( 1 ) When the operator shakes the camera and lens, observe the camera monitoring screen in the visual window, the shaking of the screen should be about  $\pm 1$  pixel;
  - ( 2 ) After one calibration of the camera results is completed, move the cutting head and camera to the four endpoints and the center of the machine tool, and then perform five calibration result verification processes - "cutting sample", "camera->cutting head", "intercept" template, click "identify", judge that the x and y coordinates need to be less than or equal to two pixel lengths (generally speaking, the length of a pixel is about 7-15 microns ) ;

Execute the "cutting sample" and "camera->cutting head" in the calibration process, and observe that the blue cross must coincide with the cut cross in parallel.

### 3.3 Area division and Mark point marking

After the camera calibration is completed, the visual positioning function can be enabled to assist processing.

Processing positioning is divided into multi-group positioning processing and single-group positioning processing according to the number of groups .

It is recommended that users choose a map with multiple sets of Mark points for processing , and cooperate with the compensation algorithm in the software to compensate the error between the plate and the original map to improve the processing accuracy .

#### Multi-group positioning processing :

##### 1) Manually divide the region

reading the dxf , lxd , lxx files , you can directly perform manual grouping operations on the overall parts (mark points including crosses or circles) or frame selection areas (mark points including crosses or circles ) . It supports 255 groups from 1 to 255 at most, and the processing sequence is 1 → 255 .

Steps:

(1) Open the processing file;

(2) According to the area to be divided according to the plan , manually select the area (need to include parts and corresponding Mark points), and then left click on the area bar under the right process bar to select the corresponding area, or use the shortcut key "ctrl+ 1 - 9 " to divide the area;



Figure 23 Manual grouping



(3) After completing the division of the area, it is necessary to mark the Mark points in the area, select the Mark points at the end points of the area in a certain order, and right-click "Mark the graphic as a MARK point" to complete the mark;

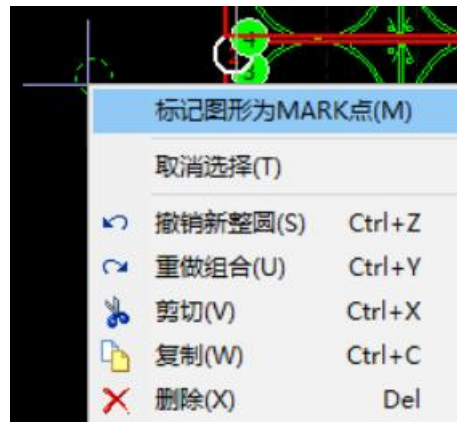


Figure 24 marks the graphics as Mark points

(4) The completed effect is as shown in the figure below. In the process of visual positioning and processing, the visual positioning and processing in the area will be carried out sequentially in the order of 1 → 255 ;

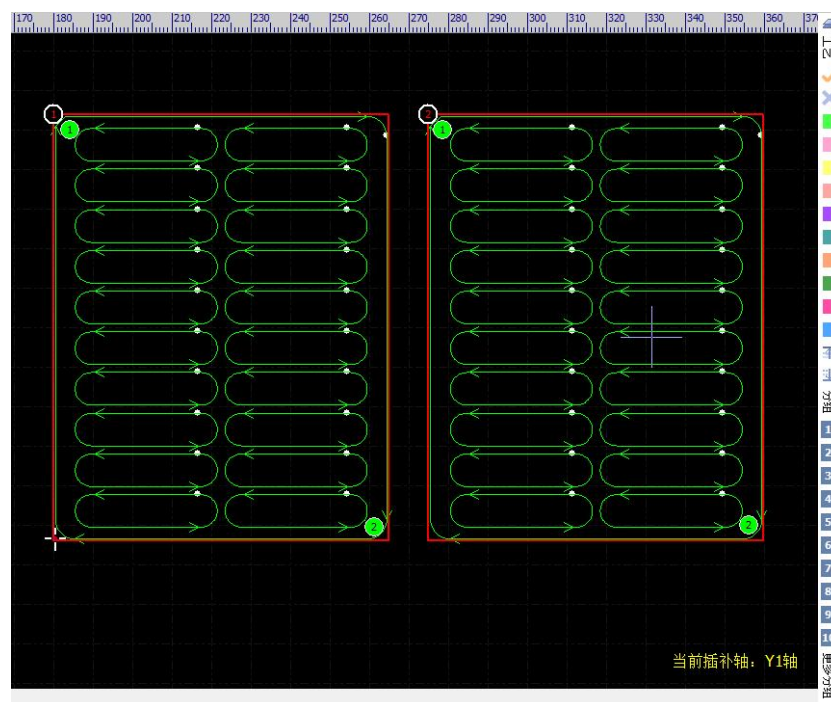


Figure 25 Effect after grouping

## 2) Single group positioning :

(1) First import the processing graphics containing the position information of Mark points. (The "ten" on both sides of the processing drawing

One corresponds to the Mark point position information on the rotten board);

(2) Choose four "ten"-shaped Mark images and set them as Mark points (the recommended order is upper left, right



up, down right, down left);

The setting method is to first select a "ten"-shaped Mark diagram.

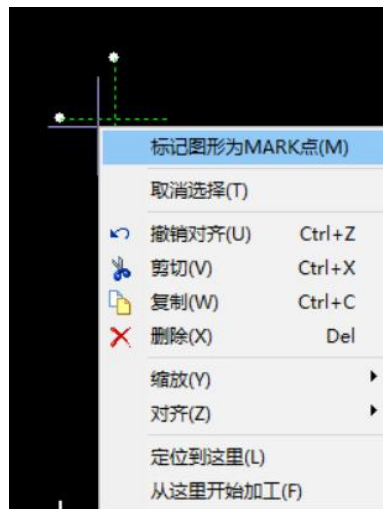


Figure 26 marks the graphics as Mark points

After the marking is successful, the Mark point will be displayed as a white "cross", and the Mark point serial number will be automatically marked according to the set order;

(3) "Intercept" the Mark point through the visual interface as a reference template, and click the "Recognition" button to detect the effect. (will be displayed if recognized).

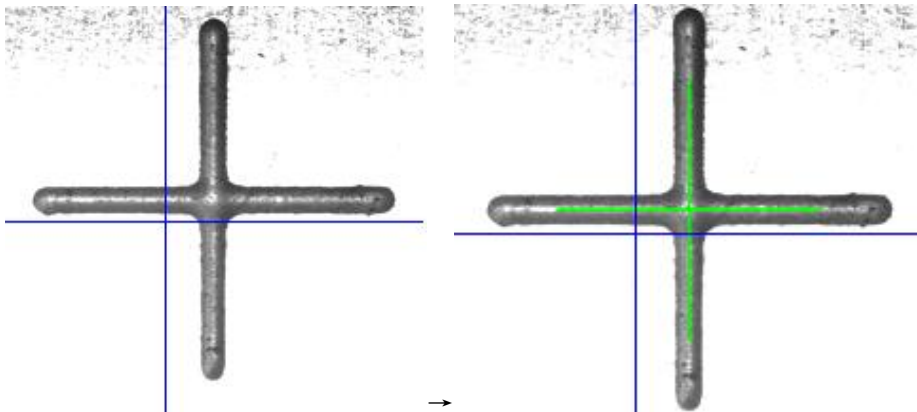


Figure 27 Schematic of recognition results

### 3.4 Visual positioning and processing

**We define the first Mark point of the first group as the first Mark point.** (For example, if there are four groups of positioning processing, and each group has two Mark points, then the first Mark point of the first group is the first Mark point)

According to the different recording coordinate modes of the first Mark point, we have three first point positioning modes, namely **file**, **vision** and **mark**.

The usage scenarios and methods of the three first point positioning modes are:



- 1) Marking mode, when using this mode, you can specify and record any mechanical coordinate position of the machine tool as the first Mark point (such as the backing point or the fixture fixing point), which is convenient for clamping and visual positioning of batch materials .

Mark point of the machine tool and cutting material , and set the mechanical coordinates of the first Mark point;

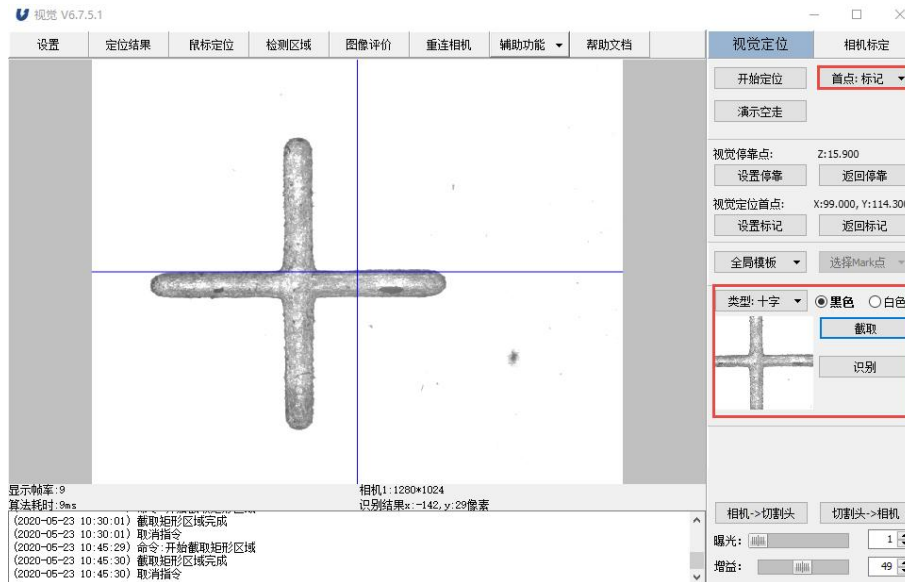


Figure 28 "First Point Positioning: Marker"

(2) Click "Visual Positioning" or "Start". In the process of running visual positioning, the system will first move the camera to the position of the first recorded Mark point for photo identification, and then perform photo identification according to the relative position of the Mark point provided by the drawing, and finally calculate the visual positioning results of all groups;

The recorded visual marking points will be saved and recorded along with the processing file.

- 2) Vision mode, when using this mode, starts the visual positioning process with the current camera position, and can use a flexible position to start visual positioning and cutting in non-mass production or debugging.
- (1) Select "First Point Mode: Vision", and move the camera to the desired starting position;

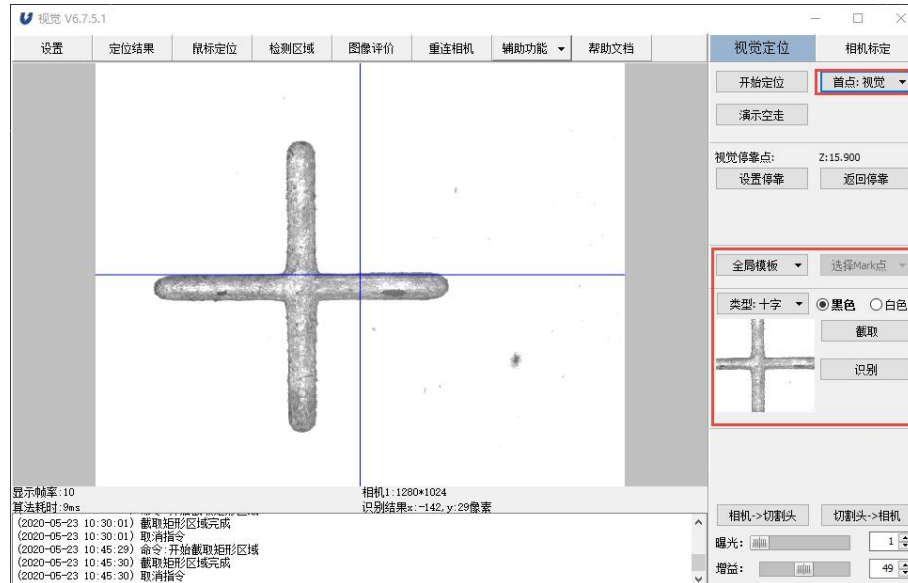


Figure 29 "First Point Positioning Mode: Vision"

(2) Click "Visual Positioning" or "Start". At this point, the visual positioning or visual positioning cutting process will start according to the current position;

- 3) File mode, when using this mode, you need to ensure that the system has completed the process of "first point positioning: vision" before, and the file mode will perform the first point positioning according to the coordinate system established by the last "first point positioning: vision". This mode is often used in batch processing scenarios.

( 1) Complete the establishment of the coordinate system in the "first point mode: vision" mode: move the camera window to the first Mark point, select "first point mode: vision", click "vision positioning", the machine will locate four Mark points in the first group and establish the corresponding coordinate relationship;

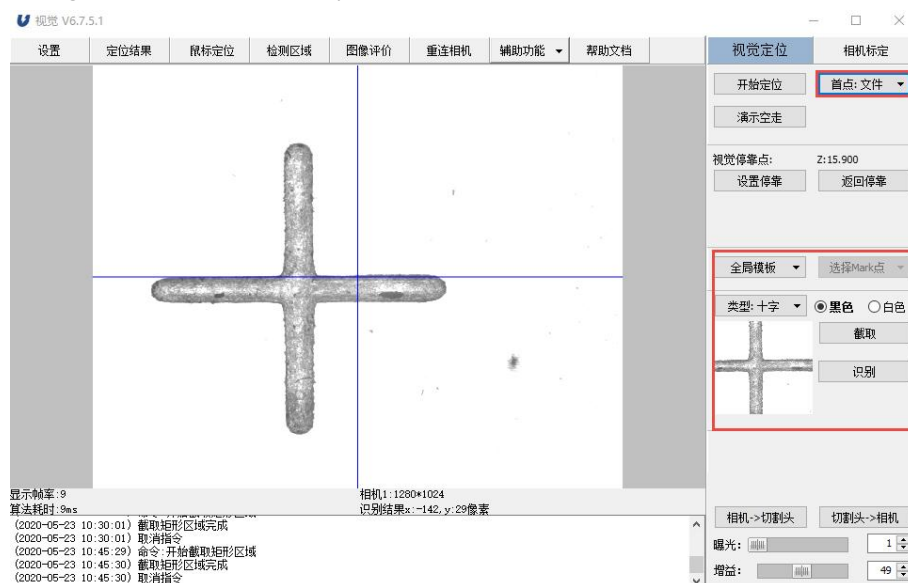


Figure 30 "First point positioning: file"



(2) Switch the "first point mode: file" mode to start positioning processing: use "first point mode: file", and then click "Start", then the visual positioning process will start at the first Mark point every time, and start the actual cutting process after the visual positioning is completed ;

During actual processing, if vision-assisted positioning is required, the visual window must be opened. At this time, click "Start", the visual positioning will be performed first, and then the actual cutting will be performed; if you want to restore the normal mode without visual positioning, close the visual window, and only the actual cutting will be performed at this time.

## 4. Function bar introduction

Common settings for visual positioning. Open the UltraCut software and you can see the vision tool icon under the vision tab . Click the icon to enter the visual positioning interface, and you can use the setting options (the two setting entries are the same).

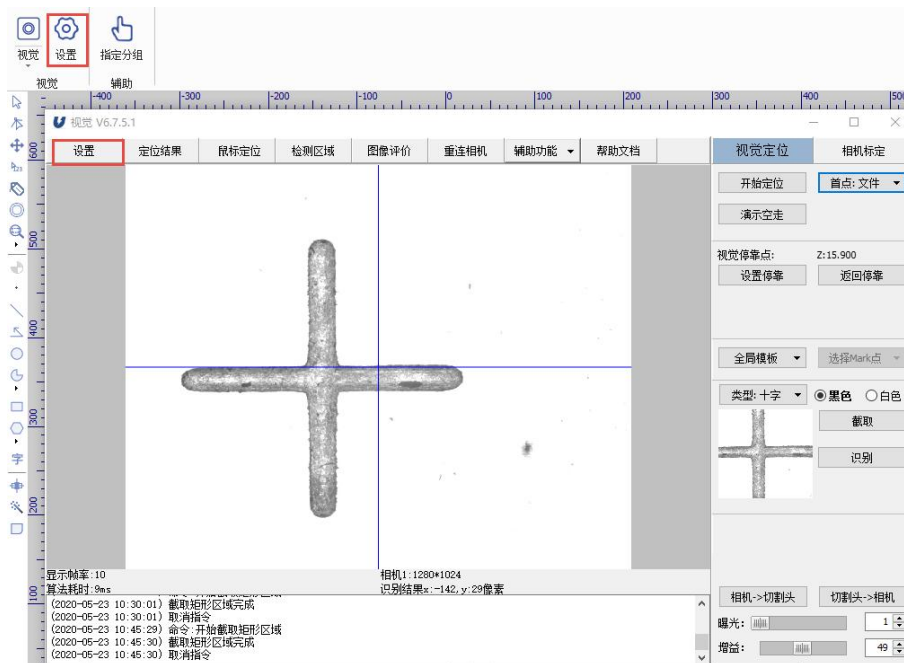


Figure 31 Visual "Settings"

### 4.1 Positioning settings

The settings are mainly parameters related to the visual positioning process, including basic settings and advanced settings.

基础设置

定位模式:

视觉+失败后手动

☐ 定位全部分组再加工 (只对单相机有效)

☐ 启用跨分组角度

☒ 启用九点标定

☒ 定位前到视觉停靠:

X,Y,Z同时运动

☐ 定位失败后警告

高级设置

☒ 启用误差限制:

允许最大误差: 0.02 mm

☒ 启用九宫格搜索:

九宫格搜索步长: 0 mm

☐ 忽略失败分组

☐ 关闭视觉, 仅做放大镜

☒ 启用定位日志

☒ 加工前检查图纸有Mark但没开启视觉

☐ 使用误差最小边计算四点定位角度

Figure 32 positioning settings

| Basic Settings                         |                                                                                                                                                                                                                                  |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| positioning mode                       | There are two types of visual positioning and visual + manual adjustment after failure. Manual adjustment after failure is a manual confirmation button that pops up after failure to manually identify and confirm the position |
| Locate all groups for reprocessing     | After checking , the software will locate all groups first, and then process, otherwise locate a group and process a group                                                                                                       |
| Enable cross-group angles              | If the following group needs to rely on the positioning angle of the previous group, it is recommended to check this option                                                                                                      |
| Enable nine-point calibration          | Check this option, and the calibration result can be used to correct the tilt of the camera during visual positioning                                                                                                            |
| Move to visual dock before positioning | If checked , the camera will move to the set docking height value during visual positioning, and the movement sequence of Z and XY can be set                                                                                    |
| Warning after location failure         | After checking , if the visual recognition and positioning fail, the system will output a warning signal                                                                                                                         |
| advanced settings                      |                                                                                                                                                                                                                                  |
| enable error limit                     | Comparing the difference between the drawing Mark point spacing and the recognition spacing with the set error value, the maximum error value of the operation can be set                                                        |
| Enable Jiugongge search                | checking this option, if it cannot be recognized, it will first do a Jiugongge search near the point                                                                                                                             |
| ignore failed                          | During the automation process, if you don' t want the process                                                                                                                                                                    |



|                                                                                    |                                                                                                                      |
|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| packets                                                                            | to be interrupted, you can check this option, and the identified groups will be ignored directly without processing  |
| enable location logging                                                            | If there is an abnormal situation, after the log is enabled, the problem log will be saved to the computer           |
| Before processing, check that the drawing has Mark but the vision is not turned on | If the drawing contains Mark points, but the visual positioning function is not enabled, a pop-up window will prompt |
| Calculate the four-point positioning angle using the minimum error side            | the side with the smallest error to calculate the rotation angle                                                     |

## 4.2 Identification settings

Setting the recognition strategy helps to meet different recognition needs, and it is also divided into basic settings and advanced settings.

Figure 33 Identification settings

| Basic Settings                          |                                                                                                                                                                                       |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| passing score                           | If it is higher than this score, it is considered that the Mark point recognition is successful. If the score is lower than this, it is considered that Mark point recognition failed |
| Recognition times                       | Set the number of times you want to recognize, the value ranges from 1 to 5 times                                                                                                     |
| Single recognition in the field of view | After selection, judge whether to stop recognition according to the position of the center of the Mark point within the range                                                         |



|                                                            |                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                            | of the area                                                                                                                                                                                                                                                                                                                                 |
| <b>Enable CCD Capture Accuracy</b>                         | After checking, you can set the size of the capture precision                                                                                                                                                                                                                                                                               |
| <b>advanced settings</b>                                   |                                                                                                                                                                                                                                                                                                                                             |
| <b>Enable expert access</b>                                | After it is enabled, it will enter template editing when recognizing and recognizing , and can adjust some difficult-to-recognize images                                                                                                                                                                                                    |
| <b>Enable simultaneous recognition of multiple cameras</b> | For multi-camera, the efficiency of recognition will be improved after setting, but the occupied CPU will become larger                                                                                                                                                                                                                     |
| <b>Cut circle area template</b>                            | After checking , the interception template will be intercepted according to the circle area (if it is not checked, it will still be a rectangular frame selection ) ; after interception, enter the area adjustment state, left click on the circle area to pan, left click on the circle to zoom, right click to complete the interception |

### 4.3 Camera settings

Mainly for camera display and camera image capture settings, the page is as follows:

The screenshot shows the 'Camera Settings' window. It is divided into two main sections: 'Basic Settings' (基础设置) and 'Advanced Settings' (高级设置).  
**Basic Settings:**  
 - Camera Brand (相机品牌): A dropdown menu currently showing 'Hikvision' (海康威视).  
 - Anti-shake Delay (防抖延时): A checkbox labeled 'Manual setting anti-shake delay' (手动设置取图防抖延时) is checked. Next to it is a dropdown menu set to '500ms'.  
 - Display Center Crosshair (显示中心十字线): A checked checkbox.  
 - Display Image Information Bar (显示画面信息栏): A checked checkbox.  
 - Real-time Display Template Thumbnail (实时显示模板缩略图): An unchecked checkbox.  
 - Display Camera Log (显示相机日志): A checked checkbox.  
 - Trigger Image Capture (触发取图): A checked checkbox.  
**Advanced Settings:**  
 - Frame Rate (帧率): A numeric input field set to '10'.  
 - Template Binding Light Parameter (模板绑定光照参数): An unchecked checkbox.  
 - Select Working Camera Number (选择工作相机号): A dropdown menu with 'Camera 1' (相机1) selected.  
 - Reduce Resolution (降低分辨率): An unchecked checkbox.  
 - Original Resolution 1/2 (原始分辨率 1/2): An unselected radio button.  
 - Original Resolution 1/4 (原始分辨率 1/4): A selected radio button.

Figure 34 Camera Settings

| <b>Basic Settings</b>       |                                                                                                                                                                                                        |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>camera brand</b>         | According to the actual camera, select the corresponding camera brand                                                                                                                                  |
| <b>Set anti-shake delay</b> | The camera is cached, and there may be shaking when the machine tool stops, resulting in unstable picture taking, so after the movement is in place, it will wait for this time before taking pictures |



|                                        |                                                                                                                                                                               |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Show Center Crosshair</b>           | After checking , a blue crosshair will be displayed in the center of the field of view                                                                                        |
| <b>show camera log</b>                 | After checking , the log information of the camera will be displayed below the field of view                                                                                  |
| <b>display screen information bar</b>  | Display the frame rate of the camera, recognition results, etc.                                                                                                               |
| <b>trigger capture</b>                 | A picture taking mode, the real-time performance of taking pictures is better                                                                                                 |
| <b>Display thumbnails in real time</b> | The corresponding template information will be displayed on the upper left of the field of view                                                                               |
| <b>advanced settings</b>               |                                                                                                                                                                               |
| <b>frame rate</b>                      | Suggested 10 ~ 20 , too high frame rate will lead to high CPU occupancy, which will seriously cause freeze                                                                    |
| <b>Select job camera number</b>        | When there are multiple cameras, if one or several do not work, just uncheck it and keep at least one working                                                                 |
| <b>reduce resolution</b>               | After checking , you can set the corresponding resolution reduction ratio. If the high resolution causes the display to freeze, you can enable this option.                   |
| <b>Template Binding Lighting</b>       | If the lighting in the machine tool area is inconsistent, you can enable this option. After enabling it, the lighting parameters of the template will be used for recognition |

## 4.4 Positioning results \_

Displays the results of visual positioning.

This function can view the image coordinates and machine coordinates of the identified Mark points after positioning, which is convenient for debugging of cutting accuracy problems.

After clicking the positioning result, the latest visual recognition result will pop up, as shown in the figure below:

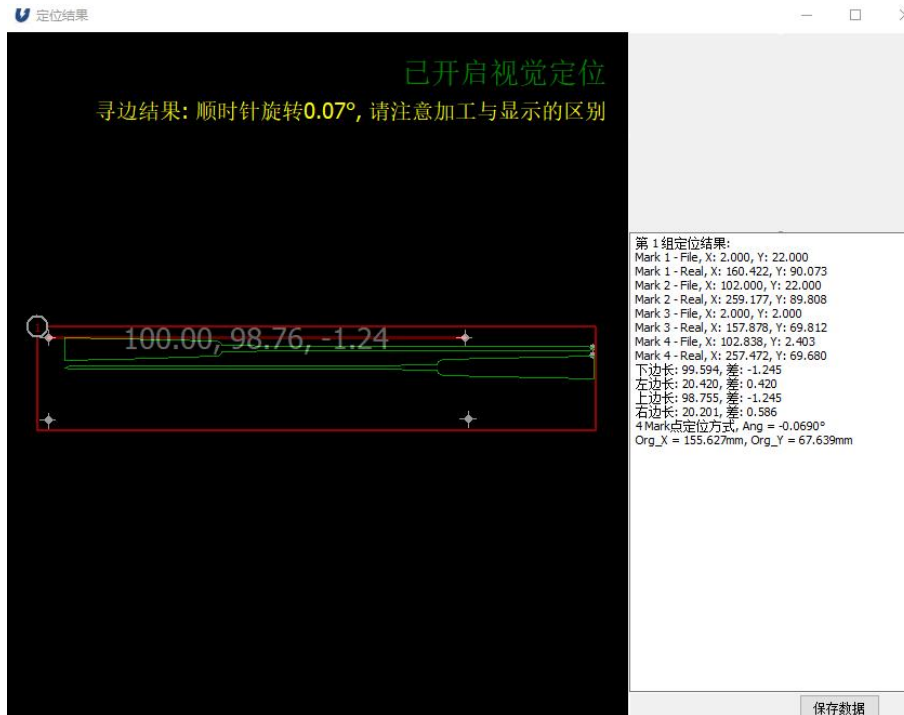


Figure 35 Visual positioning results

## 4.5 Mouse positioning \_

After the camera is calibrated, click the mouse to locate the mouse to enable the mouse positioning function. After enabling this function, click the position of the field of view, and the machine tool will move the center of the field of view to this position. The moving direction is: move the image feature clicked with the left mouse button to the center of the field of view; click the mouse again to locate or click the keyboard "esc" to exit the mouse locate.

## 4.6 Detection area \_

If multiple Mark points appear in the field of view at the same time, and the Mark points are similar, there may be a phenomenon of misrecognition at this time. In order to solve this problem, a detection area function has been developed. Click the detection area on the top of the software, and the interception detection area will appear below the camera, as shown in the figure below:

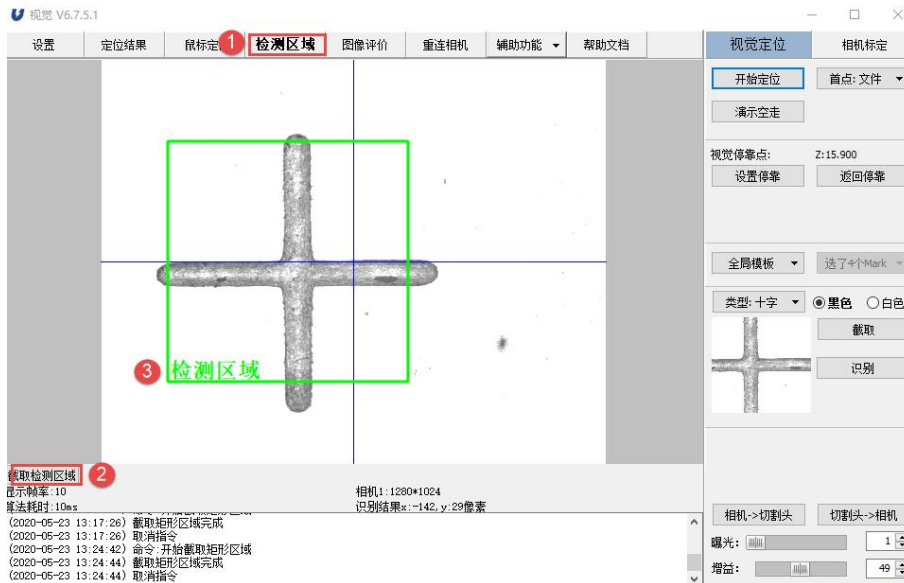


Figure 36 Detection area

Click again to turn off the detection area function, and the interface will return to its original state.

## 4.7 Image evaluation \_

The image evaluation function is used to assist in judging the most suitable camera and lens working height.

Instructions for use:

As shown in the figure above , click "Image Evaluation" at the top of the visual interface , click the "Intercept Image Evaluation Area" button, and then select the area with the left mouse button on the image interface , and the clarity of the image in the framed area will be displayed in real time . This function is used to determine the docking height for visual positioning to obtain the clearest image. When the sharpness score has a maximum value at a certain height, that is, increasing the height or reducing the height score is smaller than this maximum value, then the position of the maximum value is the best height when the camera is installed.

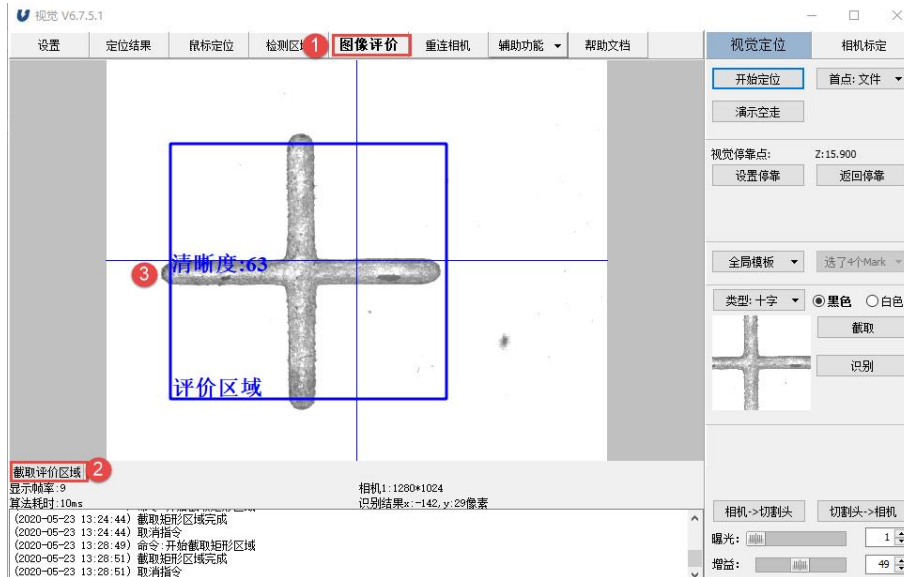


Figure 37 Image Evaluation

## 4.8 Reconnect the camera

After clicking, the camera will perform a reconnection. If there are multiple cameras, all cameras will perform a reconnection.

## 4.9 Auxiliary functions \_

The pull-down function mainly provides some auxiliary debugging functions.

### 4.9.1 Camera Stability Test

In the machine tool frame, by moving back and forth to multiple mark points (recording mechanical coordinates), combined with visual recognition of Mark points, the stability of the camera lens installation is tested. The entry is in the drop-down menu of the visual aid function.



Figure 38 Camera Stability Test



Instructions for use:



Figure 39 Camera Stability Test Operation Interface

- 1) Mark point image in the camera's field of view . Click to add a mark point to record the first mark point;
- 2) the Mark type to be recognized , open the sample image, intercept the template, and test and adjust the stability of recognizing the current Mark point image;
- 3) Move the machine tool to other positions within the frame of the machine tool, add record mark points one by one, and record several mark points that are considered reasonable. Except for the first mark point, the other mark points do not need to appear Mark point images within the camera's field of view ;
- 4) Modify and confirm the speed and acceleration of air movement in the process parameter-global parameter interface;
- 5) At any position on the machine tool, you can click the start test button, and the machine tool will return to mark point 1, and execute the process of mark point 1-mark point 2-mark point 1, 1-3-1, 1-4-1... in the form of space shift , and finally return to mark point 1;
- 6) After the automatic test is completed, the average pixel error and maximum pixel error in the X and Y directions will be displayed.

#### 4.9.2 Alignment \_

If there is an error between the workpiece and the actual positioning result, how should the error be handled at this time? For different situations, three alignment methods are provided for customers to choose.



Figure 40 Alignment

The left end is aligned, there is no error on the left side, and the errors are scattered on the right side;

Center alignment: There is no error in the center, and the error is averaged on the left and right sides;

Right alignment: There is no error on the right side, and the error is concentrated on the left side.

#### 4.9.3 Verification of camera calibration results

Under this page, you can test the camera, the average value and maximum value of the recognition error.



Figure 41 Camera calibration result verification

#### 4.9.4 Duplicate recognition test

On this page, you can set the number of recognition times. After clicking Recognition, the image in the current field of view will be recognized for a specified number of times, and the recognition result will be displayed in the text box at the bottom right, and the recognition data can also be saved as txt.

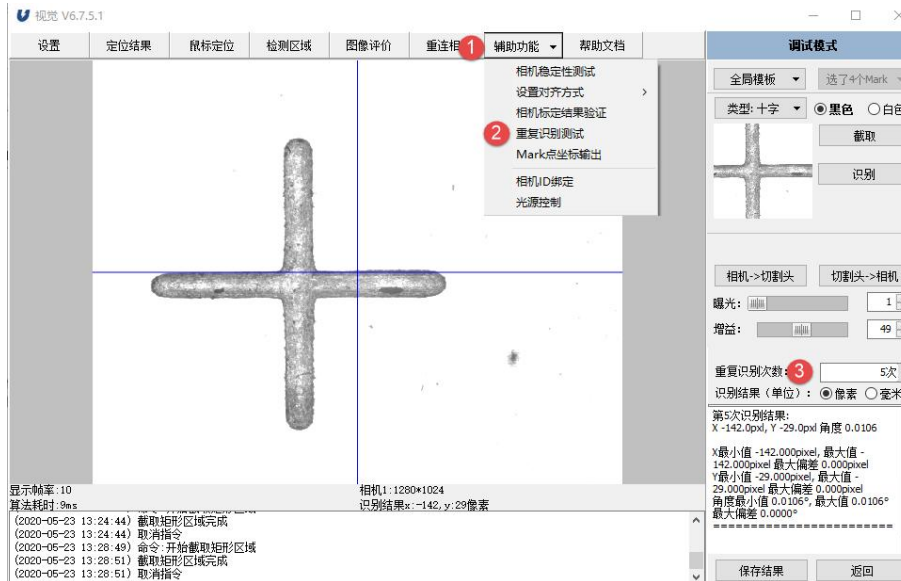


Figure 42 Repeat recognition test

#### 4.9.5 Camera ID Binding

When the camera is displayed, the serial number with the smaller SN number is also smaller by default, and sometimes it may be inconsistent with the actual installation. At this time, if you want to achieve the same display and actual effect, you can use this module to achieve it.

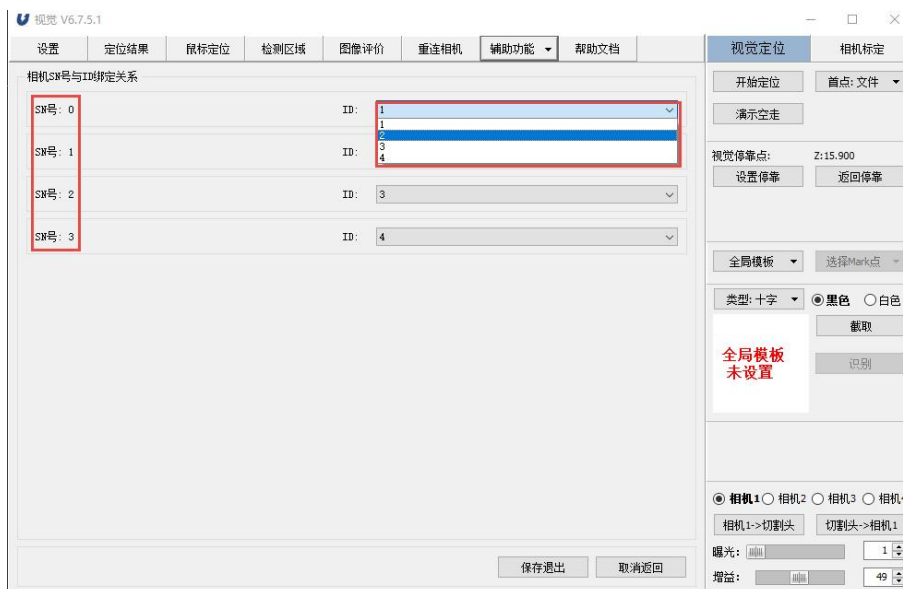


Figure 43 Camera ID Binding

The left side is the SN number, and the right side is the displayed camera serial number. The default order is from left to right and from top to bottom. When calling the camera ID number, the display of the visual page will also be changed accordingly.



## 4.9.6 Light source control

For the serial light source controller, develop an auxiliary function that can directly adjust the brightness of the light source.

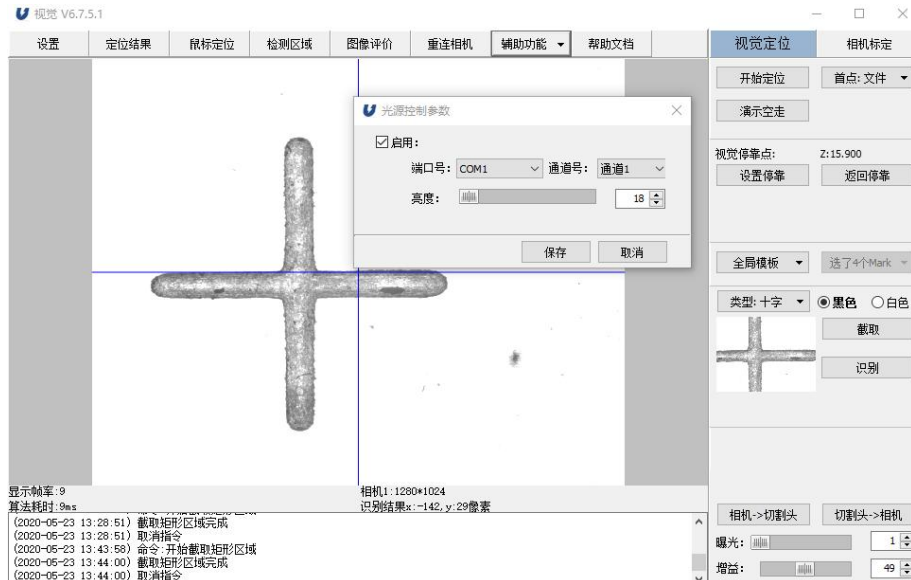


Figure 44 Light source control

On this page, you can select the enabled port number, channel number and light source brightness value, and click Save to take effect.

# 5. Other function description

## 5.1 Edit template

Please note that you can only enter the template editing interface after enabling the expert operation permission in the advanced visual settings .

On the template editing page, after the parameter is changed, the recognition result can be displayed in real time, which is more convenient for parameter adjustment;

### 1.1.1 Determine template parameters

#### 1) Determine the Mark parameter

Currently supported Mark types are cross, circle, corner, straight line, general type, and the supported feature colors are black and white (straight line corresponds to black to white, white to black)

(1)确定Mark参数

|        |    |
|--------|----|
| Mark类型 | 圆  |
| 特征颜色   | 黑色 |

Figure 45 Determine the Mark parameter

## 2) Determine the identification strategy

The recognition strategy is divided into **priority contour search** and **priority edge detection**. Choosing the most reasonable recognition strategy can improve the recognition performance. Image processing parameters can be adjusted under each strategy. If the image processing results are displayed, select to display the processing graph at the bottom of the interface;

(2)确定识别策略

☒ 优先轮廓查找
 ☐ 优先边缘检测

(2)确定识别策略

☒ 优先轮廓查找 ☐ 优先边缘检测

☐ 滤波
 

类型: 高斯滤波
 核宽度: 3

☒ 形态学
 

类型: 闭运算
 核宽度: 3

☒ 阈值化
 

算法: 手动阈值
 阈值: 255

☐ Log变换
 ☐ 图像增强

收起

(2)确定识别策略

☐ 优先轮廓查找 ☒ 优先边缘检测

☒ 滤波
 

滤波类型: 高斯滤波
 核宽度: 15

☒ 边缘提取
 

低阈值: 4
 高阈值: 10

☒ Log变换
 ☐ 图像增强

收起

Figure 46 Determine the identification strategy

| Priority Contour Finding |                                                                                                                                                 |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicable situation     | The identified Mark points have complete closed contours                                                                                        |
| filtering                | Remove the interference in the image by smoothing, the larger the kernel width, the stronger the smoothing                                      |
| morphology               | Remove interference by corrosion, expansion (inner shrinkage and outer expansion), etc., the larger the core width, the stronger the smoothness |
| Threshold                | Segment the grayscale image into black and white images according                                                                               |



|                    |                                                                                                                                                                      |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ng                 | to the threshold value. If the automatic threshold value segmentation effect is not satisfactory, manually set the threshold value to adjust the segmentation effect |
| Log transformation | Enhance image contrast                                                                                                                                               |
| image enhancement  | Enhance image contrast                                                                                                                                               |

| Priority edge detection |                                                                                                                                                                                                                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicable situation    | The recognized Mark point does not have a complete closed contour, such as a straight line or an incomplete Mark point                                                                                                                                                                                 |
| filtering               | Remove the interference in the image by smoothing, the larger the kernel width, the stronger the smoothing                                                                                                                                                                                             |
| edge extraction         | Adjusting the high and low thresholds can adjust the sensitivity of detecting edges, that is, increasing or reducing the number of detected edges ( check the display processing map to display in real time ) , so as to achieve the purpose of removing interference or enhancing feature extraction |
| Log transformation      | Enhance image contrast                                                                                                                                                                                                                                                                                 |
| image enhancement       | Enhance image contrast                                                                                                                                                                                                                                                                                 |

Part of the adjustment effect diagram is as follows:



Figure 47 Morphological renderings

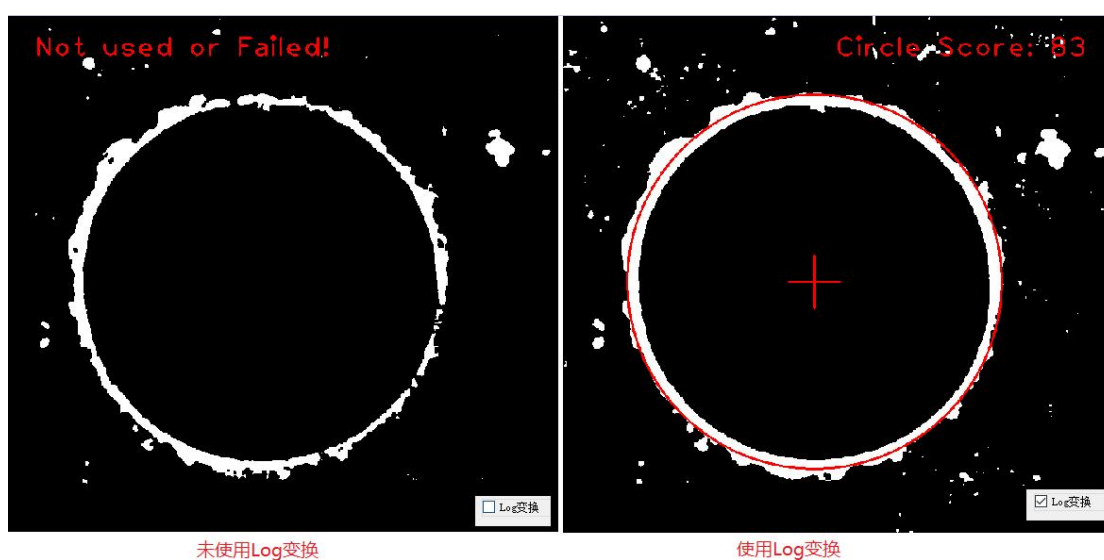


Figure 48 Log transformation effect diagram

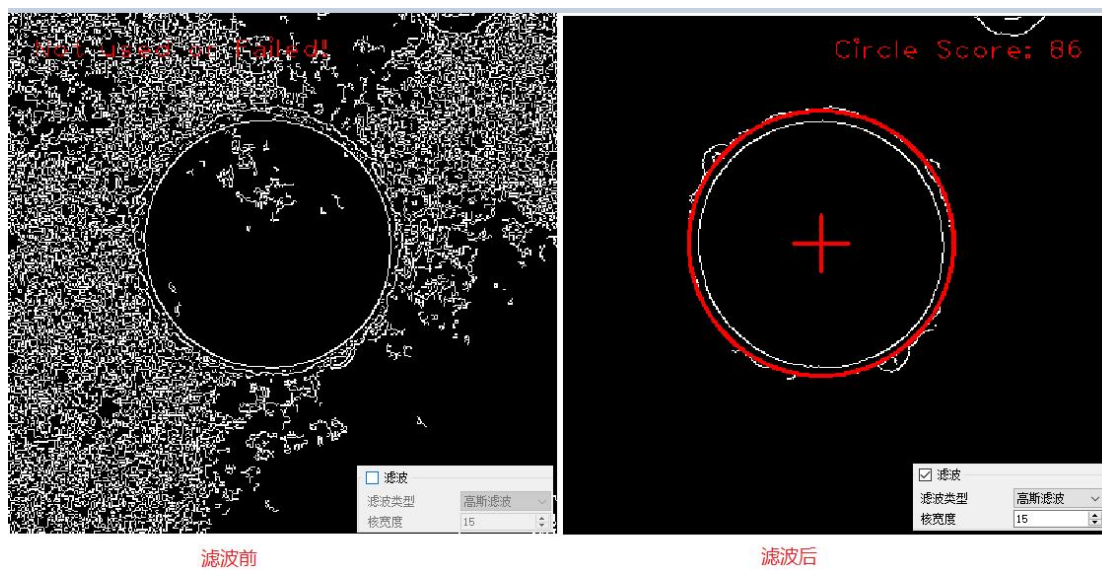


Figure 49 Filter effect diagram

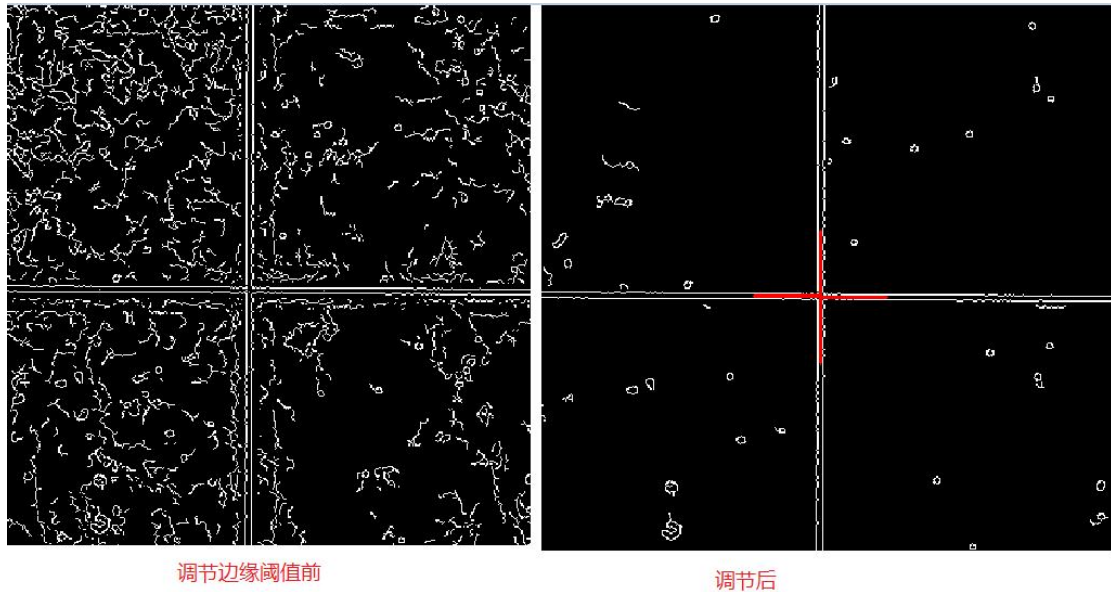


Figure 50 Edge Extraction Threshold Adjustment Diagram

### 3) Determine fit parameters

The parameters of this part are mainly to adjust the size parameters of the Mark point, such as the radius range of the circle and the angle range of the cross;

拟合方法:

截断值:

| Fitting parameters |                                                                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fitting method     | The fitting algorithm for fitting straight line/circle, Ransac , Huber, and Tukey have better anti-interference performance. These three are generally used, and can be selected according to time-consuming and actual fitting effect |
| cutoff value       | The larger the value, the looser the fitting, and the easier it is to identify successfully, but the error of identification will become larger                                                                                        |

#### a: cross parameter

理想水平边宽  (5.00)

理想竖直边宽  (4.00)

最大边宽误差

理想倾角  (0.00)

最大角度误差

最小宽度比

注: 绿色参数为模板当前识别结果

Figure 51 Cross Mark parameters

Cross Mark parameters



|                            |                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>side width</b>          | <p>The ideal horizontal/vertical side width represents the side width of the cross that needs to be identified</p> <p>Find the side width range of the cross = ideal side width + - maximum side width error</p> <p>For example, the ideal horizontal side width is 100 and the side width error is 30, then the detected cross side width range is [ 70, 130], if it exceeds, it will fail</p> |
| <b>angle</b>               | <p>The ideal inclination represents the angle formed by the horizontal side of the cross and the X-axis of the image,</p> <p>Find the angle range of the cross = ideal inclination + - maximum angle error</p>                                                                                                                                                                                  |
| <b>Minimum width ratio</b> | <p>The ratio of the width of the two sides of the cross (wide side/narrow side), appropriately reducing this value can identify crosses with inconsistent side widths, excessive reduction may cause misidentification</p>                                                                                                                                                                      |

**b: circle parameter**

理想半径: 755.98 (756.99)

最大半径偏差: 30.00

☒ 优先拟合圆环外侧点

Figure 52 Circle Mark parameters

| Circle Mark parameters                     |                                                                                                                                                                                                                                                    |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ideal radius</b>                        | Display the radius of the intercepted template circle Mark (unit: pixel)                                                                                                                                                                           |
| <b>Maximum Radius Error</b>                | Find the radius range of the circle = target radius + - tolerance radius error                                                                                                                                                                     |
| <b>Fit points outside the circle first</b> | If it is checked, it will give priority to fitting the outer point of the circle Mark, and if it is not checked, it will give priority to the fitting of the inner point of the circle (effective for the case of a ring or a lot of interference) |

Case 1:

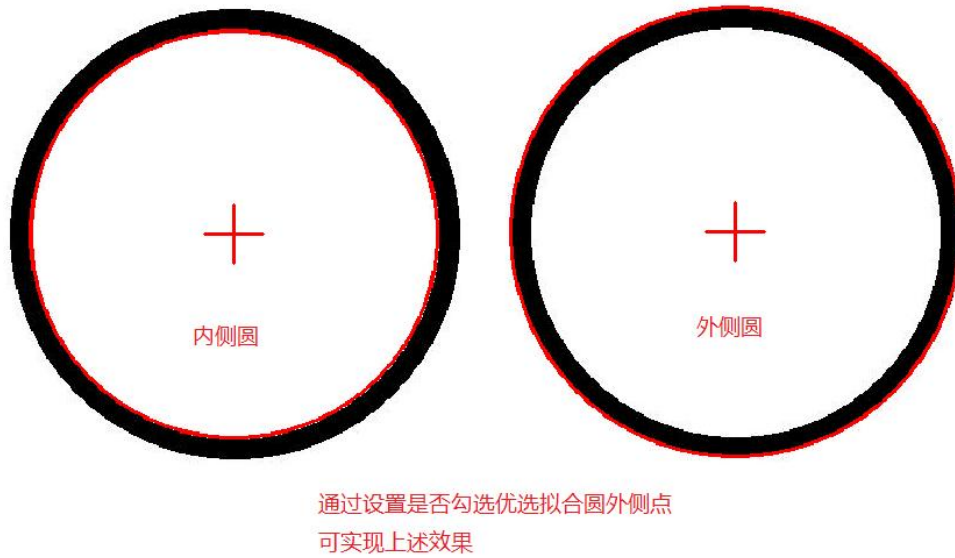


Figure 53 The case of preferentially fitting points outside the circle

#### c : General Mark parameter setting

| General Mark parameters |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| constraint type         | Center Constraint: Find the contour center as the recognition result (without angle )<br>Circle constraint: Fit each closed contour into a circle, and return the average of all circle centers as the recognition result (without angle), such as a multi-circle rectangle<br>Horizontal/Vertical Parallel Line Constraint: On the basis of the center constraint, a pair of parallel lines is also detected as the recognition angle ( with angle ) , such as the runway type |
| Number of contours      | The identified universal Mark points consist of several complete contours                                                                                                                                                                                                                                                                                                                                                                                                       |

#### 5.1.1.2 Determine the matching parameters

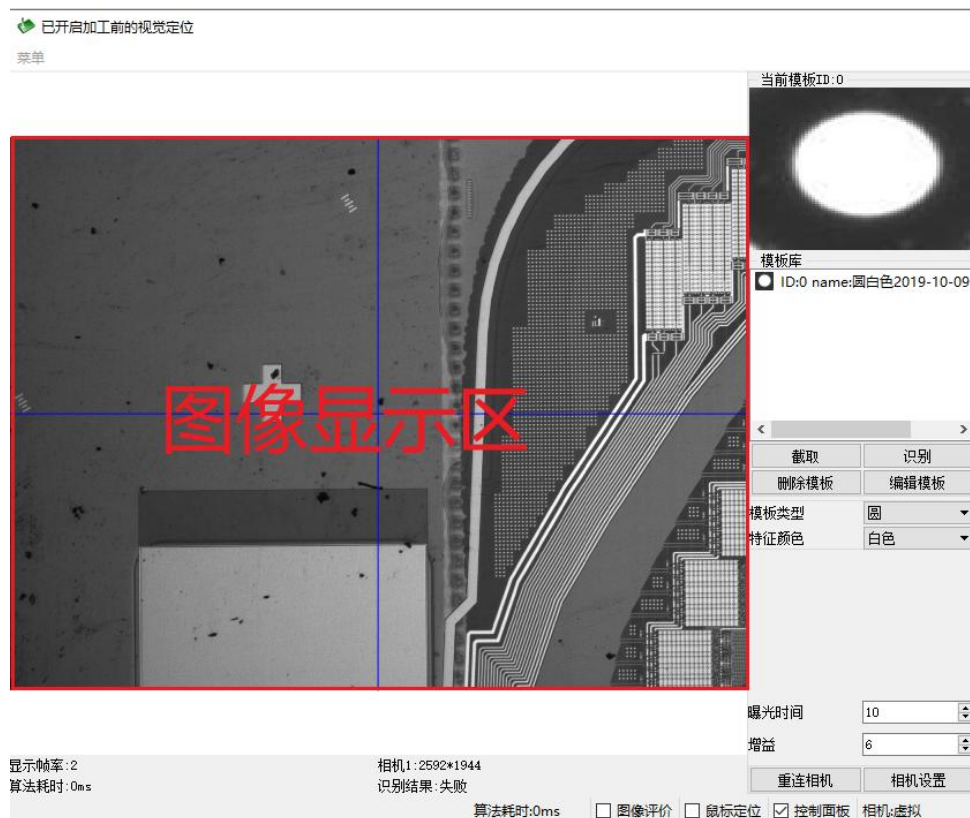
This page mainly sets the template matching parameters, and tests the recognition effect of the current template in the current screen;



Figure 54 Determine the matching parameters

| matching parameters |                                                                                                                                                                                                                                               |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| downsampling layers | The number of template scaling layers, the larger the value, the smaller the template scaling, the faster the matching speed, too large may cause errors in the matching area; the scaled image of the template can be displayed in real time |
| downsampling method | The algorithm used when scaling, linear interpolation is the fastest, pyramid sampling and area interpolation are good                                                                                                                        |
| matching method     | Correlation Coefficient and Correlation Matching Method                                                                                                                                                                                       |

## 5.2 Mouse interaction function in image display area



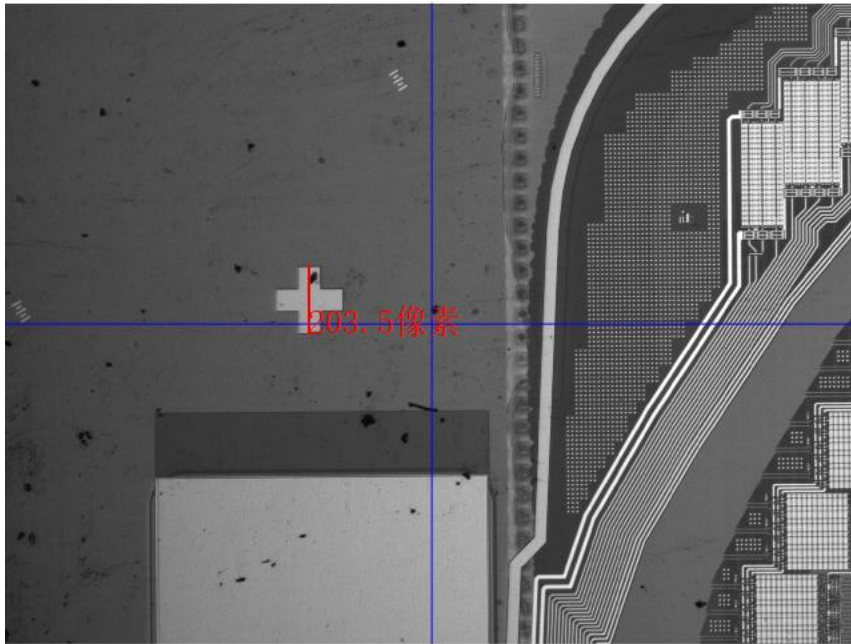


Figure 55 Mouse interaction in the image display area

Description : Image display area , real-time display of camera images . This software provides image zooming, panning, measuring and other functions, the specific operation instructions are as follows:

- 1) enabling the "mouse positioning" function, click the left mouse button to move the machine tool;
- 2) Roll the mouse wheel to zoom in and out of the image centered on the current mouse position ;
- 3) Right-click the mouse to restore to the original image size ;
- 4) Press and hold the middle button of the mouse to pan the image (only effective after the image is enlarged);
- 5) Ctrl + left mouse button, you can measure the pixel distance between two points (as shown in the figure above);
- 6) Ctrl I + right mouse button, cancel the display of the pixel distance between two points ;

### 5.3 Mark point manual recognition

Explanation : Under normal circumstances, the Mark point in the visual positioning process relies on the image recognition algorithm for fast and accurate recognition. However, in the following special cases, you can manually identify through the Mark point and continue to go through the positioning process.

- 1) The recognition failure caused by the stain on the surface of the Mark point ;
- 2) There is a very small probability of recognition failure during long-term positioning processing;
- 3) In the sample proofing stage, a new type of Mark was encountered;

- 4) Other algorithm recognition failures ;

### Operating Instructions :

- 1) As shown in the figure below, in the positioning setting interface, select the visual positioning mode as: visual + manual after failure.

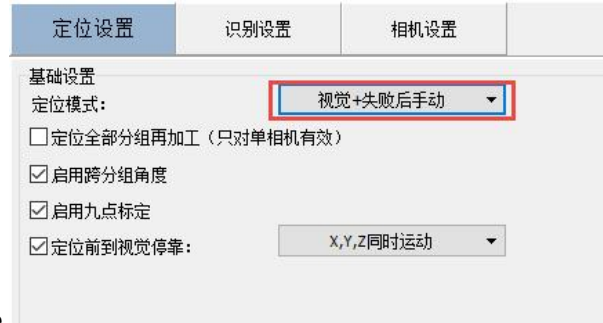


Figure 56 Manual identification

- 2) During the visual positioning process , if the algorithm fails to recognize the Mark point , the visual window will immediately switch to the Mark point manual recognition interface as shown in the figure below .

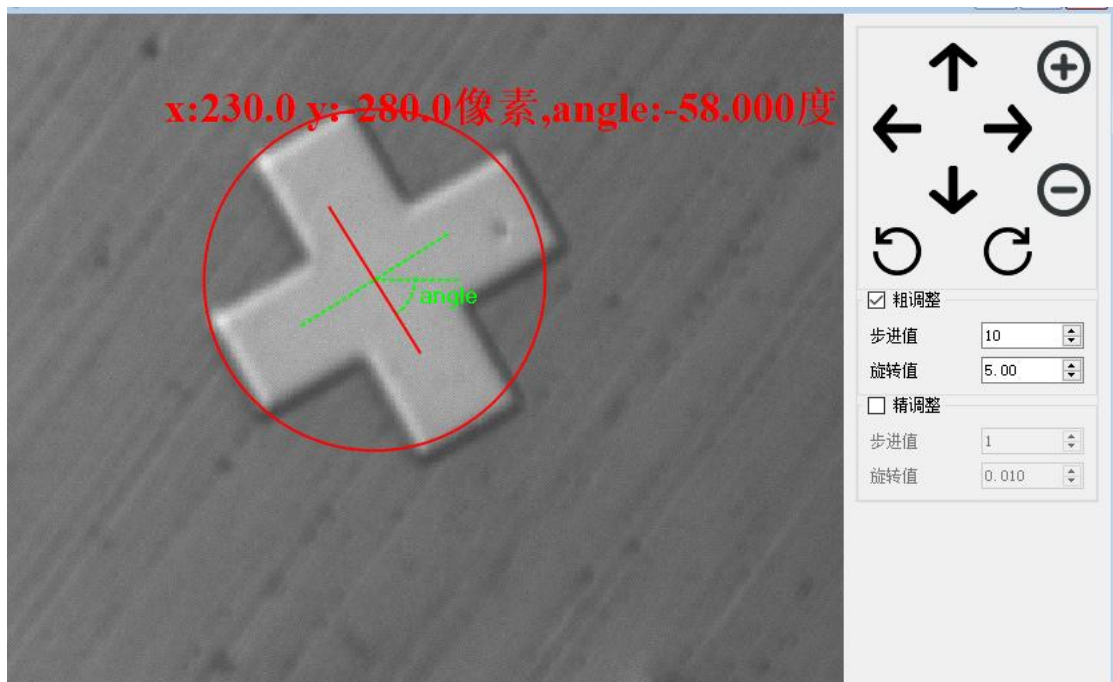


Figure 57 Manual identification interface

The operation method for manual identification is as follows:

- 1) Up, down, left and right keys can move the cross circle (composed of red cross and green circle);
- 2) The zoom in and zoom out keys can change the size of the green circle ;
- 3) The angle of the red cross can be changed counterclockwise and clockwise ;
- 4) two kinds of step values, coarse adjustment and fine adjustment , which are saved immediately after modification ;



- 5) checking the "mouse click to move the machine tool", the recognition feature can be moved to the center of the camera field of view by the left mouse button;

Finally , after overlapping the cross circle with the Mark feature , you can click the "OK" button to complete the manual identification.

## 5.4 Group template

Explanation: By using a group as a template, the same graphics of the array can be quickly and automatically grouped.

### Instructions:

- 1) a group as a template by manual setting ;

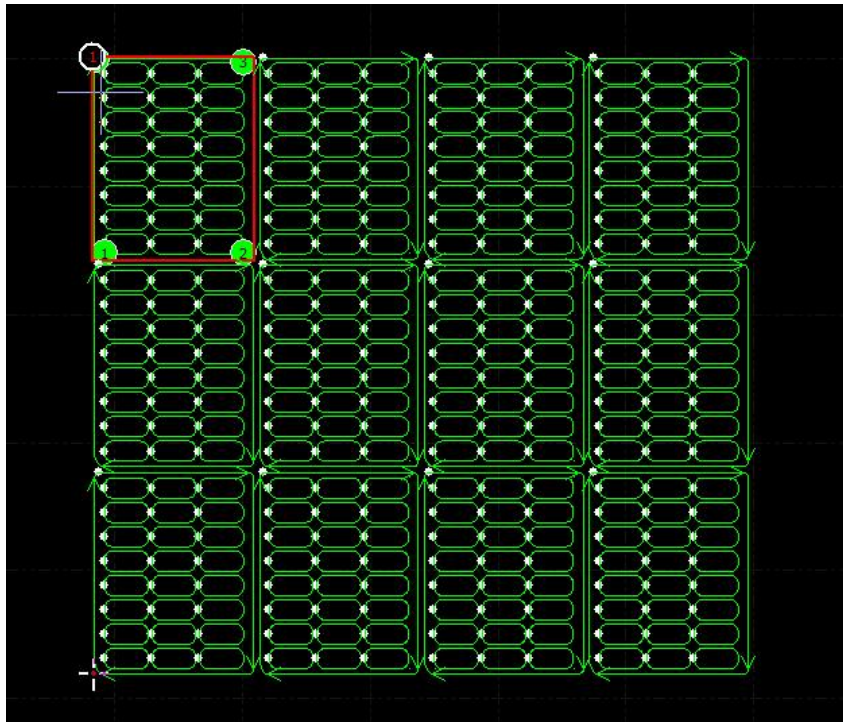


Figure 58 Set a single group as a template

- 2) Select the grouping template function, select the group as the template, and choose to apply to "All graphics" or "Selected graphics";

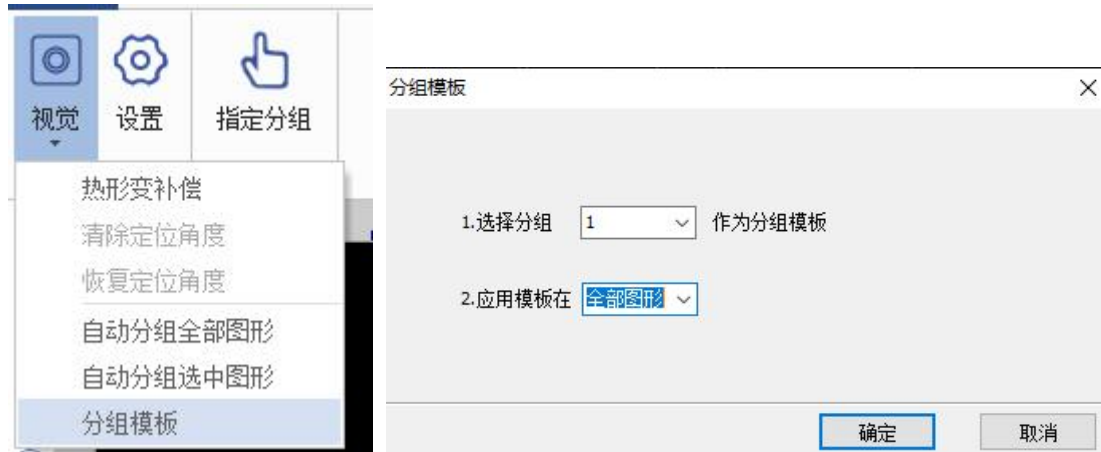


Figure 59 Parameter settings of the grouping template

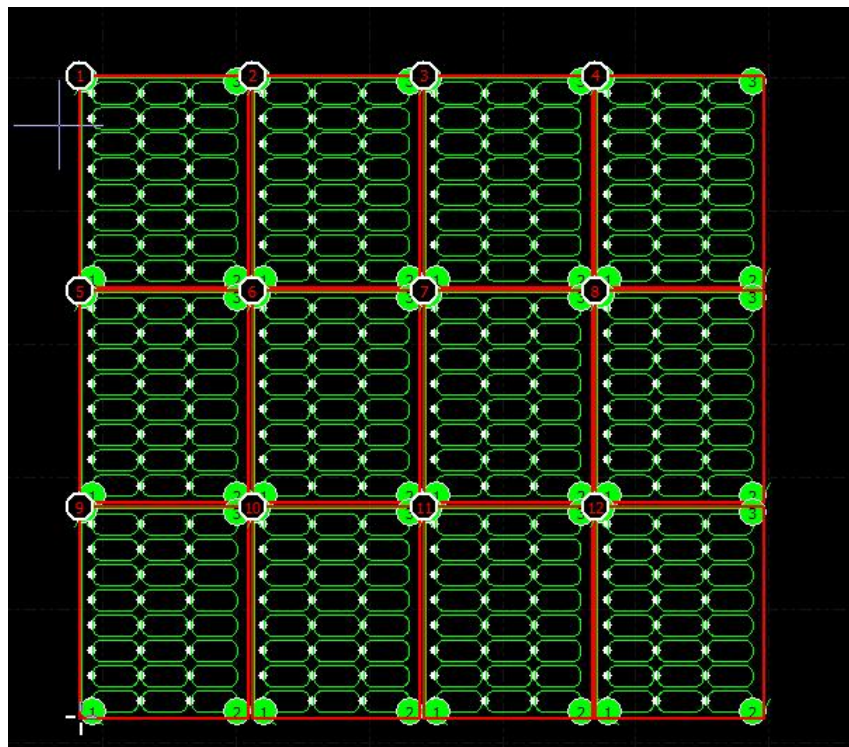


Figure 60 group template applied to all graphics

## 5.5 Multi-camera visual positioning

Note : In order to improve the efficiency of visual positioning, this software supports multi-camera visual positioning function. Its usage scenarios are (currently supports up to 4 cameras, taking 4 cameras as an example):

- 1) next to the cutting head , and 4 stations are installed on the stage;
- 2) The distance between cameras is consistent with the distance between stations, and each camera is responsible for one station;
- 3) Nth Mark point of station 1 is within the field of view of camera 1 , the Nth Mark point of station 2 is within the field of view of camera 2 , and so on;

### 5.4.1 Multi-camera IP configuration

camera IP configuration, please refer to the first chapter of this document .

What needs to be explained here is that each camera has a unique SN number . When this software opens multiple cameras , it is the default opening sequence provided by the camera SDK , that is, the smallest SN number is taken as camera 1, followed by camera 2, and the largest camera is taken as 4th camera.

Therefore , there may be such a situation : a total of four cameras are installed from left to right , but the leftmost camera is not the No. 1 camera that the software thinks, and the second left camera is not the No. 2 camera that the software thinks. The solution is to adjust the installation order of the cameras so that they are cameras 1, 2, 3, and 4 from left to right.

### 5.4 .2 Configure the number of cameras

As shown in the figure below , in the platform configuration tool - other configuration interface, set the number of cameras to 4.



Figure 61 Configure the number of cameras

opening the UltraCut software visual window, its interface is shown in the figure below, and the image display area contains real-time images of four cameras.

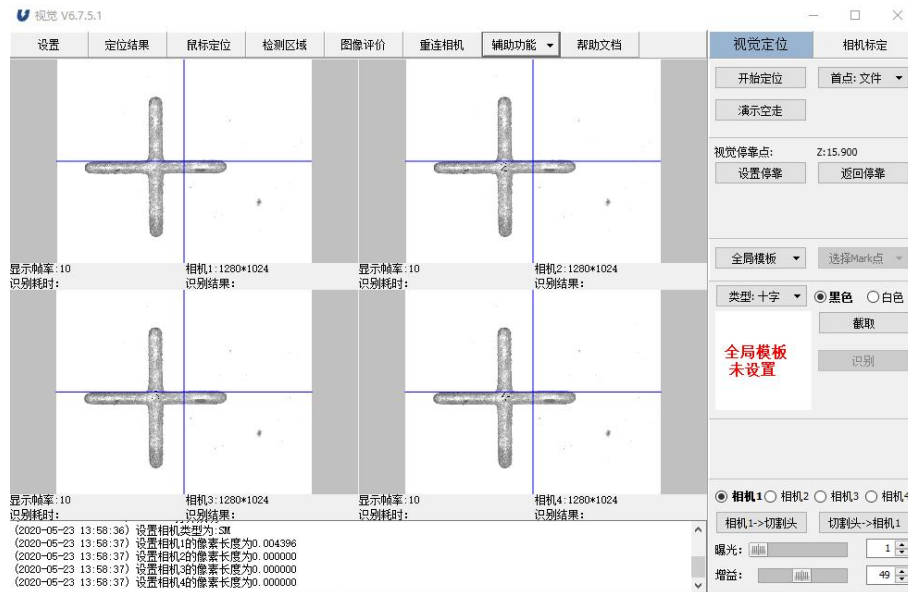


Figure 62 The effect of multiple cameras

### 5.4.3 Multi-camera camera calibration

The four-camera calibration interface is shown in the figure below. Only one sample image needs to be cut, and the specific calibration steps are:

- 1) Processing samples ;
- 2) Move the Mark to near the center of the field of view of camera 1, capture the template, and click to calibrate the camera to complete the calibration of camera 1;
- 3) Switch to camera 2, move the Mark to near the center of the field of view of camera 2 , and click to calibrate the camera to complete the calibration of camera 2 ;
- 4) Switch to camera 3 , move the Mark to near the center of the field of view of camera 3, and click to calibrate the camera to complete the calibration of camera 3 ;
- 5) Switch to camera 4 , move the Mark to near the center of the field of view of camera 4 , and click to calibrate the camera to complete the calibration of camera 4;
- 6) After the calibration of the 4 cameras is completed, click "Save and Exit".

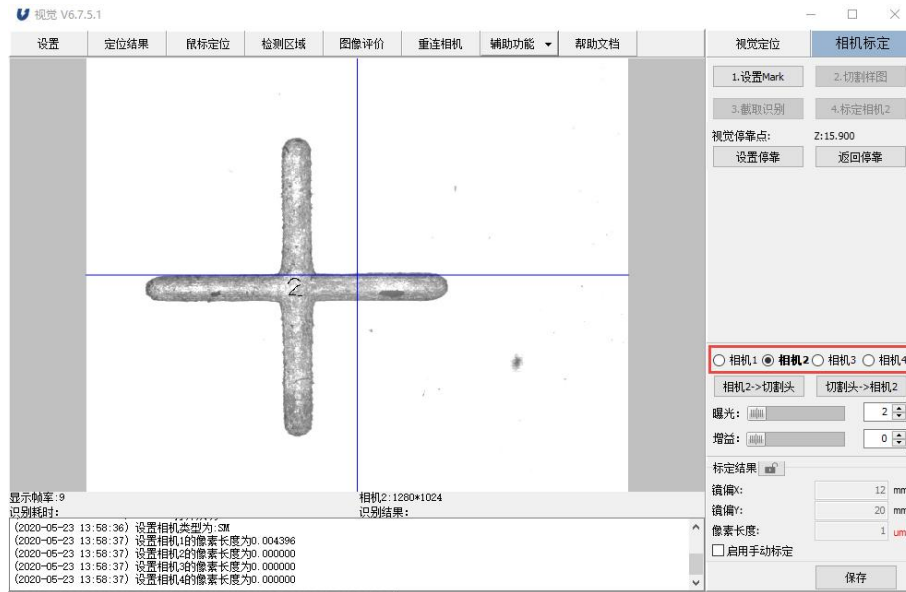


Figure 63 Multi-camera calibration

#### 5.4.4 Making processing drawings

The design scheme adopted by this software is : one camera corresponds to one station and binds one group, so the way to make drawings is:

- 1) For 4 cameras, 4 groups are required;
- 2) Group 1 corresponds to camera 1, which corresponds to station 1, group 2 corresponds to camera 2 , which corresponds to station 2 , and so on ;
- 3) On the processing drawings , the distance between groups should be consistent with the distance between stations and the distance between cameras ;

stations 1, 2, 3, and 4 from left to right, corresponding to cameras 1, 2, 3, and 4 as an example, the drawings produced are shown in the figure below.

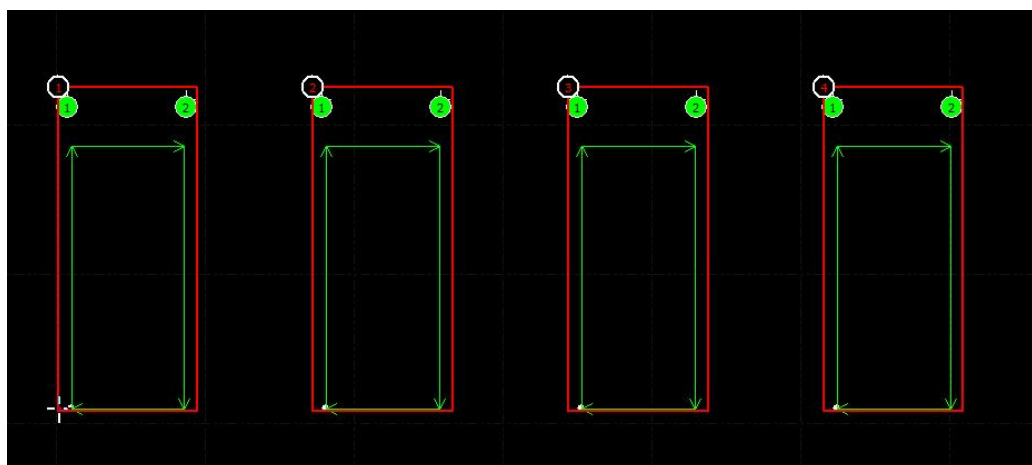


Figure 64 Multi-camera vision positioning processing

## 5.5 Use of straight line Mark

**Note:** This function is applicable to the scene where there is no mark point on the material, but visual positioning is required to improve the processing accuracy. You can use the frame (line) of the material as the mark point for visual recognition.

The straight line Mark requires that there must be no less than one straight line mark in the user group, otherwise it will prompt "single line Mark cannot be less than two , and the corresponding group does not meet the conditions". According to the number of straight line marks, it is divided into two straight line mark positioning, three straight line mark positioning and four straight line mark positioning.

**Note:** For the positioning of each straight line mark, the software is to find the position of the mark point in the line for visual positioning. Please ensure that the camera is aimed at the midpoint of the straight line mark when recognizing the first straight line mark. The subsequent straight line mark system will run to the corresponding point for visual recognition according to the relative position.

### 5.5.1 Set the straight line Mark

Select a line, right click and select "Set Line Mark Point"

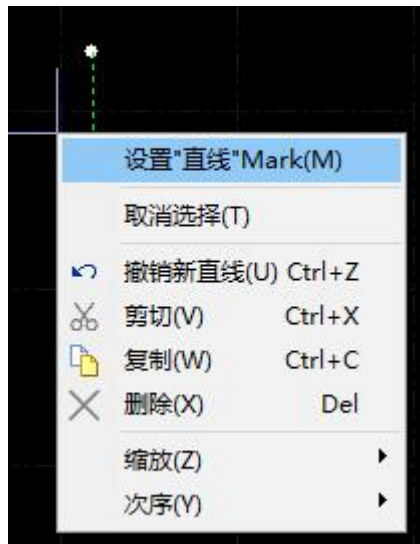


Figure 65 Set the straight line Mark

popping up the setting line Mark window, you can set the positioning constant, and at the same time allow to set the relative starting position, please set it according to 1/2 similar to this value. The number of straight line Mark points can be set to 1-4.

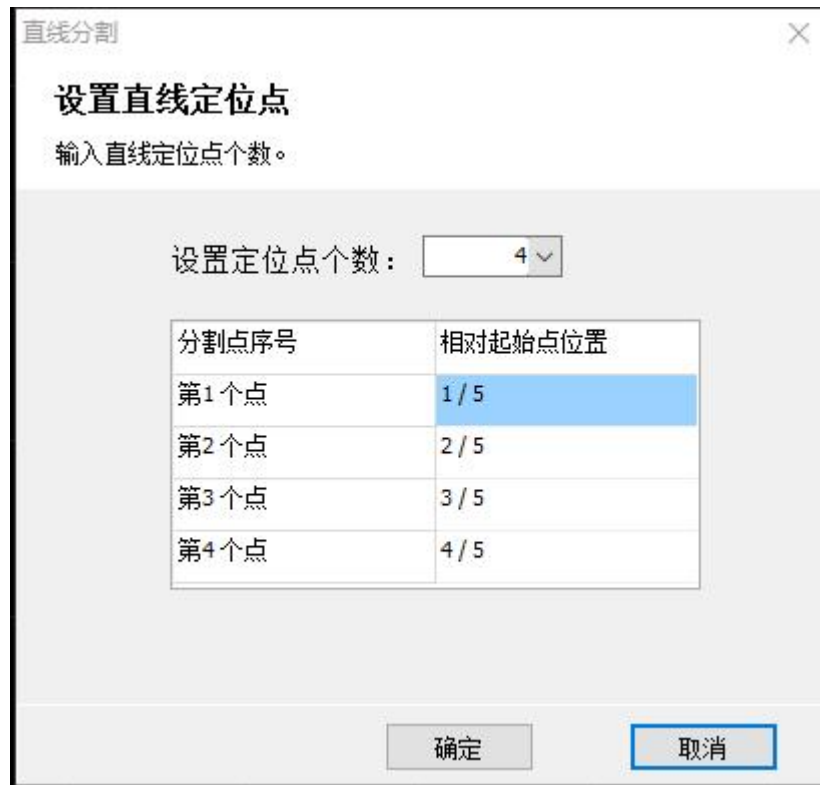


Figure 66 Set the straight line Mark

## 5.5. 2 Two straight lines Mark

It is required that the angle between the two straight lines Mark cannot be less than  $15^{\circ}$ , otherwise the calculation will display "abnormal calculation compensation value", and the visual positioning process will not continue.

Press and hold Ctrl+corresponding number to divide the selected Mark into the corresponding group, or select the Mark and select the corresponding group on the right console.

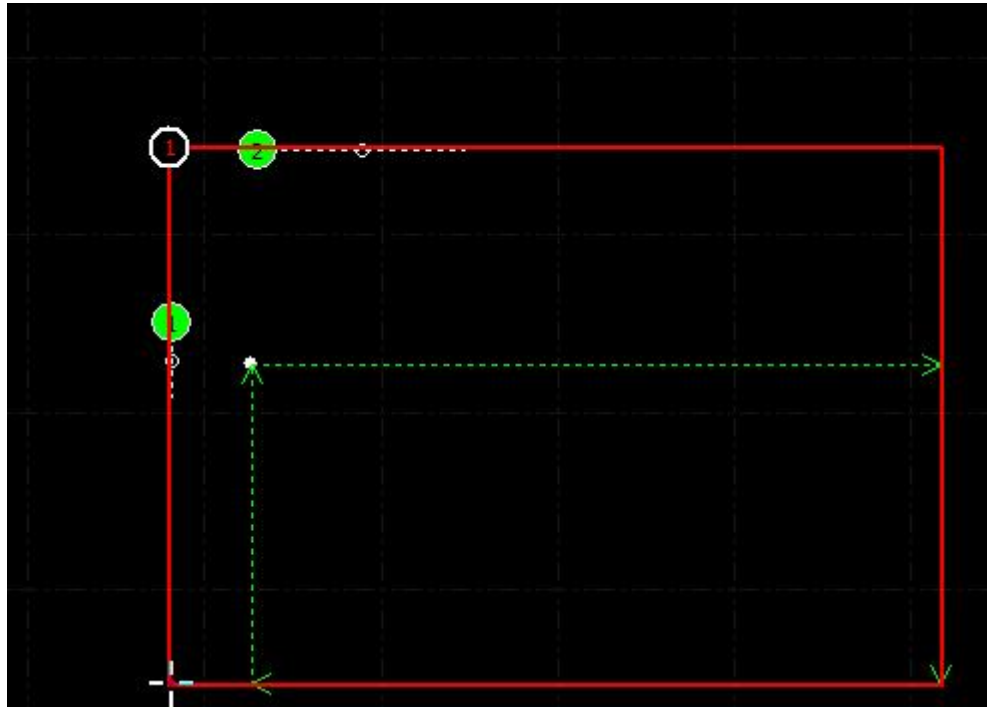


Figure 67 Mark grouping of two straight lines

### 5.5. 3 Three -line Mark

It is required that the angle between any two straight lines in the three-line Mark cannot be less than  $15^\circ$ .



Figure 68 Three straight lines Mark grouping

## 5.5. 4 Four -line Mark

At present, the four straight line Marks must be parallel to each other, otherwise the calculation will display "abnormal calculation compensation value", and the visual positioning process will not continue.

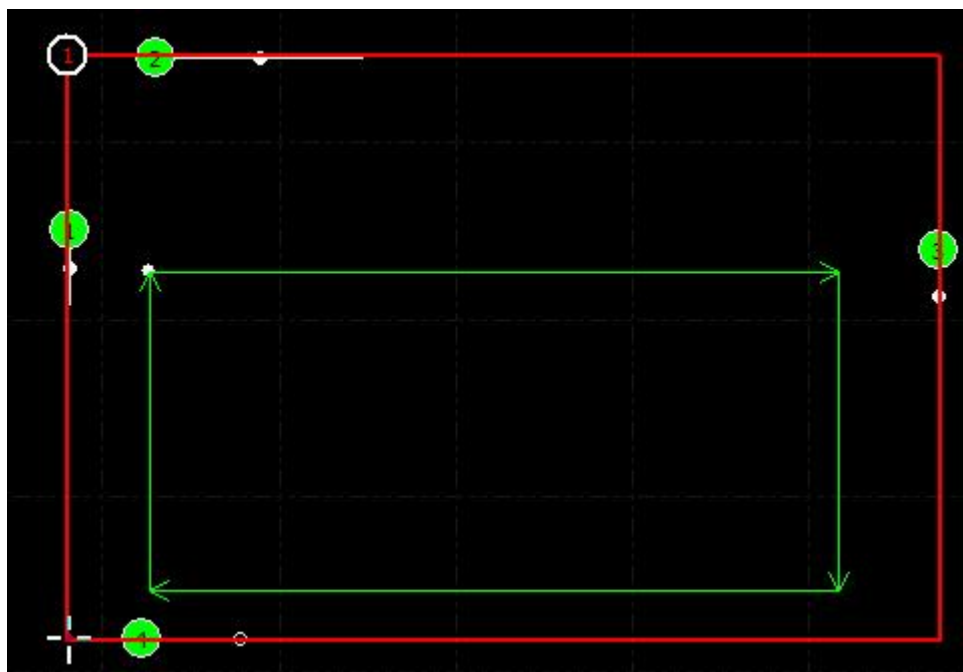


Figure 69 Four straight lines Mark grouping

## 5.5.5 Line Mark Identification Parameters

Relevant parameters can be adjusted during the straight line mark recognition process to help better recognize the straight line mark. The following is the description of the relevant parameters.

| Linear Mark parameter |                                                                                                                                                                  |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| characteristic color  | During the scanning process, judge the position of the Mark line according to the transition of the color, including from black to white and from white to black |
| scan direction        | The direction of scanning pictures, including four ways: left to right, right to left, top to bottom, bottom to top                                              |

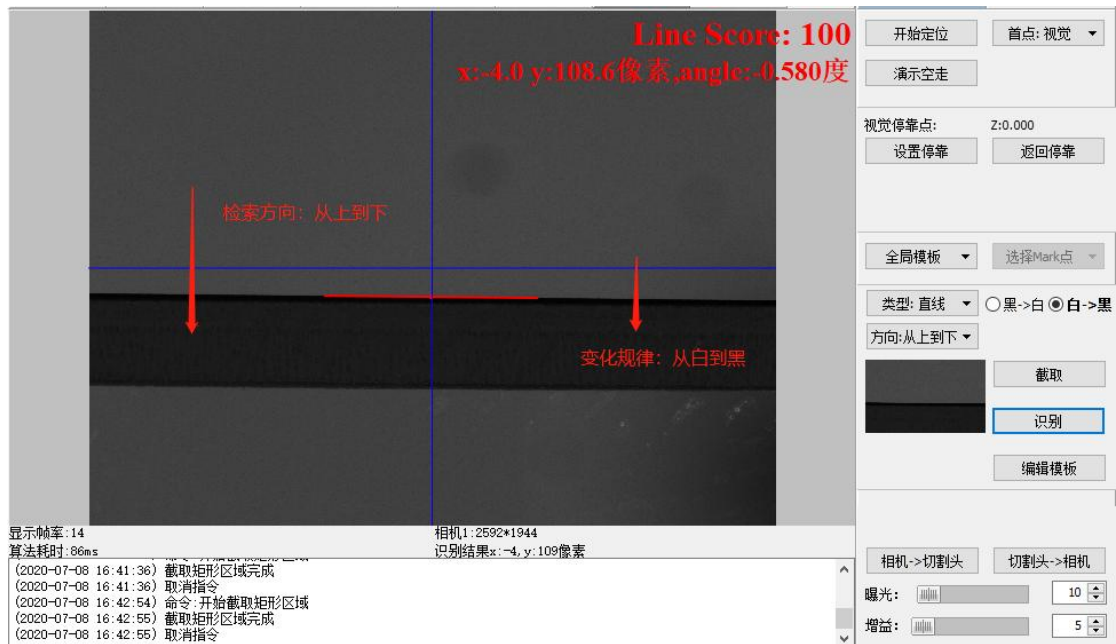


Figure 70 Recognition settings of straight line Mark

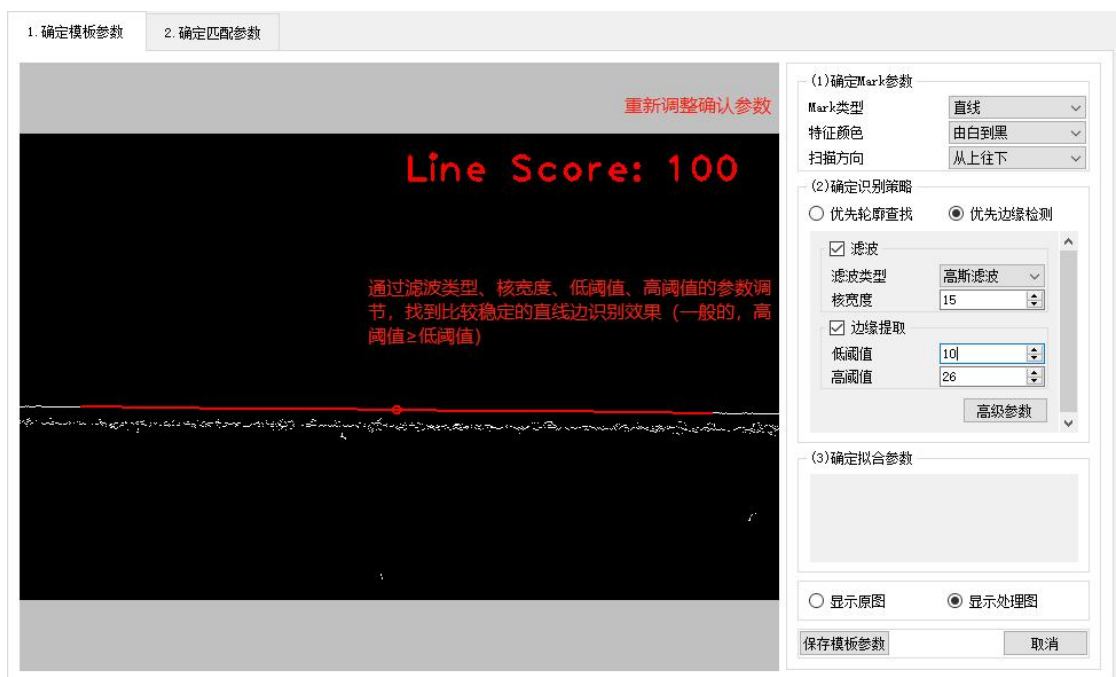


Figure 71 Straight Mark expert mode editing

## 5.6 Mark graphics can be processed

Realize the rapid copying of the original position of the Mark point graphics, which is convenient for the processing of the Mark point graphics.

Set the Mark point and Mark point can process the operation steps:



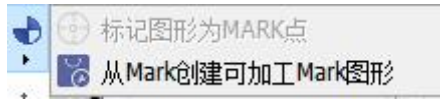
- 1) Set the Mark point. Select the graph that needs to be set as a Mark point, click the "



" button in the shortcut bar, or click the right mouse

button -> "Mark graph as a Mark point" to mark the currently selected graph as a Mark point.

- 2) Mark points can be processed. Click the " " button in the shortcut bar



, or click the right mouse button -> "Create Machinable

Mark Graphics from Mark", and a machinable Mark graphic will be created automatically.

Note: Mark points can be checked for setting.



Figure 72 Machinable Mark graphic creation effect diagram

## 5.7 Multi-camera supports multi-group processing

Now group and camera can be processed normally by combining according to the following relationship:

- 1) The processing group is proportional to the number of cameras, and the number of processing groups is N times the number of cameras, where  $N > 0$  and is an integer;
- 2) The distance between the group position and the camera is consistent;
- 3) The number of Mark points in the group recognized at the same time remains the same, and the relative position remains the same.

Examples are as follows:

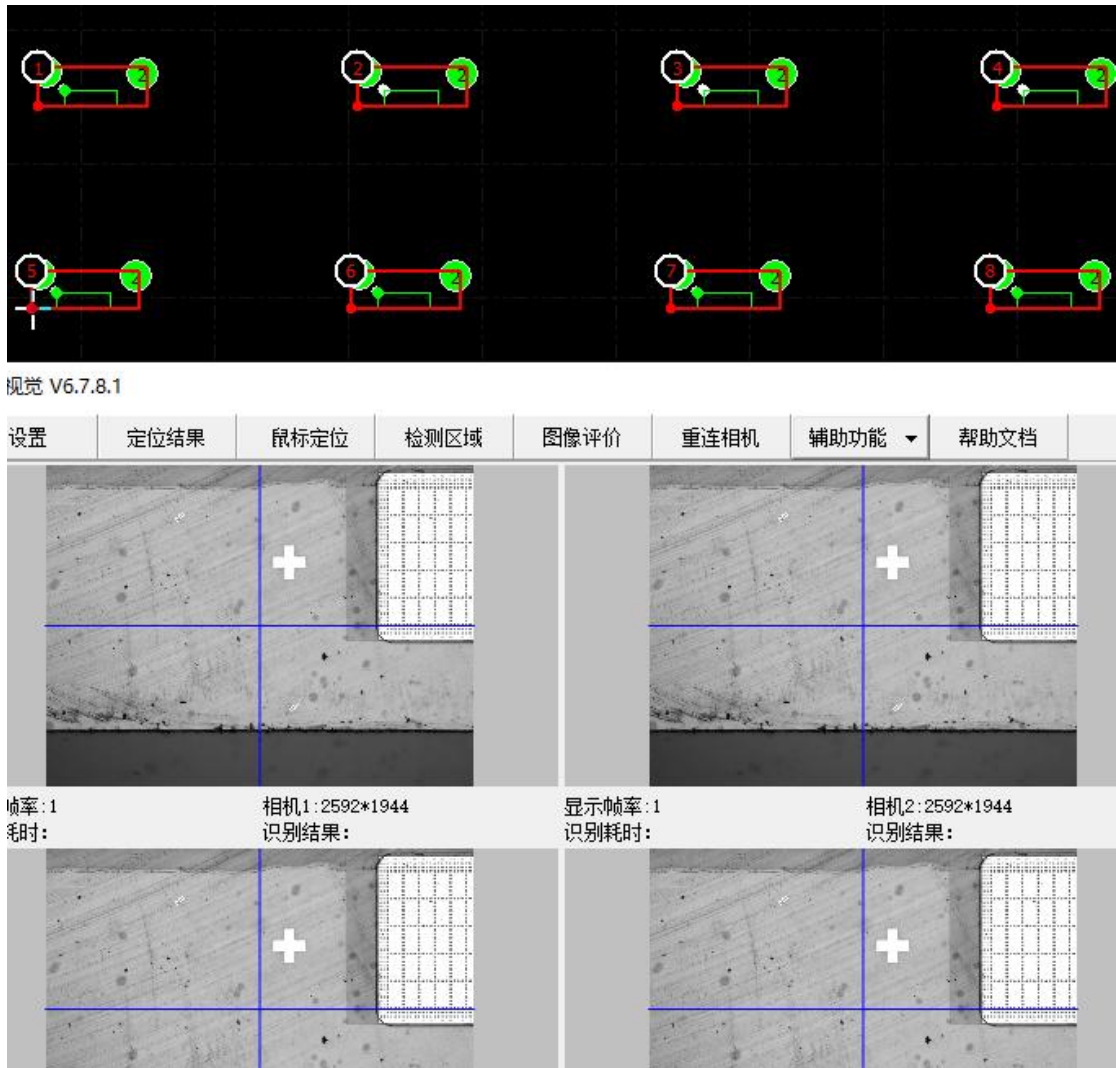


Figure 73 The camera corresponds to 8 groups for processing

The corresponding relationship is that cameras 1, 2, 3, and 4 first correspond to the Mark points of groups 1, 2, 3, and 4, and then move to the position of group 5, which correspond to the Mark points of groups 5, 6, 7, and 8 respectively. Please add the groups that need to be processed in this order, and the incorrect setting of the group number may cause the Mark point to not be recognized.

## 5.8 Image auto focus

The image focus function can conveniently confirm the best visual stop point. Click the image focus function, and the Z axis will move up and down (the current position  $[-4\text{mm}, 4\text{mm}]$ , executed at the z-axis speed) to confirm the clearest visual height.

Note: Please move the camera field of view to a clearer position before performing image focusing, otherwise the camera may fail to find the best visual stop point or the wrong one.

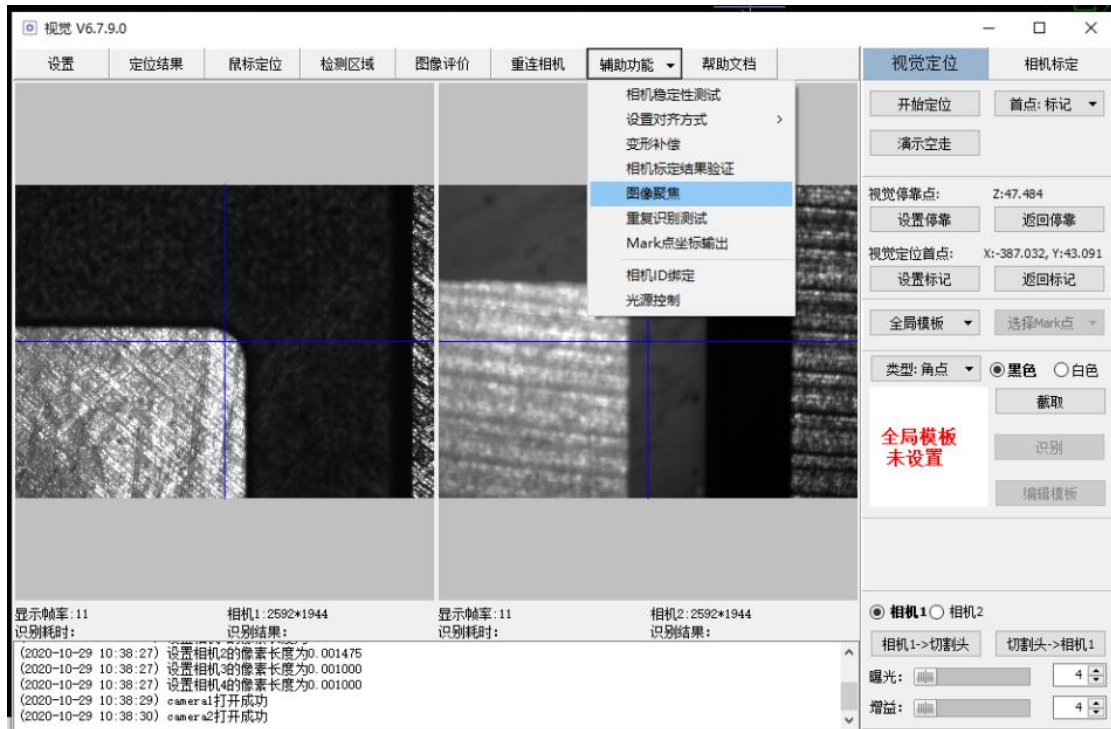


Figure 74 Image focus function entry

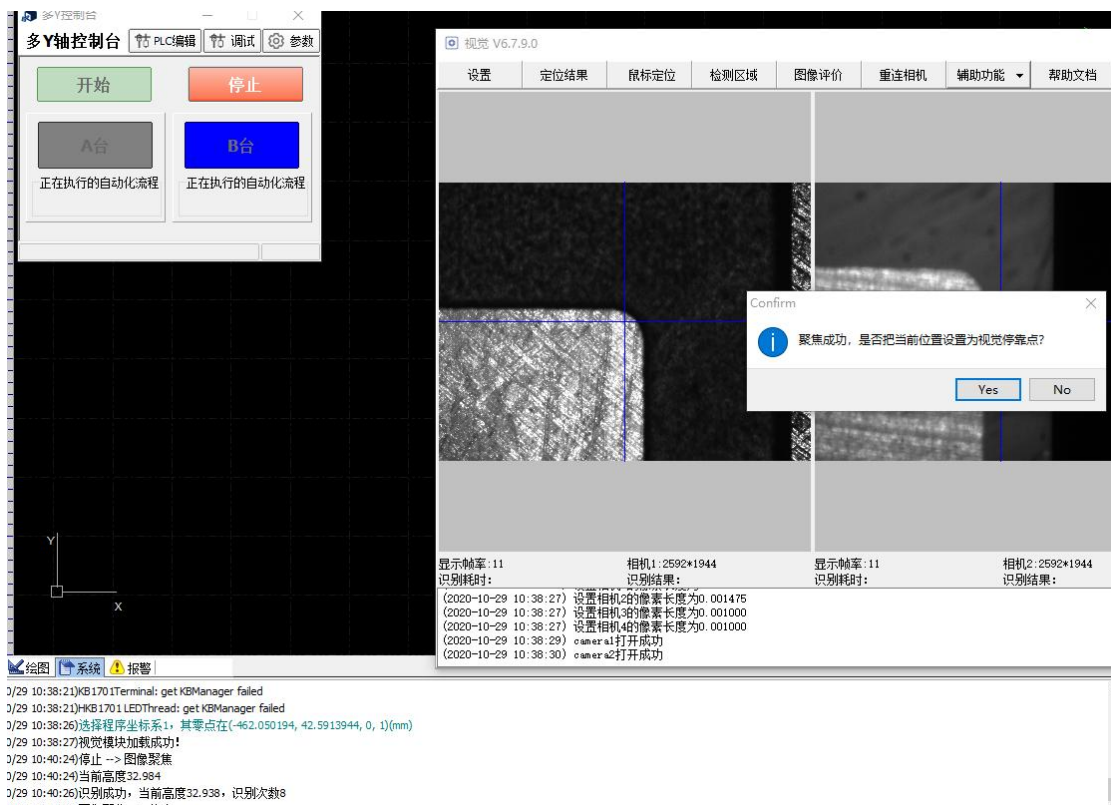


Figure 75 Image focus function successful display interface