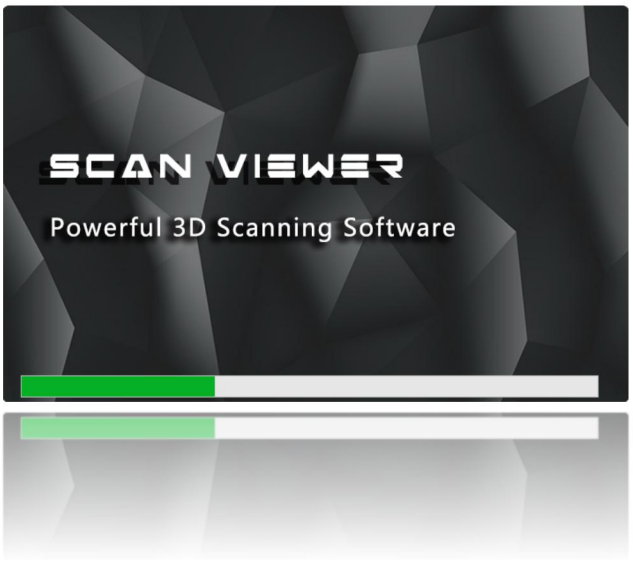
SCANTECH™

# ScanViewer

User manual




V5.3.5

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# Introduction

**Please read user manual before start.**

**After reading, keep it safely for next time review.**



## Notice

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## Basic label

This manual will use the following labels to describe different significance, so please red carefully and make sure understand all of labels.

| | |
|---|---|
| Danger | Fail to obey the announcement will cause dangerous situation or injuries and deaths |
| Warning | Fail to obey the announcement may cause dangerous situation or injuries and deaths |
| Caution | Fail to obey the announcement may cause minor injury |
| Attention | Fail to obey the announcement may damage product or surrounding |

## Safety Announcement

| | |
|---|---|
| Notice | During scanning process, must obey announcement and use product correctly |

## Notice

| | |
|---|---|
| Notice | The options in the function panel of the software will be adjusted according to different product models, and It is subject to the actual software configuration to be delivered when using;<br>Please refer to the user manual for specific computer configuration requirements. |

# Contents

# 1 Software installation

This product needs to install the scanning software ScanViewer. The following mainly explains the operating environment and installation steps required by the software.

## 1.1 Computer configuration requirements

The scanning software performs real-time processing on the scan data transmitted in real time during the scanning process, and selecting the appropriate hardware configuration can effectively improve the working efficiency of the entire scanning system. Refer to Table 1-1 for the computer parameter configuration requirements for installing the scanning software.

Table 1- 1 Computer parameter configuration requirements

| Project | Recommended configuration |
|---|---|
| CPU | Intel Xeon (Xeon) w-10885m @ 2.40hz, 8-core 16 threads |
| RAM | 32G DDR4 3200MHz |
| Memory | Nvidia Quadro RTX 3000 independent 6G |
| Interface mode | USB3.0 |
| Operating system | Win10 professional |

The software installation packages to be installed before the device is used is Scanner X.XX-CN.exe.

| | |
|---|---|
| Notice | The X.XX of the Scanner X.XX-CN.exe is the software installation package version number. It may be changed later due to software upgrade. It is subject to change without notice. |

| | |
|---|---|
| Attention | ① Please close all protection software before software installation;<br>② All software installations require administrator privileges. |

## 1.2 Scanning Software Installation

### 1.2.1 Install 3D Scanner

This section describes the steps for installing the scanning software Scanner X.XX-CN.exe. Here, the installation to the Windows 10 system is used as an example.

■Right click on the Scanner X.XX-CN.exe installation package, select Run as administrator, select the language to be installed and then click “Next”, as shown in Figure 1-1.

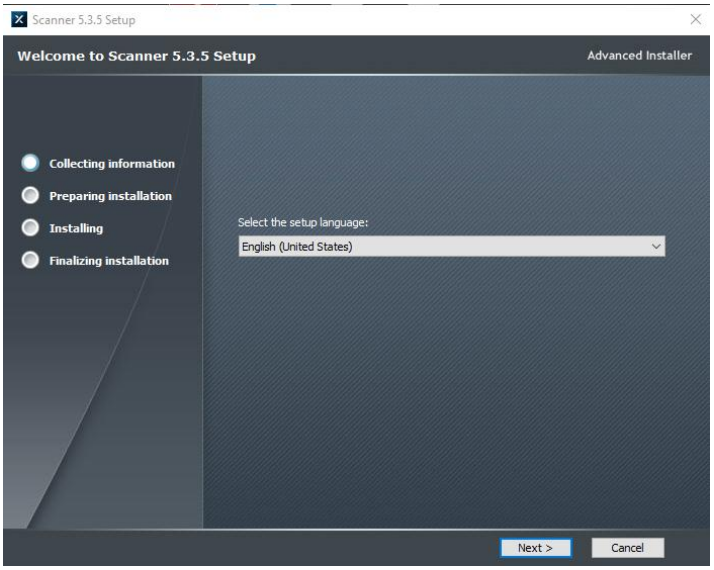



Figure1- 1 Install Scanner X.XX-CN.exe

■Click “Next”, as shown in Figure 1-2.

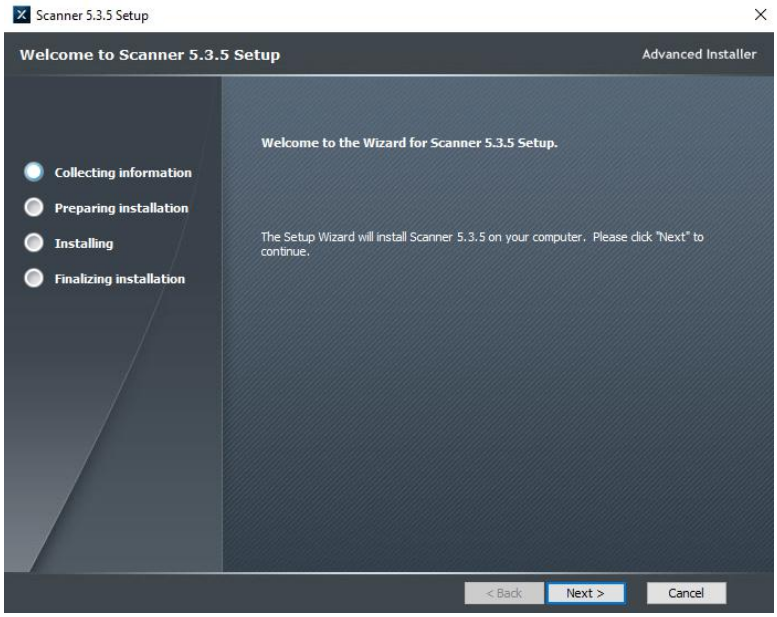



Figure1- 2 Install Scanner X.XX-CN.exe

■Choose a directory for installation and click “Next”, as shown in Figure 1-3.

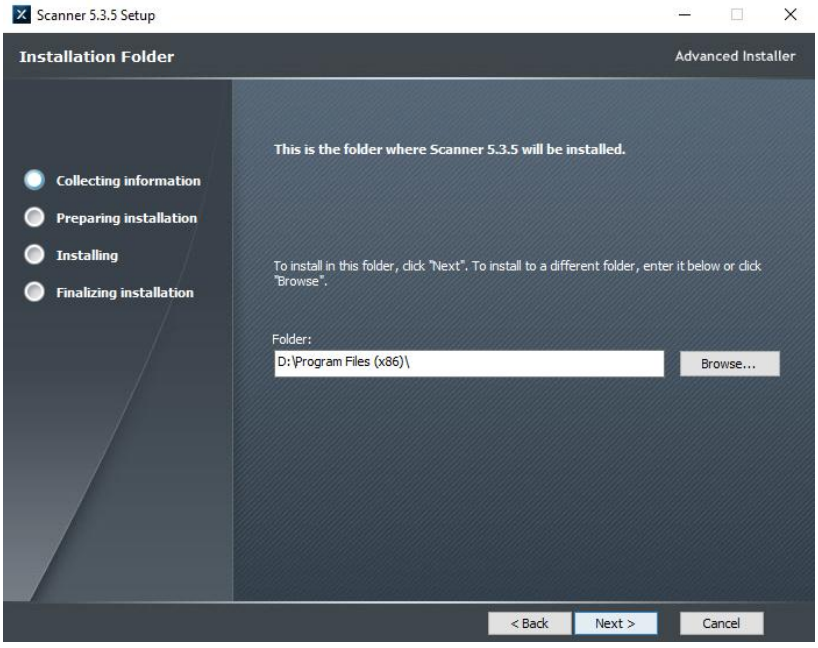



Figure1- 3 Install Scanner X.XX-CN.exe

| | |
|---|---|
| Attention | The Scanner scanning software cannot be installed in the Program Files folder of the C drive. |

■Click “Install”,as shown in Figure 1-4.

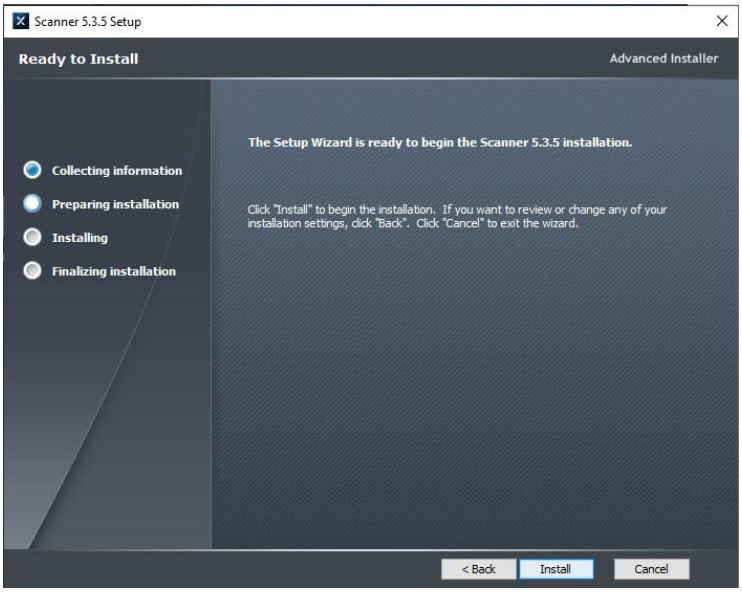



Figure1- 4 Install Scanner X.XX-CN.exe

■The installation process as shown in Figure 1-5.

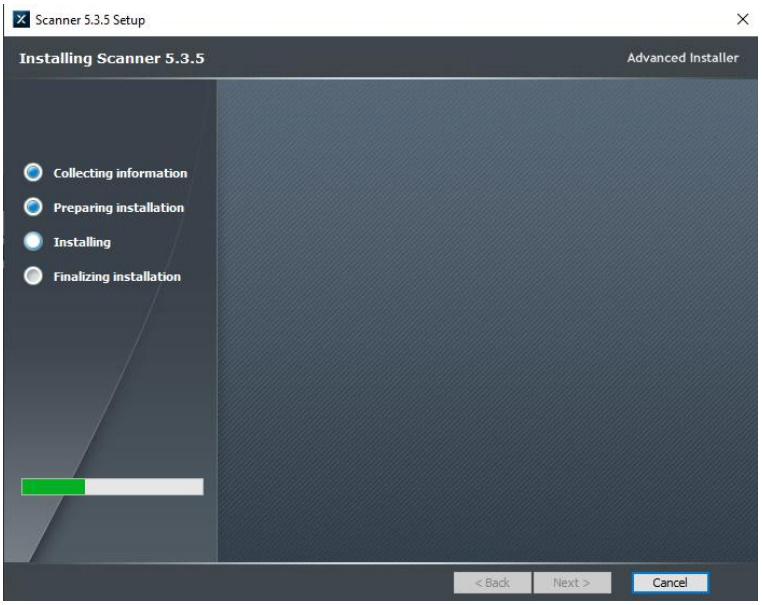



Figure1- 5 Install Scanner X.XX-CN.exe

■After the camera driver is installed, click “Finish” to complete the installation of Scanner X.XX-CN.exe, as shown in Figure 1-6.

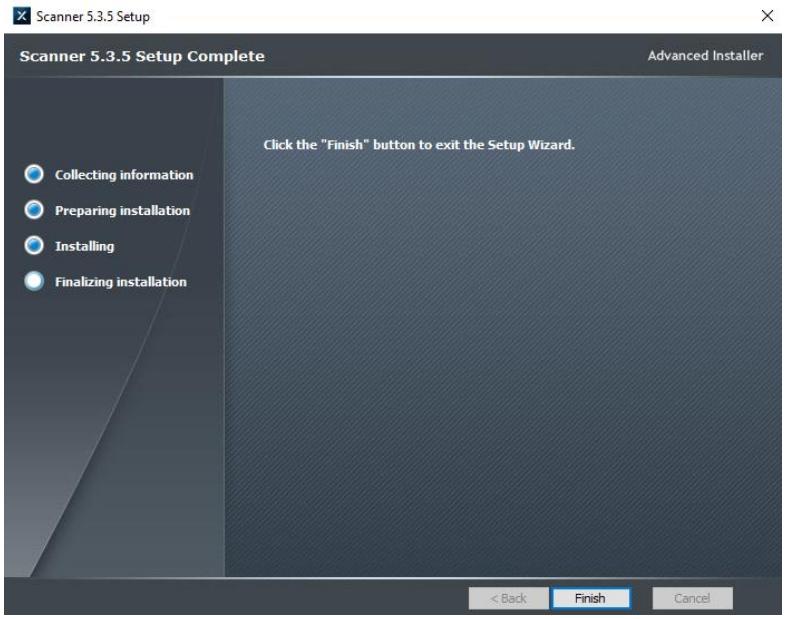



Figure1- 6 Install Scanner X.XX-CN.exe

## 1.3 Software Uninstallation

To uninstall the software or reinstall the software, you can enter the software name to start uninstalling; enter the computer "Control Panel - Uninstall Program", select the corresponding software and uninstall (Figure 1-7).


Figure1- 7 Uninstallation

## 1.4 Software Running Environment Settings

After the installation of the scanning software is completed, in order to ensure the smoothness of the software usage, it is necessary to set the running permission of the software:give the scanning software administrator permission to run, and put the scanning software into the graphics card to run.

**Give administrator permission to run:** Right-click the scan software shortcut icon, click "Properties", select the "Compatibility" tab in the pop-up properties window, check the "Run this program as an administrator" option, click "Change Settings for all users", after checking "Run this program as an administrator" in the pop-up dialog box, click the "OK" button. A similar operation can be used to the MODELING.exe which in the lowPartSW folder of installation directory to add the administrator privileges.As shown in Figure 1-8.

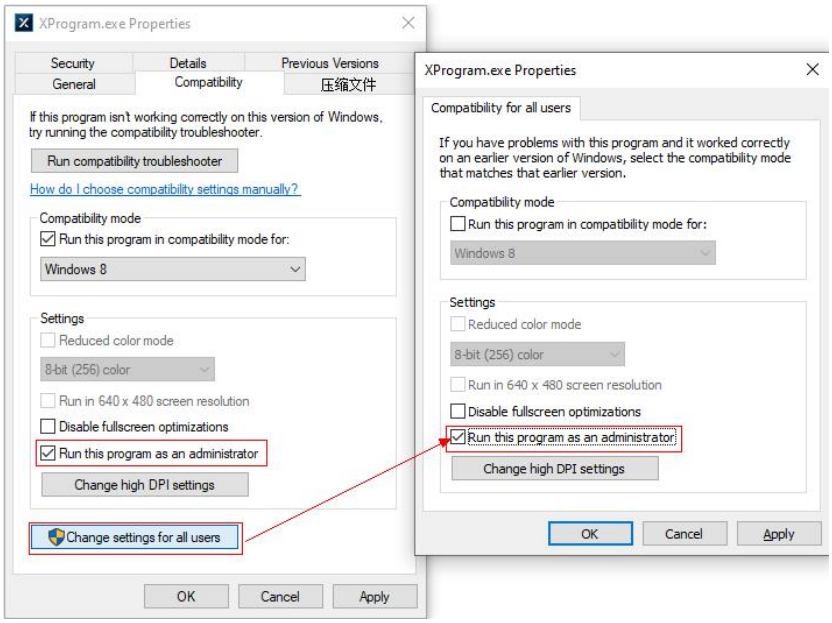



Figure1- 8 Give administrator permission to run

**Put into the graphics card to operate** (take NVIDIA graphics card as an example):Right-click the mouse in the blank space of the desktop, select "NVIDIA Control Panel" in the pop-up menu, in the NVIDIA Control Panel that opens, select "Manage 3D Settings" - "Programs" Settings - "The preferred graphics processor for this program" option - select "High Performance NVIDIA Processor" (if you don't have this option, just skip it.) - "Add" - "Scanviewer.exe" - "Apply". As shown in Figure 1-9.

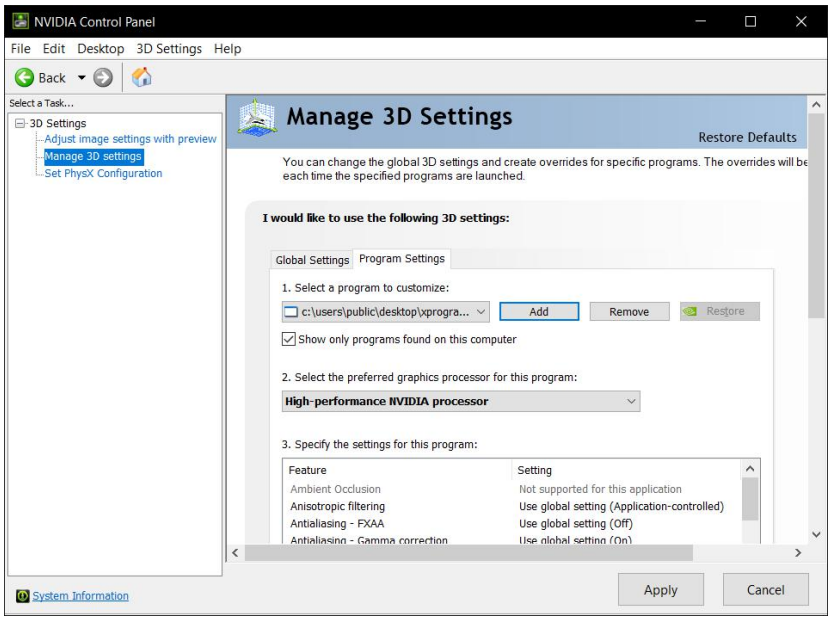



Figure1- 9 Put into the graphics card to operate

Follow the steps above to put the "Glopho.exe" installer into the graphics card (Figure 1-10).

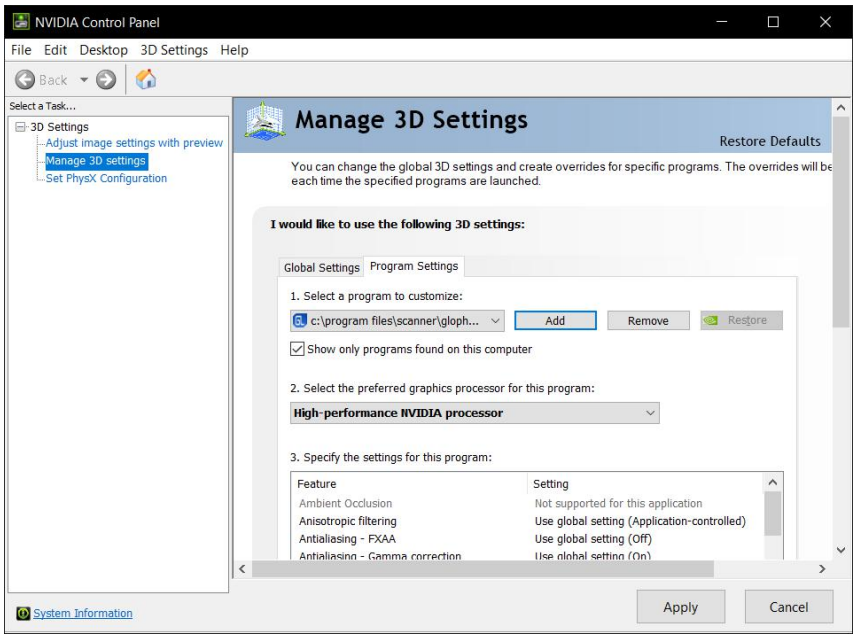



Figure1- 10 Put into the graphics card to operate

At this point, the scan software installation settings are all completed. Restart the computer and plug in the dongle to start the software. The software startup interface (Figure 1-11), select “SV” to enter the laser scanning work, and select “GL” to enter the photogrammetry work.


Figure1- 11 Select work

## 1.5 Managing File Configuration

After starting the ScanViewer scanning software, you need to manage file configuration. There are two ways to manage file configuration:

**■Replace the RGF file**

Open the ScanViewer scanning software and click "Menu Bar - Other - Device Management - Replace Authorization File" to replace the RGF file in the U disk provided with the KSCAN scanner. When the device license is about to expire, the software will pop up a prompt box to replace the valid RGF file by clicking "configuration license". As shown in Figure 1-12.

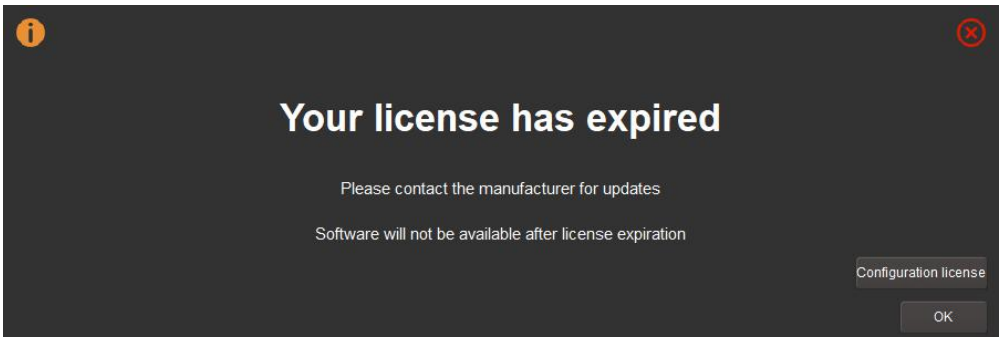



Figure1- 12 Authorization prompt box

**■ Update configuration folder**

Open ScanViewer scanning software, click "Menu Bar - Other - Device Management - Replace Authorization Folder", and replace it with "Backup - LowPartSW-SETXXXX (Product Model)" in the U disk provided with the KSCAN scanner.

| | |
|---|---|
| Notice | When photogrammetry software needs to change the configuration of management files, right-click the software shortcut "Open the configuration of files", open the Glopho folder, and replace the authorized folder. |

# 2 scanning software

## 2.1 Introduction to Scanning Software Interface

This chapter mainly introduces the scanning software interface and its icons. The interface is mainly composed of five parts: menu bar, toolbar, three-dimensional display area, function panel and status bar. As shown in Figure 2-1.

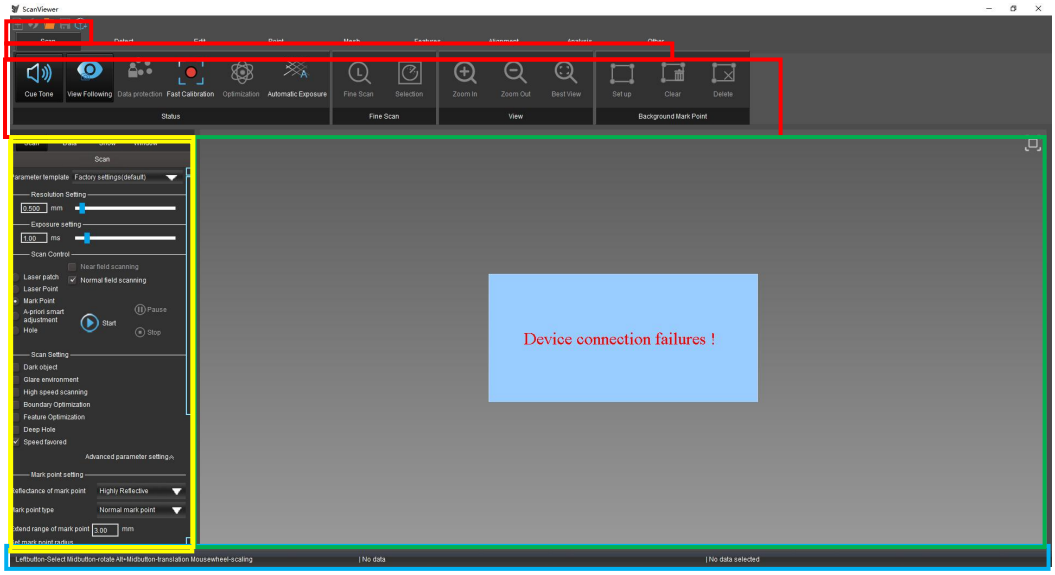



Figure2- 1 Scanning Software Interface

## 2.2 Scanning software icon function

### 2.2.1 Menu Bar

The menu bar mainly includes 5 functions such as new, reset, open, save, add, and 9 application menu bars such as scan, dot, edit, point, mesh, feature, alignment, analysis, and others.

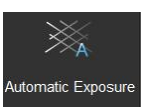
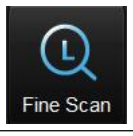
■The quick menu bar mainly performs operations such as opening, creating, and saving files. See Table 2-1 for details.

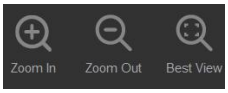
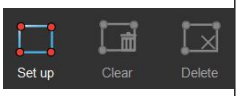
Table2- 1 Menu Bar

| Menu | Icon | Function |
|---|---|---|
| New |  | The “New” function will clear all data . When you click “New”, the “Clear scanning data” will pop up to confirm. |
| Reset |  | The current point cloud and mark point data can be cleared (or only the marker point data can be cleared) without resetting the scan parameters. |
| Open |  | Project File：.pj3、.pjs;<br>Mark point File：.mk2、.umk、.asc、.igs、.txt、.refxml；<br>Laser point File：.asc、.igs、.txt；<br>Mesh data File：.stl of ASCII、.stl；<br>Model File：.stp、.step. |
| Save |  | Project File：.pj3；<br>Mark point File：.mk2、.umk、.asc、.igs、.txt、.refxml；<br>Laser point File：.asc、.igs、.txt；<br>Mesh data File：.stl、.ply、.obj. |
| Add |  | Add a scan object. |

■The description and function of the toolbar in the “Scan” application menu bar interface are shown in Table 2-2.

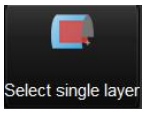
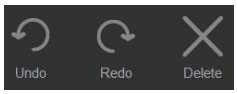
Table2- 2 “Scan” application

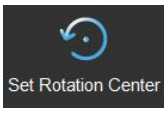
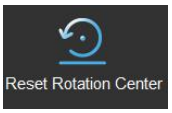
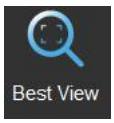
| Tool Bar | Icon | Function |
|---|---|---|
| Status |  | Turns on/off the beep during scanning. |
| |  | Turn on view following, and the 3D display area displays the current scanning area in real time;<br>Close view following, the 3D display area shows the scanned workpiece at a fixed angle, and the user can manipulate the view. |
| |  | When data protection is enabled, the user selects a part of the engineering data and performs data protection. All subsequent deletion and selection operations are invalid for the protected data. For details, refer to 3.1.1 Data Protection. |
| |  | Calibration. |
| |  | After the multi-angle scan of the mark points, click optimization, and then can increase the accuracy .<br>Note:<br>(1) The saved scanning data can not be optimized by reopen it.<br>(2) The optimization can only be operated after the mark points are fully scanned from all angles, and it can be viewed by using intelligent mark points;<br>(3) After the scanning of the mark points, click stop and then optimize them immediately. At this time, you cannot click start, otherwise the optimization will not be carried out. |
| |  | The software automatically adjusts to the most suitable value for exposure. For details, refer to 3.1.2 Auto Exposure. |
| Fine Scan |  | It allows users to scan the detail of the features. Fine scan mode can effectively reduce the amount of scanning data while maintaining the features of large workpiece. |

| | | |
|---|---|---|
| | | The level of fine scan is divided into four types: no, low, medium and high. The higher the level, the higher the data fineness. For details, refer to 3.1.3 Fine Scan.<br>Note: This feature can only be used in the pause or stop state. |
| |  | The area for doing fine scan. |
| View |  | The view can be zoomed in, zoomed out, and optimally viewed, and can only be used during the scan. |
| Background mode |  | A background plane can be generated to prevent the user from scanning background data that is not related to the workpiece during the scan. For details, refer to 3.1.4 Background Mark Points. |

■The description and function of the toolbar in the “Edit” application menu bar interface are shown in Table 2-3.

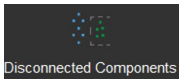
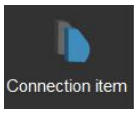
Table2- 3 “Edit” application

| Tool Bar | Icon | Function |
|---|---|---|
| Selection Tool |  | The selection tool includes four tools: rectangle, lasso, polyline, and brush. Users can choose according to actual needs.<br>Note: Press and hold Alt+Mouse Wheel to zoom in and out on the brush diameter. |
| Selection |  | When the user selects data, the data in the back direction of the current view cannot be selected. For details, please refer to 3.2.1. |
| |  | The user can only select the data of the visible part when selecting the data. For details, refer to 3.2.2 Selection Through. |
| Edit |  | According to the selected material and the set temperature, the compensation coefficient is automatically calculated, then can be adjusted. The material type can be selected in the temperature compensation window and if you need to customize, you can click the "new" button to input the material category, name and CET (thermal expansion coefficient) value. For details, refer to 3.2.3 Temperature Compensation. |
| |  | Delete: delete the currently selected data;<br>Undo: It can roll back the state before the last operation, and is only used for "delete" and "delete background markers";<br>Redo: You can restore the most recent Undo operation. |
| |  | Select all: select all data;<br>Do not select all: cancel all data selection;<br>Reverse selection: reverse selection of data. |
| View |  | Users can adjust the translation or rotation parameters of the origin of the coordinate system in steps of 0.1, 1, 10, and 100, or input the parameter values directly.<br>Note: the unit of rotation around the axis is degree, |

| | | |
|---|---|---|
| | | and the adjustment order is translation first and then rotation. |
| |  | After clicking the icon, click the model location where the point to be set as the rotation center, or right-click the location of the model to be set as the rotation center, then select “set rotation center”.<br>Note: the point on the model must be selected for setting. |
| |  | Click to reset the center of rotation, or right-click in the 3D display area and then select “reset rotation center” .<br>Note: this will have an effect on all data. |
| |  | The data in the 3D viewing area during editing can be displayed in the best position. |

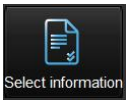
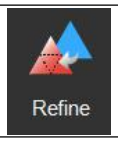
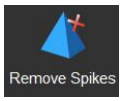
■The description and function of the toolbar in the “Point” application menu bar interface are shown in Table 2-4.

Table2- 4 “Point” application

| Tool Bar | Icon | Function |
|---|---|---|
| Object |   | Indicates the object that can be operated at this time. The blue icon indicates that the operation object is a laser point, and the red icon indicates that the operation object is a mark point. |
| Laser Point |   | Encapsulate the point cloud data to turn it into surface so that the file can be used for 3D printing and reverse operation. For details, refer to 3.3.1 Wrap. |
| |   | Some points whose distance from most other point clouds exceeds a certain threshold. |
| |   | The part that is not connected to the data. It can evaluate the proximity of point cloud, divide the point cloud blocks, and select the block with less adjacent points. |
| |   | Dilution point cloud data. Reduce the amount of data by reducing non feature points and retaining feature points, so that the details can be retained as much as possible. |
| |   | No separate data. It can evaluate the proximity of the point cloud to obtain the adjacent blocks of the selected points.<br>Left mouse button: select data;<br>CTRL + left mouse button: deselect data. |
| Register |   | Splicing data. For details, refer to 3.3.5 Splicing. |
| |   | Point splicing. For details, refer to 3.3.5 Splicing. |

■The description and function of the toolbar in the “Mesh” application menu bar interface are shown in Table 2-5.

Table2- 5 “Mesh” application

| Tool Bar | Icon | Function |
|---|---|---|
| Function |  | Quickly select patches with similar curvature and adjacency. For details, refer to 3.4.1 Quick Selection . |
| |  | Forming a mesh state. |
| |  | Fill hole function. For details, refer to 3.4.2 Fill Holes. |
| |  | Simplify mesh data volume. For details, refer to 3.4.3 Simplify. |
| |  | Delete broken faces in mesh data. |
| |  | Encrypted mesh data. For details, refer to 3.4.4 Refine. |
| |  | Optimize mesh surface quality. For details, refer to 3.4.5 Removing Spikes. |
| |  | Remove sharps from mesh data. |
| |  | Optimize sharp edges. |
| |  | Optimize mesh surface quality. |

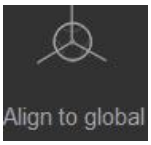
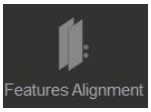
■The description and function of the toolbar in the “Features” application menu bar interface are shown in Table 2-6.

Table2- 6 “Features” application

| Tool Bar | Icon | Function |
|---|---|---|
| Features |  | Create a circle feature. |
| |  | Create elliptical groove features. |
| |  | Create rectangular groove features. |
| |  | Create circular groove features. |
| |  | Create point features. |
| |  | Create line features. |
| |  | Create plane features. |
| |  | Create sphere features. |
| |  | Create cylindrical features. |
| |  | Create cone features. |

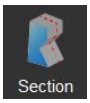
■ The description and function of the toolbar in the “Alignment” application menu bar interface are shown in Table 2-7.

Table2- 7 “Alignment” application

| Tool Bar | Icon | Function |
|---|---|---|
| Alignment |  | Best fit. For details, refer to 3.6.1 Best Fit Alignment. |
| |  | Align data to the global coordinate system. For details, refer to 3.6.2 Aligning to the Global. |
| |  | Features alignment. For details, refer to 3.6.3 Feature Alignment. |
| |  | Point-to-point alignment. For details, refer to 3.6.4 N-point Alignment. |
| |  | Point-line-plane alignment. For details, refer to 3.6.5 PLP Alignment. |
| |  | RPS alignment. For details, refer to 3.6.6 RPS Alignment. |

■The description and function of the toolbar in the “Analysis” application menu bar interface are shown in Table 2-8.

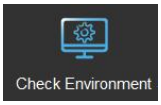
Table2- 8 “Analysis” application

| Tool Bar | Icon | Function |
|---|---|---|
| Measure |  | Measure the distance between features. For details, refer to3.7.1 Measure. |
| |  | Measure the angle between features. For details, refer to 3.7.2 Angle. |
| Comparison |  | Create a section. For details, refer to Section 3.7.3. |
| |  | 3D view comparison. For details, refer to 3.7.4 3D Comparison. |
| |  | View the annotation. For details, refer to 3.7.5 Creating Report. |
| |  | Create a report page. For details, refer to 3.7.6 Creating a Report. |
| Pipe |  | Functional application of pipe fitting data. |
| GD&T |  | Roundness function. |
| |  | Straightness function. |
| |  | Flatness function. |
| |  | Cylindricity function. |
| |  | Spheric function. |

| | | |
|---|---|---|
| |  | Parallelism function. |
| |  | Verticality function. |
| |  | Concentricity function. |

■The description and function of the toolbar in the “Other” application menu bar interface are shown in Table 2-9.

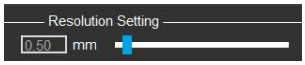
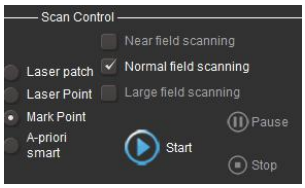
Table2- 9 “Other” application

| Tool Bar | Icon | Function |
|---|---|---|
| Other |  | Software and hardware information. |
| |  | Scanner working environment detection. |
| |  | Displays the working status of the scanner. |
| |  | Switching of software languages. |
| |  | Some settings of the software, For details, refer to 1.5 Device Management. |

## 2.2.2 Function panel

The function panel mainly includes four parts: Scan, Data, Display, Window. The details of the four parts are shown in Tables 2-10 and 2-11.

Table2- 10 Function panel

| Module | Icon | Function |
|---|---|---|
| Scan |  | The parameters of the collected point cloud data can be set, and different device models have different setting ranges.<br>The smaller the resolution value, the denser the point cloud, the larger the amount of data, the slower the scanning speed and the better the details of the object.<br>The higher the resolution value, the more sparse the point cloud, the smaller the amount of data, the faster the scanning speed, and the poor object details. |
| |  | Adjust the parameters of the laser line light and dark. The higher the value, the brighter the laser |
| |  | The laser patch displays the scanned in the form of a patch;<br>The laser point displays the scanned in the form of point;<br>Mark point and A-priori smart can obtain point data; the mark point scanned by the A-priori smart represent the angle information in color, which is convenient for judging whether the conditions for optimization are satisfied.<br>Start/Pause/Stop: Controls the start and stop of the scan;<br>Near field scanning/Normal field scanning/Large field scanning: The large field scanning mode will be entered by default when the resolution is set to ≥1; the normal field scanning or / and the near field scanning mode will be selected by default when the resolution setting is≤ 1. |
| |  | Dark objects: hook when scanning dark objects;<br>Strong light environment: hook when the scanner is working in a strong light environment;<br>High speed scanning: fixedly using a frame rate of 90 frames for scanning;<br>Boundary optimization： When edge details need to be enhanced during scanning, check this option to obtain smoother mesh edge data;<br>Feature optimization: When the software is stopped, the |

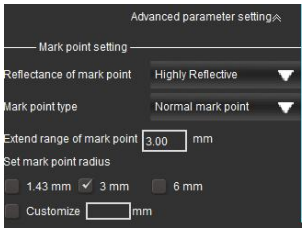
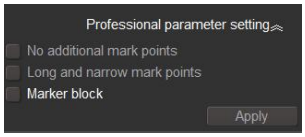
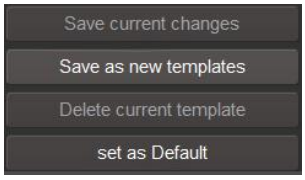
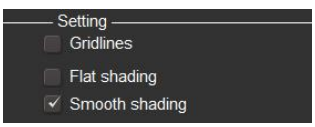
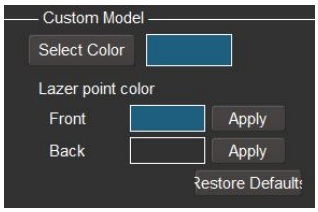
| | | |
|---|---|---|
| | | data at the feature of the object is optimized to make the feature area of the object finer;<br>Deep hole: the ratio of scan hole diameter to scan hole depth can be 1:2.<br>Speed favored：Default option. It is used to display of laser points at a speed of 60 frames per second without considering the performance of the computer. If it is not checked, the display speed will be adjusted according to the performance of the computer. |
| |  | Marker shininess: By setting the shininess of the marker points for better scan results;<br>Marker type: This option will indirectly affect the extension of the mark points, and the range is larger when "Magnetic mark points" is selected;<br>Marker extension: The parameter controls the radius of the laser point's deletion around the mark points. |
| |  | Do not add new points: no new points appear after checking;<br>Long and narrow marking points: After checking, the marking points that are narrowed and elongated can be optimized;<br>Marker Block: Check to automatically find and delete the point cloud and marker point where the marker block is located |
| |  | The user can change the scan parameter settings according to the actual situation. When you click “Save as new templates”, if the user selects the default, this parameter setting becomes the new default template. It is also possible to save/delete/set to default settings for the settings template. |
| |  | Users can choose the template format according to specific requirements. |

Table2- 11 Function panel

| Module | Icon | Function |
|---|---|---|
| Show |  | When the "mesh line" is checked, the mesh line of the grid data is displayed;<br>When "Plane Shading" is checked, the triangle mesh is displayed more realistically;<br>When "Smooth Shading" is checked, the triangle mesh is displayed more smoothly. |

| | | |
|---|---|---|
| |  | The user can change the color of the point cloud and the front and back of the laser points. |

### 2.2.3 Status Bar

The status bar mainly describes the software shortcut operation in the 3D display area and the data status and data volume during the scanning process. In the 3D display area, the shortcuts are as follows:

■Left mouse button: select data;

■Ctrl + left mouse button: uncheck the data;

■Middle mouse button: rotate the scan data;

■Alt+ mouse middle button: pan scan data;

■Mouse wheel: Data scaling.

Data Status: The amount of laser point and marker data scanned in the file. If selected, the amount of data at the selected point is displayed.

In the 3D display area, click "  ", the software interface can be displayed in full screen. Click "  " to exit the full screen display.

## 2.3 Shortcuts

See Table 2-12 for the shortcuts of the scanning software keyboard.

Table2- 12 Shortcuts

| Number | Shortcuts | Function | Info |
|---|---|---|---|
| 1 | Ctrl+D | Best view | |
| 2 | Ctrl+V | Sound prompt | Button for turn on/off, default to turn on “cue tone” |
| 3 | Ctrl+E | View following | Button for turn on/off, default to turn on “View following” |
| 4 | Ctrl+L | View Lock | |
| 5 | Space | Start/Stop scanning | |
| 6 | Ctrl+P | Pause scanning | |
| 7 | Ctrl+Z | undo | |
| 8 | Ctrl+Y | redo | |
| 9 | Del | delete | |
| 10 | Tab | Level 1 tab switching | |
| 11 | F11 | Full screen / cancel full screen | |

# 3 Scanning software operation

## 3.1 Scanning

The "Scanning" section mainly introduces four application parts of the software such as data protection, automatic exposure, fine scan and background mark point. The specific icon function is detailed in the 2.2.1 menu bar.

### 3.1.1 Data protection

The data protection feature allows the user to select a portion of the project data for data protection. During the subsequent operations, all delete and select operations are invalid for the protected data. The specific operations are as follows:

■After the scan is completed, click “Stop” (or pause)—select some data—click “Data Protection” (data protection mode, other functions are temporarily unavailable), and the selected data color turns yellow. As shown in Figure 3-1.

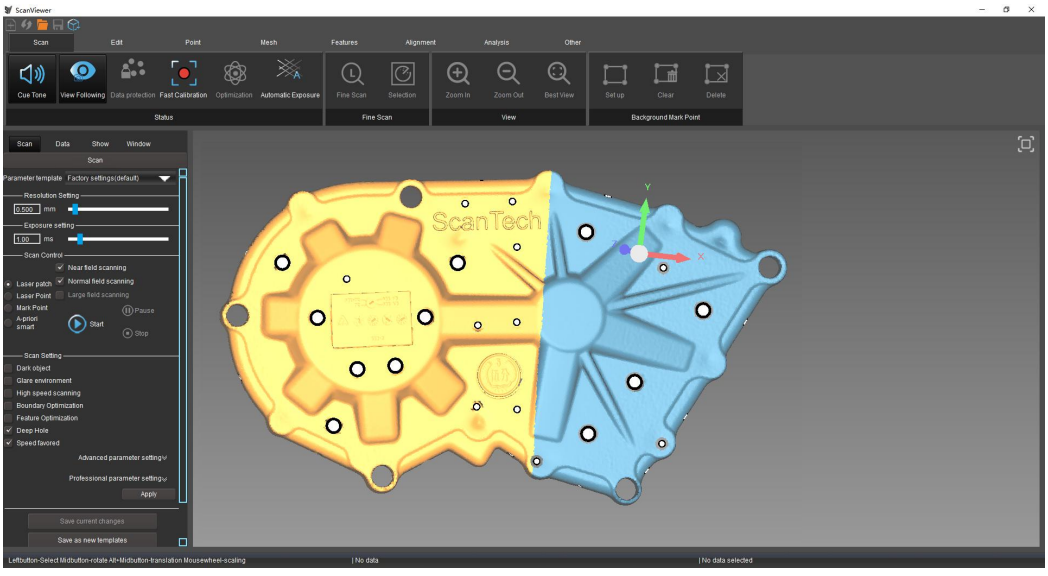



Figure3- 1 Select protect data

■Select “Data Protection”, the data color will be grayed out, and all the selection and deletion operations after selection will not affect the gray (protected) part of the data. As shown in Figure 3-2.

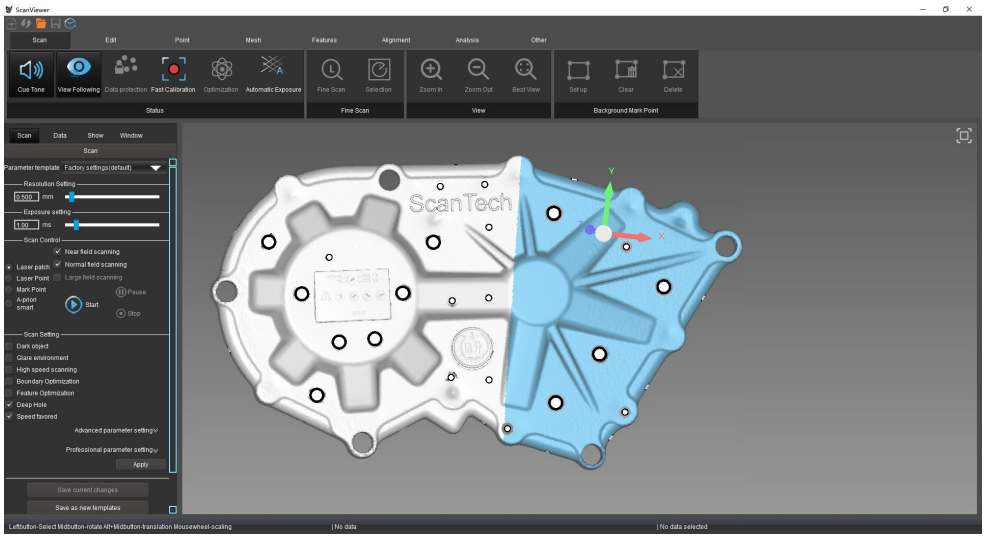



Figure3- 2 Data protected

■ Click “Data Protection” again, the data color changes from gray to yellow, indicating that the data protection function has been withdrawn. As shown in Figure 3-3.

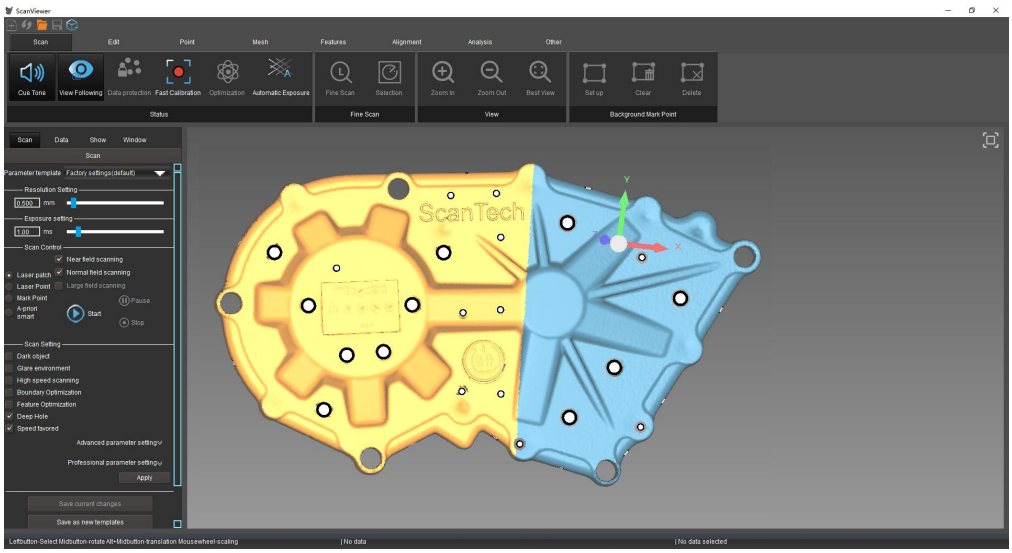



Figure3- 3 Withdraw data protection

■In the 3D display area, click the right mouse button and select “Don't select all” to exit the data protection mode. As shown in Figure 3-4.

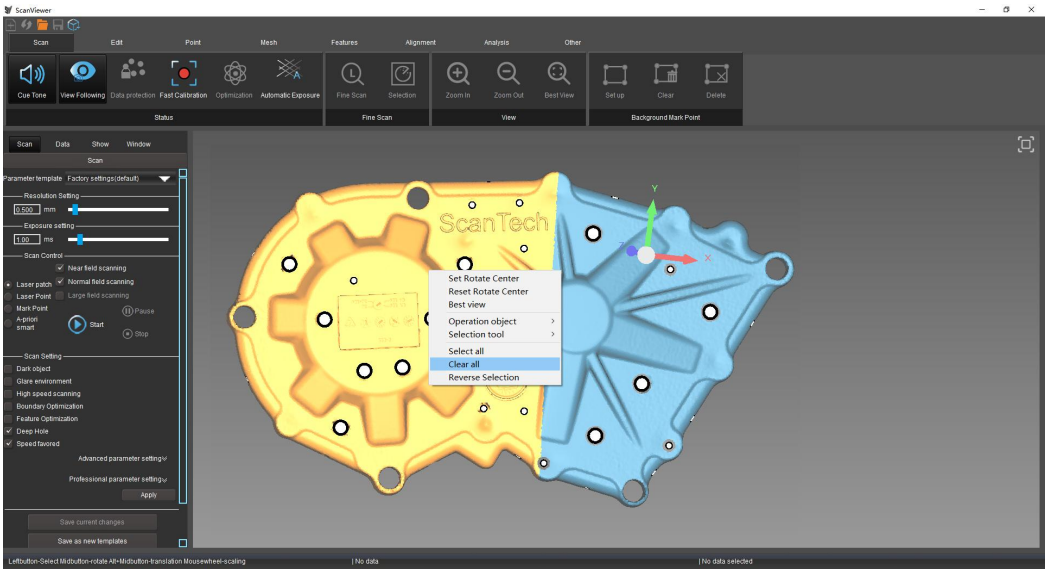



Figure3- 4 Exit data protection mode

### 3.1.2 Automatic exposure

Automatic Exposure function can automatically adjusts the laser exposure to the most appropriate value as follows.

■Click “Auto Exposure”—“Start”, as shown in Figure 3-5.

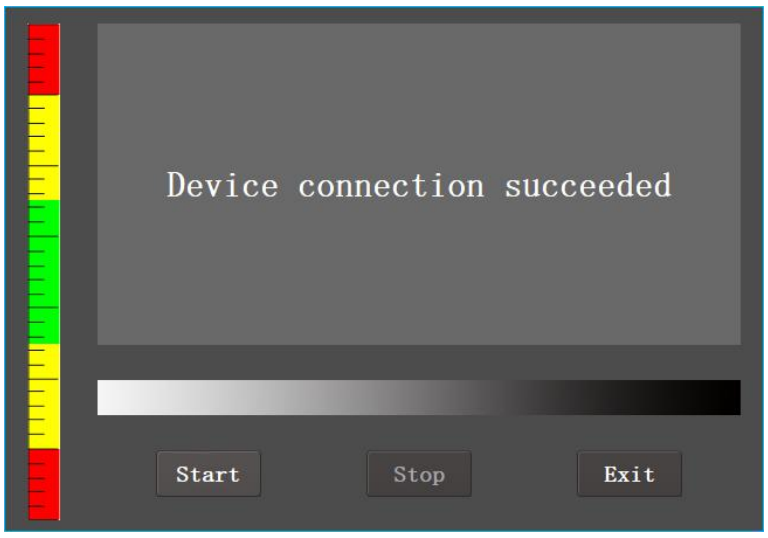



Figure3- 5 Start Adjust

■ The interface displays “Auto Exposure is in progress”—after the “Auto Exposure” font disappears—click “Exit” and the software will automatically adjust to the appropriate exposure value, as shown in Figure 3-6.

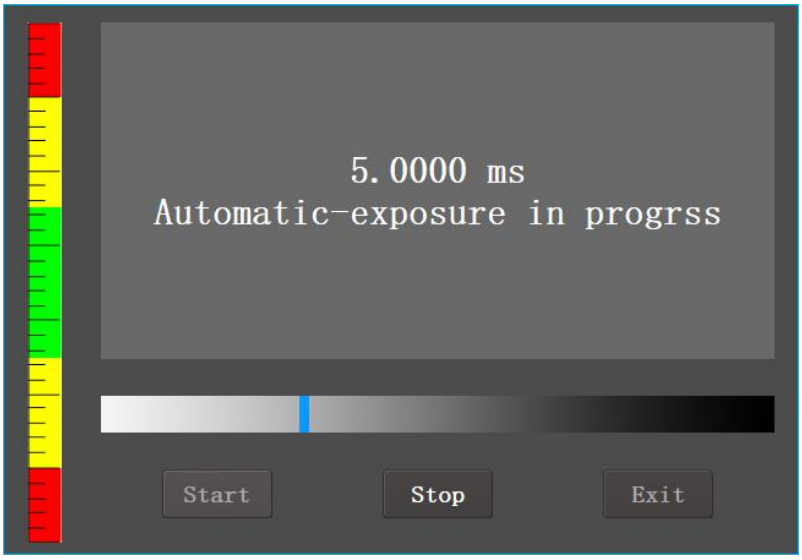



Figure3- 6 Adjust process

### 3.1.3 Fine Scan

The fine scan feature allows the user to scan for finer data at the same project. This feature can only be used in a pause or stop state. The specific operation is as follows.

■ In the case of existing scan data, click “fine scan” to select the fine level (none, low, medium, high, the higher the level, the higher the data fineness). As shown in Figure 3-7.

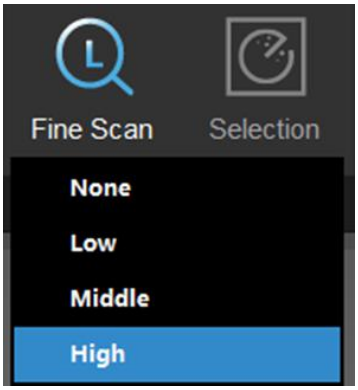



Figure3- 7 Select fine scan level

■Click “Select” to select the fine data area. The color of the data in the selected area becomes golden yellow, as shown in Figure 3-8.

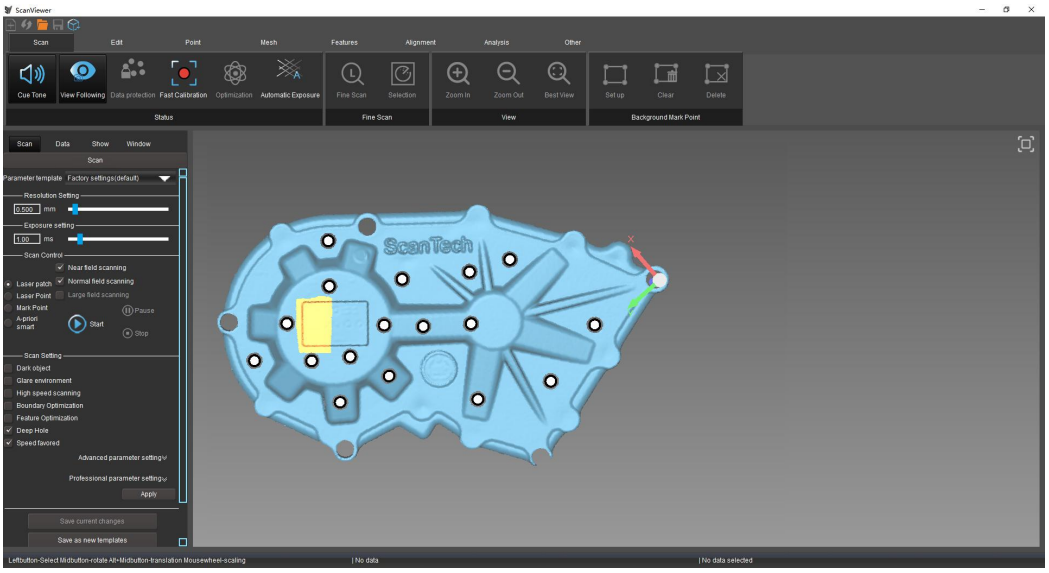


Figure3- 8 Select fine scan area

■The data after fine scan is shown in Figure 3-9. Click "Select" again to exit the fine sweep mode and enter the normal scan mode.

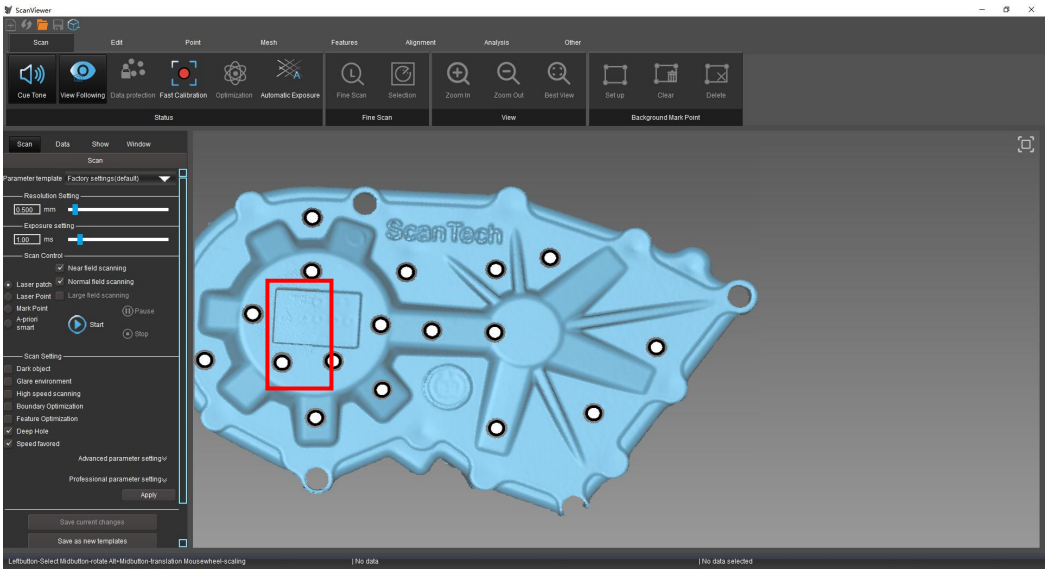


Figure3- 9 Fine scan data

### 3.1.4 Background mark point

Background mark point create a background plane that prevents users from scanning data that is not related to the artifact during the scan. The specific operations are as follows:

■ Place the object to be scanned on the plane, and paste 3 or more points on the plane. After the marker is scanned, select the mark point in a plane, click “Background Mark Point—Set up”, enter “Offset Distance”, and click “OK”, as shown in Figure 3-10.

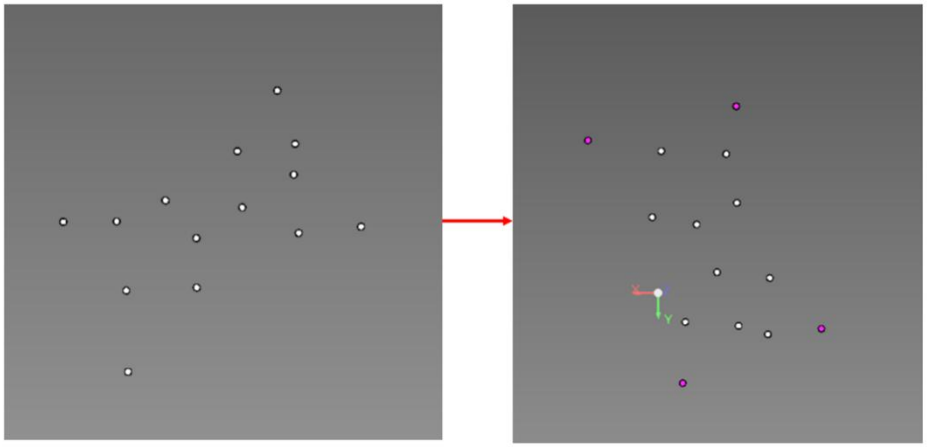


Figure3- 10 Set offset distance

■ Click “Start” to scan the object, the scanning process and the completed picture are shown in Figure 3-11. Click "Clean" or "Delete" to delete the background marker.

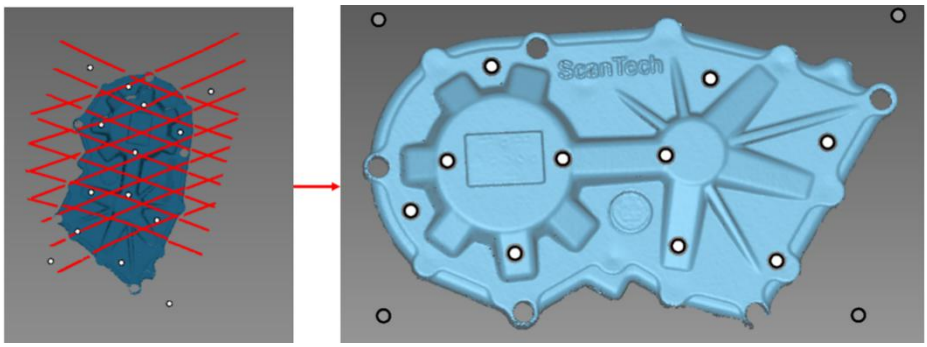



Figure3- 11 Scanning process

## 3.2 Edit

The "Edit" section mainly explains three application methods, such as select single layer, select through, and temperature compensation. The specific icon function is detailed in the 2.2.1 menu bar.

### 3.2.1 Select Single layer

Click “Select single layer”, the user will not be able to select the data of the current back side when selecting the data (Note: “Front” refers to the outer surface of the object, and “Back” refers to the inner surface of the object).

■When "Select single layer" is not clicked, the back of the selected data is also selected, as shown in Figure 3-12.

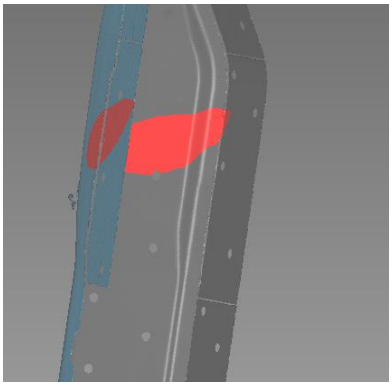


Figure3- 12 Disable select single layer function

■When you click “Select single layer”, the back side of the selected data is not selected, as shown in Figure 3-13.

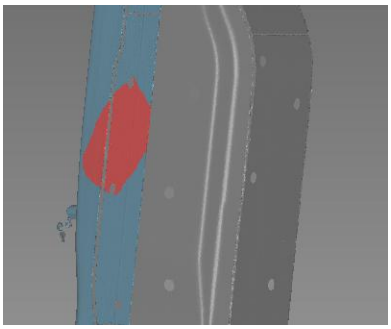


Figure3- 13 Enable select single layer

| | |
|---|---|
| Attention | The "Select single layer" function is only valid for data from laser point files and project files. |

### 3.2.2 Select through

Click "Select Through", the user will only select the data of the visible part when selecting the data.

■When “Select Through” is not clicked, the front and back of the selected data are as shown in Figure 3-14.

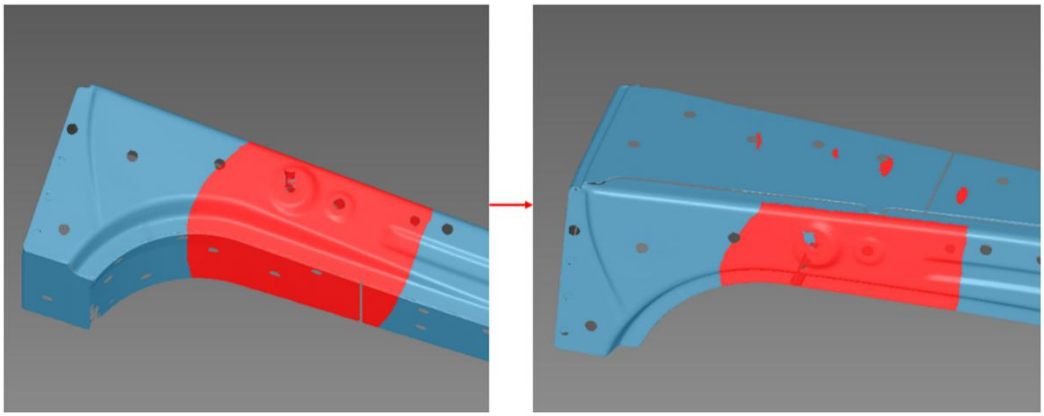


Figure3- 14 Disable select through

■When you click “Select Through”, the front and back of the selected data are shown in Figure 3-15.

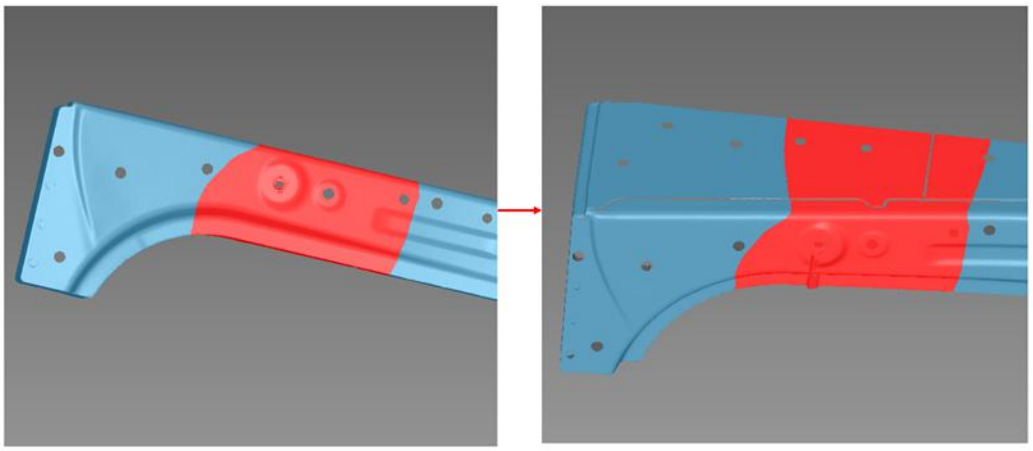


Figure3- 15 Enable select through

| | |
|---|---|
| Attention | The Select Through function is only valid for grid file data. |

### 3.2.3 Temperature compensation

The temperature compensation function automatically calculates the scaling factor based on the selected material and the set temperature, and scales the data according to the scaling factor. Click “Temperature Compensation” to select the type of material to be compensated in the “Window” function panel. If there is no such material option, click “Material” and then “New” material type. Click “OK” and the material type is added successfully. The system will automatically calculate the compensation coefficient according to the selected material and the set temperature, click the “OK” button, and finally make the current compensation coefficient to post-process the current data, as shown in Figure 3-16.

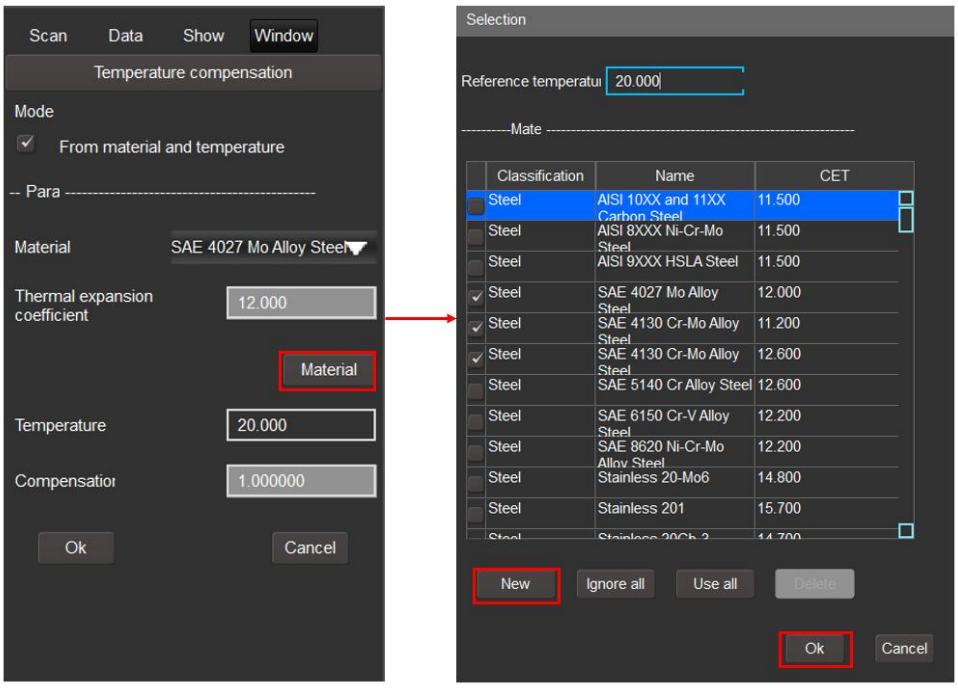



Figure3- 16 Temperature compensation interface

## 3.3 Point

The "Points" section mainly explains five application methods: Wrap, Isolated points, Disconnected Components, Curvature sampling, and Register. The specific icon function is detailed in the 2.2.1 menu bar.

### 3.3.1 Wrap

The main function of wrap is to generate the point cloud data into a form of mesh. The mesh data can be saved in .stl 、.ply or.obj format, and the file can be used for 3D printing and reverse engineering operations.

The options in the meshing process include fill mark point hole, Boundary optimization, high-precision mode, fill small holes, maximum edge number, dilute strength, smooth level, and optimization level:

(1) Filling mark point hole: In the point wrap stage, the data of the area where the mark point is located is filled according to the position of the marker point, and is encapsulated into a complete mesh.
(2) Boundary optimization: rearrange the edges of the encapsulated mesh data to obtain smoother mesh edge data.

(3) High-precision mode: Maintaining higher detail while smoothing.

(4) Fill small hole, the maximum number of edges: fill the hole with the number of edges less than the threshold (the default value of the software is 15 sides, the user can also customize) when encapsulating the grid to obtain more complete

mesh data.

(5) Dilute strength: In the wrap process, according to the dilute intensity, the number of different mesh is reduced in the flat area and the feature area to obtain the package grid data with less data volume.

(6) Smooth level: adjust the position of the mesh vertex to obtain smoother mesh data; the parameters are low, medium and high, and the smoothing grid strength is increased in turn to obtain smoother and smoother grid data.

(7) Optimization level: Continuously optimize the mesh data to make the mesh surface smoother, while reducing the number of meshes while retaining features. The parameters are low, medium and high, and the optimized mesh strength is increased in turn, and the obtained mesh data is smoother and smoother under the premise of ensuring a certain precision.

After the scan is completed, click "Stop" - "Wrap", pop up the parameter window in the function panel, you can set the parameters (generally select the default settings). As shown in Figure 3-17.

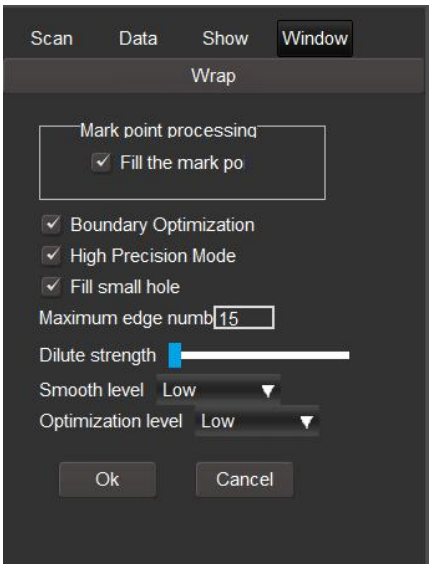



Figure3- 17 Wrap setting interface

The following mainly describes the differences between the various parameters disable and enable during the "Wrap" process.

■Fill the mark points hole

In the "Window" check "Fill Mark", click "OK", wait for the data to run, that is, complete the "fill mark point", as shown in Figure 3-18.

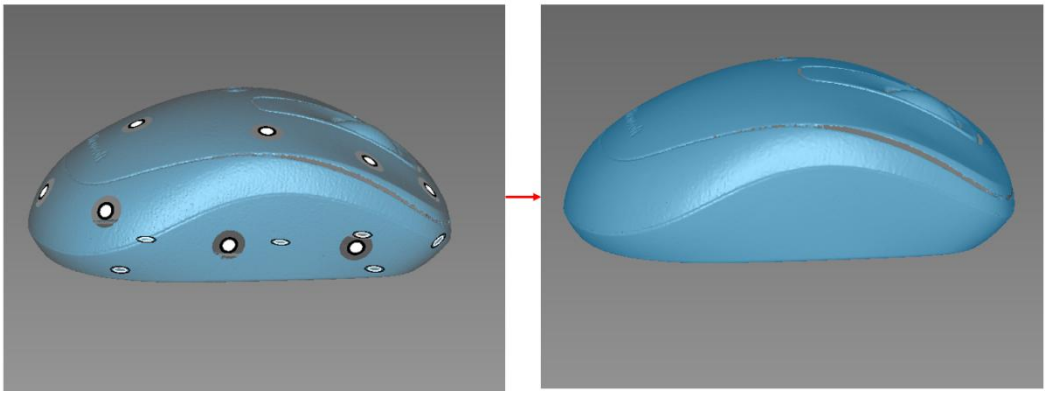


Figure3- 18 Fill mark point process

■Edge optimization

In the interface enable "Boundary Optimization", select the edge, click "OK", wait for the data to process and complete the "edge optimization", as shown in Figure 3-19.

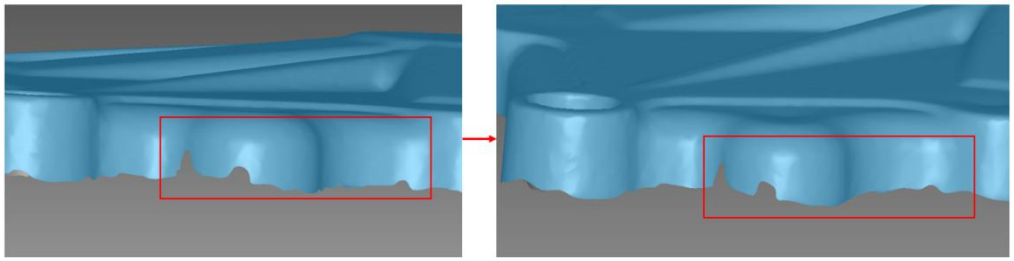


Figure3- 19 Boundary optimization effect

■Fill small hole

In the interface enable "fill small hole", you can fill the hole with the edge number less than the threshold (the default value of the software is 15 sides, the user can customize), click "OK", wait for the data to process and complete The “fill hole” operation is shown in Figure 3-20.

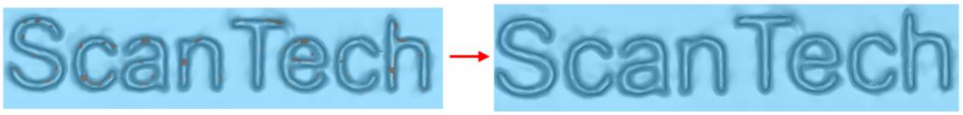



Figure3- 20 Fill small hole effect

■Smooth level

In the interface, the “smooth level” has four levels: no, low, medium and high. Select the desired “smooth level” and click “OK” to wait for the data to process and complete the “smooth level” operation, such as Figure 3-21 shows.

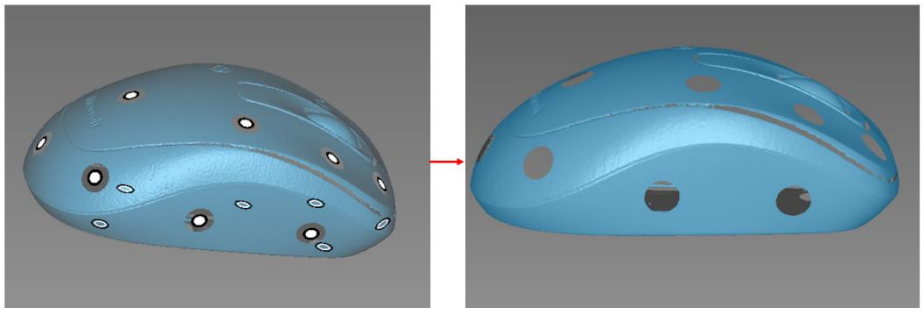


Figure3- 21 Smooth level effect

■Optimization level

In the "optimization level", there are 4 levels of presence, none, low, medium and high. Select the desired "optimization level", click "OK", wait for the data to

process and complete the "optimization level" operation, such as Figure 3-22 shows.

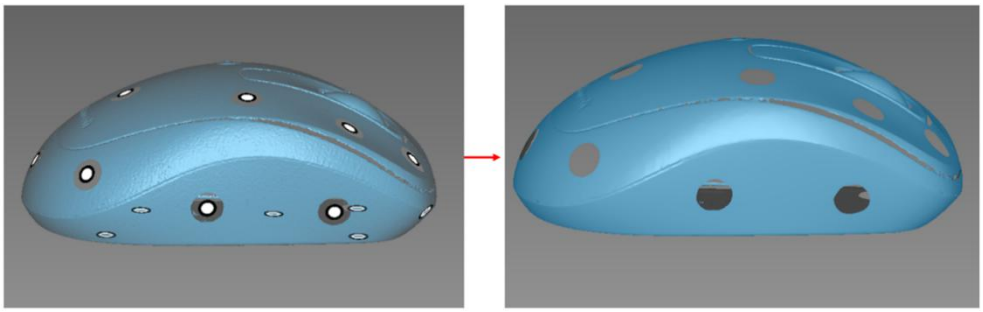


Figure3- 22 Optimization level effect

### 3.3.2 Isolated point

For the scanned data, click “Isolated Point” and select the“Sensitivity”value in the function panel. (Sensitivity 0-100 value. The larger the value, the stricter the condition of the isolated point is determined). Click "OK", after the process is complete, you can see the red "isolated point" in the data. As shown in Figure 3-23

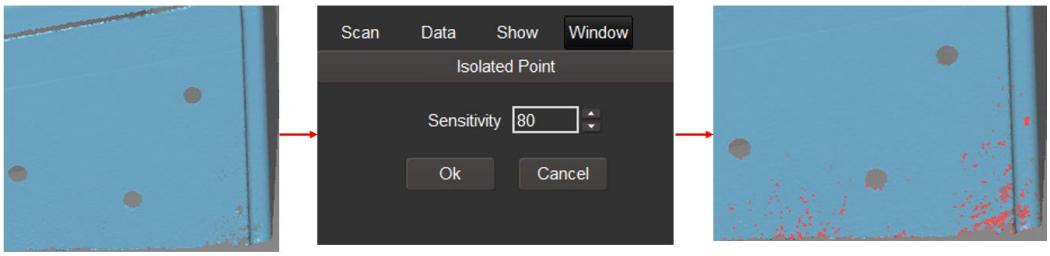



Figure3- 23 Select isolated point

### 3.3.3 Disconnected component

For the scanned data, click “disconnect component” (the function panel window is shown in the figure in Figure 3-24), select the “separation” level, and the separation level is divided into three categories: low, medium and high. The lower the level, the more the disconnected point cloud data is selected.

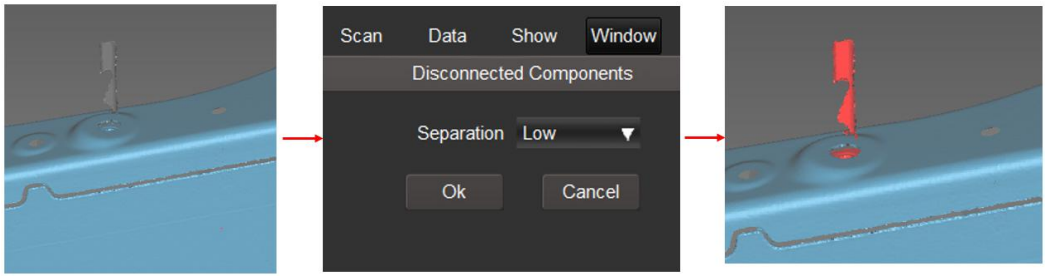



Figure3- 24 Select disconnect component

### 3.3.4 Curvature sampling

For the scanned data, click “Curvature Sample”, select “Percentage”, enter the percentage value, and click “Apply”. The curvature sampling effect is 50% and 100% in the case of Curvature Sample, as shown in Figure 3-25.

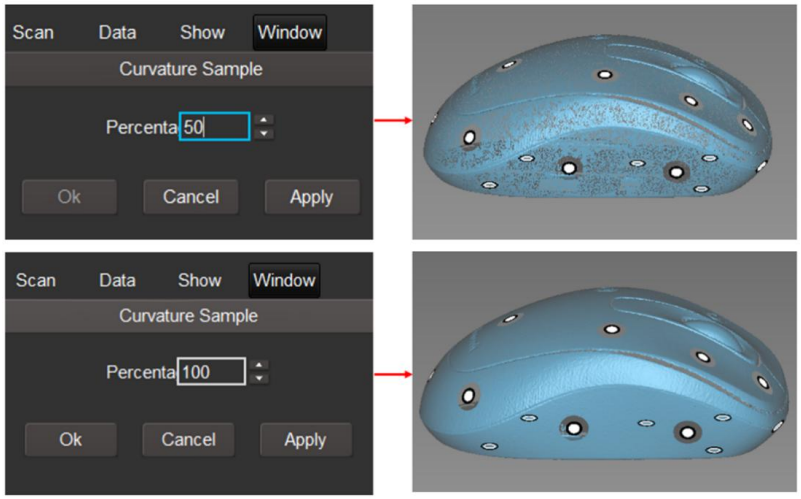



Figure3- 25 Curvature Sample

### 3.3.5 Register

The register method mainly includes two ways of marking point splicing and laser point splicing.

■ **Marking point stitching**

The first step: open two sets of marking points files that need to be spliced (the following is an example of "car 1, car 2"), right click on the data "car 1", select "Set Test", right click on the data " car 2", select "Set Reference". As shown in Figure 3-26.

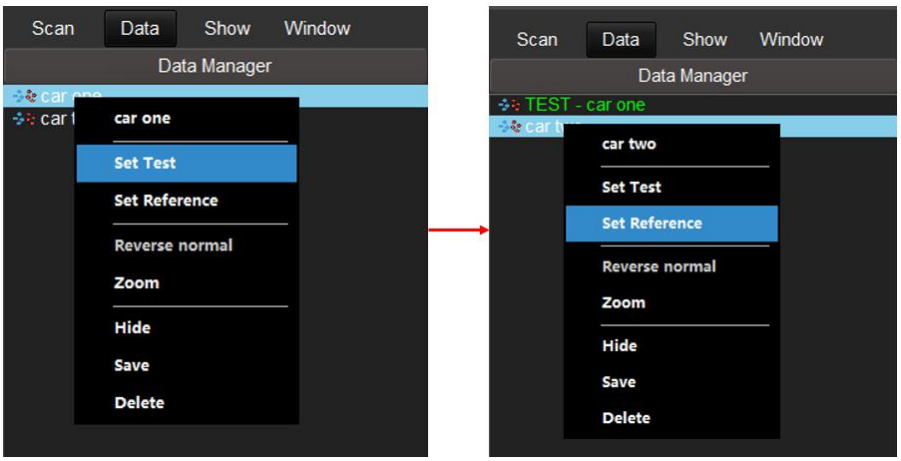



Figure3- 26 Set property before splicing

The second step: Click on the point splicing 

to select the marker points to be stitched. As shown in Figure 3-27.

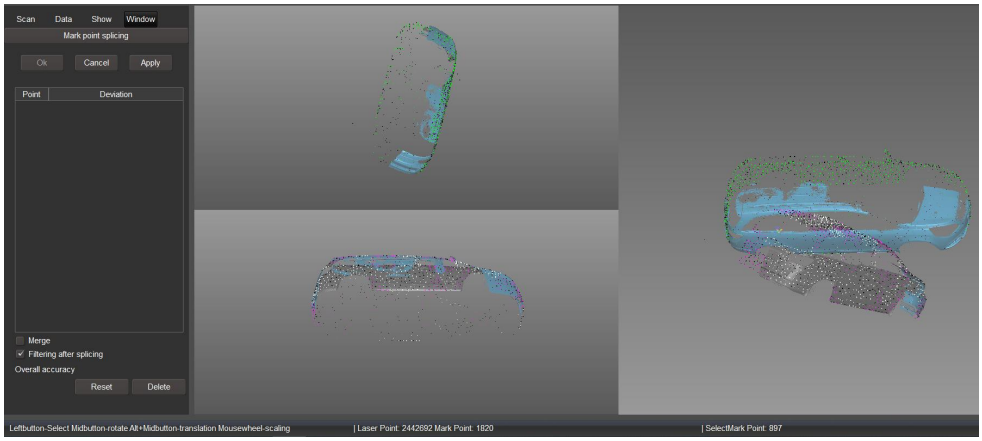



Figure3- 27 Splicing process

| | |
|---|---|
| Attention | Do not select more than 1000 points. |

Step 3: Check and delete the points with large deviations, click “Merge—Apply”, as shown in Figure 3-28.

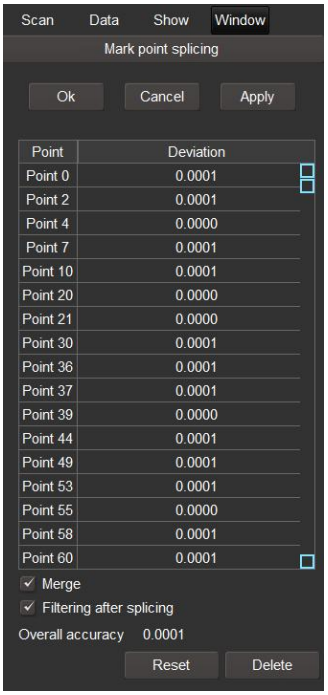



Figure3- 28 Mark point splicing interface

The fourth step: the result of the stitching of the marker points is shown in Figure 3-29.

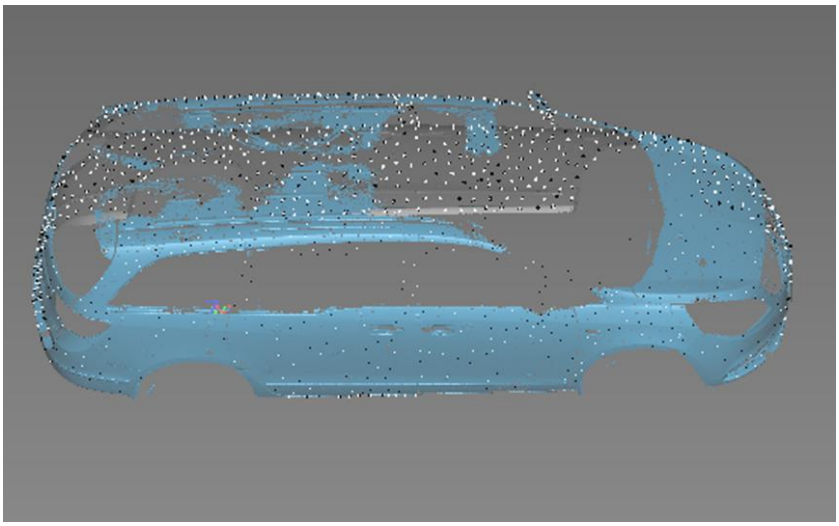


Figure3- 29 Mark point splicing process

## ■Laser point stitching

The first step: open two sets of laser point files that need to be spliced (the following is an example of "Model one, Model two"), right click on the data "Model one ", select "Set Test", right click on the data "Model two" , select "Set Reference". As shown in Figure 3-30.

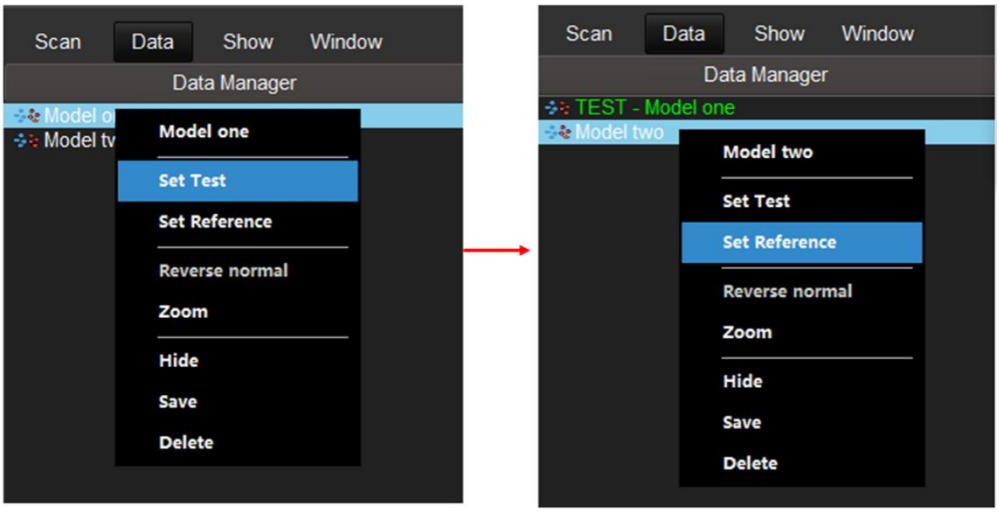



Figure3- 30 Set property before splicing

Step 2: Click on the laser spot stitching 

, select the three reference points in the left picture 1 and the three test points in the left picture 2, and click “Apply” to complete the laser point stitching. As shown in Figure 3-31.

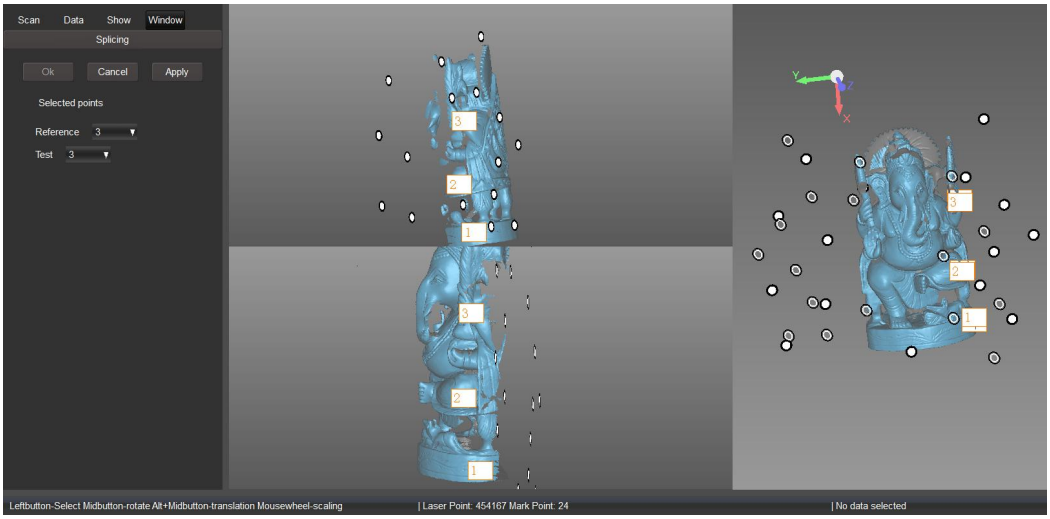



Figure3- 31 Laser point splicing process

The third step: the laser spot stitching result is shown in Figure 3-32.

Figure3- 32 Laser point splicing data

## 3.4 Mesh

The "Mesh" tab mainly explains five application methods such as quick selection and selection information, hole filling, simplify, refine, and defeature. The specific icon function is detailed in the 2.2.1 menu bar.

### 3.4.1 Quick select & select information

After scanning, click “Quick Select” for the data. After quick selection, click “Select Information” to display the area and perimeter of the selected area. As shown in Figure 3-33.

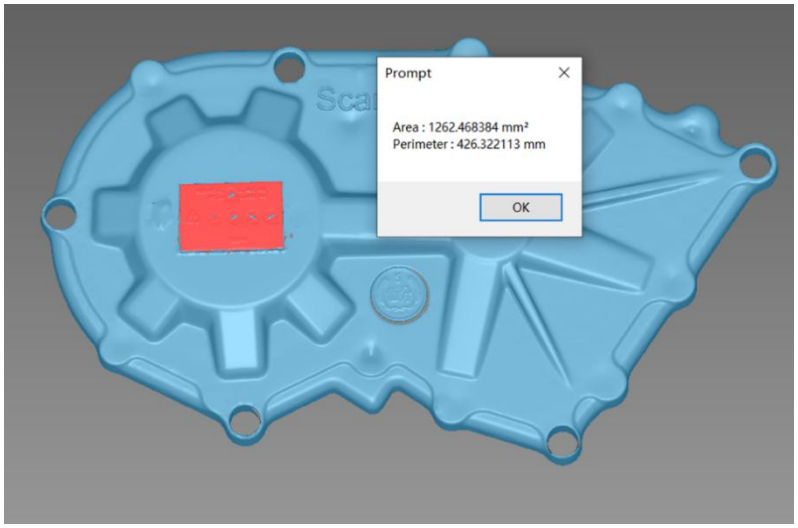



Figure3- 33 Select information interface

### 3.4.2 Fill hole

Select the scan data that will be filled in the hole, click " Fill Hole" (the data boundary turns green and other functions are locked). Select the area to be filled and click the edge". The comparison before and after filling holes is shown in Figure 3-34.

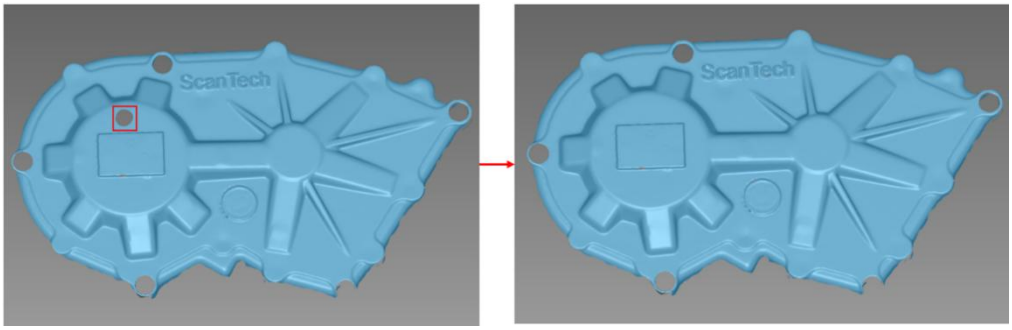



Figure3- 34 Fill hole process

### 3.4.3 Simplify

Select the mesh data to be simplified, click on “Simplify”, select the parameters (retain the number or percentage of triangles) – click “OK” to complete the data simplification. The comparison before and after simplification is shown in Figure 3-35.

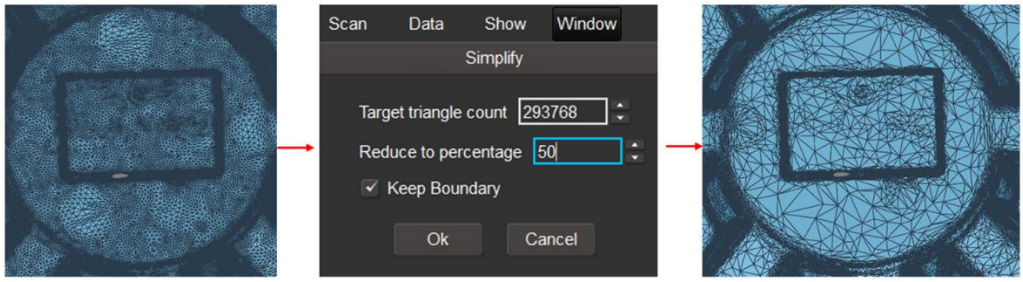



Figure3- 35 Simplify prcess

| | |
|---|---|
| Notice | Select the function panel "Display" - check the "Grid Line" to see the simplified effect more intuitively. |

### 3.4.4 Refine

Select the mesh data to be refined, and click “Refine” - “Apply” to complete the data refinement. The comparison before and after refinement is shown in Figure 3-36.

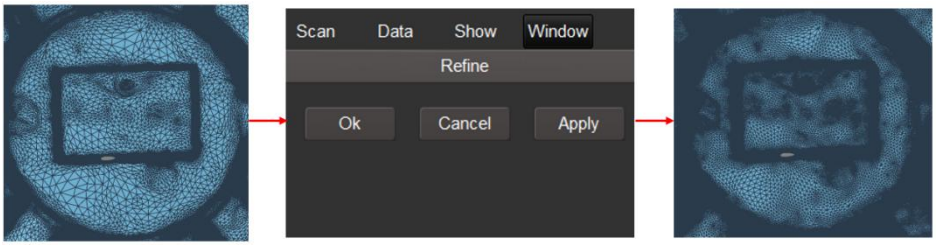



Figure3- 36 Refine process

| | |
|---|---|
| Notice | Select the function panel "Display" - check the "Grid Line" to see the refinement effect more intuitively. |

### 3.4.5 Defeature

Open the mesh data file whose features need to be removed, select the features to be removed, and click “Defeature” to complete. The comparison before and after feature removal is shown in Figure 3-37.

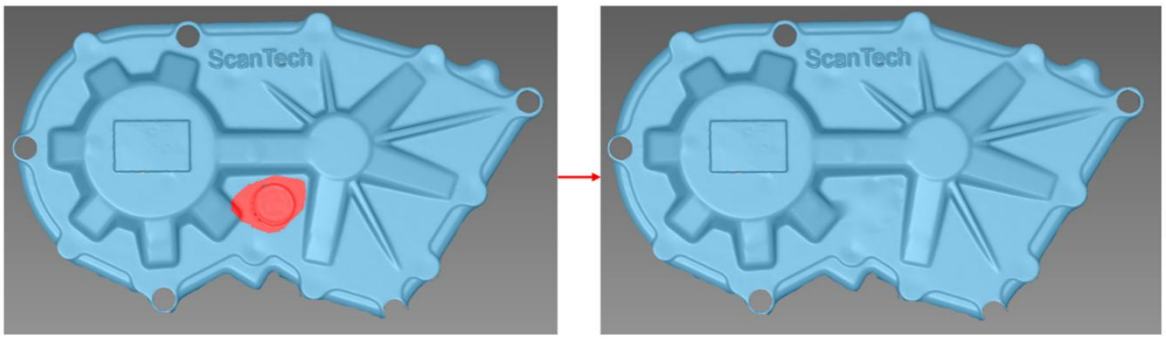



Figure3- 37 Defeature process

## 3.5 Feature

"Features" tab mainly explains the attributes of features such as circles, grooves, points, and lines, feature construction, feature preservation, and feature extraction. When you open the Model File, the feature construction method will increase the "CAD option". The properties and construction of other features are shown in Table 3-1.

Table3- 1

| Feature | Parameter | Construction ways |
|---|---|---|
| Circle | Center coordinates, direction, radius, etc. | Mode: parameters, intersections, fittings, selection points;<br>Intersection sub-mode: plane and cylinder, plane and cone, plane and ball;<br>Fitting sub-method: fitting;<br>Choose the idea of the way: three points. |
| Elliptical grooves | Center point coordinates, direction, direction of the main vector, length, width, etc. | Mode: parameters, fitting;<br>Fit sub-mode: elliptical slot. |
| Rectangular groove | Center point coordinates, direction, direction of the main vector, length, width, etc. | Mode: parameters, fitting;<br>Fit sub-mode: rectangular slot. |
| Circular groove | Center point coordinates, direction, direction of the main vector, length, width, etc. | Mode: parameters, fitting;<br>Fitting sub-mode: circular groove. |
| Point | Point coordinates | Mode:parameters,objects,intersections,projections, fittings;<br>Object sub-method: center of the circle, center of the plane, center of the sphere, midpoint of the line, midpoint of the cylinder<br>Intersection sub-mode: two straight lines, straight lines and planes, three planes, straight lines and balls; |

| | | |
|---|---|---|
| | | Projection sub-mode: projection of a point on a line, projection of a point on a plane, projection of a point on a sphere, projection of a point in a cylinder, projection of a point in a cone;<br>Fitting sub-mode: spherical center, conical cone point. |
| Line | Starting point coordinates, end point coordinates,direction, length | Mode:parameters,objects,intersections,projections, fittings, selection points;<br>Object sub-method: round normal, cylindrical axis, elliptical groove normal, elliptical groove main vector, circular groove normal, circular groove main vector, rectangular groove normal, rectangular groove main vector;<br>Intersection sub-mode: two planes;<br>Projection sub-mode: the projection of a line in a plane;<br>Fitting sub-method: straight line;<br>Choice point: two points. |
| Plane | Coordinates, directions, main vectors, radii, length, width, etc. | Mode: parameters, objects, fitting, selection points;<br>Object sub-method: circular plane, elliptical groove plane, circular groove plane, rectangular groove plane;<br>Fitting sub-mode: plane;<br>Choose the idea of the way: three points. |
| Sphere | Core coordinates, radius | Mode: parameters, fitting, selection points;<br>Fitting sub-method: sphere;<br>Choose the idea of the way: four points. |
| Culinder | Base point, direction, radius, height | Mode: parameters, fitting;<br>Fit sub-mode: cylinder. |
| Cone | Direction, half angle, height, base radius, top radius | Mode: parameters, fitting;<br>Fitting sub-method: cone. |

| | |
|---|---|
| Notice | The features described in this section are bounded or finite, such as the length of a line, the height of a cylinder, and the plane. Conical features include cones and truncated cones in the mathematical sense. |

### 3.5.1 Feature construction

The feature structure includes six modes: intersection mode, fitting mode, selection point mode, CAD mode, object mode, and projection mode.

**■Intersection mode**

The intersection modes include straight lines and straight lines, straight lines and planes, straight lines and spheres, and three planes intersecting the construction points; the two planes intersect to form a straight line; the plane and the cylinder, the plane and the cone, and the plane intersect with the sphere to construct a circle.

**■fitting mode**

The fitting method includes a least squares fitting structure, a minimum one-time fitting structure, a Chebyshev best fitting structure, a maximum inscribed circle fitting structure, and the like.

The least squares method (also known as the least square method): is a mathematical optimization technique. It finds the best function match for the data by minimizing the sum of the squares of the errors. The least squares method can be used to easily obtain unknown data and minimize the sum of the squares of the errors between the obtained data and the actual data.

Least multiplication: As long as the sum of the absolute values of the errors is minimized. It does not require random errors to follow a normal distribution, and "stability" is higher than the least squares method. This method is superior to the least squares method when the random error of the data does not obey the normal distribution.

Chebyshev fit: Named according to the mathematician Chebyshev's theory, minimizing the maximum value is the MinMax problem.

Maximum inscribed circle fit: Fits the largest inscribed circle based on actual data.

**■Selection point mode**

The selection point method includes a three-point construction plane, a three-point construction circle, a four-point construction sphere, and the like.

**■CAD mode**

That is, the feature is created by clicking on the face or line or point of the feature in the CAD data mouse.

**■Object model**

That is, points, lines and planes are obtained from the constructed features. The construction points are generally the center of the circle, the center of the sphere, the center point, etc. The structural line is generally the normal of the axis or the two-dimensional feature, and the structural plane is generally the plane of the two-dimensional feature.

**■Projection mode**

It includes a projection point whose point is on a straight line and a projection point construction point where the point is in the plane, and a straight line where the straight line projects in the plane.

### 3.5.1.1 Circle construction

■ Parameters: Click “Circular”, select “Parameter”, enter the coordinates, direction, radius value, and click “Create” - “OK”. As shown in Figure 3-38.

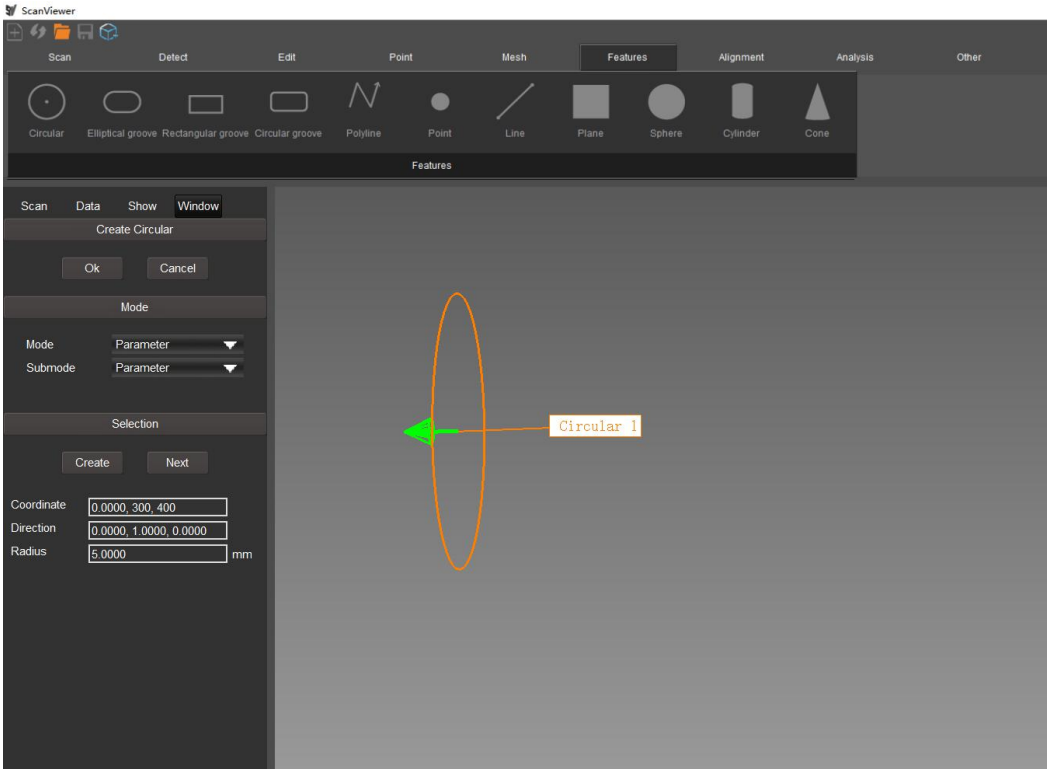



Figure3- 38 Circle structure by parameter

■ Intersection: Click “Circular” and select “Intersection”. There are 3 planes of “Plane and Cylinder”, “Plane and Cone”, “Plane and Ball”. The following mainly introduces the construction circle of “Plane and Cylinder”. Create a plane and a cylinder separately. Specific steps are as follows:

Step 1: Click on “Plane” – “Fitting” – “Create” – “OK” to create a planar feature. As shown in Figure 3-39.

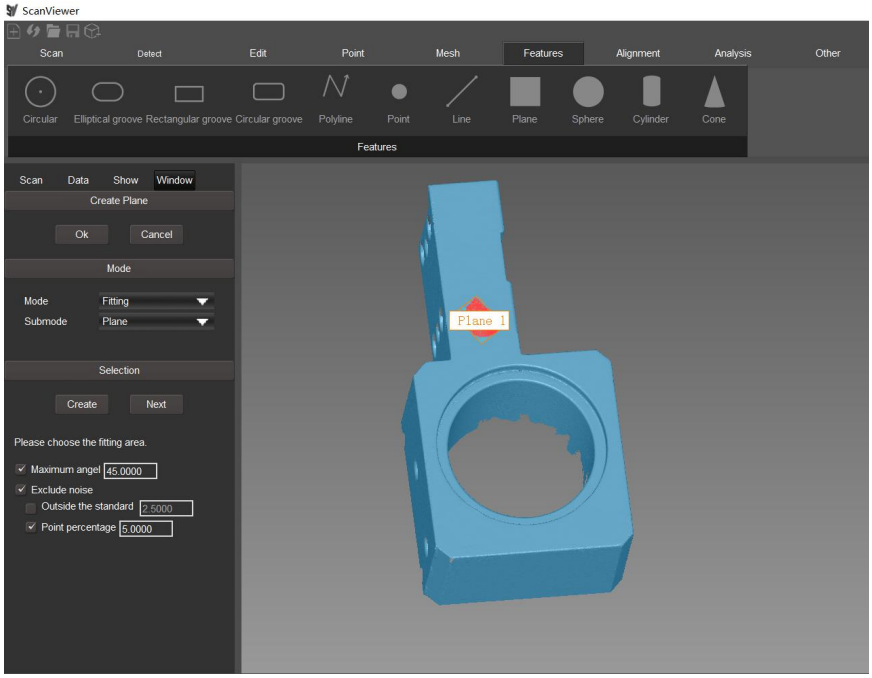



Figure3- 39 Plane fitting structure

Step 2: Click on "Cylinder" - Method "Fitting" - "Create" - "OK" to create a cylindrical feature. As shown in Figure 3-40.

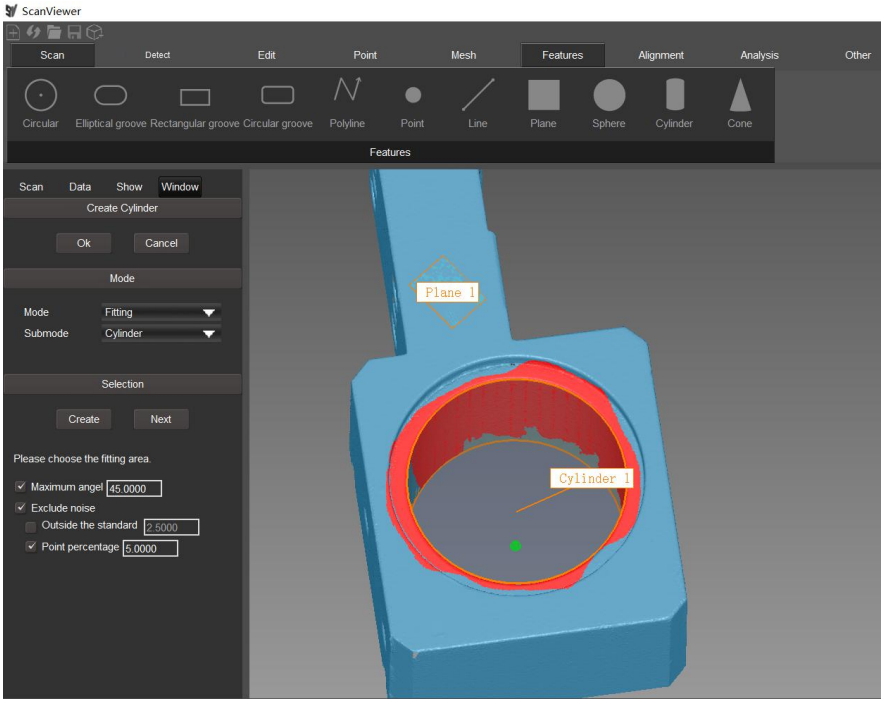



Figure3- 40 Cylinder fitting construction

At this point, the plane and the cylindrical features are constructed. Click on the “Cirular”—the way “intersect”, click on the plane and the cylinder respectively, and finally click “Create—OK” to complete the feature pattern of the intersecting construction circle. As shown in Figure 3-41.

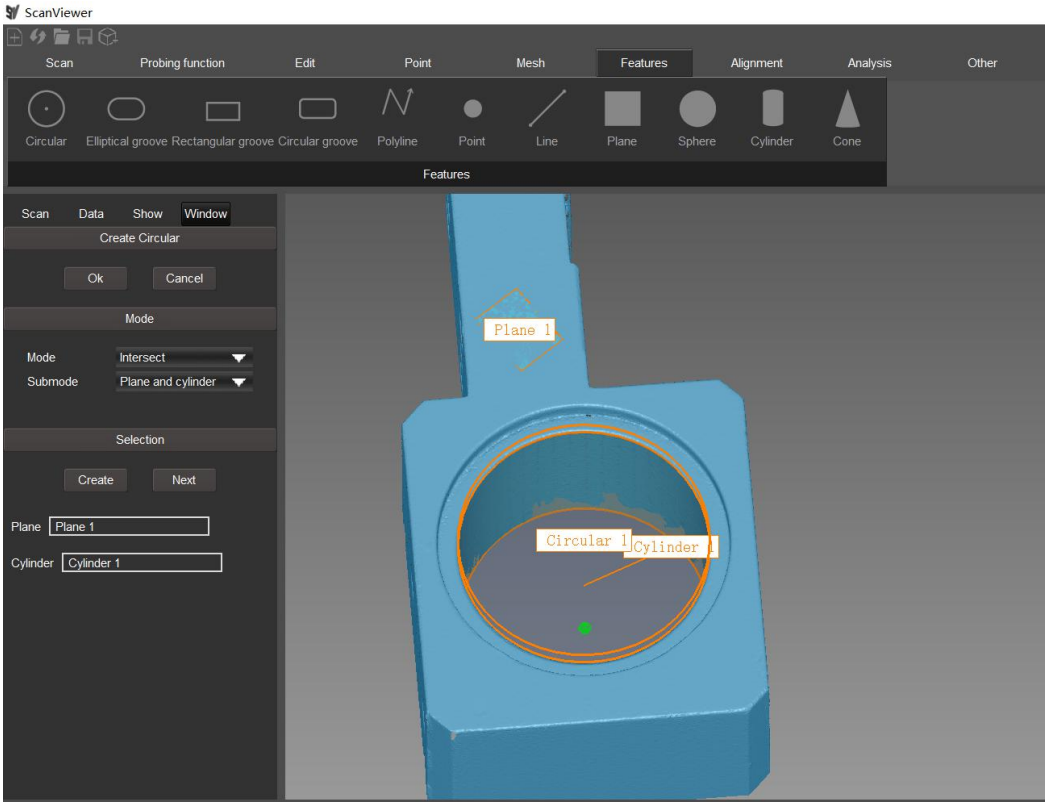



Figure3- 41 Circle structure by intersection

■Fitting: Click “cirular”—Mode “Fitting”, and divide into the least squares best fit, the least one best fit, Chebyshev best fit, The maximum inscribed circle fits four fitting methods. Among them, the "minimum one-time best fit" sub-mode has "internal, middle", "Chebyshev fit" optional sub-modes have "internal, central, external" and so on. The following uses the "least squares best fit" creation method, as shown in Figure 3-42.

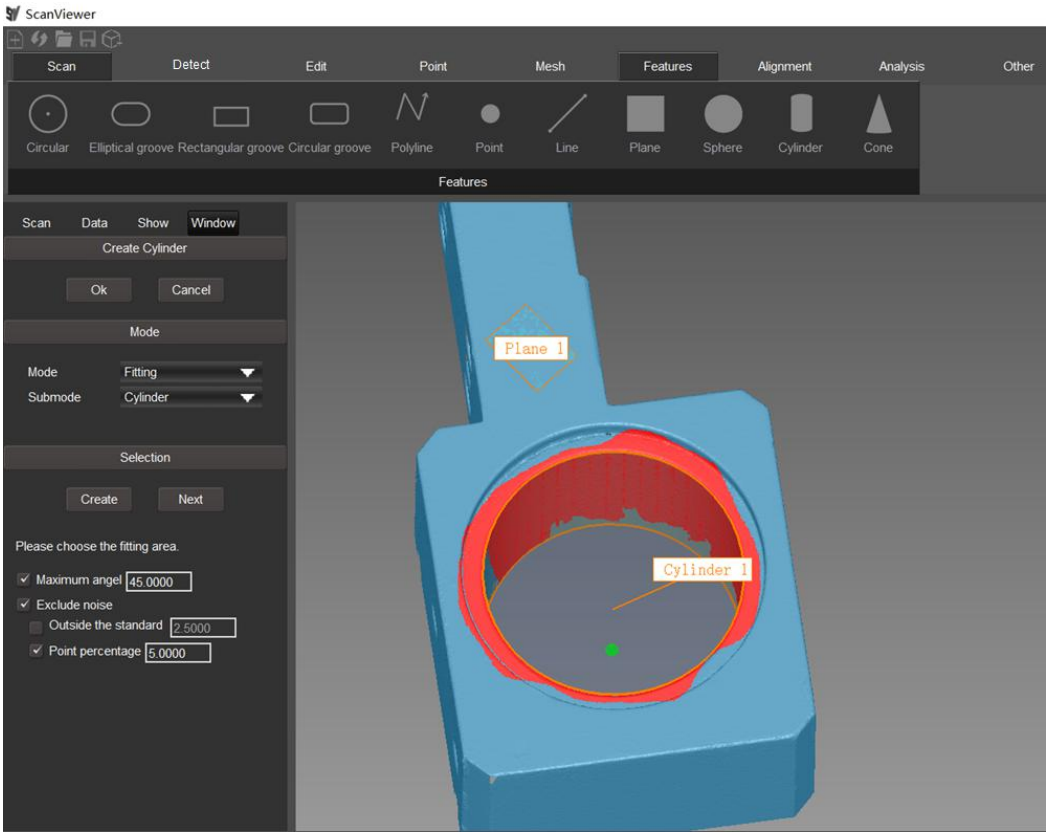



Figure3- 42 Circle structure by fitting

■Select points: Click "Circular", select the mode "Select point", sub-mode "three points", click "Create" - "determine" to complete the three-point mode to construct the circle feature. As shown in Figure 3-43.

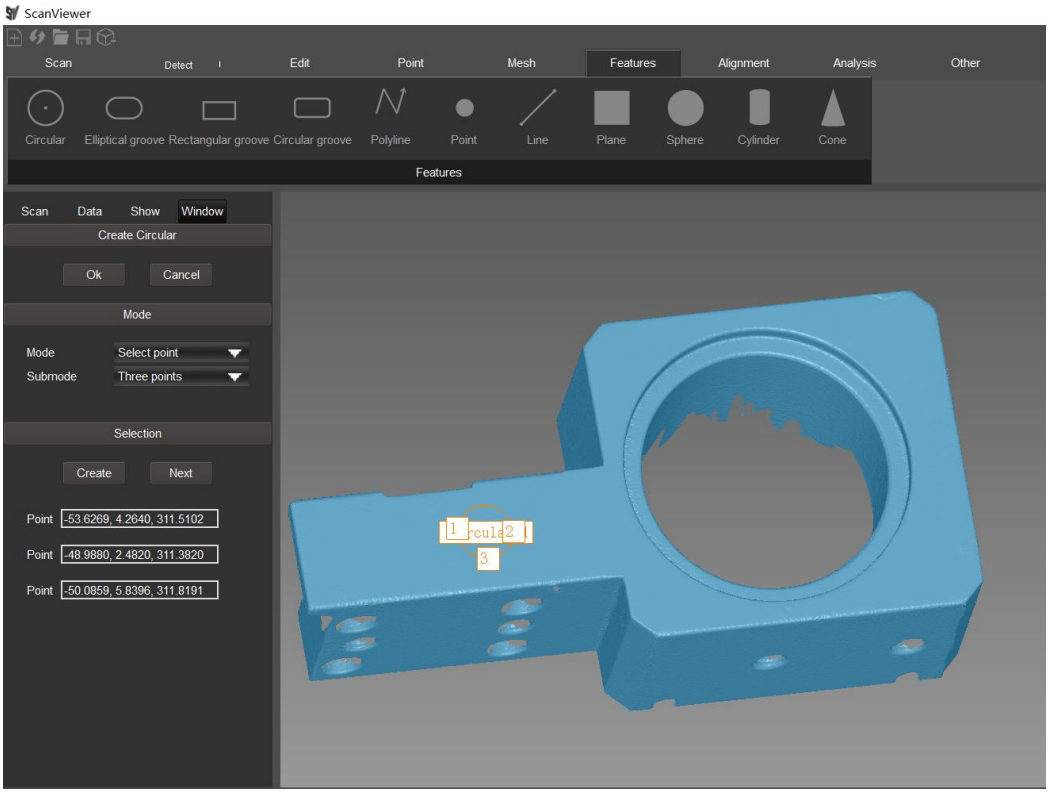



Figure3- 43 Circle structure by three point

■ In some applications, the constructed features may be opposite to the actual normal. The feature extraction function sometimes needs to "reverse" the direction of the feature. Click on the data "Circular 1" - "Attribute" - "Reverse" - "OK". As shown in Figure 3-44.

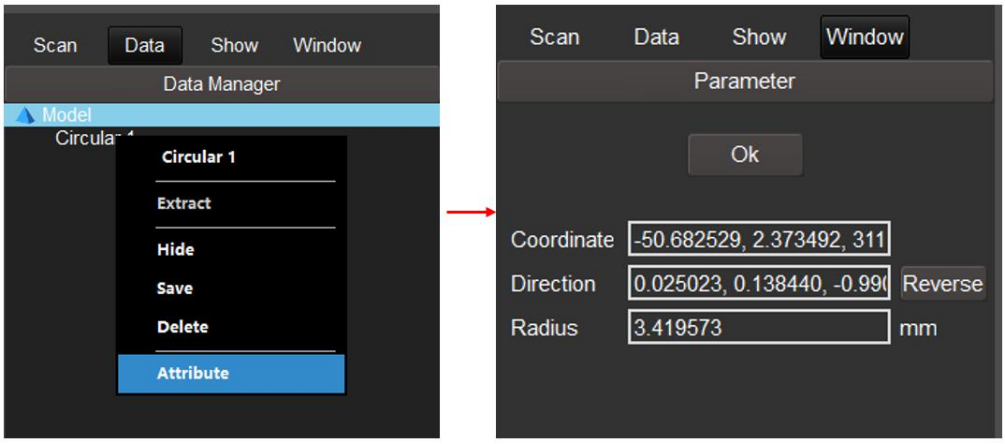



Figure3- 44 Reverse axis

| | |
|---|---|
| Attention | When the constructed normal directions are the same, this step may not be operated. |

■ The features of the structure can be saved as .step or .iges format files, in which the features of the circle, the elliptical slot, the rectangular slot, the circular groove, the polyline, the point, and the straight line are saved as .iges format files, planes, balls, The features of the cylinder and cone construction are saved as .step format files.

### 3.5.1.2 "point" feature construction

The principle of parameter, intersection and fitting structure is the same as that of the previous section 3.5.1.1 “Circle”.

■ Object: first construct a feature "circle", click "point" - mode "object" - sub-mode "center" (can be selected according to specific characteristics) - "create" - select "circle 1" data - click "OK "Yes. As shown in Figure 3-45.

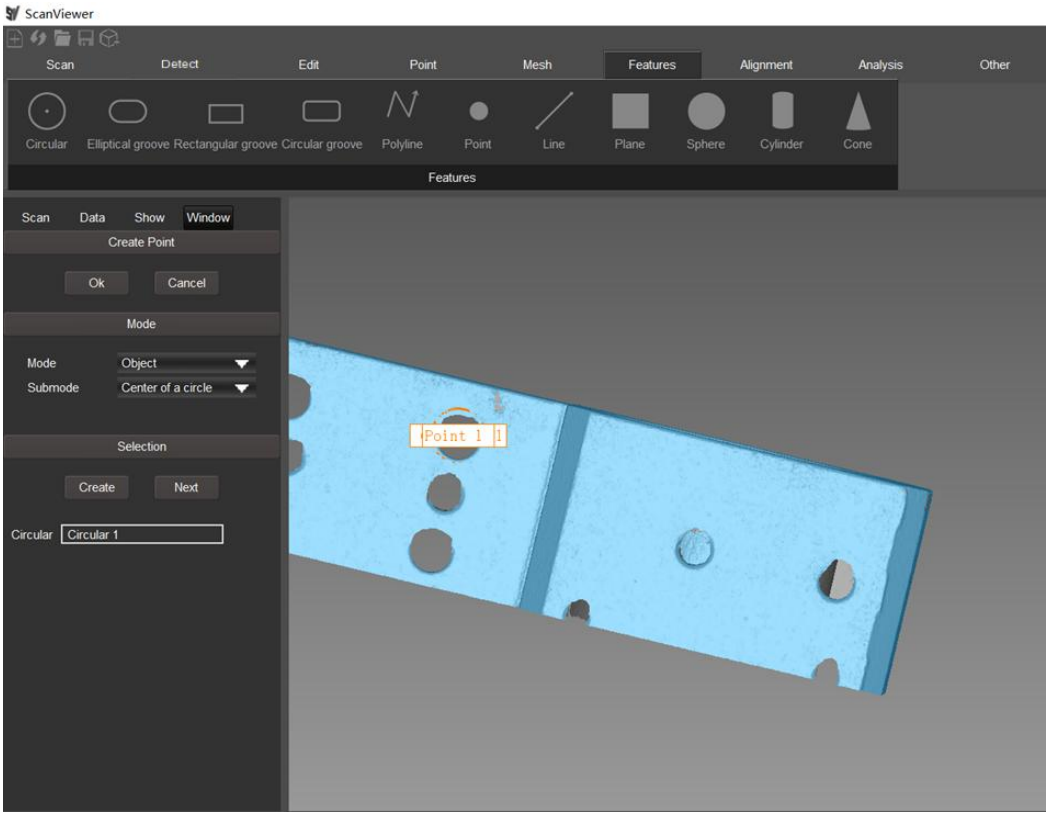



Figure3- 45 Point construction

■ Projection: first construct a feature "circle", select "point" - mode "object" - sub-mode "centre", click "circle 1" - "create" - "apply", as shown in Figure 3-46 .

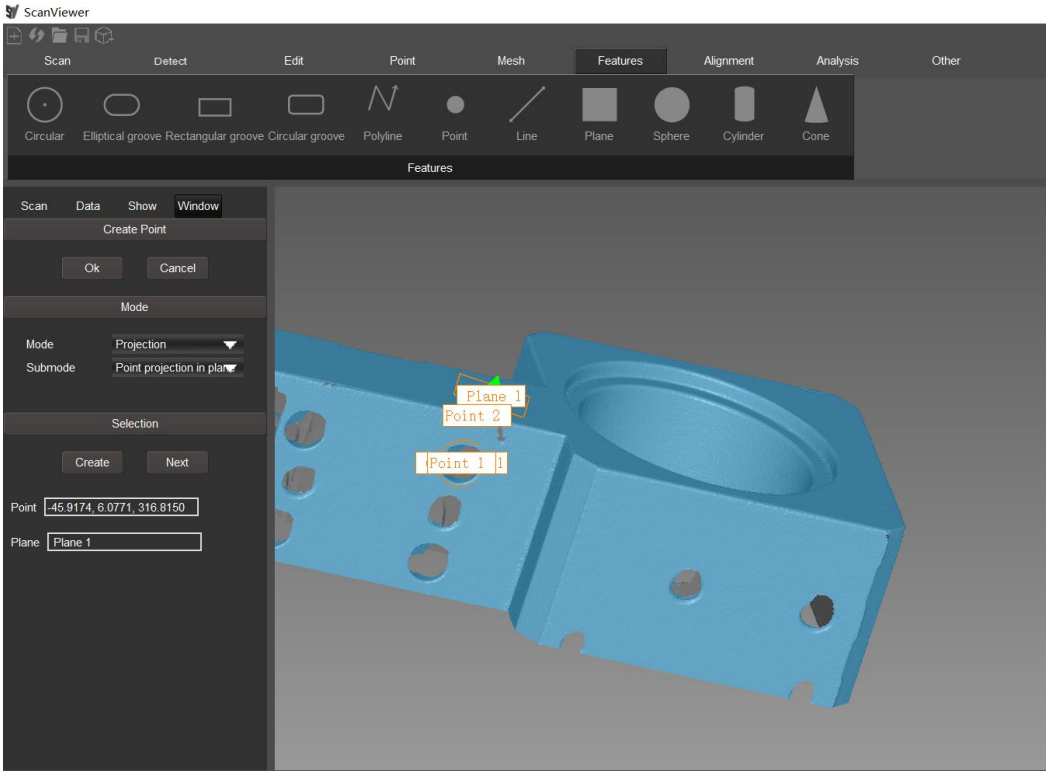



Figure3- 46 Point construction

### 3.5.1.3 "polyline" feature construction

■ Select the data that needs to construct the “polyline”, click “polyline”, select “starting point” and “end point”, and input the “step” and “radius” parameters. The data input by the step size is 2~5 times of the resolution, and the actual radius value of the radius input data. As shown in Figure 3-47.

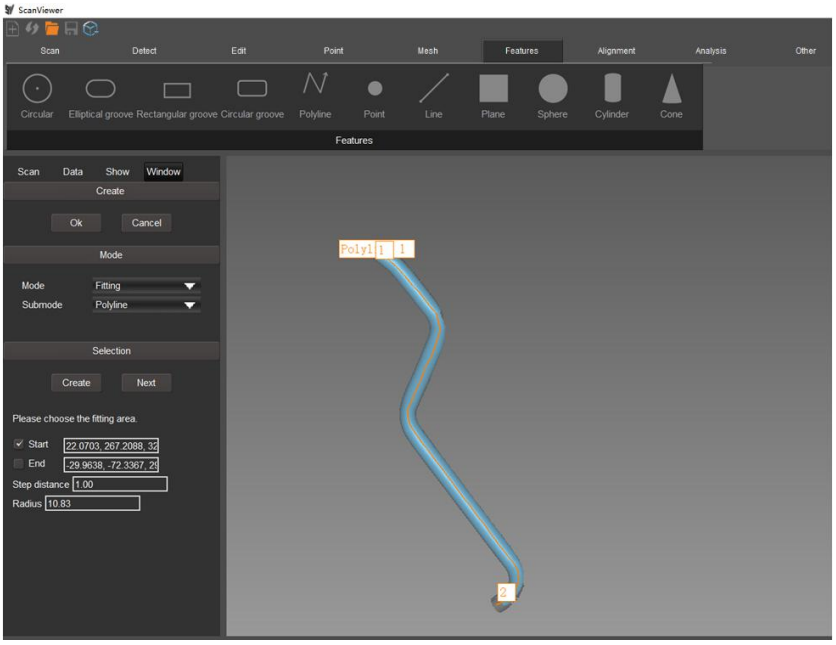



Figure3- 47 Polyline construction

■ Click “Create” - “OK” to construct the polyline (Figure 3-48), right click on “Polyline 1” to save, select the save type “polyline file (.iges)” Save it.

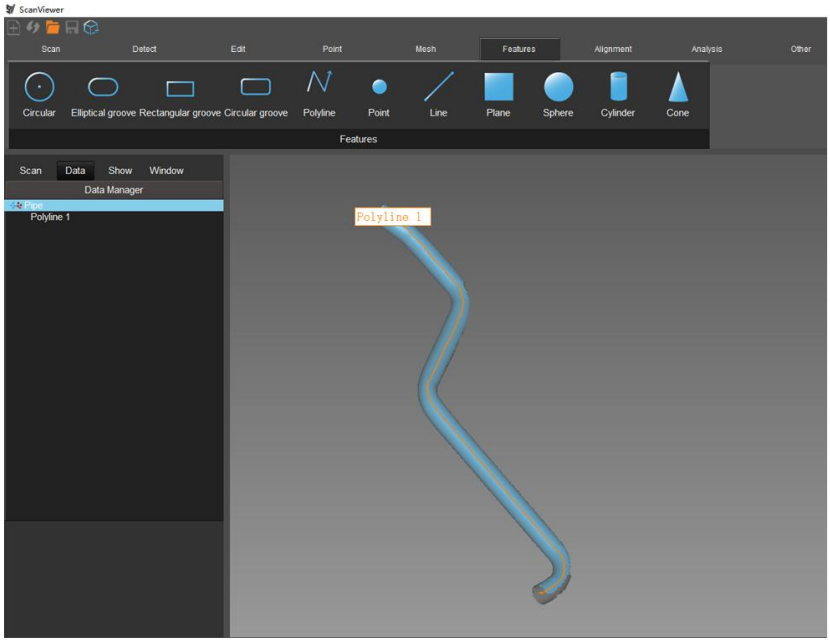



Figure3- 48 Polyline construction

| | |
|---|---|
| Attention | The data to be fitted needs to be continuous without obvious fracture, otherwise it will cause polyline cut-off. |

### 3.5.2 Feature extraction

Feature extraction means that in the same coordinate system, features on the reference data are automatically fitted to similar positions on the test data to create the same type of feature operation. The reference data must be a model file, ie a CAD data file, and the features that can be extracted must be constructed in a CAD format. At this stage, the software supports the extraction of features such as planes, circles, spheres, and cylinders selected by CAD. The following mainly introduces the plane feature extraction:

■Select the file that needs to extract “plane”, open the corresponding model file at the same time, right click on the file and select “Set Test”, right click on the model file and select “Set Reference”. As shown in Figure 3-49.

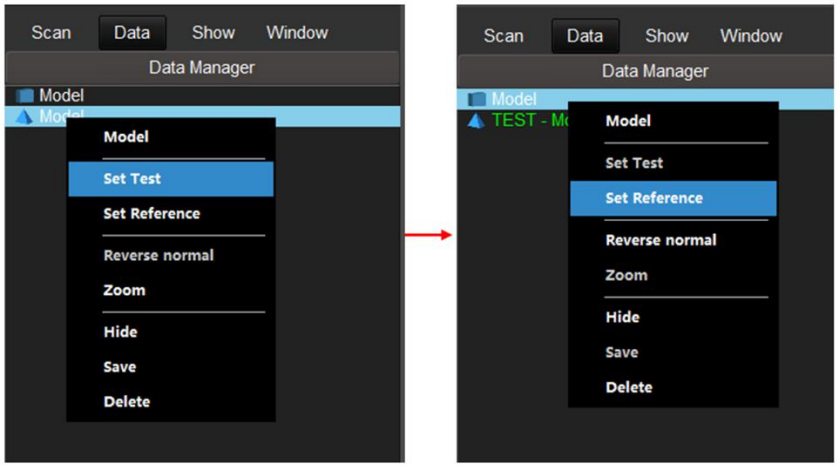



Figure3- 49 Set property

■Click “Best Fit Alignment”, select the corresponding N point (3 ≤ N ≤ 9) from the model file and the file position, and click “Apply”-“OK”. As shown in Figure 3-50.

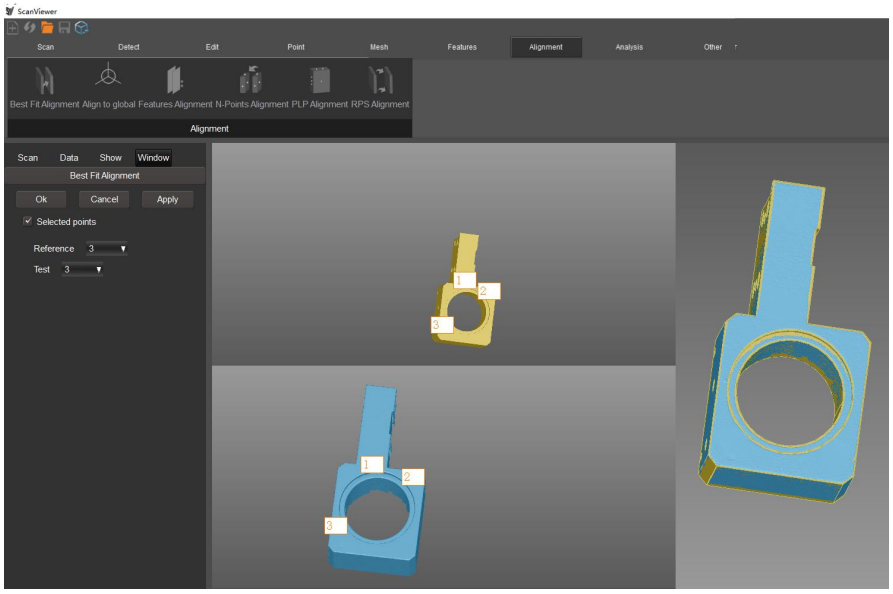



Figure3- 50 Best fit alignment

■ Construct three plane features on the model file, select the mode “CAD”, and click “OK” after the three planes are selected, as shown in Figure 3-51.

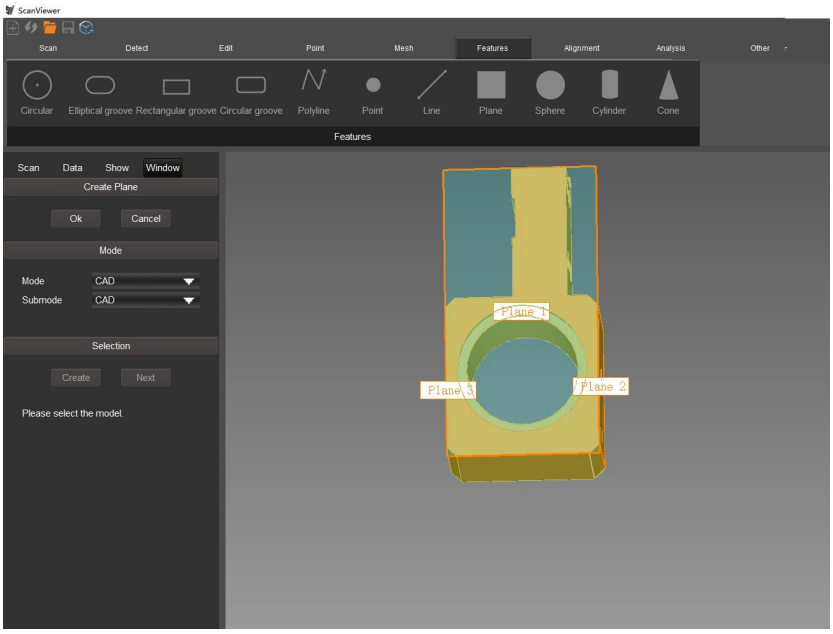



Figure3- 51 Plane construction

■Perform the “extraction” of the planar features constructed in the previous step. In general, the default parameters (the user can customize according to the actual situation), click “OK” to extract the three planes in turn. As shown in Figure 3-52.

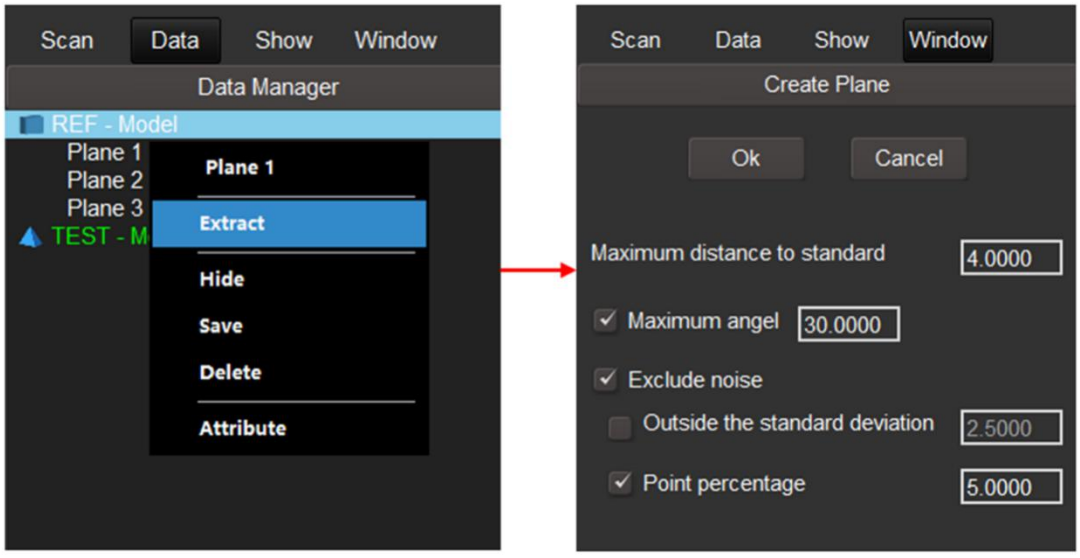



Figure3- 52 Plane extraction

After the feature extraction operation is completed, the following section describes the "Alignment" application.

| | |
|---|---|
| Attention | Feature extraction is generally after the "alignment" operation. If the deviation of the data after "alignment" is too large, it may affect the extraction effect. Please adjust each parameter according to the actual situation. |

## 3.6 Alignment

Alignment is the process of unifying two different sets of data into the same coordinate system by rigid transformation. All of the alignments described in this section are rigid transformations, which are transformations that only change the position and orientation of the object without changing the shape and size of the object. Common alignments include: best fit alignment, alignment to global, feature alignment, N dot alignment, PLP alignment, and RPS alignment.

### 3.6.1 Best fit alignment

■ Select the file data to be aligned, and open the corresponding model data. Right click on the file and select “Set Test”. Right click on the model file and select “Set Reference”. As shown in Figure 3-53.

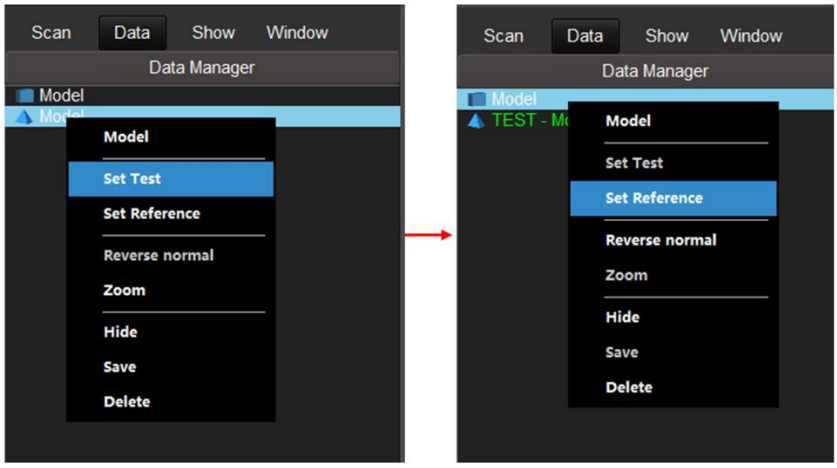



Figure3- 53 Set property

■Click “Best Fit Alignment”, select the corresponding reference and test N points ($3 \leqslant N \leqslant 9$) for the model file and file position respectively, and click “Apply”-“OK”. As shown in Figure 3-54.

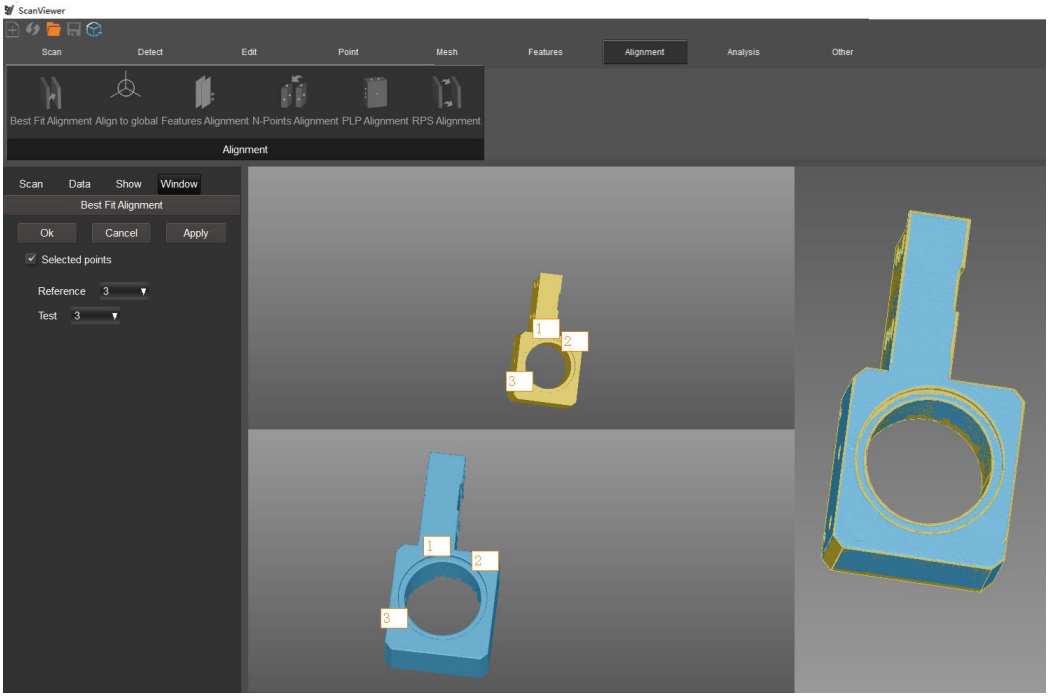



Figure3- 54 Best fit alignment

The fitting results can be used for subsequent 3D comparisons, etc. (refer to 3.7.4 3D comparison).

## 3.6.2 Align to global

■ Select the data that needs to be aligned to the global, construct three plane features (refer to 3.5.1 Feature Construction), and after the construction is complete, click “Align to Global”. As shown in Figure 3-55.

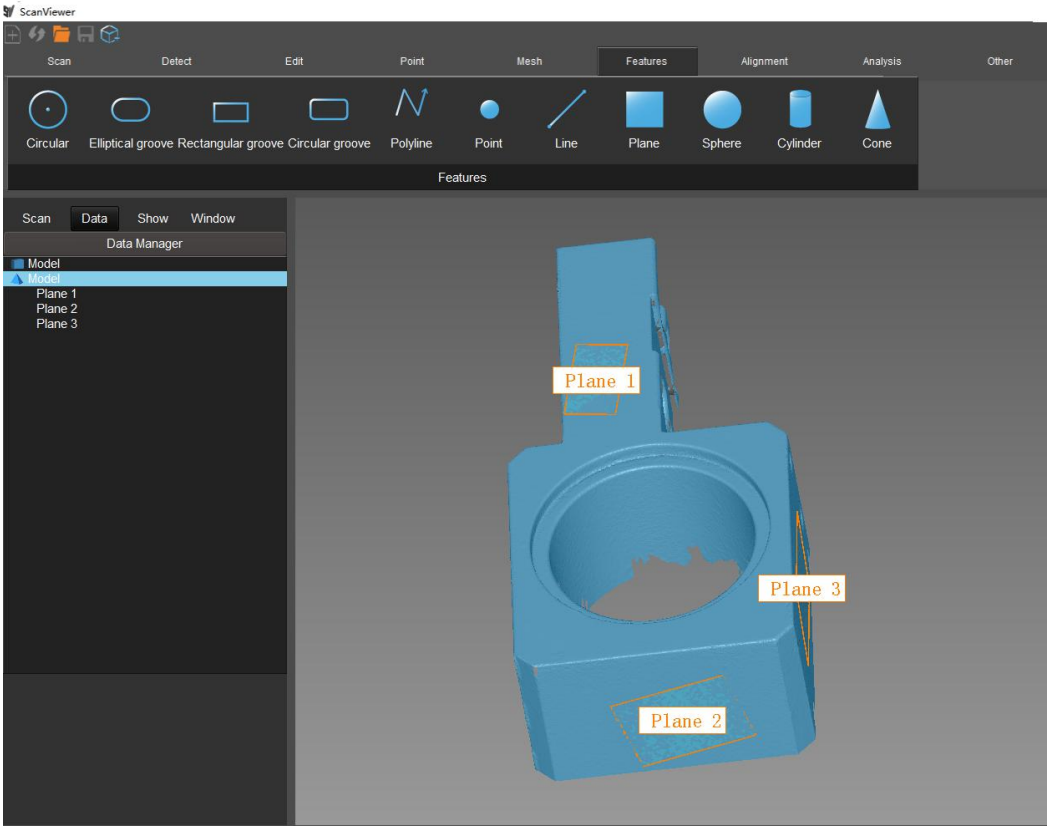



Figure3- 55 Align to global (construct plane features)

| | |
|---|---|
| Attention | Alignment into the global process should avoid constructing parallel (or coincident) plane features. |

■Select plane 1, plane 2, plane 3 corresponding to the XY plane, XZ plane, and YZ plane respectively, click “Create Pair”—“OK”, and finally run the data alignment to the whole, as shown in Figure 3-56.

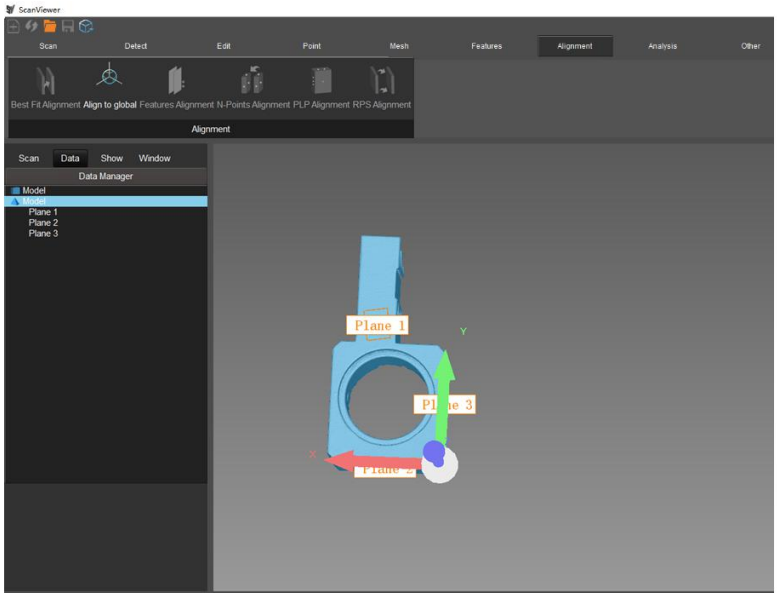



Figure3- 56 Align to global interface

### 3.6.3 Features Alignment

After the feature extraction (see 3.5.2 Feature Extraction for details), click “Align—Features Alignment” and click “Auto”—“OK” to complete the feature alignment. You can also click “Create Pair”, “Reference” and “Test” to match one by one, and select the priority of the corresponding feature to complete the feature alignment. As shown in Figure 3-57.

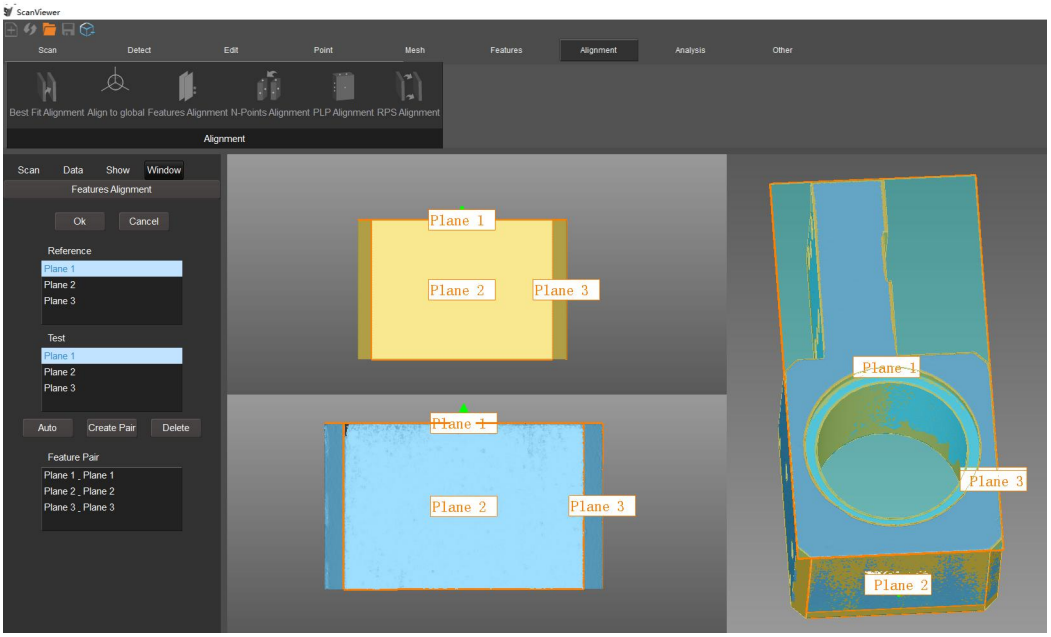



Figure3- 57 Features alignment interface

### 3.6.4 N-Points Alignment

Select the data to be aligned, and open the corresponding model data. Right-click "Set Test" and "Set Reference", click "Align - N Point Alignment", and click 3 reference points in the model file and grid file respectively. And 3 test points, click "OK". As shown in Figure 3-58.

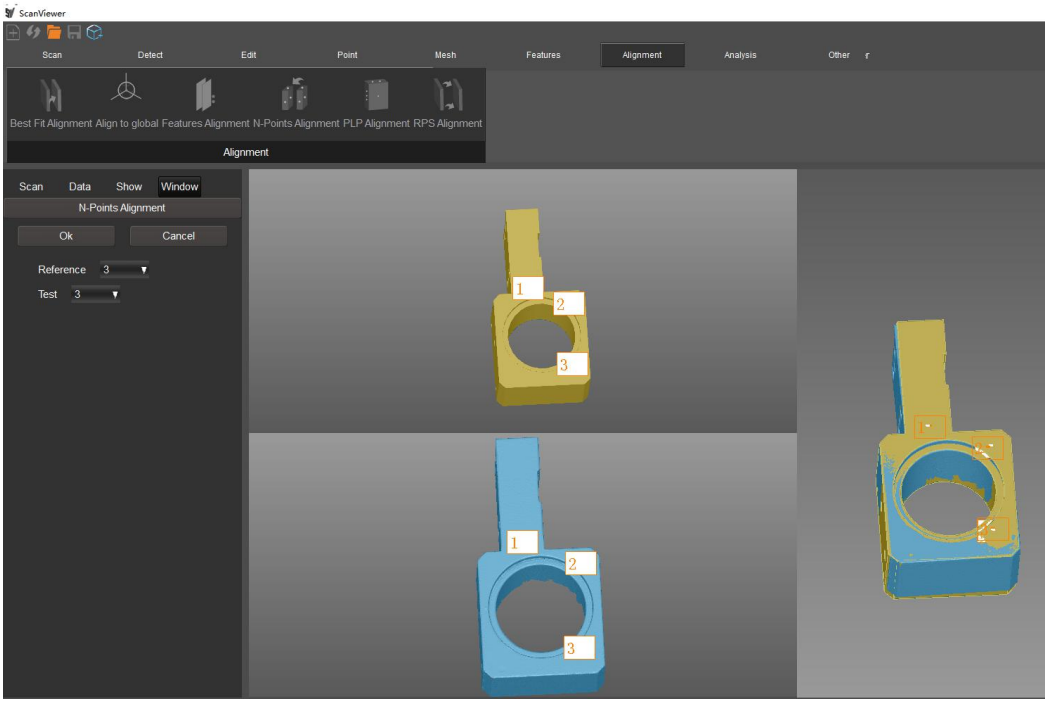



Figure3- 58 N-Points alignment

### 3.6.5 PLP Alignment

Select the data to be aligned, and open the corresponding model data. Right-click "Set Test" and "Set Reference" respectively, and click "Align - PLP Align". PLP alignment is an alignment method that unifies two sets of data into the same coordinate system according to the feature plane, line, and point. Before using this method, the features of plane, line, and point should be constructed respectively in the corresponding positions of the two types of data. After the feature is constructed, click on "Apply" - "OK". The PLP alignment effect is shown in Figure 3-59.

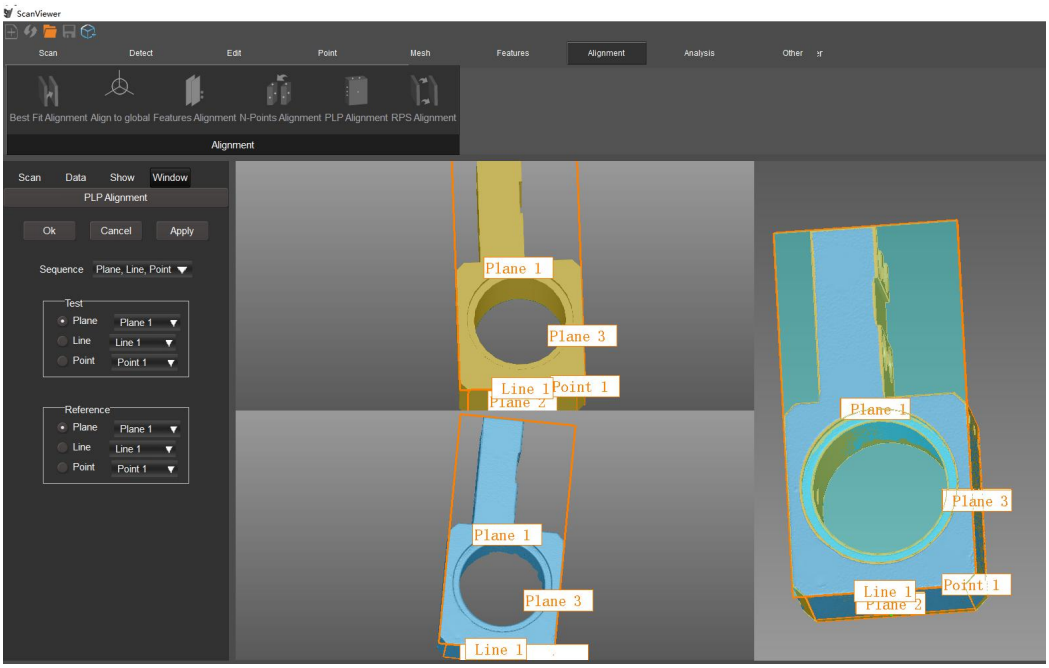



Figure3- 59 PLP alignment

### 3.6.6 RPS alignment

Select the data to be aligned, and open the corresponding model data. Right-click "Set Test" and "Set Reference" respectively, and click "Align - RPS Align". RPS alignment is an alignment method that unifies two sets of data according to a reference point to the same coordinate system. Before using this method, two different sets of features are constructed in corresponding positions in the two data. After the feature is constructed, click on "Automatic" - "Apply" - "OK". The RPS alignment interface is shown in Figure 3-60.

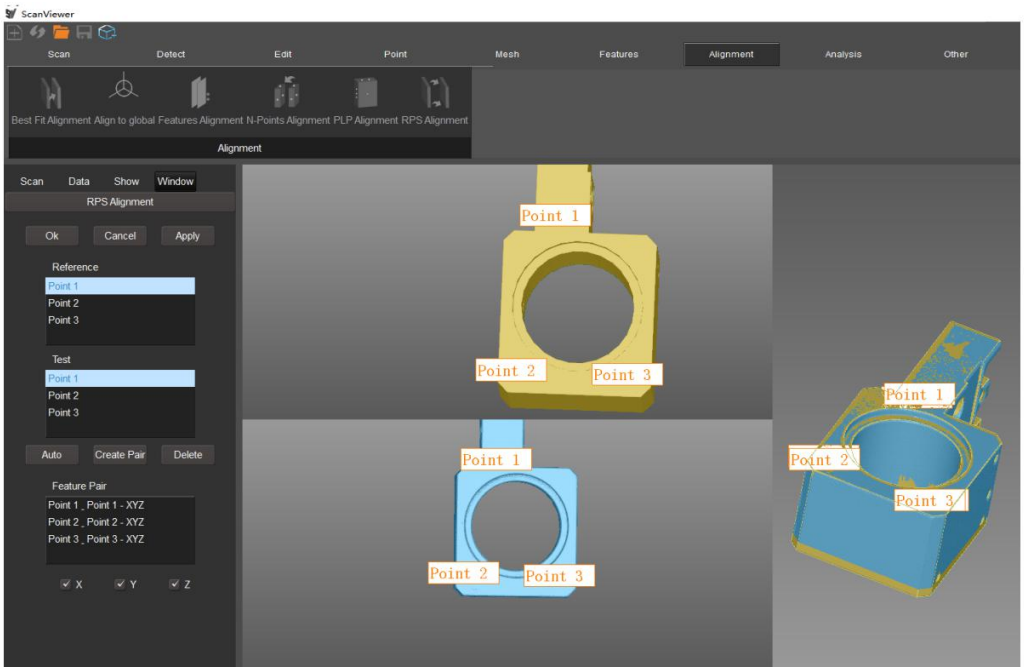



Figure3- 60 RPS alignment

## 3.7Analysis

The “Analysis” tab mainly covers five application methods such as distance, angle, section, 3D comparison, and GD&T. The specific icon function is detailed in the 3.2.1 menu bar.

### 3.7.1 Distance

When measuring the distance between features, the second feature is the main feature, the circle degenerates into the center of the circle, the circular groove, the elliptical groove, the rectangular groove will degenerate into the center point, the ball degenerates into the center of the sphere, and the cylinder and cone will degenerate into the axis. The distance will eventually be converted into one of three ways: point-to-point distance, point-to-line distance, and point-to-face distance.

Select the data to be measured and construct the characteristics of the required measurement (see 3.5.1 Feature Structure for specific feature structure), then measure the distance between the features. The following is an example to measure the distance from the center of the feature circle to the center of the circle.

Click “Distance” and select “Circle 1” and “Circle 2” respectively to measure the spatial distance between the two centers. As shown in Figure 3-61.

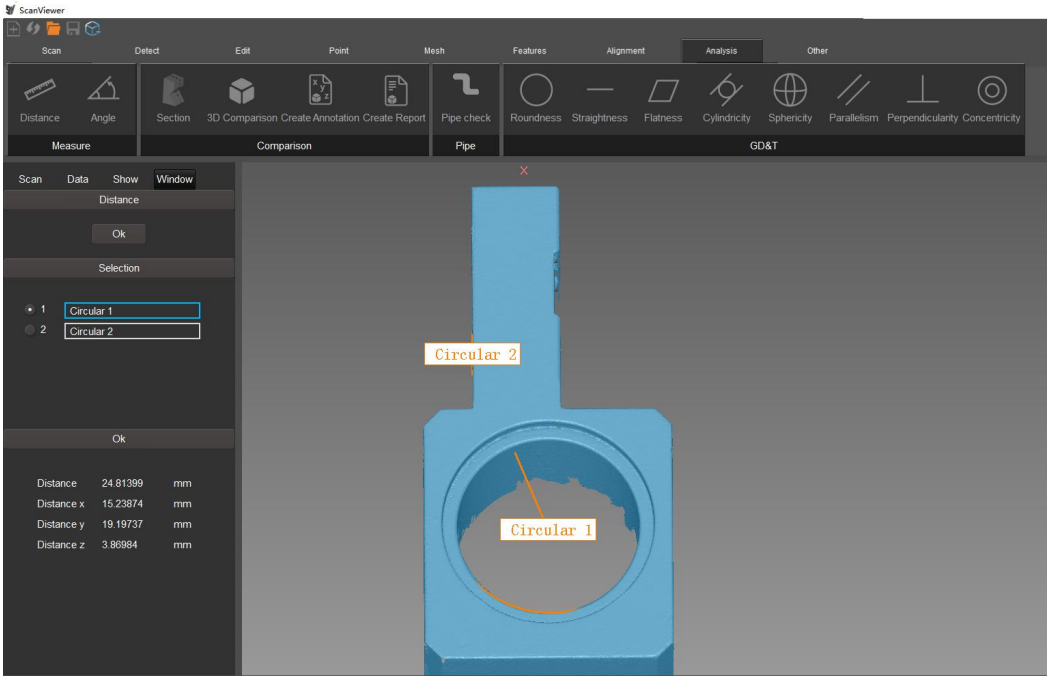



Figure3- 61 Measure distance

### 3.7.2 Angle

When measuring the angle between the feature (plane and plane), the cylinder and the cone degenerate into the axis, and the circle, the circular groove, the elliptical groove, and the rectangular groove take the corresponding plane.

After selecting the data to be measured and constructing the required features (see 3.5.1 Feature Construction for specific feature construction), you can measure the angle between the features. The following is an example of measuring the angle of a feature from a straight line to a plane:

Click on "Angle" and select "Plane 1" and "Line 1" respectively to measure the angle between the plane and the line. As shown in Figure 3-62.

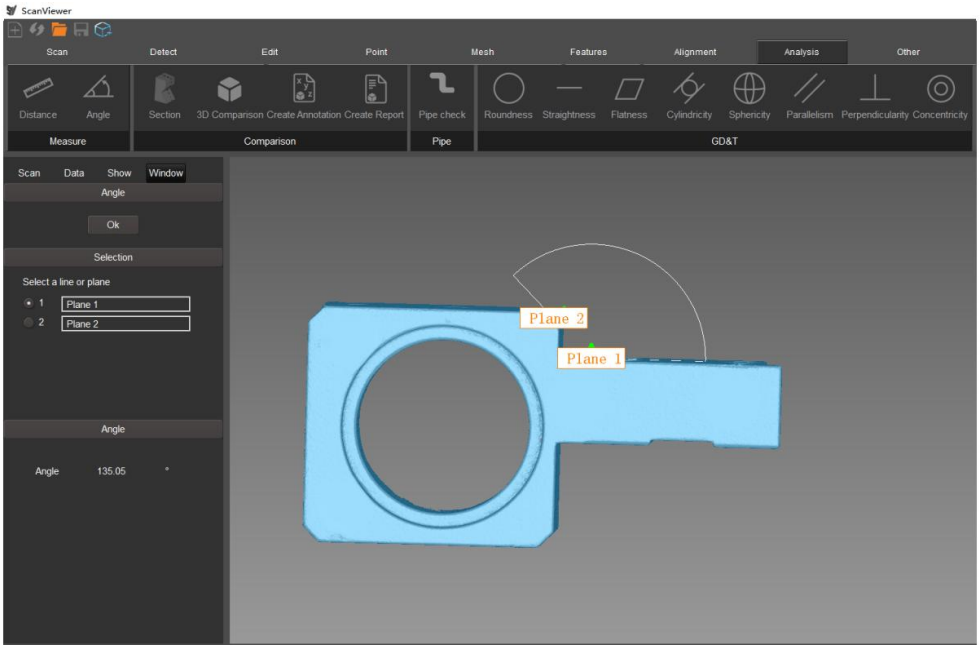



Figure3- 62 Angle distance

### 3.7.3 Section

When creating the cross-section of point cloud, mesh, and CAD data, the plane intercepts the CAD data and the mesh data to obtain the section line, and the plane intercepts the scanned data to obtain the point cloud. The cross-section data, like other scan data, allows for feature fitting, feature measurement, and GD&T detection.

■ Section mode: object and selection plane. Object: Interactive line as the intercept plane; select plane: Select the constructed plane as the intercept plane.

■Thickness: It is effective only when the point cloud is intercepted in the plane, that is, the point within the thickness range is considered to be on the plane and finally output.

■Position degree: refers to the up and down translation of the intercept plane along the normal direction, the positive number is along the normal direction, and the negative number is along the normal direction.

Open the grid file, select the required data, click on "Section", sketch the section in the 3D view, and then click "Calculate - OK" to view the section data. As shown in Figure 3-63.

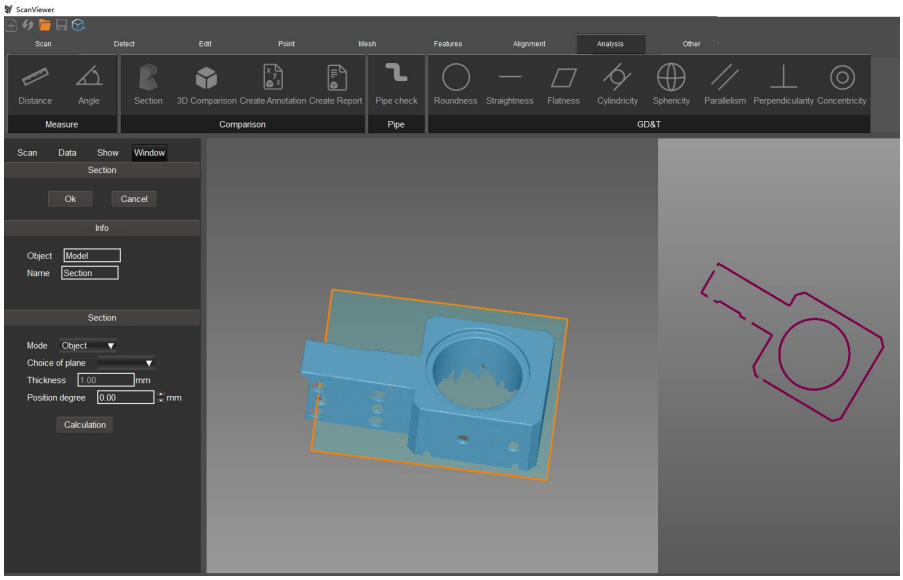



Figure3- 63 Section data

### 3.7.4 3D Comparison

The 3D comparison represents a deviation map between the Test data and the Reference data by generating a different color, and the deviation map is defined as a chromatogram (color difference diagram). The deviation is positive or negative, and the color values in the chromatogram evolve from blue to green to red. Blue indicates that the measured surface is lower than the Reference surface. If the measurement data is displayed in red, it means that the data is above the Reference surface. The calculation of the deviation uses the nearest point principle.

As shown in Figure 3-64, the chromatographic deviation mainly includes the color segment, the maximum deviation value, the minimum deviation value, the maximum nominal value, the minimum nominal value, and the number of decimal places.

Maximum critical value: the maximum deviation allowed, the deviation is the

deviation

Minimum critical value: as opposed to the maximum deviation, generally taking the opposite of the maximum deviation.

Maximum nominal value: The maximum ideal deviation.

Minimum nominal value: as opposed to the maximum nominal value, generally taking the opposite of the largest nominal value.

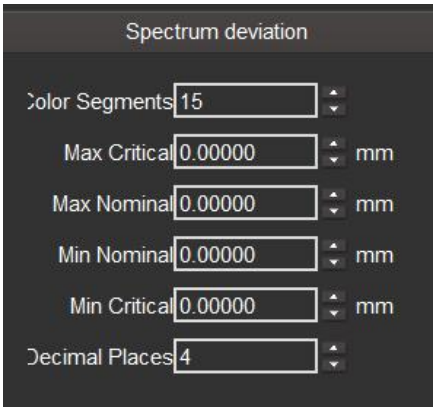



Figure3- 64 Spectrum deviation

After the data alignment is completed, if you need to analyze the data, you can click “Analyze—3D Comparison”, enter “Maximum Critial Value” and “Maximum Nominal Value”, click “Apply” - “OK”, and the 3D comparison ends. As shown in Figure 3-65.

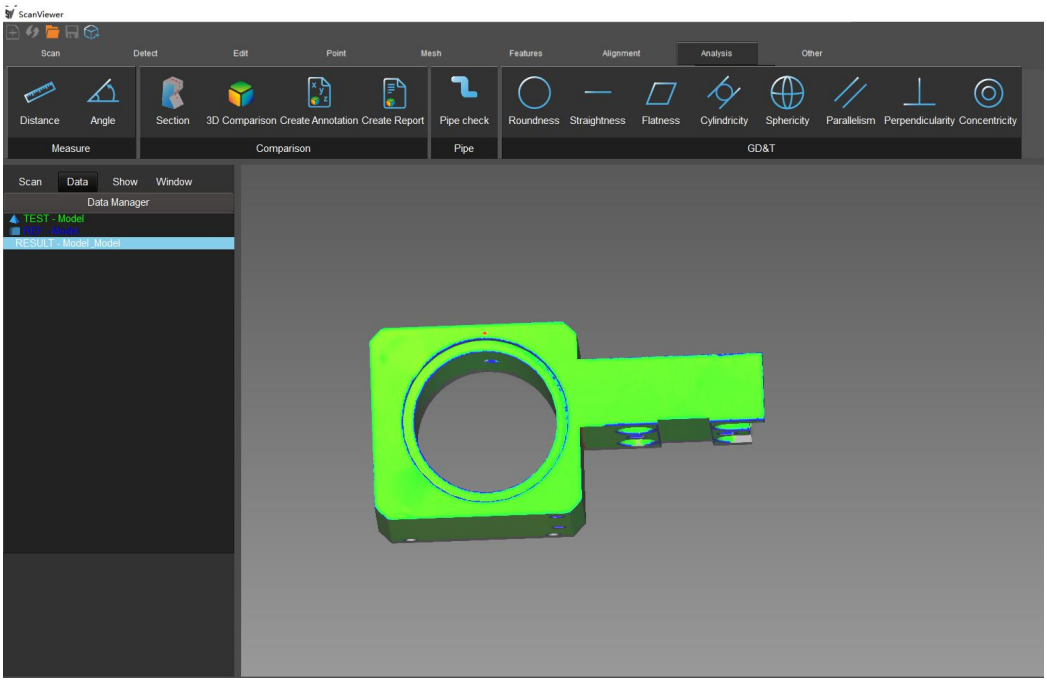



Figure3- 65 3D Comparison

## 3.7.5 Create annotation

After the 3D comparison is completed, click “Create Comment” to view some “Deviation Notes” and click “OK” to see “New View 1” in the left frame. As shown in Figure 3-66.

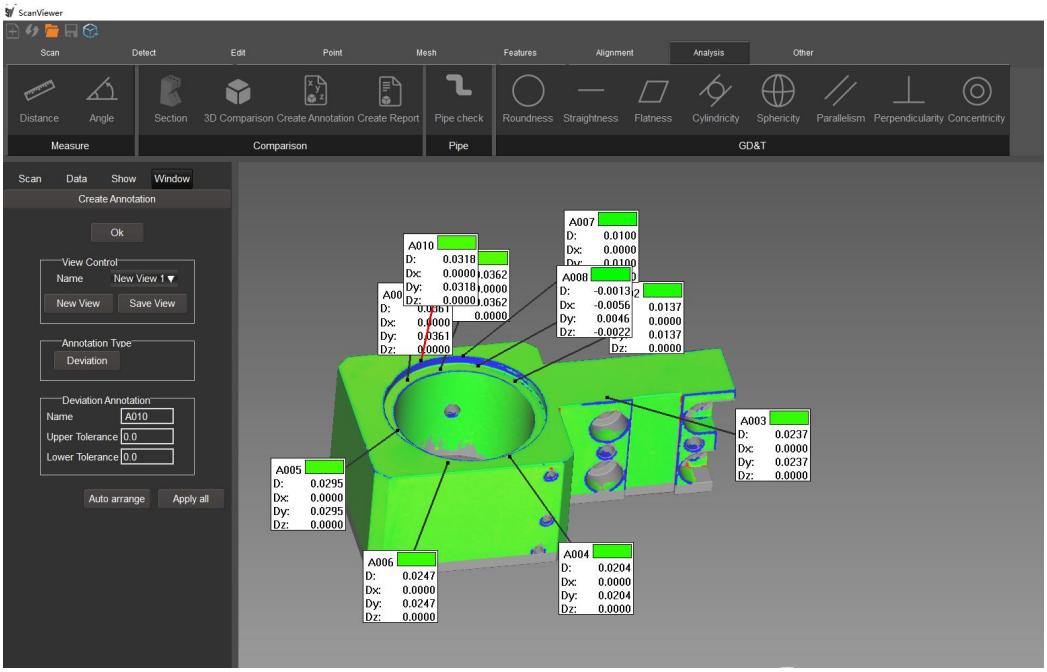



Figure3- 66 Create annotation

### 3.7.6 Create report

After creating the annotation, click “Create Report”, fill in the relevant report information in the pop-up dialog box, click “Save” to save it in .pdf format file. As shown in Figure 3-67.

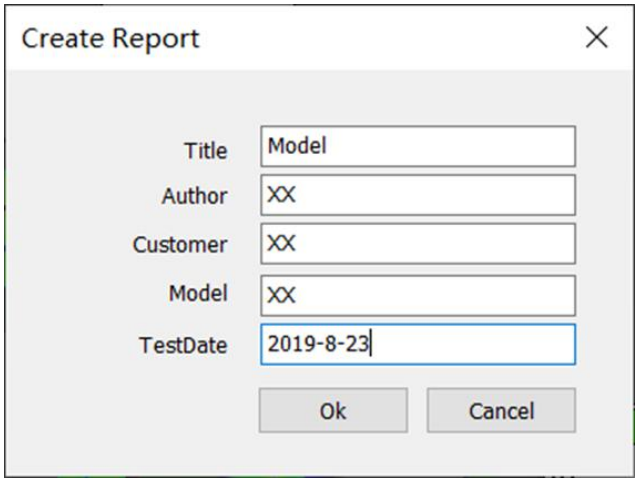



Figure3- 67 Create report

### 3.7.7 GD&T

GD&T, the geometric tolerance, including shape tolerance and position tolerance.

Shape Tolerance: The amount of variation allowed for the shape of a single actual element, such as roundness, straightness, flatness, cylindricity, sphericity, and so on.

Position Tolerance: Correlate the deviation of the actual measured element from the ideal measured element with a certain direction. The position tolerance zone is an area that is allowed to change in association with the actual measured element, and has parallelism, perpendicularity, coaxiality, and the like.

The detection of GD&T is based on the fitting characteristics. Shape tolerances are only relevant to the fitted features and the fitted point cloud data. Positional tolerances require the setting of datum features, which can be constructed in any configuration.

### 3.7.7.1 Shape Tolerance

Shape tolerances include roundness, straightness, flatness, cylindricity, and sphericity. The following is an example of the shape tolerance of roundness:

■Taking the section data as an example (section section 3.7.3 section), first fit a “circle” feature, and click “Create” - “OK”. As shown in Figure 3-68

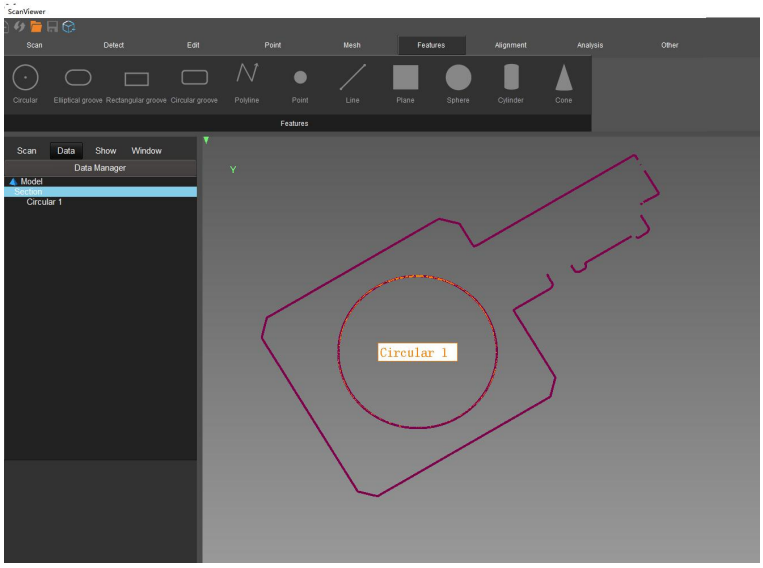



Figure3- 68 Create circle feature

■ Click “roundness”, click “Circle 1” – “Apply” at the object to display the roundness deviation, click “OK”, and “roundness” analysis is completed. As shown in Figure 3-69.

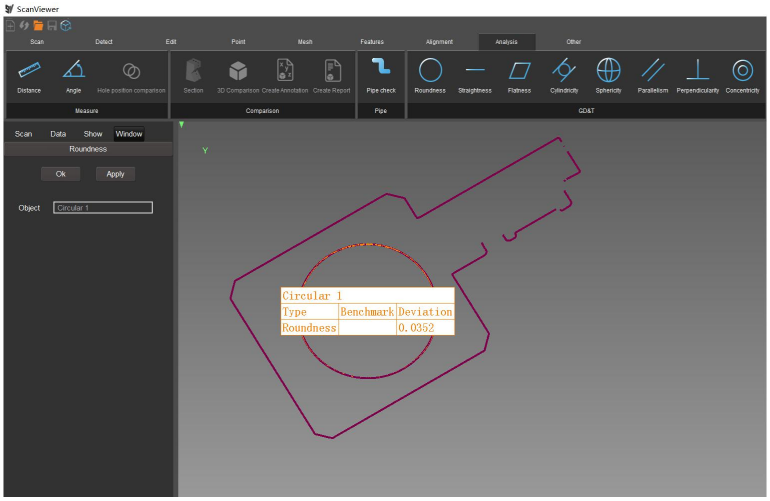



Figure3- 69 Roundness test result

### 3.7.7.2 Position Tolerance

Position tolerances include parallelism, perpendicularity, concentricity, and the like. The following is an example of the parallelism tolerance of two planes:

■ First fit two "plane" features (refer to 3.5.1 feature construction, if the fit plane already exists, this step can be skipped), click "OK". As shown in Figure 3-70

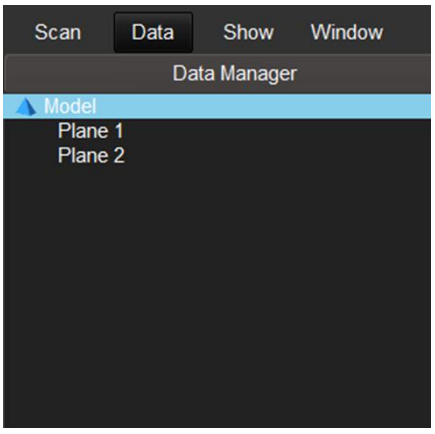



Figure3- 70 Create plane features

■ Click “flatness”, select the object “plane” and the reference “plane”, click “Apply” to display the parallelism tolerance. As shown in Figure 3-71.

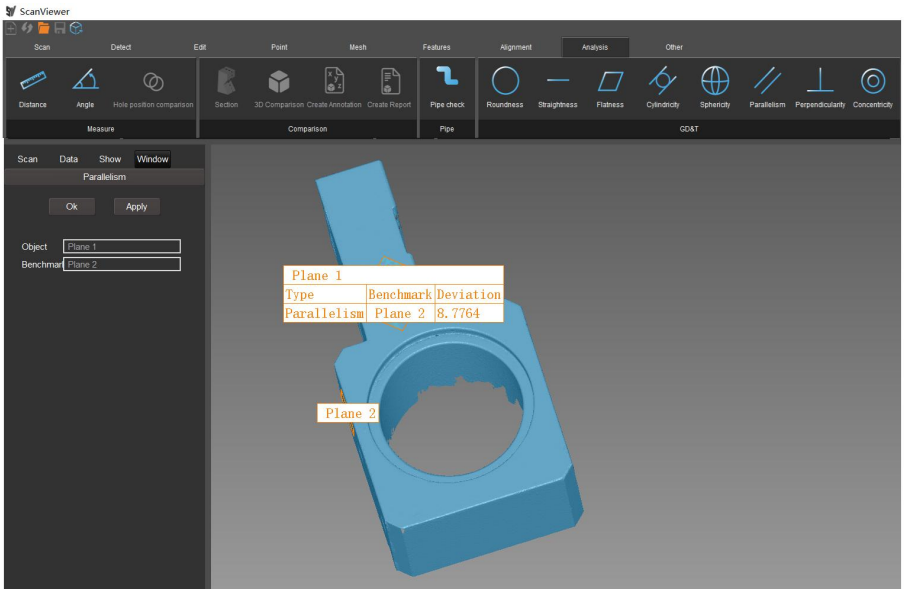



Figure3- 71 Flatness test result

# 4 Pipe inspection (optional)

The pipe fittings provided by the software are mainly used for the pipe bending machine. After the surface point cloud data is obtained by the scanner, the corresponding pipe bending parameters are input, and the relevant pipe bending parameters can be automatically calculated, which can be used for reverse engineering and detection comparison.

Intersection coordinate xyz data: including the intersection of two end points and two adjacent straight pipe segments;

Cut point coordinate xyz data: replace the intersection point in the intersection coordinate xyz data with the corresponding two tangent points;

Ybc data: also known as LRA data, the feed length of the bender, the angle of rotation (with positive and negative points), the bending angle, and the control system of the bender with Y-axis, B-axis, C-axis and X-axis as the control object

To achieve digital control;

Polyline: The center line of the intersection point of the intersection coordinate XYZ is the intersection polyline (referred to as the polyline). Unless otherwise specified, the XYZ mentioned in the pipe inspection is the intersection coordinates.

The following mainly introduces the definition and use of individual modules of "construction" and "fitting".

## 4.1 Parameter construction

The parameter construction method is mainly divided into the xyz construction method (where the xyz structure refers to the intersection coordinate xyz) and the ybc construction method.

### ■ xyz construction method

Select “Enter xyz data”, you can enter the new model name and the corresponding parameters of the pipe XYZ, such as pipe radius, bending radius, straight pipe number, click “input data”, in the pop-up window, double-click the active edit box to manually input the pipe fittings. Point data (use the Tab key to switch the input), you can also select "Read Data" to enter the data of each point, click "Finish" to construct the pipe model. As shown in Figure 4-1and Figure 4-2

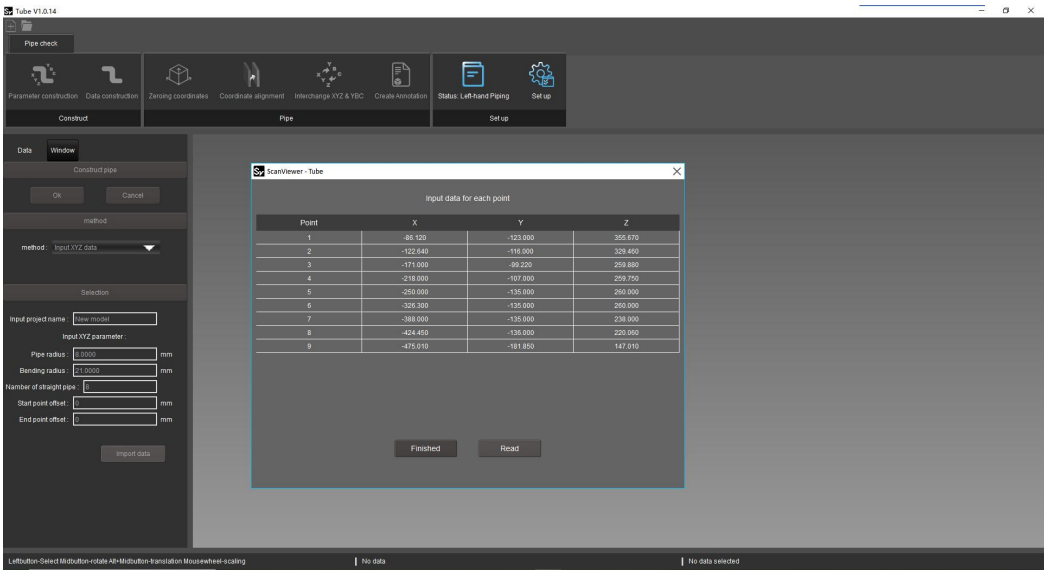



Figure4- 1 xyz construction method

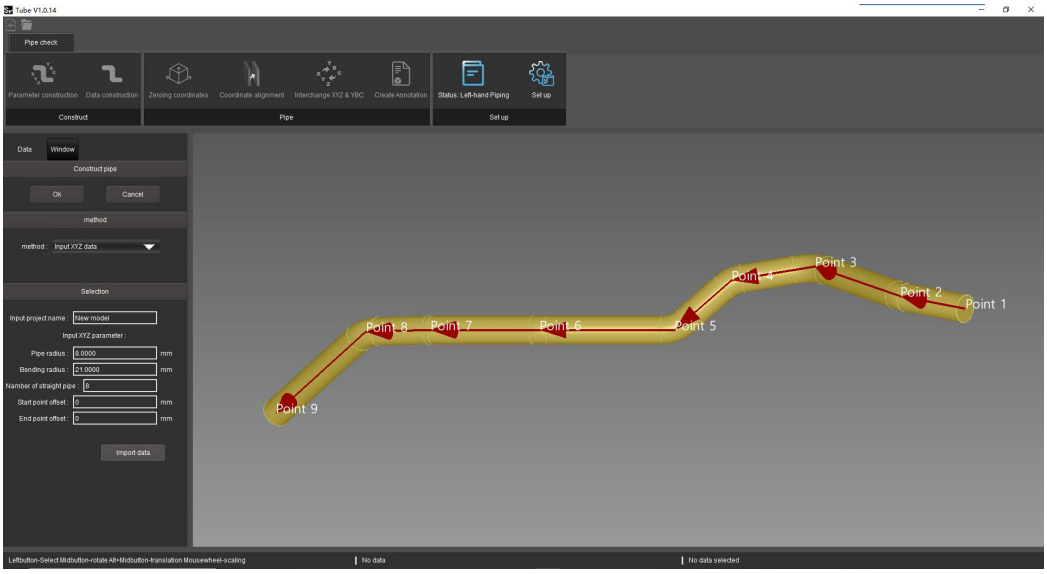



Figure4- 2 xyz construction method

## ■ ybc construction method

Click “cancel” to return to the main interface then select "Enter ybc data", the rest of the operations such as "xyz construction method", refer to (1) xyz construction method.

## 4.2 Data construction (reverse engineering)

Data construction (reverse) is the construction of the pipe model by data reverse. Data constructs operate differently depending on the file format. Mainly divided into laser point cloud data, engineering data, grid data and model data.

■Laser point cloud data

Select the laser point cloud data, enter the “construction pipe fittings” function area, select a point on the point cloud as the starting point of the construction pipe fittings (preferably select the edge point of the first end of the pipe fitting), and input the parameters corresponding to the pipe fittings, such as the pipe radius and bending radius. The number of straight pipe segments, the maximum common vertical line error is generally default, click "construction" to complete the laser point cloud data structure. As shown in Figure 4-3.

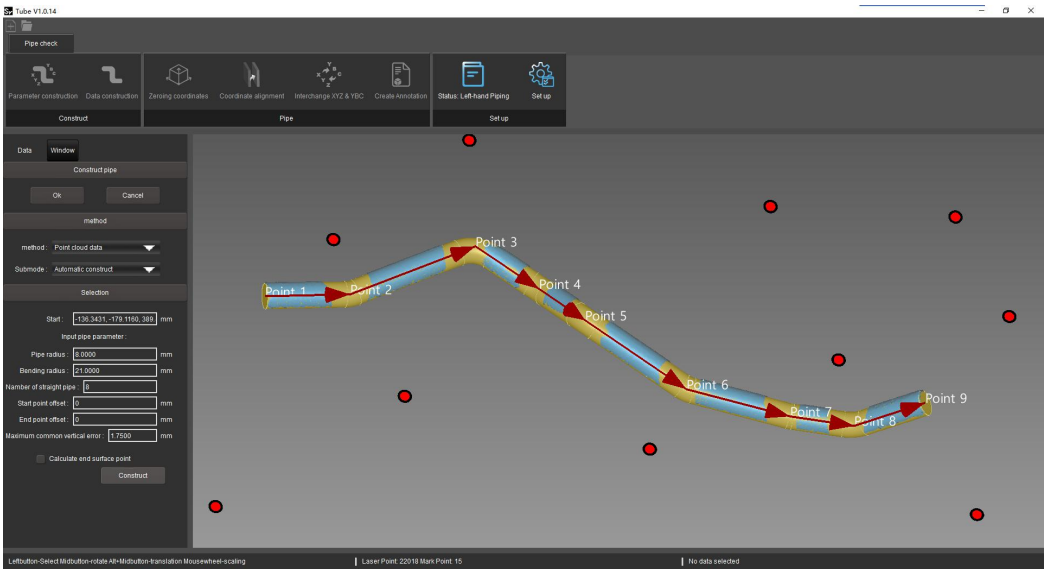



Figure4- 3 "laser point data" construction

When the sub-mode is selected for automatic construction, click “Construction” to perform the best fitting construction of the pipe fittings;

When the sub-mode is manually configured, the user needs to manually group the point cloud according to the pipe radius, the bending radius and the number of straight pipe segments, select the laser point cloud data, click "mark point cloud" - "next", select the next group in turn, when grouping When the number of point clouds reaches the number of straight pipes, click “Construction” to construct the pipe fittings best. The fitting process can check whether the end points are calculated.

| | |
|---|---|
| Attention | Calculating the end point requires that there must be data on the data end face, otherwise the fit fails. |

After the data is constructed out of the pipe fitting model, click “ OK” and then click “Create Comment” to generate the pipe fitting parameter report. As shown in Figure 4-4.

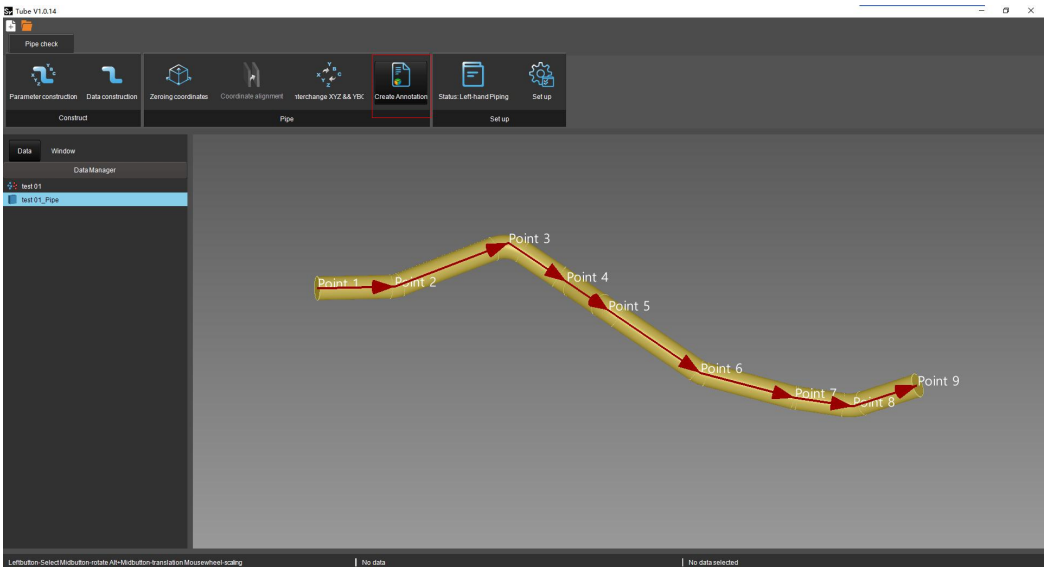



Figure4-4 Create a single model annotation

Under the “Create Report” function bar, you can check the contents of the pipe fitting report (such as pipe fitting information, bending intersection, bending point and Bend elements), you can enter the model name, date of creation, create author, notes and other display information, click "Create Report" to generate a pipe report. As shown in Figure 4-5.

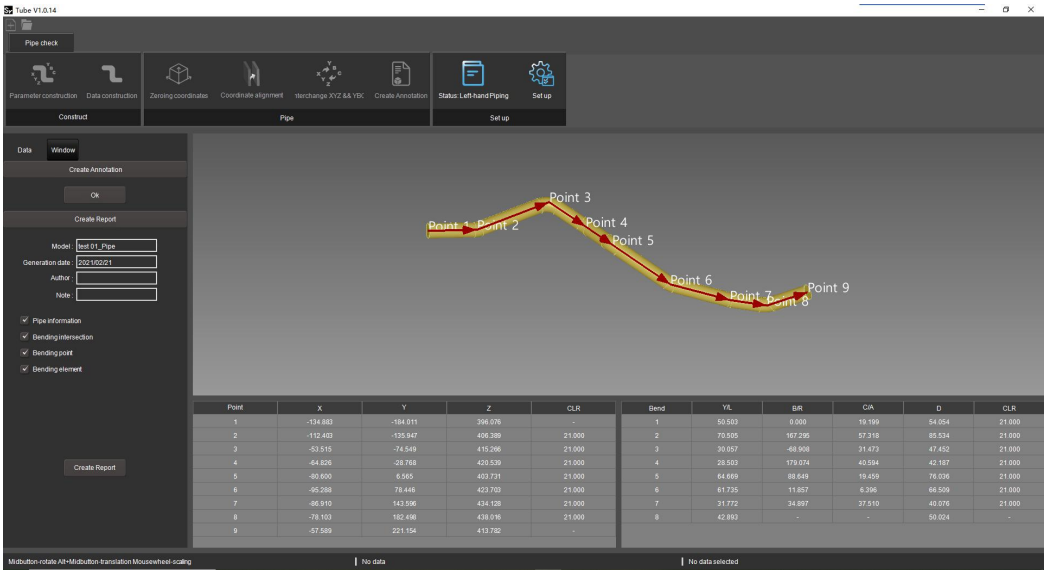



Figure4- 5 Create a single model annotation

## ■Engineering data and mesh data

Select mesh data, engineering data, enter the "construction pipe fittings" function, construct the flow such as laser point cloud data, refer to (1) laser point cloud data.

## ■Model data

Select the model data, enter the "construction pipe fittings" function, click "recognition" to automatically identify the pipe fitting parameters on the model data. As shown in Figure 4-6.

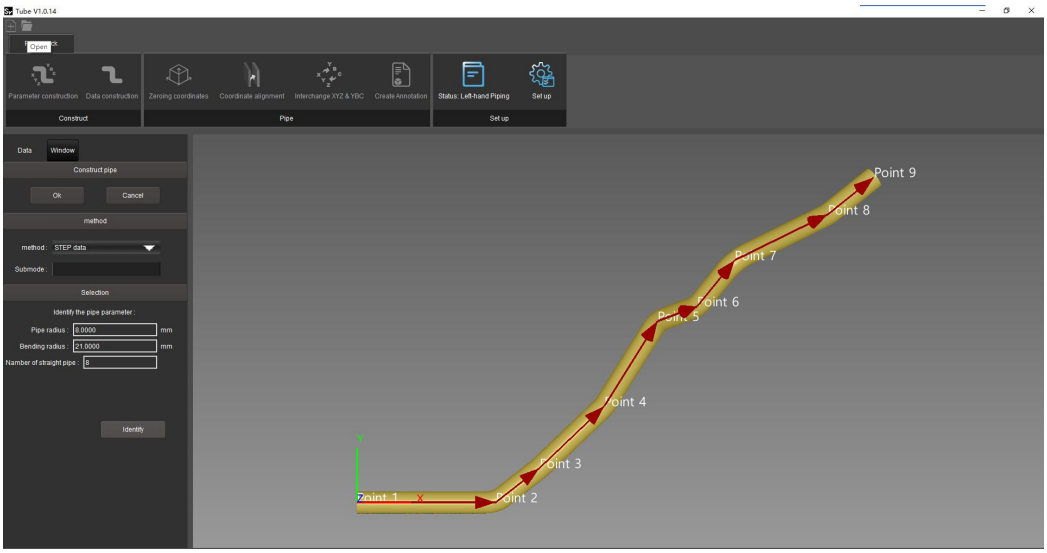



Figure4- 6 Model data "data construction"

## 4.3 Zeroing coordinates

Convert the bend data to the bender coordinate system, which is determined by the first two straight sections.

Select the pipe model data, enter the “Zeroing Coordinates” function, click “Apply—OK” to save and overwrite the alignment data, and click “Cancel” to restore the alignment operation. The comparison before and after zeroing coordinates is shown in Figure 4-7.

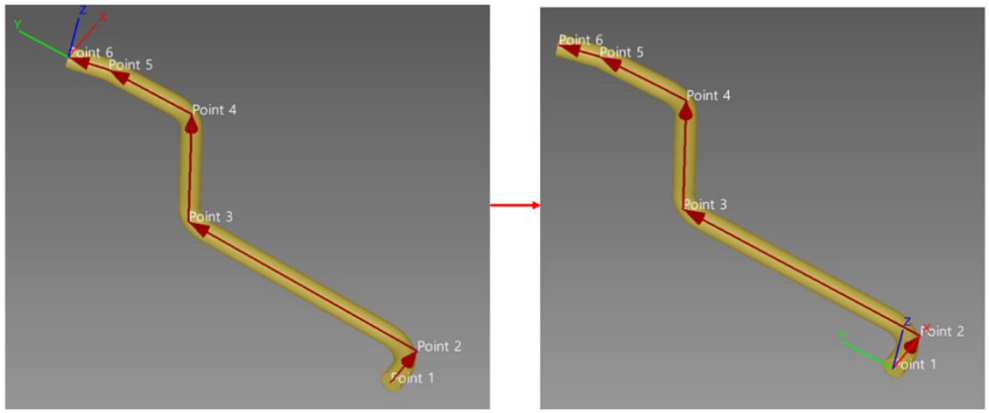



Figure4- 7 Zeroing coordinates interface

## 4.4 Coordinate alignment

The elbow data to be detected is unified into the coordinate system of the reference elbow data (general model data), and the two sets of data must be constructed with polylines, and set to "Test" and "Reference" respectively. As shown in Figure 4-8 and 4-9.

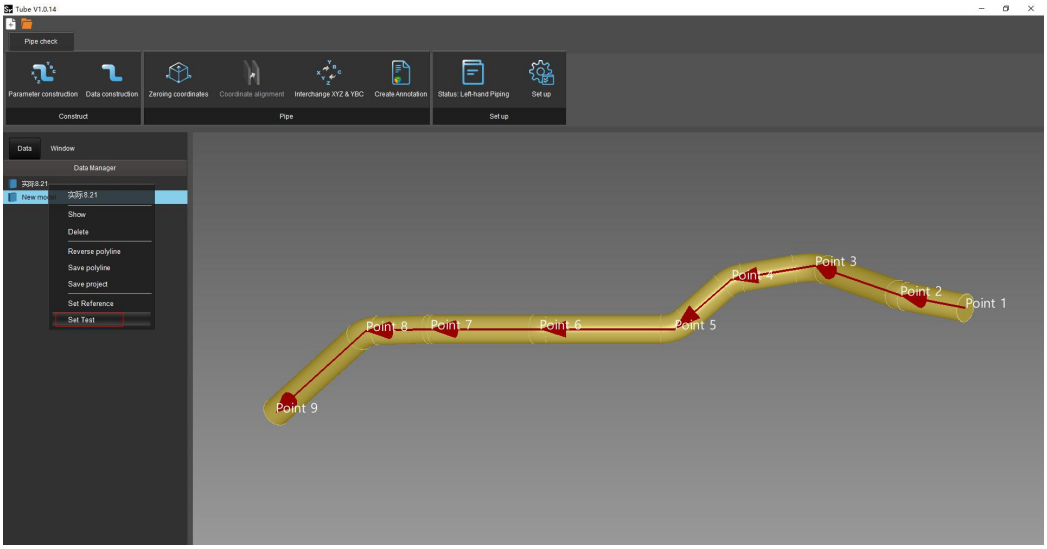



Figure4-8 Set to test

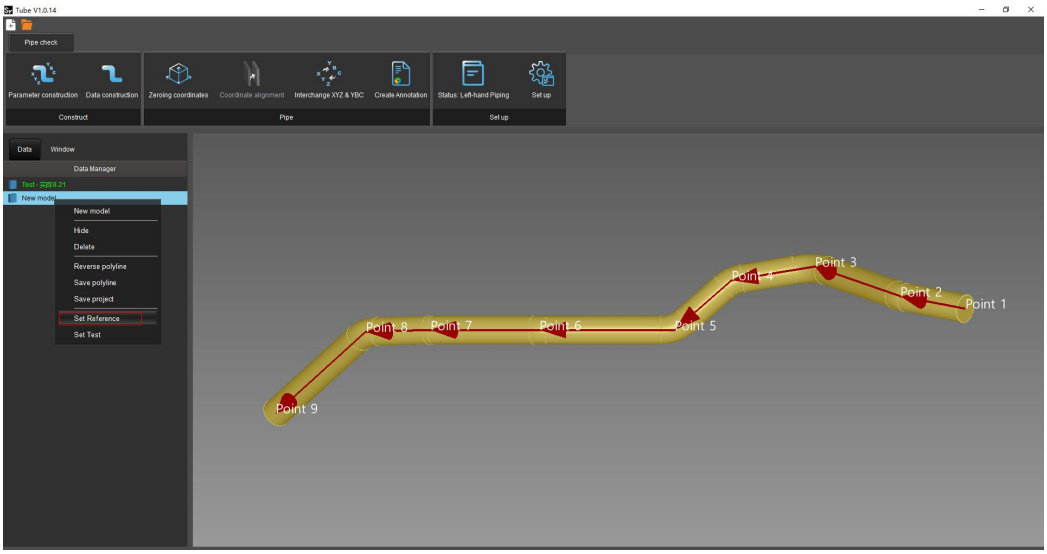



Figure4-9 Set to reference

And then click "coordinate alignment", (check "Endpoint Participation Alignment" according to the actual situation) Click "Apply" to complete "Coordinate Alignment". As shown in Figure 4-10 and 4-11.

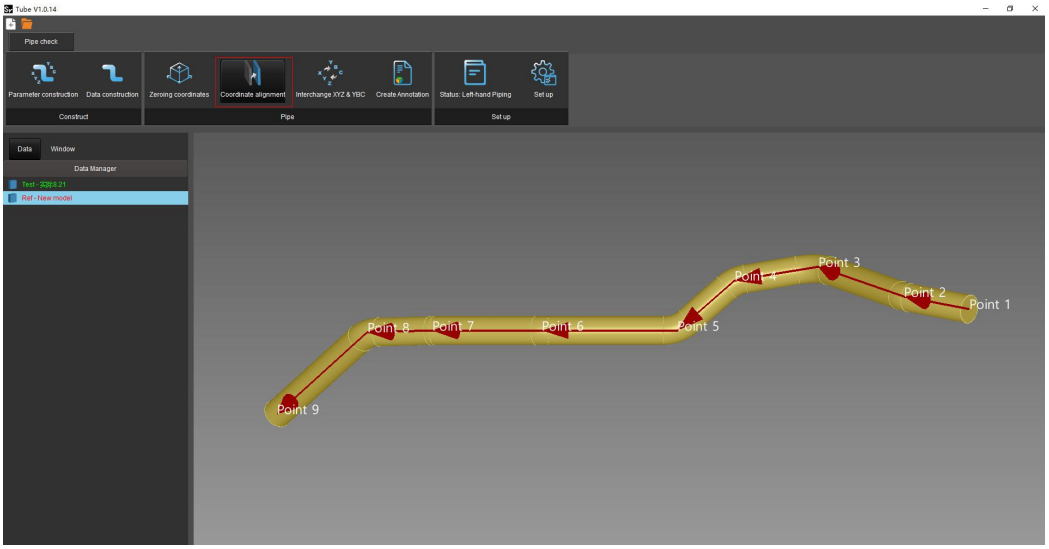



Figure4-10 The interface of “coordinate alignment”

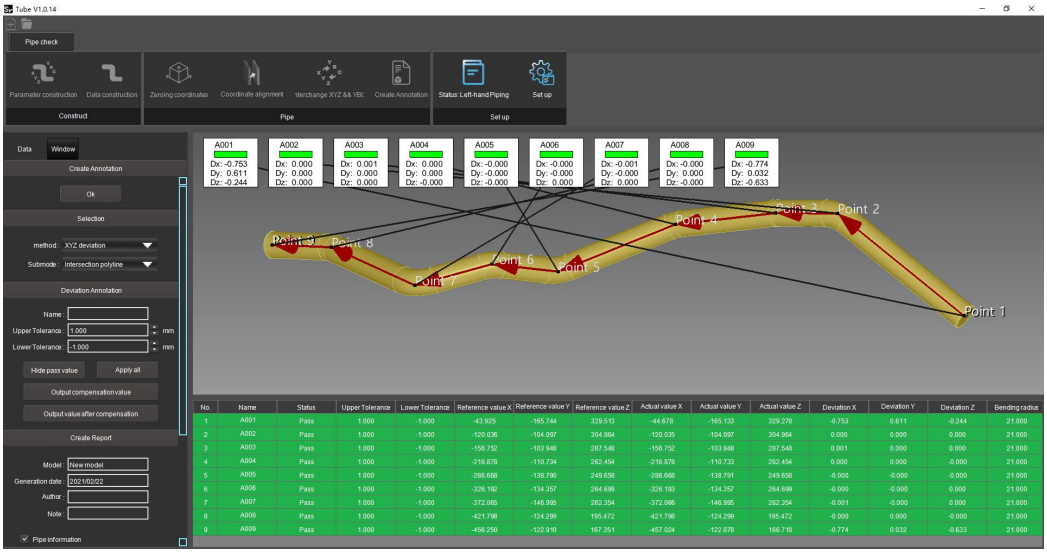



Figure4-11 The interface of “create annotation”

## 4.5 Interchange XYZ/YBC

The “Object” column displays the pipe model data in all current data. The “Pipe length” column displays the length of the pipe fitting of the currently selected pipe model; the mode is divided into “XYZ to YBC” and “YBC to XYZ”, so that the pipe data is in XYZ data. Switch the display between the value and the YBC data value, and finally click "Save to File" to save the converted data to the TXT file. As shown in Figure 4-12.

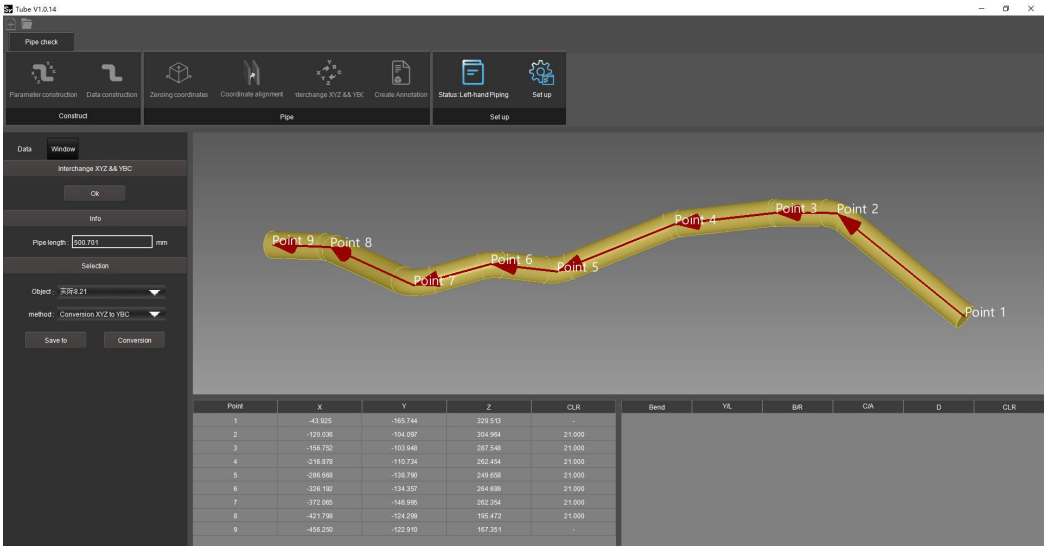
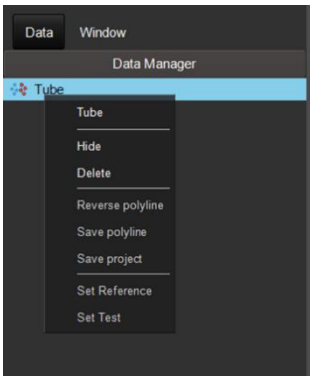



Figure4- 12 Interchange XYZ/YBC

## 4.6 Pipe inspection function panel

See Table 4-1 for the description and description of the tube inspection function panel.

Table4- 1 Pipe inspection function panel

| Pipe inspection function panel | **Description and description** |
|---|---|
|  | "Pipe 1": the name of the current data; |
| | Show/Hide: Click to toggle whether the data is displayed. |
| | Delete: delete the data from the directory tree; |
| | Reverse polyline: if there is a polyline in the data, the reverse polyline direction; |
| | Save polyline: If there is a polyline in the data, save the polyline data, you can choose to save as a .txt file or .iges file; |
| | Save the model: if the data is a constructed pipe model, save the pipe model to the .step file; |
| | Set/Clear Reference: Set the model data as reference data or cancel the reference data identifier; |
| | Set/Clear Test: Set the model data to test data or cancel test data identification. |

## 4.7 Pipe inspection

The pipe fitting detection steps are as follows:

■ Click “pipe fitting detection”, check the data and click “Enter pipe fitting detection module”, jump to the pipe fitting detection software interface, click “Yes” to open the model file of the corresponding pipe fittings. As shown in Figure 4-13.

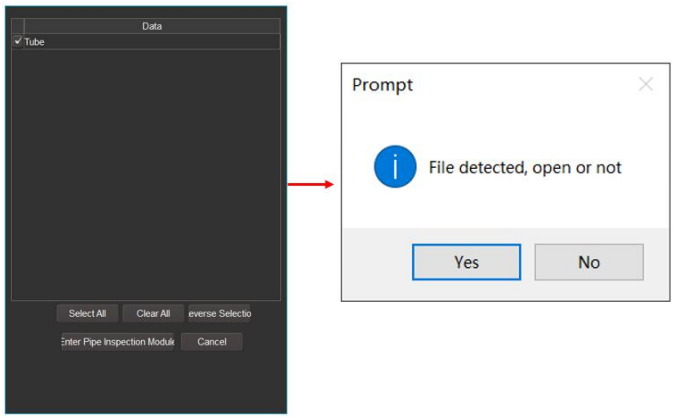



Figure4- 13 Step to enter pipe function

■ Since the “Pipe Inspection” software does not delete the data function, the project file imported by the software needs to delete the bent part of the pipe. As shown in Figure 4-14.

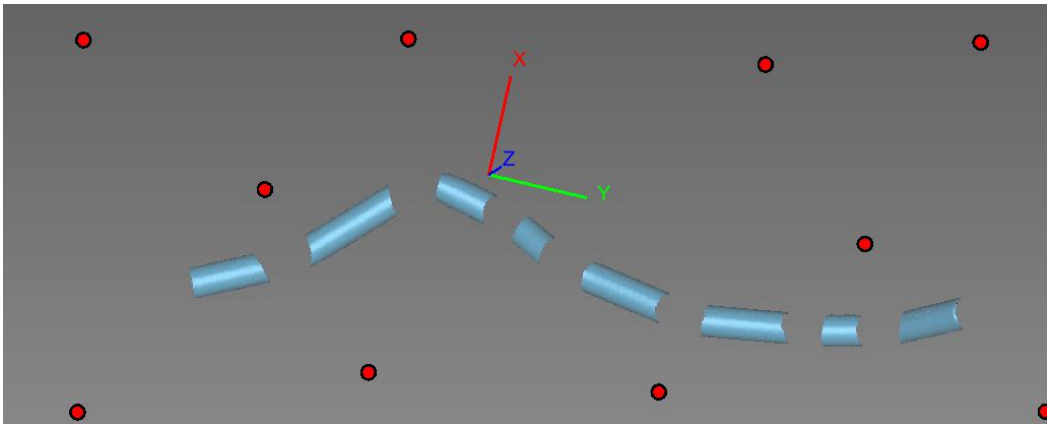



Figure4- 14 Pipe project file

■In the pipe fittings project file, click “Data Structure—Pipe Starting Point” to enter the pipe fitting radius, bending radius, and number of straight pipe segments (the three kinds of data are known values). Click on "Construction - OK", as shown in Figure 4-15. After constructing the data, you can create a comment and save it. For details, see 4.2 Data Construction (Reverse).

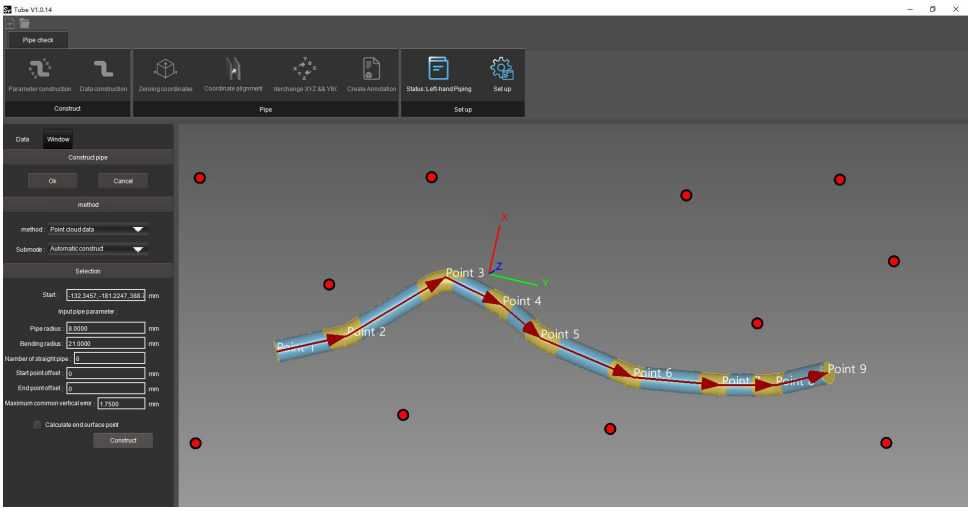



Figure4- 15 Pipe project file construction result

■ Open the model file of the pipe fitting and click “Data Construction—Identification—OK” to complete the data structure of the pipe model file. As shown in Figure 4-16.

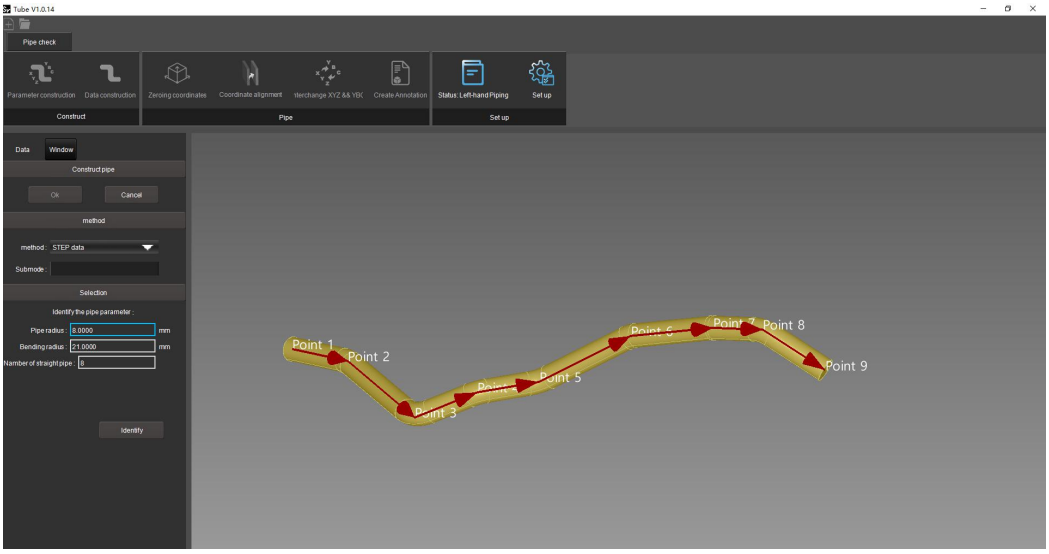



Figure4- 16 Pipe project file construction result

■Construct the pipe fittings of the project file "Set Test", the pipe fittings of the model file "Set Reference", note: the direction of the polyline of the two files must be the same, such as inconsistent mouse click on the pipe fitting model, click "Reverse" The line of ideology, as shown in Figure 4-17.

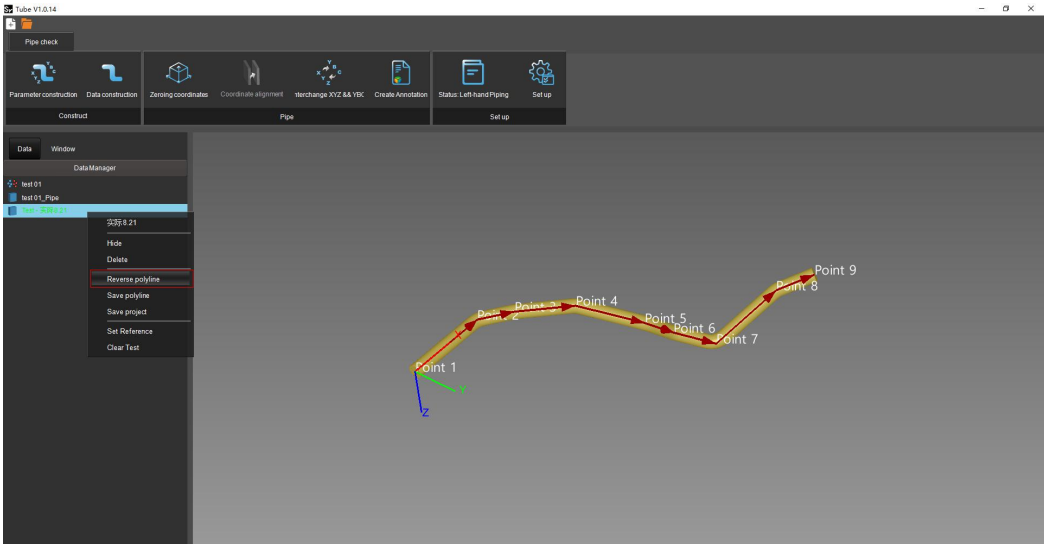



Figure4- 17 Result

(6) Click "Coordinate alignment", click "Apply - OK" to complete the coordinate alignment, click "Create Comment", enter the name, upper tolerance and lower tolerance, click "Apply All", the result is as shown. The green portion indicates that the pipe project file is aligned with the model file within the specified tolerances, and the red portion indicates that the pipe alignment data is out of tolerance. As shown in Figure 4-18.

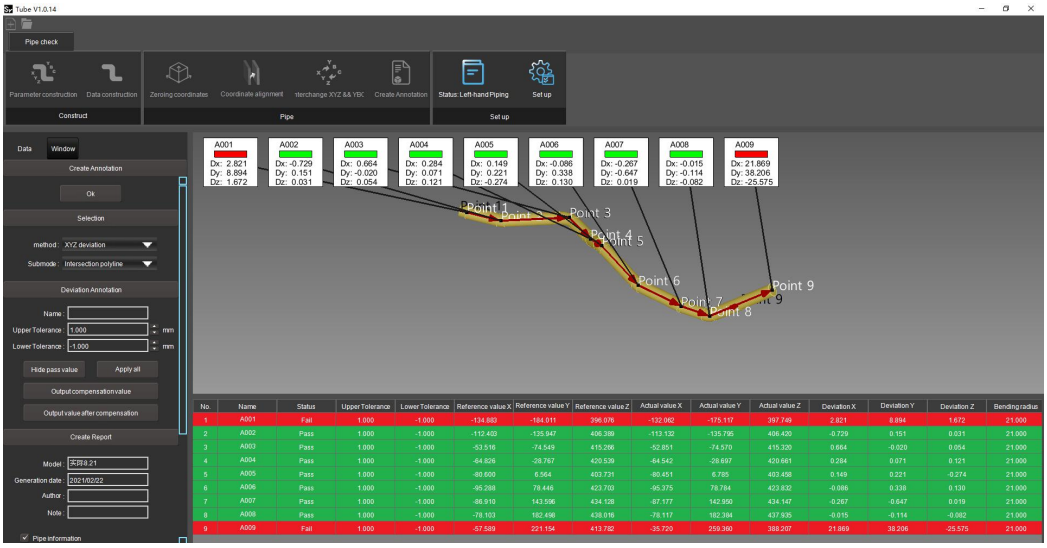



Figure4- 18 Annotation

(7) Finally, click “Create Report” to save the pipe fitting data in .pdf file format.

# 5 Detect (optional)

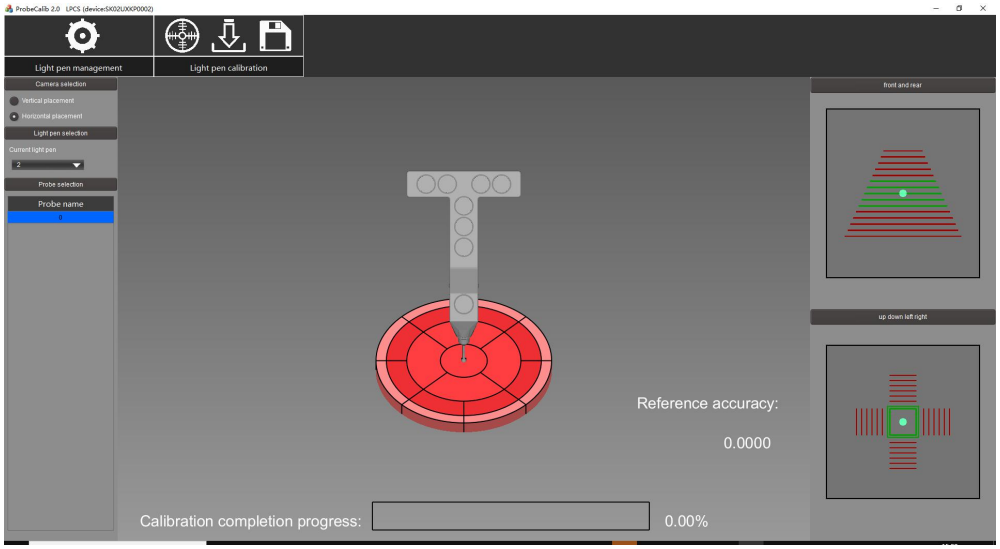
The stylus is an accessory on the scanner that can be used in scanning and measuring scenes. The stylus can measure the feature elements on the workpiece, then align the measurements and continue scanning. It is also possible to directly measure the characteristic elements of the workpiece to give measurement results without the need for full model scanning. Especially convenient for large castings and automotive applications.

| | |
|---|---|
| —The ruby probe | This is mainly used to touch the surface of the workpiece, so that the mechanical device of the probe is displaced, generating a signal trigger and collecting a measurement data. |

“Detect” mainly includes four application parts: light pen number, probe number, light pen and features. The management of the light pen number and probe number is mainly reflected in the calibration software. The following mainly introduces the light pen (calibration) and feature application.

## 5.1 Calibration

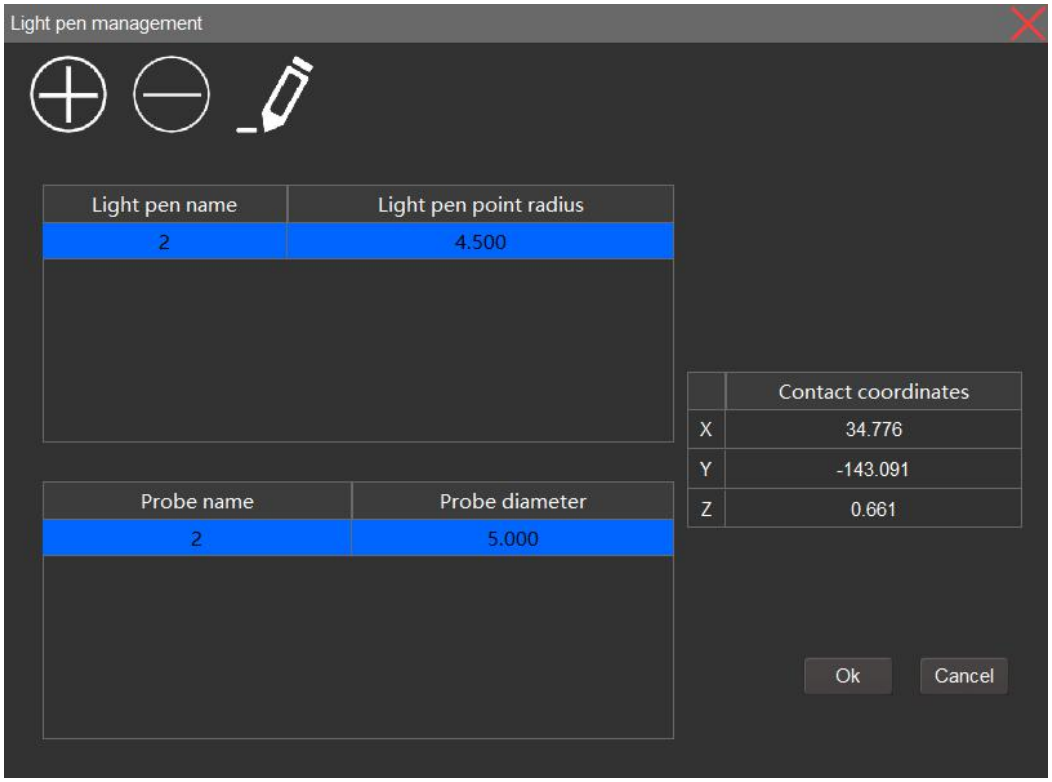
The calibration of the light pen is a necessary step for the light pen to be spotted. The correct position of the light pen probe can be obtained by calibration to obtain accurate feature information when detecting the feature. The calibration interface is shown in Figure 5-1.




Firgure5- 1 Calibration interface

### 5.1.1 Light pen management

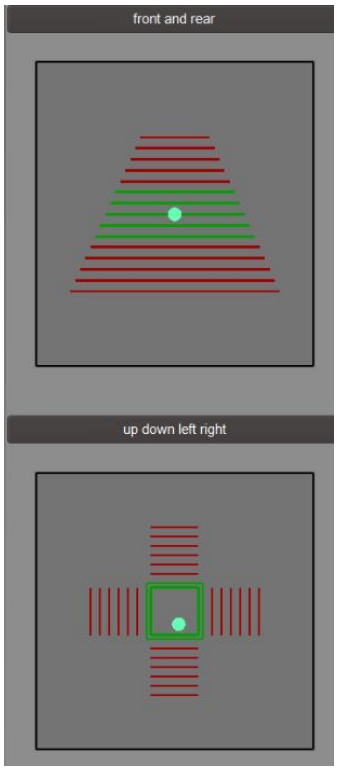
In the light pen management, the existing light pen name and the light pen mark point radius can be obtained, and the probe can be added and deleted at the same time; the calibration contact coordinates are also reflected in the light pen management. The interface is shown in Figure 5-2.




Firgure5- 2 Light pen management

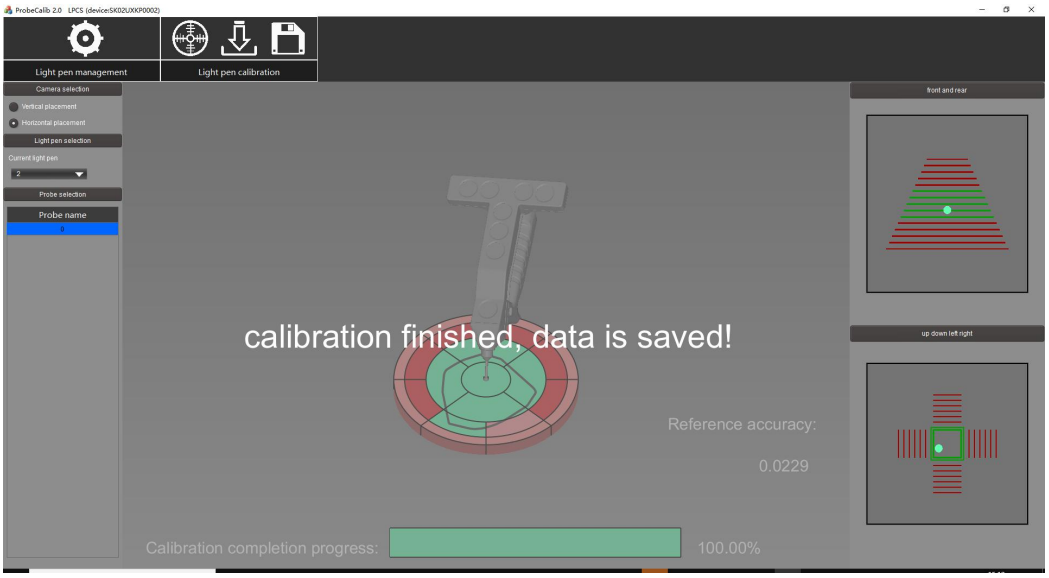
### 5.1.2 Start calibration

Click “Start Calibration”  , then turn on the scanner to get the position of the light pen; move the light pen or the calibration block position to enter the green area (Figure 5-3).




Firgure5- 3 Calibration starting position

■ After moving the light pen or calibration block to the green area, click “Receive Data”  or short press the round button to calibrate. The calibration block and the device should be kept relatively stationary. During the calibration process, the light pen is rotated in the circumferential direction (to ensure that the light pen mark is within the field of view of the scanner), and the upper right disk will gradually turn green (Figure 5-4).




Firgure5- 4 Calibration completed

| | |
|---|---|
| Attention | When the following occurs: 1.The relative position between the calibration block and the device changes;<br>2.The ruby probe on the light pen is not tightened;<br>3.The ruby probe is not completely embedded in the calibration block during the calibration;<br>4.The accuracy of the device is too low or uncalibrated for a long time may cause the stylus calibration to fail. |

■ Click “finish Calibration” and the calibration result will be automatically saved in the file.

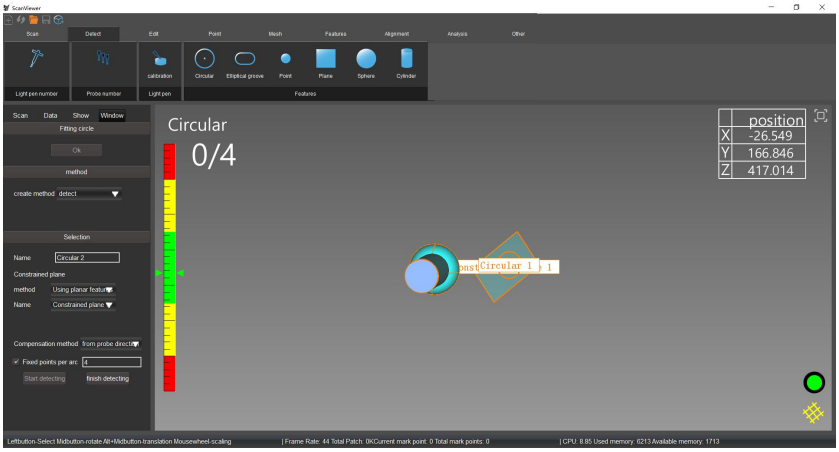
| | |
|---|---|
| Attention | After using the calibration software, you need to close the calibration software to continue using the Scanviewer scanning software. |

## 5.2 Features

Using a light pen in combination with the scanner, the surface of the object to be measured is detected and acquired, and the feature element is obtained by fitting. It can detect six kinds of features such as circle, elliptical groove, point, plane, sphere and cylinder. The following mainly introduces the feature detection of circles and spheres.

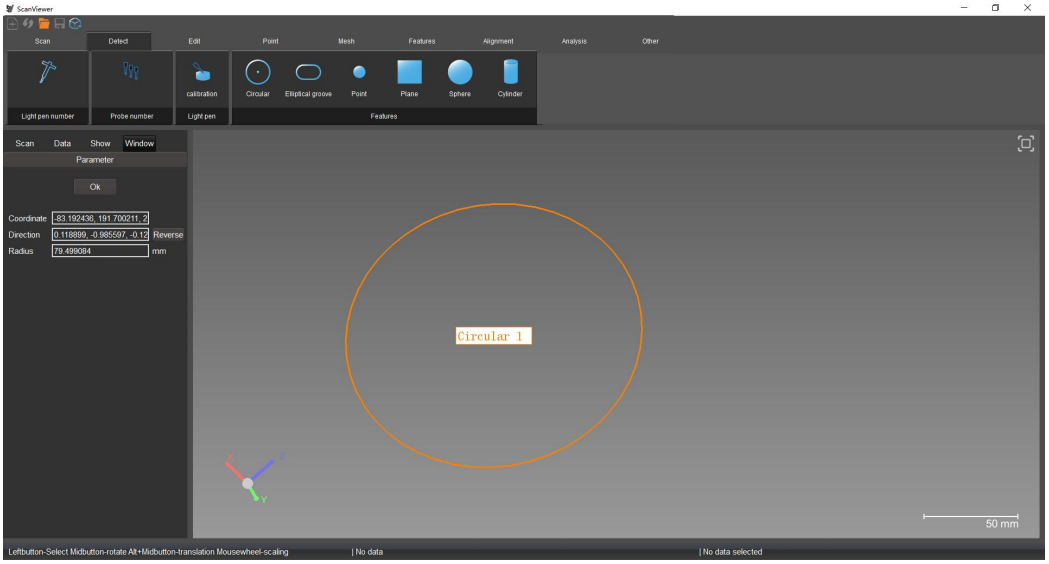
### 5.2.1 "Circle" feature detection

Click the “circle” button to enter the detection interface. When the detection is not performed, click “OK” to exit the detection mode. The constraint plane mode includes “detecting the local plane” and “using the plane feature”. The compensation method includes “testing”. Head direction, internal hole and external. The detection constraint plane and the compensation method have a fixed number of points of at least 3 points, and the fixed number of points can be checked. Click “Start Probing” to enter the detection interface, then start the scanner. When the light pen is in the field of view of the scanner, press the round button of the light pen to get a detection point. When the minimum required value of the detection point is reached, click “End Detection”. Or press and hold the square button of the light pen to end the detection. The resulting feature circle is finally fitted (Figure 5-5).



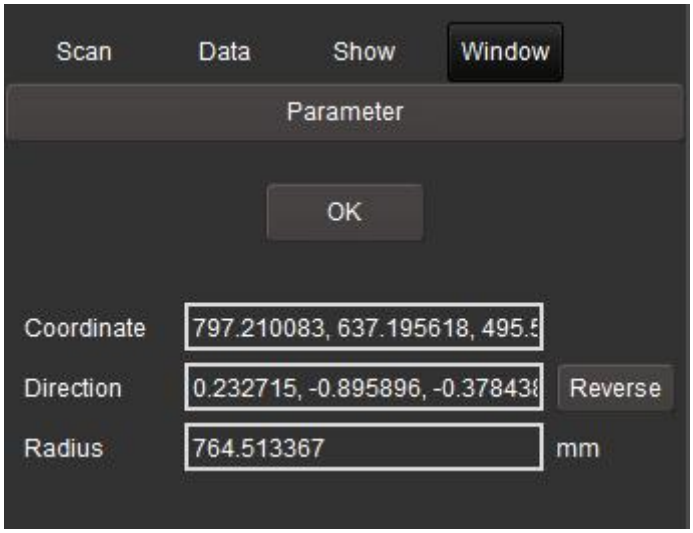

Firgure5- 5 "Circle" feature detection

After the probe is finished, you can get the circle feature in the left tree. Right-click the feature to view the feature properties. You can view the probe feature "circle" attribute.As shown in Figure 5-6.




Firgure5- 6 "Circle" feature detection

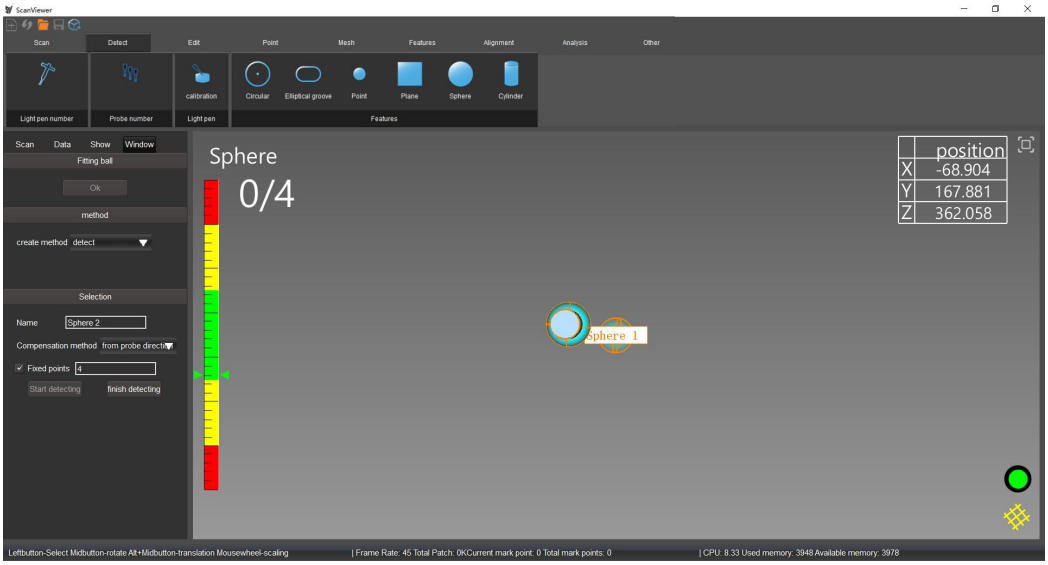
Finally, the "circle" attribute of the probe feature can be viewed, as shown in Figure 5-7.




Firgure5- 7 "Circle" feature detection

### 5.2.2 "Sphere" feature detection

Click the “Sphere” button to enter the detection interface. Before the detection, click “OK” to exit the detection mode. The compensation mode includes “from the side head direction”, “internal (groove)” and “external”. The fixed number of points is at least 4 points, and the fixed number of points can be checked. Click “Start Detection” to enter the detection interface, then turn on the scanner. When the light pen is in the field of view of the scanner, press the round button of the light pen to get a detection point. When the minimum required value of the detection point is reached, click “Detection completed”. Or press the stylus square button to finish the probe. The resulting feature sphere is finally fitted (Figures 5-8).




Firgure5- 8 "Sphere" feature detection

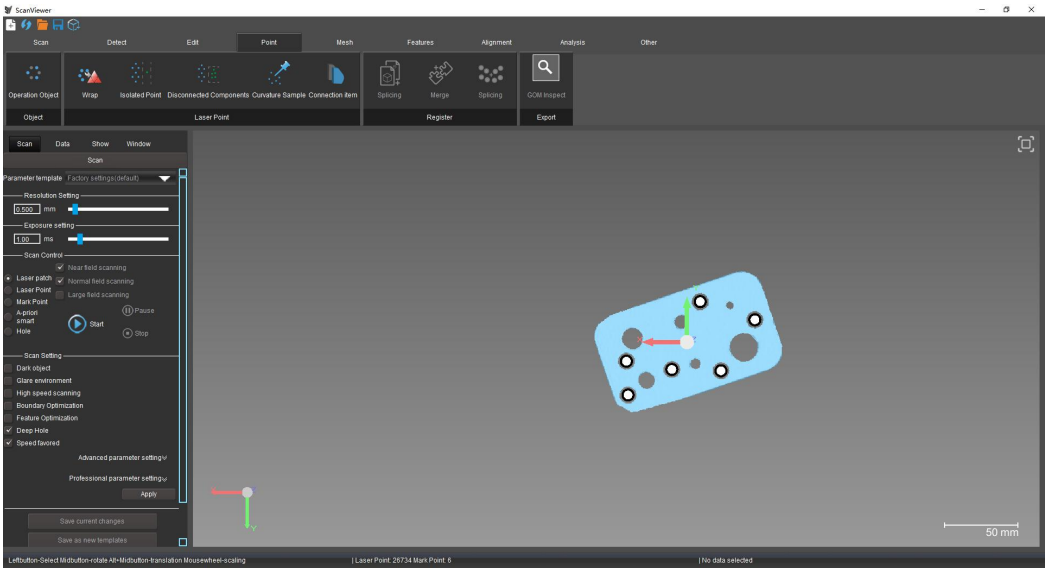
For the detection feature attribute, please refer to 5.2.1 "Circle" feature detection operation mode.

| | |
|---|---|
| Notice | The "elliptical groove" feature detection, if the fixed number of arcs per segment is fixed at 3, the dot position is preferably the start, middle and end of the arc, and the dot effect is best. |

# 6 Hole (optional)

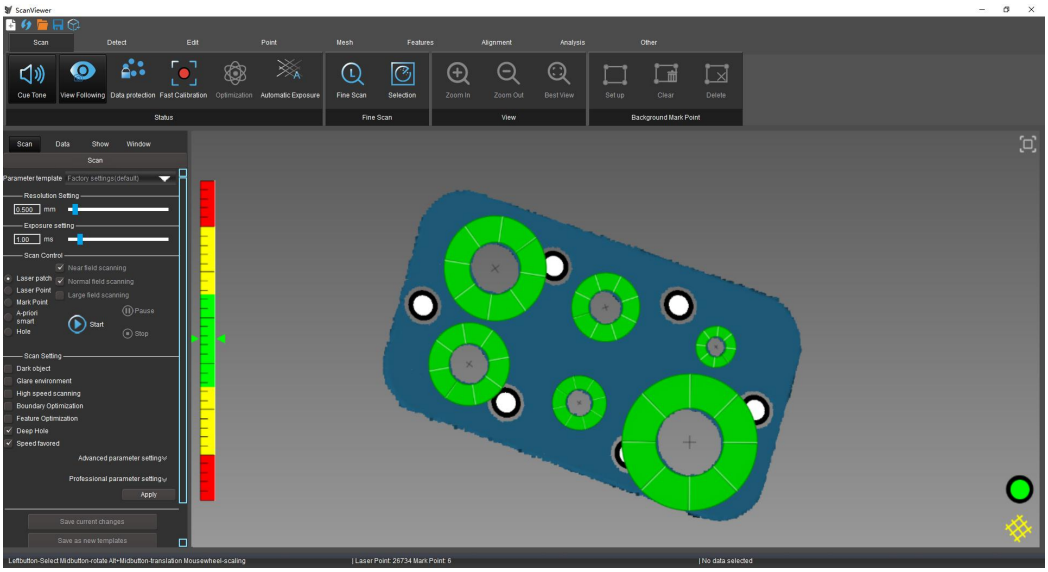
The hole scanning mode is to obtain the hole information by obtaining the gray level of the hole of the sheet metal part. It has high precision and good stability, which make it has the great advantage in the scanning hole. At the same time, it can greatly improves the efficiency. The following mainly introduces the operation method of hole scanning mode.

■Select "laser patch" and click "start" to scan the workpiece. After scanning, click "pause" to delete the extra patches outside the workpiece. As shown in Figure 6-1.



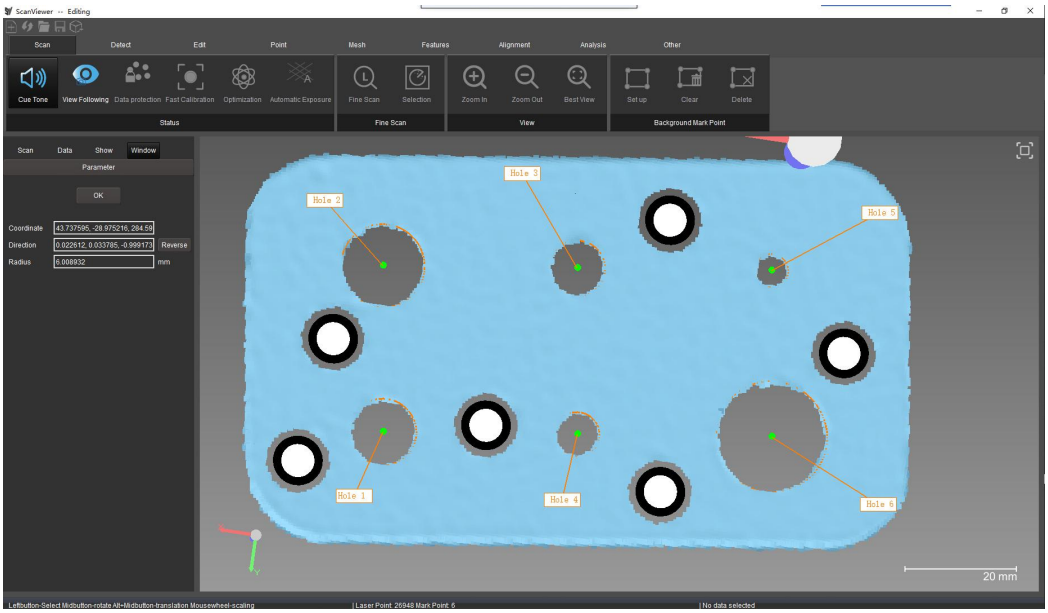

Firgure6- 1 Hole scanning

■Click "hole" - "start" to scan the hole of the workpiece, and all the positions of the hole in the workpiece are displayed in green (Figure 6-2).



Firgure6- 2 Hole scanning

■After the data is scanned, click "stop" - "data" and right-click “properties” to view the hole location coordinate, direction, radius and other attributes, as shown in Figure 6-3.




Firgure6- 3 Hole scanning

# 7 Cautions

(1) The device must be connected using the USB3.0 data interface;

(2) The device must be directly connected to the computer interface and cannot be plugged into an external USB hub;

(3) If there is slight heat on the top and bottom of the device after prolonged use, it is a normal phenomenon and does not affect the use of the device;

(4) If the computer is equipped with protection software (360 security guards, computer housekeeper, Windows Defender, etc.), scanning frame phenomenon may occur;

(5) Do not remove the dongle during the use of the software.

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