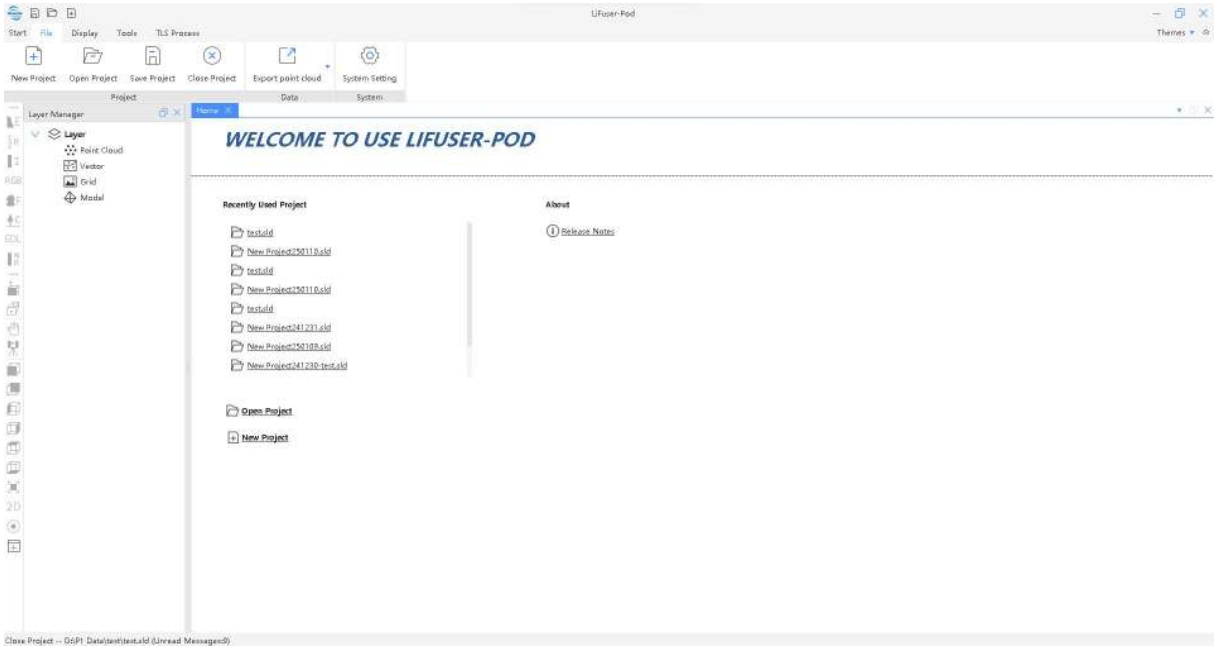
User Manual of LiFuser-Pod
（V1.2）

1.The software operation interface:



The main interface of the software consists of the following components: Quick Access Toolbar, Function Menu Panel, Start Menu, Toolbar, Layer Manager,etc.

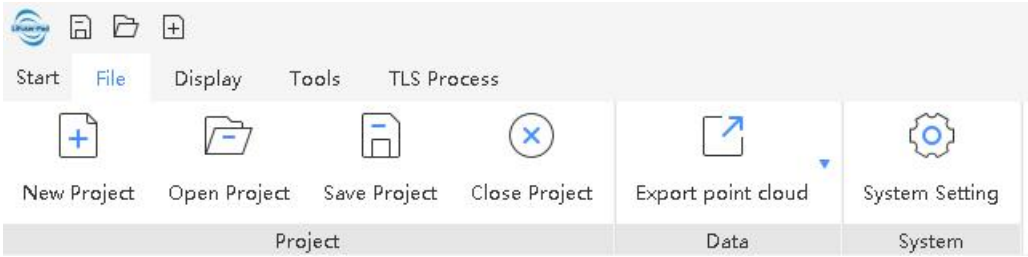
1.1 Quick Access Toolbar



A quick access toolbar is located above the start menu in the upper-left of the software interface. This toolbar will not disappear when switching between menus, it provides users with quick access to essential operations such as "New", "Open", and "Save".

1.2 Function Menu Panel

The function menu panel is located at the top of the main interface of the software, organizing the command operation buttons into office-style "function groups". For example, the "File" function card includes functions such as "New Project", "Open Project", "Save Project", "Close Project", "Export Point Cloud", and "System Setting".



1.3 Toolbar

The software toolbar consists of the view toolbar, projection toolbar, and rendering mode toolbar, which are located on the left side of the layer panel. The toolbar's position can be adjusted according to operating habits.



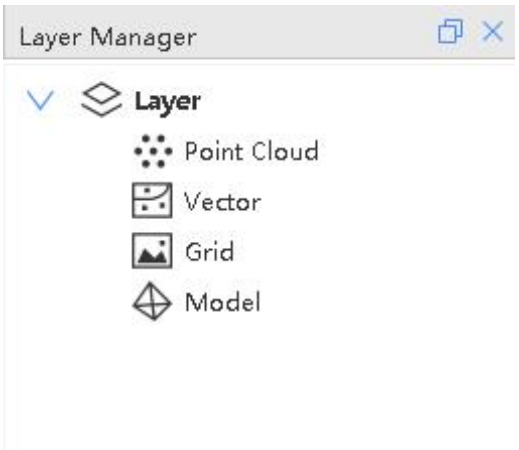
1.4 Windows Management

The software windows consist of the Layer Manager, Command Window, Pre-processing Manager, Home Page, and View Panel.

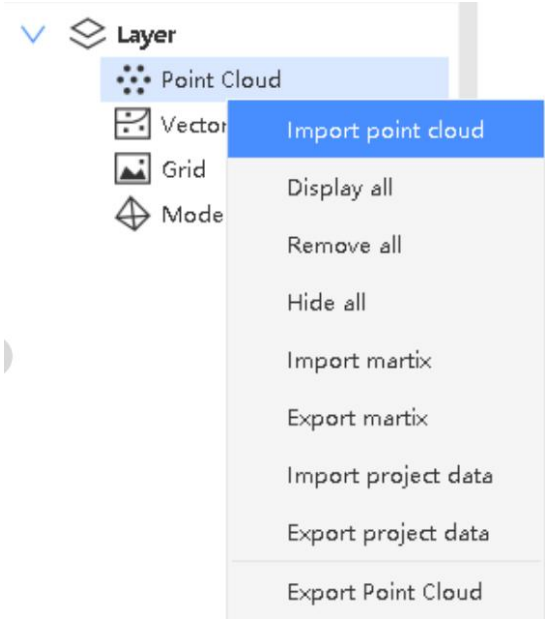


1.5 Layer Manager

The layer manager is mainly used to control the visibility of each layer in the view window. It includes four types of layers: "Point Cloud", "Grid", "Vector" and "Model".



The point cloud layer is used to manage imported point cloud data. Right-clicking on the "Point Cloud Layer" pops up a context menu with options such as "Import Point Cloud Data", "Remove All", "Show All" and "Export Point Cloud" . Right-clicking on a sub-node of the point cloud layer opens a context menu with functions including "Show all", "Hide all", "Remove all", "Plane View", "Set as Base Station", "Set World Coordinates", "Zoom to", "Open File Path", "Export Point Cloud" and "View Properties".



1.6 View Window

The view window is used for visualizing imported data and supports the creation of multiple views, which makes it easier for users to intuitively organize data, such as point cloud

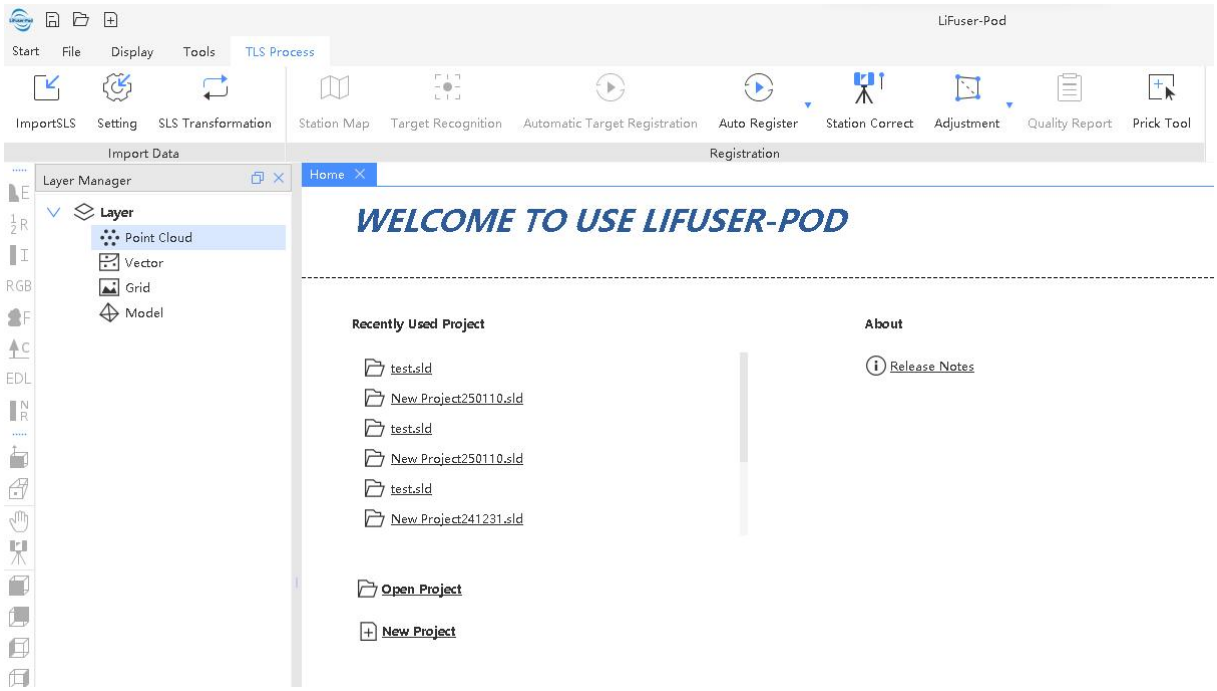
browsing, point cloud editing, point cloud measurement, etc.

1.7 Command Window

The software supports command-driven functions. The command window is used to accept commands, receive interactive parameters, prompt execution status, real-time feedback information and logs, etc.



2 TLS Process



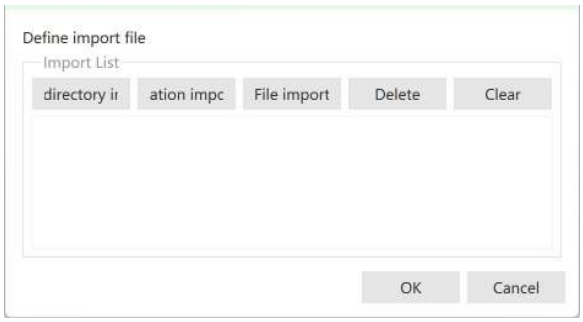
2.1 Import SLS

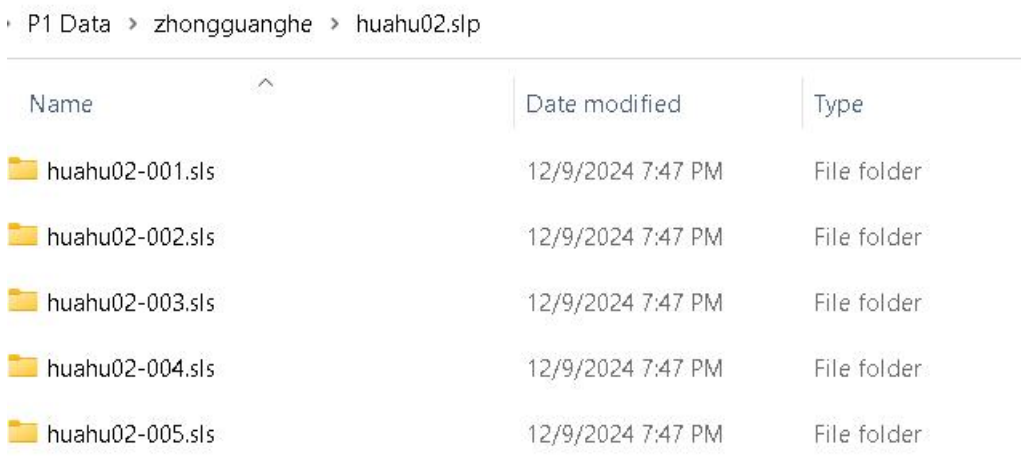
Import the laser scanning data (folders with the .sls extension) of the terrestrial laser scanner into the pre-processing manager panel.

Operation steps:

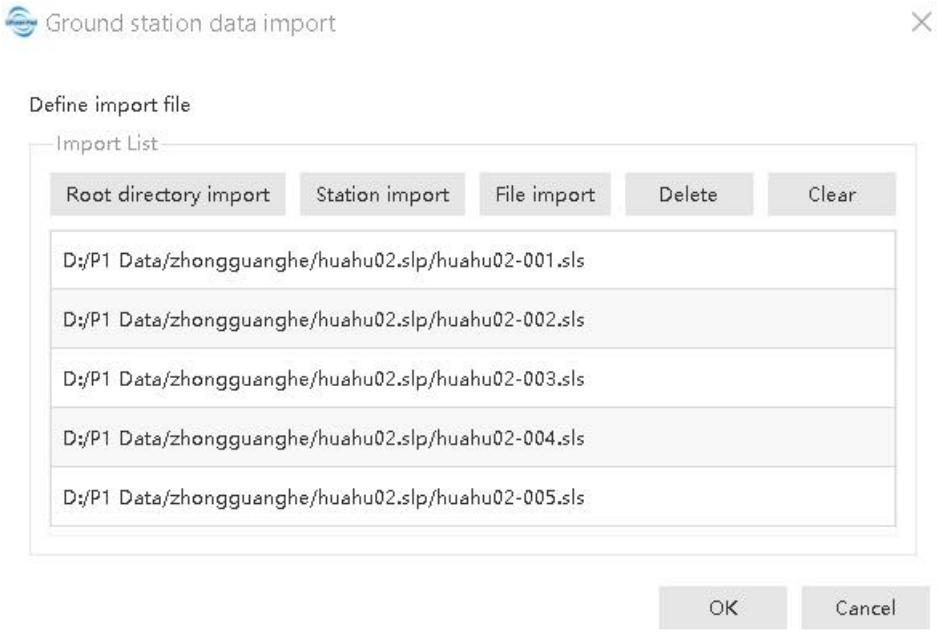
1)Click on the ImportSLS, select the Project Path, Project Name can be customized.

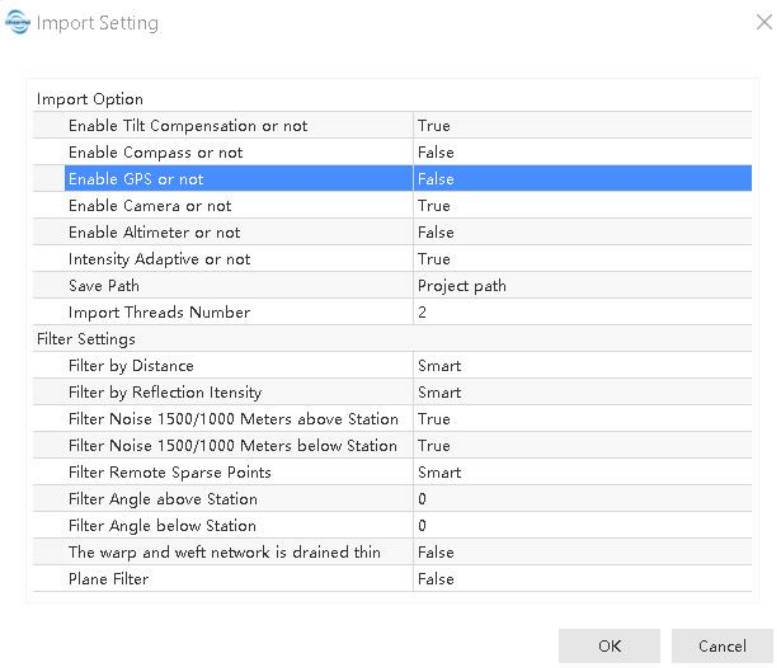






2) Select the target scan data folder to import (multiple folders can also be selected and dragged in).





Tilt Compensation: The device is not leveled, but the point cloud result is compensated, ensuring that the z-axis is in the plumb direction.

Compass: Electronic compass, can be used for primary orientation.

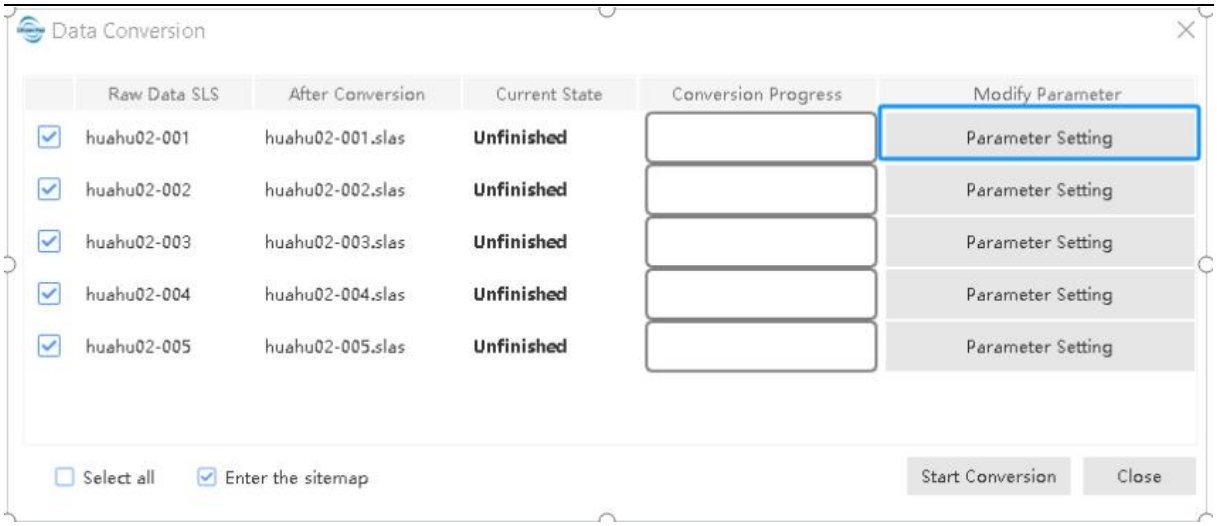
The above two options can improve the success rate of automatic registration for outdoor scenes.

Altimeter: The height of the site can be preliminarily estimated, which is helpful for controlling the initial value of the z-axis height of the registration.

Intensity Adaptive: Automatically assign appropriate intensity values when scanning different target objects.

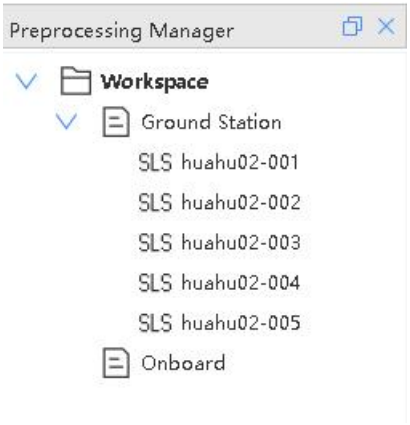
Filter by Distance: Centered on the site, point clouds beyond the set distance will be filtered out.

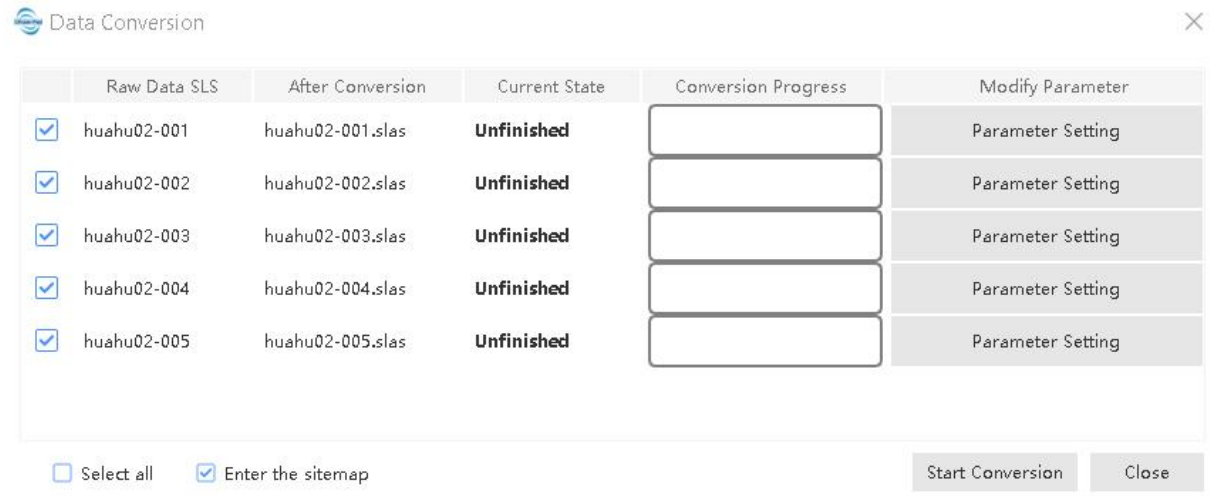
Filter by Reflection: Point clouds exceeding the set intensity will be filtered out.



Parameters for individual stations can be configured separately on the data import interface, which can be applied to a single station or to all stations.

After the import is successful, a sub-node of the corresponding data will be generated under the ground station workspace in the pre-processing manager panel.

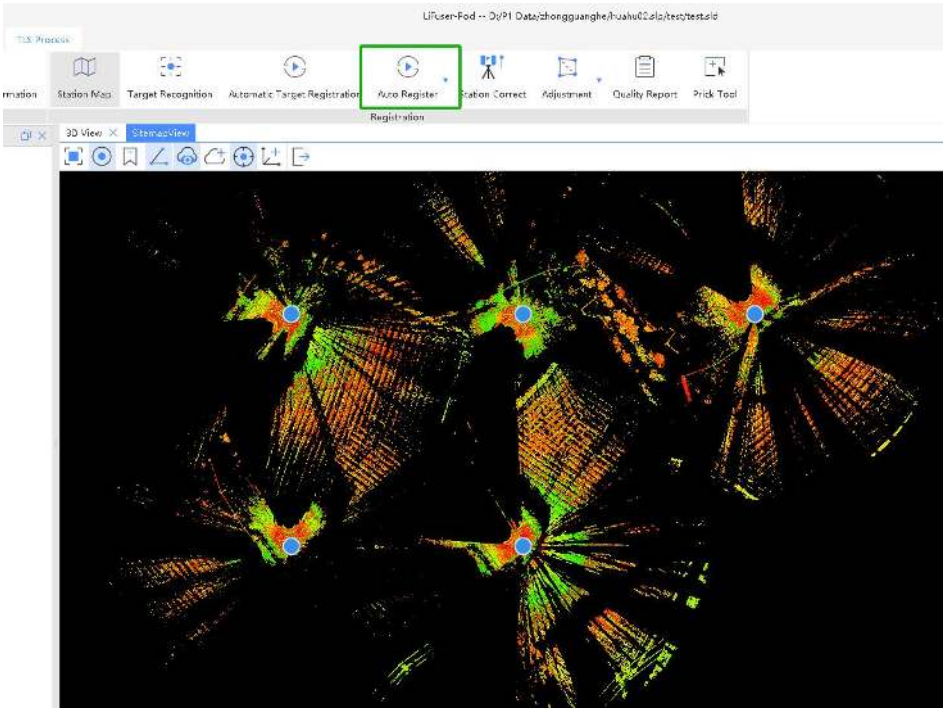




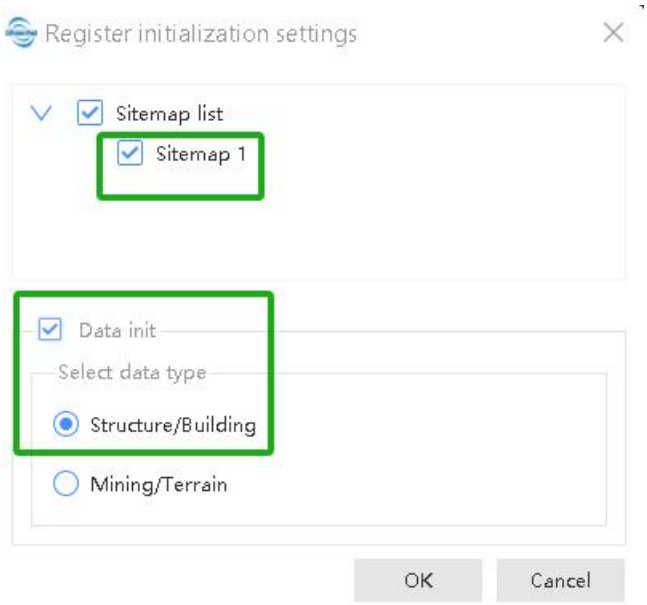


2.2 Automatic Registration

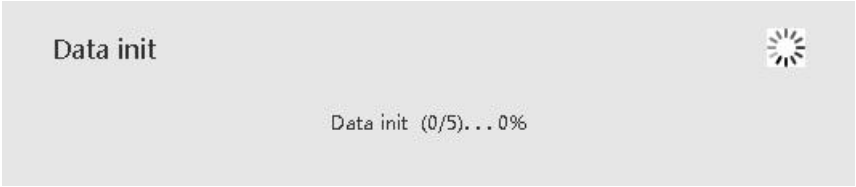
1. Click on Auto Register.



2.The “registration initialization” setting window pops up. Select the data initialization type according to the actual situation, then click “OK”.

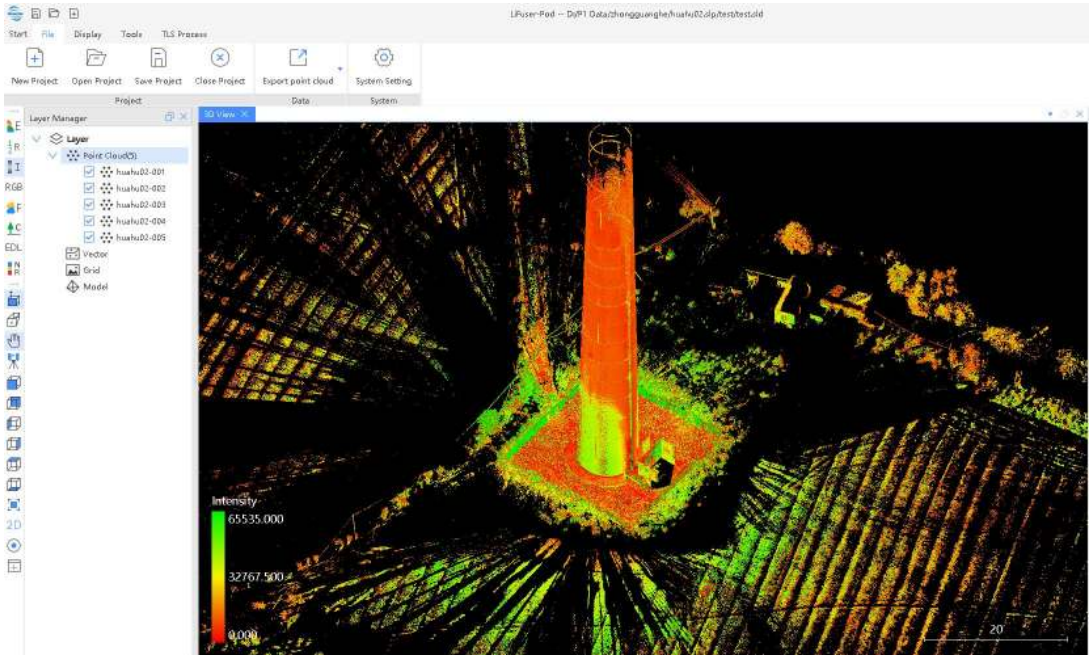


3.Data initialization, waiting for data initialization to be completed.

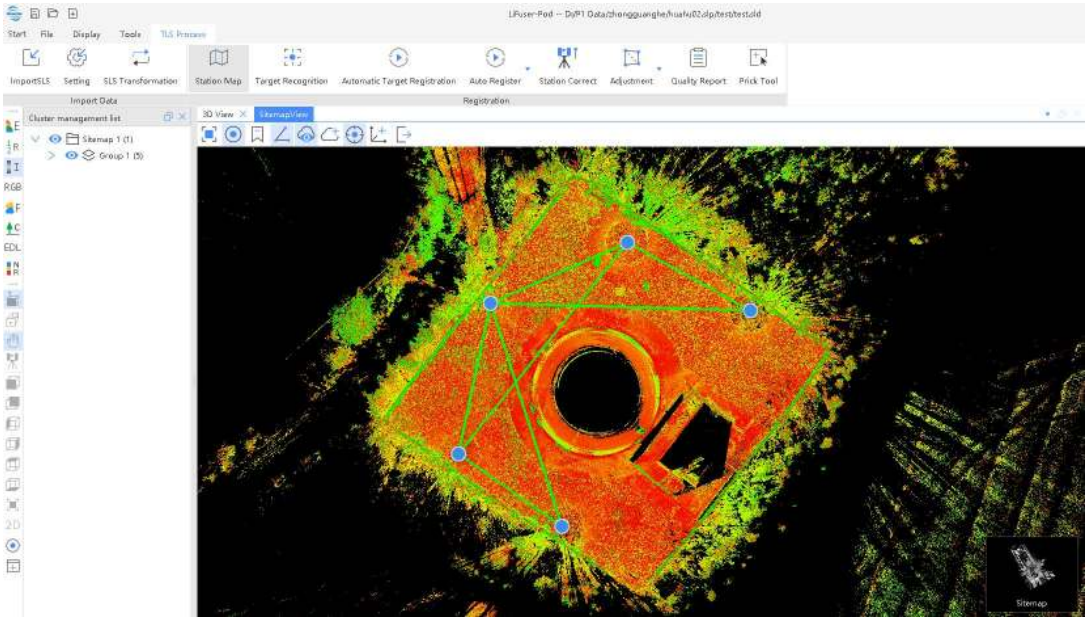


4.After initialization is completed, it will perform automatic registration.

5.Automatic registration finished.



6. Check the registration report. Click the Quality Report and select to open the successfully exported report.



Registration report

Project name: New Project240828

Report time: 2024-09-02 16:09:35

Execution standards:

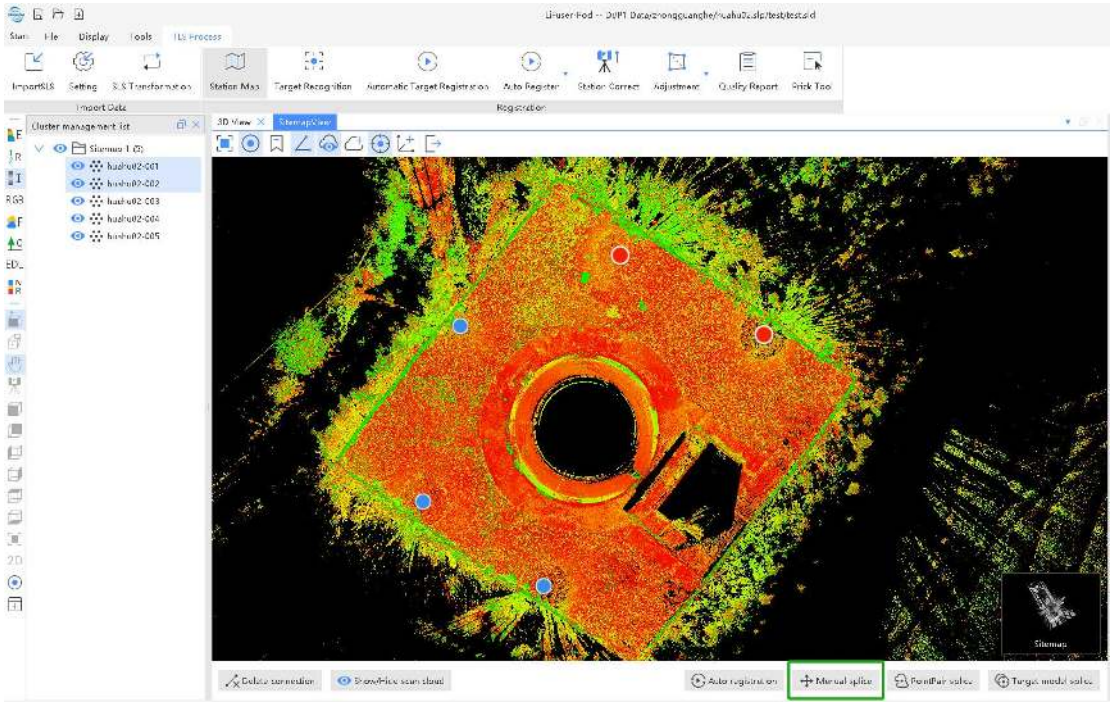
	Qualified	Inspect	Error
Connection error	< 30 mm	30-100 mm	> 100 mm
Overlap rate	> 25 %	10-25 %	< 10 %

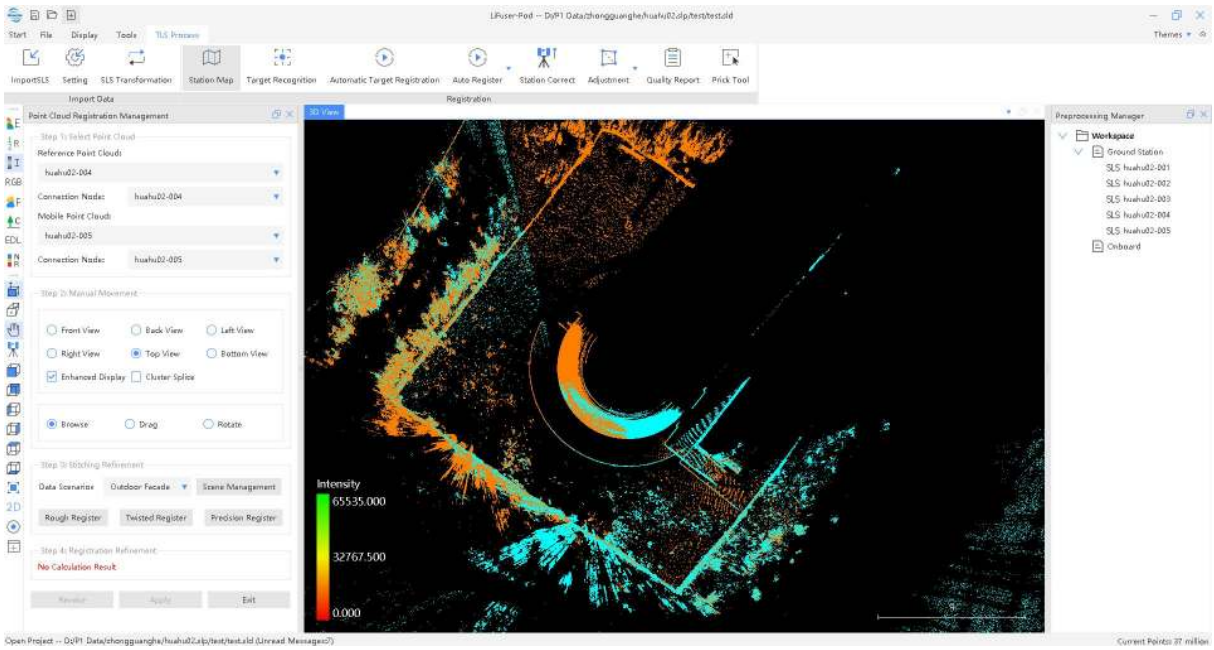
1. Report statistics

Max error(mm)	4.02
Average error(mm)	2.04
Min overlap rate(%)	12.06
Scan number	13
Scan connected edges number	13

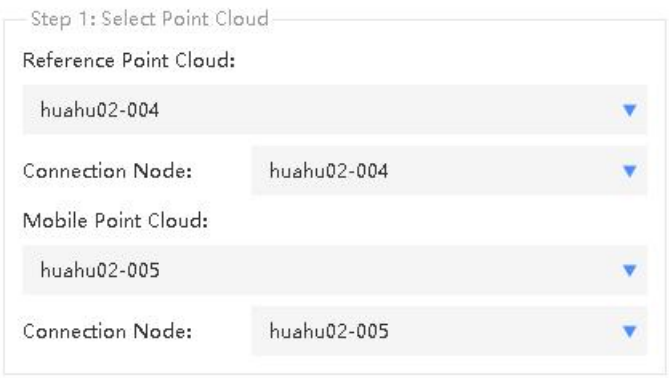
2.3 Manual Registration

1. Select any two stations (hold down the Ctrl key), then click Manual splice in the lower right corner.

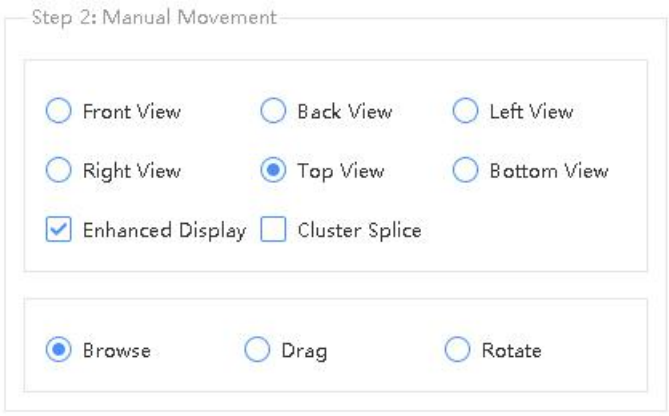




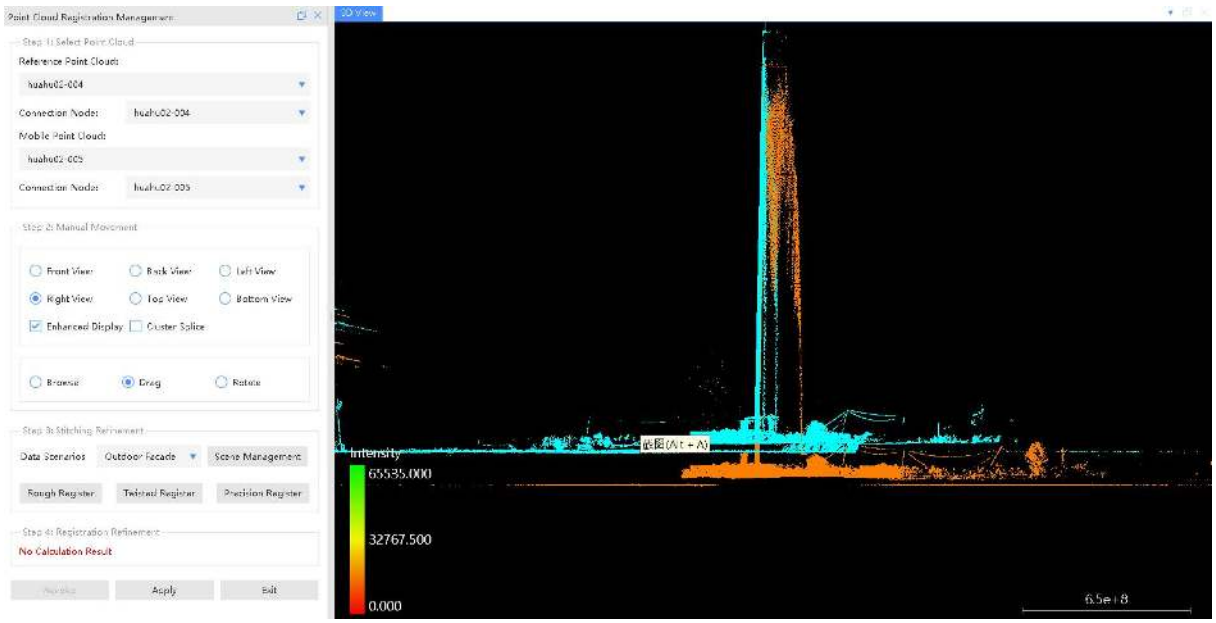
2. Select the corresponding Reference Point Cloud and Mobile Point Cloud.



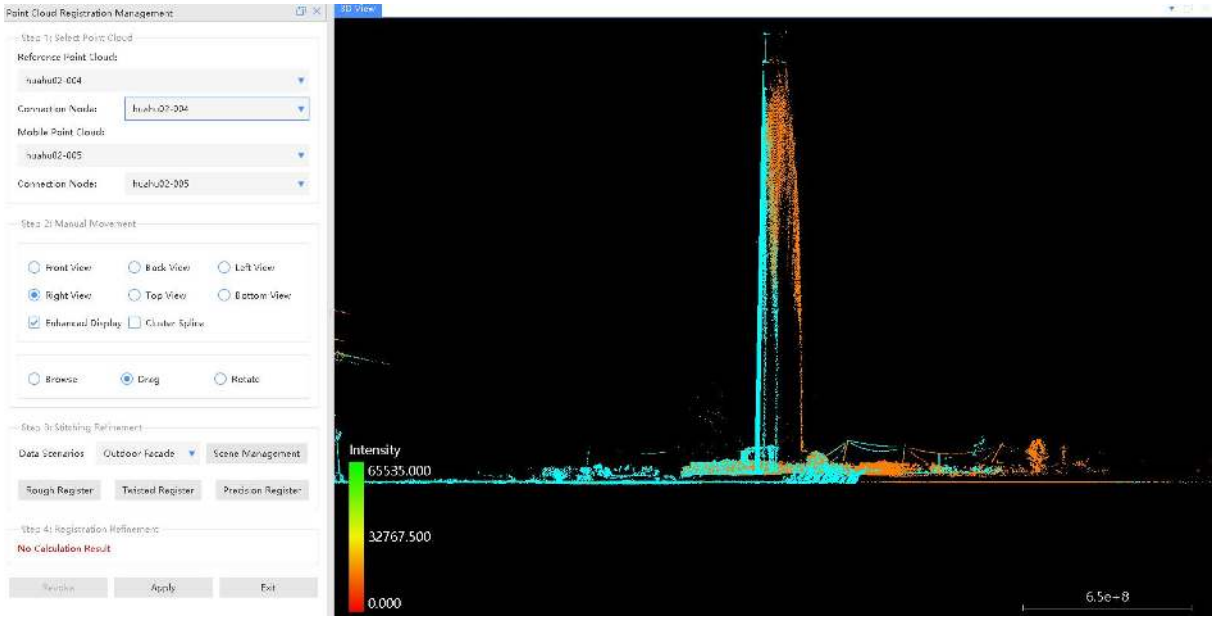
3. Manual movement. Select different views, movement methods, and different registration refinement methods to complete the alignment of the station cloud in the x, y, and z directions.

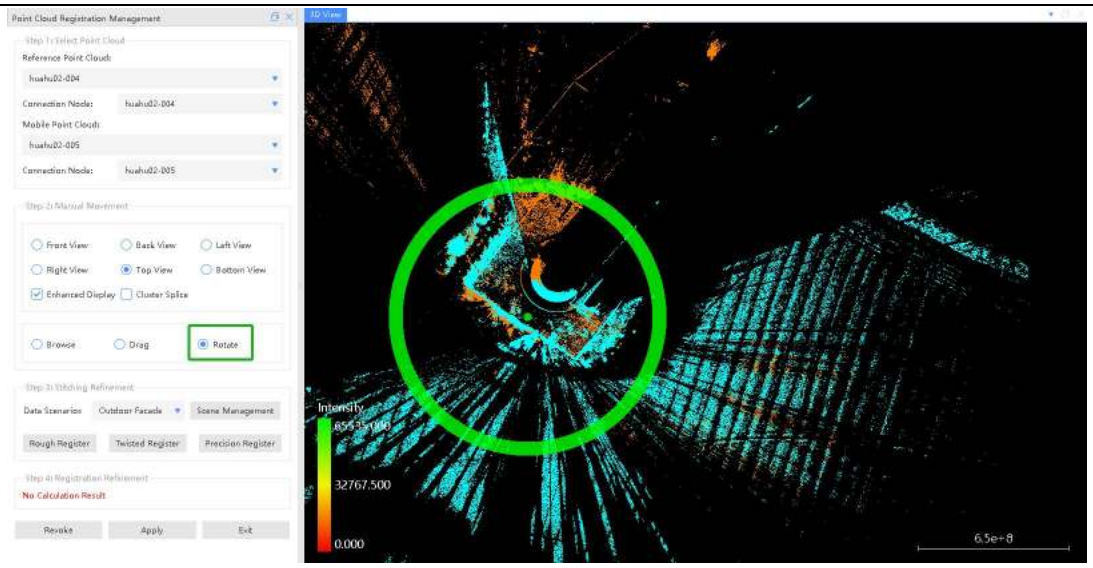


4. Select the side view and complete the alignment of different station clouds in the Z direction, select drag/rotate as the movement mode. The middle mouse button (scroll wheel) can be used to zoom the view at will.

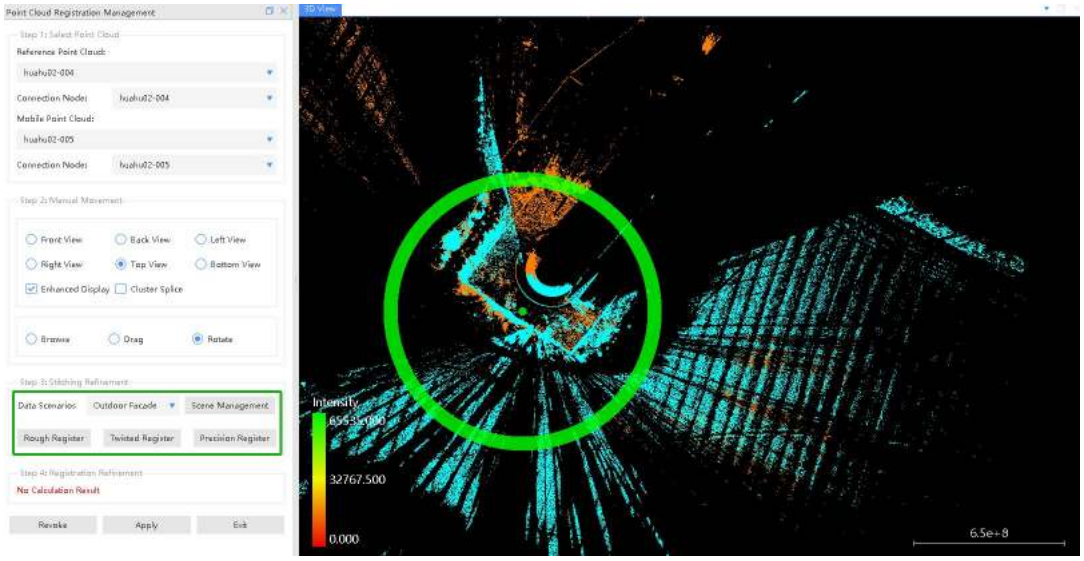


5. Select the top view, drag or rotate the point cloud to complete the alignment of the point cloud in the x and y directions, when using the rotation tool, double-click the left mouse button to change the rotation center.

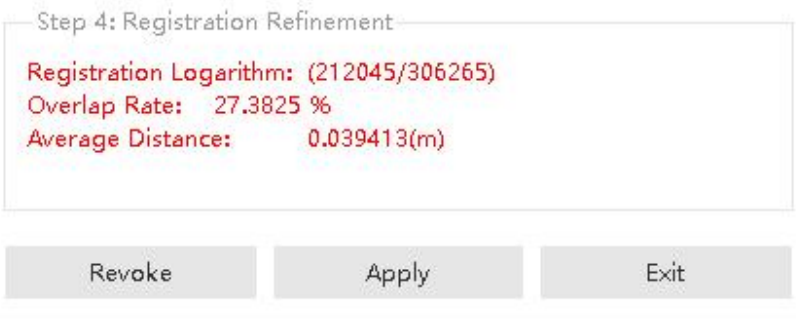




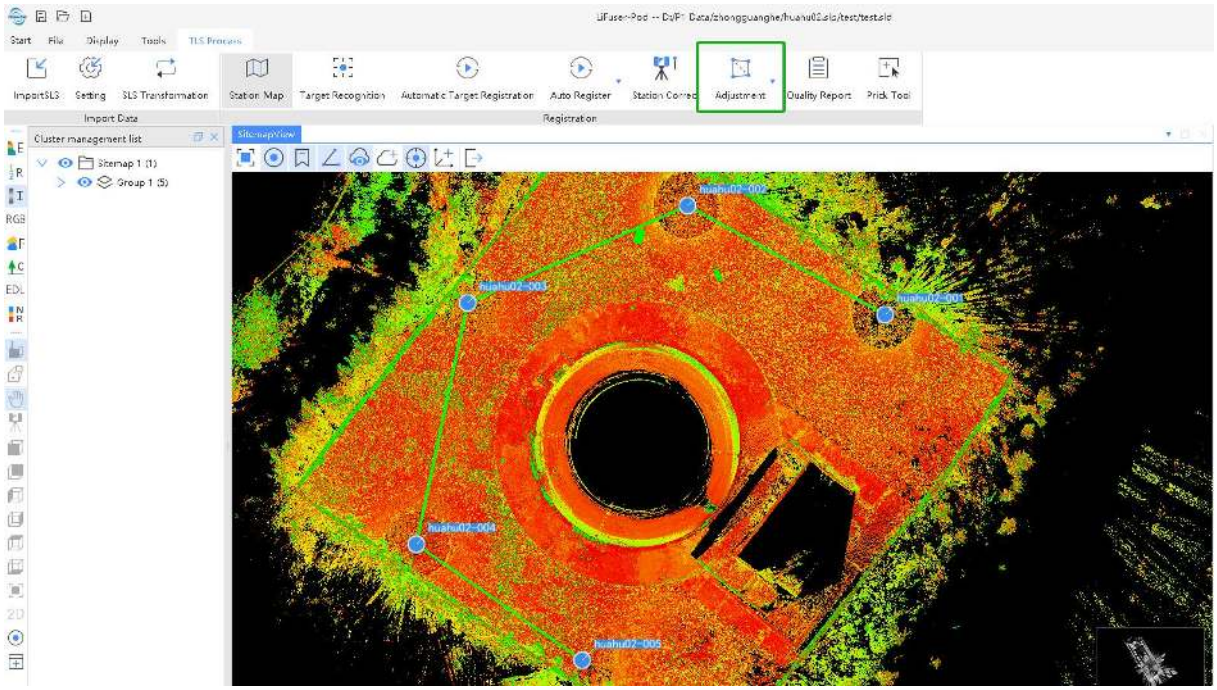
6. Fine-tuning registration. Select the data scenario and fine-tuning registration method to complete fine-tuning registration.



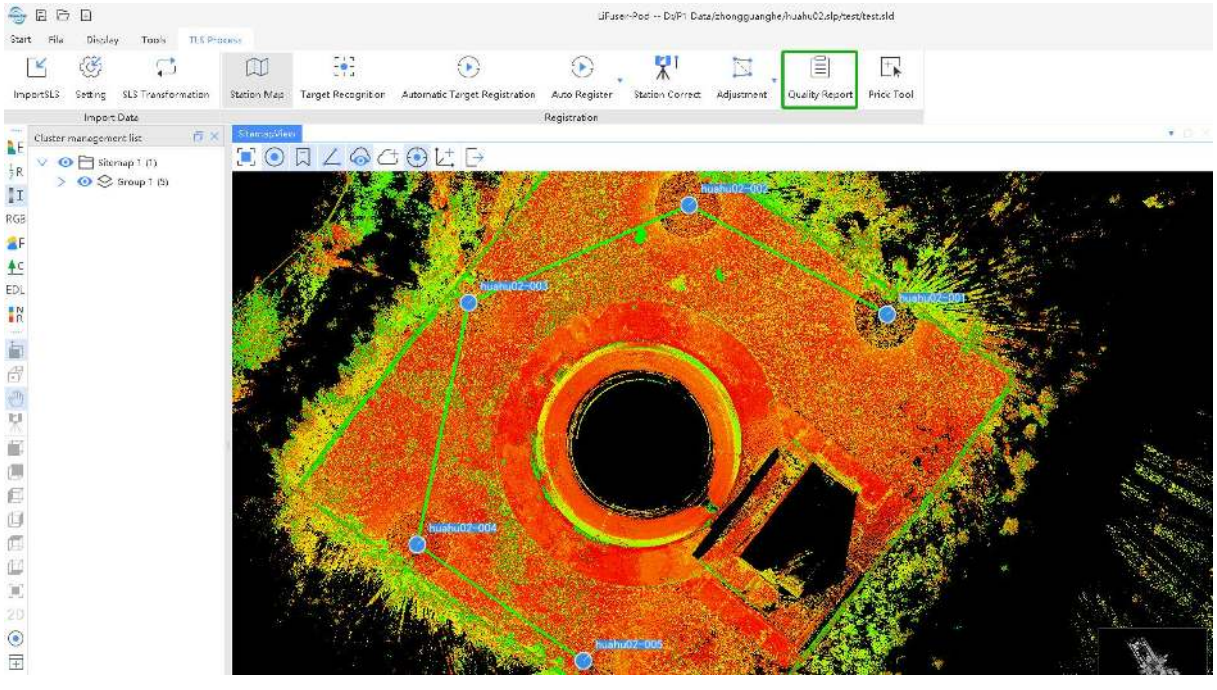
7. Registration accuracy. Evaluate the registration accuracy, where the average distance is for reference only; finally, click Apply to exit manual registration.

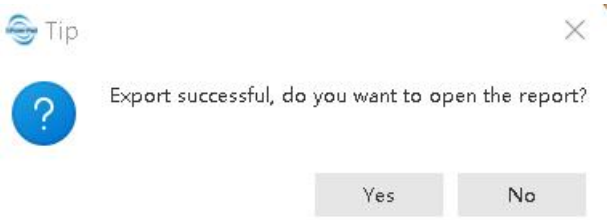


8. Station adjustment. Click Station Adjustment.



9. Check the registration report. Click the Quality Report and select to open the successfully exported report.





Registration report

Project name: test

Report time: 2025-01-21 17:35:13

Execution standards:

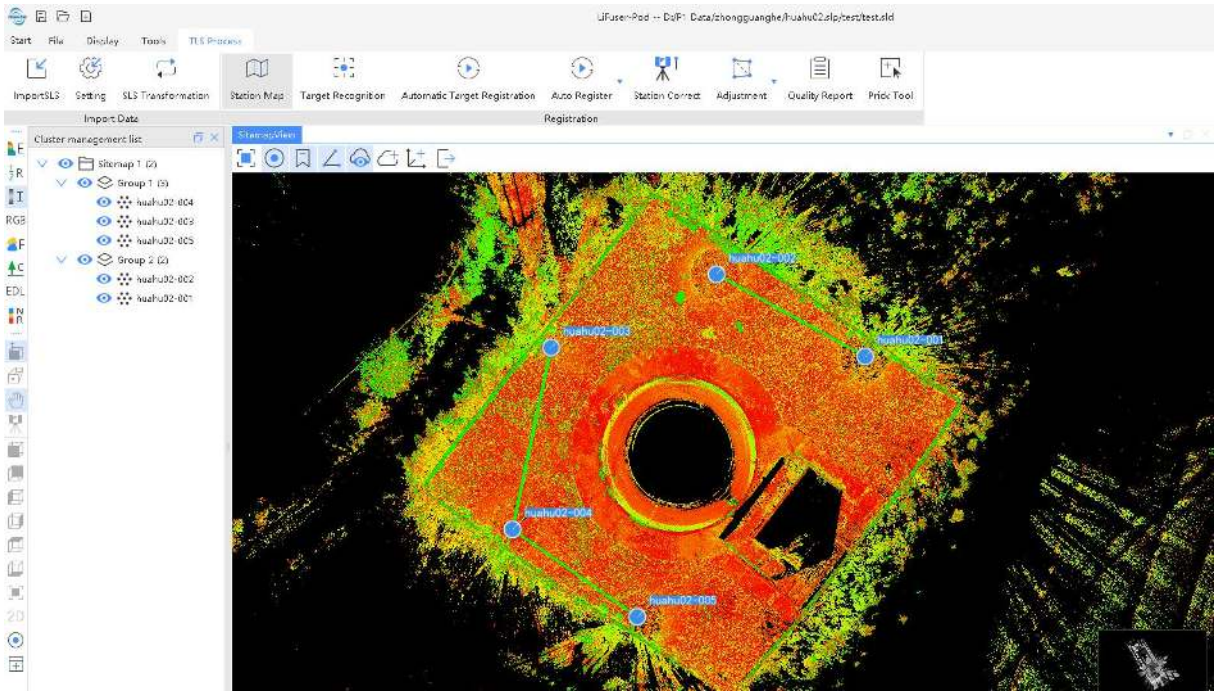
	Qualified	Inspect	Error
Connection error	< 30 mm	30-100 mm	> 100 mm
Overlap rate	> 25 %	10-25 %	< 10 %

1. Report statistics

Max error(mm)	0.67
Average error(mm)	0.54
Min overlap rate(%)	52.52
Scan number	5
Scan connected edges number	4

2.3.1 Manual Registration - Cluster registration

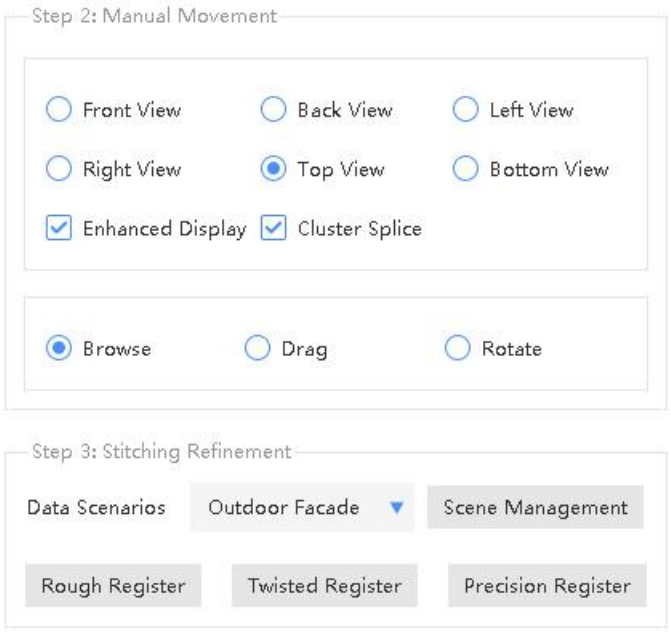
1.Start Manual registration. For detailed operation steps, please refer to Section 2.3.



2.Select the point cloud. The reference point cloud here refers to a station in cluster 1 (public connection station). The mobile point cloud needs to be fused to the station in cluster 1. The connection node is not available here.



3.Check Cluster Splice.

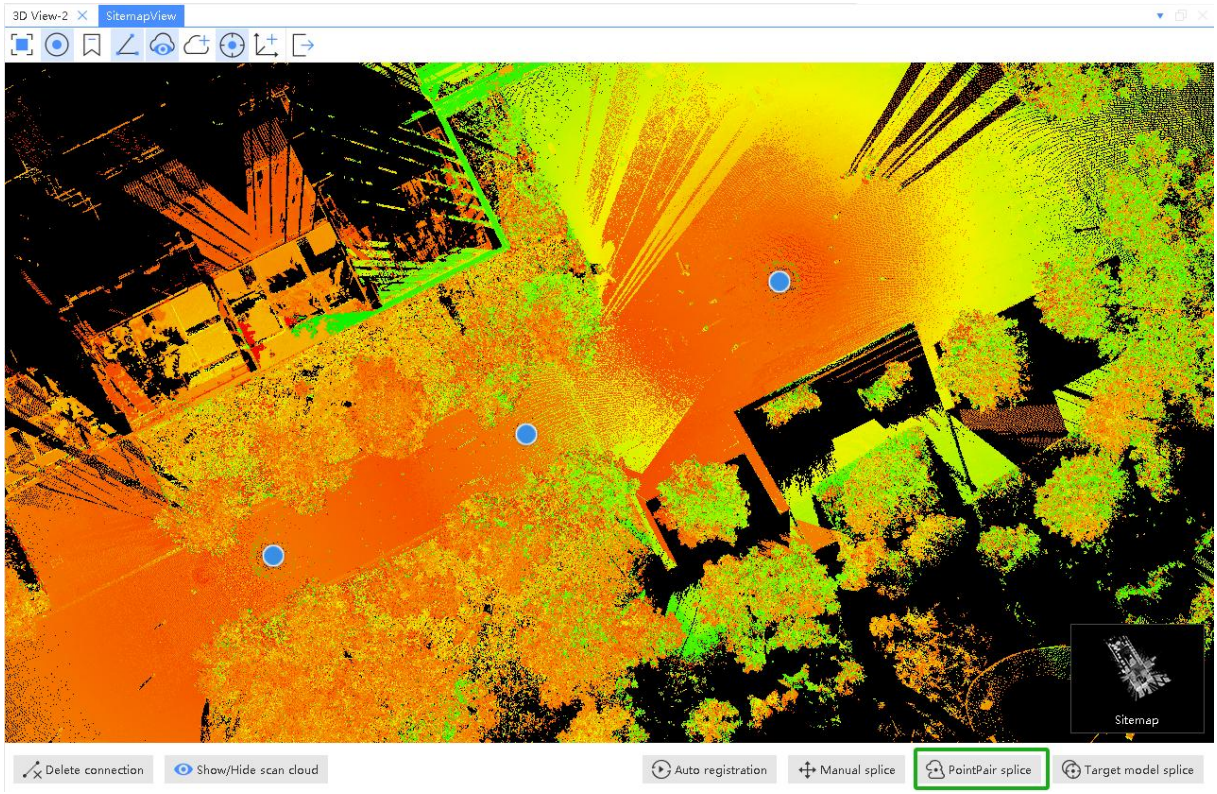


4.For subsequent steps, please refer to Section 2.3.

2.4 Target Registration

2.4.1 Manual Target Registration

1. Start PointPair registration. Click the Station Map, then select any two stations (hold down the Ctrl key) , click PointPair splice in the lower right corner to start the point-to-point connection.



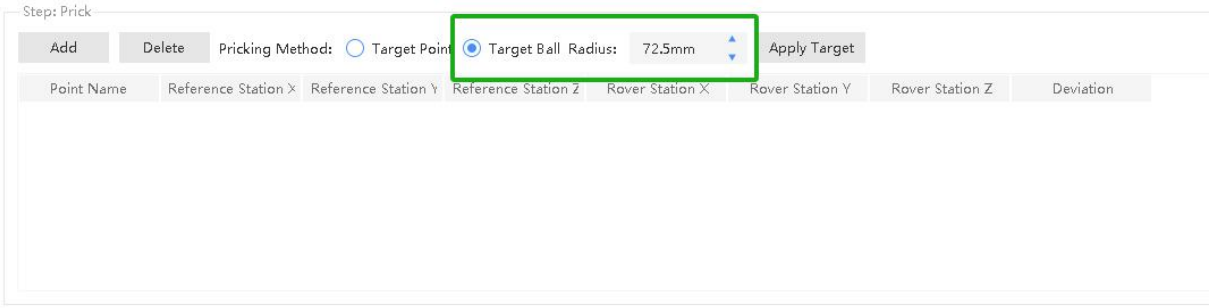
2. Set the base station. Select 3D view.



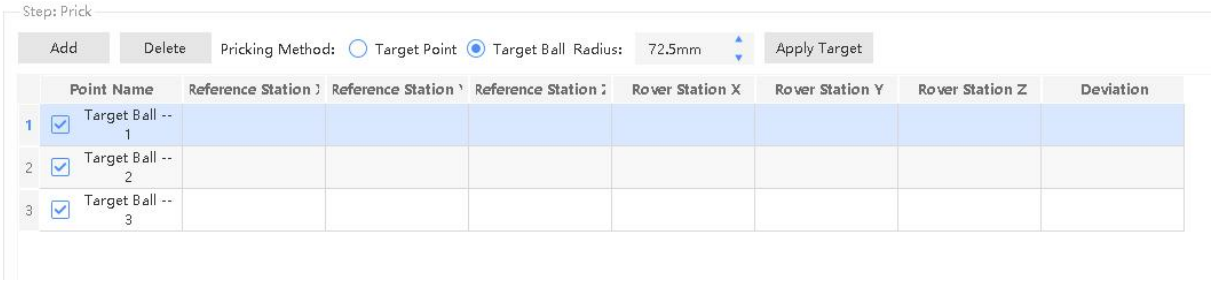
3. Select the corresponding Reference Point Cloud and Mobile Point Cloud.



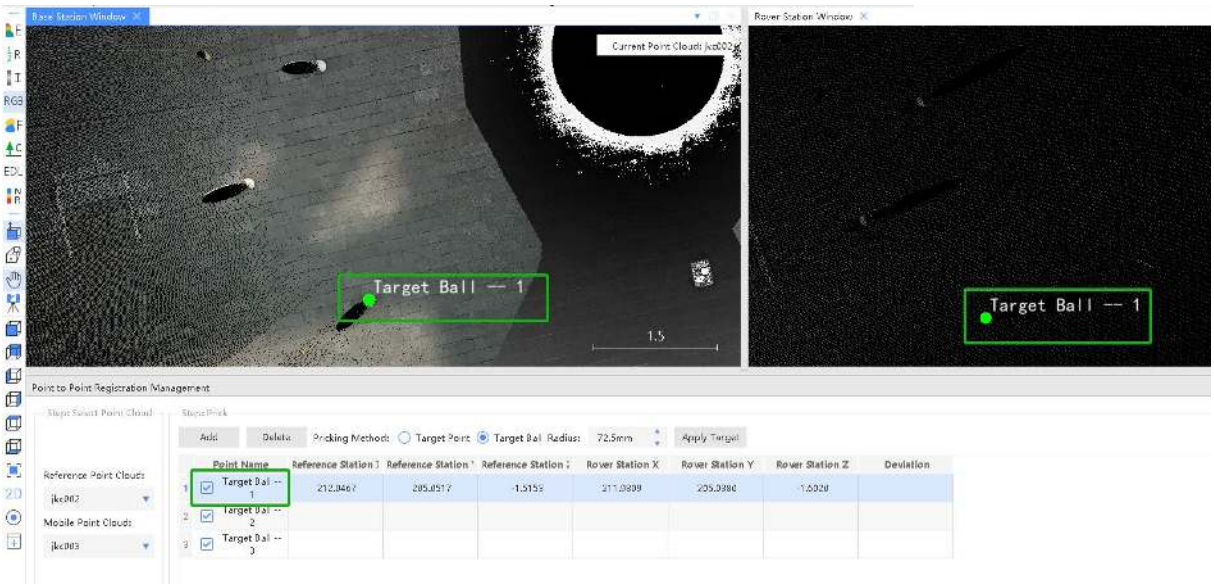
4. There are two types of targeting methods. Since the demonstration data only includes target balls, the target ball method will be selected for this demonstration. The operational procedure for target points is the same as that for target balls. If the target point method is used as the targeting approach, the target ball targeting procedure can be referenced.



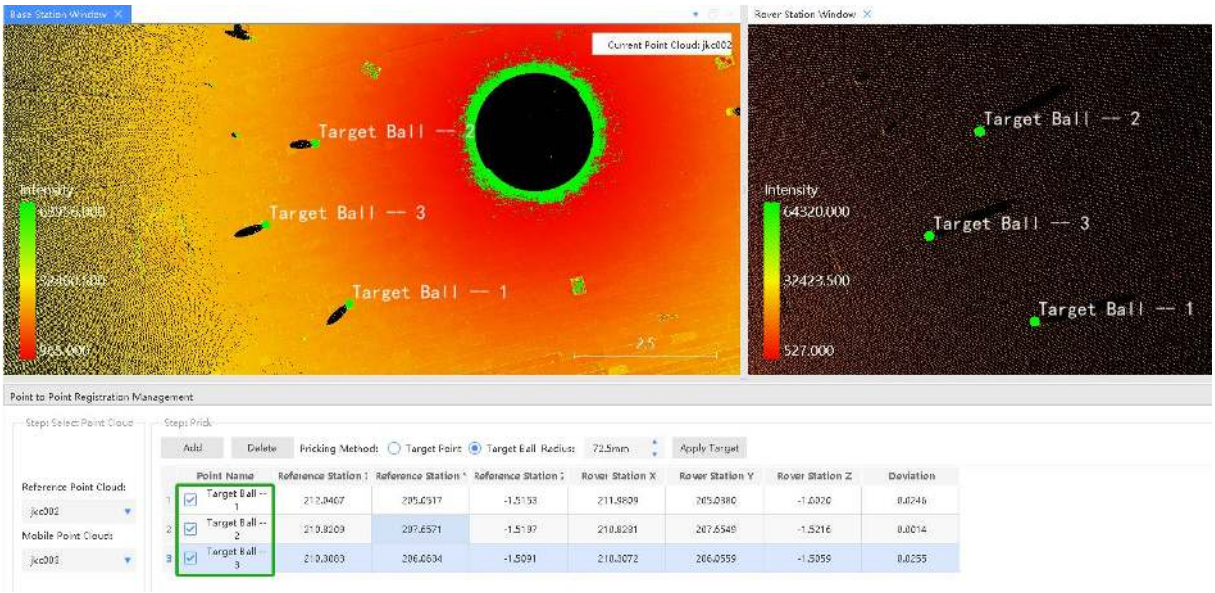
5. Increase the number of target balls.



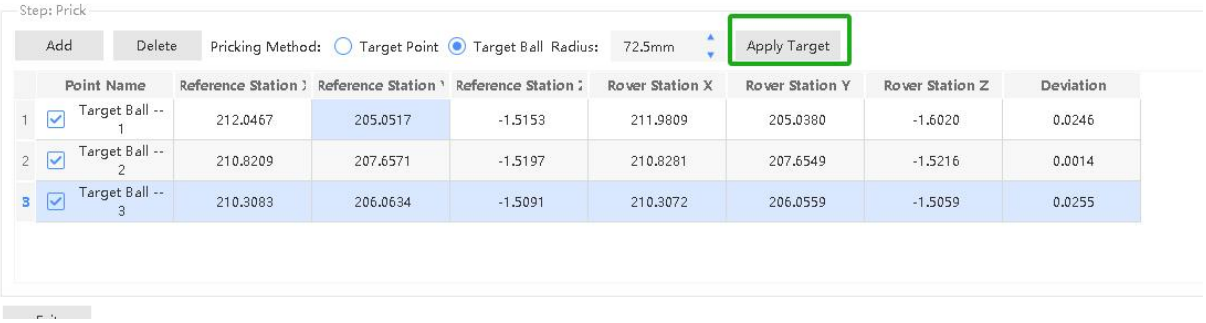
6. Select the same ball between two stations and double-click to identify the fitted sphere.



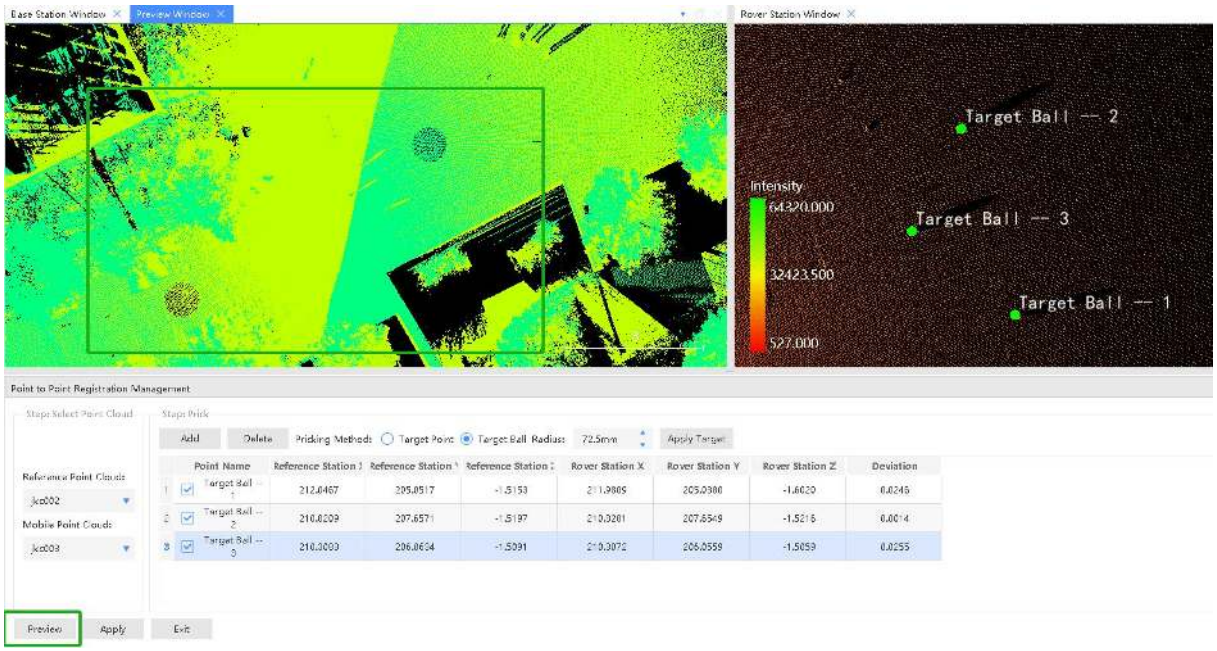
7. Similarly, using the same method, pierce out the remaining two common target balls.



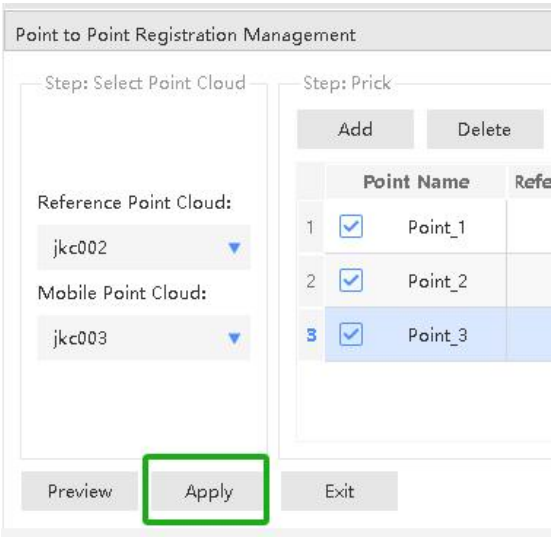
8. Apply the target sphere. Pay attention to the Deviation value. If it is too large, it means that the target spheres of the base station and the rover station are not selected accurately or incorrectly, and they need to be reselected and then fitted.



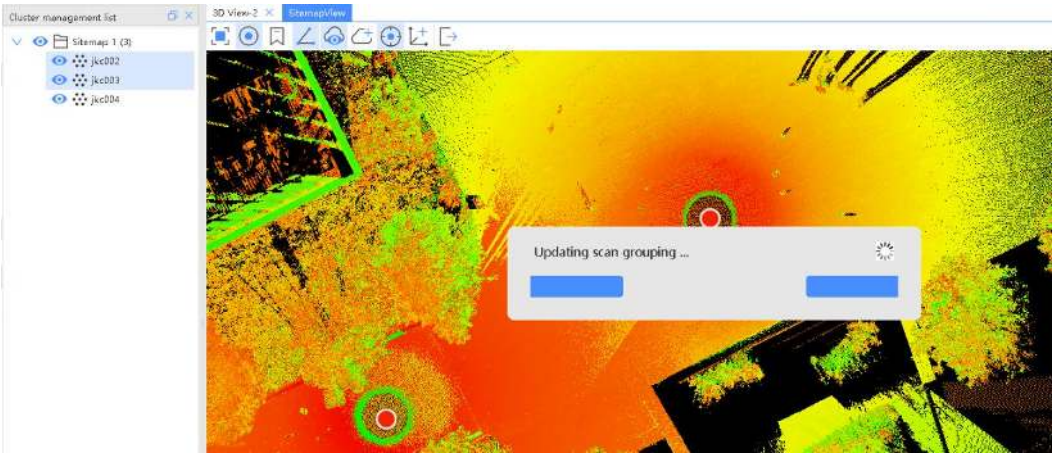
9. Preview. Check the registration effect in the preview window, if the effect is satisfactory, proceed to the next step. If not, return to the previous step.



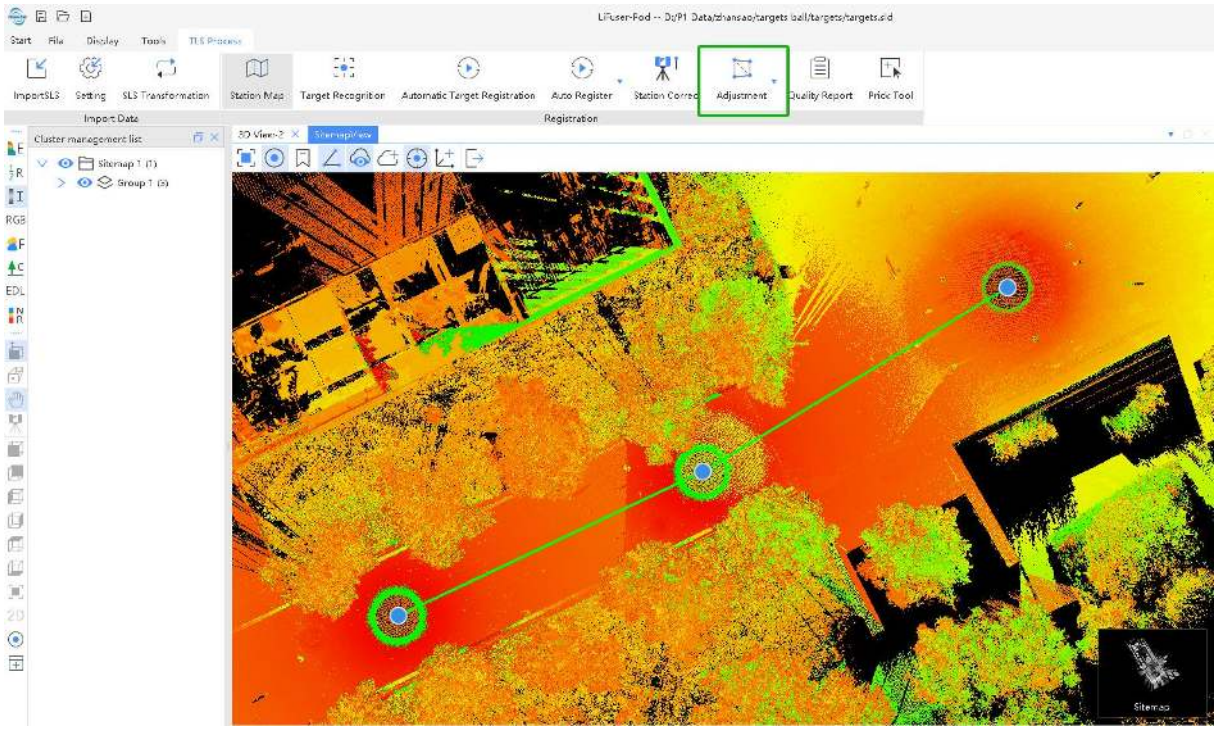
10.Click Apply.



11.Update the scan. Repeat this operation again to complete the registration between stations.



12.Station adjustment. After all the target balls are registered, click Adjustment.



13. Check the Report. The Registration report will be saved in the project folder.

Registration report

Project name: targets

Report time: 2025-01-22 14:07:17

Execution standards:

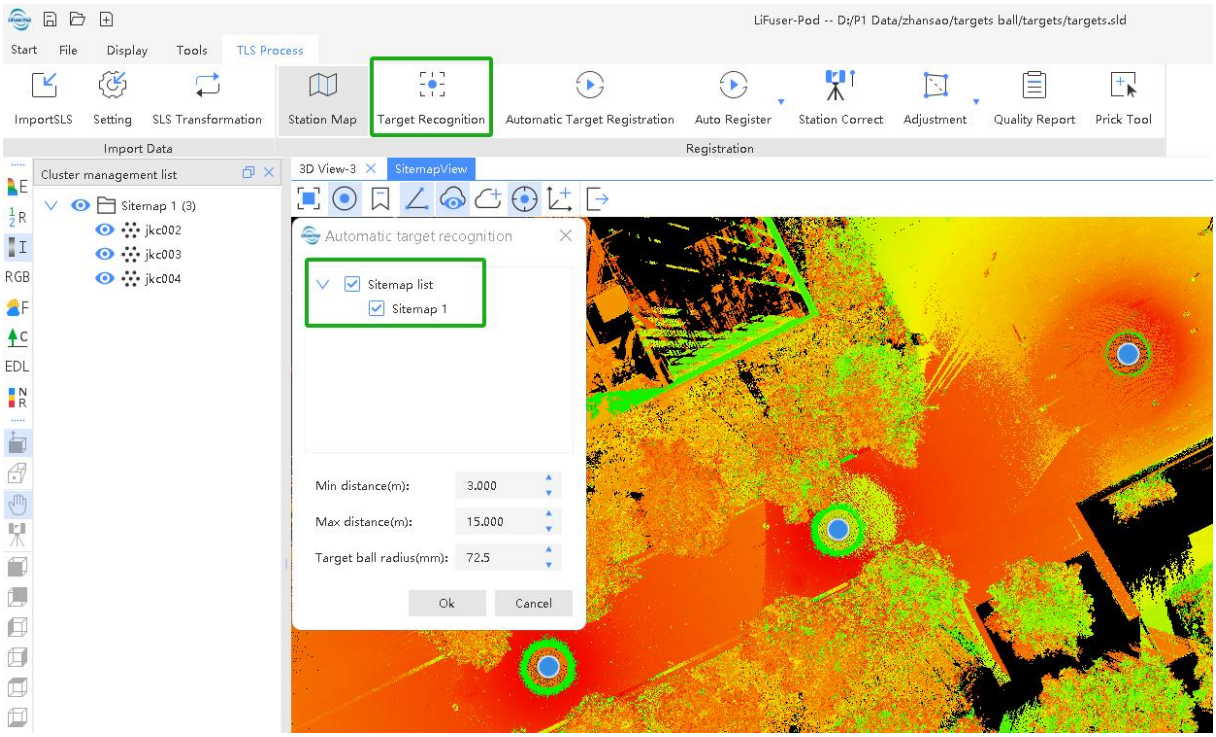
	Qualified	Inspect	Error
Connection error	< 30 mm	30-100 mm	> 100 mm
Overlap rate	> 25 %	10-25 %	< 10 %

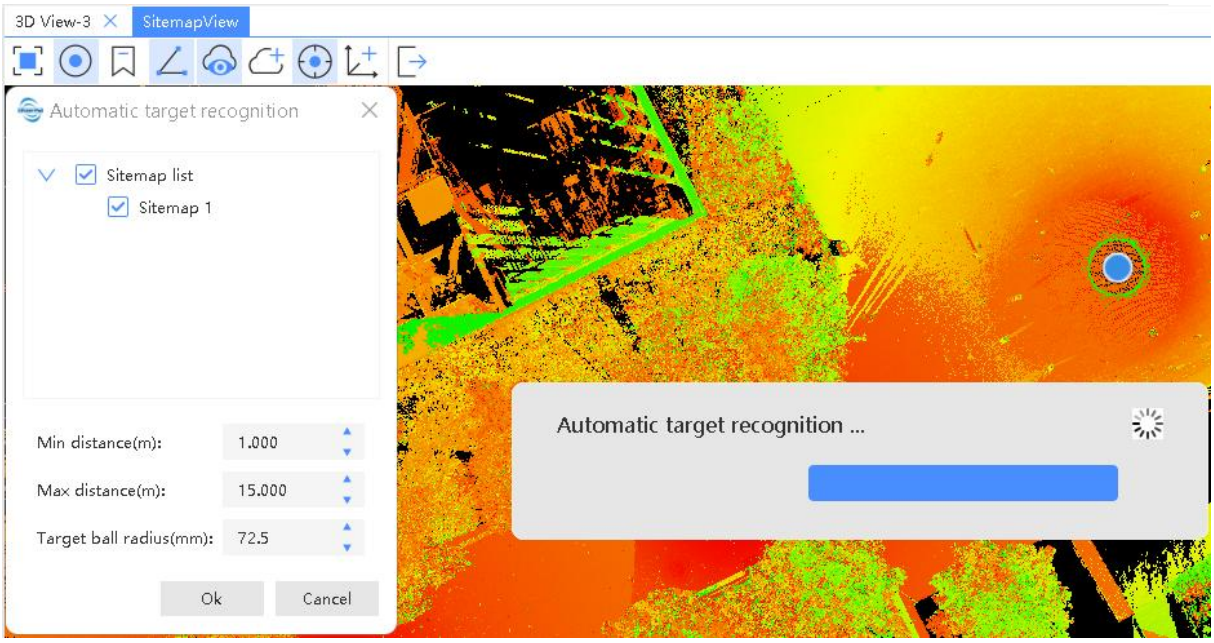
1. Report statistics

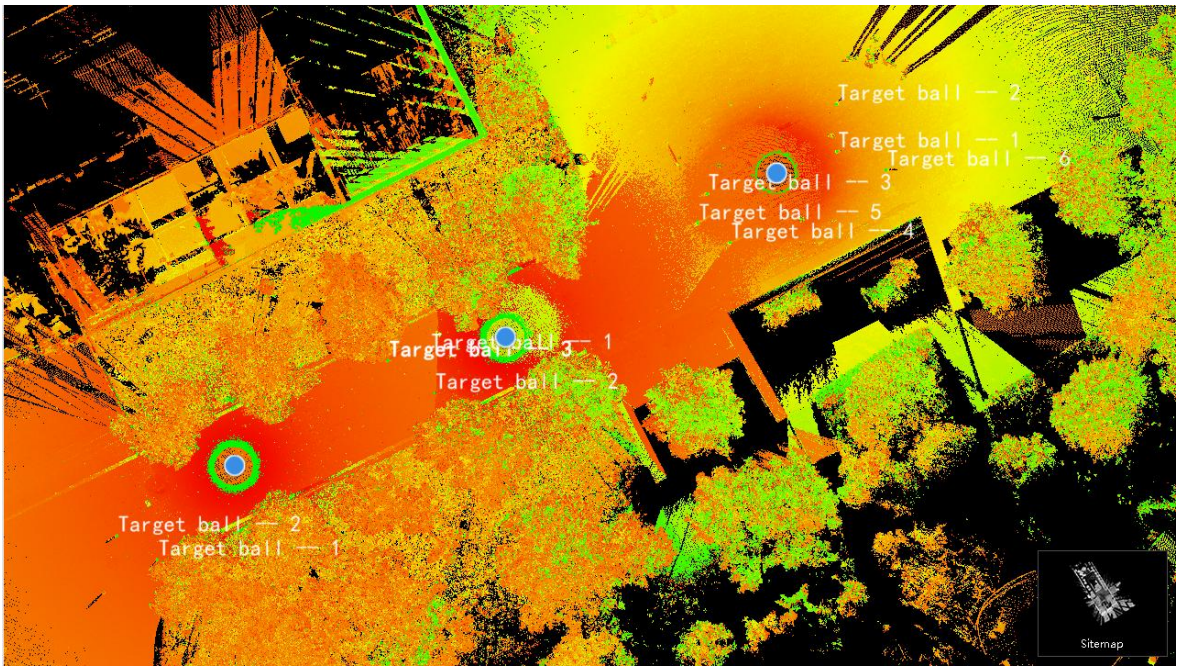
Max error(mm)	3.37
Average error(mm)	2.30
Min overlap rate(%)	29.47
Scan number	3
Scan connected edges number	2

2.4.2 Automatic target sphere recognition and registration

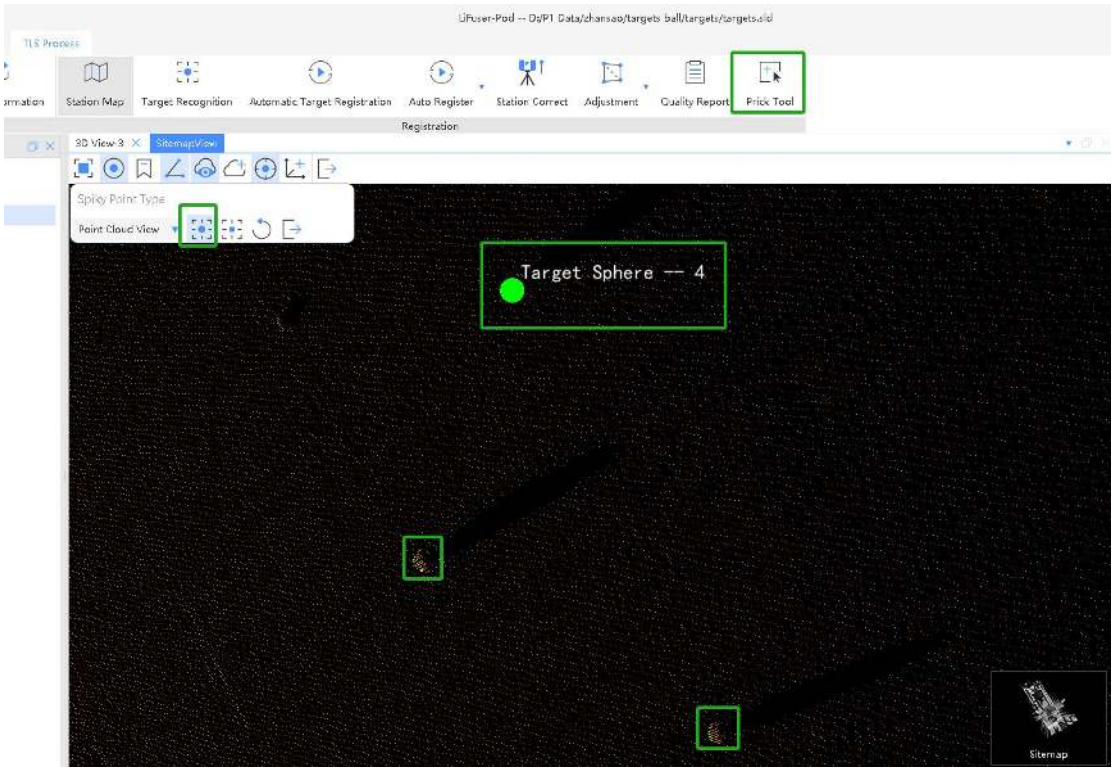
1.Click on the Target Recognition in TLS Process, enter the target sphere radius (the default target sphere radius is 72.5mm).



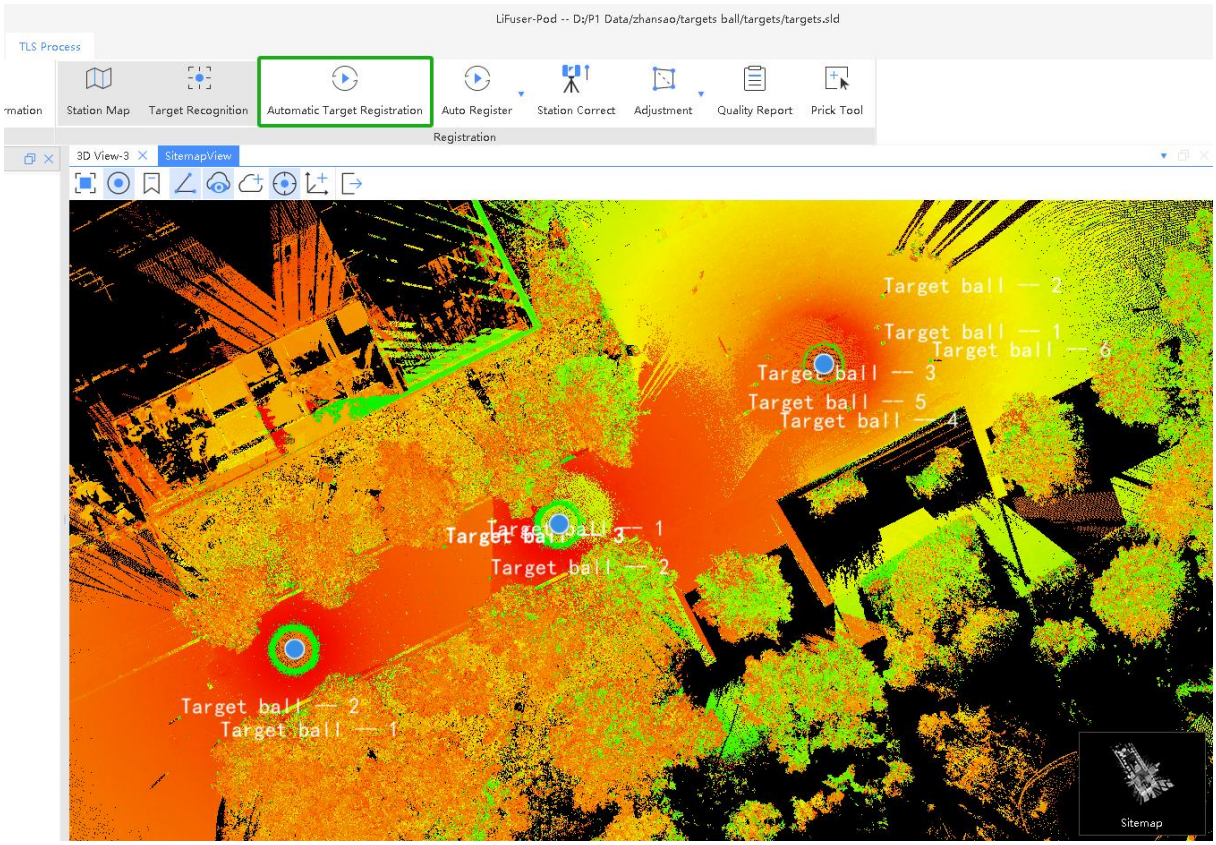


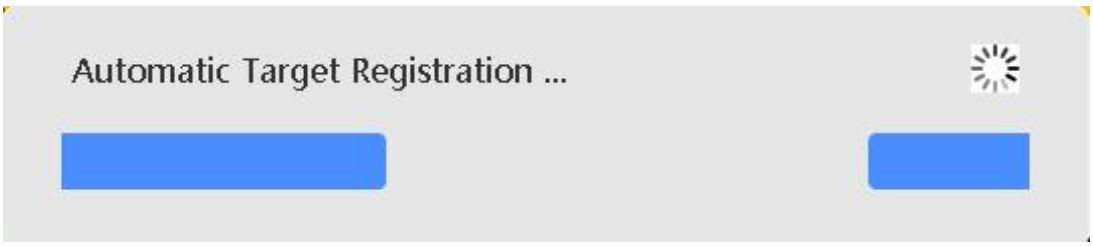


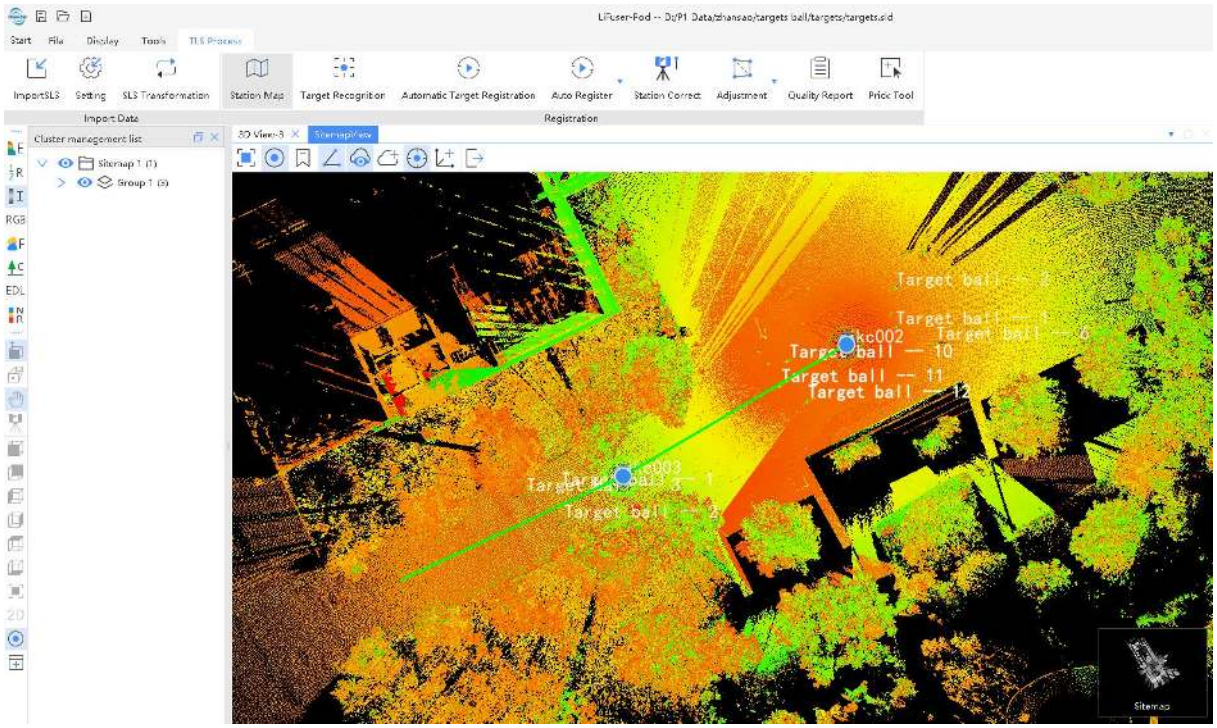
2. If some target balls are lost or incorrectly identified due to distance or poor placement, they can be manually identified. There is no need to consider the names of the target balls, as the registration is done through position matching rather than names. It is necessary to ensure that the common target balls at each station are identified before proceeding with automatic target ball registration.



3. Click on the Automatic Target Registration, data initialization, then the target balls will be automatically registered.

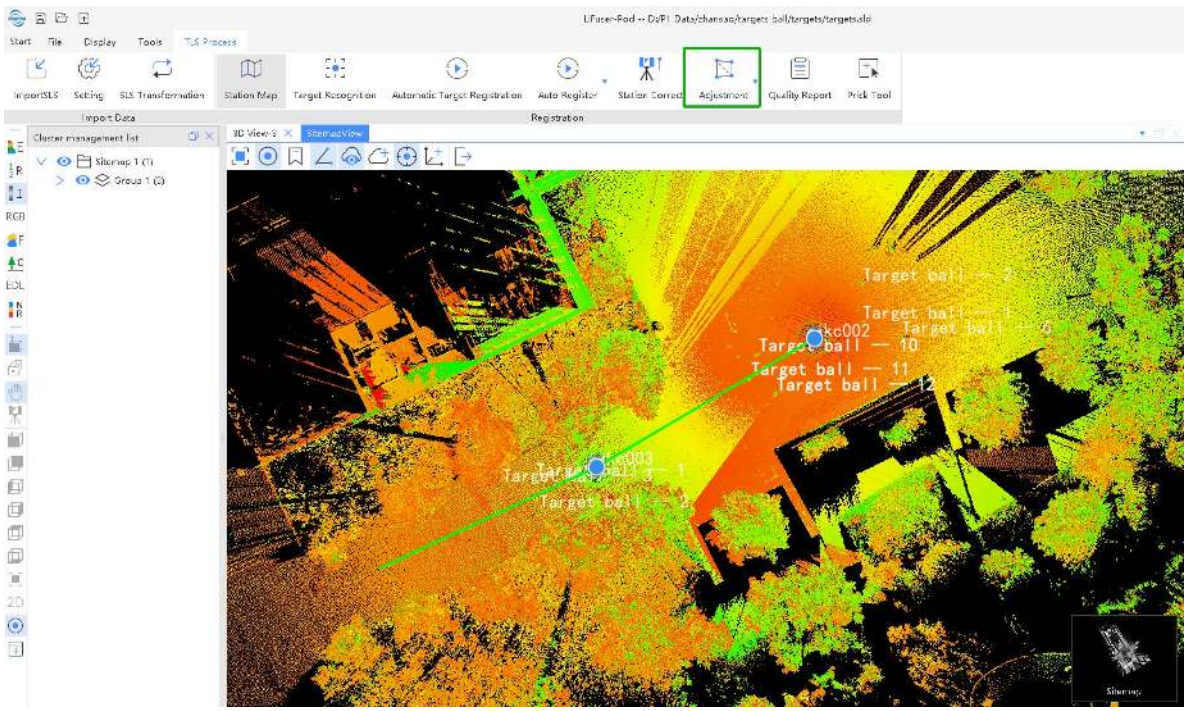






Attention: The automatic recognition of target spheres may occasionally miss some targets, which is related to the distance and angle between the target spheres and the station during fieldwork. If any target spheres are missed during automatic recognition, please manually identify them before proceeding with the automatic target registration. If the target sphere recognition is poor, it may result in registration failures. In such cases, please manually register the target spheres that fail to register automatically.

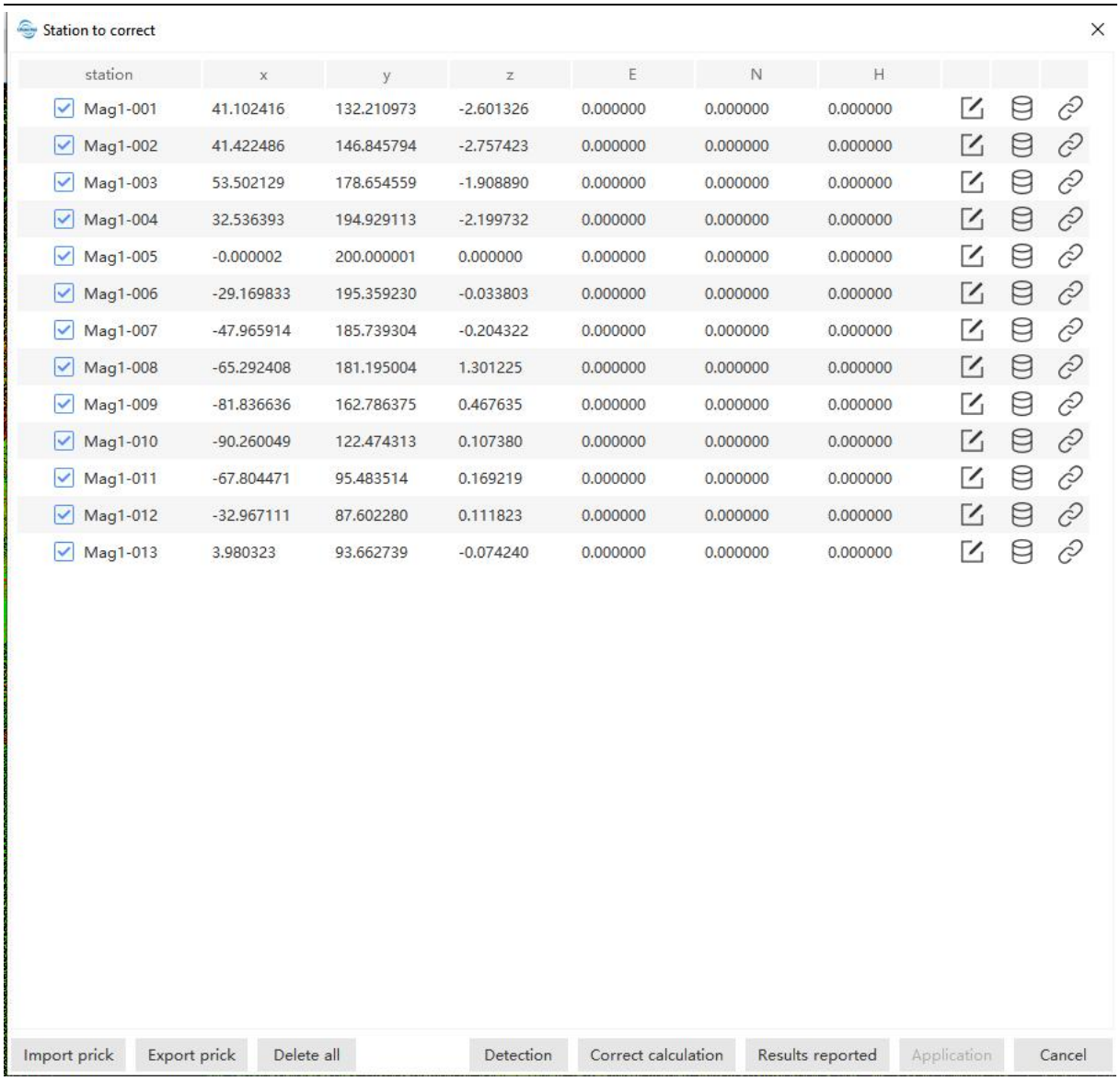
4.Click Adjustment.



5.Check the Registration report. Click the Quality Report and select to open the successfully exported report.

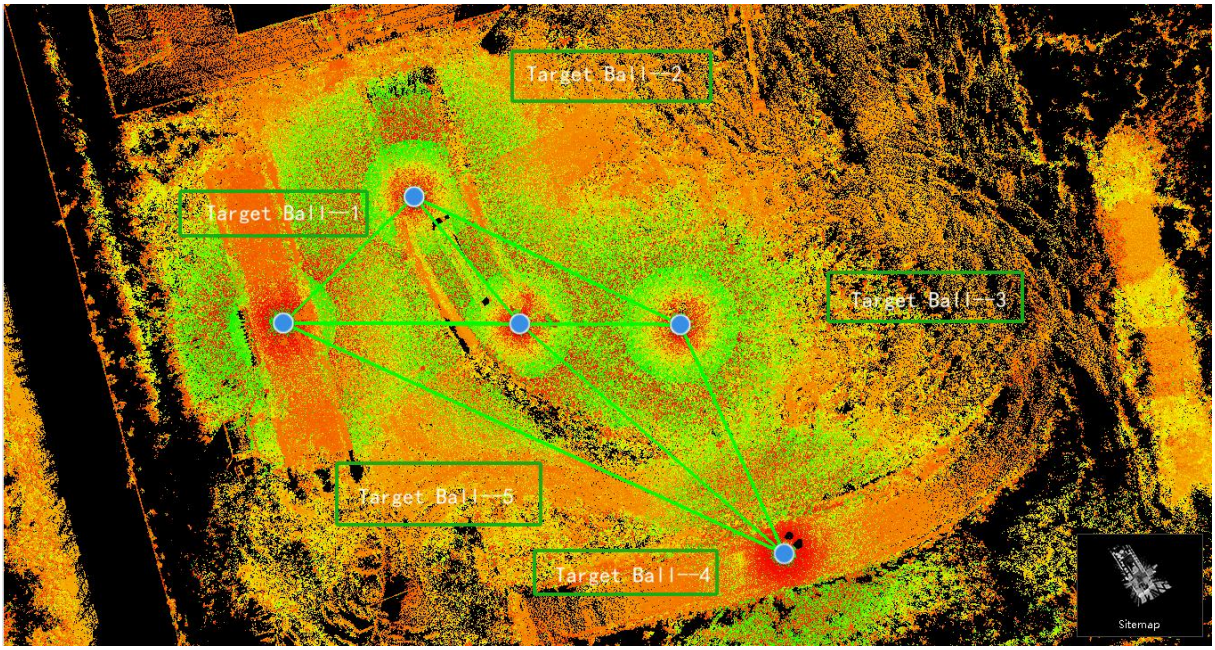
2.5 Station Correction

Station Correction is to correct the station position manually or by importing station/target point coordinates, thereby assisting in registration and improving the registration success rate and accuracy. If the user is using the standard carbon fiber tripod and does not have the function of centering and leveling, it is impossible to input the station coordinates.



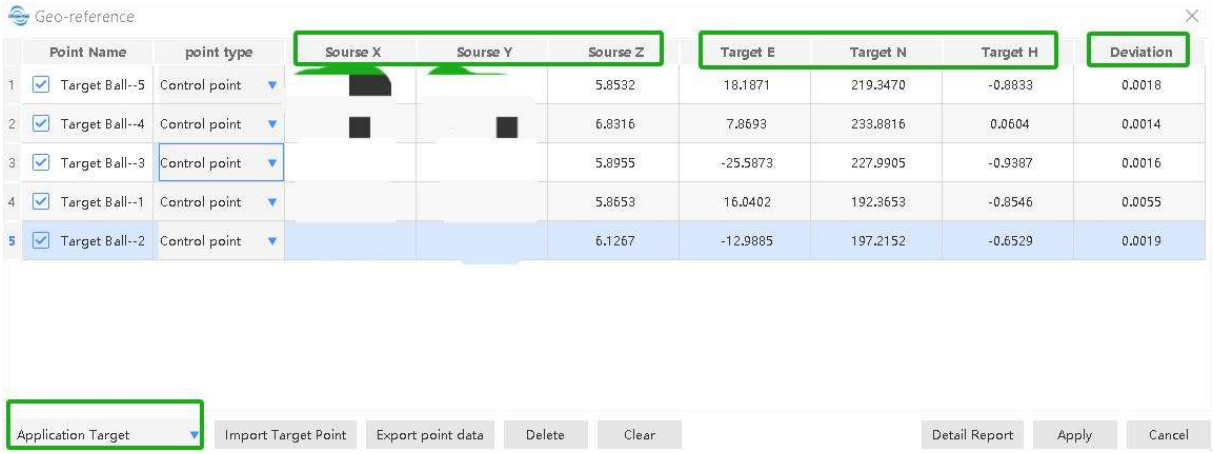
2.6 Absolute coordinate transformation

1.Firstly, ensure that all sites have been registered, which is a prerequisite for inputting absolute coordinates. The conversion to absolute coordinate can be achieved through target balls or feature points. Below is an explanation using target spheres as an example.



Registration can be completed either automatically or manually, and target ball identification can also be achieved through automatic or manual recognition. For specific steps, please refer to the content in the previous chapters.

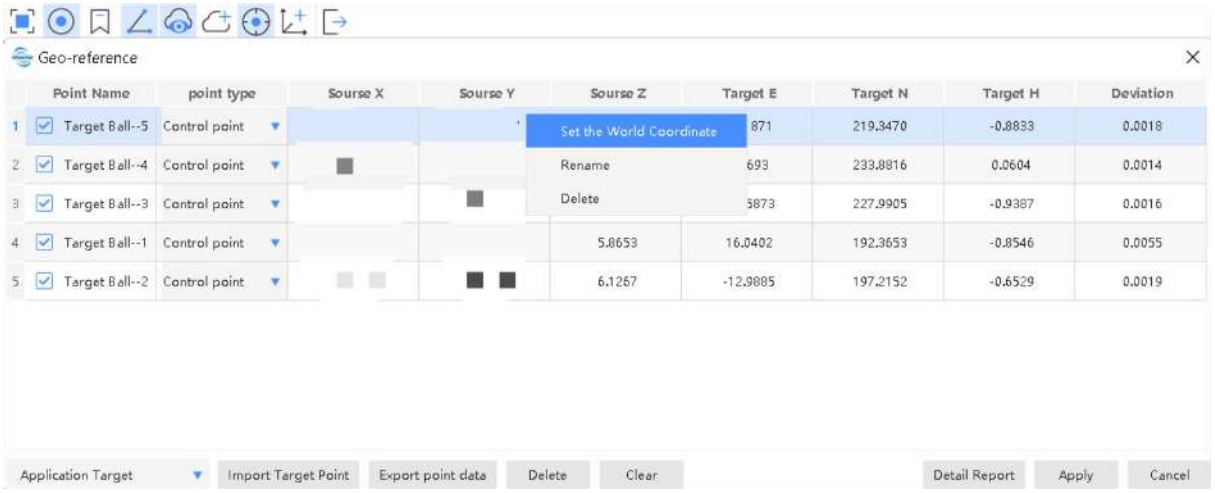
2.Prepare the absolute coordinates of the target ball or feature point in advance, and correspond them one-to-one with the identified target balls. If the names and coordinates do not match, it will lead to confusion during the coordinate transformation process.



Source (XYZ) is the original coordinate after registration, and target (ENZ) is the absolute coordinate that needs to be imported.

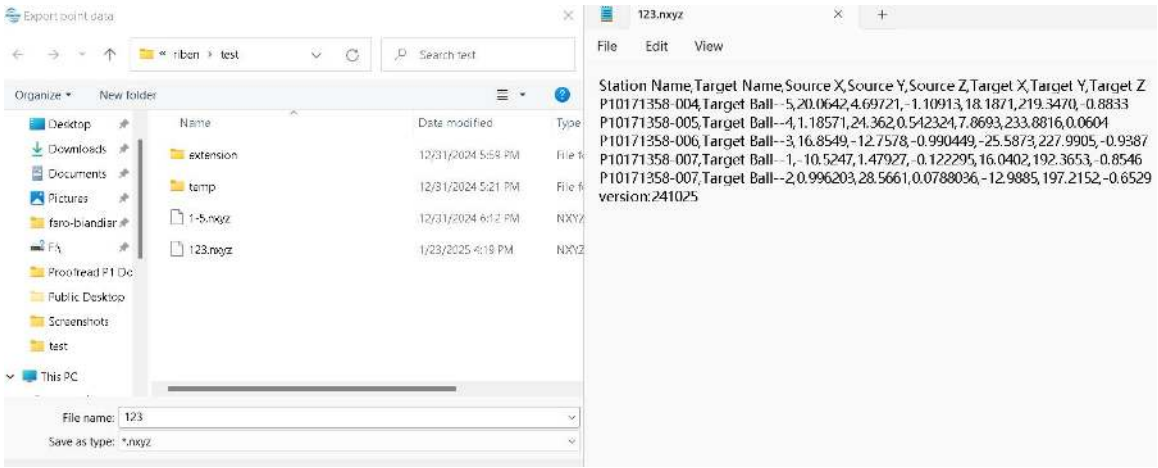
3. There are three options for coordinate transformation.

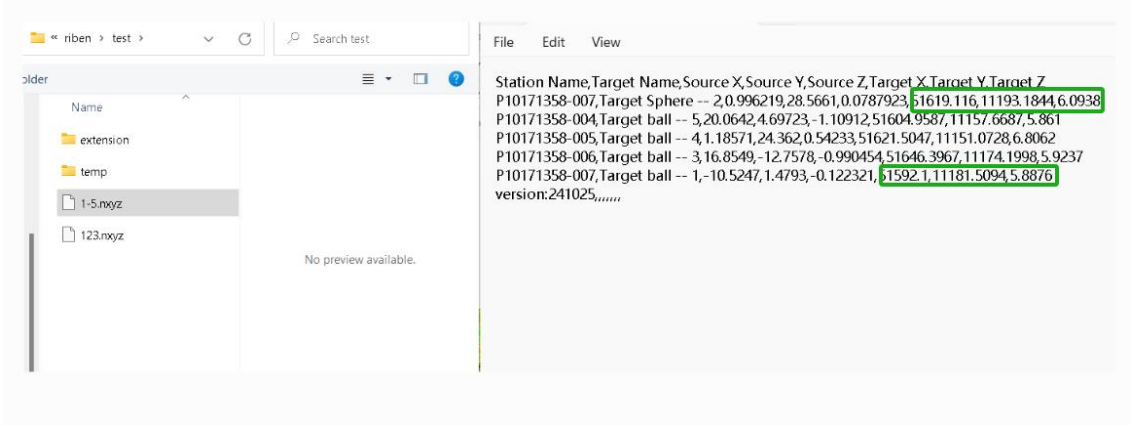
The first method: Manually input coordinate values one by one.



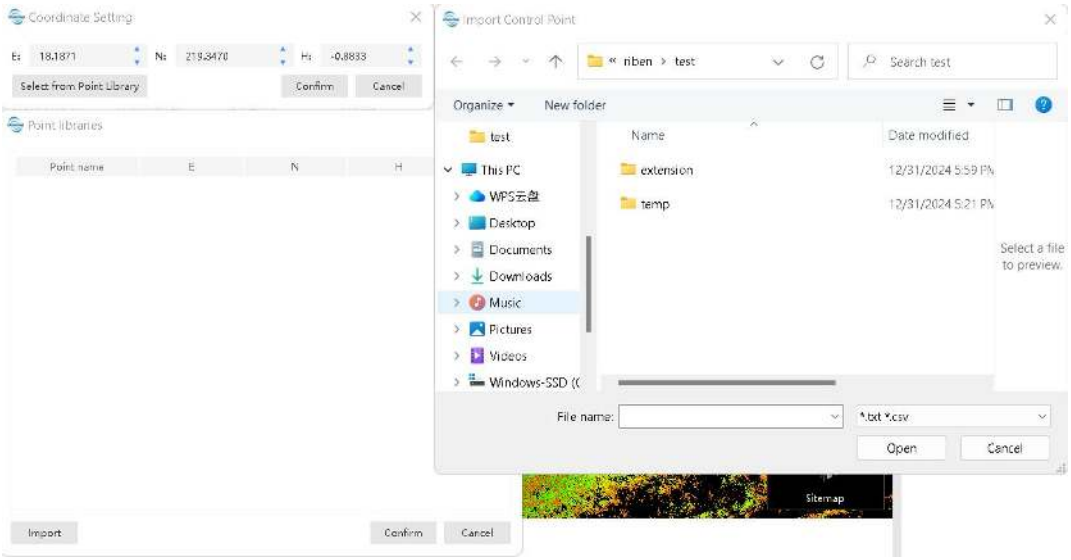


The second method: Export the file template first, fill in the absolute coordinates and complete them before importing.

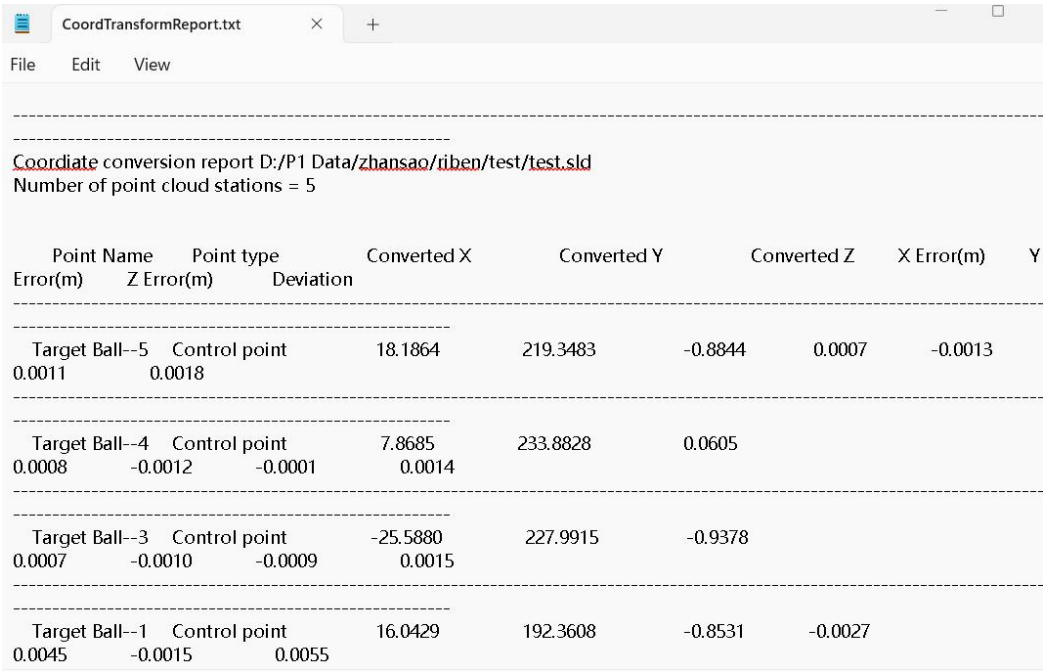




The third method: Import the center coordinates of the target spheres through CSV or TXT files (exported from the RTK device).



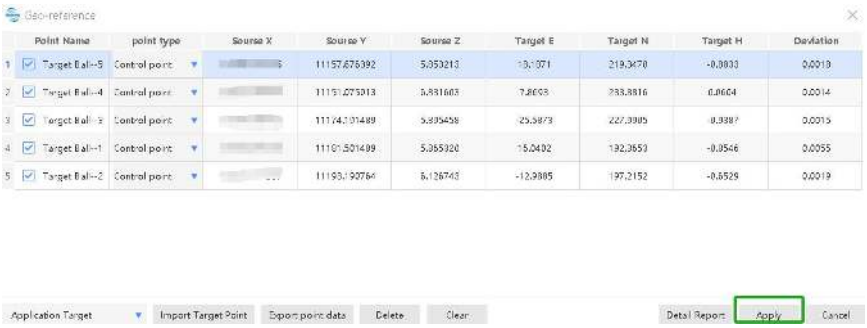
4. After completing the input, you can view the error situation of the import through the report, and click apply to complete the coordinate import.


CoordTransformReport.txt

File Edit View

Coordiate conversion report D:/P1 Data/zhansao/riben/test/test.sld
Number of point cloud stations = 5

Point Name	Point type	Converted X	Converted Y	Converted Z	X Error(m)	Y Error(m)	Z Error(m)	Deviation
Target Ball--5	Control point	18.1864	219.3483	-0.8844	0.0007	-0.0013	0.0011	0.0018
Target Ball--4	Control point	7.8685	233.8828	0.0605	0.0008	-0.0012	-0.0001	0.0014
Target Ball--3	Control point	-25.5880	227.9915	-0.9378	0.0007	-0.0010	-0.0009	0.0015
Target Ball--1	Control point	16.0429	192.3608	-0.8531	-0.0027	0.0045	-0.0015	0.0055



3 Other contents (display, toolbar)

3.1 Display Bar

Rendering mode: Include various display modes such as elevation, intensity, RGB, file, category display, etc. Different display modes can be selected according to needs, among which EDL mode can improve the edge effect of displayed objects.

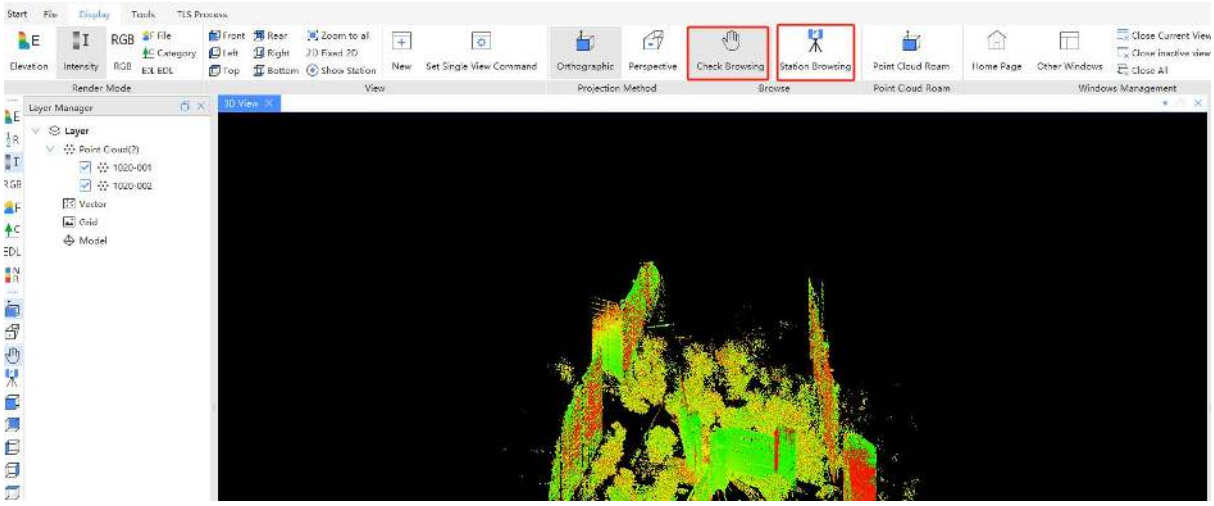
View: Contain commonly used 6 views and some view tools that can be used as needed.



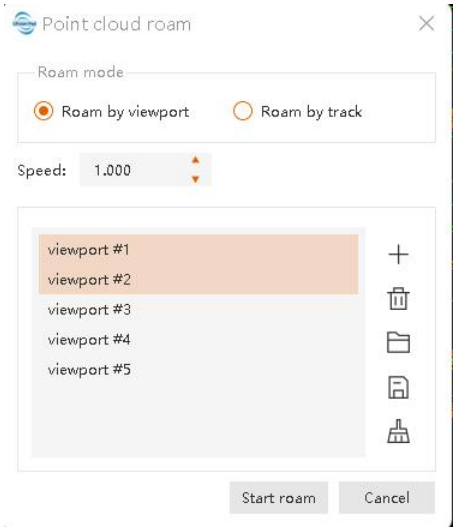
Projection method: You can create a new view, and in the single view settings, you can set

the background color, point size, and number of displayed points. The more points you set, the better the display effect, but the higher the computer load.

Browse: It can be based on inspection browsing, which is the third perspective browsing method; Based on station browsing, the person's vision is moved to the scanner position for browsing, which allows for 360° viewing of point cloud data with better display effects.



Point Cloud Roam: There are two options available: Roam by viewport or Roam by track. Viewpoint roaming requires setting different viewpoint positions, while trajectory roaming requires importing trajectory files in txt format.



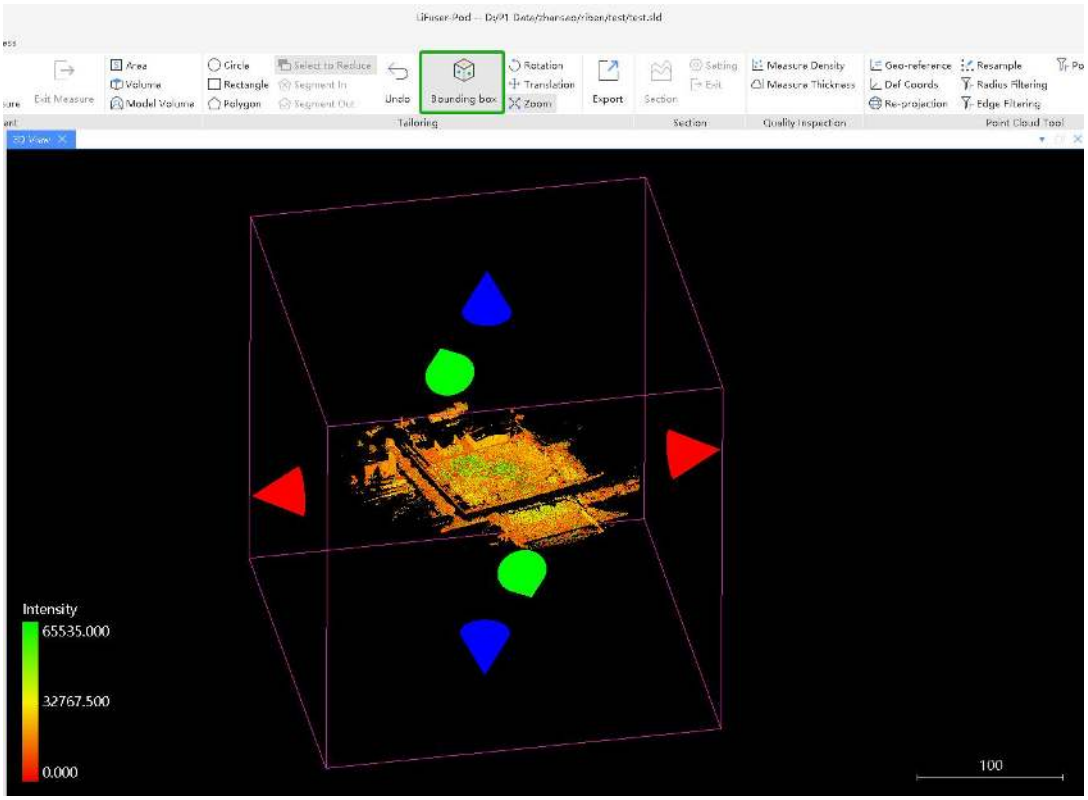
Windows Management: Support closing, hiding, or displaying windows.

3.2 Tools

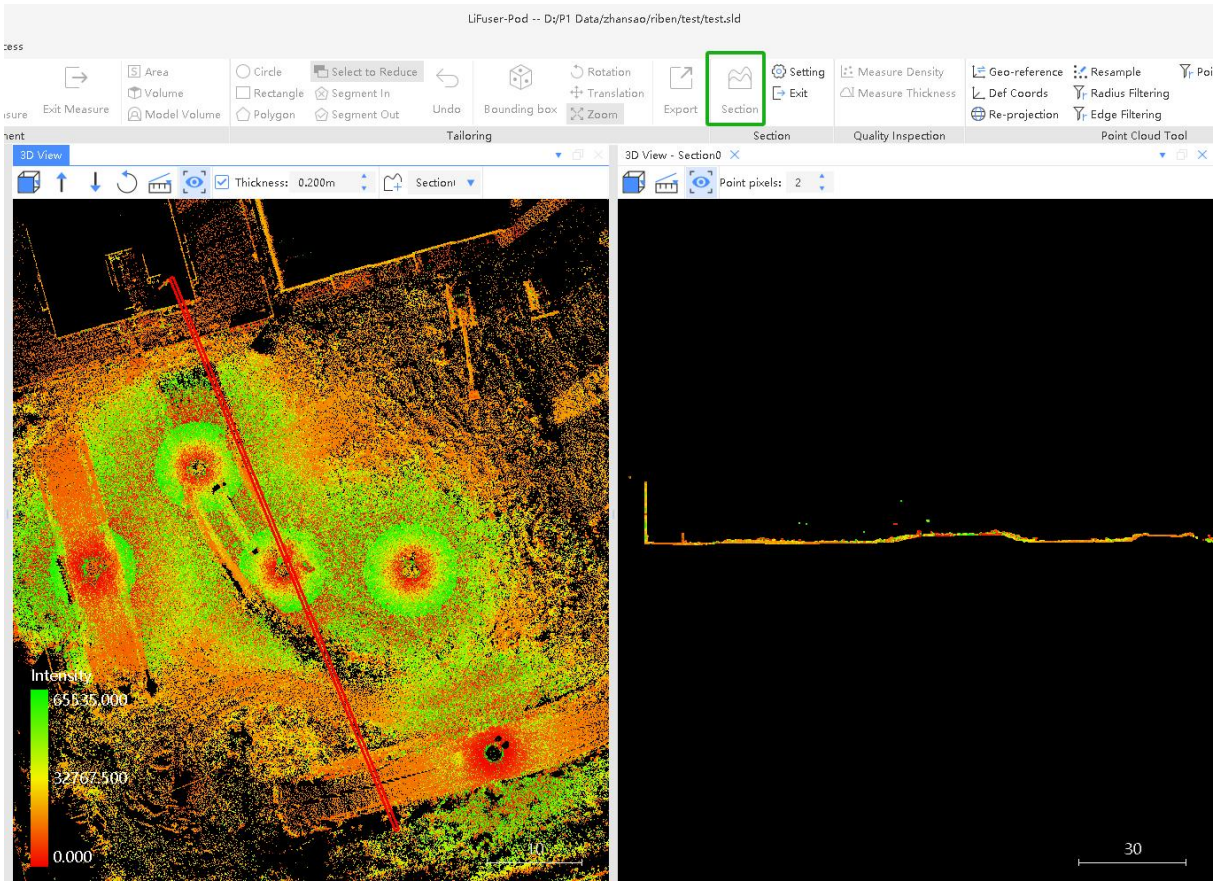
Measurement: Include point measurement, distance measurement, length measurement, area measurement, volume measurement and other functions.

Tailoring: Include tools for cutting rectangles, circles, etc., with internal and external cropping modes.

Here is also a Bounding box function that allows for Rotation, Translation, Zoom. The cropped content can be exported.



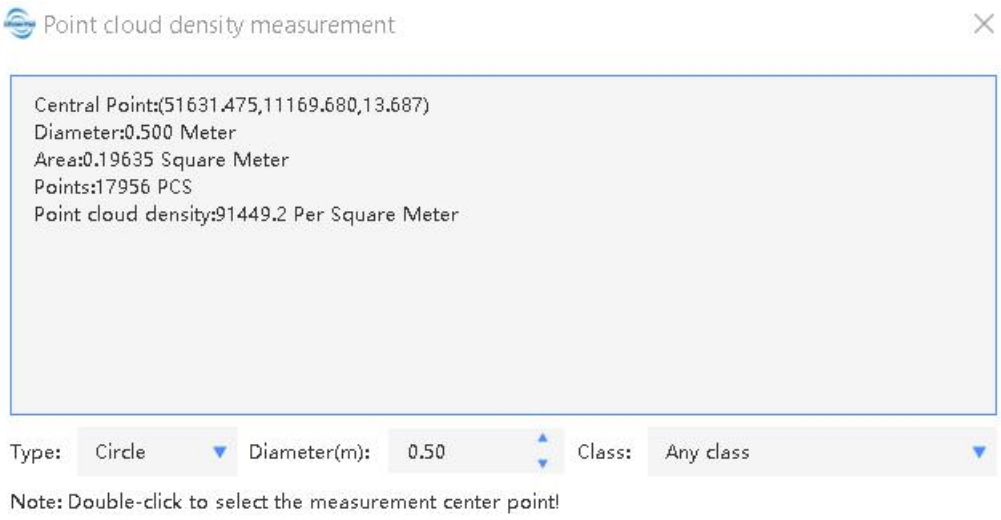
Profile: Perform vertical profile operations to view the thickness of the ground or wall, and set the thickness and pixel values of the profile.



Quality inspection: Include two functions: density measurement and thickness measurement.

Density measurement is mainly used to evaluate the number of point clouds per unit area;

Thickness measurement mainly evaluates the thickness of point clouds.





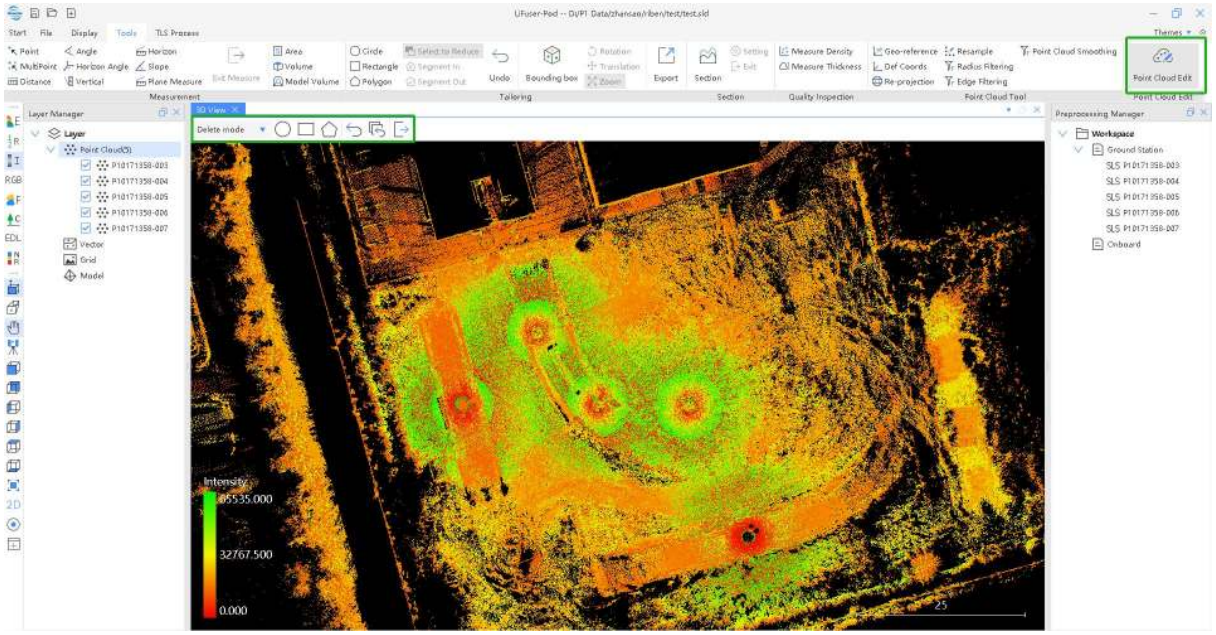
Point Cloud Tool:

Resample : Support various methods for resampling point clouds, including minimum point spacing sampling, octree sampling, and sampling rate sampling. These techniques can reduce the volume of the point cloud, but they may also diminish its analytical capabilities.

Point Cloud Smoothing and Radius Filtering are both filtering tools for point clouds that can reduce noise.

Edge Filtering: Mainly used to filter out trailing images at the edges of objects, which is very useful for denoising.

Point Cloud Editing: This tool allows for the deletion of points within the point cloud and supports the undo function.


Point Cloud Edit
Delete mode
Intensity
65535.000
32767.500
0.000