NcStudio V12 CCD Control System Manufacturers' Manual

Version: 2018.10 1st Version
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This manual is intended for manufacturers of machine tools. It mainly includes:

1. Configuration and Wiring Diagram

This section introduces product configuration and wiring.

1.1. Product Configuration

Product configuration can be divided into hardware configuration and software configuration.

Hardware configuration is as follows:

- NC65C controller
- Lambda 5M terminal board
- EX31A1 terminal board
- Camera
- WISE driver (Absolute type)
- MA/MN/ME/MB series motor (Absolute type)
- Handwheel (Optional)

Software configuration is as follows:

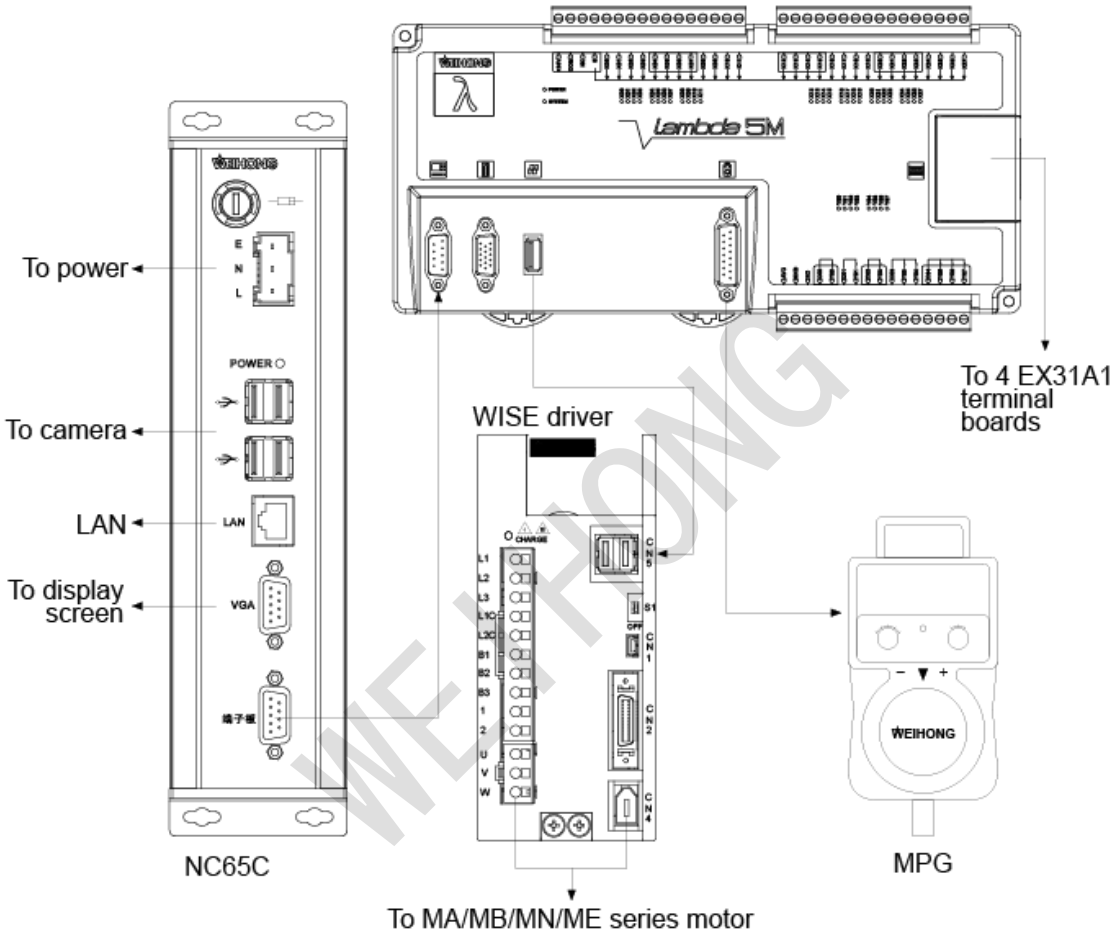
- NcStudio V12 CCD software
- Camera driver

1.2. Wiring Diagram

Wiring Diagram includes the wiring diagram of the product and terminal boards.

1.2.1. Product wiring diagram

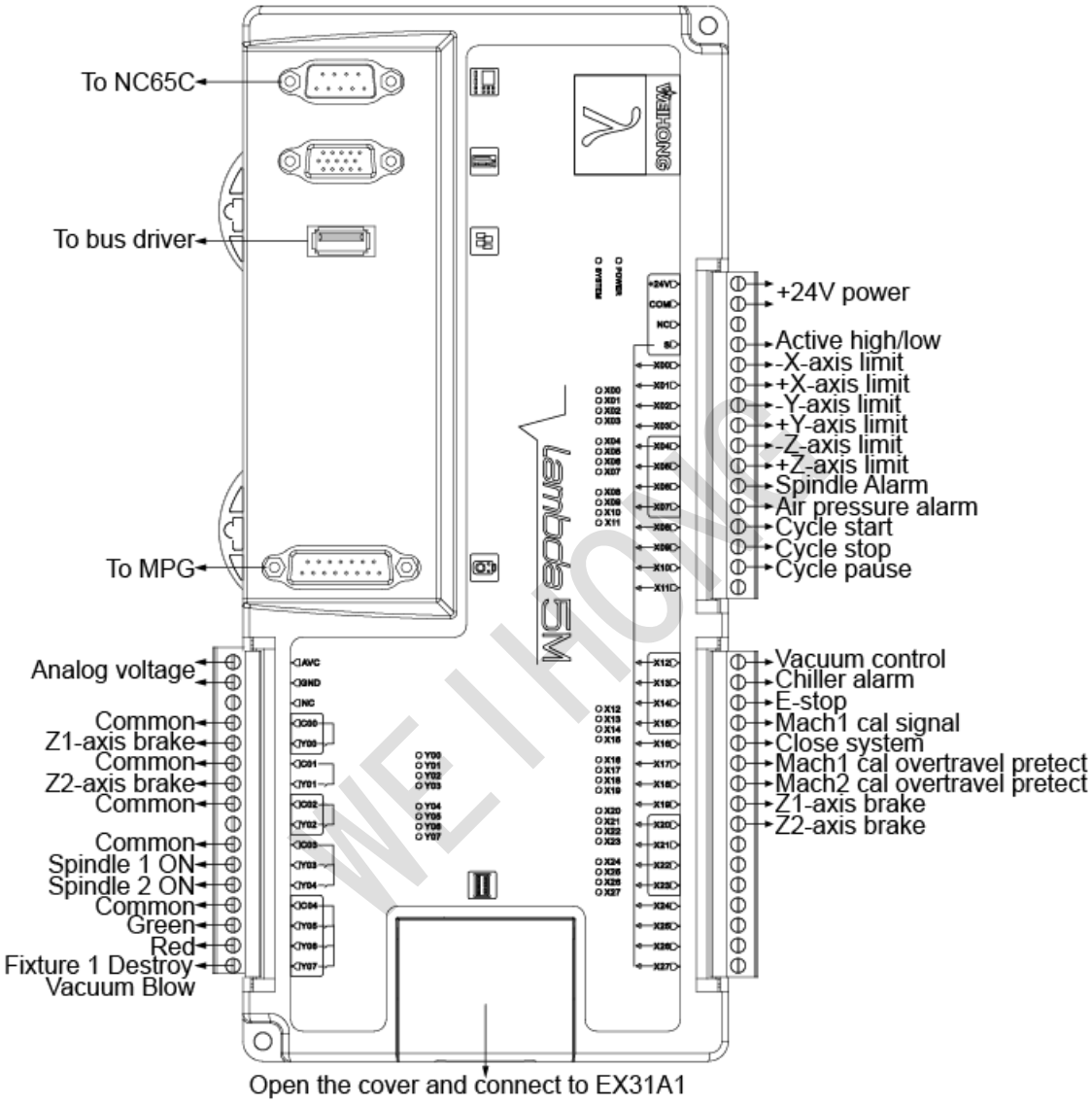
The product wiring diagram is as follows:



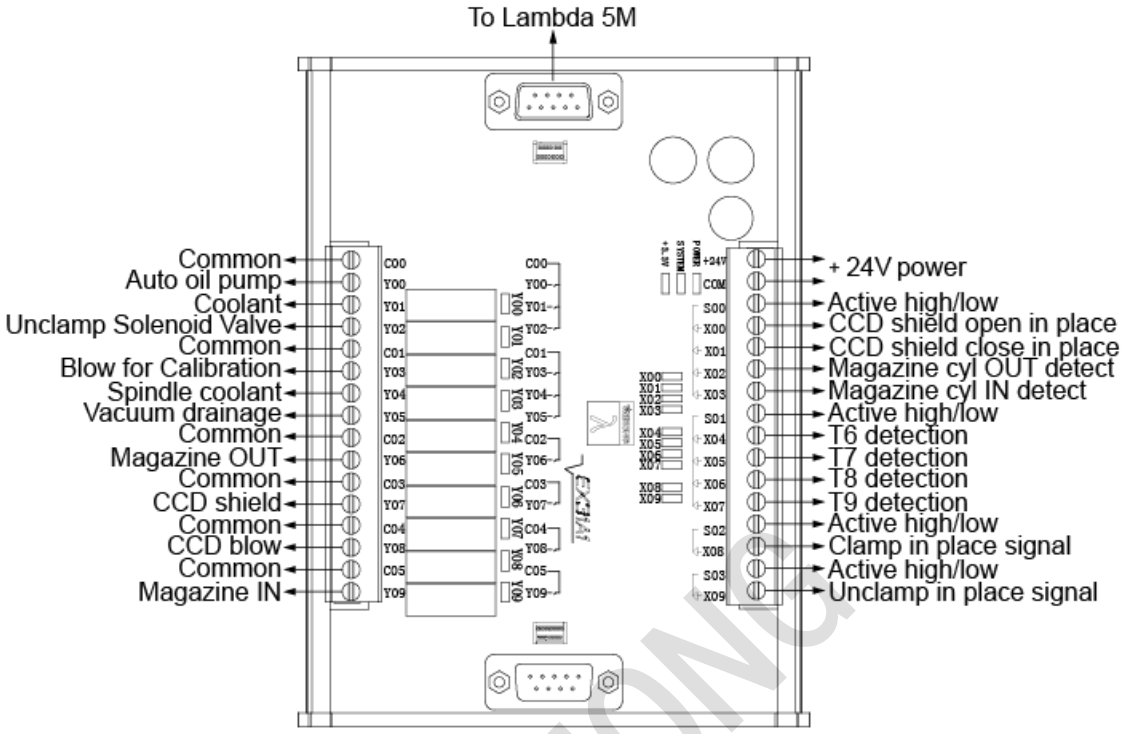
1.2.2. Wiring Diagrams of Terminal Boards

Terminal boards used in CCD system include Lambda 5M and EX31A1.

The wiring diagram of Lambda 5M terminal board is as follows:



The wiring diagram of EX31A1 extended terminal board is as follows:



2. Install Software

This section includes installing the following in order:

1. Camera driver
2. NcStudio V12 CCD control system

During installation, plug-in **NcCloud** will be installed automatically.

2.1. Install Camera Driver

To install the camera driver, do the following:

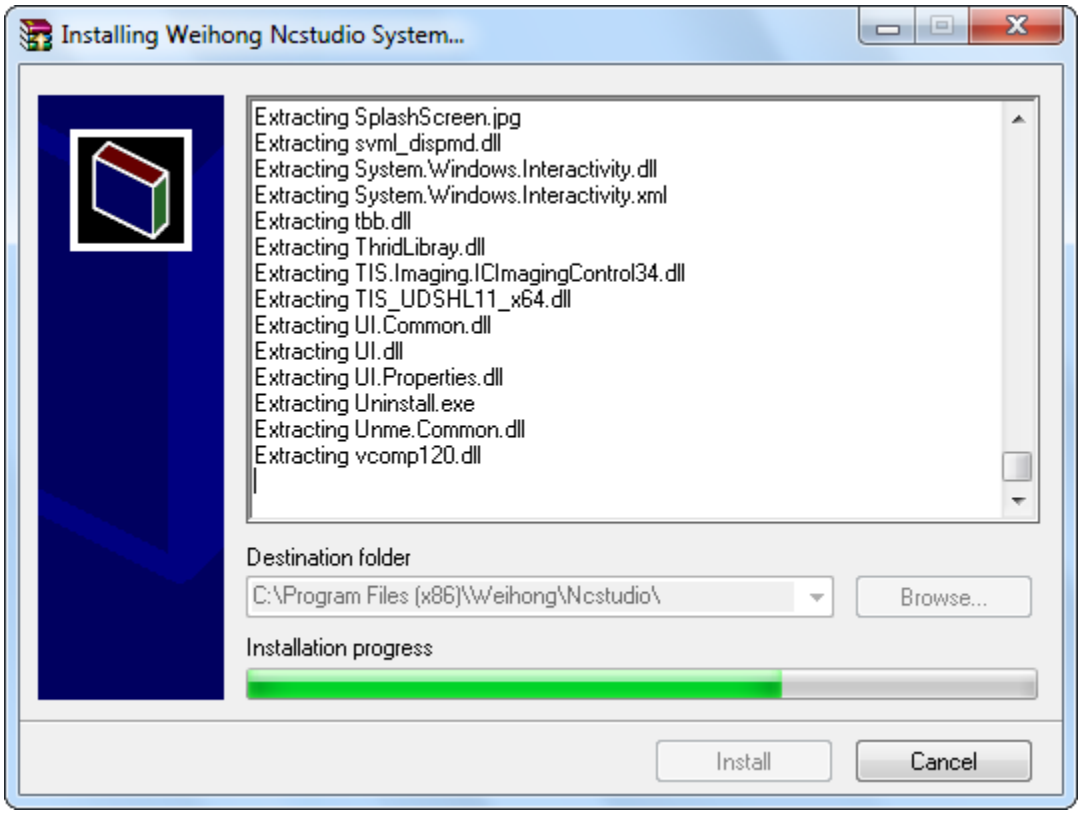
1. **Optional:** If the camera driver has been installed before, uninstall it.
2. Click the camera driver installer and follow the setup wizard.

2.2. Install NcStudio V12 CCD Control System

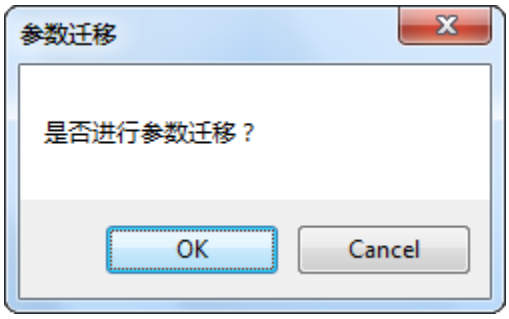
It is unnecessary to install **NcStudio V12 CCD Control System**, because it has been installed correctly when you own the NC65C host.

If you need to re-install or update NcStudio, do the following:

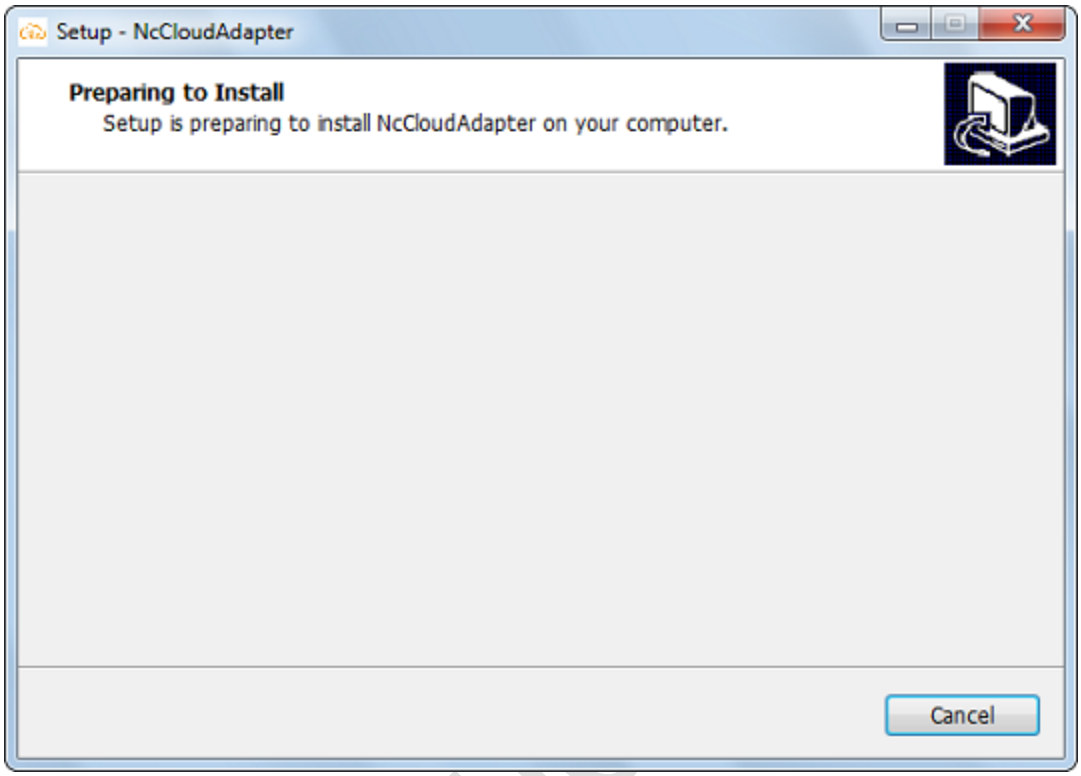
1. Double click NcStudio V12 installer. The window showing setup progress pops up:



2. When **Parameter Migration** dialog box pops up, select whether to save the previously configured parameters:

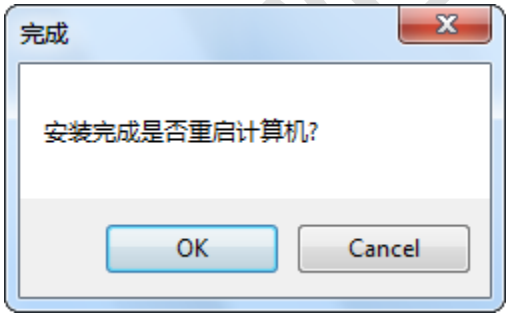


Meanwhile, a window showing NcCloud setup progress pops up:



During this period, plug-in **NcCloud** will be installed automatically.

3. Click **OK** to restart the computer. Re-installing/updating NcStudio V12 succeeds.

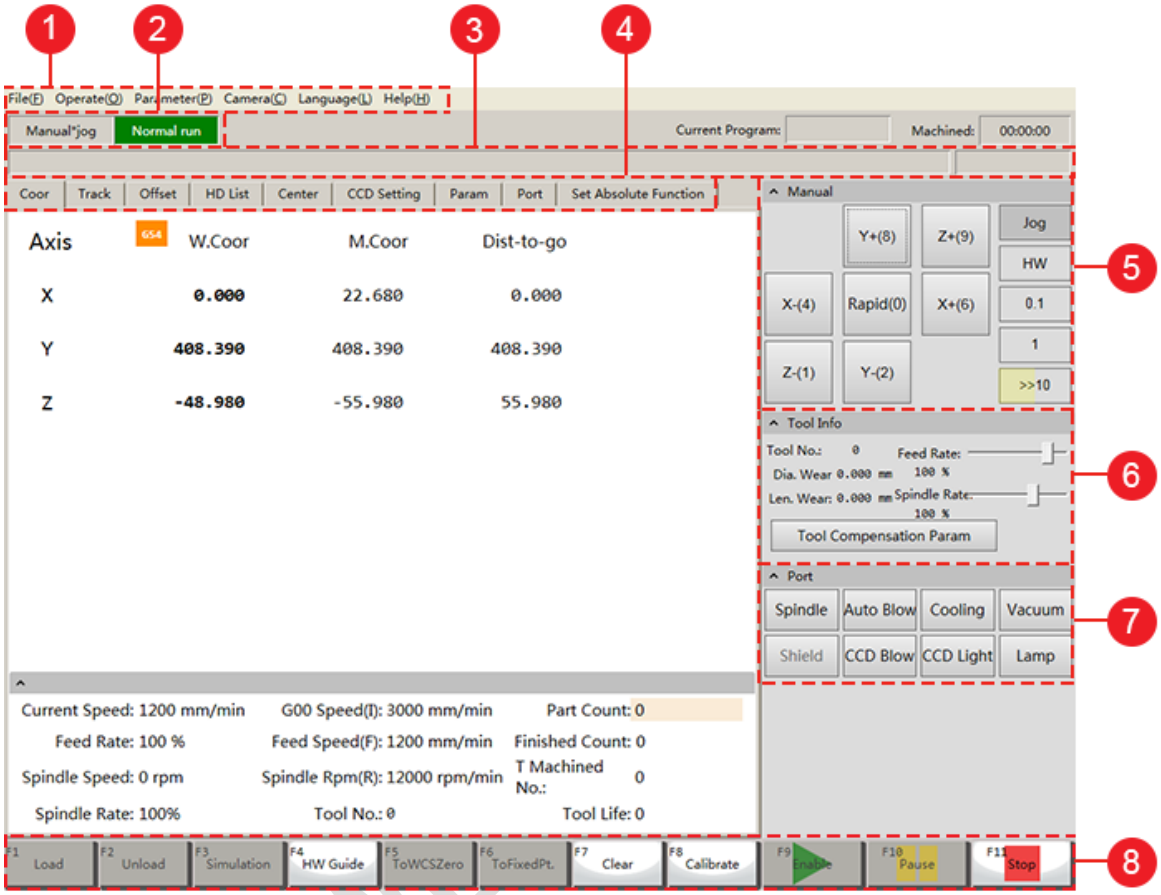


If you need to uninstall the system, delete the following:

- **Ncstudio** folder under path *C:\Program Files\Weihong*
- **NcStudio** item in **Start** → **Program**
- **NcStudio** shortcut icon in desktop

3. Operating Interface

The operating interface of **NcStudio V12 CCD Control System** is as follows:



1. Menu bar
2. Status bar
3. Machine control bar
4. Function windows
5. Manual control area
6. Tool information area
7. Port control area
8. Operating buttons

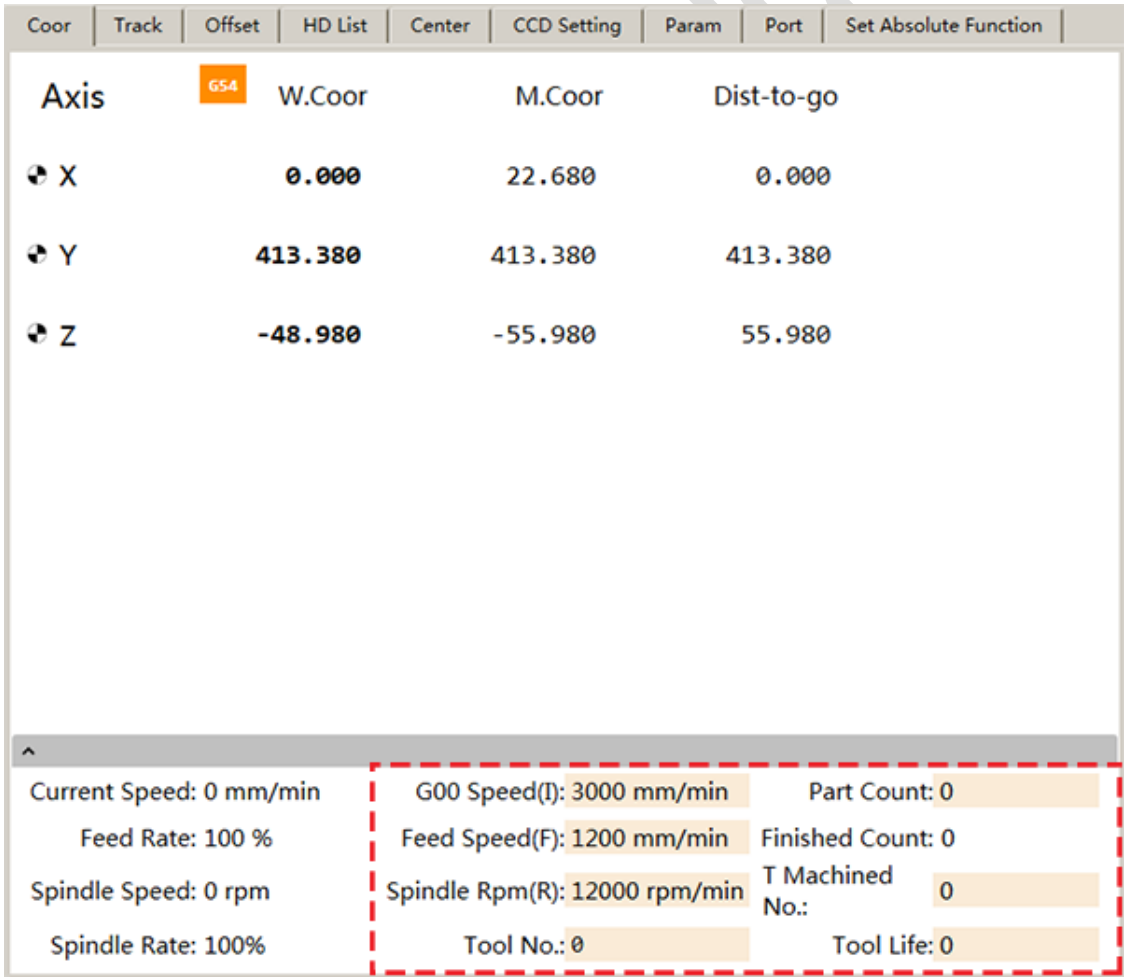
3.1. Function windows

Function windows include the following:

- Coor window
- Track window
- Offset window
- HD List window
- Center window
- CCD Setting window
- Param window
- Port window
- Set Absolute Function window

3.1.1. Coor Window

This window shows machine coordinate system and workpiece coordinate system:

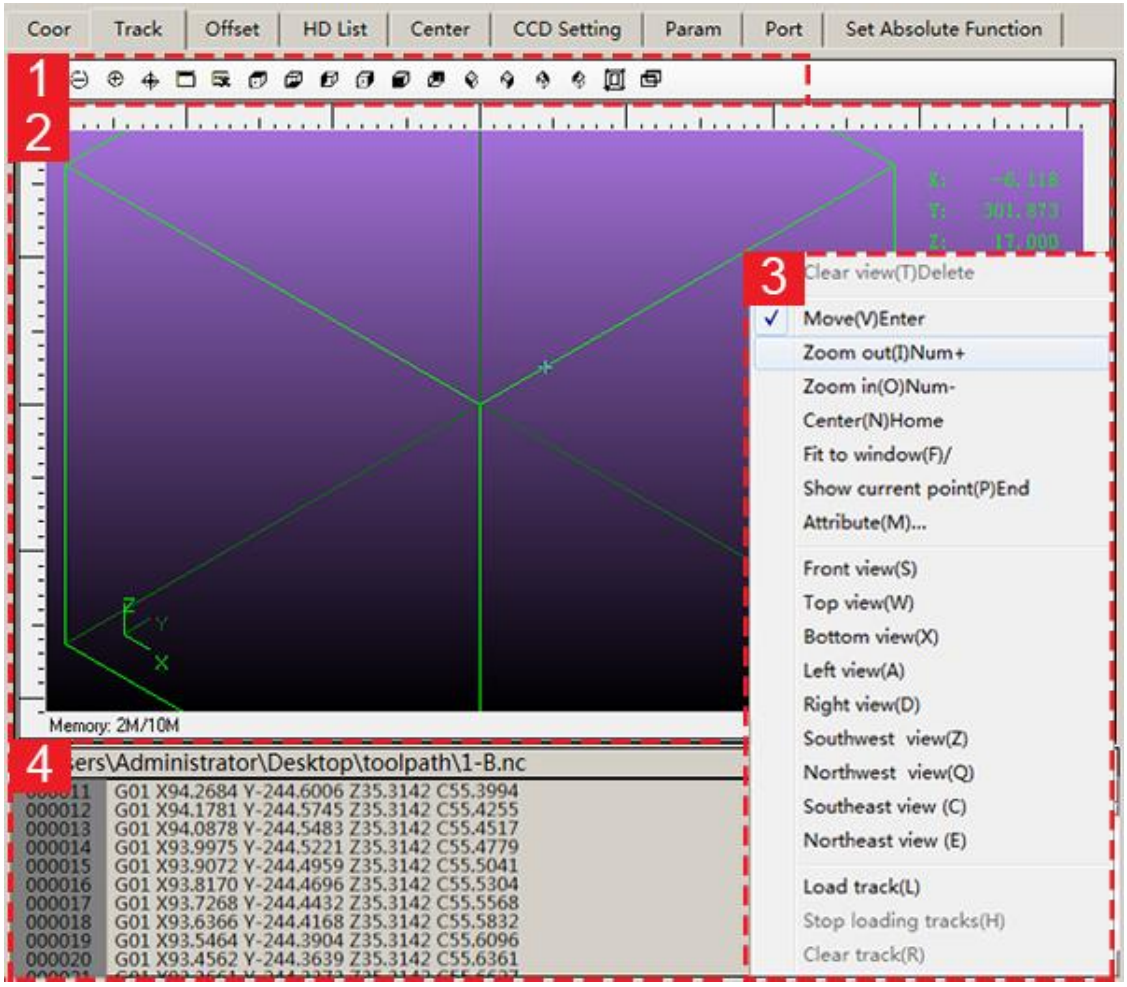


You can click the input boxes in yellow to directly edit the value of related parameters.

After axes have returned to the machine origin, the sign will appear before related axes.

3.1.2. Track Window

This window shows the machining track of tool in real time:



1. Toolbar
2. Track display area
3. Right-click menu
4. Machining file area

3.1.3. Offset Window

In this window, you can set workpiece offset and public offset, which is good for programming and shortening axis moving distance:

- Workpiece offset: it shows the distance of the workpiece origin relative to the machine origin.
- Public offset (external offset): it records temporary adjustment value of the workpiece origin and it can only be modified manually.

The relationship among workpiece offset, tool offset and public offset is as follows:

```
Workpiece Coordinate = Machine Coordinate – Workpiece Offset – Public O
ffset – Tool Offset
```

With **Automatic Layer Compensation** enabled, the relationship turns to:

```
Workpiece Coordinate = Machine Coordinate – Workpiece Offset – Public O
ffset – Tool Offset – Real-time Length Compensation
```

Among them, **Tool Offset** can be set by switching to **Param** window and modifying **Tool** parameters.

To set workpiece offset and public offset, do the following:

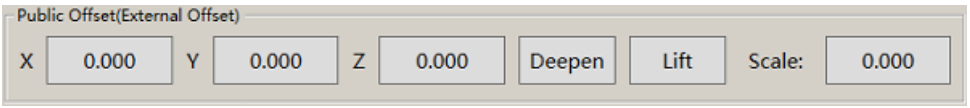
1. To set workpiece offset, do the following:
    1. Click the workpiece coordinate system to select a workpiece coordinate system:

    The selected coordinate system turns to orange.

    2. Click the input box of related axis and set a value.
    3. Click **Set** to set the machine coordinates of the current point to the offset.

2. To set public offset, do the following:

    1. To set public offset for X-axis/Y-axis, click the input box of related axis and set a value:



    2. To set public offset for Z-axis, do one of the following:

        - Click the input box of Z-axis and set a value.
        - Click the input box of **Scale**, set a value and do one of the following:
            - Click **Deepen**. The workpiece origin of Z-axis moves down the corresponding distance.
            - Click **Lift**. The workpiece origin of Z-axis moves up the corresponding distance.

3.1.4. HD List Window

This window includes the following interfaces:

- **Local** interface

  It shows the list of local program files under the root directory *D:\NcFiles*.

- **USB** interface

  It shows the list of program files from removable flash disks both under the root directory and subdirectory folders.

- **Wizard** interface

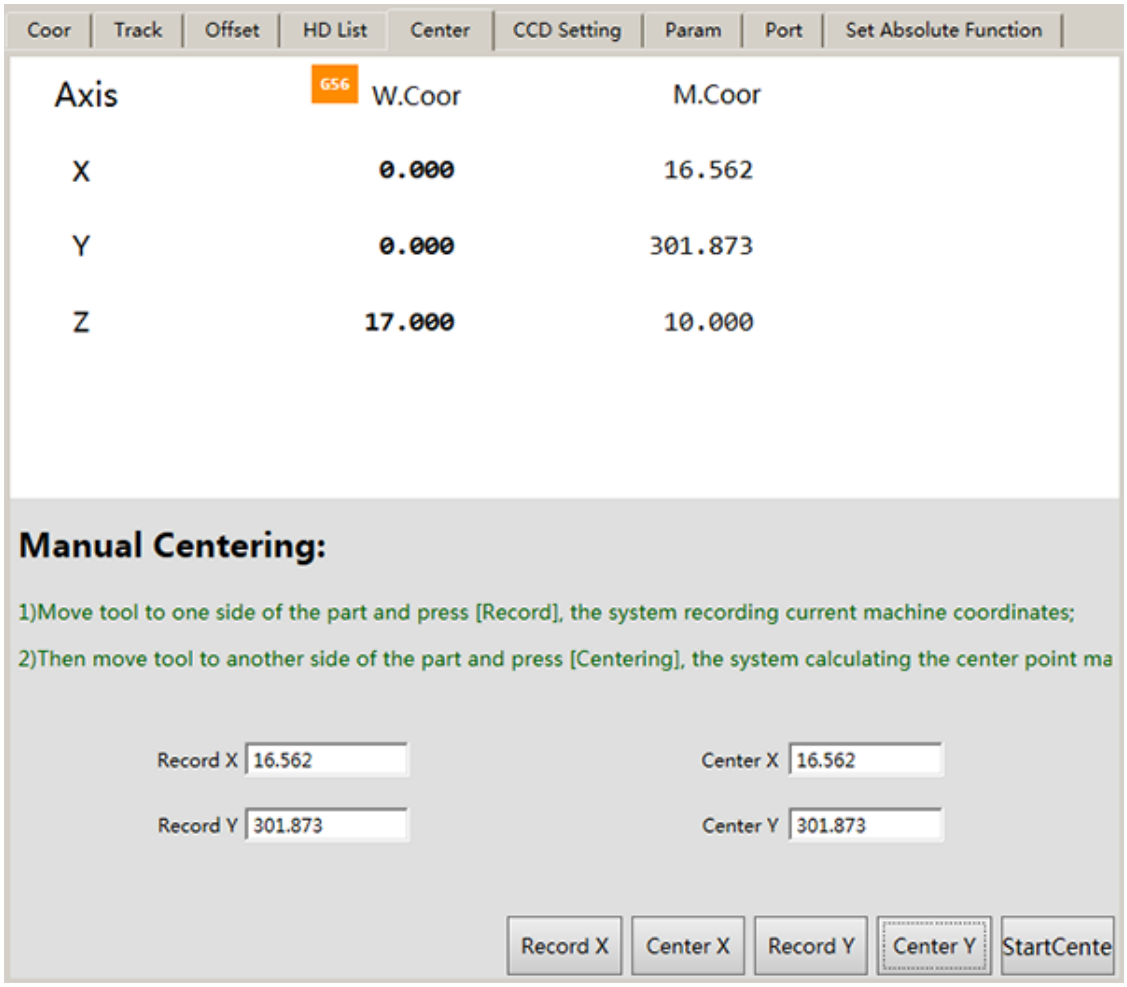
  You can generate program files from the following program wizards:

  - Cir. Contour
  - Cir. Pocket
  - Rect.Contour
  - Rect.Pocket

In conclusion, in this window, you can access various program files, stored in the system and in removable flash disks and generated from wizard.

3.1.5. Center Window

In this window, you can define the workpiece origin for regular rectangular workpiece through finding the center point by two points on the workpiece:



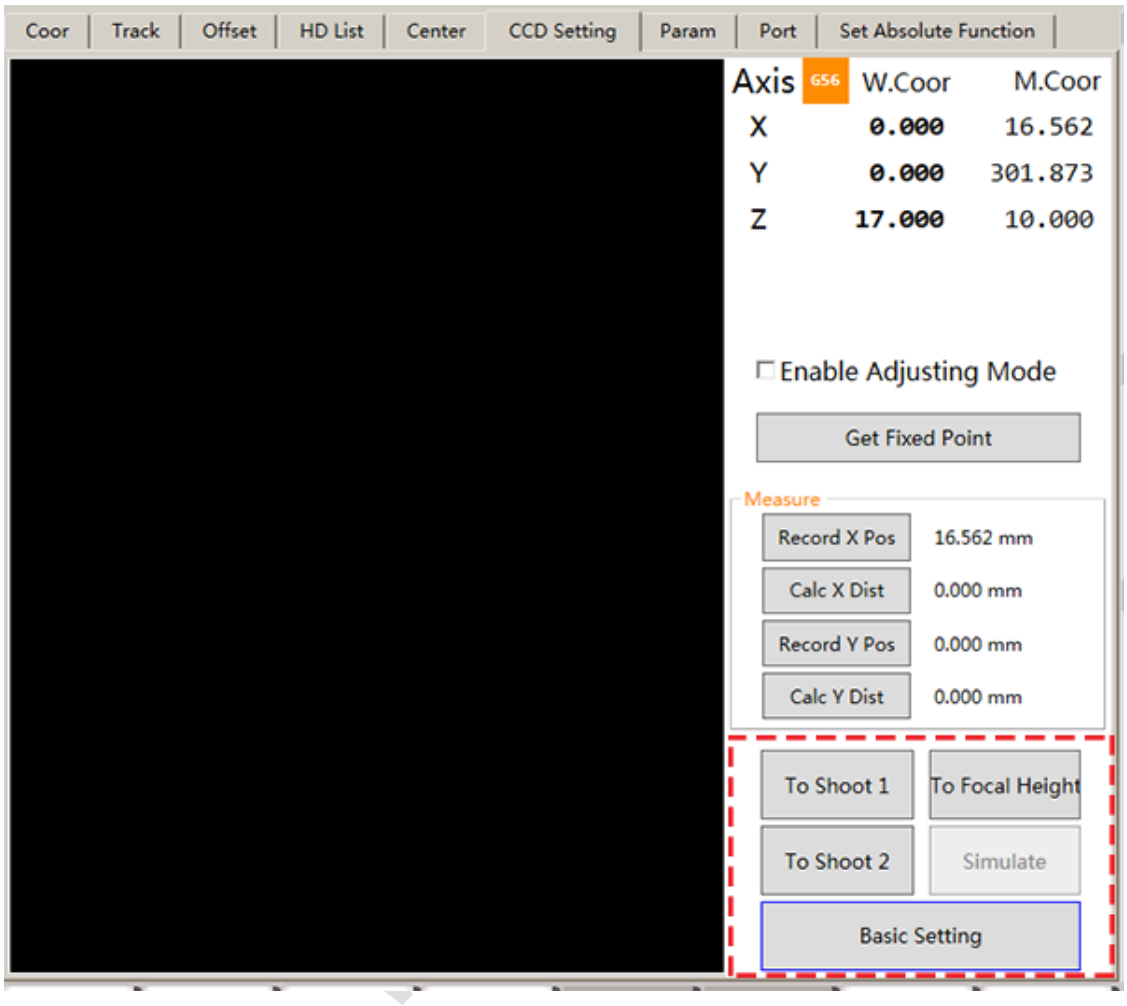
To do centering, do the following (take centering X-axis as an example):

1. Turn off the spindle to avoid danger from too fast spindle speed.
2. Click **StartCenter**.
3. Move the tool to one side of the workpiece and press **Record X**. The system records the machine coordinates of current point.
4. Move the tool to the other side of the workpiece and press **Center X**. The system does the following:
    1. Record the machine coordinates of current point.
    2. Calculate the center point based on coordinates of current point and previous point.

Note: When one axis is centered, the other axis should keep still.

3.1.6. CCD Setting Window

In this window, you can execute operations of CCD setting:



- **To Shoot**

  CCD moves to the related shooting position.

- **To Focal Height**

  Spindle moves to the clearest position of the picture.

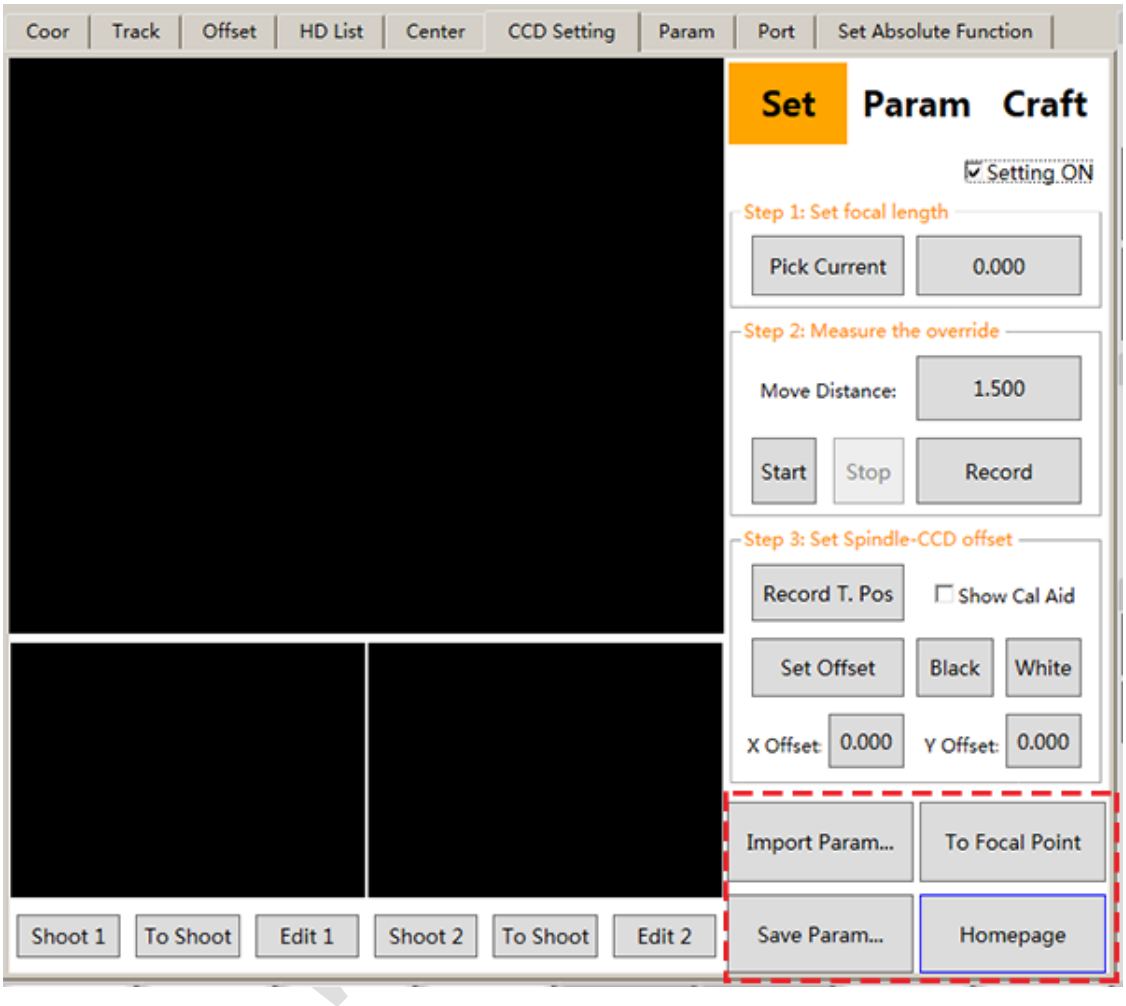
- **Simulate**

  Spindle moves to the clearest position of the picture and then moves along tool path.

  No actual machining occurs.

- **Basic Setting**

  Click this button, **CCD Basic Setting** interface pops up:

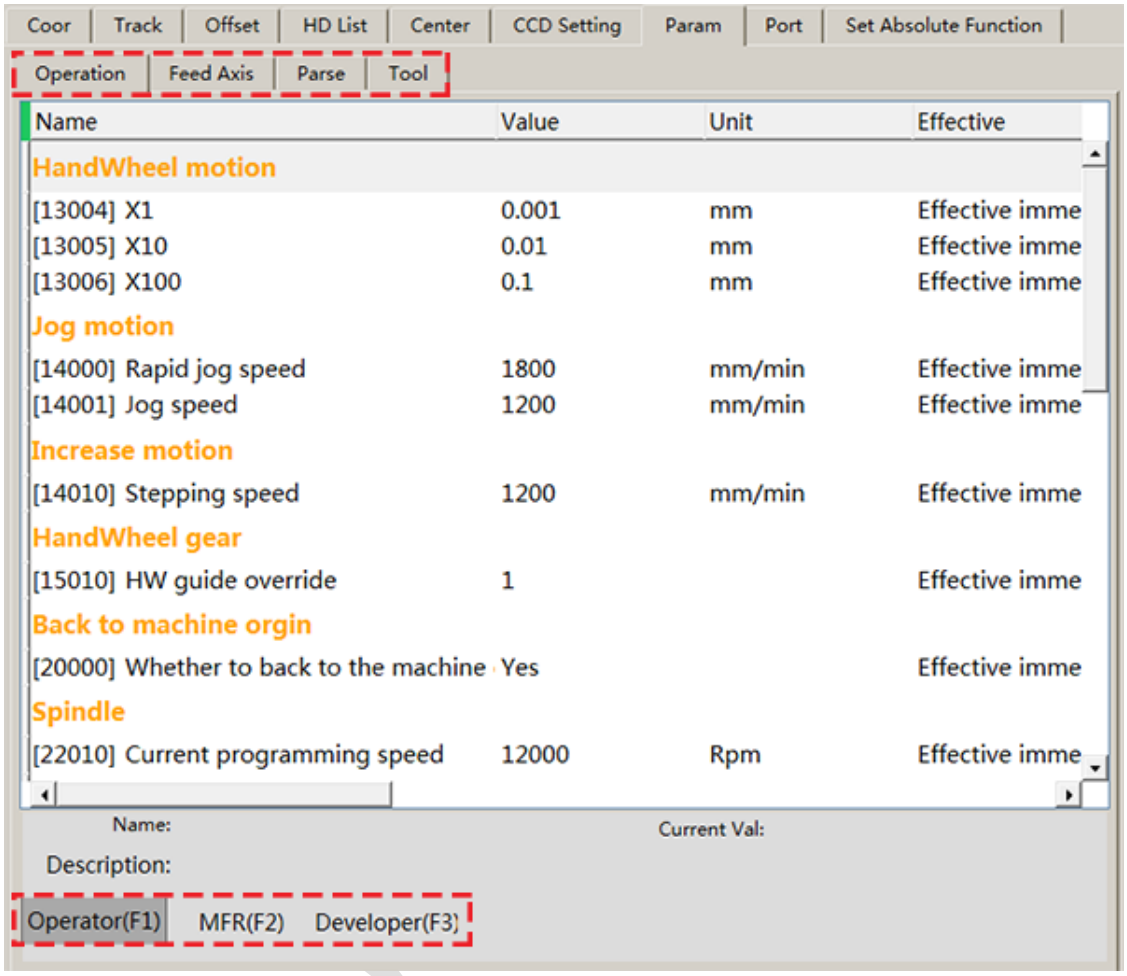


  - **Save Param**: save CCD related parameters.
  - **Import Param**: import parameters saved by **Save Param** operation.
  - **To Focal Point**: move the camera to the focal height.
  - **Homepage**: jump to **CCD Setting** window.

This function window is quite important in this manual. This section only focuses CCD function. For CCD operations, please refer to CCD Operations.

3.1.7. Param Window

This window shows all parameters in **NcStudio V12 CCD Control System**:



You can check and modify the values of parameters by:

- Function

  Parameters are divided into **Operation**, **Feed Axis**, **Parse** and **Tool**.

  In running state, only parameters of tools except the current tool can be modified.

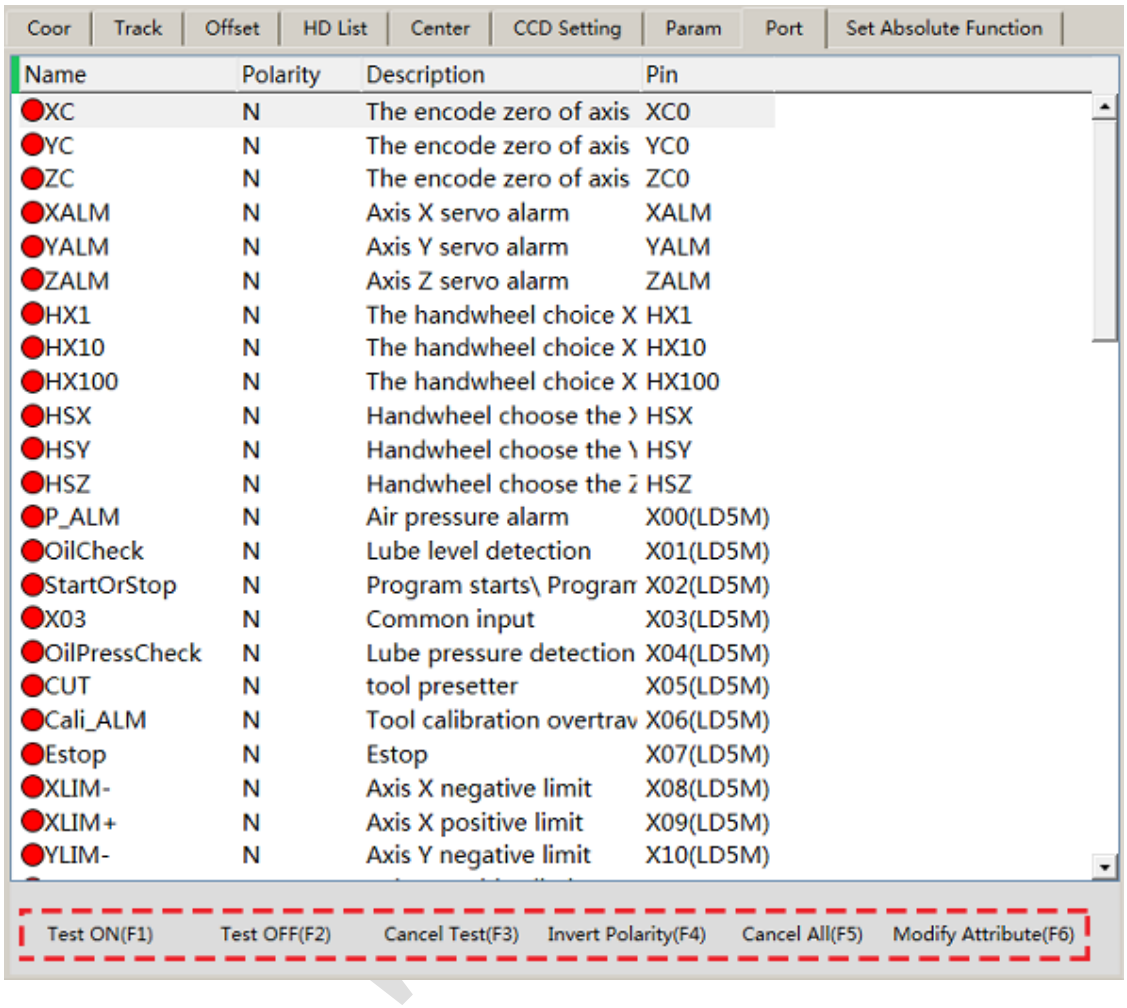
- Permission

  Parameters are divided into **Operator**, **MFR** (manufacturer) and **Developer**.

  For MFR and developer parameters, password is required.

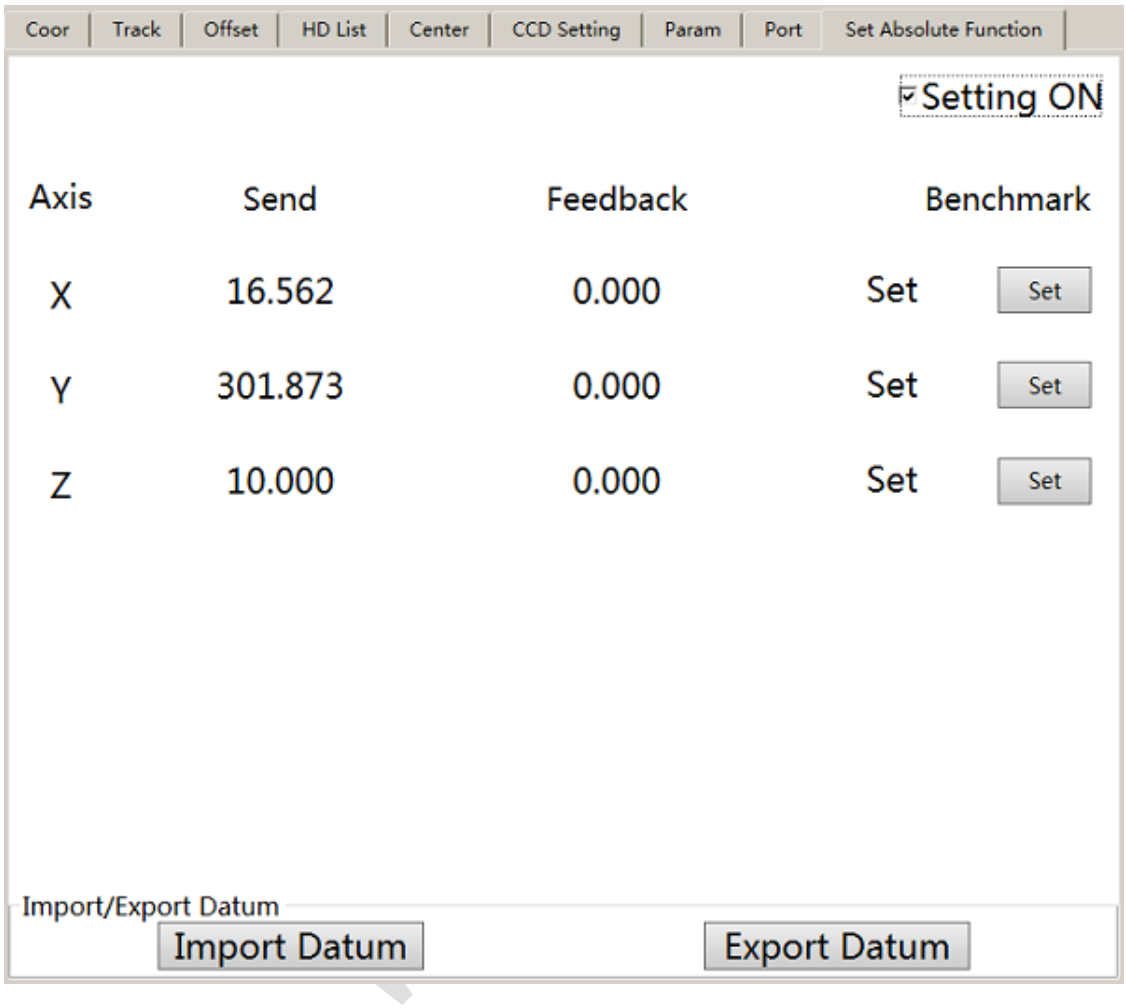
3.1.8. Port Window

This window shows port information:



3.1.9. Set Absolute Function Window

In this window, you can set the machine origin, also known as datum:



This operation is required only commissioning for the machine tool is required.

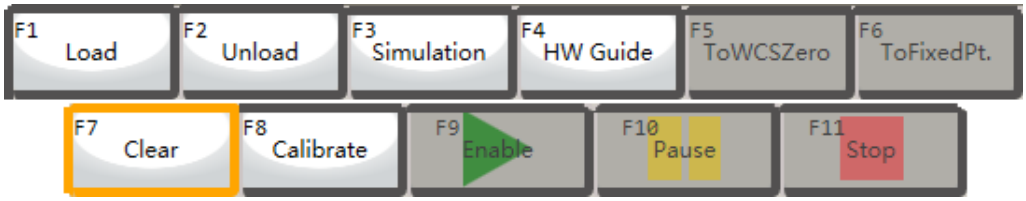
To set datum, do one of the following:

- Click **Set** to set current coordinate as datum.
- If you have replaced the software, click **Import Datum** to import previously set datum parameters.

After setting, click **Export Datum** to export the set datum for later use.

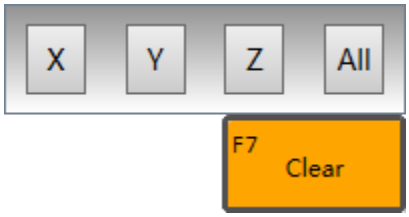
3.2. Operating Buttons

You can click corresponding buttons or shortcut keys (F1~F11) to realize corresponding operation:



Among them, **Clear (F7)** is used to clear the pubic offset.

Click it to select the corresponding axis to do clearing:



3.3. Port Control Area

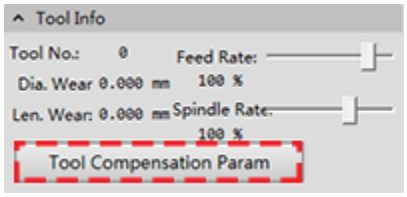
In this area, you can detect the communication of software and hardware.

Click corresponding button. The port turns to green and the related valve is on.

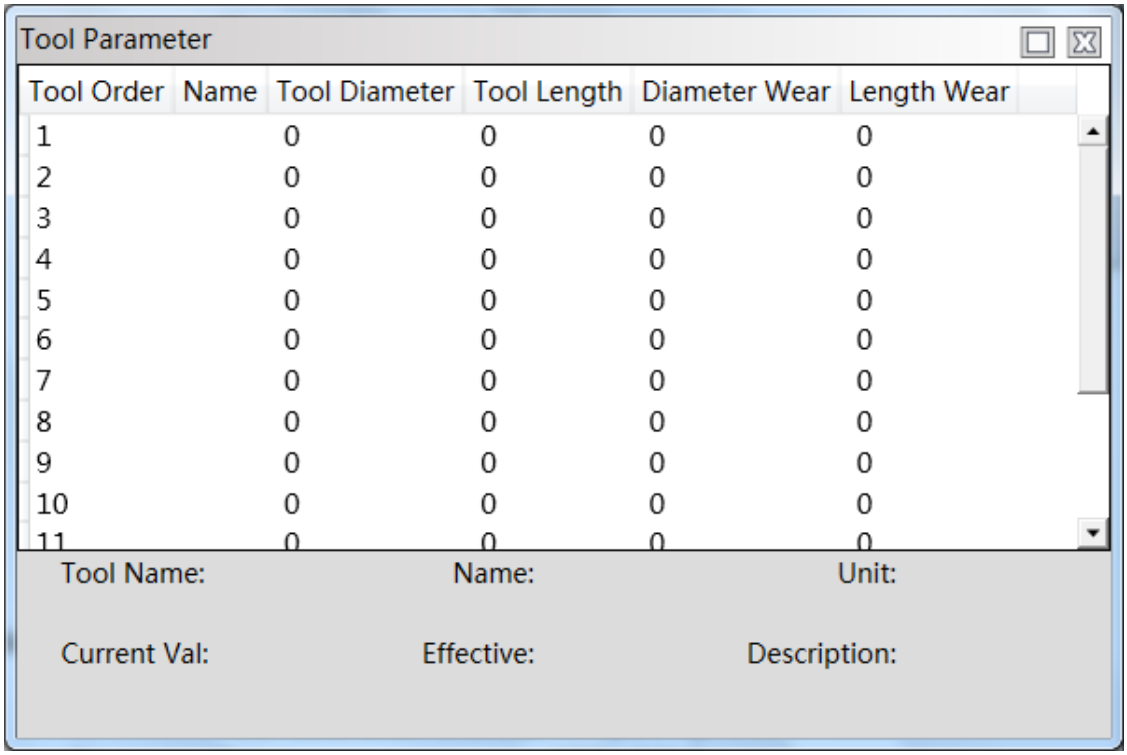
Lights ON of the port in the terminal board shows good communication.

3.4. Tool Information Area

In this area, you can check tool information:

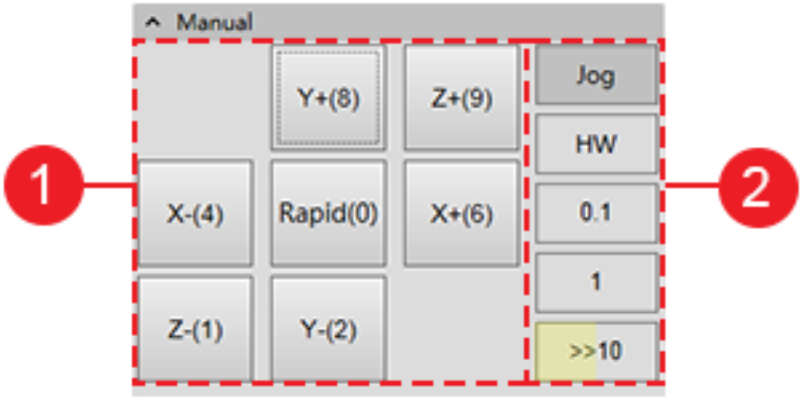


Click **Tool Compensation Param** to set tool compensation parameters:



3.5. Manual Control Area

In this area, you can control axis movement and select feed mode:



1. Axis direction buttons: used to move each axis towards positive or negative direction:
   - Only click an axis button. The axis moves at jogging speed.
   - Click an axis button after clicking **Rapid**. The axis moves at rapid jogging speed.
2. Mode buttons: used to select feed mode:
   - Jog mode

     Press an axis direction button and **Jog**. The machine tool keeps running until you release the button.
   - HW mode

     The machine tool is controlled by handwheel.
   - Stepping mode

     Click an axis direction button and **0.1**, **1** or the left yellow area on button **>>10**. The machine moves 0.1mm, 1mm or a customized step size separately.

     Click the right grey area on button **>>10**, **Stepsize** dialog box pops up and you can customize the step size.

     The customized step size should not be too large to avoid damage from misoperation. And its default value is 10mm(inch).

     Note: Please do not click frequently, for the system needs a certain time to execute the command.

4. CCD Operations

To execute CCD operations, do the following:

1. Switch to **CCD Setting** window.
2. Set camera
3. Debug CCD and the machine
4. Set CCD and the workpiece
5. Execute other operations

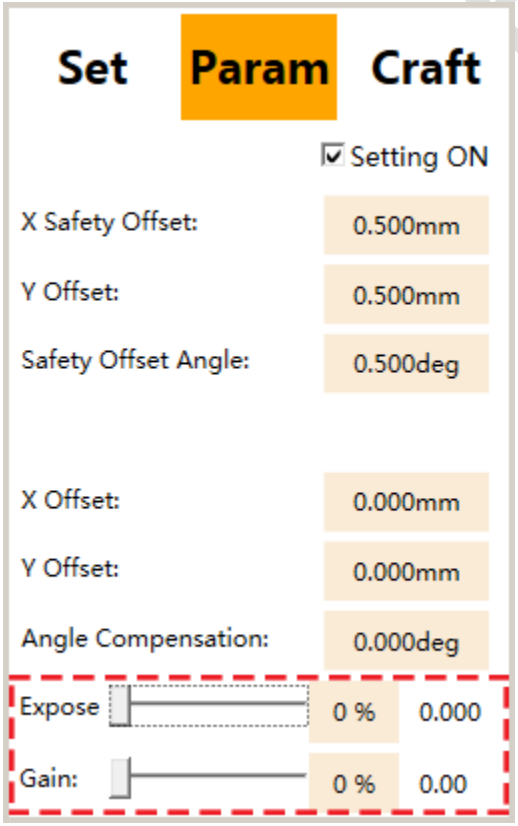
4.1. Set the Camera

This operation mainly contains setting the following two parameters:

- Exposure
- Gain

To set the camera, do the following:

1. Switch to **Param** interface.
2. Check **Setting ON**.
3. Drag the slider to adjust the percentages of **Expose** and **Gain**:



After setting, exposure and gain time corresponding to the percentages automatically shows.

Note: Too large percentage of **Expose** results in low captured frame rate. Thus, **Expose** should be set properly.

After setting **Expose**, you need to consider whether to increase the shoot delay time(unit: ms).

In general, the requirement of shoot delay time is as the follows:

```
Shoot Delay Time ＞ 100ms + Exposure Time
```

Among them, **100ms** refer to the machine's stop time.

Example

If **Expose** is set to **7%**, the corresponding exposure time is 0.035s (35ms). Thus, it is reasonable to set the shoot delay time to 200ms.

4.2. Debug CCD and the Machine

Focal length, magnification and offset are fixed after the machine tool is installed. If the machine tool is replaced or repaired (e.g. the camera or lens is reinstalled), these three values need to be re-measured. That is, debugging CCD and the machine tool is required.

To debug CCD and the machine tool, do the following:

1. Click **Basic Setting** → **Set** and check **Setting ON**.
2. Measure the focal length
3. Measure the magnification
4. Measure the offset between the spindle and CCD

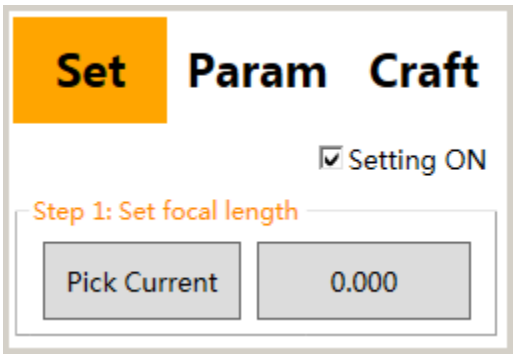
4.2.1. Measure the Focal Length

Aim of the operation: Before shooting, X-axis and Y-axis move to the shooting point and Z-axis moves to the focal height.

To measure the focal length, do the following:

1. Manually move Z-axis until the camera can take a clear picture.
2. Enable **X10** with handwheel to move Z-axis until Z-axis finds the clearest position.

3. Click **Pick Current** to set Z-axis coordinate of the focal length:



The value automatically fills to the right button.

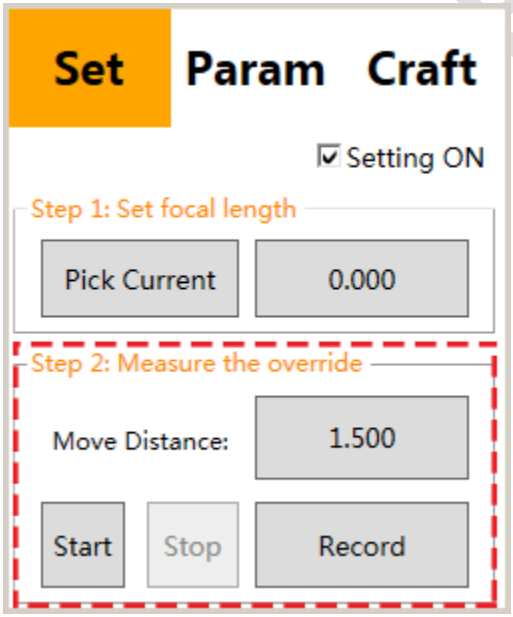
4.2.2. Measure the Magnification

Aim of the operation: To obtain the proportional relationship between the pixel and the displacement.

Wrong magnification results in wrong CCD result.

To measure the magnification, do the following:

1. Set the movement distance for the machine, e.g. 1.500mm:



2. Click **Pick Feature Pt** to set the current point as feature point. The point will be looked for during measuring magnification.

   The point must be unique within the camera view.

   See What Are the Requirements for the Selected Feature Points in Measuring Magnification? for details.

3. Click **Start** to start to measure magnification.

After measuring the magnification finishes, do the following:

1. Click **Start** repeatedly to do several measurements.
2. Click **Record** to view the measurement results.
3. Remove the values changing greatly.

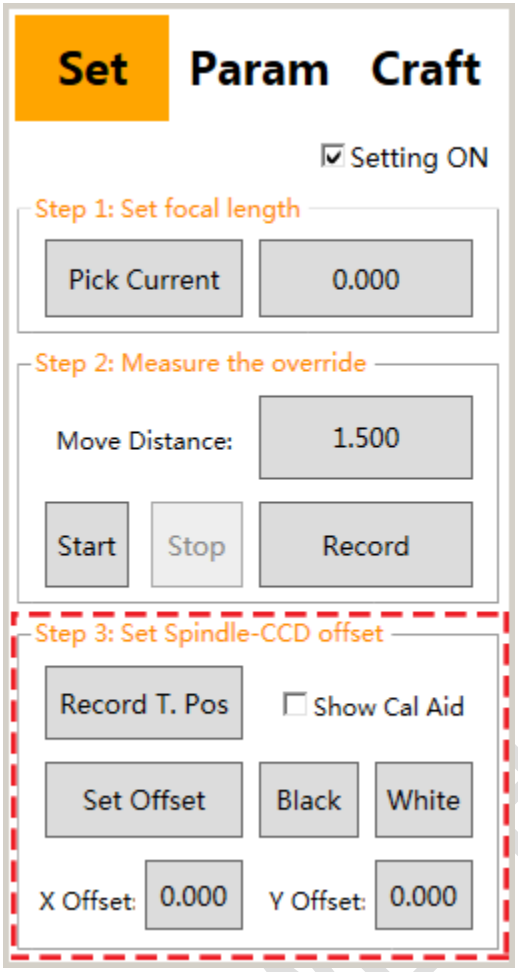
4.2.3. Measure the Offset between the Spindle and CCD

Without the offset between the spindle and CCD, the workpiece will deviates in the X and Y directions.

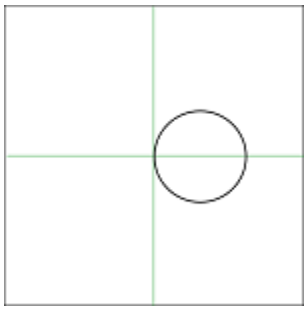
To measure the offset between the spindle and CCD, do the following:

1. Turn the handwheel to make Z-axis slowly approach an useless area in the workpiece.
2. Click **Spindle** on the port control area to enable the spindle.
3. Switch handwheel override to X10 and slowly deepen Z-axis to drill a hole.
4. Click **Spindle** again to disable the spindle.

5. Click **Record**:

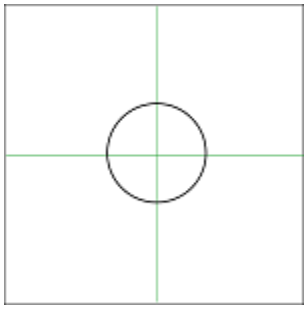


6. Turn the handwheel to find the hole position and move camera center to the tangent position of the hole in X-axis direction:

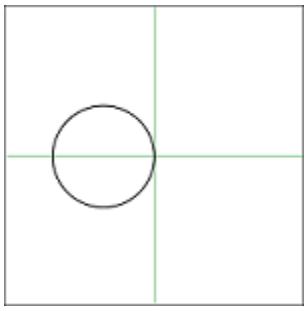


7. Move a tool radius in X-axis direction.

   At this time, the coordinate in X-axis direction is the position of the circle center:



   Repeat the step to check the setting of tool radius. If it is set correctly, the CCD center should be on the other side of the tangent position:



8. Repeat steps 6 and 7 to find the center position in Y-axis direction.
9. Click **Set Offset** to set the offset.

4.3. Set CCD and the Workpiece

To set CCD and the workpiece, do the following:

1. Set image matching mode
2. Shoot
3. Edit a template

4.3.1. Set Image Matching Mode

With a few exceptions, most feature points are the same.

For shooting points with the same features, you only need to set a template; for shooting points with different features, you need to set templates for each shooting point.

To set image matching mode for feature points, do the following:

1. Switch to **Param** window and check **Operation** parameters.
2. Set parameter **26003 CCD Image Match Mode**:
   - If the feature points are exactly the same, set the parameter to **0**.
   - If the feature points are different, set the parameter to **1**.

4.3.2. Shoot

To shoot, do one of the following:

- Shoot by single point
- Shoot by two points
- Shoot by three points
- Shoot by four points

These methods differ in the number of shooting points:

- Comparison between Shoot by two points and other operations is as follows:

Differences	Shoot by two points	Shoot by single/three /four point(s)
Used coordinate	Workpiece coordinate	Machine coordinate
Shooting position	Input manually.	Directly move to the corresponding position and set.
When to set coordinate system	Set before machining.	Reset based on the actual position after shooting.

- Difference between Shoot by three points and Shoot by four points:

  The later is actually an upgraded operation of the former. If shooting a point fails in shooting by three points, shooting by four points is required.

Shoot by Single Point

When programming, you need to set the circle center as the workpiece origin. After shooting, the system will set the found center as the workpiece origin.

This operation is suitable to process circles.

To shoot by single point, do the following:

1. Switch to **Param** page and set the parameter **CCD Shoot mode** to **1**.
2. Move to the circle center and click **Shoot** to record the position of the shooting point.

After setting, click **Template Edit**. **Outline Positioning** dialog box pops up. For details, please refer to Edit a Template.

Shoot by Two Points

With this shooting method, the positions of the shoot points are the theoretical position on the drawing.

To shoot by two points, do the following:

1. Set the workpiece origin and the first shooting point:

   It is recommended to do the following:

   1. Switch to **Craft** page and check **Setting ON** and **Set Work Zero by CCD Center**.
   2. Move X-axis and Y-axis to the position of the first shooting point, and click **Clear** → **X** and **Y**.
   3. Switch to **Set** page and click **Pick Current** under **Mark 1**.

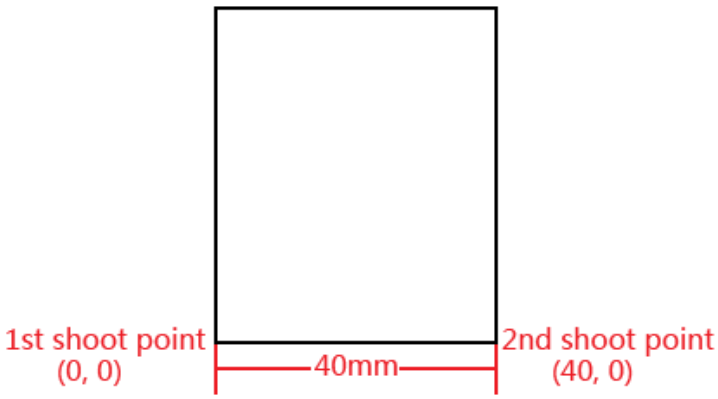
      At this time, the position of the first shooting point is the workpiece origin.

2. Switch to **Param** page and set the parameter **CCD Shoot Mode** to **2**.
3. Set the second shooting point under **Mark 2**.

   It is recommended to manually input the position of the second shoot point, according to the distance between the two shooting points.

Example

In the figure below, the two shooting points are horizontal in X-axis direction with 40mm distance and the first shooting point is set as workpiece origin:



Thus, the position of the second point is (X40, Y0).

After setting, click **Template Edit**. **Outline Positioning** dialog box pops up. For details, please refer to Edit a Template.

Shoot by Three Points

With this shooting method, the three points must form a right triangle. And when programming, you need to set the center point of the hypotenuse as the workpiece origin.

To shoot by three points, do the following:

1. Switch to **Param** page and set the parameter **CCD Shoot Mode** to **3**.
2. Move X-axis and Y-axis to the position of the first shooting point and click **Pick Current** under **Mark 1**.
3. Move X and Y axes to the position of the second shooting point and click **Pick Current** under **Mark 2**.
4. Move X and Y axes to the position of the third shooting point and click **Pick Current** under **Mark 3**.

After setting, click **Template Edit**. **Outline Positioning** dialog box pops up. For details, please refer to Edit a Template.

Shoot by Four Points

This method is similar to shooting by three points. If shooting a point fails in shooting by three points, shooting by four points is required.

To shoot by four points, do the following:

1. Switch to **Param** page and set the parameter **CCD Shoot Mode** to **4**.
2. Move X-axis and Y-axis to the position of the first shooting point and click **Pick Current** under **Mark 1**.
3. Move X-axis and Y-axis to the position of the second shooting point and click **Pick Current** under **Mark 2**.
4. Move X-axis and Y-axis to the position of the third shooting point and click **Pick Current** under **Mark 3**.
5. Move X-axis and Y-axis to the position of the fourth shooting point and click **Pick Current** under **Mark 4**.

After setting, click **Template Edit**. **Outline Positioning** dialog box pops up. For details, please refer to Edit a Template.

4.3.3. Edit a Template

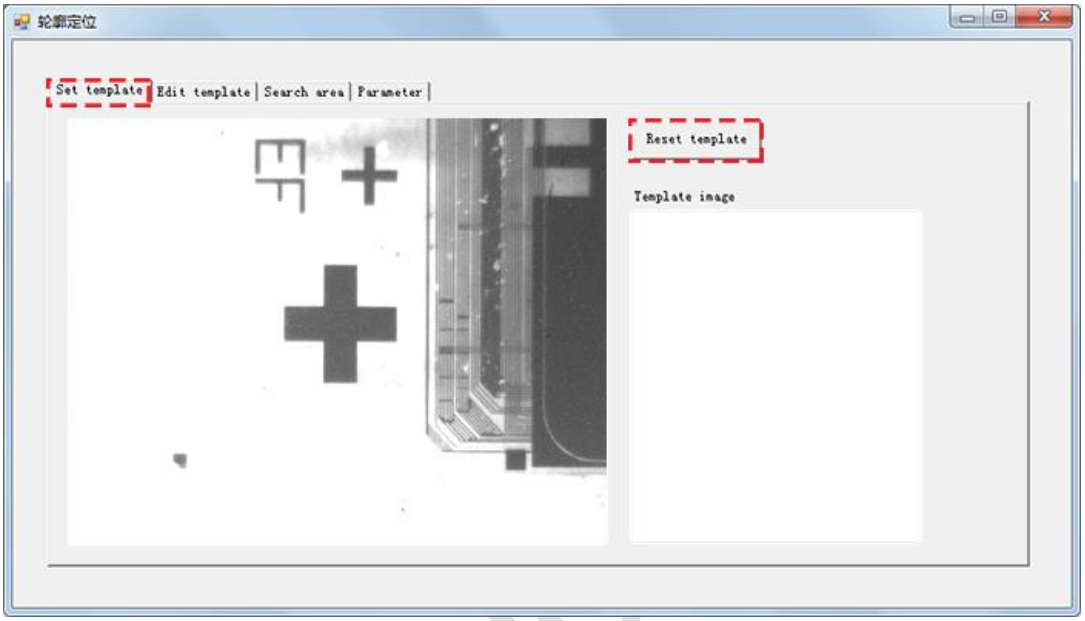
The purpose of editing a template is to extract features of shooting points. Thus, it is convenient to find the position of the feature points in the picture according to the extracted features.

When enditing a template, please ensure:

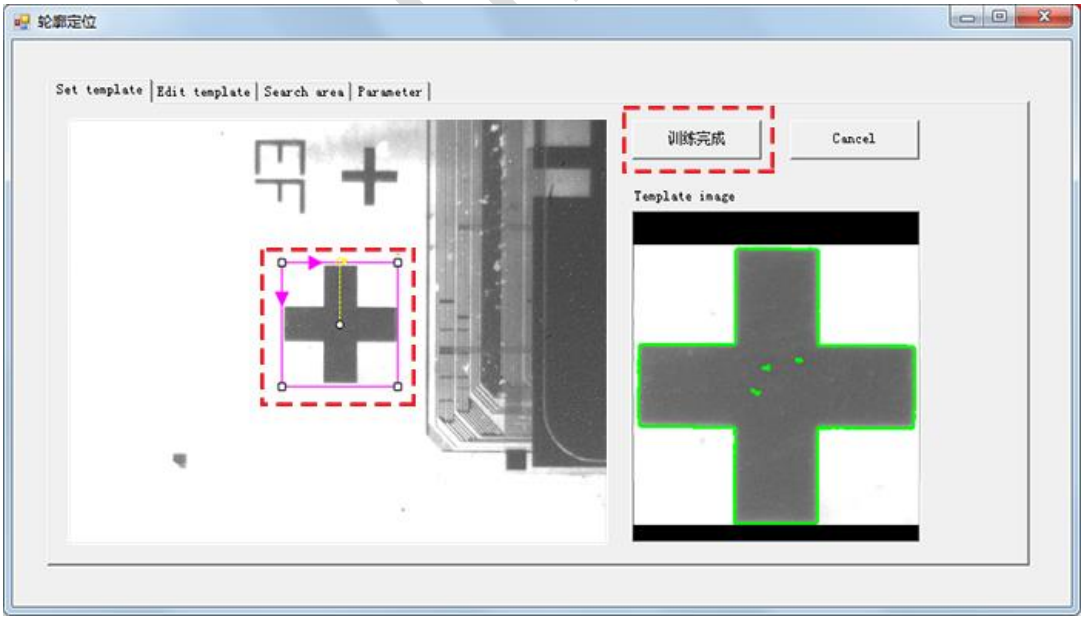
- The number of extracted feature points is enough.
- The workpiece is not tilted, because it is not allowed to pick the feature points while the feature points are tilted.

To edit a template, do the following:

1. Click **Edit**. The **Outline Positioning** dialog box pops up.
2. Switch to **Set Template** page and click **Reset Template**.



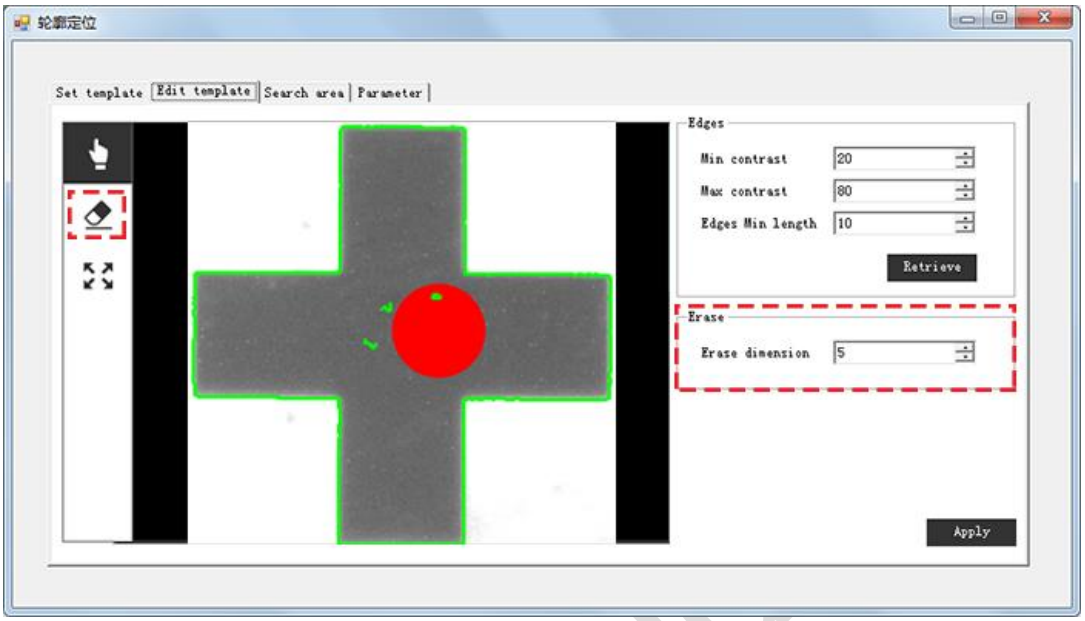
3. Drag the rectangle to the position of the feature point:



The size of the rectangle needs to be equal to the size of the feature point.

After it is done, click **Finish**.

4. Switch to **Edit Template** page to process the extracted features:

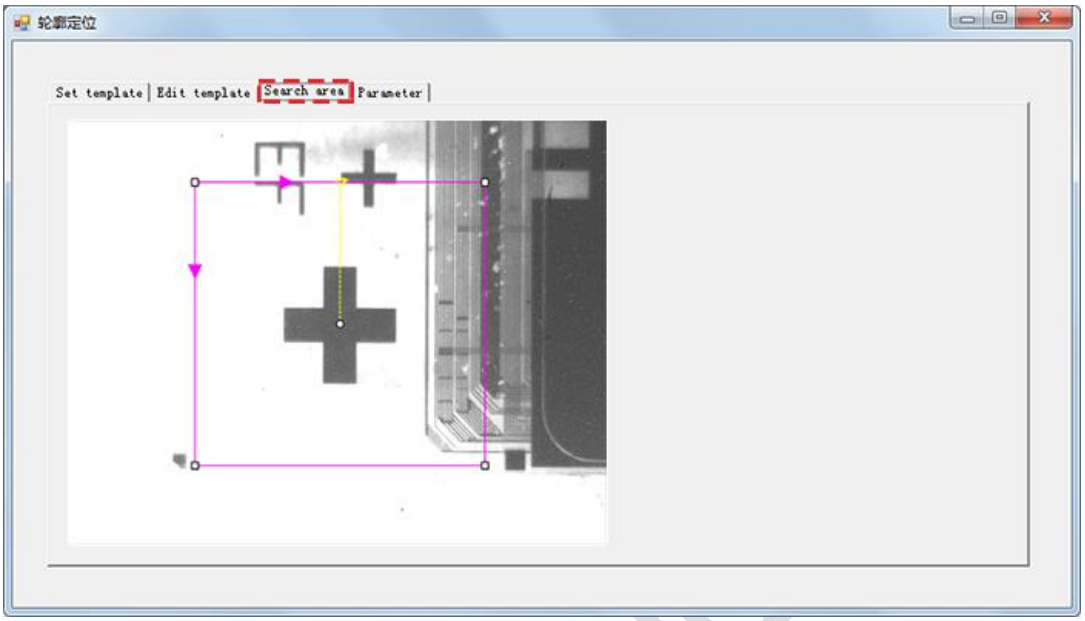


Min Contrast and Max Contrast
Used to set the contrast of the feature points.
In general, the range of the minimum contrast is [20, 80] and the range of the maximum contrast is [60, 120].
If the picture is blurry and the feature points are not obvious, you can lower these two values.

Edge Min Length
The minimum pixel of the extracted feature point's edge.
In general, it is set to 10.

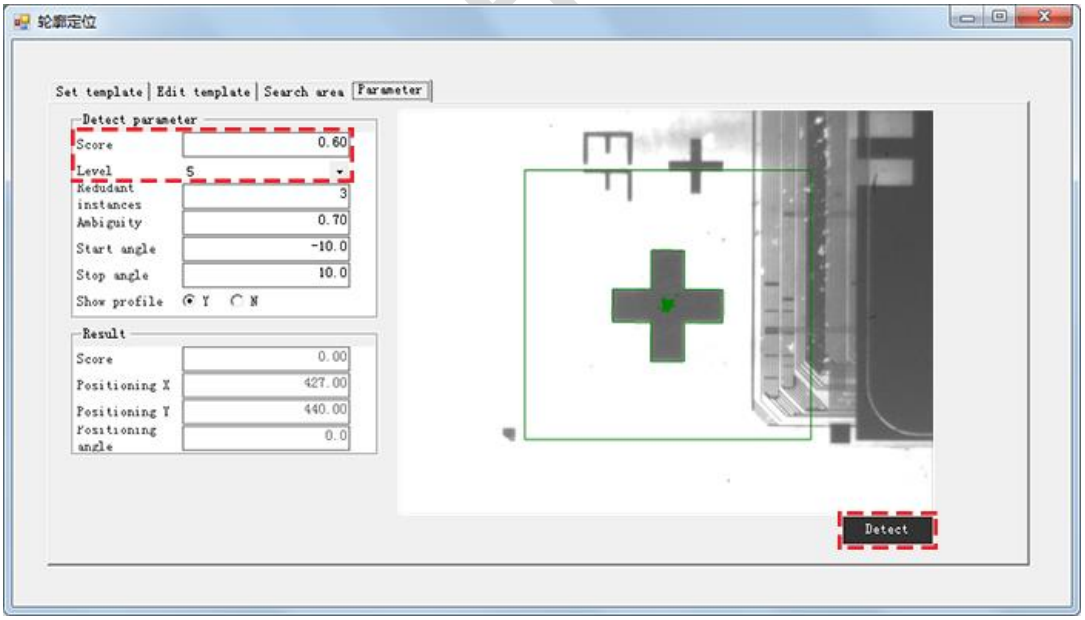
Erase Dimension
The dimension of eraser that used to erase unnecessary parts.
After it is done, click **Apply**.

5. Switch to **Search Area** page to set search area for the feature points.



In general, the feature point is near the center of the picture. Thus, it is recommended to select a smaller range.

6. Switch to **Param** page and set parameters for outline positioning:



Set the parameters **Score** and **Level** according to the picture quality. If the picture quality is good, these two parameters can be set higher.

Remember too small values result in wrong positioning and too big values result in positioning missing.

In general, the range of the parameter **Score** is [0.3, 0.7] and the range of the parameter **Level** is [4, 6].

After it is done, click **Detect** to detect whether shooting is successful.

After the setting is completed, it is necessary to repeatedly observe in case of mistakes.

4.4. Execute Other Operations

This section introduces the following auxiliary operations:

- Select image display mode
- Execute array machining
- Enable CCD
- Set the workpiece origin by CCD center
- Set safety offset
- Set workpiece offset compensation
- Set workpiece size compensation
- Set Z-axis depth compensation
- Execute simulation
- Set automatic layer compensation

4.4.1. Select Picture Display Mode

Currently, picture display mode includes the following:

- Display live pictures captured by the camera.
- Display the shooting pictures.

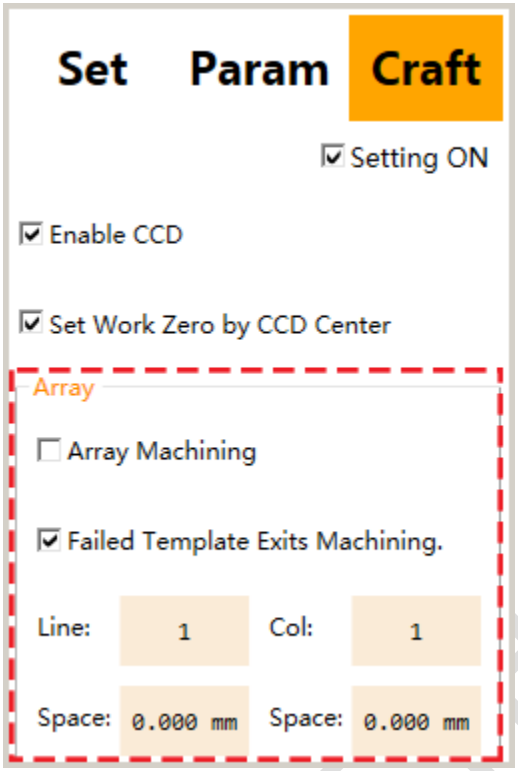
After matching, whether the matching is successful or not, the picture display area in **CCD Setting** window displays the currently matched picture in real time.

To display live pictures captured by the camera, click the picture display area in **CCD Setting** window.

4.4.2. Execute Array Machining

To execute array machining, do the following:

1. Switch to **Craft** page:



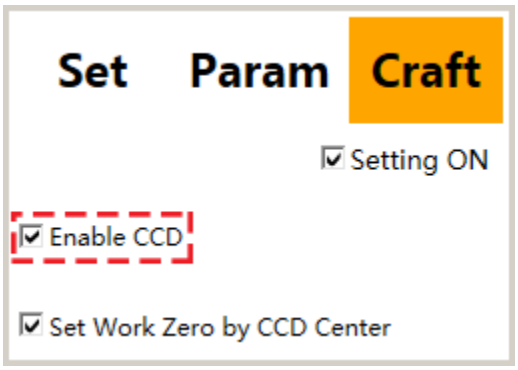
2. Check **Setting ON** and enter the manufacturer password.
3. Check **Array Machining** to enable array machining.
4. Set line number and space and column number and space.
5. **Optional:** check **Failed Template Exits Machining**.
   - Check: Only if the shooting for a workpiece fails, machining for all workpieces stops.
   - Uncheck: if the shooting of a workpiece fails, machining for other workpieces continues.

4.4.3. Enable CCD

You can choose whether to enable CCD according to machining technics.

To enable CCD, do the following:

1. Switch to **Craft** page:



2. Check **Setting ON** and enter the manufacturer password.
3. Check **Enable CCD** to enable CCD.

4.4.4. Set the Workpiece Origin by CCD Center

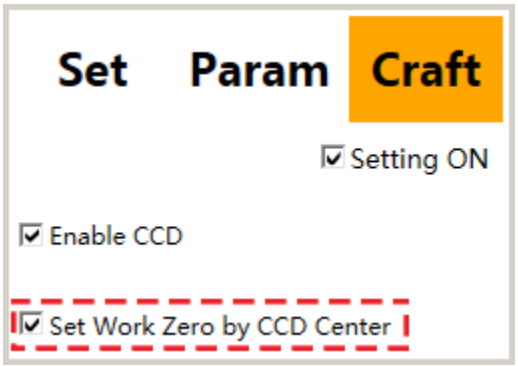
There are two methods to set the workpiece origin:

- By tool nose
- By CCD center

  This ways is only suitable to shooting with two points. For other shooting methods, the workpiece origin is reset based on shooting results.

To set the workpiece origin by CCD center, do the following:

1. Switch to **Craft** page:



2. Check **Setting ON** and enter the manufacturer password.

3. Check **Set Work Zero by CCD Center** to enable set the workpiece origin by CCD center.

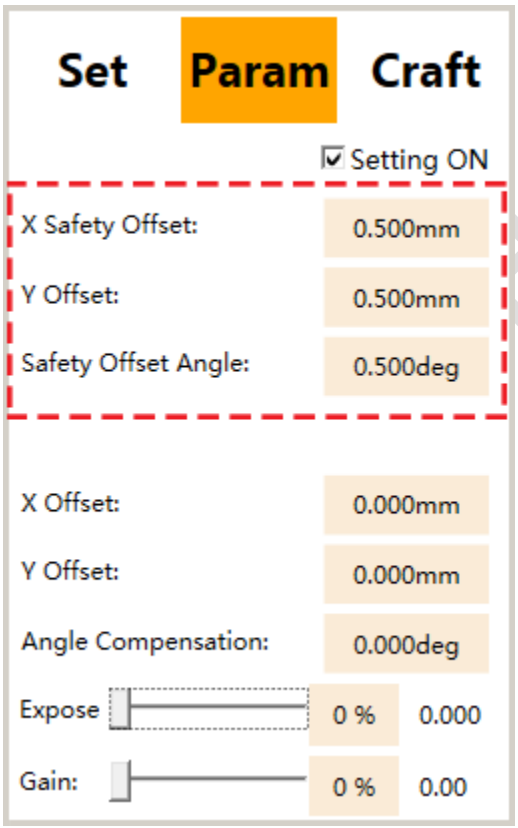
4.4.5. Set Safety offset

In actual machining, the hollowed-out area on the workpiece is quite small. If the workpiece is tiled, direct machining may damage the workpiece. Thus, it is necessary to set safety offset.

The range of the safety offset and its angle is decided by the dimension of the hollowed-out area.

To set safety offset, do the following:

1. Switch to **Param** page and check **Setting ON**:



2. Modify the following parameters:

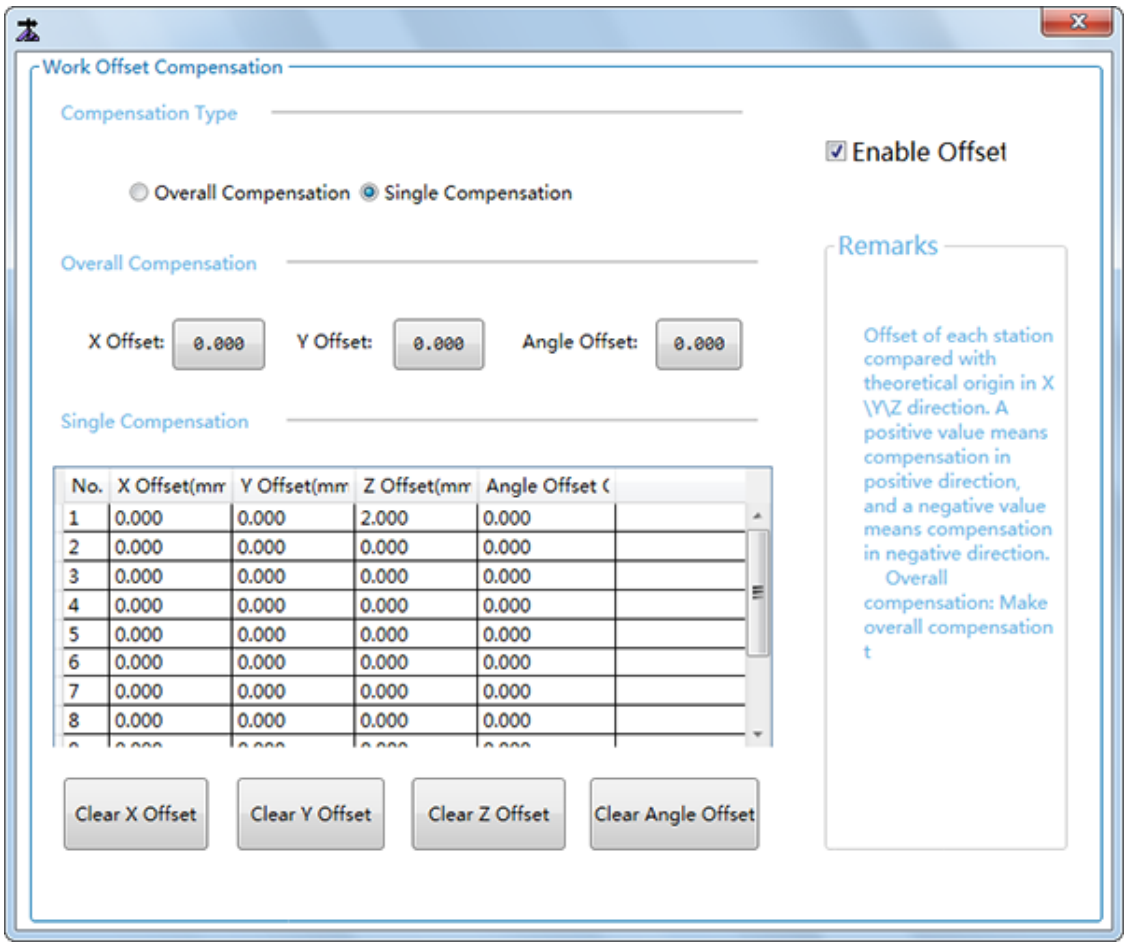
   - **X Safety Offset**
   - **Y Safety Offset**
   - **Safety Offset Angle**

4.4.6. Set Workpiece Offset Compensation

In actual machining, if the machined workpiece is tilted to one side, setting workpiece offset compensation is required.

To set workpiece offset compensation, do the following:

1. Switch to **Craft** page and check **Setting ON**.
2. Click **Set Part Offset Comp**. **Work Offset Compensation** dialog box pops up:



3. Check **Enable Offset** to enable offset.
4. Select compensation type:
   - Overall compensation

     It is the common compensation type.

     With array machining enabled, the set workpiece offset compensation is suitable for all workpieces in the array.

– Single compensation

With array machining enabled, the workpiece offset compensation of each workpiece needs to be individually set.

When lead screw of the machine results in the damage of a certain workpiece, **single compensation** is required.

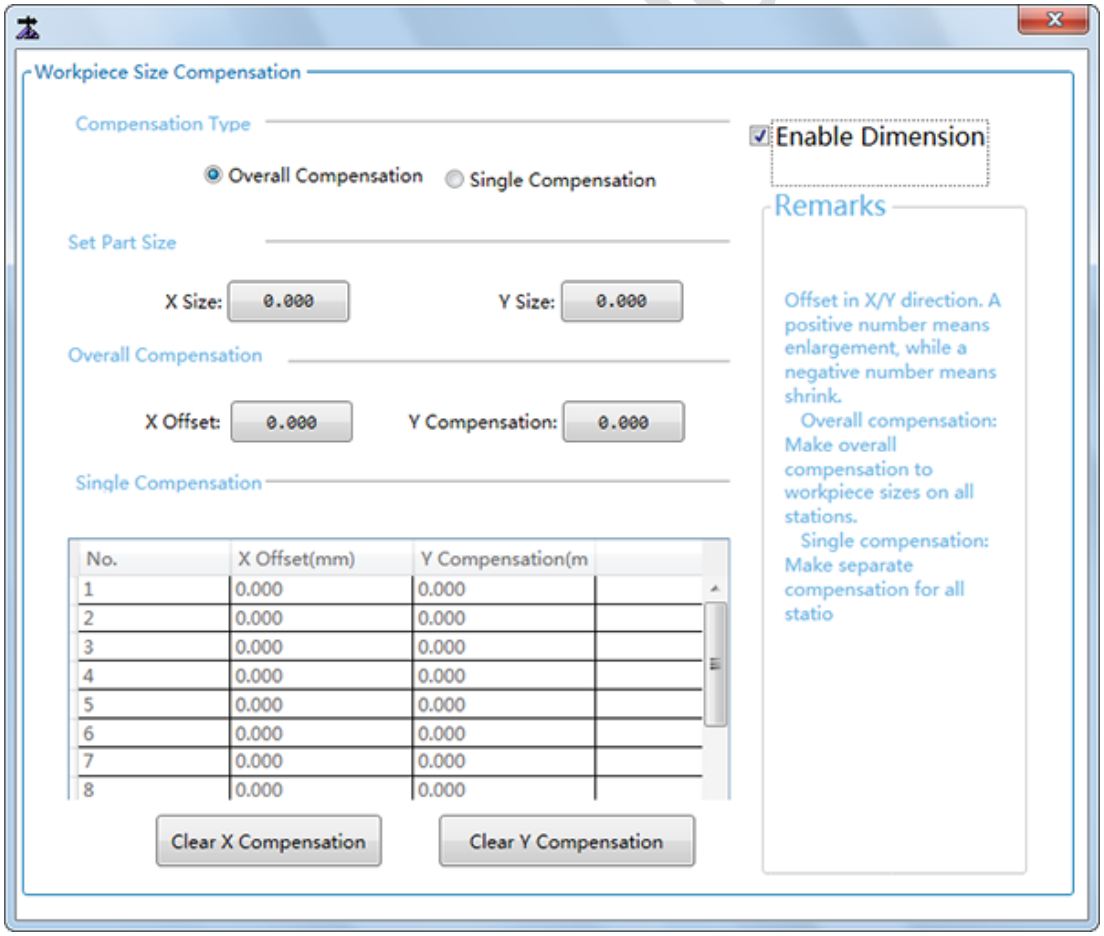
5. Set related parameters for overall compensation or single compensation.

4.4.7. Set Workpiece Size Compensation

During machining, if the size of the machined workpiece is not the same as the ideal size, setting workpiece size compensation is required.

To set workpiece size compensation, do the following:

1. Switch to **Craft** page and check **Setting ON**.
2. Click **Set Part Size Comp**. **Workpiece Size Compensation** dialog box pops up:



3. Check **Enable Dimension**.

4. Select compensation type:

   – Overall compensation

     It is the common compensation type.

     With array machining enabled, the set workpiece offset compensation is suitable for all workpieces in the array.

   – Single compensation

     With array machining enabled, the workpiece offset compensation of each workpiece needs to be individually set.

     When lead screw of the machine results in the damage of a certain workpiece, **single compensation** is required.

5. Set the workpiece size.

6. Set related parameters for overall compensation or single compensation.

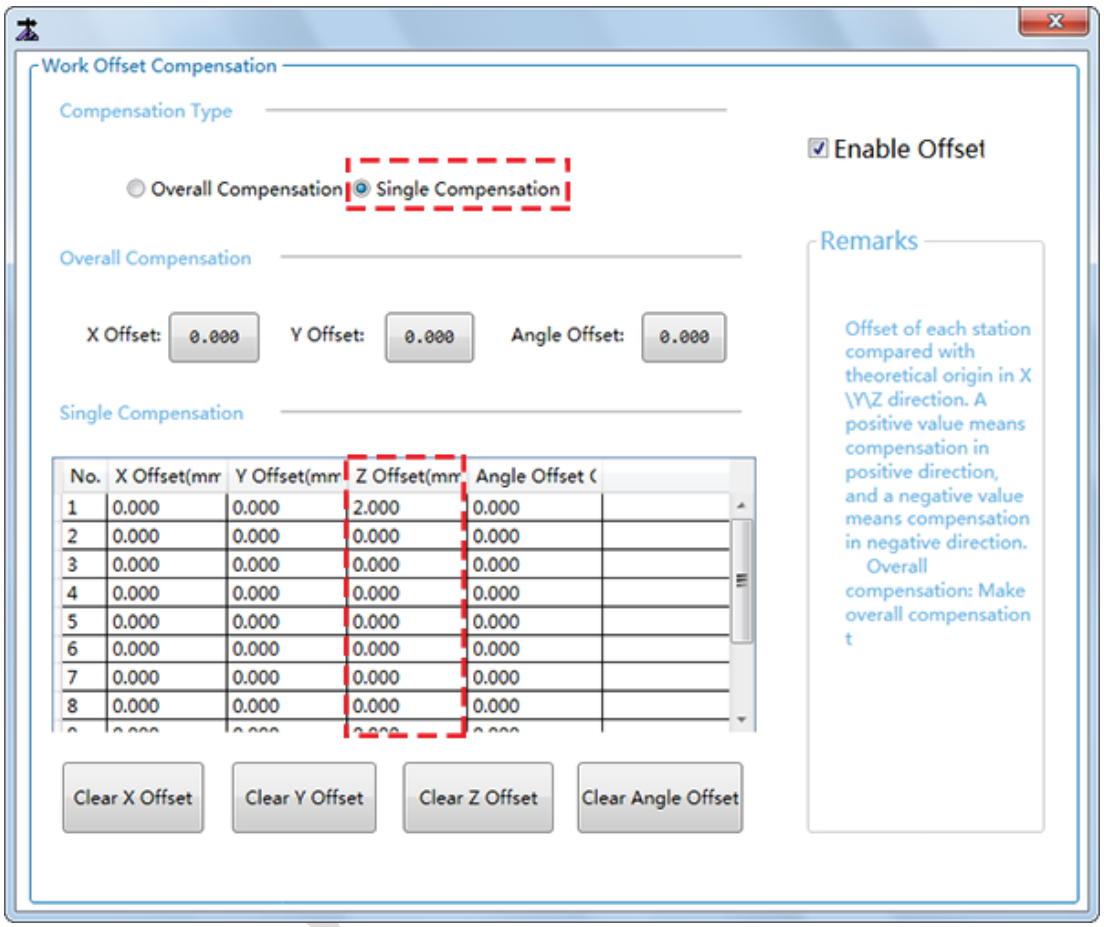
After setting, if the workpiece origin is not at the center of the workpiece, further adjust the offset compensation of X-axis and Y-axis.

4.4.8. Set Z-axis Depth Compensation

With array machining enabled, all workpieces are in the same horizontal plane, so one of the workpieces damaged takes a long time to machine all the workpieces from start. At this time, you can set Z-axis depth compensation for the replaced workpiece after machining.

To set Z-axis depth compensation,do the following:

1. Switch to **Craft** page and check **Setting ON**.
2. Click **Set Part Offset Comp**. **Work Offset Compensation** diaglog box pops up:



3. Check **Enable Offset** to enable offset.
4. Set **Compensation Type** as **Single Compensation**:
5. Set Z-axis offset of the corresponding station.

   The station number corresponds to the shooting order.

4.4.9. Execute Simulation

After finishing all settings, you can execute simulation.

To execute simulation, click **Simulate** in **CCD Setting** window.

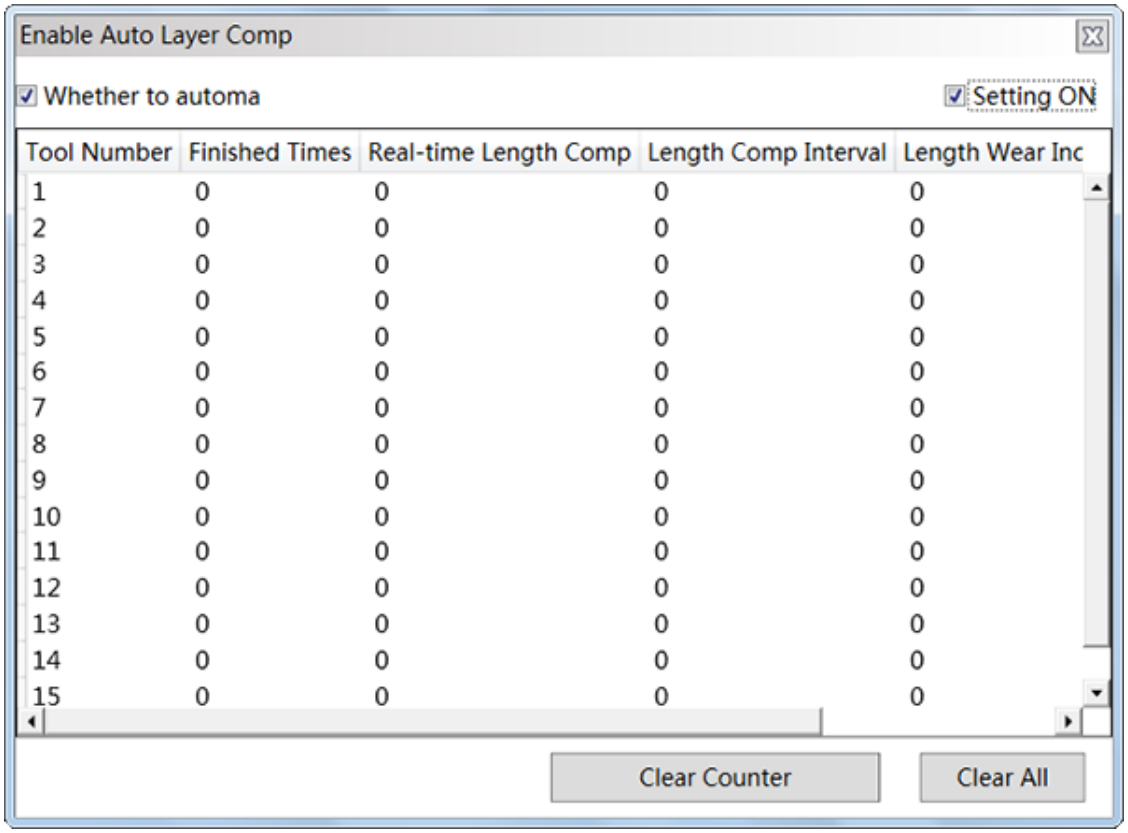
For differences between simulation and actual machining, please refer to What are the Differences between Simulation and Actual Machining?.

4.4.10. Set Automatic Layer compensation

This operation helps to solve the problem of reusing the same tool and increase its reusing rate.

To set automatic layer compensation, do the following:

1. Click **Operate** → **Auto Layer Compensation**. **Enable Auto Layer Comp** dialog box pops up:



2. Check **Settings ON** and enter the manufacturer password to enable setting.
3. Check **Auto Layer Comp** to enable automatic layer compensation.
   - Check: enable automatic layer compensation.
   - Uncheck: disable automatic layer compensation.
4. Set the following parameters:
   - **Length Comp Interval**
   - **Length Wear Increment**
   - **Max Length Comp**
5. **Optional:** Click **Clear Counter** to clear values of the column **Finished Times**.
6. **Optional:** Click **Clear All** to clear values of all columns, except the column **Max Length Comp**.

After setting, click **Start** to start machining:

- The system executes length compensation based on **Length Wear Increment** of all tool.
- After completing machining once, the values of **Finished Times** automatically adds 1 and the system judges whether **Length Comp Interval** has reached.
  - Reach: the system accumulates a **Length Wear Increment** to the value of **Real-time Length Comp** and judges whether the value of **Real-time Length Comp** exceeds the value of **Max Length Comp**.
    - Exceed: an alarm *The compensation values of automatic layer compensation exceeds the upper limit. Cannot continue machining!* pops up and machining with current tool stops.
    - Not exceeded: machining continues.
  - Not reached: the value of **Real-time Length Comp** keeps unchanged and machining continues until the value of **Finished Times** is equal to the value of **Length Comp Interval**.

5. Frequently Asked Questions(FAQ)

This section contains answers to common questions in **NcStudio V12 CCD Control System**.

For additional questions, contact our technical sales engineers.

5.1. May Errors Exist in the CCD? If Errors Exit, Why It Happens?

Errors may exists in the CCD.

The image algorithm takes pixel as its unit and its accuracy is ±1 pixel.

Example

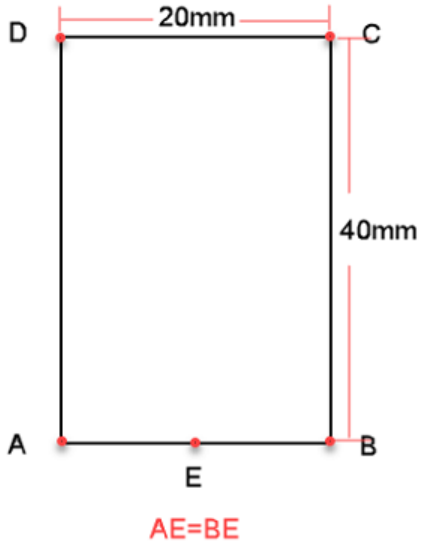
If the magnification is 200, that is, 200 pixels corresponds to 1 mm, then the error range in the CCD is ±0.005.

5.2. How Much Error Does the Finished Workpiece Exist in the CCD?

The error value at the shooting point is ±1 pixel and the error value of the finished workpeice is determined by specific workpieces.

Example

If the following workpiece is machined:



Then: the maximum error value in machining point C is CE/BE*1 pixel, which is about 2.2 pixels.

If the magnification is 200,

- The maximum error value of point C and point D is 0.011mm.
- The maximum error value of point A and point B is 0.005mm.

5.3. If Errors Exist in the Finished Workpiece, What to Do?

If errors exist, firstly confirm whether the error value is within the reasonable error range:

- If the error value is within the reasonable error range, do nothing.
- If the error value is not within the reasonable error range, do the following to troubleshoot the issue.

Troubleshooting

1. Check the magnification.

   See Measure Magnification for details.

2. Check the installation of the camera or lens:

   - Tap the camera to see if the imaging is shaking.
   - Manually test the installation.

     See How to test the installation of the camera or lens for details.

3. Check the setting of shooting points.

   See Shoot for details.

4. Check the shoot delay time to see if it is too short.

   If the shoot delay time is too short, shooting will be calculated without the machine's stop. The image obtained at this time may not be the image obtained after moving to the shooting point. Thus, the calculated position may exist errors.

   For judging the setting of the shoot delay time, please refer to Set the Camera for details.

5. Check the template.

   Incorrect template setting leads to errors in images matching.

   It is recommended to observe for a while after setting the template to ensure stable machining.

5.4. How to Test the Installation of the Camera or Lens?

To test the installation, do the following:

1. Manually move X-axis towards negative direction.
2. Click **To Shoot** and save the image.
3. Manually move X-axis towards positive direction.
4. Click **To Shoot** and save the image.
5. Move Y-axis and repeat the above steps.
6. Observe the saved images in image viewer to see if the images are different.

   If the images are different, it shows the camera is not fixed or the machine's accuracy is not enough.

5.5. What is the Impact of Incorrect Position of Shooting Points in Shooting by Two Points?

Incorrect position of shooting points results in errors in the machined workpiece.

In general, the two shooting points in shooting by two points should be horizontal or vertical and the coordinates of the two points should be symmetrical.

5.6. What are the Differences between Simulation and Actual Machining?

The main differences are as follows:

- Tool nose is used in actual machining; while view center of the camera is used to simulate along tool path in simulation.
- Z-axis moves along tool path in actual machining; while Z-axis moves at the focal height in simulation.

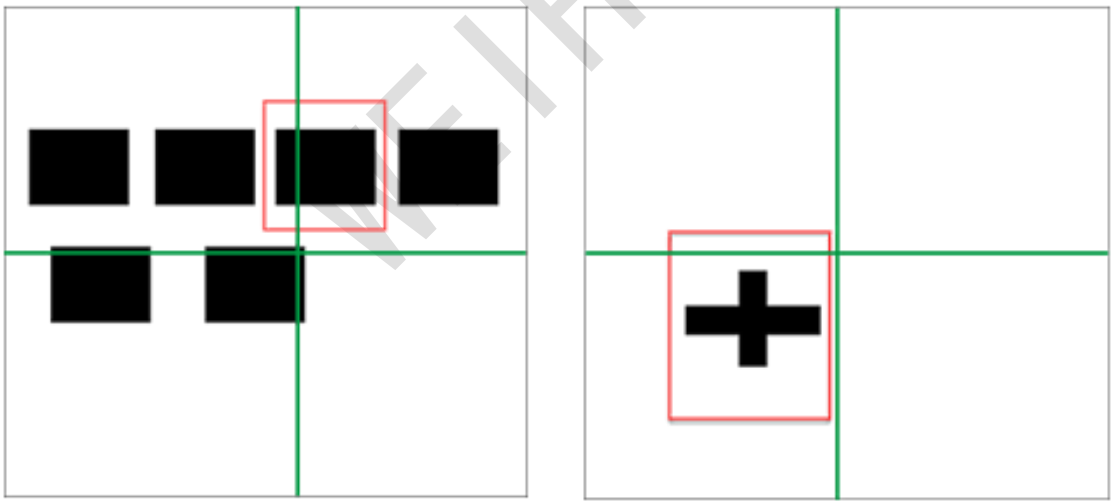
Before actual machining, it is recommended to execute simulation to check all settings.

5.7. What Are the Requirements for the Selected Feature Points in Measuring Magnification?

The feature point must be unique in the camera view.

Example

In the figure below, the rectangle in the left is not unique in the view, so it cannot be set as a feature point to measure magnification; the cross in the right is unique in the view, so it can be set as a feature point to measure magnification.



6. Terms

This section introduces important terms in **NcStudio V12 CCD Control System**.

Focal Length
Only when Z-axis moves to a fixed position, you can get a clear picture. This position is the focal length.

Magnification
Image algorithms takes pixel as its unit and machining of the machine takes millimeter as its unit. The proportional relationship between these two units is magnification.

Example: Magnification is 200, means 200 pixels is equal to 1mm.

Offset between Spindle and CCD
When the machine machines with CCD, the position of the actual point is obtained according to the position of the picture and the shooting position; however, in actual machining, it is the spindle that is used. The distance between the two is the offset between the spindle and CCD.

Exposure
It refers to the light amount on the photosensitive element during shooting.

It is controlled by aperture, shutter and light sensitivity.

The exposure value means the combination of aperture and shutter. The aperture and shutter are offered by cameras that can give the same exposure.

Gain
It refers to the camera's gain.

Along with the camera's **Exposure**, it is used to compensate light during imaging so as to improve image quality.

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