Read this manual before operation

➢ The content includes of electric connections and operating steps

➢ Read the manual to operate the systems

LSWorks

Precision Cutting Control System Software Manual

Shenzhen Ruida Technology Co., Ltd

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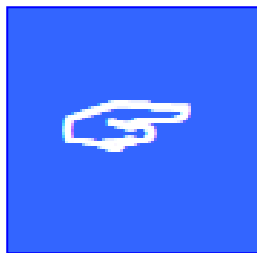
Warning：

It indicates a serious danger. In the process of using, if improper operation or wrong usage method may cause injury to the personnel, please do not operate

Contents

Chapter 1　Overview

This section includes:

■ **LSWorks software introduction**

■ **Software requirement for operating system**

1.1 LSWorks software introduction

LSWorks software is a software for precision cutting control system developed by Ruida Technology. The system includes RDC6555G series mainboard, control panel and LSWorks. The software interface is simple, beautiful, rich in functions and practical. The interface layout is carried out for the cutting process, the meaning of the icons and buttons are clear, and the interface elements are neatly laid out.

1.2 Software requirement for operating system

(1) Running on Windows7 and above operating systems, it is recommended to use Windows7.

(2) CPU 586, PIII or PIV or above is recommended.

⑶ It is recommended to use memory above 4G.

Chapter 2　Software

Installation

This section includes:

■ **LSWorks software installation**

■ **USB driver installation**

2.1 Software installation

Double-click the system software installation file LSWorks Setup.ext to install the system software. After double-clicking the installation file, the following dialog box pops up, click "Next".
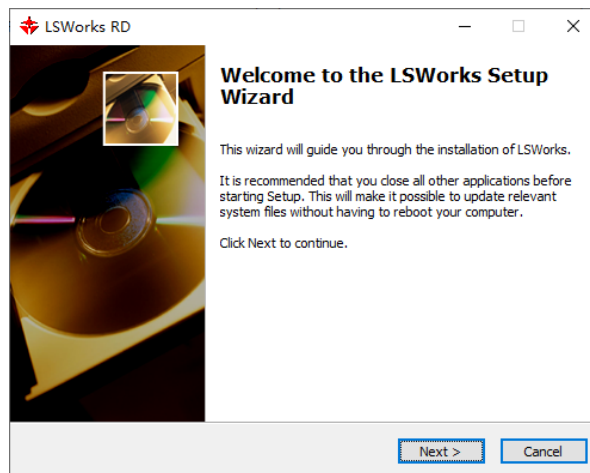
The installation location selection dialog box pops up, and user can modify the installation path or it can be the default installation path displayed on the interface.
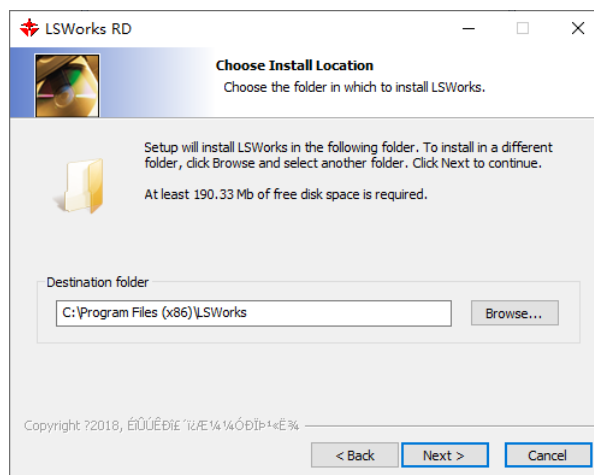
Click "Next". A dialog box of whether to create a shortcut pops up.
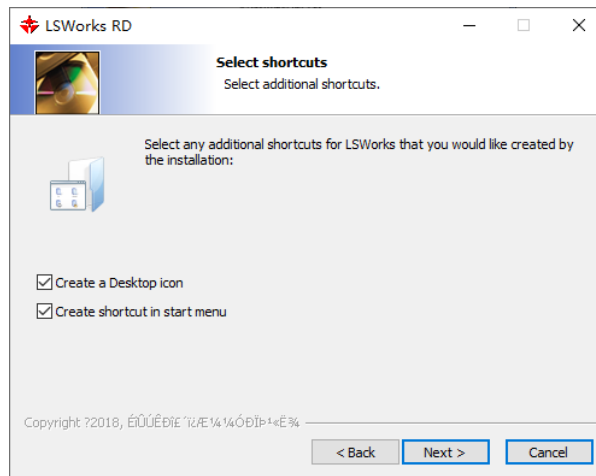
Select "Next". A Installation Information dialog box pops up. After confirming, click "Install".
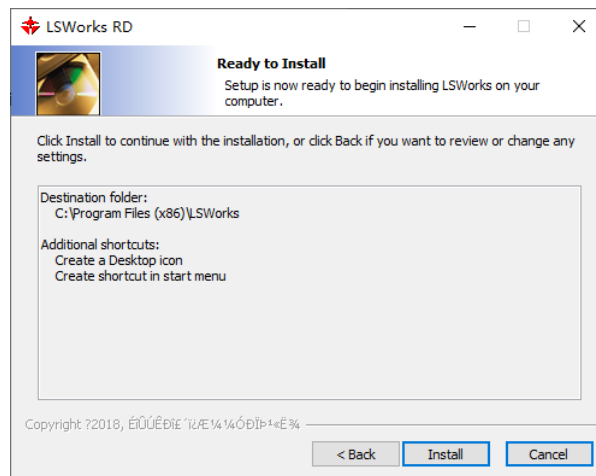
After clicking "Install", the system pops up the installation process dialog box.
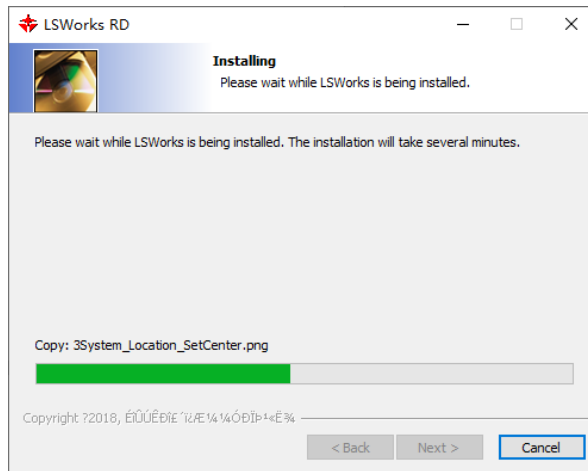
After installation, the Installation Complete dialog box and the USB Driver Installation dialog box will pop up.
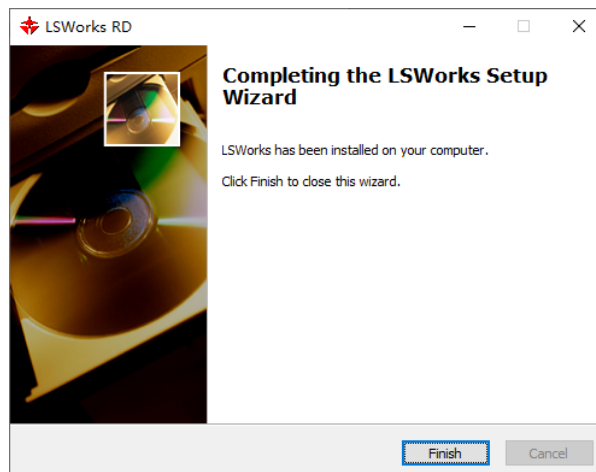
Click Finish, the software has been successfully installed on the computer. Users can use the shortcut LSWorks on the desktop or menu bar to open the system software.

2.2 USB driver installation

Find the LSWorks software shortcut on the computer <Start>.
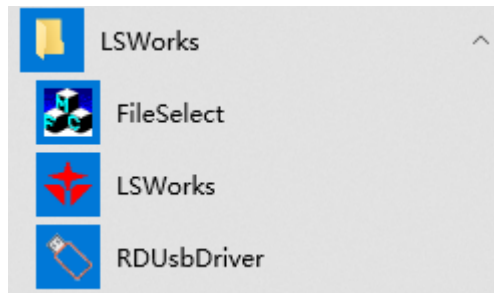
Click the <RDUsbDriver> option, the board USB driver installation window will pop up, and the software will automatically recognize the current system environment.
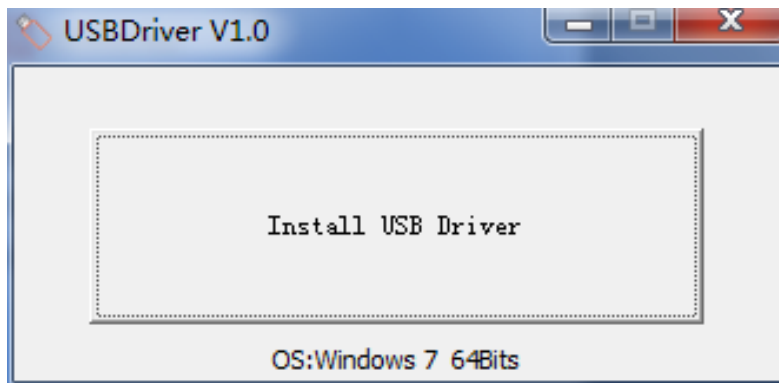
Click <Install USB Driver>, and the USB installation wizard will pop up.
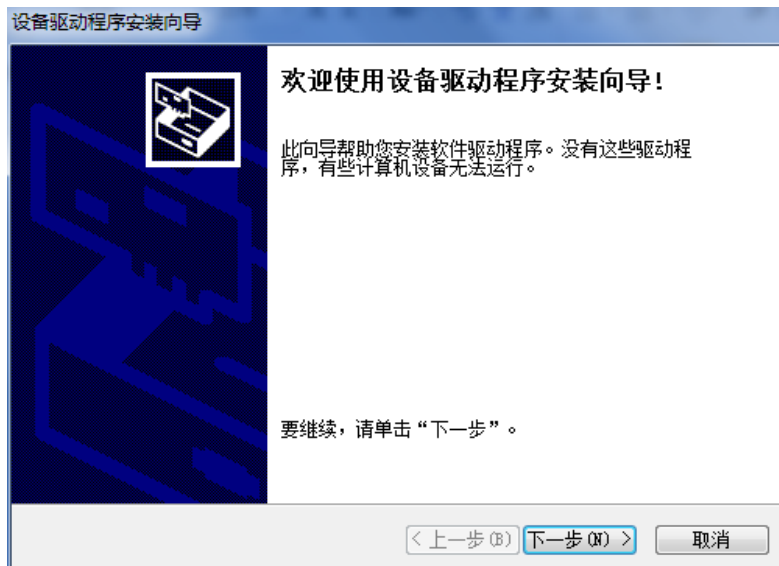
Click <Next> to install the USB device driver automatically.

设备驱动程序安装向导

正在安装驱动程序...

驱动程序正在安装，请等待。这可能需要一段时间才能完成。

〈上一步(B)〉 下一步(N) 〉 取消
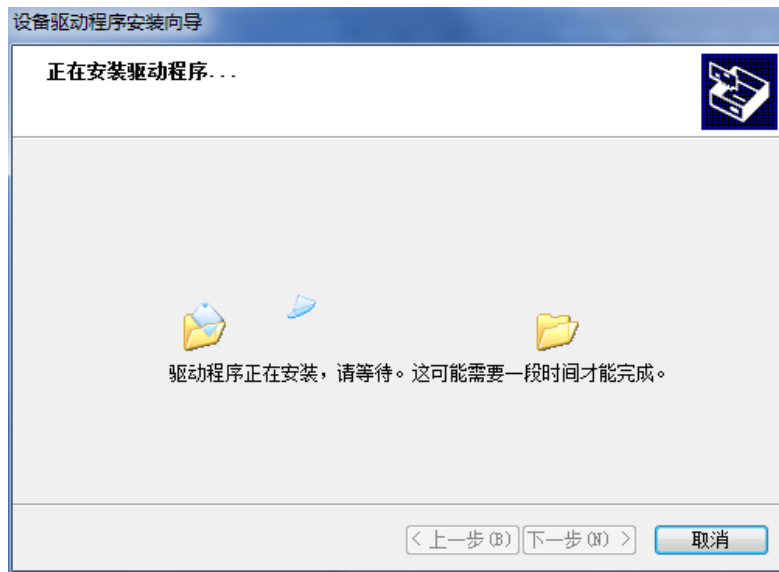
After the driver is installed normally, it will prompt that the installation is complete.

设备驱动程序安装向导

正在完成设备驱动程序安装向导

此计算机上成功地安装了此驱动程序。

现在您可以将设备连接到此计算机。如果此设备附有说明，
请先阅读。

驱动程序名	状态
✓ FTDI CDM Driver Pa...	可以使用了
✓ FTDI CDM Driver Pa...	可以使用了

〈上一步(B) 完成 取消
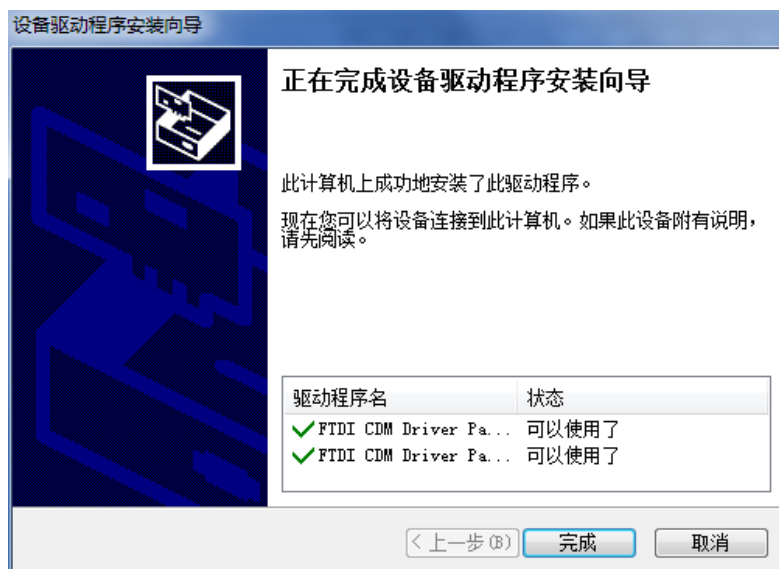
Chapter 3   Software Introduction

This section includes:

■ **Software main interface**

■ **Function introduction**

■ **Toolbar description**

■ **Parameter description**

3.1 Software main interface
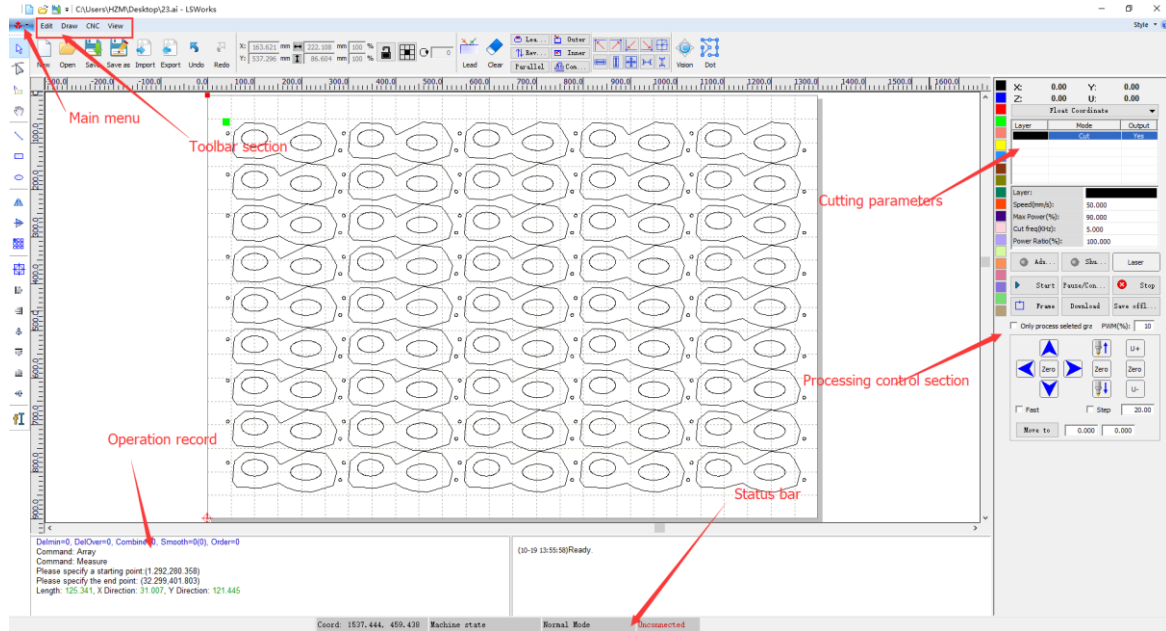
Figure: Software main interface

The main interface includes menu section, toolbar section, processing interface section, process parameter configuration section, operation record section and status bar section.

3.1.1 Main menu

Click the main menu button in the upper left corner of the main interface to pop up the main menu. The options in the main menu are related to file operations, including: new, open, save, save as, import, export, undo, redo, user settings, parameter backup, etc.
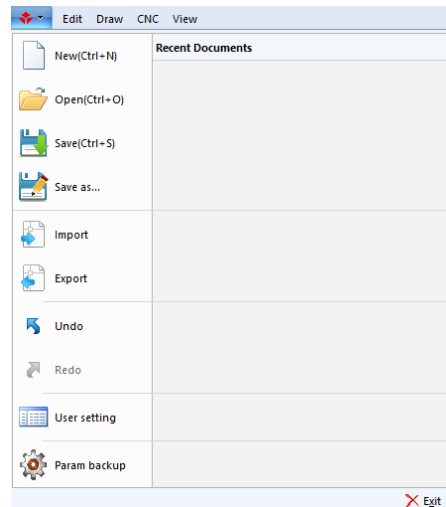
Figure: Main menu

3.1.2 Toolbar section

The toolbar has four parts: editing, drawing, numerical control, and view.
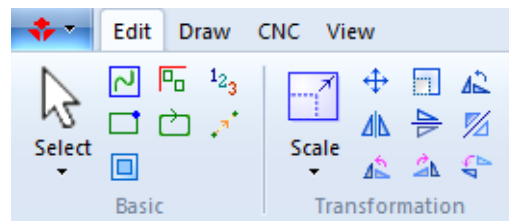
Edit toolbar: Mainly includes viewing display, geometric transformation, process setting, sorting, graphics processing tools, etc.

Drawing toolbar: It is mainly used for drawing and aligning simple graphics.

CNC tool bar: It can perform the machine-related configuration, the processing-related parameter setting and the processing-related function.

View toolbar: It mainly includes the selection of interface modes (panning, sorting, editing), the display and hiding of the clipboard, some modules, and the display, hiding and locking of each layer.

3.1.3 Processing control section

Processing control mainly refers to various operations related to processing. There is coordination system selection, absorption, shutter, pulse, start, pause/continue, stop, frame, download, save offline file, process selected graphics, key movement and return to zero, etc.
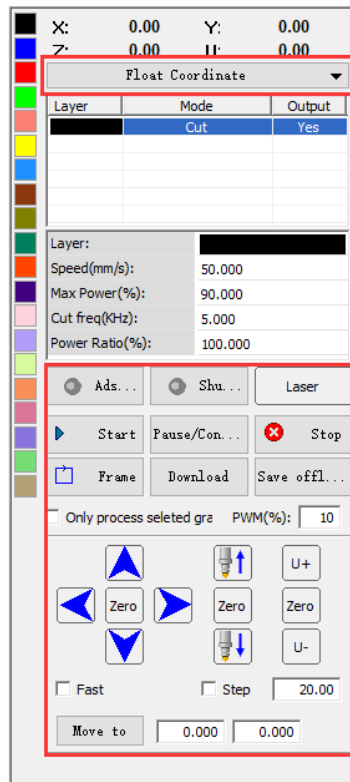
Figure: processing control interface

3.1.4 Cutting parameters

Process parameters are mainly processing power setting, processing frequency setting, processing speed, laser on delay, laser off delay, over-cutting and other parameter settings. Common parameters such as processing power, processing frequency, and processing speed can be directly modified in the main interface of the software, and the process parameters can be modified in detail after double-clicking the layer.
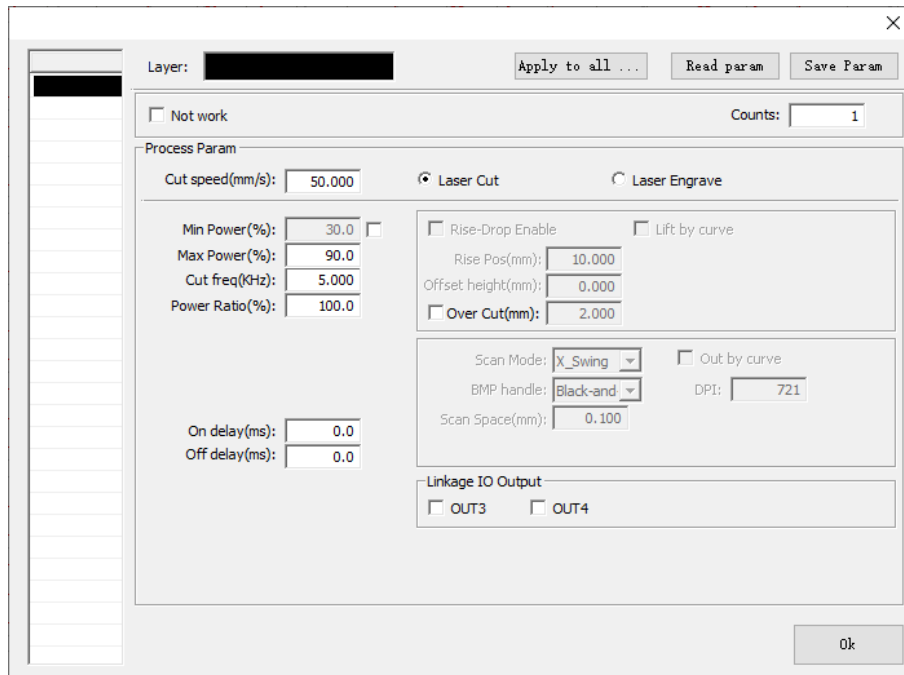
Figure: cutting control interface

3.1.5 Operation record

On the bottom of the software, recording various functional operations and the realization process of this operation.
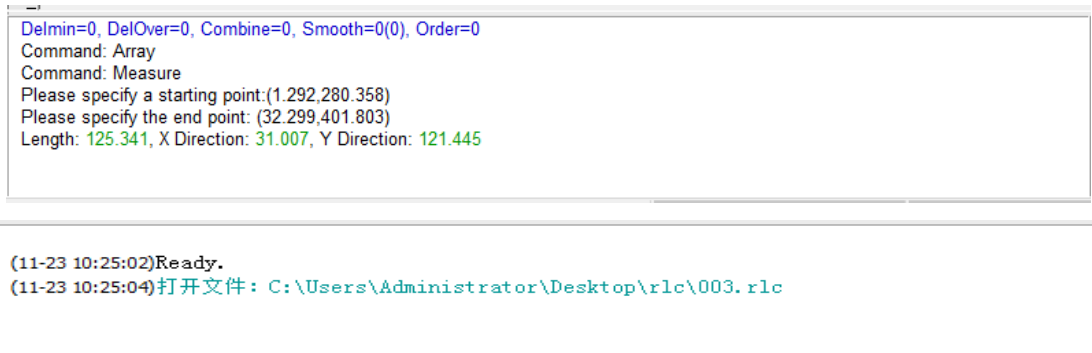
Figure: Operation record interface

3.1.6 Status bar

The status bar displays the attributes of the primitive, cursor position, processing timing, connection status, etc.

| Select 1，No compensate，No over cut，Inner，Total length: 563.341 mm | Coord: -5.168, 810.854 | Machine state | Normal Mode | Unconnected |

3.2 Function introduction

3.2.1 Main interface

The main menu includes new, open, save, import, export, undo, redo, and interface settings.
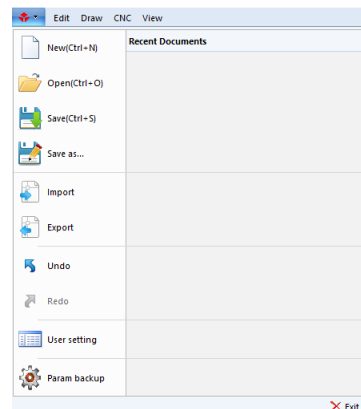
Figure: Main menu interface

New: Create a new view page. If the original view page has no saved graphic data, it will prompt to save it.

Open: Open the project file saved by this software in rlc format.

Save: Save graphic data. If the open file is modified, it will be directly saved to the original file. If it is newly created graphic data, the graphic save interface will pop up.

Save as: pop up the graphic save interface for the graphic save operation.

Import: The interface for importing graphical data pops up, and you can import file data in ai, plt, dxf, bmp, png, and jpg formats.

Export: Export file data in ai, plt formats.

Undo and Redo: User can undo or redo the recent graphic processing. The shortcut keys are Ctrl+Z and

Ctrl+Y.

Interface setting: Set the interface displaying related parameter settings and parameters related to the imported file (automatically optimized parameters).

Parameter backup: Back up the software parameter to the specified folder, and restore the software parameters through Recovery-Para program (this program can be found in the installation directory Recovery-Para.exe). Back up the parameters after the factory completes debugging machine, and the parameters can be restored after the software parameter file is destroyed. The backup parameter is a folder, the manufacturer can name the folder with the date, and the file name in the folder cannot be modified.
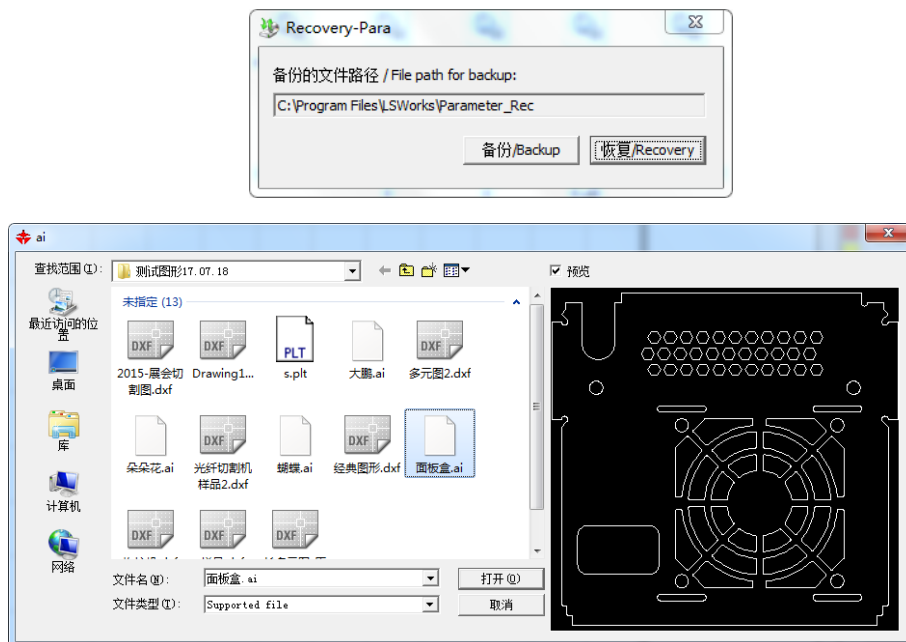
Figure: Interface for importing and exporting data
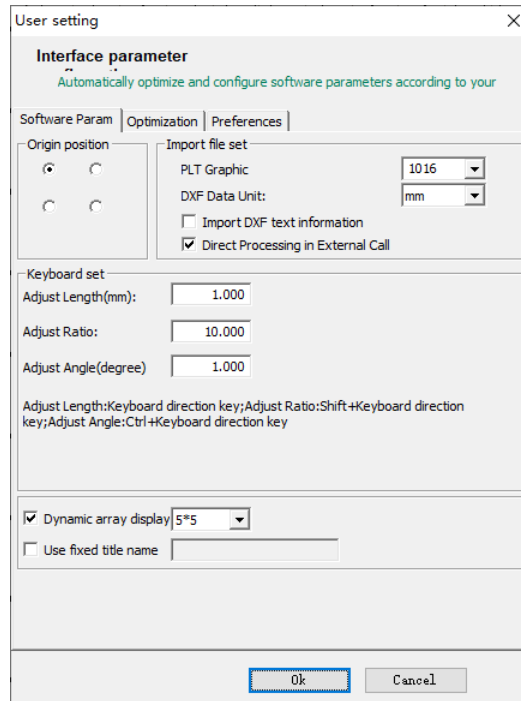
Figure: Software parameter interface

3.2.2 Software parameter description

Origin position: Set the zero position of the graphic display area. This position needs to correspond to the actual origin position of the machine (the position where the reset is located). Otherwise, the processed graphics will not correspond to the graphic coordinates of the drawing area. It is the benchmark for creating a graphic coordinate system.

File import settings: Set the precision of PLT graphics, the ratio of length unit to logic unit conversion. DXF data unit can be millimeter, centimeter, inch and custom. Select this item when importing DXF text information to import DXF text.

Keyboard setting: Set the distance and rotation angle of single step movement of the selected graph when the keyboard is operated by the up, down, left, and right keys.

3.2.3 Optimize parameter description

Parameters on this page can be set for the processing operations of the graphics and parameter settings of each operation when the graphics are imported.

Delete minimal graphics: Remove the graphics whose outer frame length and width are less than the set length.

Delete duplicate lines: Remove the overlapping line segments between the graphs.

Combine: When the distance of the start points and the end point of multiple non-closed graphic primitives is smaller than the length, the connection is merged into one graph.

Auto sort: According to the parameters set in the software sorting interface, automatically sort the imported graphics.

Auto smooth: Automatically smoothing the imported graphics. The minimum number of nodes of smoothing graphic primitives and the output precision after smoothing can be restricted.
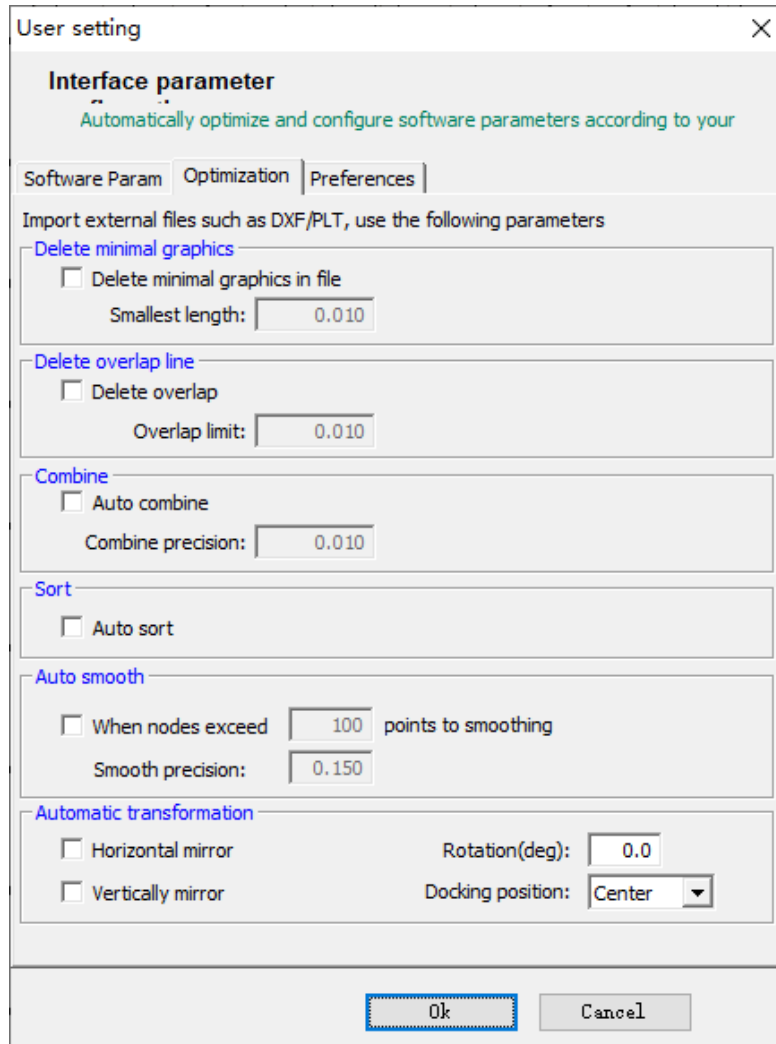
Figure: User setting interface

3.3 Toolbar description

The toolbar of this software is a Ribbon-style toolbar, including four toolbar pages: Start, Draw, CNC and

View. The two buttons in the upper right corner of the software Style can set the software style and view the

system version information. Win7's system must set Style to Windows 7, otherwise the icon buttons on the

entire Ribon toolbar will collapse.
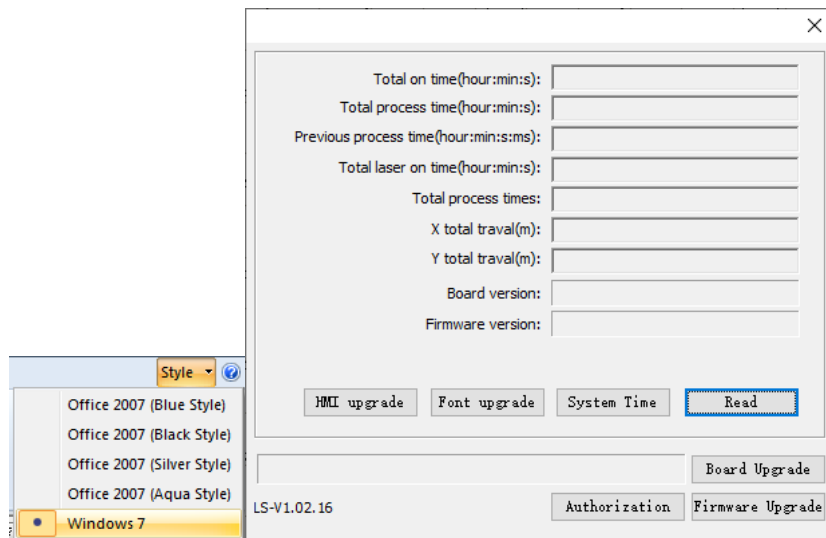
System information: User can view the various accumulative time of control system, view the system version number, and the card can be upgraded and authorized management.

Read: You can read the accumulative time, total process time, number of times of the control system, as well as the version number of the mainboard and firmware, etc.

System time: It can read or modify the local system time of the control card. After the installment is set, the local system time of the control card cannot be modified.

Font upgrade: Upgrade the local font of the control card.

Board upgrade: Use the upd. type file o upgrade the system card.

LFS upgrade: Use the .bin type file to upgrade the LFS system firmware version.

Authorization: Cooperate with the dongle for installment authorization operation.

HMI upgrade: Cooperate with the panel program to upgrade the operation panel.

Before performing the upgrade operation, be sure to contact with Ruida Technology to confirm whether the card is allowed to upgrade and the program file version.

3.3.1 Authorization management

Authorization is mainly to cooperate with the dongle for installment operations. Machine manufacturer can perform operations such as activation, encryption, and authorization. If the end user purchases the machine in installments, it needs to be obtained the corresponding authorization code in installments from the manufacturer to unlock it.
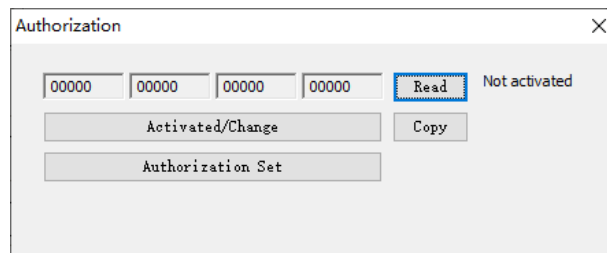
Authorization page: Both customers and manufacturers can use this page, and can read the authorization status of the control system (not activated, unencrypted, activated encryption) when connected to the control system. If the encryption is activated, the code of the system can be read.

Activate/Change authorization: Activation is for an inactivated system, and the manufacturer uses a dongle to activate it. Changing the authorization is to authorize the encryption time to the system, to achieve the purpose of installment. The manufacturer activates first, after activating successfully, the code assigned to the system will be obtained after reading .
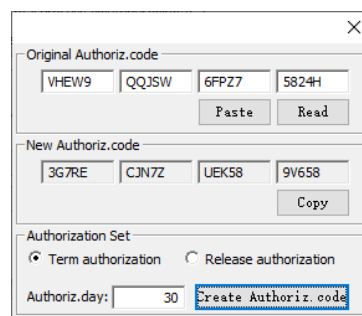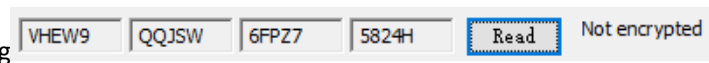
Authorization: An authorization code can be generated in this pop-up interface, to authorize the encryption

time for the system. Input the read system code, which is the original authorization code, then set the authorization period, and click "Generate New Authorization Code" to generate a new authorization code. This operation is that the manufacturer generates a new installment authorization code in the case of using a dongle based on the original authorization code of the system provided by the customer.
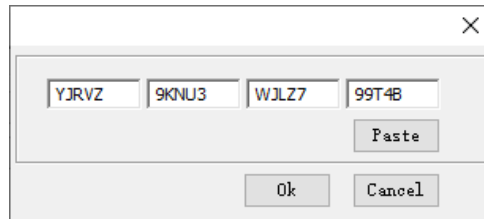
Change authorization: for unencrypted and only activated systems, the manufacturer can generate an initial authorization code (operated in the authorization settings), which is the number of authorization days in the first period, and then change the system authorization when the system is connected. For encrypted systems, the customer provides the original authorization code to the manufacturer, and then the manufacturer generates the authorization code for the next period of authorization days. The new authorization code is sent to the customer, and the customer uses Change Authorization, and enter the new authorization code to unlock the system.
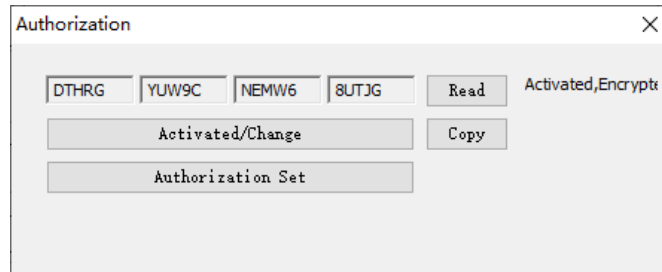
Figure: Activated and encrypted system

3.3.2 Edit toolbar

Figure: Edit toolbar interface

Edit toolbar is divided into several parts: view, geometric transformation, process setting, sorting, tools and parameter setting.

■ **View:**

Various graphics can be selected, and the auxiliary information can also be displayed when the graphics are displayed on the interface as needed (unclosed image highlighting display, graphic frame display, starting point, direction, number, idling path, node display, and the selected graphics can also be displayed in the center).
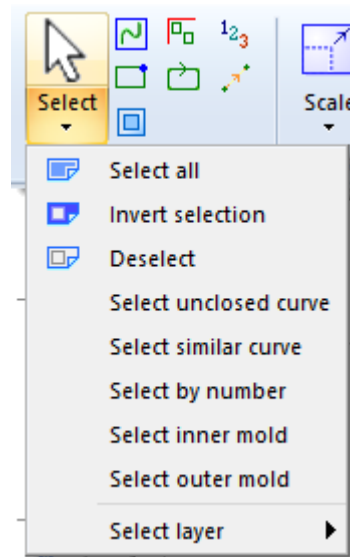
Figure: View part of the page

■ **Geometric transformation**

Quickly perform operations such as translation, graphic size transformation, mirroring, and rotation, and interactive rotation, zooming, and mirroring operations at any angle.

Translation: click the Translate button to pop up the translation setting interface. The interface displays the position coordinates of the reference point of the selected graphic, then input the position of new reference point. After confirming, the selected graphics will be translated to the new position set based on the reference point. You can also select the graphics, and use the keyboard direction keys to translate (press Shift + direction keys to quickly translate), and the translation distance is set in the keyboard parameters of the user parameters.
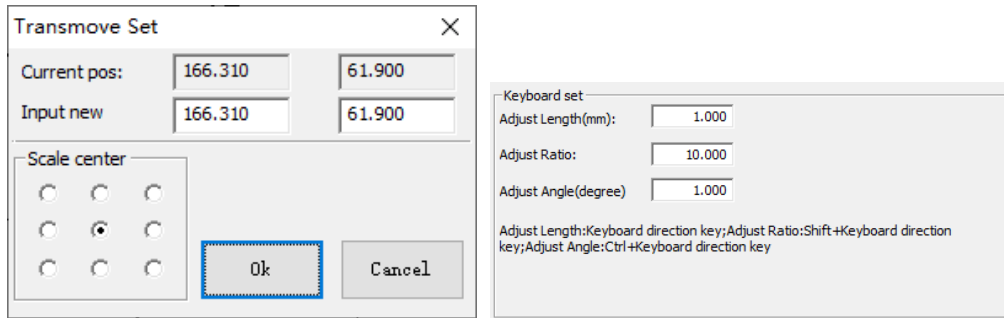
Figure: Translation setting interface

Rotate at any angle: Click the icon to rotate at any angle to enter the state of rotation at any angle, and then select the base point according to the interactive window prompt in the lower left corner, enter the angle, and press Enter to rotate the graph. If you do not select the base point and directly enter the angle, the rotation operation will be performed with the center of the graph as the base point.

Interactive zoom: The operation is the same as the operation of rotating at any angle, except that the input is the magnification of the graphics zoom.

Mirror at any angle: click the icon of mirror at any angle to enter the state of mirroring at any angle. According to the interactive window prompt, the mouse rotates the two end points of the mirrored mirror surface to finish the mirroring at any angle.
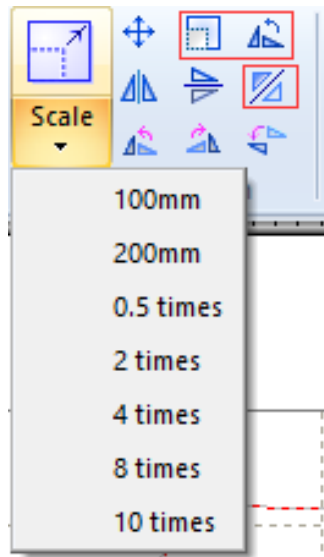
Figure: Geometric transformation page

Size change: in addition to quickly selecting the zoom times in the pop-up menu, you can also click the size icon to pop up the size setting interface. You can select a common size or enter a new size. The zoom center is the benchmark when the image is zoomed and changed.
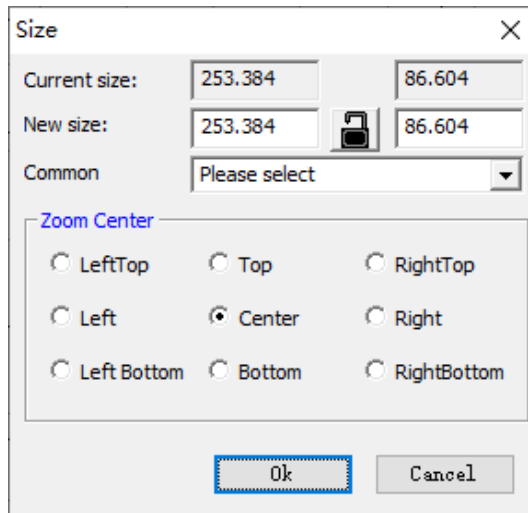
Figure: Size setting interface

■ **Process setting**

The process setting can perform operations such as lead wire, compensation, starting point modification, positioning setting, cooling point setting, inner and outer cutting setting, micro-joining, direction setting, sealing setting, etc.
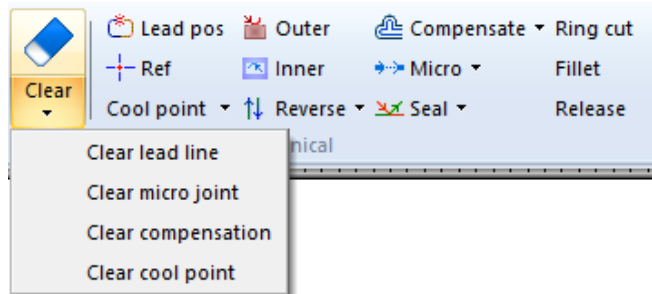
Figure: Process setting page

■ **Lead wire:** Add, modify and check the lead wire.
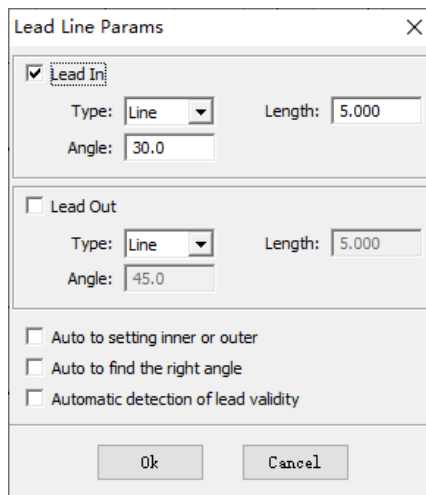
Figure: Add lead wire interface

◼ **Add lead wire**

Select to add the lead-in wires or lead-out wires, as well as the length and angle of the lead wire. automatically set the inner and outer cutting properties of the graphics and automatically detect the validity of the lead wires as needed.

Auto searching an appropriated angle is to automatically calculate the angle of the added lead wire according to the graphic characteristics (from the tangent direction or vertical direction).

To check the lead-in and lead-out, you can set the safe distance of lead wires, and modify the qualified lead wires (check the inference among the lead wires and the graph itself and other graphs)

Modify lead-in lead-out wires: Enter the modification status, use the left mouse key to drag the end point of the lead wires to the desired position. (Status operations press the ESC key to exit)
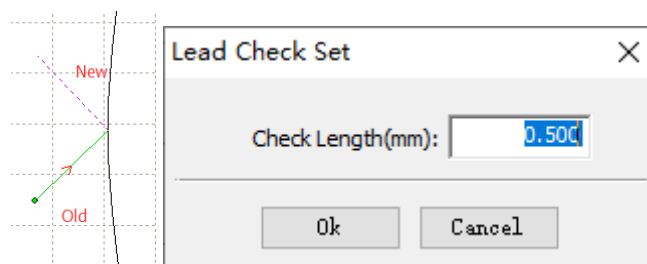
Detect lead-in lead-out wires: set the lead wires safe interval in the pop-up window, if the lead wires intersect the original primitives, it will be shortened automatically. The safe interval of the lead wires is generally set to be relatively small, otherwise it will easily cause the failure of lead wires addition.

◼ **Modify starting point:**

Click to modify the starting point icon 🖱 Lead pos to enter the state of modifying starting point. Click the mouse in the drawing interface. If the first click is outside the graph, and the second click is on the graph, add a lead wire between the first click position and the second click position, and modify the starting point to the second click position. If you click on the graph for the first time, the starting point is directly modified to this position (the starting point of the non-closed graph cannot be modified). (Status operations press the ESC key to exit)

◼ **Positioning setting:**

Set the graphic reference point (the point marked by the green square) as a reference for various motions of the graph (it is used when the floating coordinate system and the workpiece coordinate system are processing). User can directly specify the 9 relative positions of the selected graphics as the reference points, or you can use

the mouse to specify the absolute positions as reference points. Reference points are mainly used in the floating coordinate system, so it is best to set the reference points close to the origin, otherwise the problem of exceeding the breadth may occur in the floating coordinate system.
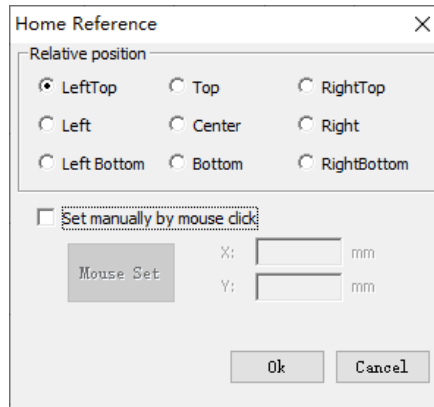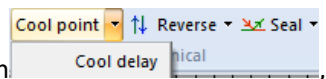
Figure: Graphic reference point setting interface

■ **Cooling point setting:**

Click the button Cool point ▾ to enter the state of adding cooling points, and then use the mouse to click the left key on the graphic primitives to add cooling points. When processing, the default process is laser off here-

cooling point delay-laser on. At the same time, click the expand button of this button
click the button to enter the setting interface.
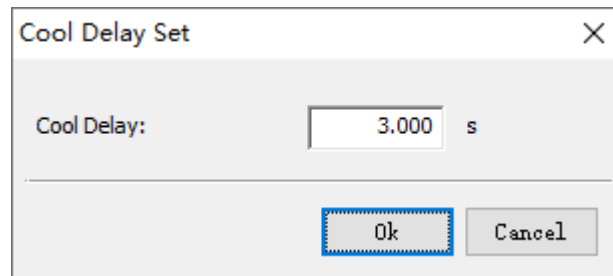
Figure: Cooling point delay setting interface

■ **Inner and outer cutting setting:**

Set the inner and outer cutting properties of the selected graphics, and the related lead and compensation will be changed accordingly.

■ **Compensate:**

Click the compensation icon to pop up the compensation dialog box, set the compensation parameters, and confirm, then the graphic compensation operation is realized. Compensation can correct the inconsistency between the size of the cut graphics and the original graphics due to the size of the laser spot.
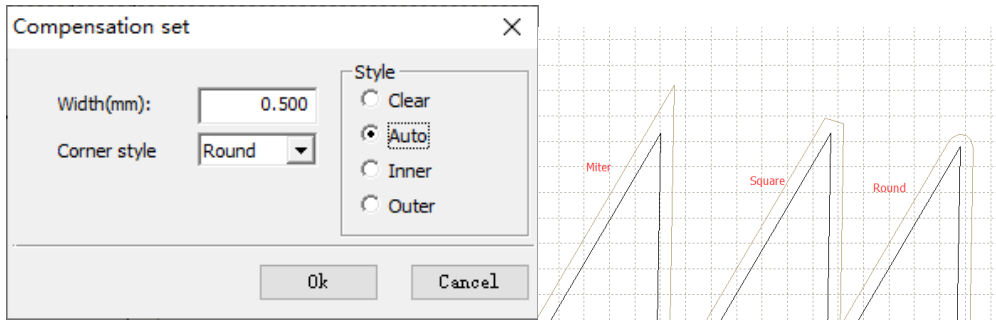
Figure: Compensation setting interface

Turning processing: Represents the connection method adopted by the compensation line.

■ **Micro-joining**

There are manual micro-joining and automatic micro-joining. The micro-joining is to prevent the cut graphics from falling down (turn off the laser at the set micro-joining position).

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Manual micro-joining is realized with the left mouse key. Click the micro-joining button to enter the state of manual add micro-joining. According to the interactive window prompt in the bottom left corner, click on the graphic primitives to add a micro-joining at the clicked position. The size of the micro-joining is the size set during automatic micro-joining. (Status operations press the ESC key to exit)

Auto micro-joining can choose to add micro links automatically by quantity and by interval distance. By quantity is to add a specified number of micro links on the selected graph; by interval distance is to add a micro link at such a long interval according to the set interval size.
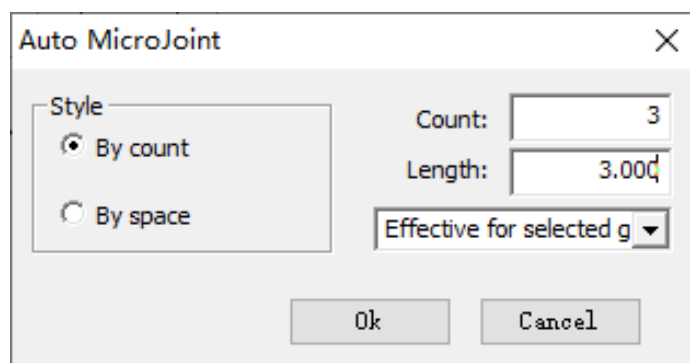
Figure: Automatic micro-joining setting

■ **Direction setting:**

Reverse the selected graphics, and set the direction of the graphics to be clockwise or counterclockwise.

■ **Sealing processing:**

Including sealing, notching, and over-cutting. Sealing is to seal and close the graphics with notches or over-cut operations; Notching is the treatment of cutting off a section of the closed figure at the last position; Over-cutting is to overcut the closed figure for a certain distance.
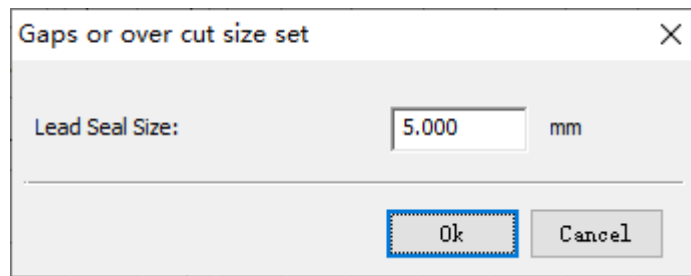
Figure: setting interface for notch and over-cut size

■ **Circular cutting:**

In order to prevent the speed from reducing too severely in the sharp corners and resulting in burnt corners, a curve is added in the sharp corners to go around and cut to achieve the purpose of reducing the speed down.

Maximum included angle: Only when the angle is smaller than this angle can the circular cutting effect is added.

Shortest side length: The length of the two sides forming the angle cannot be less than this value.

External length: the length of the extended circular cutting.

Automatic, external, internal, internal and external cutting: whether the circular cutting acts on the convex corners or concave corners.

Cancel circular cutting: It is to eliminate the circular cutting of curve with circular cutting.
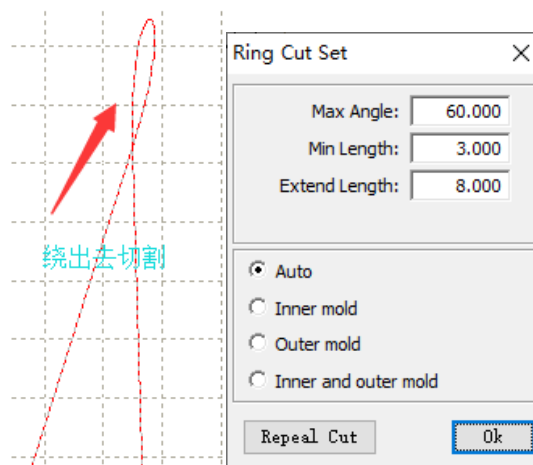
Fillet: After setting the radius of the rounded angle, enter the fillet state, click the vertex of the included

angle of the graph with the left mouse button to turn the included angle into a rounded angle.

Release angle: After setting the radius of the rounded angle, enter the release angle state, and click the convex of the included angle of the graph with the left mouse button to turn the included angle into a release rounded angle. It is mainly used for materials with thickness. After cutting, it should be folded at the angle position. In order not to withstand the thickness, a release angle is added.
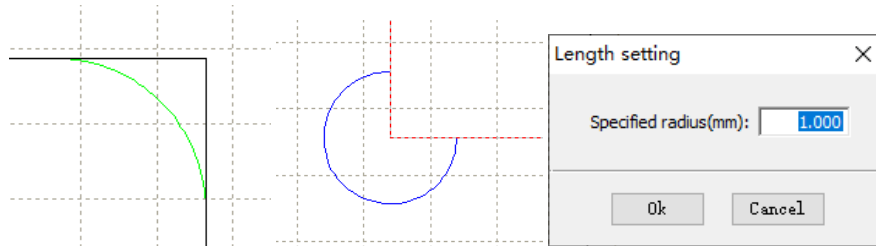
Figure: Fillet, release angle effect and radius setting

■ **Sorting:**

Sorting can perform path optimization processing for all graphics, or manually select a single graph for sequence adjustment operations.

Path optimization: Set the parameters of path optimization. Sorting can set the block height and direction according to the layer, sort the inner and outer membranes from the inside to the outside, and automatically determine the starting point and direction of the cutting.
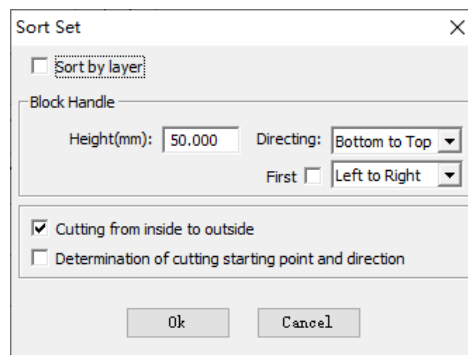
Figure: Path optimization setting interface

By layer order: in the overall ordering, it is sorted according to the order of adding layers, and the inside of the layer is sorted according to the following selections.

Block processing: All graphics can be divided into regions according to height, and sorted in each region according to the set direction and the position of the reference point.

Direction/Priority: Set the processing direction.

Cutting from the inside to the outside: The sorting of the graphic primitives follows the cutting order from the inside to the outside.

Automatically determine the cutting starting point and direction: Modify the starting position and direction of the graphics as needed when sorting. If this option is not selected, the starting position and direction of the graphics will not change.

Adjust the position of a single graph: Move the single graph to the end, move to the front, move forward, and move backward.

Single step preview: Select a graph, click the buttons to preview the previous graph and the next graph, the processing order shown by the selected graph.
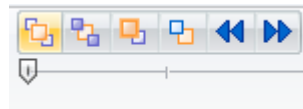
Figure: Position adjustment of single graph

■ **Tools:**

Tools are mainly some auxiliary processing functions for processing graphics, which is to improve processing efficiency and complete some special functional requirements. There are arrays, groups, scanning, coedges, bridges, measurements, curve splits, automatic bridges, delete duplicate lines, delete small graphics, and merge connected lines in the tools.
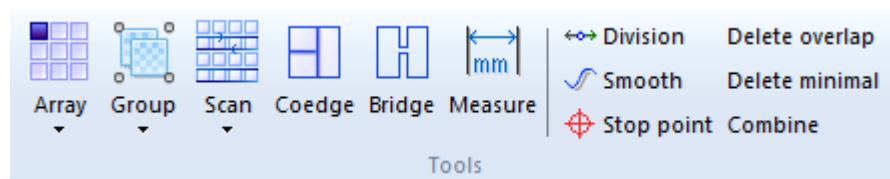
Figure: Auxiliary function toolbar

■ **Array:**

According to the set number of rows, columns, offset (can be offset or spacing), as well as row and column directions, perform array processing on the selected graphics.
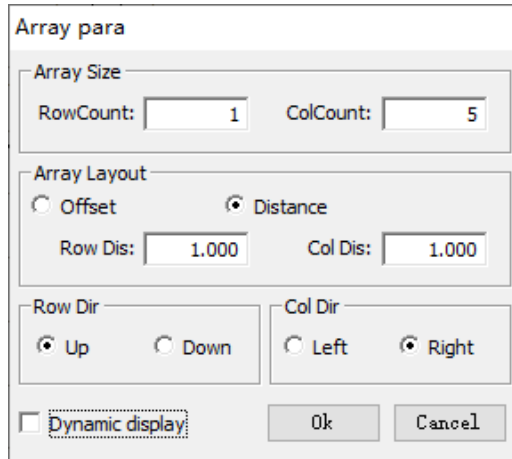
Figure: Array settings

■ **Full array:**

The array in the sub-item of the array automatically fills the breadth range with the selected graphics according to the setting breadth size.
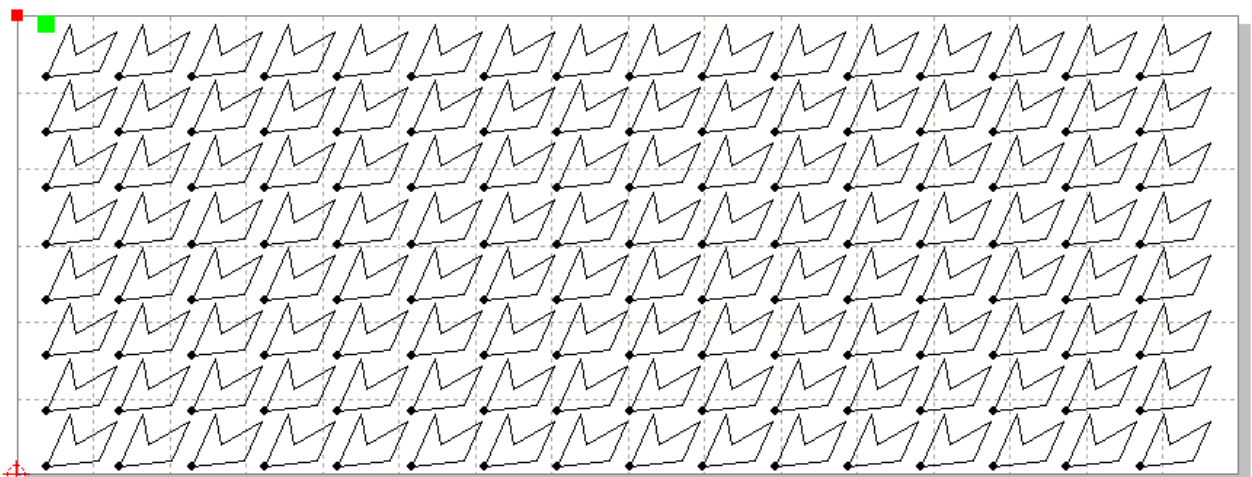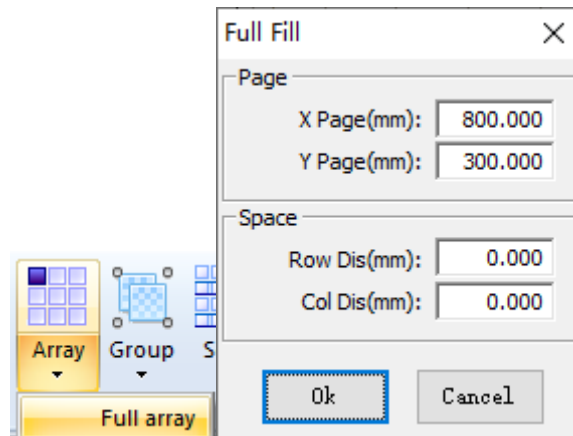
Figure: Parameters and effects of array

■ **Group:**

Combine the graphics that need to be grouped into a group for processing. Generally, a single part composed of multiple graphics is combined into a group. For groups, the selected group can be scattered or all groups can be scattered. Select multiple graphics, and then click the group button, so that the selected graphics are combined into a group. The selected graphics can be a single graph or a group, so the group can also contain a group.
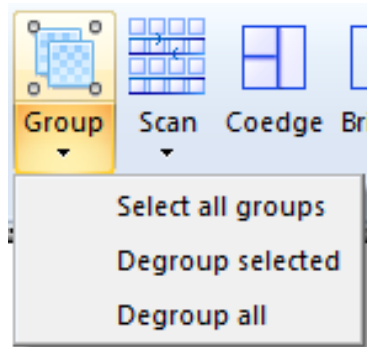
Figure: Operations on groups

■ **Coedges**

Combining workpieces with the same boundary and sharing a boundary can save a lot of processing length and improve efficiency. When the boundary distance is smaller than 0.1mm between two graphics, they can be co-edged. Select multiple graphics and click the coedge button on the toolbar , the software will coedge the selected graphics.

■ **Scan:**

Straight line same direction group scan will compose a scan line from the line segments on the same line according to the set spacing. When processing these scan lines, the processing of line segments on the same straight line will not slow down. Scanning can reduce the time-consuming of processing (the internal sorting of the scan line follows the set direction when the scan was initially performed other than affected by path optimization).
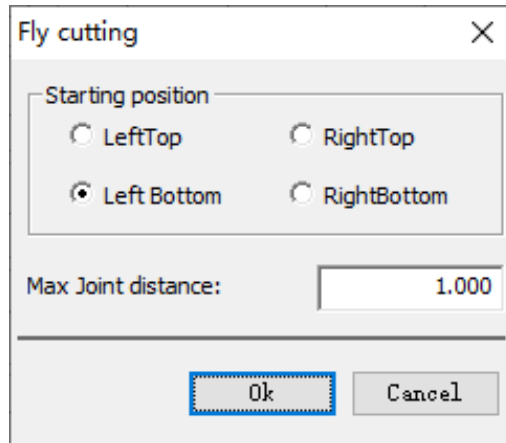
Figure: Straight-line flight scan settings

Starting position: Refers to the position to start cutting. For example, the upper left is to start cutting from the upper left position of the overall graph, and the subsequent graphs are sorted according to the nearest principle (find the graph closest to the end of the current graph).

Minimum scan length: if the length of the line segment is smaller than this length in the graph, the graph will not perform linear scan operation.
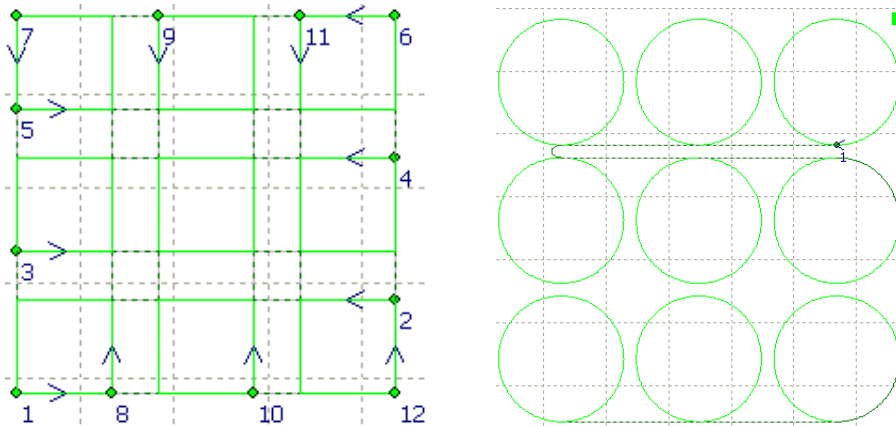
Figure: Scanning results

■ **Bridging:**

When a workpiece is composed of multiple parts, and you don't want it be scattered after cutting, you can connect them through "Bridging".

Click the bridging button 桥接 to enter the bridging state, click a position with the mouse, and then pass through the graphics to be bridged and click another position to form a bridge line, and all graphics that the bridge line passes through will be automatically bridged. (Hold down the Ctrl key to generate a horizontal or

vertical bridge line)

There are two configurable parameters for bridging, one is the maximum distance allowed to bridge the graphics, which is the maximum distance between adjacent curves, as well as the width of the bridge.
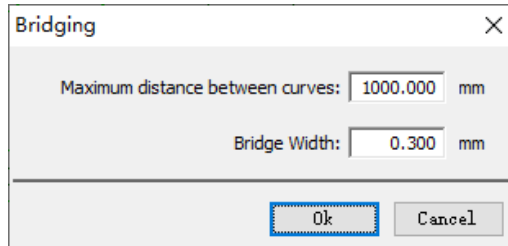
Figure: Bridge parameter settings
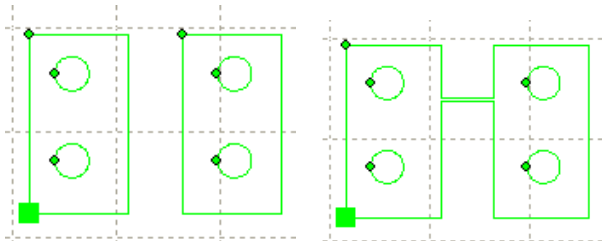
Figure: Changes before and after bridging processing

■ **Measure**

Measuring the distance between two points is also to measure the distance between two graphics. Click the measurement button on the toolbar to enter the measurement state, click the interface with the mouse to obtain two points (hold down the Ctrl key to get the horizontal or vertical distance), then calculate the distance between the two points, and display it in the interactive window in the lower left corner.
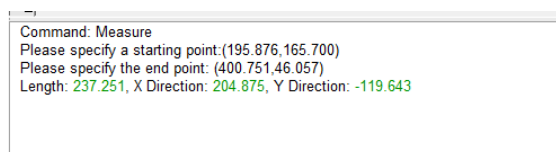
Figure: Measuring length display

■ **Curve split:**

Split a single curve into multiple curves as required. Click the curve split button to enter the split curve state, and then follow the prompts in the interactive window in the lower left corner, and click the graph to be split with the left mouse button to split a single graph into multiple ones.

■ **Merge connected lines:**

Merge multiple curves that meet the requirements into one. When using this function, if the graphics are selected, the selected graphics will be merged, and if the graphics are not selected, all the graphics will be merged. If the graph that has been split has not been moved, you can use the function of merging connected

lines to merge multiple graphs that have been split.
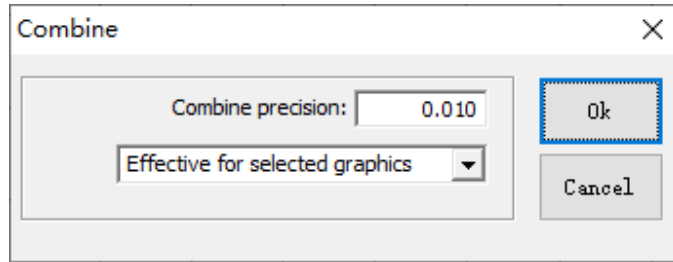
Figure: Merge connected line settings

■ **Delete duplicate lines:**

This function is aimed at a single graph, and removes the duplicate line segments in a single graph. After

such processing, a single graph may become multiple graphs.

■ **Delete minimal graphics:**

According to the conditions of the set minimal graphics, delete these qualified graphics.
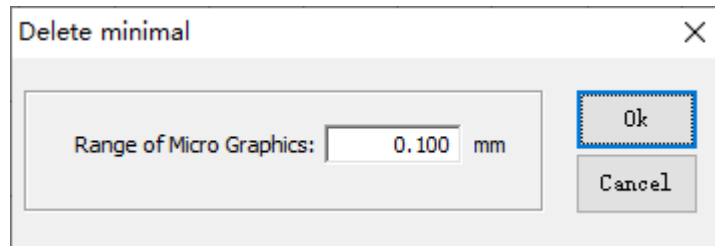
Figure: Condition setting for minimal graphics

■ **Stop setting:**

Click the stop ⊕ button to pop up the stop setting dialog box. Directly enter the stop location (To get the

coordinates of the current laser head location) or select the stop location with the mouse.
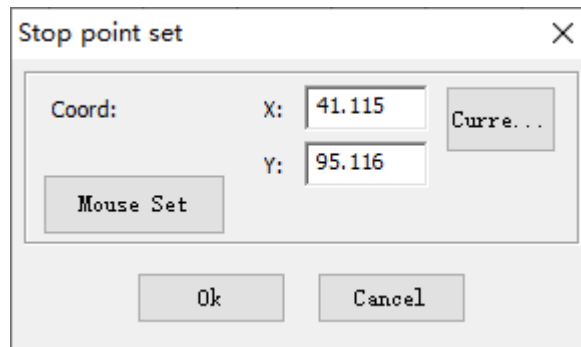
igure: Stop setting interface

3.3.3 Draw toolbar

Draw some simple graphics, align, move, and transform the selected graphics.

■ **Graphics drawing**

Draw polyline, rectangle (square) and ellipse (circle), etc.
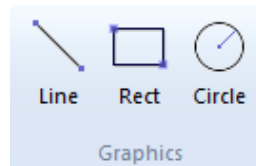
Figure: Draw

■ **Align processing:**

The selected graphics can be aligned (press the shift key + the left mouse button to select multiple graphics).

The alignment includes top, bottom, left, right, vertical center, horizontal center, and center alignment.

Figure: Align processing

■ 平 **Translate and transform**

Translate the selected graphics to the 4 corners and the center position of the breadth, which is convenient

for processing. The selected graphics can also be transformed with equal width, equal height, equal size, and

arranged horizontally and vertically at equal intervals.
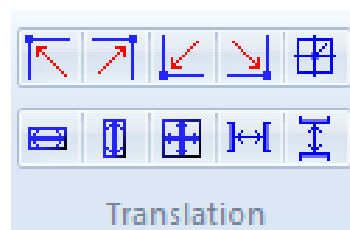
Figure: Translate and transform

3.3.4 CNC toolbar

Perform processing operations, processing-related parameter settings, machine detection, laser settings

and other auxiliary function operations.

■ **Processing operations:**

Here start and stop the normal cutting, idling processing and simulation (simulation speed is adjustable).
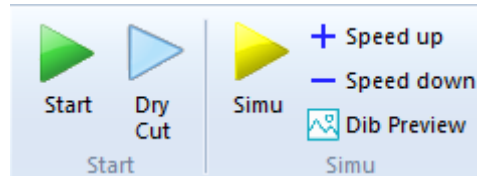
Scan preview: After setting the mode to "Laser scanning" in the layer parameters, you can view the processed processing data here. In addition, after resetting the corresponding layer parameters here, you can "preview" the effect, and click the "Apply" button to directly apply the set parameters to the corresponding layer. There is no need to set these scan-related parameters again in the layer parameter interface.
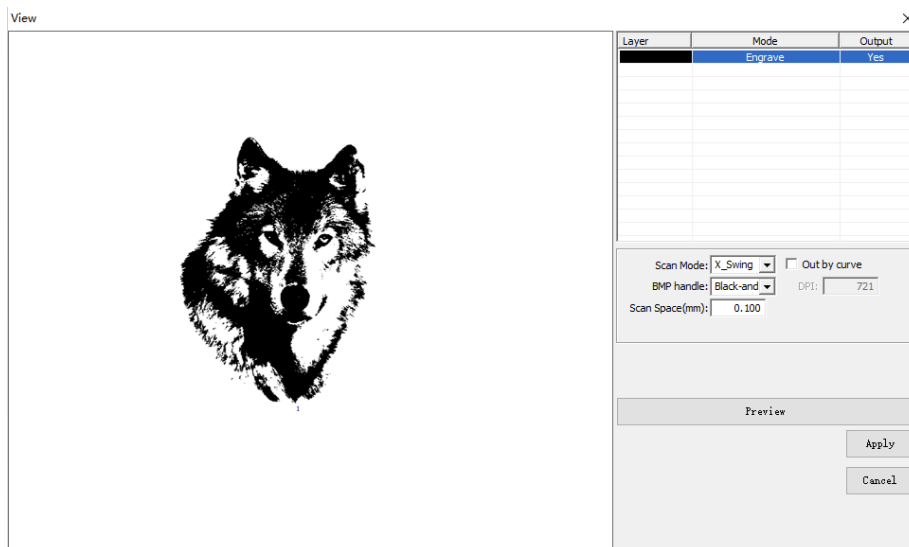
■ **Go origin:**
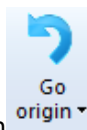
Click the button to expand to return to the origin (click the button directly without expansion to return to the origin at the same time for X and Y). It can be the operation of returning to the origin of the X and Y axes at the same time, or it can be a single axis of returning to the origin.
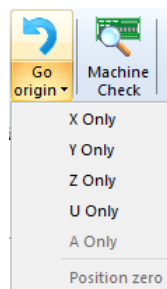
Figure: Go to origin

Go to origin, first the axis moves in the negative direction in a maximum speed. When the origin switch is triggered, the movement is stopped and the position is captured. Then move in the reverse direction for a set distance, and then move in the negative direction at a smaller speed until the origin switch is triggered.

◼ **Machine check:**

Click the button ![Machine Check] to perform machine detection. It can detect the IO input and output and limit of the system are normal.
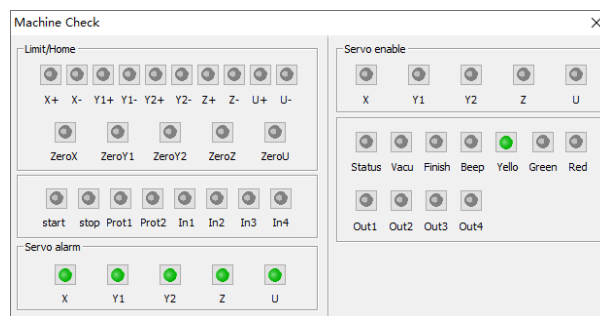
Figure: Machine detection interface

Hard limit level status, input IO level status: These statuses are read automatically when the dialog box pops up. After entering the interface, manually click the read button to read. Here is the trigger status, green means the alarm or IO is triggered, and gray is not triggered.

Output IO test: click the output IO button and check the interface status of the control system. The green shown on the interface means it is connected to GND, and the gray means it is turned off (i.e. suspended).

◼ **Machine adjustment**
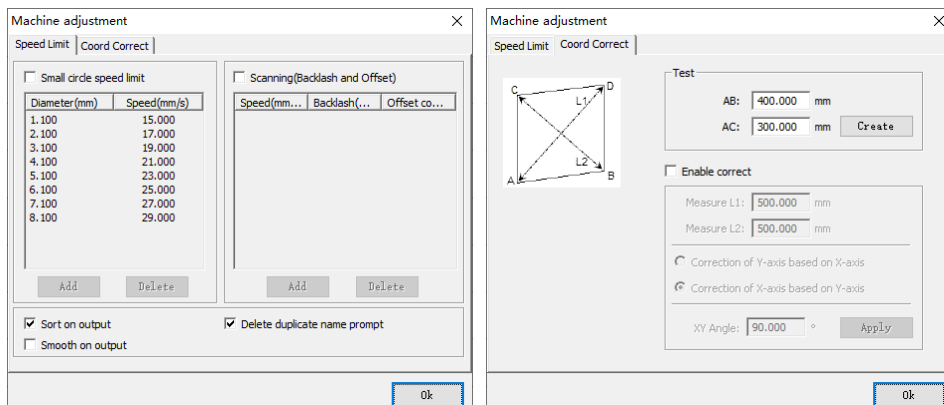
It is mainly used to compensate the dissatisfaction of the software with the effect of the existing machine. Here, small circle limit speed, verticality correction and other operations are performed.

Small circle limit speed: After enabling, fill in the diameter and speed. Then during processing, the speed

limit will be processed according to the range where the small figure is located.

Sort on output: When start processing, downloading or generating offline files, reorder the graphic primitives in the graphics editor.

Smooth on output: When start processing, downloading or generating offline files, smooth again the graphic primitives in the graphics editor.

Coord correction: It is mainly for the compensation of machines with insufficient verticality of the X and Y axes. First, generate a set size rectangle, then cut the rectangle, and then measure the length of the diagonal. After enabling, fill in the corresponding diagonal length into the corresponding position, select the reference axis, and click "Calculate" to automatically calculate the compensation data.

Scan (Reverse compensation): It is used to compensate the interval and offset at the corresponding speed when engraving. When the scanning pattern is misaligned left and right, using the reverse to compensate when the scanning pattern as a whole deviate to a certain direction.

■　**File management:**

It can be used only when it is connected to the system. Here can view all the files downloaded by the system, delete these files, and download the saved offline files to the system. And can start the processing of the selected files.
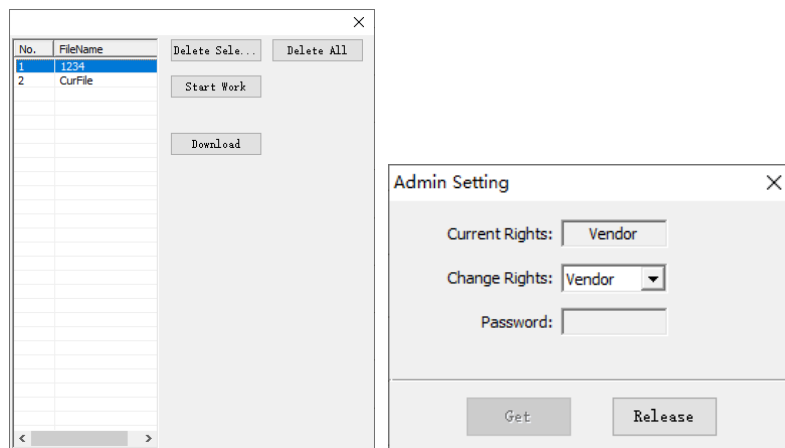
Figure: File management, permission settings

■　**Permission settings:**

After "Enable Authority Management" in the vendor parameters, click here to enter the authority management interface, select the authority and enter the correct password, and click the "Change" button. If the password is correct, set the software authority level to the selected level, and if the password is incorrect, the level cannot be modified. Click the "Cancel" button, and the software authority level will be restored to the

lowest "operator" level. There are four levels of authority: "Operator", "Engineer", "Administrator", and "Manufacturer". The following is a description of all levels of authority:

Operator: Only operate the software to open the .rlc project file, and start processing, downloading and other operations.

Engineer: Can add import, export, save and layer parameter setting operations on the basis of the operator.

Administrator: All operations except for the "Factory Parameter" setting can be performed.

Manufacturer: All software operations can be performed.

The manufacturer has to contact RUDIA compony to get the passwords

3.3.5 View toolbar

The toolbar is mainly some functions related to the interface display, such as: the translation mode and sort mode switching of the drawing interface, the selection of special graphics (inner membrane, outer membrane, similarity, etc.), the display and hiding of the drawing bar and status bar, the display and lock of the layer, etc.
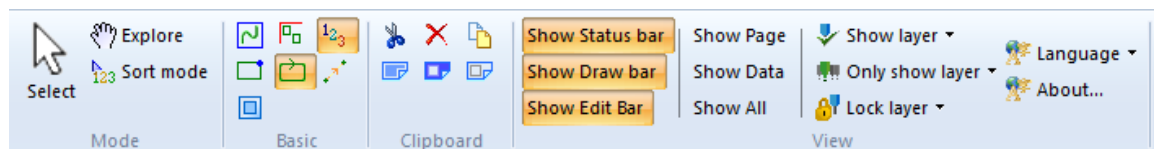
Figure: View toolbar

3.4 Parameter description

3.4.1 Vendor parameters
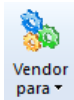
Click the button ![Vendor para] from the CNC to open the vendor parameter setting interface, the axis parameters, machine configuration parameters, and clear the control card information can be set here.

Figure: Axis parameters

X, Y, Z, U Axis	**Motion polarity**	Modifying the direction polarity can make the motor move in the opposite direction. The goal of the modification is to make the axis move in the direction of the origin when resetting. If the axis moves away from the origin when resetting, it means that the axis direction polarity setting is wrong and should be modified.
	Limit polarity	It is used to set the high and low voltage mode of the limit signal. When the motion axis reaches the limit position and inputs a low-voltage signal to the mainboard, the limit polarity should be

		set to negative. (Limit switch must use NPN type)
	Control mode	The type of controller output pulse includes positive and negative pulse, pulse + direction two modes. Generally, set to pulse + direction mode.
	Back to origin signal	When the system is reset to find the origin, negative limit or zero point can be selected as the position of 0 coordinate. After setting the parameters, the corresponding CN2, CN3, CN4 hardware interfaces require to be correctly wired.
	Hard limit protection	If the hard limit is enabled, when it is triggered, limit protection will be generated; if the hard limit is disabled, when it is triggered, no protection.
	PWM rising edge effective	It is used to set whether the pulse signal of the motor driver is effective on the rising edge or on the falling edge. When this item is not enabled, the controller uses the falling edge to be effective; when the item is enabled, the controller uses the rising edge to be effective.
	Motor step	The pulse equivalent of the motor. When sending a pulse to the motor, it corresponds to the absolute distance value traveled by the motion axis. Before this value is correctly set, the machine can cut a rectangle as large as possible (larger graphics can make the error smaller), and the motor step can be automatically calculated by the length of the graphics and the measured length.
	Stroke	The maximum distance the motion axis can move, depends on the actual situation of the machine.
	Origin offset distance	If the hard limit protection is enabled for this axis, the value should usually be set between 2 to 5mm. If it is set to 0, when the motion axis runs to the minimum coordinate 0, it may make the limit valid, which will trigger the hardware limit protection function by mistake.
	Maximum speed	The highest ultimate motion speed that the axis can withstand. This parameter is related to the drive capacity of the motor, the inertia of the motion axis and the transmission ratio.

Work start speed	The speed at which the motion axis starts directly from a stationary state, typical value is 5~20mm/s.	
Manual start speed	The starting speed when the axis is moved by pressing the key, which cannot be higher than the work start speed of this axis.	
Work maximum acc	The maximum acceleration value of the motion axis during acceleration and deceleration.	
Manual ACC	The acceleration value when the axis is moved by pressing the key, which cannot be higher than the maximum acceleration.	
Ems stop acc	If the hard limit protection is enabled for this axis, when the axis moves to the limit position, the axis will perform an emergency deceleration stop operation at the emergency stop acceleration. This value can be 1.5 to 3 times the maximum acceleration of the axis.	
Servo alarm enable	If the servo alarm is enabled, when the servo drive alarms, protection will be generated; if the servo alarm is disabled, when the servo drive alarms, no protection.	
Key reverse	Control the motion direction of the manual key when moving the motion axis. When the direction polarity parameter is correctly set, if you press the direction key on the operation panel, the axis moves in the opposite direction, then enable the key to reverse.	
Servo enable	It is used to configure whether the servo enable interface outputs an effective signal.	
Encoder enable	If the encoder is enabled, it is considered that the system hardware wiring is connected to the encoder correctly.	
Encoder polarity	It is used to set the encoder polarity.	
Encoder resolution	Set the number of pulses of the encoder feedback per revolution of the motor.	
Screw pitch	The distance that the motor moves in one revolution, this parameter needs to be set according to the actual situation of the machine.	
Follow alarm enable	When the encoder is connected, the system will detect the sent command signal and the feedback signal of the servo drive. If the deviation is too large, an alarm will prompt.	

	Maximum following error	The maximum allowable motor lag.
Dual-drive configuration	**Y axis dual-drive enable**	It is used to enable whether the Y axis of the machine is a dual-drive structure
	Dual-drive synchronous alarm enable	If the dual-drive synchronous alarm is enabled, protection will be generated when the dual Y axis is misaligned; if the dual-drive synchronous alarm is disabled, no protection will be generated when the dual Y axis is misaligned.
	Dual-drive synchronization error	If the dual-drive synchronous alarm is enabled, when the Y-axis dual-drive misalignment difference is greater than the dual-drive synchronization error, protection will be generated;
Machine configuration	**Grating protection enable**	When this signal is enabled, a low-voltage signal needs to be continuously input from the outside to the corresponding hardware interface, otherwise an alarm will prompt during processing
	Open cover protection enable	When this signal is enabled, a low-voltage signal needs to be continuously input from the outside to the corresponding hardware interface, otherwise an alarm will prompt during processing
	Water protection enable	When this signal is enabled, a low-voltage signal needs to be continuously input from the outside to the corresponding hardware interface, otherwise an alarm will prompt during processing
	Press control enable	Whether to enable the Y axis pressing rod control. If it is enabled, check it. When the Y axis pressing rod control is checked, also can choose whether the absolute origin of the machine is above or below the machine table.
	Feeding mode	Unidirectional/bidirectional optional. When it is unidirectional feeding, it can always feed in one direction without checking the coordinates; When bidirectional feeding is selected, the system will check the maximum and minimum coordinates. Feed materials in one direction at odd times, and feed materials in the other direction at even times. The initial direction of the first time can be changed by setting the direction polarity or

		modifying the positive and negative values of the feeding length.
	Power-off delay	0~3000ms can be set. After the power grid is cut off, the system power supply will not drop to 0V immediately, during which there is a delay. The delay value set here should be basically the same as the actual power-off delay value. If the deviation of the setting value is large, when the power is cut off and the engraving is continued, the processed graphics and the graphics before the power failure are either not closed or overlapped too much.
	Y axis origin position	It is applied to Y axis pressing material, select whether the pressing material is above or below.
	Software testing the laser	This option is used in conjunction with Mark point vision. Check it to control the brightness of the light source through the serial port.
	Enable permission protection	After enabling the permission protection, from "CNC" -> "Permission Management" to perform hierarchical authority management for each function of the software, and the corresponding operations can only be obtained by modifying it to the corresponding authority level.
Z axis configuration	**Enable Z axis auto lifting**	The system will execute the Z axis automatic lifting control only after the enable is checked. If the Z axis automatic lifting function is disabled, all Z axis lifting and lowering actions are invalid, and the Z axis movement is only controlled by manual movement.
	Control mode	It is used to describe the actual configuration of Z axis of the equipment, and support motor control and cylinder control. Use card Z axis control interface when selecting the motor mode, and use card OUT1 interface when selecting the cylinder mode.
	Control object	It is used to describe the actual configuration of the Z axis of the equipment, and control whether the cutting head moves or the platform moves.
	Z axis origin position	It is used to describe the actual configuration of the Z axis of the equipment. When the Z axis is reset, the control object is to move up to reset or move down to reset.

Laser source	Laser source enable	Whether to enable the laser source control, if it is not enabled, the laser source cannot be controlled.
	Laser source type	Different types of laser sources have different control signals, so you need to select the correct laser source type.
	Control mode	Support PSS, PSV, PSP, FSP mode optional. PSS is a fixed power mode, PSV is a power following mode, PSP is a position synchronization mode, FSP is a fixed pulse width mode, and the default is FSP mode.
	Processing signal effective	Set the PWM control signal effective level
	Laser frequency	Set the PWM working frequency
	Maximum power	Maximum allowable output power
	First pulse suppression starting power	Taking the RF tube as an example, if the same signal is used to control the laser on, the first few pulses actually output by the laser source have a large energy, so it needs to be suppressed.
	First pulse suppression duration	The first pulse suppression time, beyond this time, the normal laser control signal will be output
	Enable pre-combustion	Some RF tubes need to have a pre-combustion signal, and parameter is used to output a pre-combustion signal.
	Pre-combustion frequency	Some RF tubes need to have a pre-combustion signal, and parameter is used to set the pre-combustion signal frequency
	Pre-combustion pulse width	Some RF tubes need to have a pre-combustion signal, and parameter is used to set the pre-combustion signal duty cycle

Step distance measurement method: Manual to move 100mm in a single direction to measure the actual movement distance. Then click the button [⋯] to enter the calculation interface, fill in the value set at the beginning and the measured value, and click OK to calculate the equivalent. You can also cut a relatively large rectangle, and then measure the size of the cut graphics and compare with the size set by the software.
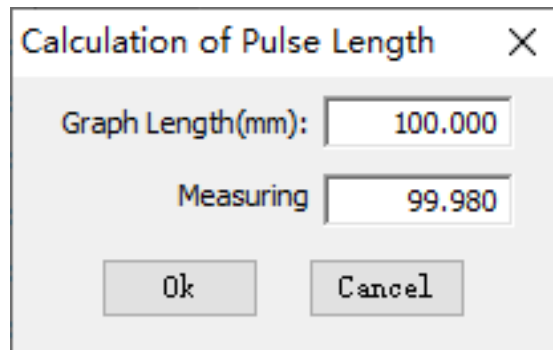
Figure: Step distance calculation

3.4.2 User parameters

When you click [User Param] to open the user parameter setting to view and modify.
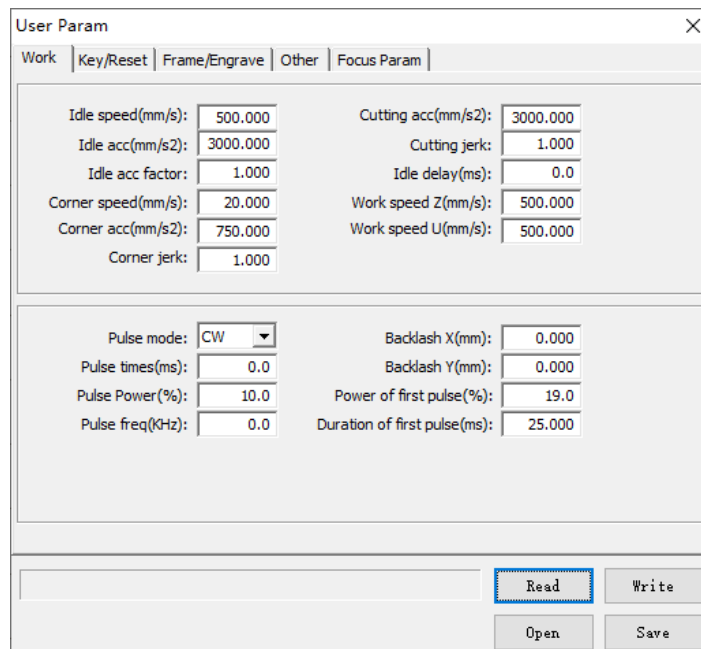
Figure: User parameter settings

Processing parameters	Idle speed	This parameter determines the maximum speed of all unprocessed motions during the processing of the machine.
	Idle ACC	The maximum acceleration of unprocessed motions. Larger

		settings for idle speed and idle acceleration can shorten the overall working time of the graph, but too large a setting may cause a jerky trajectory.
	Idle acceleration factor	This parameter reflects the speed of acceleration change during unprocessed motions.
	Corner speed	The speed during processing at the corner and it is also the minimum speed in the whole processing process.
	Corner acceleration	The acceleration during processing at the sharp corner. If the turning speed and turning acceleration are set too large, the turning will be jittery. If the setting is too small, it will affect the trajectory speed. Turning acceleration is the minimum acceleration value in the whole graphics processing.
	Corner factor	This parameter reflects the turning speed when processing arcs of various curvature.
	Processing acceleration	The highest acceleration value during the whole processing.
	Processing acceleration factor	This parameter reflects the speed of acceleration changes during processing.
	Idle delay	If this parameter is 0, there will be no delay after idling, otherwise the speed will be reduced and delayed after idling.
	Z axis working speed	Speed when Z axis is working
	U axis working speed	Speed when U axis is working
	Pulse mode	Set pulse mode, there are continuous/pulse optional
	Pulse time	When the mode is <pulse >, the time for a single laser on
	Pulse power	Laser on control signal power
	Pulse power	laser on control signal power
	X axis backlash	Backlash of X axis. Set this value according to whether the machine actually has backlash, accurate to 1um, if the value is not zero, the mainboard will compensate for the backlash.
	Y axis backlash	Backlash of Y axis. Set this value according to whether the machine actually has backlash, accurate to 1um, if the value is not zero, the mainboard will compensate for the backlash.
	Power of first pulse	This power is used for processing during the suppression

		duration when the primitive starts to be processed. The first pulse suppression is to prevent over burning at the start processing position.
	Duration of first pulse	Set the duration of power suppression at the beginning of the processing position of the primitive.
Key parameters	**Manual fast X**	Refers to the speed of manually moving the X axis when [Fast Speed].
	Manual slow X	Refers to the speed of manually moving the X axis when [Slow Speed].
	Manual fast Y	Refers to the speed of manually moving the Y axis when [Fast Speed].
	Manual slow Y	Refers to the speed of manually moving the Y axis when [Slow Speed].
	Manual fast Z	° Refers to the speed of manually moving the Z axis when [Fast Speed].
	Manual slow Z	Refers to the speed of manually moving the Z axis when [Slow Speed].
	Manual fast U	Refers to the speed of manually moving the U axis when [Fast Speed].
	Manual slow U	Refers to the speed of manually moving the U axis when [Slow Speed].
Reset parameters	**X axis reset speed**	Speed when X axis is reset
	Y axis reset speed	Speed when Y axis is reset
	Z axis reset speed	Speed when Z axis is reset
	U axis reset speed	Speed when U axis is reset
	X axis power-on reset enable	If the X axis power-on reset is enabled, the X axis will be automatically reset when the machine is turned on, otherwise it will not be automatically reset.
	Y axis power-on reset enable	If the Y axis power-on reset is enabled, the Y axis will be automatically reset when the machine is turned on, otherwise it will not be automatically reset.
	Z axis power-on reset enable	If the Z axis power-on reset is enabled, the Z axis will be

		automatically reset when the machine is turned on, otherwise it will not be automatically reset.
	U axis power-on reset enable	If the U axis power-on reset is enabled, the U axis will be automatically reset when the machine is turned on, otherwise it will not be automatically reset.
Frame/Return	**Return position**	The position where the cutting head stops after processing. There are four types of zero origin, original, non-return, and dock position
	Stop point X coordinate	It is used to set the X-axis coordinate position of the stop point.
	Stop point Y coordinate	It is used to set the X-axis coordinate position of the stop point.
	Frame mode	The motion mode when the panel start to frame, it can be frame with laser on or no laser.
	Frame distance	The extension distance of the moving track of the frame relative to the actual graphics frame.
	Frame speed	The maximum speed of frame movement
Engraving	**X, Y axis start speed**	The start speed of scanning, when the motor is used for dragging, it is not necessary to start acceleration from 0, but can directly start from a certain speed to shorten the overall processing time, but the speed cannot be too high.
	X, Y axis acceleration	To match the scanning speed (the layer speed in the layer parameters). if the setting is too small, the scanning will require a longer acceleration distance, which will affect the scanning efficiency. The actual setting varies according to the machine structure and load condition.
	Line feed speed	This parameter is specially used to control the maximum speed of vertical movement from the previous line to the next line in the scanning mode. If the line-to-line spacing is large during scanning, or the distance between each block is large when scanning block graphics, and each line or block needs to be accurately positioned, user can set the scan line feed speed to a lower value.
	Scan ratio	It is equivalent to the acceleration in S-type, which indicates the degree of urgency of acceleration and deceleration.
Other parameters	**Blowing Type**	Set the blowing interface control mode, with manual blowing, work, laser on blowing.
	Absorb Type	Adsorption control mode supports manual and automatic control
	Absorb on delay	Used for automatic absorption, the system will start processing after a period of time after opening the adsorption

	Absorb off delay	Used for automatic absorption, after the system processing is completed, the adsorption will be turned off after a period of delay
Feed	**Feed counts**	Use and set the number of feedings during automatic feeding
	Feed length	U axis distance per feeding
	Delay before feed	The time can be set from 0 to 300s. When the previous working is completed and the value is delayed, the feeding axis starts to move. During the delay period, it is convenient for users to load and pick materials on the feeding device.
	Delay after feed	The time can be set from 0 to 9.9s, which is convenient for the feeding device to move in place, delay de-jitter, and wait for the feeding shaft to be completely stationary before performing the second work.
	Finish feed enable	Set whether to continue feeding after the last feeding process is completed
Focus parameters	**Focus position**	The Z axis is working in the motor mode, and the Z axis is controlled up and down so that the laser focus is on the Z axis coordinate of the cutting table.
	Enable single lift of Z axis	After the Z axis single lift is enabled, it will only lift once during the whole processing process, and the lift setting in the layer parameters is invalid.
	Offset height	When the Z axis lift is controlled by motor, after enabling the Z axis single lift, the Z axis focusing will keep the distance between the laser focus and the table.
	Z axis docking point	Enable the Z-axis to lift backward, the Z-axis docking position of each process completed
	Lift delay	Lifting action means that the cutting head is separated from the table. After the Z axis automatically lifts, it will delay for a period of time before proceeding to the next step to ensure that the Z axis moves in place.
	Down delay	Falling action means that the cutting head is closed to the table. After the Z axis automatically drops, it will delay for a period of time before proceeding to the next step to ensure that the Z axis

	moves in place.

3.4.3 Layer parameters

Double-click the layer in the control interface to open the layer parameter settings. Different layers are distinguished according to the different colors of the primitives, and one color represents one layer. When the process parameters are turned on, all the layers appearing in the primitive will be displayed according to the primitive color. Different layers can set different parameters, so that the layers can be used to distinguish the processing technology. The parameters of the selected layer can be "applied to all layers", and the selected layer can also be "import parameters" and "export parameters".
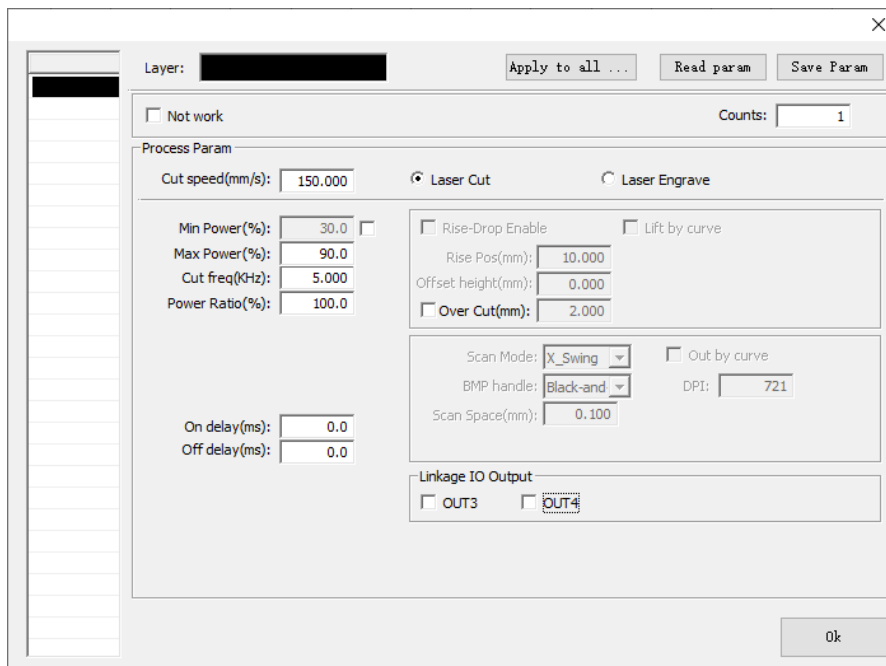
Figure: Layer parameter settings

	Layer	The software uses layers to distinguish the processing parameters of different graphics.
	No work	Indicates that the metadata data corresponding to this layer will not be output.
通用 General	Number of times	The processing times of the image metadata corresponding to this layer.
	Processing speed	The speed of processing the corresponding primitives of this layer.
	Laser cut/Laser scan	Choose this layer is cutting or scanning. Vector scan uses the

		filling method to process the closed metadata to this layer before outputting. Bitmap cutting is to cut the outer frame of the bitmap, and scanning is to output the scanned image data after processing according to the processing method.
	Min, max power	The power value ranges from 0 to 100, which indicates the strength of the laser during processing; The value is large, the laser is strong, and the value is small, the laser is weak; The minimum power should be less than or equal to the maximum power. When scanning, set the maximum and minimum power to be the same. In FSP mode, only the maximum power is valid. In PSV mode, the maximum power and minimum power need to be adjusted.
	Cut freq	When processing corresponding primitives, control the frequency of the PWM signal output by the laser.
	Power ratio	。 Valid in FSP mode for micro pulse processing. Generally, the RF tube cutting is set to 100%.
	On delay	When processing graphics, delay the opening time to prevent the starting point from over burning due to the motion lag.
	Off delay	Delay the time of turning off the laser to prevent the cutting pattern from not closing due to the motion lag.
	Linkage IO output	When processing the data of this layer, the checked IO also outputs a low-voltage signal, which can be connected to the external equipment that needs to distinguish the layer for related process processing.
Layer lift	**Lift control enable**	After checking, this layer will execute automatic lifting action during processing
	Enable primitive lift	After checking, each primitive will perform a lifting after processing
	Rise position	When the motor is used to control the Z axis up and down, the coordinate position that the Z axis will rise automatically when cut this layer
	Offset height	When the motor is used to control the Z axis up and down, the distance between the laser focus and the cutting table when processing this layer
	Overcut	In the case that the effect of delaying the laser-off is not work, repeat the processing of a motion trail of the starting position on the output metadata.
Scan	**Scan mode**	Vector and bitmap can generate scan lines in horizontal one-way, two-way scanning and vertical one-way and two-way scanning.
	Bitmap processing	The bitmap processing method supports three types: black-and-white image, dot image, and hanging network processing.
	Scan space	Sampling interval when generating scan data.
	Out by curve	When the primitives of the same layer are scanned and calculated, they are output as a single primitive or calculated and output together with the layer data. Checking means a single primitive output. Bitmap and vector graphics are calculated separately.

3.4.4 Processing interface description

The processing interface is in the split window on the right of the software, which mainly contains some control processing. Including: coordinate system setting, manual movement, status display and control, automatic processing, layer parameter setting, system connection。
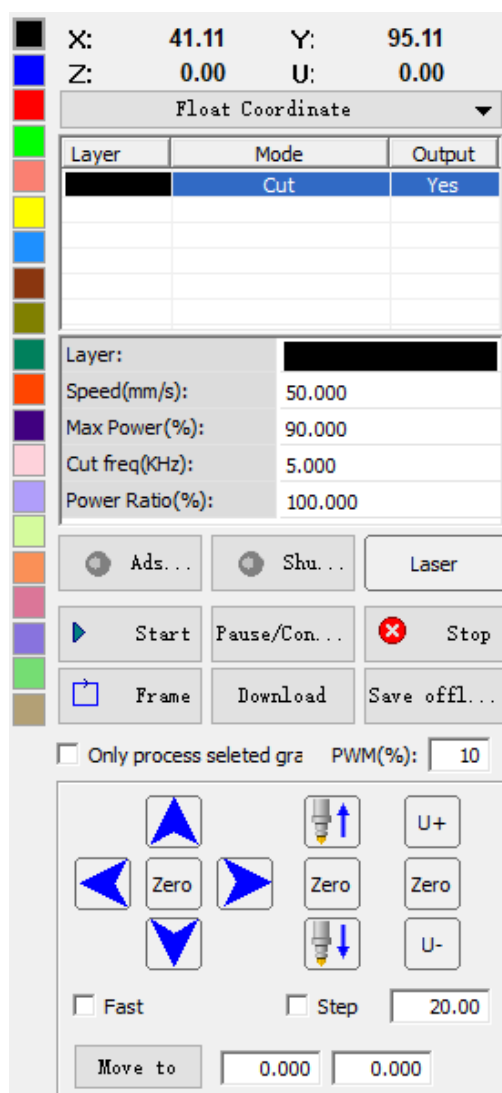

Figure: Processing control interface

■ **Coordinate system setting:**

It is Used to set the positioning method used in automatic processing, which can be set as a floating

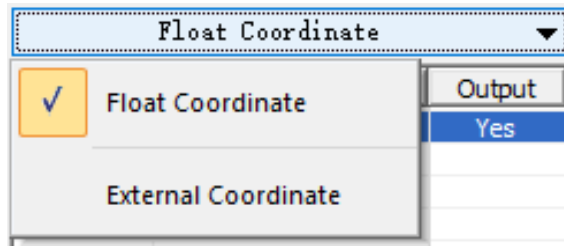coordinate system and an absolute coordinate system in the software.

Figure: Coordinate system selection

Floating coordinate system: In this coordinate system, the positioning method used is processing at the current position. That is, according to the current position of the laser head and the positioning point of the processed graphic (the small green square next to the graphic), the graphic is moved to the current position for processing. In this coordinate system, the positioning point of the graph should be appropriately set. If the positioning point setting (can be set in the user parameters) is not appropriate, it may cause the graphics to exceed the processing area after moving. For example: the laser head is currently located at the lower left corner of the breadth, and the graphic positioning point is set at the upper right corner of the graphic, then when the processing starts, the graphic will move beyond the breadth.

Absolute coordinate system: In this coordinate system, the position of the graphics is unchanged during processing, and the laser head moves to the position of the graphics to start processing. Generally, absolute coordinate system processing is used.
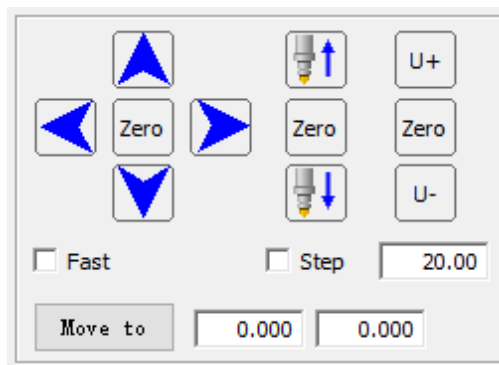
■ **Manual movement:**

Figure: Manual movement

Manual movement is mainly used for single axis movement to control the axis to move in up, down, left and right four directions. The single axis movement can be continuous or stepping. Continuous movement is to press and hold one of the up, down, left and right buttons, then it will keep moving in that direction; Inching

movement is to select inching and set the step distance, and then click the button to move a step distance in the corresponding direction.

Manual movement is divided to slow speed and fast speed, which correspond to the slow speed and fast speed of the axis buttons set in the user parameters. Fast is to check the "Manual High Speed" option, then the movement will move at a set higher speed.

Move to: Enter the target coordinate position you need to move to, and then click the "Move to" button. After a confirmation dialog box pops up, select the next operation and choose whether to move to the target position.

◼ **Status display and control:**

Figure: Status display

Absorb: used to quickly control the absorption interface status;

Shutter: Used to quickly control the shutter interface status;

Laser: click the "Laser" button to perform a pulse test (pulse signal can be set in the user parameters).

◼ **Automatic processing:**

It is mainly for graphics cutting related processing. Including: cutting process, walking frame, idling, cycle processing, simulation, downloading and saving offline files.
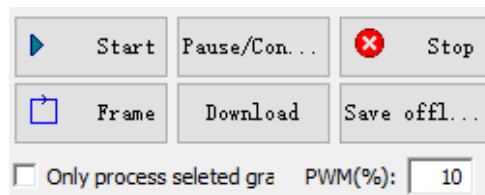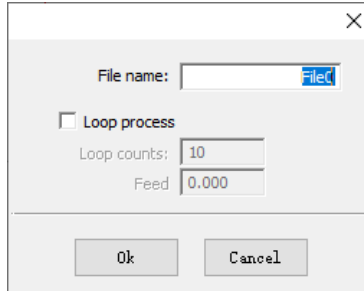

Figure: Automatic processing

Cutting process: start, pause, continue, stop. To continue is to pause after starting the processing and then continue to start the processing, first move the laser head to the breakpoint position recorded during the pause, and then proceed to the unfinished cutting processing.

Process the selected graphics only: When you click to start processing, only the selected graphics will be processed.

Frame: The laser head run along the circumscribed rectangular frame of the processed graphics.

◼ **Download:**

The graphics to be processed are downloaded to the control system in the form of files, and the processing of the files can be started directly from the HMI. The downloaded data includes user parameters, layer parameters, processing data and necessary logo data.

Downloaded file name: Set the name of the downloaded file. The length of the file name cannot exceed 8 characters (the Chinese characters cannot exceed 4).

Cycle processing: Check it here to download the file for cycle processing.

■ **Save offline files:**

The processing file can be saved to the computer or U disk, and the file is saved in .rd type. You can copy it out, and use the "Download Offline File" in the file management function of the software to download the file to the system connected to the software.

3.4.5 Z axis lift control usage

一、 **Basic parameter setting**

Vendor parameters: First, set the parameters correctly in <Vendor Parameters>——<Machine Configuration>——<Z Axis Configuration> according to the equipment structure.

User parameters: If the Z axis is controlled by a motor, you need to set the Z axis focal point coordinate position first, manually move the Z axis lift so that the laser focus point is on the cutting table plane, and record the Z axis coordinate position at this time and fill in it. Then manually move the Z axis lift to keep the cutting head away from the table to ensure that the Z axis is in an absolute safe position. Record the Z axis coordinate at this time as the Z axis stop point and fill it in. Finally, set lifting and dropping delay.

二、　　**Lift parameter setting:**

The height of processed materials is consistent (using a single lift): When only one lift is required during the entire processing process, enable a single lift in the user parameters, and then set the offset height of the single lift.

After starting processing, the Z axis will check whether the current position is safe. Then the XY axis moves to the processing starting point (②), and the Z axis moves to the processing position (③), and starts processing after reaching the position (④). After the processing is completed, the Z axis moves up to the stop point (⑤), as shown in Figure 1:
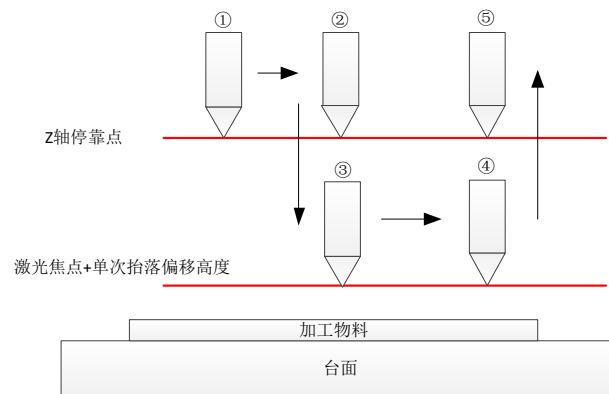
The height of processed materials is inconsistent: Use the control method of layer lifting to distinguish different heights by layer. Set the relative offset height separately according to the process requirements, and then use the teaching function to adjust the lifting position of this processing layer. After the last processing is completed, the Z axis will move to the position of the stop point of the Z axis.

(Pay attention to the rationality of the parameters, and try to avoid the unreasonable setting of the lifting position after the processing of the previous layer is completed, which may cause collision during the idle movement.)
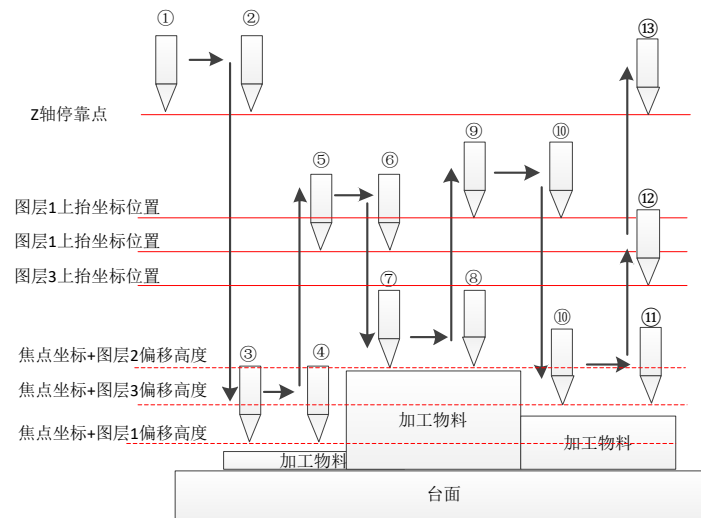
Primitive lift: Each primitive in this layer will be lifted and dropped after the processing is completed, and the lift position is controlled by the parameters of each layer.

Chapter 4   Quick start

This section includes:

■ **Connect the system**

■ **Create processing data**

■ **Manual operation**

■ **Automatic operation**

Software quick instruction is the first time to use contact the system, through some simple operations, you can make the system run normally. Even novices can get a preliminary understanding of the entire system relatively quickly. Quick operation is basically divided into connecting the system, creating processing data (including some graphics processing), manual movement, and automatic processing.

4.1 Connect the system

Open the software, if the system has been set last time, it will automatically connect, otherwise there will be a connection failure. There are two main reasons for connection failure. One is physical connection problem (the computer and the system are not wired, or the wiring is loose, or the physical interface is faulty). The second is that the setting of the connection port is wrong (the physical wiring is a network cable, but the USB connection or IP address is set incorrectly, and the physical connection is the network connection set by the USB or USB port is set incorrectly). If the computer only connects to one machine and uses a USB port, directly use the automatic option, otherwise user have to select a specific USB port.
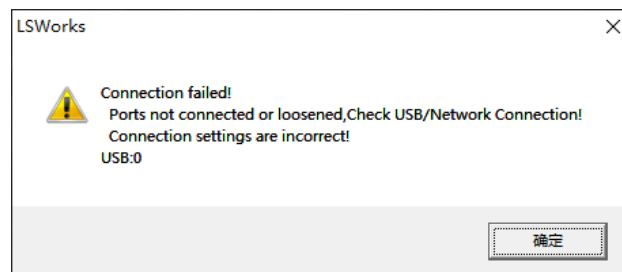

Figure: Connection failure prompt interface

When multiple machines are connected to one computer, please name the different machines through the connection settings, and operate different machines by checking different connection options. One computer can only establish connection with one machine in one time.
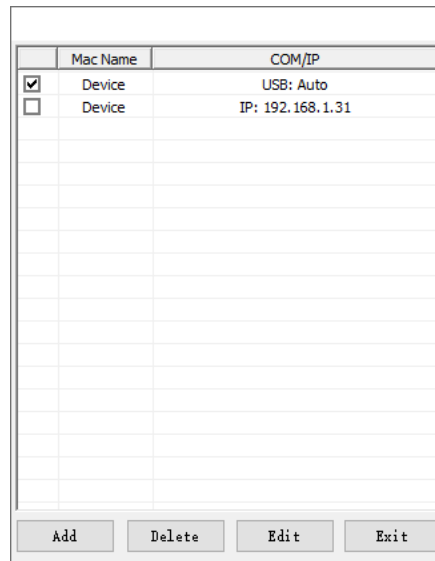
Figure: Connection setting interface

4.2 Create processing data

To create the processing data, it can be a graphic file imported from outside, a project file saved before, or a simple graphic drawn directly.
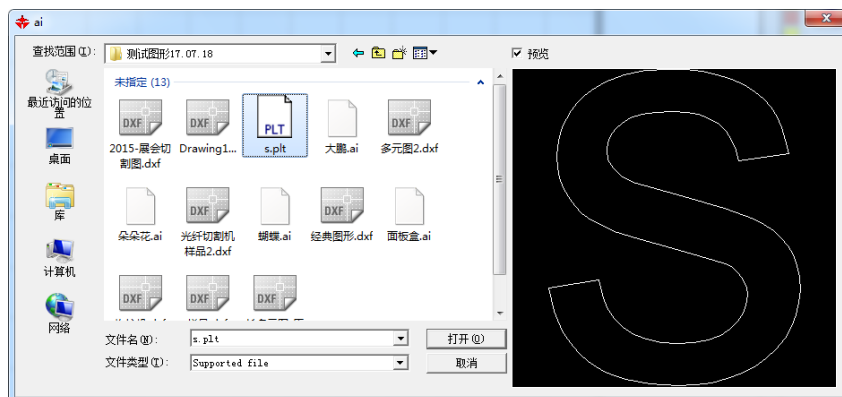
Figure: Imported graphics interface

Select Import in the main menu, the interface of importing graphics will pop up. The software can import files in three formats: AI, PLT, and DXF.
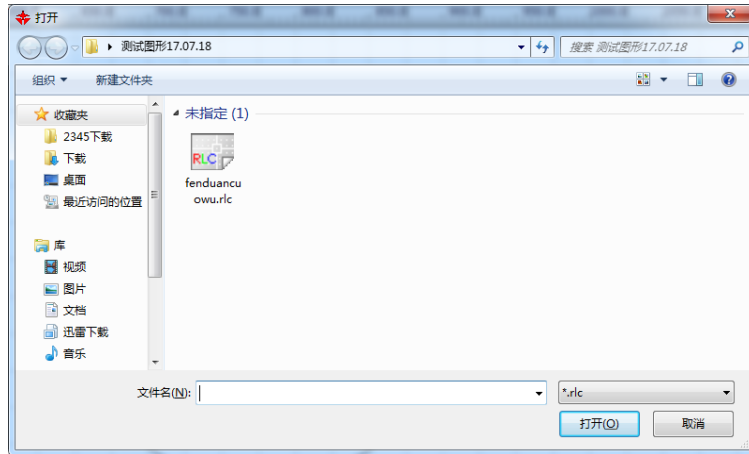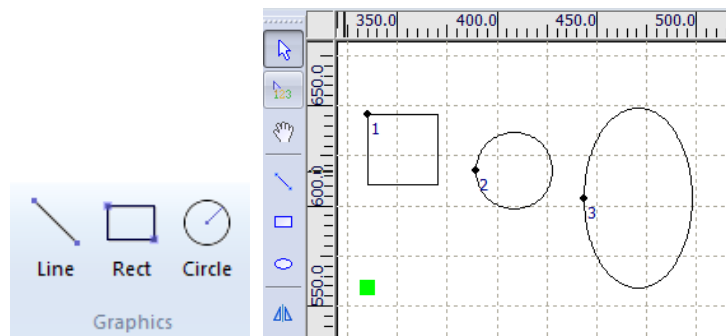
Figure: rlc file opening interface

The rlc program file saved by the previous software can be directly opened here for processing by using the Open in the main menu.

Select the simple drawn graphics on the drawing page (or select from the left side of the toolbar), the software can draw broken lines, rectangles, and ellipses. Hold down the Ctrl key when drawing rectangles and ellipses, you can draw squares, perfect circles, horizontal lines and vertical lines.
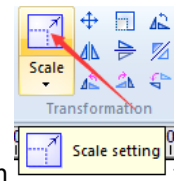
After creating the graphics data, you can select the graphics data, then click the size button to modify the size of the graphics on the pop-up interface.
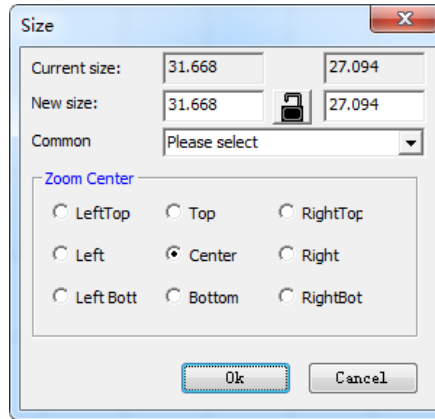
Figure: Size modification interface

The size of the selected graphics will be displayed here, or you can enter the modified graphic size (When you select lock, enter one of the width and height values, and the other value will changed in proportion). The zoom center refers to the reference point of the graphics zoom.
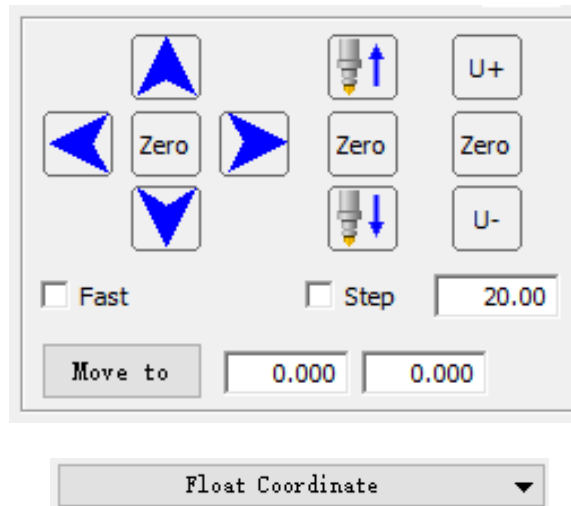
4.3 Manual operation

Figure: Coordinate system selection and manual operation

The choice of coordinate system can be floating coordinate system and absolute coordinate system. When the coordinate system is set, the graphics data changes depending on the coordinate system when the data is loaded in automatic processing. Manual operation can a single axis for fast and slow inching and continuous motions. It can also perform point shot laser on, adsorption test, and so on.

Use single-axis manual movement to move the laser head to the position to be processed, and use the floating coordinate system to move the processing data to that position for processing

4.4 Automatic operation

Figure: Automatic processing related operations

Start, Pause/Continue, Stop: Software control of automatic processing. In the case of the processed graphics, and setting the layer parameters, you can directly use these three buttons for processing control.

Frame: The walking frame function of the software control system (This function simply determines the position of graphics cutting, which is different from the frame controlled by HMI).

Download: Download the graphics to be cut to the control system, and then start processing this graphics in the control system (You can set the parameters to download cycle processing graphics).

Save offline files: Save the graphics files for processing, and the file format is .rd. The file can be copied from the computer and used on other machines.

# Chapter 5 Vision Function Operation Instructions

This chapter includes:

■ **Mark function instruction**

■ **Mark point description**

■ **Quick start of Mark point**

5.1 Mark point function description

Vision cutting control system is a software function based on target intelligent recognition. The hardware consists of a motion control card, a CCD industrial camera, and an industrial computer. Based on the basic cutting function, combined with image processing algorithms, perform target image feature extraction, target recognition and pre-drawn cutting contours to complete the cutting job.
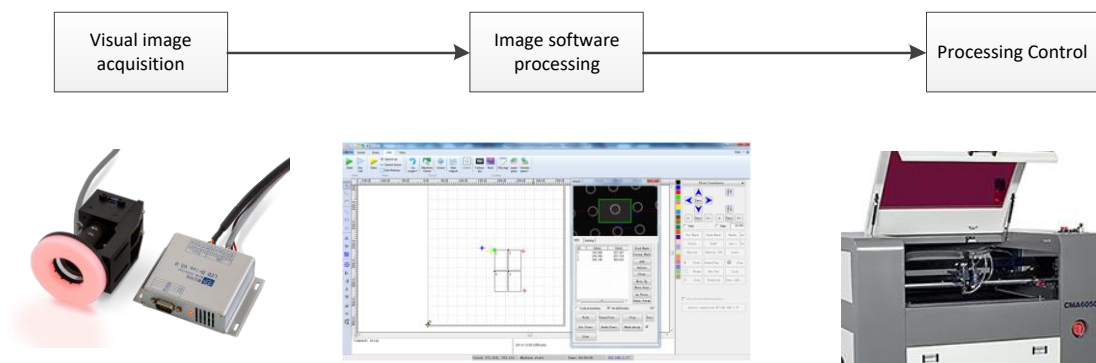
5.2 Vision hardware components

| Parts	Qty	Description
RDCamera-SW-Tooling components with light source-Plastic case	1 Set	
Black and white camera-130W pixels	1 Piece	
Lens	1 Piece	
Lens circle	1 Piece	
Custom film-50*50MM (Circle diameter 0.1mm center distance 1mm)	1 Piece	
USB2.0_AM/BM with ear+dual magnet rings straight head_5.0M_Camera cable(6442) dark green	1 Piece	
Brightness regulator cable- 2M-Five-core black	1 Piece	
Vision light source adapter fold-resistant cable-5M-black-white two-core terminal	1 Piece	
RDV_LightDrv-C-CCD Light source driver board	1 Piece	

☞ Some visual configuration components can be selected according to user demand, such as camera, lens, lens circle, light source, etc., to ensure the accuracy and stability of visual recognition.

5.3 Mark point instructions

5.3.1 Visual software interface

After the machine is powered on to reset normally, open the LSWorks software and connect the control card, select the [CNC] interface on the menu bar, click the [Vision] button, and the Mark point vision software window will pop up as a floating window.
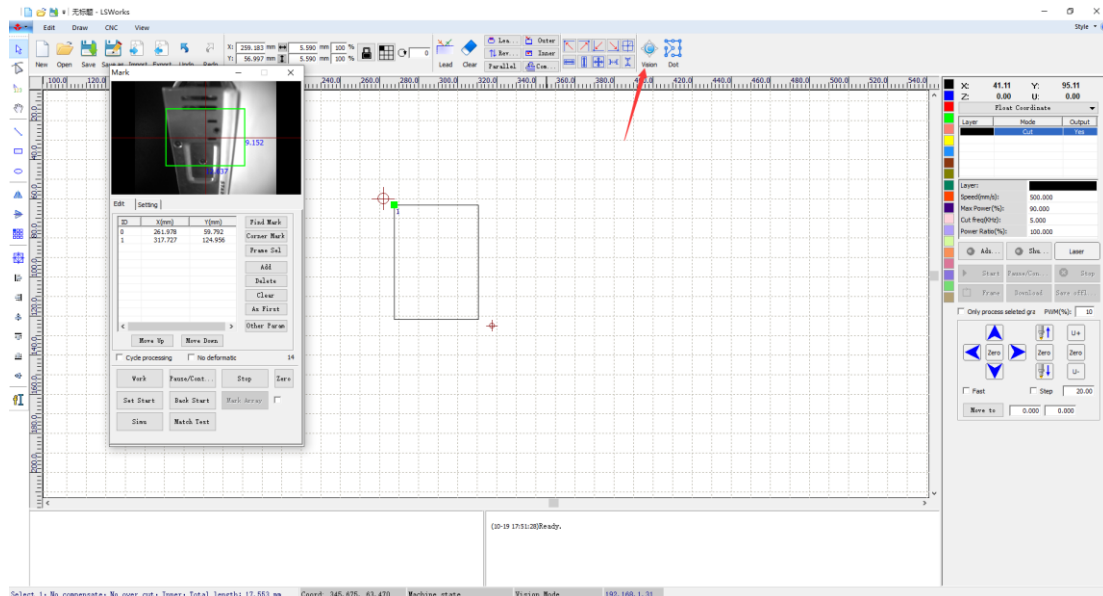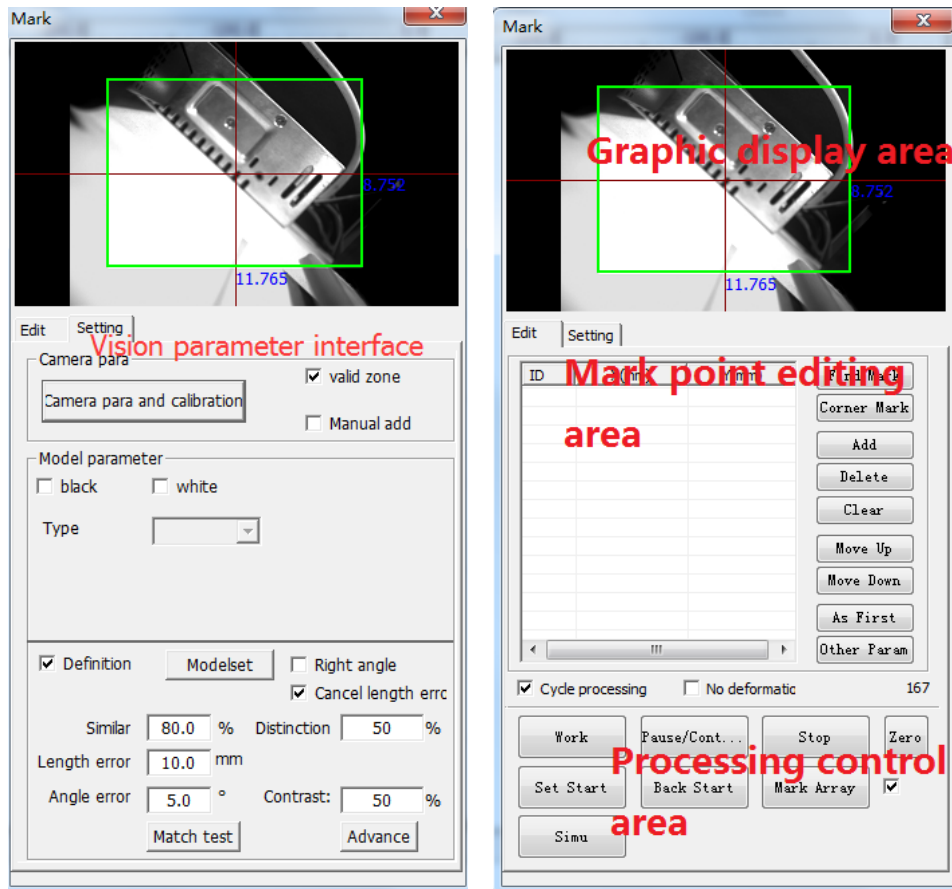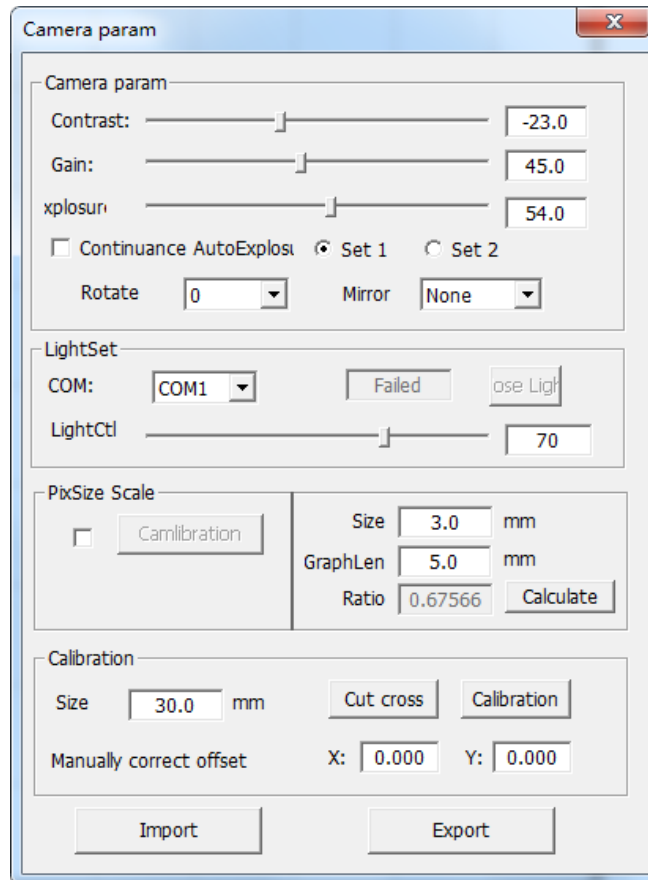
5.3.2 Camera setting instructions

■ **Camera parameters:**

Click [Camera parameters and correction], the following window will pop up, and you can set the camera parameters.

The adjustment of the camera in hardware mainly adjusts the quality of the image by adjusting the aperture and focal length, but after the camera is installed, it cannot be adjusted casually. After the hardware adjustment is completed, the environment light source and camera parameters are usually adjusted to improve the software imaging effect.

Contrast: Mainly by adjusting the difference between the background color and the material color to fine-tune the image quality.

Gain: It is the magnification times relationship of image brightness.

Exposure: the longer the exposure time, the higher brightness of the image.

Continuous auto exposure: The software will automatically adjust the above exposure value. When the exposure value is adjusted automatically to a stable level, need to uncheck it.

Parameter 1, Parameter 2: When the external environment has a greater impact on the imaging quality, two sets of parameters can be used for recognition.

Rotation angle: The imaging angle of the image display area is rotated.

Mirror: Set whether the imaged graphics in the image display area are mirror displayed.

■   **Pixel accuracy correction:**

Pixel accuracy calibration is to correct the camera pixel imaging data, which can improve the accuracy of camera recognition, and supports two methods of ratio correction and film calibration. When [Calibration] is checked, the [Calibration] button is valid and the scale correction parameter on the right is invalid, indicating that the film is used for correction; When [Calibration] is not checked, the [Calibration] button is invalid and the scale correction parameter on the right is valid, indicating that the scale correction is used.
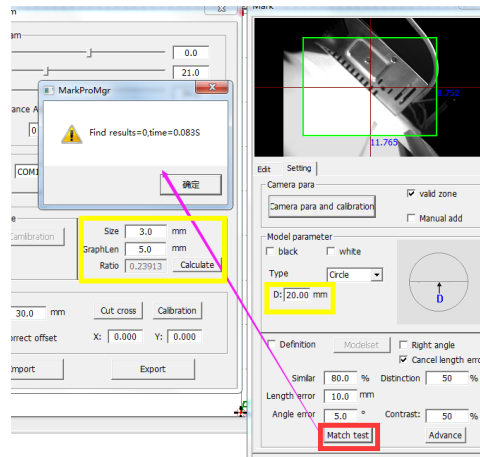
The operation steps of scale calibration are as follows:

1.Prepare a reference object for comparison. Prepare a reference object in suitable size, such as cutting or printing a 5mm small circle.

2.Place the reference object close to the table, adjust the camera position, lens and camera parameters, until the reference object can be clearly displayed in the software graphic display area;

3.Select the green frame in the graphic display area as the effective recognition area. Drag the green frame on the software to make the frame of the effective area just tangent to the reference object.

4.Fill in the actual size of the graphics and the recognized length calculated by the software in the pixel accuracy correction, click [Calculate Proportion] to finish the scale correction, and the [Proportion] will automatically update.
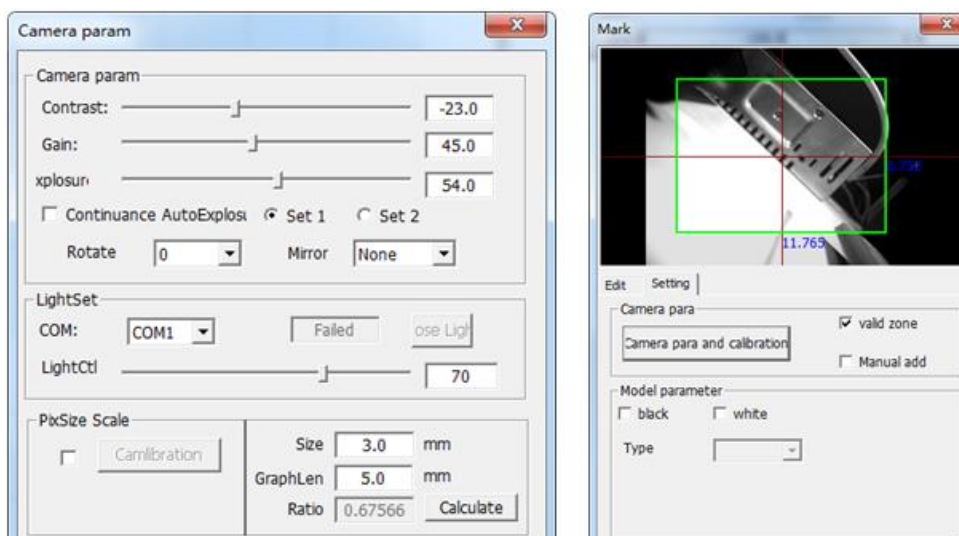

5.After adjusting the correct scale, click Match Test. If the number of results found in the pop-up is 0, there are the following possible reasons: D is incorrect or "Proportion" is incorrect, or the black

template and white template are incorrectly selected.

The operation steps for film calibration are as follows:

1.Place the matching film under the camera's field of view, adjust the camera and camera parameters, so that the black dots on the film can be clearly identified in the image display area.

2.Check the calibration option. Then the [Calibration] button on the left will become a valid button, and the [Proportion Calculation] parameter on the right will become invalid.
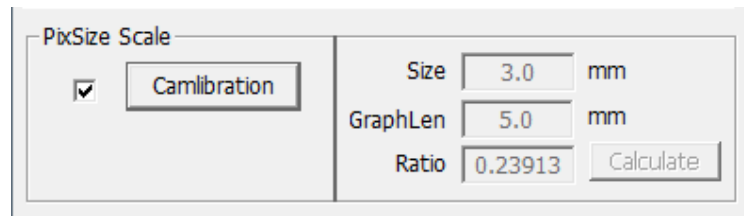

3.Click the [Calibration] button, and the calibration process pop-up window will pop up.
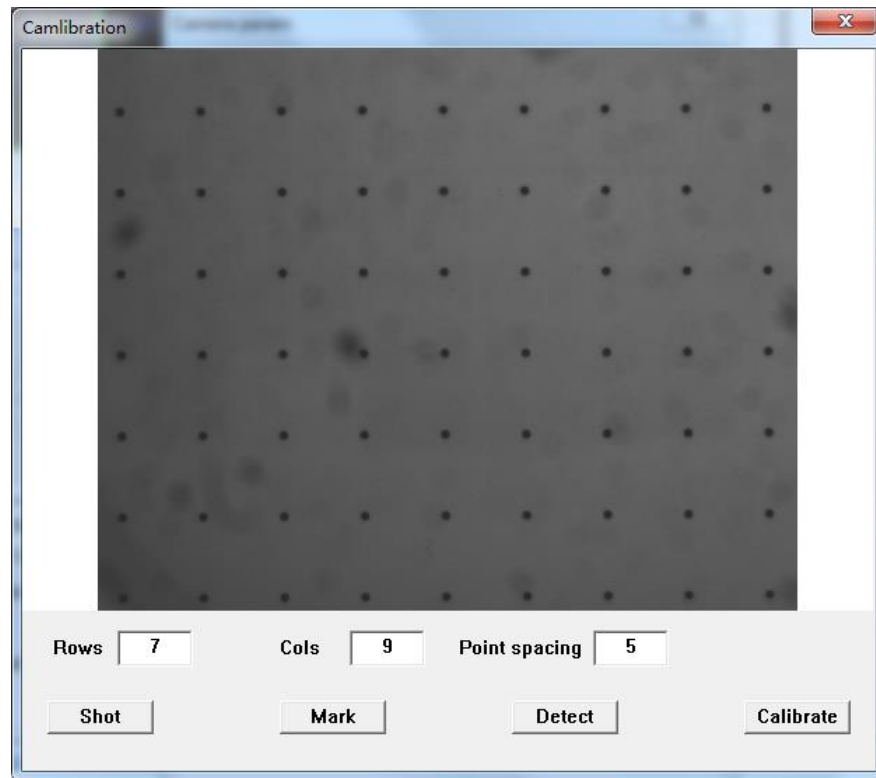
4.Fill in the number of rows and columns according to the array points in the picture, and the dot pitch is the actual pitch of the film array points.

5.Click [Photo].

6.Mark feature points. Enlarge the picture to clearly select a feature point, select this feature point by frame selecting, and then click [Mark].
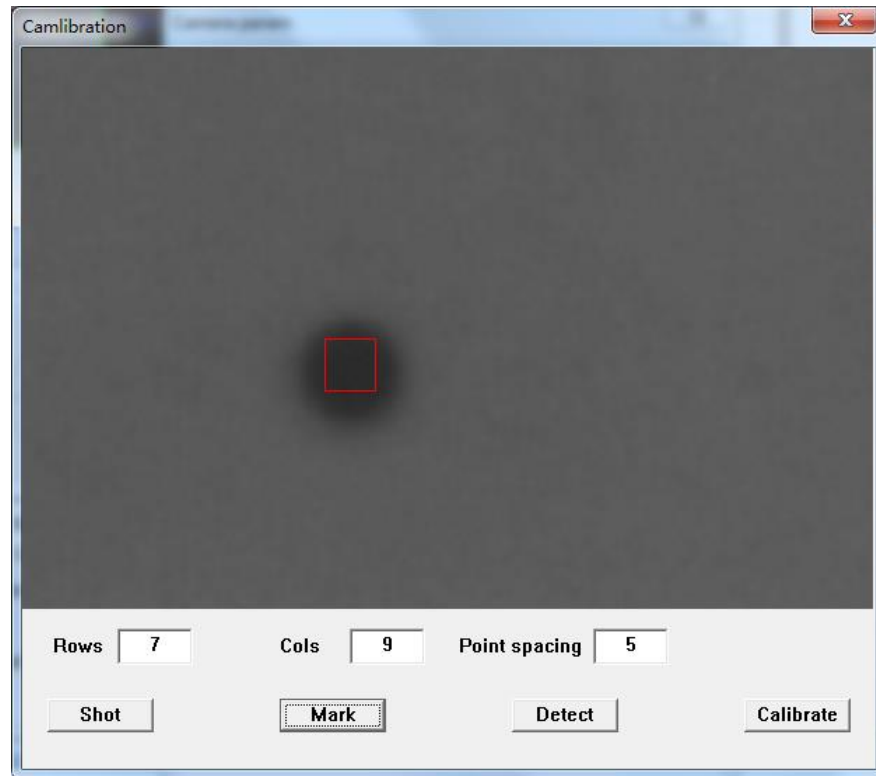
7.Identify feature points. Click the [Identify] button, and the software will automatically identify the feature points in the picture. If there are misidentified feature points in the picture, you can select them with mouse and delete them; if there are missing feature points in the picture, you can enlarge the picture to find the feature points, and then double-click the center of the feature point with the mouse to add it manually.

8.When there is no result pop-up window for point identification or there are few matching points, check whether the black template or white template in the "template parameter" is selected correctly.
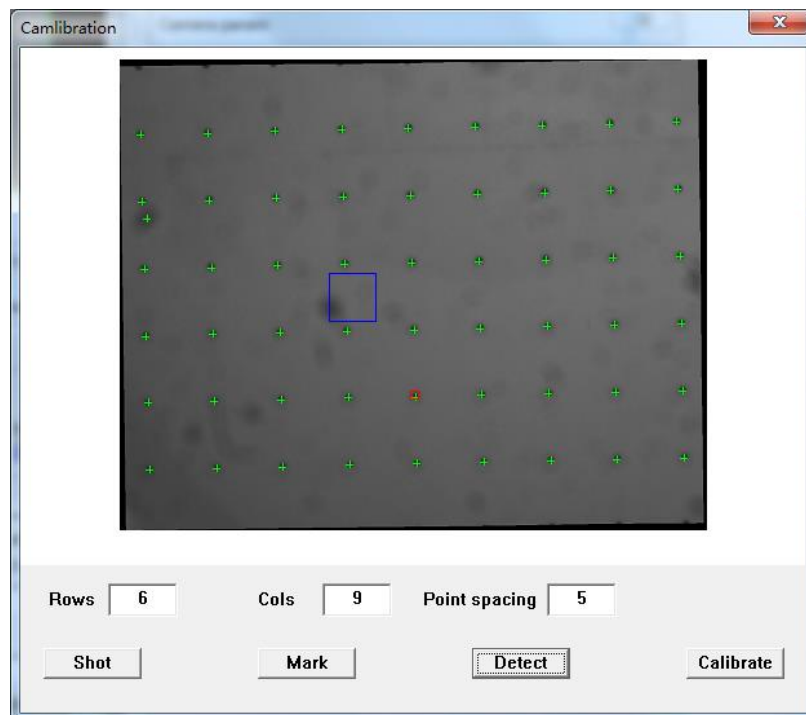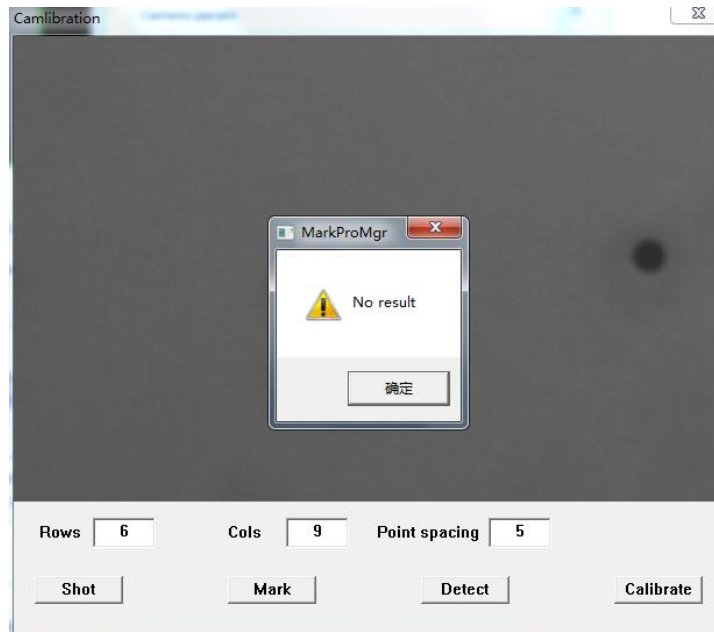
9.Click the [Calibration] button to complete the calibration. According to the set number of rows and columns, if the feature points are extracted correctly, the system will automatically complete the calibration, and the green cross in the picture will automatically disappear. Thus the camera calibration is completed, and you can close the [Camera Calibration] pop-up window.
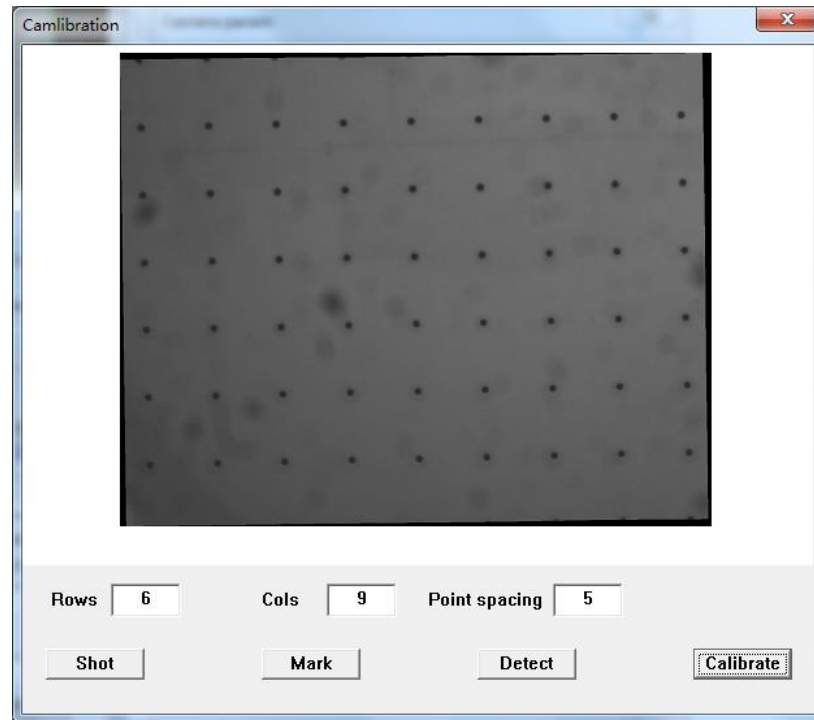
■ **Distance calibration**

Distance correction is used to test the relative installation position between the cutting head and the camera. After the distance correction, the system can perform visual processing.

The operation steps of distance correction are as follows:

1.Cut a cross. Set the size of the cutting cross and move the cutting head to an idle position to ensure that there is enough space for the camera to see the cut cross. After clicking [Cut Cross], the system will automatically cut a cross graph, and then move the camera to a position where you can see the cut cross. The cutting power can be set from other parameters under the edit page.

2.Distance correction. Move the cutting head to make the cross center of the camera field of view coincide with the cross center, click [Camera Correction], and the system will calculate the offset from the center of the camera field of view to the center of the laser head.

3.Check the effect. Repeat the above steps to observe the center position of the camera's field of view coincides with the center position of the cutting cross after the cutting cross is completed.

■ **Correction file management:**

Save the pixel accuracy correction parameters, and support importing and exporting correction files.

| Import | Export |

- ◼ **Effective area:**

Select the effective recognition area within the camera's field of view. If it is not checked, the effective area is the entire picture.

- ◼ **Deformation processing:**

When the Mark point position has offset from the actual position of the drawing, whether to deform the processing file.

- ◼ **Manually add points without identification:**

When there is no matching target during processing, add dots in the manual image display area, and then continue to work.

- ◼ **Template parameters:**

Black template/White template: After the camera takes a picture and generates a picture, the Mark dot template displays the color during the process of identifying the feature template by the software.

Model parameter
☐ black   ☐ white
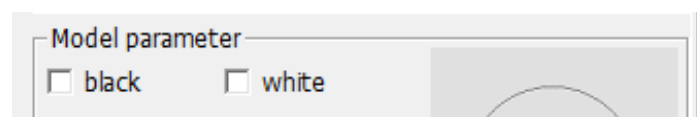
Custom templates: The software supports custom templates, Mark point templates and right-angle templates. Mark point template supports a variety of common types of Mark points. After selecting the Mark point template, you need to set the relevant characteristic parameters of the Mark point. For example, if you select [Circle], you need to set the diameter D of the circle.
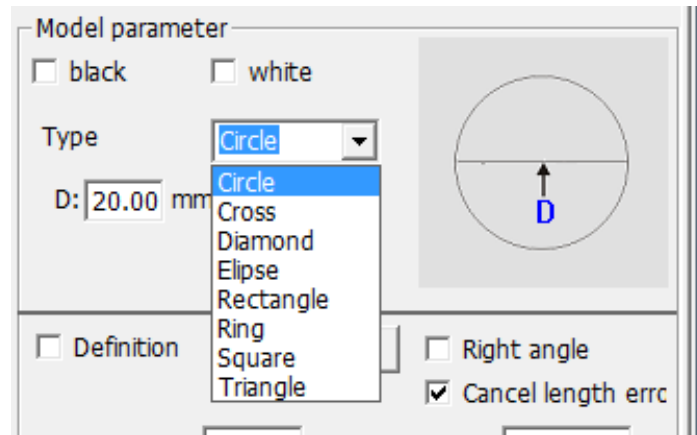
Similarity: The similarity between the Mark point in the visual imaging picture and the set Mark point. This value will directly affect the matching identification result.

Distance offset: The maximum distance of relative position deviation between the Mark points recognized by the system.

Angle deviation: The allowable angle deviation when matching.

Cancel deviation error report: When multiple points match Mark points, the system recognizes that the actual distance between the Mark point and the preset position deviation is greater than the distance deviation and will prompt an error. If Cancel Deviation Alarm is checked, no error will be prompted.

Differentiation/Contrast: It is valid when the right angle module template is selected.
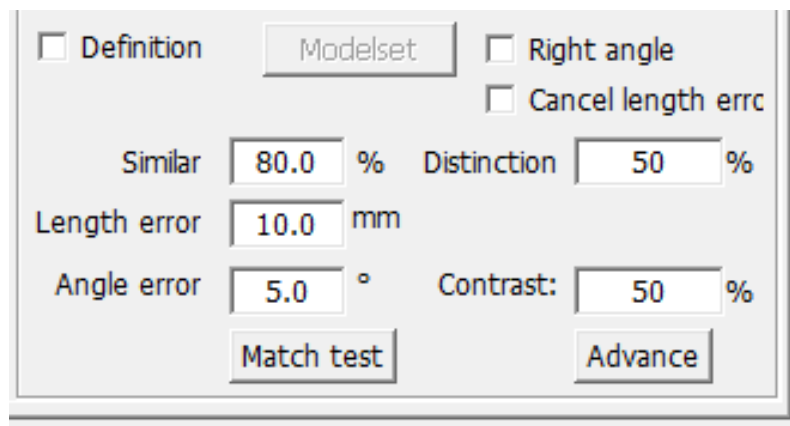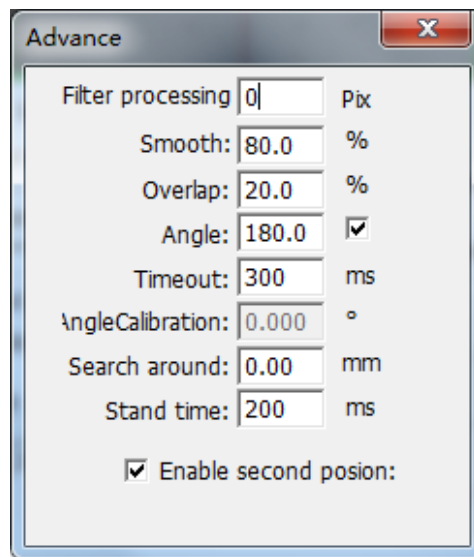

■ **Matching test:**

The current template is matched with the target image in the current field of view of the camera, and the test result will be returned in the result interface.

■ **Advance:**

Enter the advance options to set the template matching parameters.

Smooth coefficient: The higher the smoothing coefficient, the fewer scattered points of the extracted features.

Similarity: the score of the matching between the template and actual graphics.

Overlap: The overlap percentage of the envelope rectangle of the two target images. This parameter controls whether the target is recognized when there are overlapping parts.

Matching angle: The angle range allowed to search by the template rotation. For example: the value is set to 180 degrees, and the search angle range in the template matching process is: -180~180 degrees. The matching angle is set according to the actual needs. The larger the angle, the longer the matching time is required. If the user does not need to set this parameter, it can be directly unchecked.

Matching timeout: This parameter controls the matching time. During the search process, to avoid waiting too long or insufficient time to cause target image matching failure, this parameter needs to be adjusted. This parameter is mainly affected by the complexity of the template features.

Expanded search: During Mark point processing and recognizing, the target feature may not in the camera's field of view. Setting this parameter can expand the search range.

Stabilization time: During the process of finding the Mark point, the time to wait for the photo after moving to the target position. It is recommended to be at least 200ms.

Enable secondary positioning: After finding the target, it does not directly take the found target position coordinates as standard, but moves automatically to the target, takes photos again, and repositions the target position coordinates.

5.3.3 Mark point edit instructions
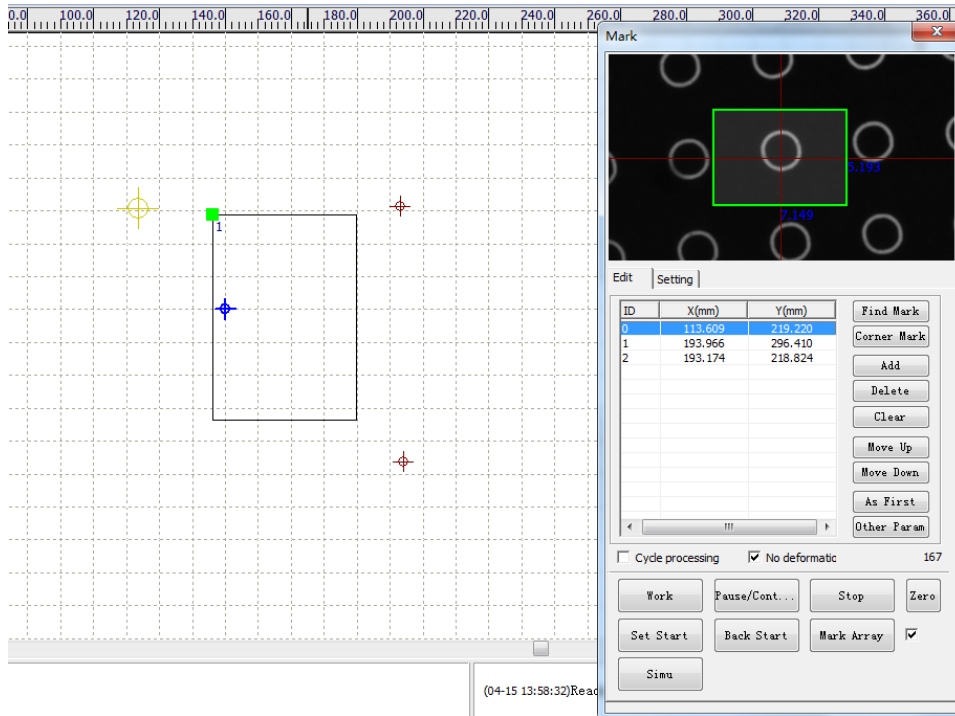
To use the Mark point visual function, edit the Mark first, including adding Mark points, and editing the Mark position and order. Several shortcut buttons are available on the right side of the software for users to use.

The Mark point graphic identity can be seen in the software graphics editing area ⊕, with the maximum identification being the Mark point first point.

Extract Mark point: After selecting a primitive in the graphics editing area of the software, the similar graphics will be automatically extracted to Mark point coordinates.

Four-corner Mark point: in the graphics editing area, use the four corners of the circumscribed rectangle of the selected primitive as the coordinate position of the Mark point.

Add: Add the selected primitive position center in the graphics editing area of the software as the Mark point coordinate to the Mark point coordinate queue.

Delete: Select an item in the Mark point coordinate editing queue and delete it.

Clear: Clear all content of Mark point.

Move up: Select an item in the Mark point coordinate editing queue and move it up to change the sequence of finding Mark points.

Move down: Select an item in the Mark point coordinate editing queue and move it down to change the sequence of finding Mark points.

Set as the first point: select an item in the Mark point coordinate editing queue and set is as the first point.

Cross cutting speed: Distance correction cutting cross movement speed.

Cross cutting power: Distance correction cutting cross cutting power.

Cross cutting frequency: Distance correction cutting cross cutting frequenc**Delete original images after adding Mark points:** This is configured in [Other Parameters]. When selecting a primitive in the graphic editing area to add a Mark point, and delete the original graphic data in the editing area.

5.3.4 Mark point processing control

Mark point visual processing control is similar to ordinary processing control. Operate through the processing control buttons in the Mark visual pop-up window. The system also supports starting the Mark point vision processing from the panel. The user can directly learn the current processing status of the system from the entry bar in the lower left corner of the main interface of the panel, and distinguish the current status as <normal mode> or <visual mode>.

Start: start visual processing.

Pause/Continue: Pause/continue visual processing.
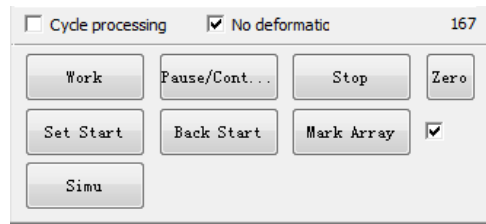
Stop: stop visual processing.

Set starting point: Set the starting point of Mark point processing, which is displayed as a mark ⊕ in the graphics editing area.

Return to the starting point: click the button and quickly move to the starting point.

Moving speed: During the visual processing, search for the moving speed of the Mark point.

Return position: After processing, the position where the laser head returns. There are Mark point starting

point, mechanical origin, stopping point, and non-returning optional.

Mark point visual processing supports array processing and cycle processing. Array processing functions can facilitate the user to place multiple processing parts on the machine table at a time, and the system will process one by one according to the entire list of processing parameters. Cycle processing function can support the use of cycle feeding function.

Array processing: After checking the array processing, click the array processing button to pop up the configuration information of <Mark Point Array Processing>. Fill in the corresponding parameters according to the number of rows, columns, row spacing, and column spacing of the tabletop materials.
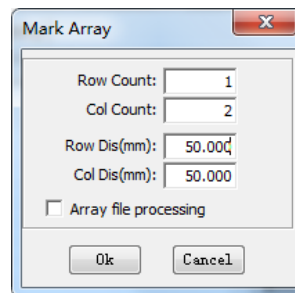
Cycle processing: After checking the cycle processing, the system will automatically cycle processing according to the feeding parameters.

Feeding times: Cycle processing times.

Feeding length: The length of each feeding during the cycle processing.

Feeding direction: After the system automatically compensates for feeding according to the feeding direction, the position offset of the first point is recognized.
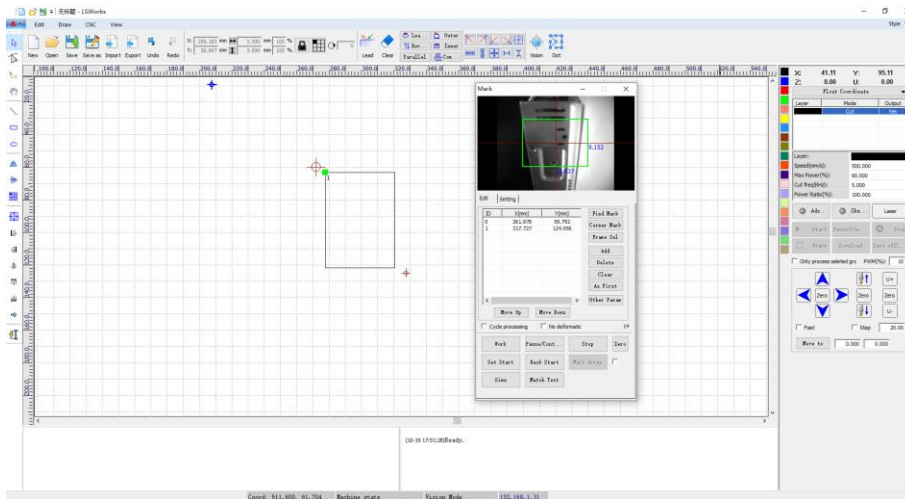
5.3.5 Quick start of Mark point processing

1.When the system is powered on, the reset motion must be completed.

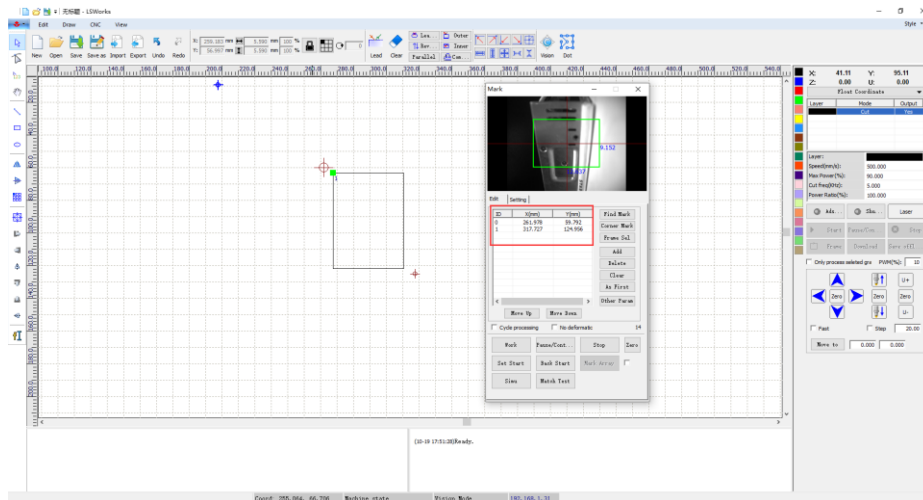2.Import processing files and set all process parameters, such as cutting parameters, sorting, etc.
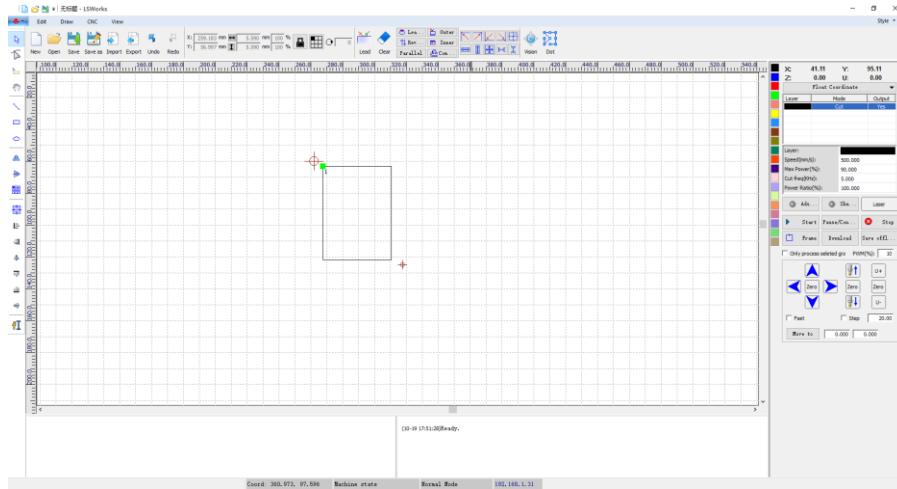
3.Open the Mark point visual window and adjust the camera parameter setting to ensure that the matching
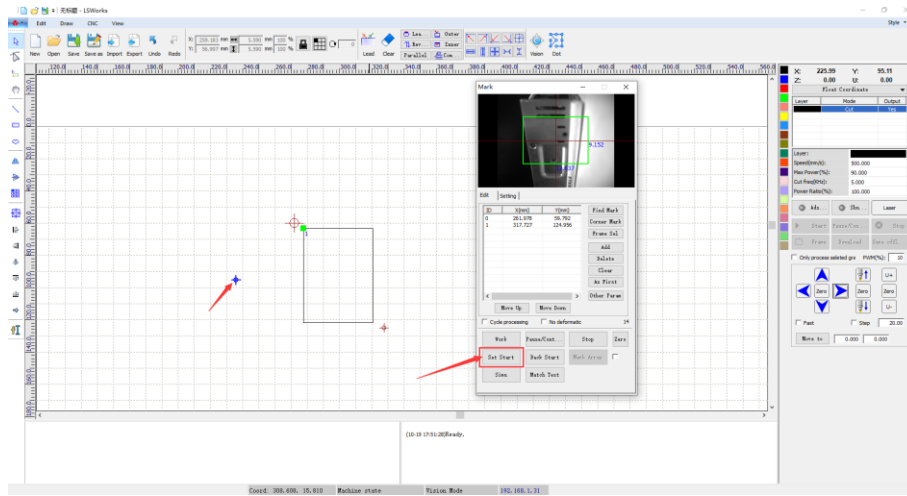
test can correctly identify each Mark point.

4.Extract and edit the coordinate position of the Mark point in the graphics editing area.

5.Set the starting point. Move the laser head so that the camera can see the starting point of Mark, and

then click [Set starting point].

6.Set the visual processing process parameters. Such as array processing, cycle processing, return position,

etc.

7.Start visual processing.

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