SinoGNSS
By ComNav Technology Ltd.

LS600 User Manual 2025

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Content

1 Product Overview

The LS600 is a highly integrated, high-precision handheld 3D real-world reconstruction device that supports real-time data viewing, instant reconstruction upon capture, and ready-to-use data export. It is available in two models based on liDAR configurations: 16-channel 120m and 32-channel 300m. Its key features include:

1. Real-time RTK Integration: This function enables direct output of point clouds in the projected coordinate system without post-processing, eliminating layering issues in the RTK-assisted point clouds.

2. Real-time RTK Survey: When transitioning from outdoor to indoor environments, users can directly obtain absolute RTK coordinates for indoor locations using the device.

3. High-precision Point Cloud Post-processing: With RTK disconnection or when control points are spaced less than 100m apart, the post-processed data achieves a precision (RMSE) of 3cm.

4. Exceptional Point Cloud Density and Color: Capable of reaching up to 1 million points per square meter.

2 Basic Operation

2.1 Battery Installation

1. Press the tabs on each end of the instrument toward the center.

2. Insert and fasten the batteries in alignment.

Note: Failure to lock the battery securely may result in the device slipping.

2.2 Function Key Operation

Function	Button Operation	Device Status
Power On	Press the button twice, one short press and one long press, the long press lasts up to 4 seconds.	When the indicator starts blinking green and changes to solid green, it indicates that the unit is in standby mode.
Power Off	Press and hold for 4 seconds	While in standby mode, long press for 4 seconds. The indicator light will change from solid green to flashing white, indicating the system is saving data. The device powers off once the indicator turns off.
Start Scanning	In standby mode, double-click the button.	The indicator light will switch from solid green to fast-flashing green, then slow-flashing green. The LiDAR will begin to rotate, indicating that scanning has successfully started, and the device has entered scanning mode.
Stop Scanning	In scanning mode,	The indicator light will change from slow-flashing green to fast-

	double-click the button.	flashing green, then solid green. The LiDAR will stop rotating, indicating that scanning has successfully stopped, and the device has returned to standby mode.
Control Point Collection	In scanning mode, single-click the button.	The indicator light will stay on for about 1 second, then return to slow-flashing green. This indicates successful control point recording.
Switch to USB Mode	In standby mode, single-click + indicator light turns white + single-click	After a single click, the indicator light will turn white and remain for up to 3 seconds. During this white light period, single-click the button again to switch to USB mode. If no further action is taken within 3 seconds, the device will remain in its original mode.

Note：

1. Before starting the scan, ensure the device is placed on a flat surface. Once the LiDAR begins rotating after initiating the scan, you can move the device to begin scanning.

2. During the stop-scanning process, a fast-flashing green light indicates that the device is saving the scan files. Powering off during this time may result in file loss or incomplete file saving.

3. The saving period (device light fast-flash green) after stopping the scan may vary based on the size of the scanned environment.

2.3 Indicator Light Descriptions

Indicator Light Status	Meaning
No light	Device not started
Slow-flashing green light	Scanning mode
Solid green light	Standby mode
Solid blue light	USB mode
Solid yellow light	Device not activated
Solid red light	System error
Slow-flashing blue light (~30s)	Powering on
Solid white light	Switching between standby and USB mode
Fast-flashing green light	Scan starting/stopping
Light alternates between red and green	Upgrading

2.4 Data Transfer Instructions

To transfer data, connect the device to a computer using the provided USB cable while the device is in standby mode. Use the app or the power button to switch to USB mode. Once the device is recognized, you can proceed with data copying.

Notes:

1. The USB mode will automatically disable after a device restart.

2. If you want to continue scanning after enabling USB mode without powering off or disconnecting the device, you must manually exit USB mode.

3. Using other USB cables may result in slower transfer speeds or other issues.

4. A common problem could be that the USB cable could only be recognized in one direction. When rotating the Type C port 180 degrees, with the other side pointing up, it cannot be recognized by the device.

2.5 Usage Precautions

1. The LS600 is a precision surveying device. Dropping it or subjecting it to impacts may cause damage, leading to malfunctions or inaccurate measurements.

2. Ensure that the LiDAR rotates freely without any external obstructions when the device is powered on. At the same time, avoid obstructing the radar and camera’s field of view, as this may cause mapping failures and color anomalies..

3. The metal base ensures stability and thus accuracy during initialization process. Avoid initializing on uneven surfaces, as this may cause initialization failure or thicker mapping layers.

4. When using the device, try to avoid rapid rotations or fierce shaking, as excessive movement may lead to mapping failures or reduced mapping accuracy. Additionally, when using other vehicles like cars for mapping, place proper shock absorption to prevent high-frequency vibration.

5. The LS600 is rated IP54 for water resistance. Do not use the device in conditions exceeding this protection level. For device maintenance, clean the device with a soft, dry cloth or the cloth provided in the case.

6. Do not block the ventilation areas during operation. Significant obstruction can reduce cooling efficiency, causing the device to overheat and shut down automatically.

3 Device Activation and Connection

3.1 Scan Master Introduction

Scan Master is a mobile app that comes with the LS600 scanner. Its functions include viewing and managing projects. With this app, the management of digital 3D spatial assets is streamlined and efficient.

3.2 Recommended installation environment

Recommended phone configuration :

Module	Specs
System	Android
CPU	Recommended Snapdragon series, preferably Snapdragon 8 or above
Random Access Memory	Minimum 8GB
Display chip	It is best to have an independent display chip
Other	it needs to support Bluetooth and Hotspot function; larger storage memory preferred; and longer battery life preferred.

Recommended :

Brand	Product	Processor CPU	Random Access Memory	Graphics card GPU
ComNav	P6	8-core processor 2.0GHz	4/6GB	Adreno 730

3.3 Device Activation

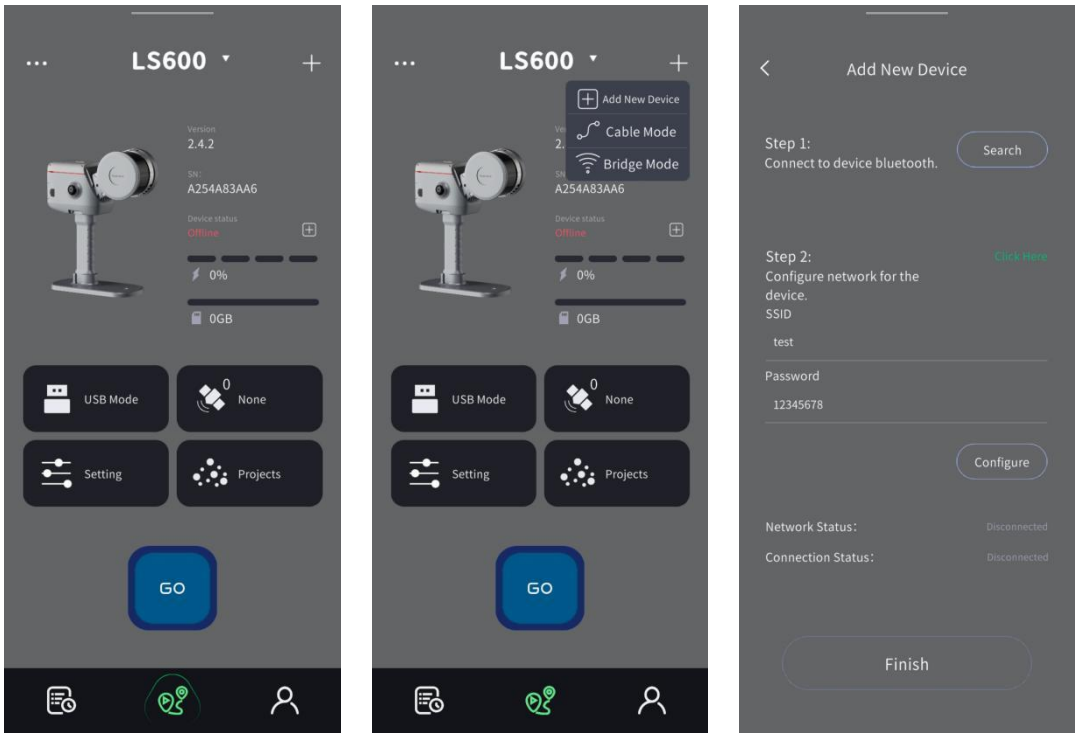
3.3.1 Switch language

By clicking on the upper right corner of the screen to switch languages. The app currently supports Simplified Chinese and English.

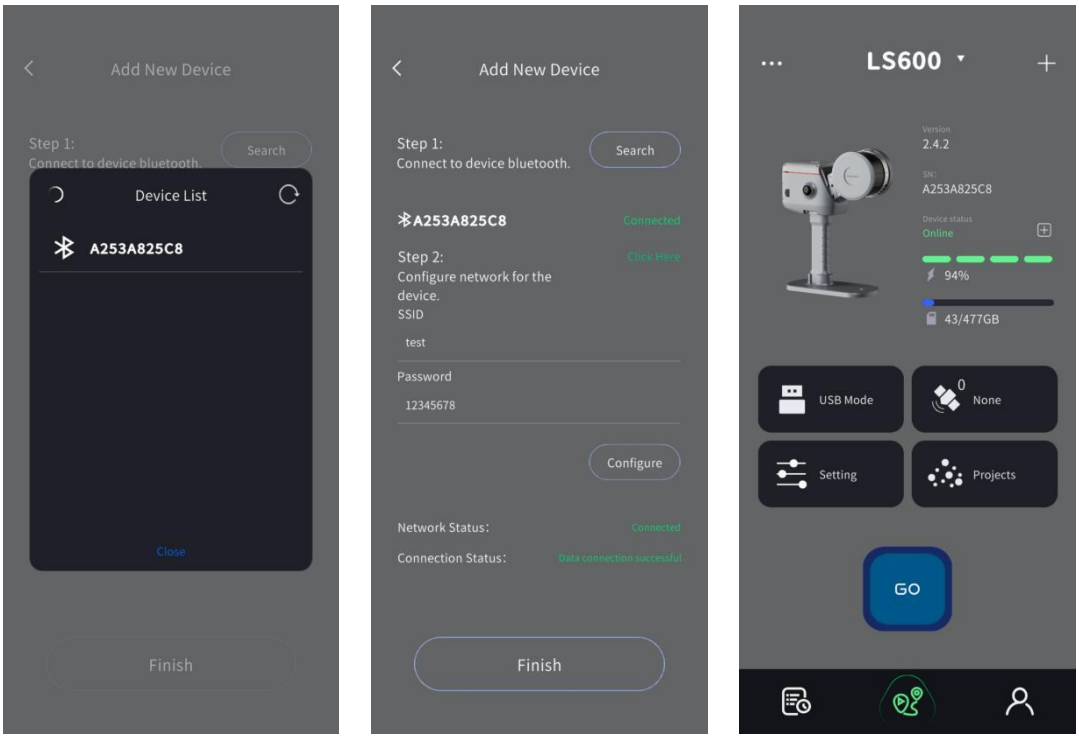
3.3.2 Add a New Device

Press and hold the power button to turn on the LS600. The indicator light changing from fast-blinking blue to steady green indicates a successful startup.

Direct Connect Mode: Click Add a new device, allow permissions, and then follow the steps.



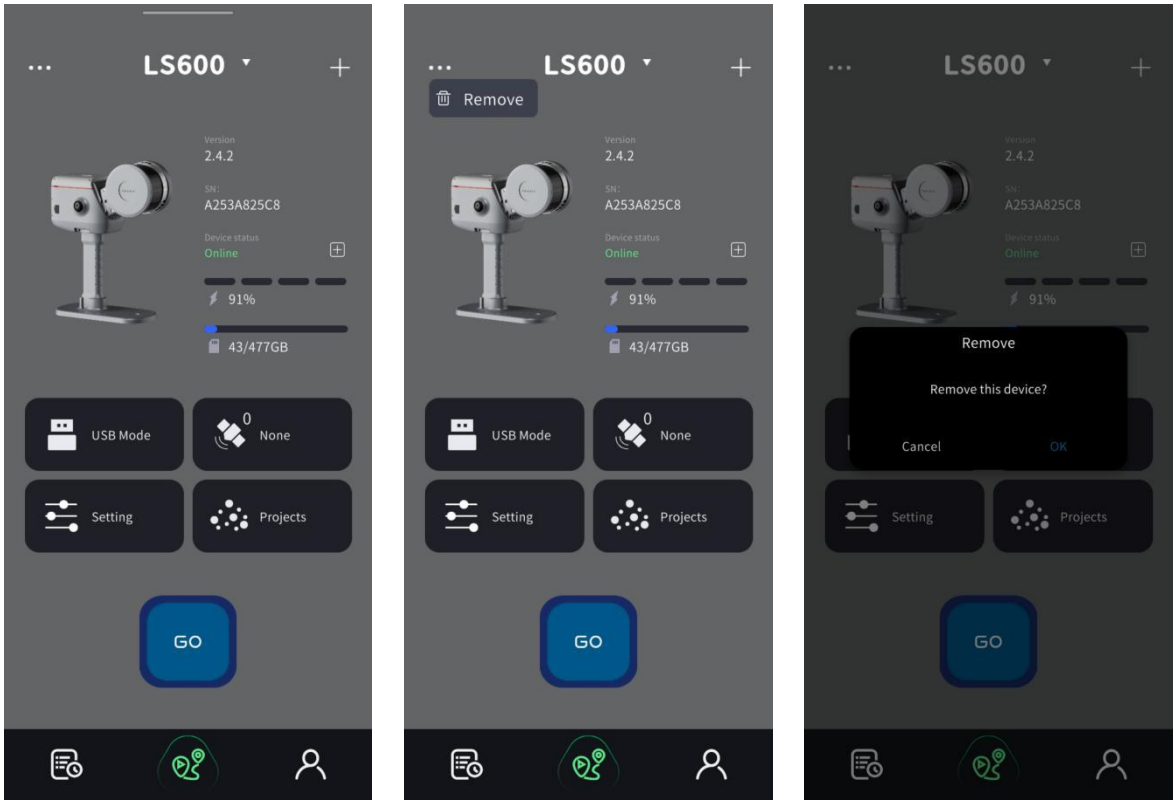
First, turn on the phone's Bluetooth, search for and connect to the corresponding device's Bluetooth. Secondly, configure the network for the device by turning on Hotspot [set the Hotspot name and password as simple as possible] and entering the Hotspot information. Click on Configure, and the device will automatically connect to the phone's Hotspot.



When Network Status becomes "Connected" and Connection Status reads "Data connection successful", click "Finish". You will be directed back to the home page where the basic information of the connected device is shown.

3.3.3 Device Management

In the device interface, click and pull down the device name at the top of the screen to manage connected devices. Click Remove Device to remove the connection to the device.



3.3.4 Device Activation

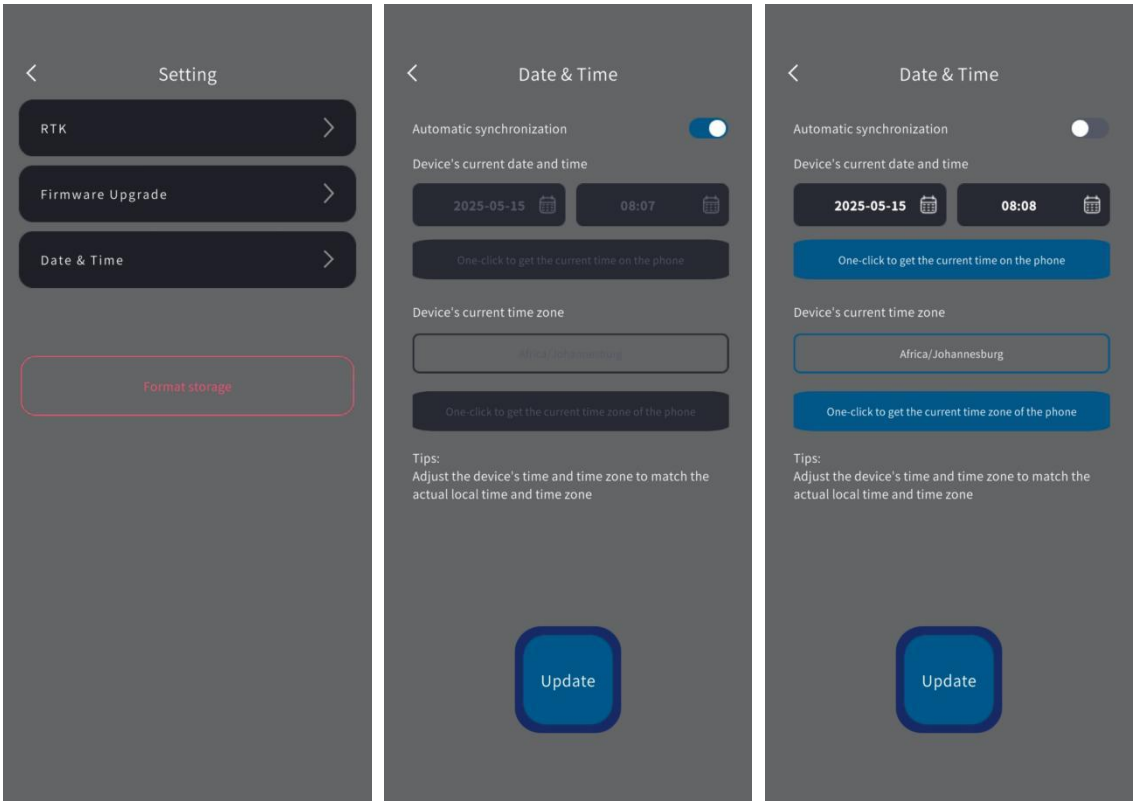
Click "Go", and confirm the activation and binding of the device.

4 Scan

4.1 Connected the device

Click "Go" to enter the scanning standby page.

The device undergoes time calibration before leaving the factory, but if it is stored for an extended period, the device's time may become inaccurate. The automatic synchronization switch in LS600 is turned on by default, which will automatically synchronize the device's time with the time on your phone. Users can also customize the device's time settings through LS600. It is recommended that the device's time and time zone match the actual time and time zone of its location.



4.2 Start Scanning

After the scanning mode selection is completed, the LiDAR scanner will start. The indicator light will turn green and will flash quickly. The app will prompt that static initialization has started, and then it will start a 15s static initialization countdown. During this process,

ensure that the device is always in a stable state. After the countdown ends and a pop-up window prompts that static initialization is complete, close the pop-up window, pick up the device, walk around, and start scanning according to the planned route.

Note:

①Keep the device stable during initialization.

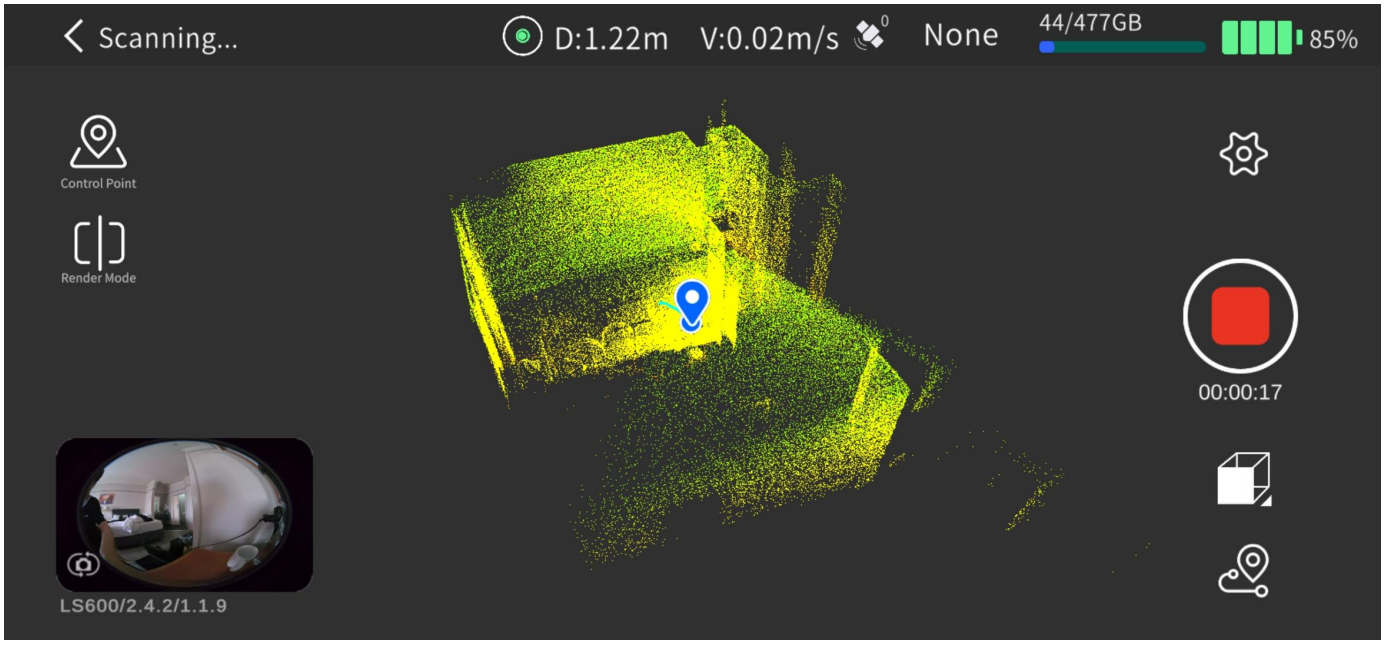
②When initialization is complete, lift the device slowly.

③During scanning, try to keep the device level and about half a meter in front of your chest.

④Walk at a normal pace when moving in a straight line, and slow down when turning.

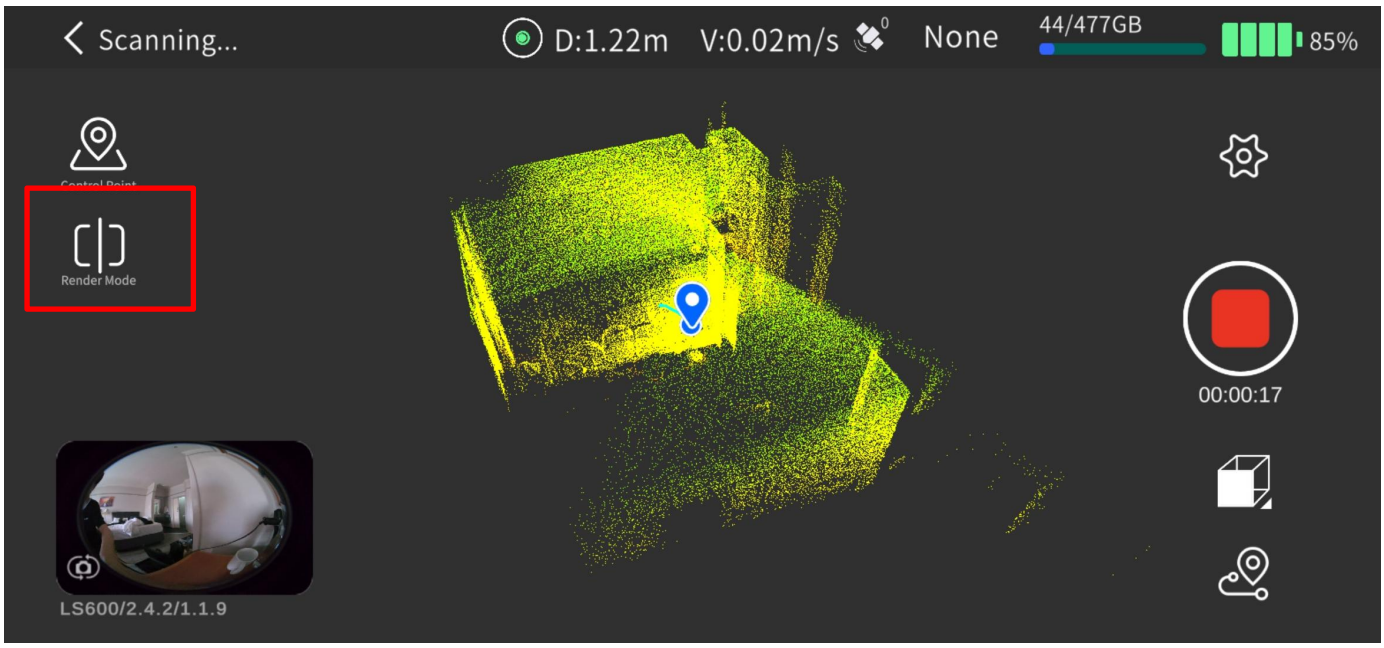
⑤When turning, try to walk in a figure-eight pattern.

⑥If you need a control point, you can align the marker on the base with the control point during scanning, and then press the power button once briefly.



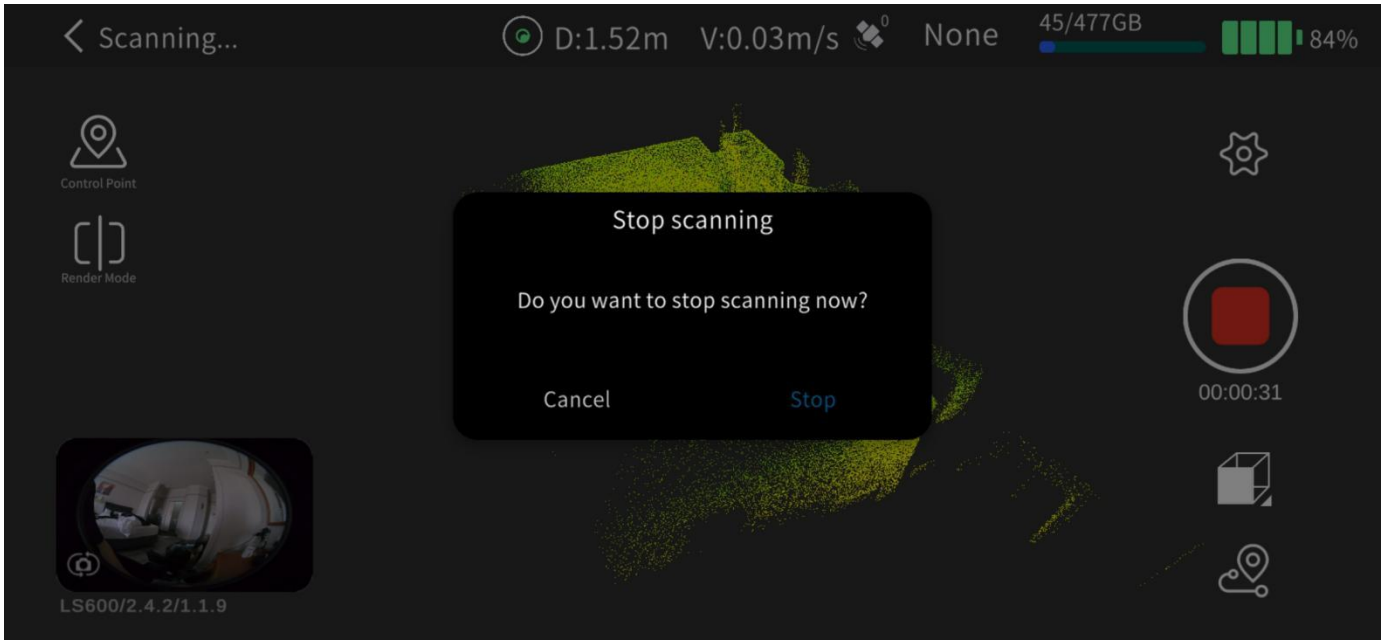
4.3 Rendering Mode

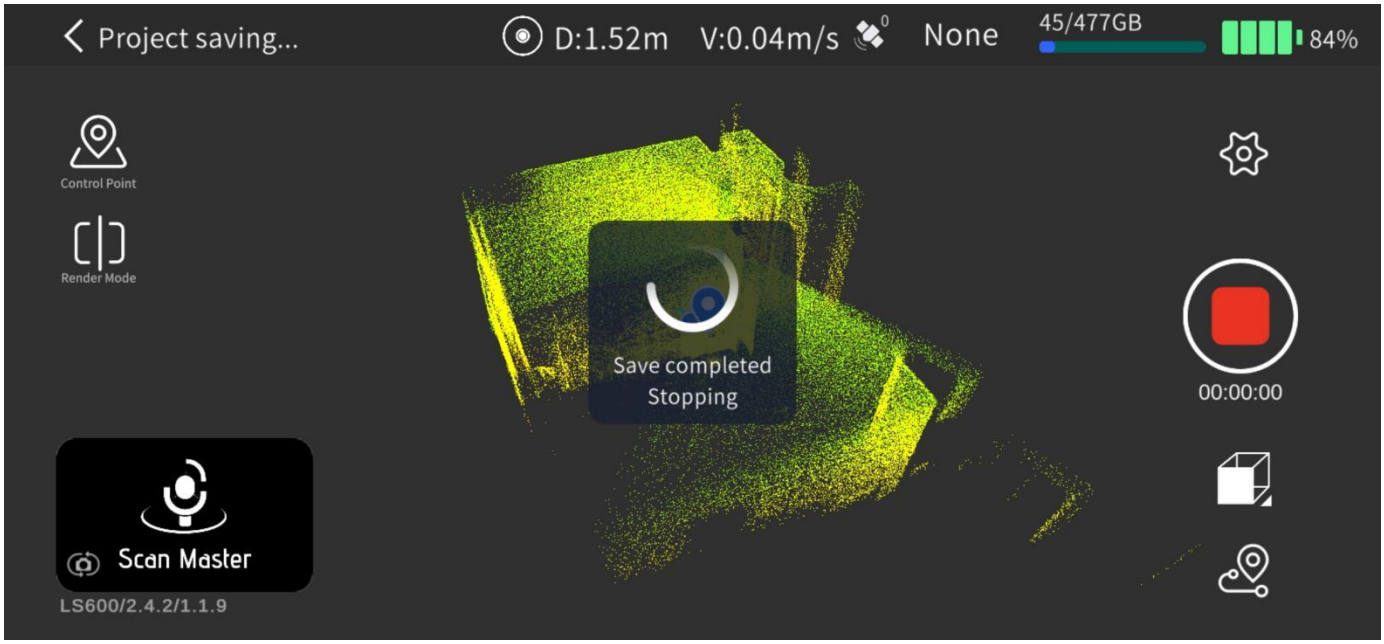
Click the "Render Mode" button on the left side of the screen to modify the real-time point cloud rendering method. Currently, there is one mode available: " EL " - elevation.



4.4 Stop Scanning

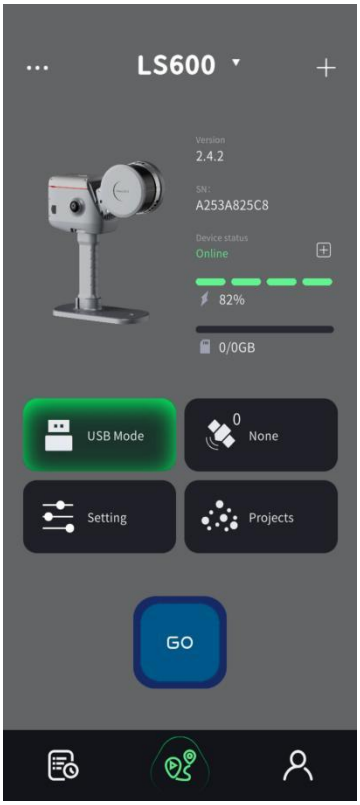
Click the red Record button on the right side of the screen. After confirming, the device's green light will flash quickly. The indicator light will turn green and stay on after the scanning is saved completely. Then you can shut down the device or start the second scan.





4.5 Downloading Scanned Data

Turn on the device, set the device to USB mode in the app, and then use a Type-C cable to connect the device to the computer.



In the model file in the directory of USB disk mode, select the corresponding project file And you can copy it to the appropriate directory of the computer.The project files name after the time of scan starting: ProjectName-year-month-day-specific time

4.6 Data Project File Structure

.hbc is the raw sensor data recorded by the device.

File or folder name	Files in the subdirectory	Introduction
xxx.hbc	-	raw sensor data recorded by the device.
map.las	-	the point cloud data directly output by the scanning device in real time.
project_data	control_points.csv	A file that records control point information when using the app to add control points.
	gnss.csv	A file that records GNSS information when using RTK.
	poses.csv	Record the trajectory file during the scanning process.
	project.json	Record device-related information.
	log	The log folder records the relevant log information of the device.
external_data	-	This folder is empty when the data is initially copied from the handheld device. It is mainly used to copy and store external file data required for post-processing in CRE, such as video files of external panoramic cameras and gnss.csv files after coordinate conversion.

Please note: The direct point cloud data is downsampled. If you need complete point cloud data, please use Realeditor software for post-processing.

5 Acquire Point Cloud Data with Absolute Coordinate

5.1 Through Existing Ground Control Points (GCP)

You can achieve coordinate conversion through the existing Ground Control Points (GCP) you marked during the scan, by which the accuracy of the point cloud data can be optimized as well.

Note: The number of control points in the scanning area is determined according to the accuracy requirements. And the layout of control points should be evenly distributed. To ensure subsequent coordinate conversion to be successful, at least 3 or more control points reasonably distributed are required for a single scan. The more high-precision control points covered by scanning, and the more evenly distributed, the higher the accuracy will be. Control points should not be located on the same line.

5.2 Through the RTK Module

With the RTK module, absolute coordinate information can be directly obtained during the scanning process, and the overall accuracy of point cloud data can be improved.

Note: In order to ensure good performance, please use this mode to scan when the outdoor RTK signal is good.

6. Data Post-Processing——CRE ComNavRealEditor

CRE ComNavRealEditor(Abbreviated as CRE) is a 3D processing software, providing project post-processing, point cloud and other data viewing, editing, processing services and industry applications for LS series handheld scanner, bringing breakthrough 3D data productivity.

Specifically, CRE ComNavRealEditor mainly includes the following modules:

Project processing module: mainly used to process the data obtained by LS series handheld scanner. Including project processing, map fusion, and accuracy check.

Tool Module: mainly used for point cloud data post-processing, including basic point cloud denoising, resampling, measuring, etc.

Applications module: mainly include applications such as volume calculation and Mesh reconstruction.

6.1 Software Installer Download

Please use the official download link provided for the software installer.

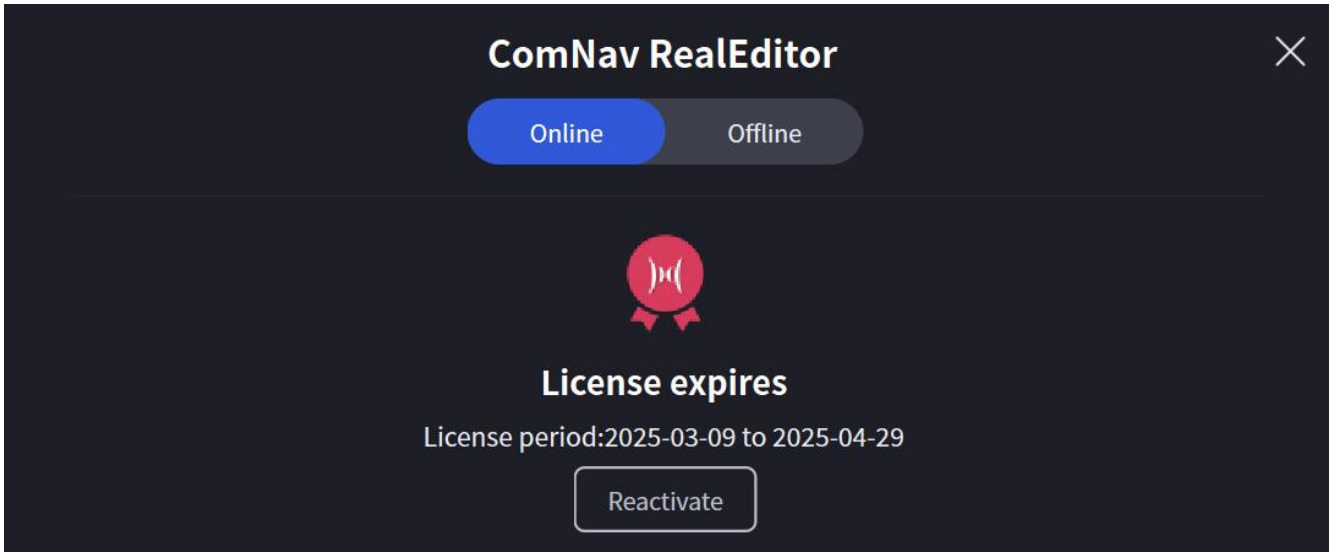
6.2 Recommended Computer Configuration

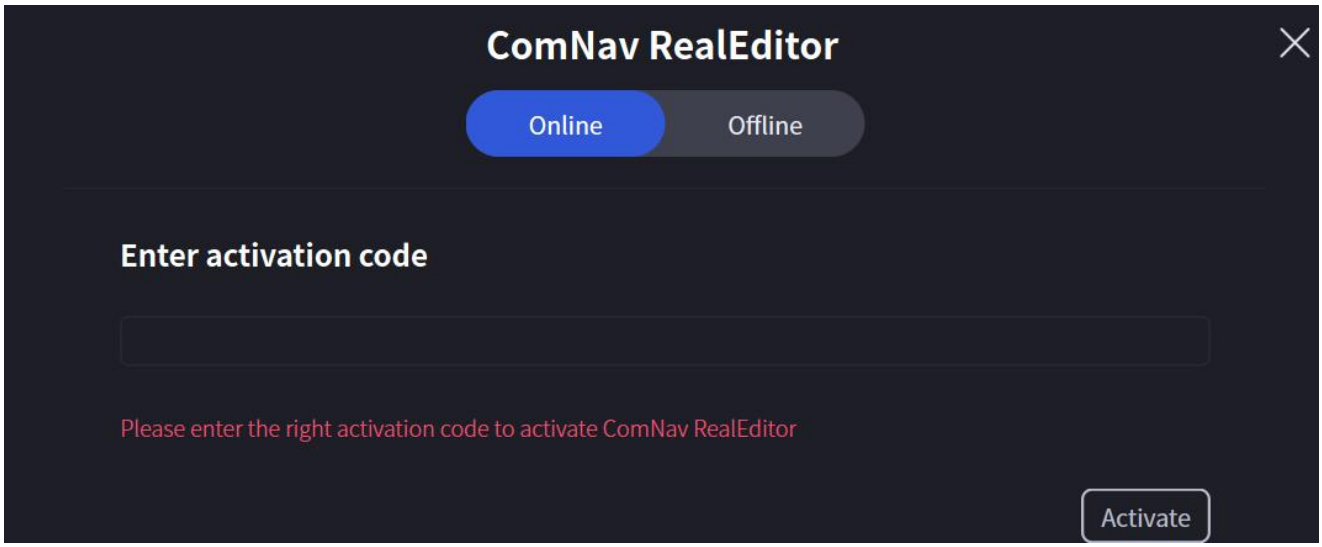
Category	Basic Configuration	Recommended Configuration
Operating System	Windows 10 / 11 (Professional, Home)	Windows 10 / 11 (Professional, Home)
CPU	Intel Core i7 (11th generation)	Intel Core i9 (12th generation)
GPU (Graphics Card)	NVIDIA GeForce RTX 3060 or above	NVIDIA GeForce RTX 3070 or above
Memory (RAM)	64 GB	64 GB
Storage	1 TB (HDD or SSD)	1 TB SSD

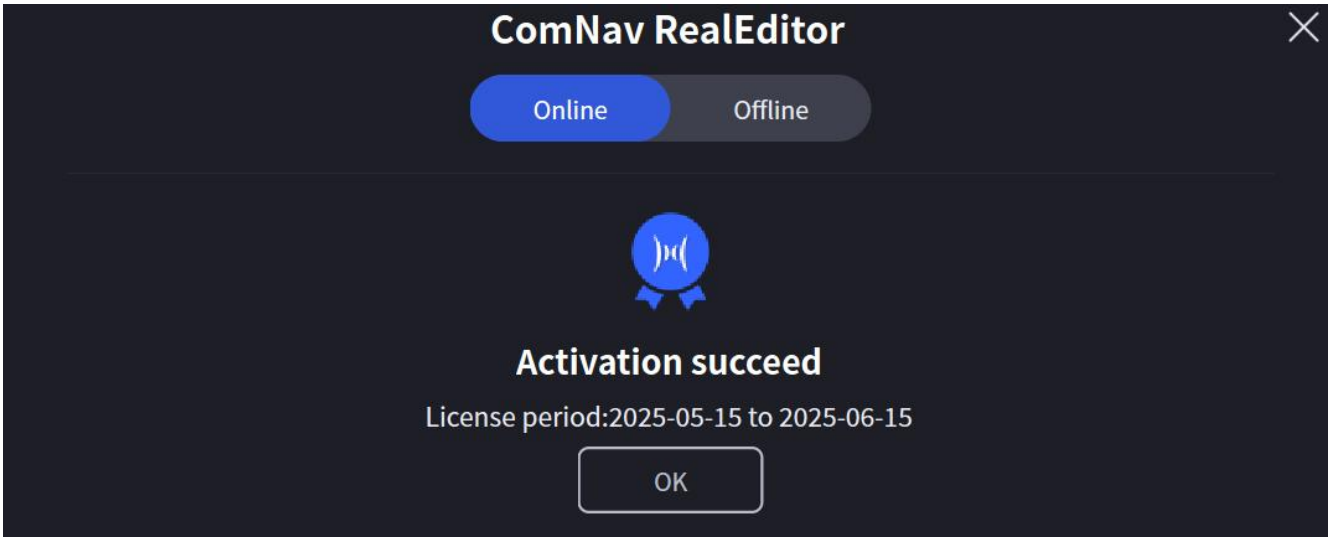
Not support 50 series GPU NOW

6.3 Authorization and Activation

Registration is required to use the post-processing software.

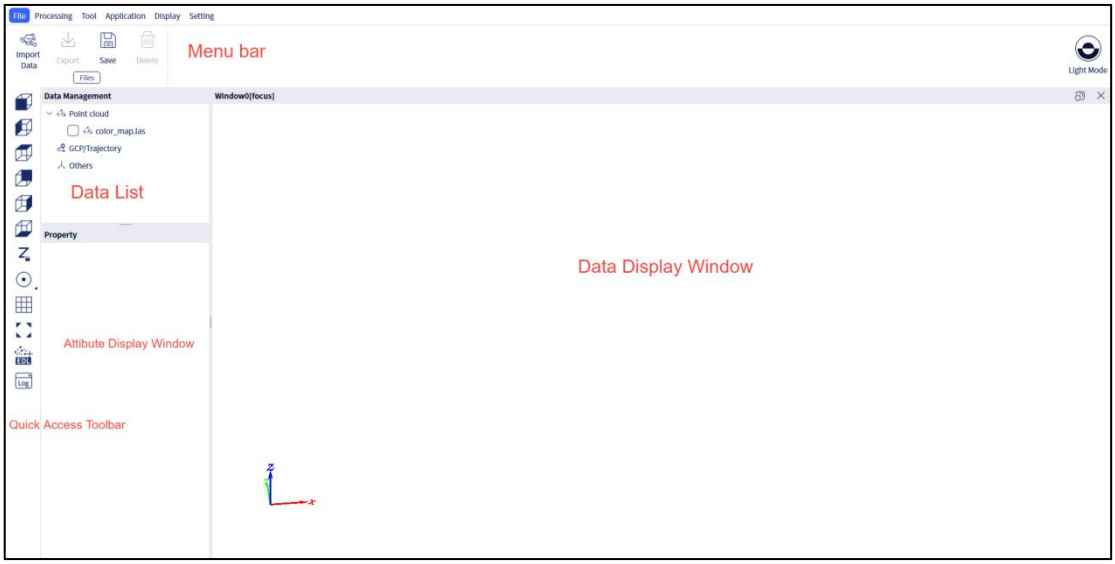






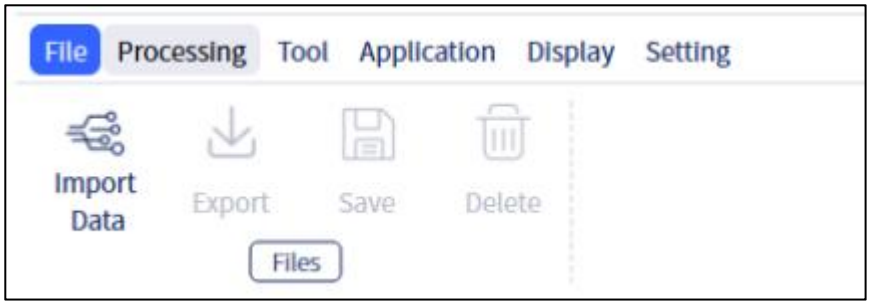
6.4 Overall Interface

The figure below shows the overall interface of the CRE software, including the menu bar, data list, attribute properties information bar, data display area, and quick operation bar.



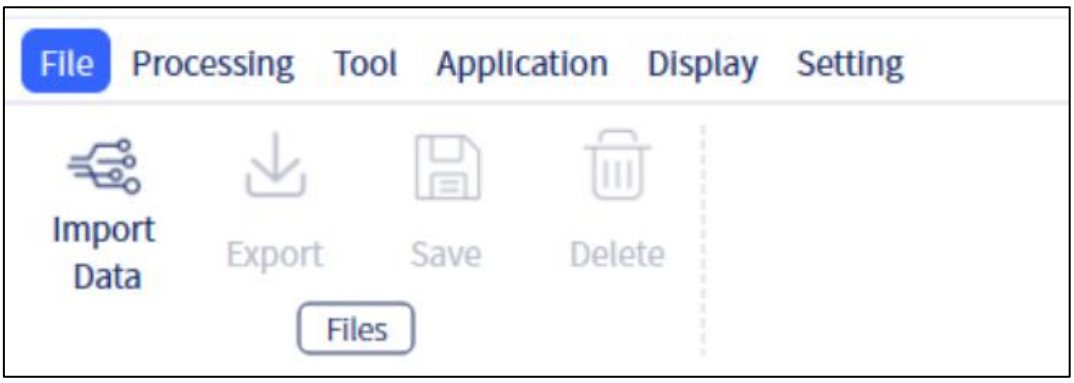
6.4.1 Menu Bar

The menu bar includes File, Processing, Tool, Application, Display, and Setting.



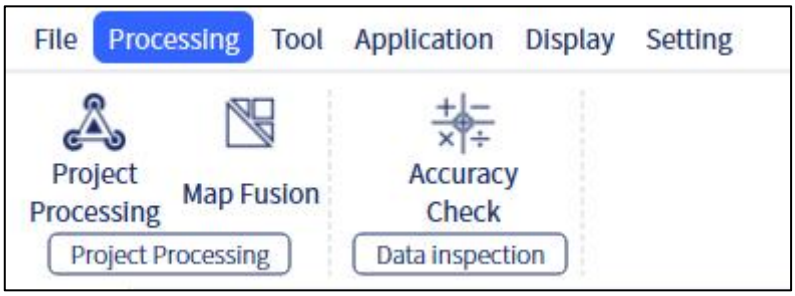
6.4.1.1 File

Files include import data, export data, save, and delete.



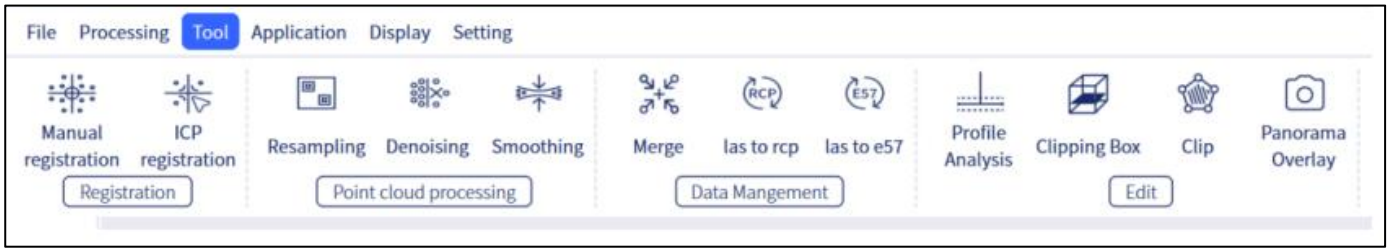
6.4.1.2 Processing

Processing includes project processing, map fusion, and accuracy check.



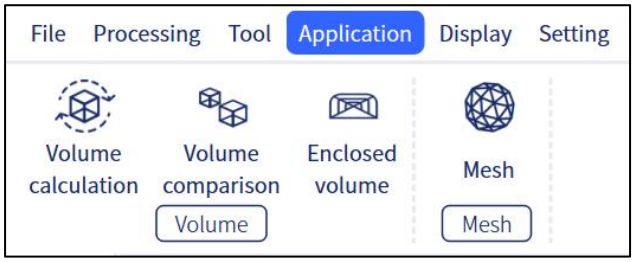
6.4.1.3 Tools

Tools include Manual Registration, ICP Registration, Resampling, Denoising, Smoothing, Merge, las to rcp, las to e57, Profile Analysis, Clipping Box, Clip, and Panorama Overlay.



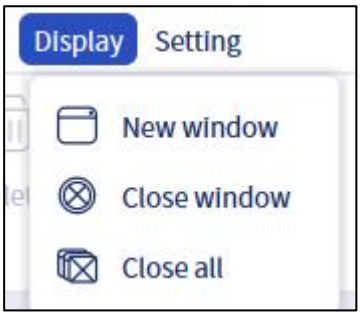
6.4.1.4 Application

Applications include volume calculation, volume comparison, enclosed volume calculation, and Mesh.



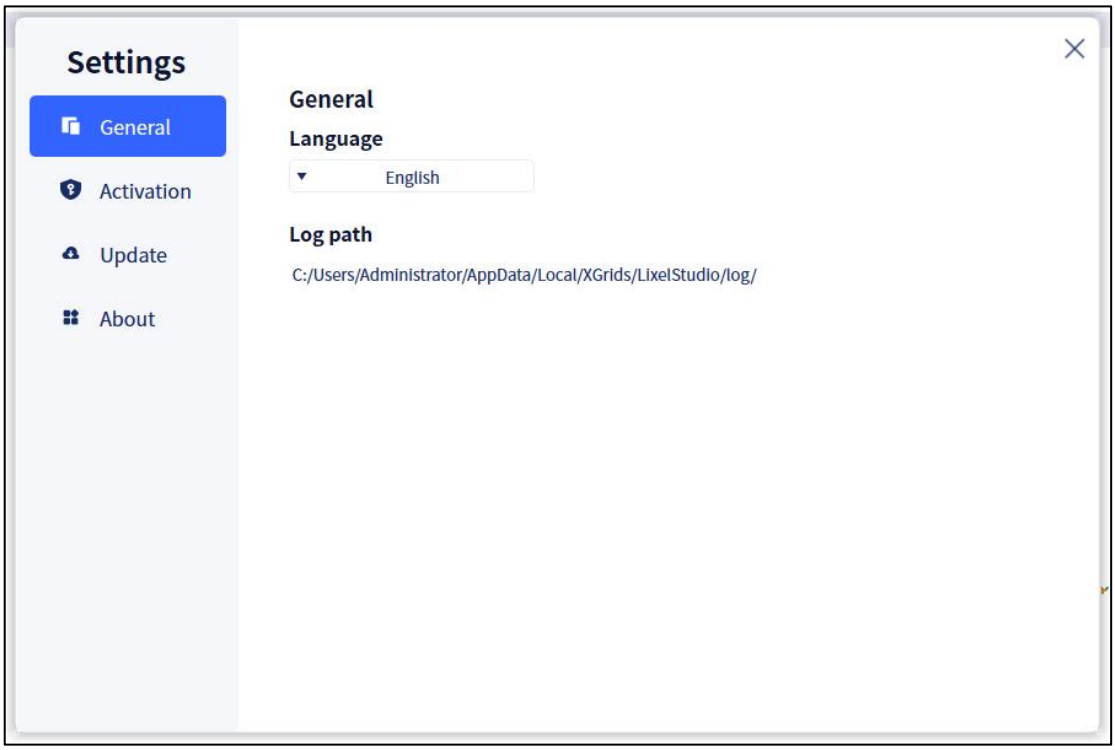
6.4.1.5 Display

Display includes new window, close window, and close all.



6.4.1.6 Setting

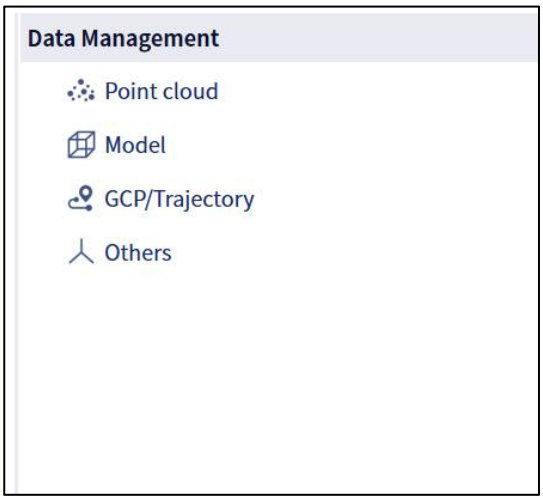
Settings include General, License, Update, and About.



6.4.2 Data List

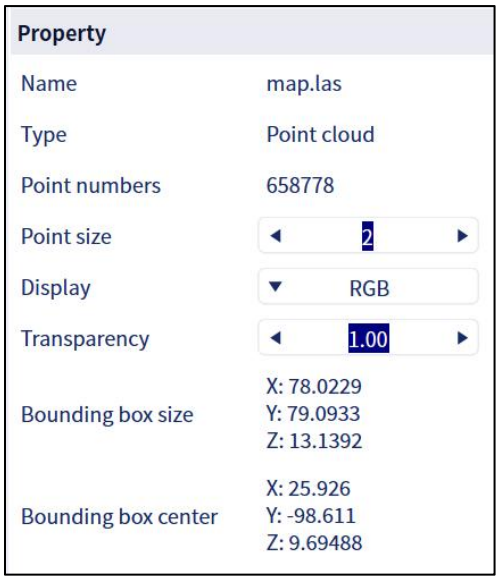
The data list is located in the upper left area of the software and is used to manage the

imported data files in the project.



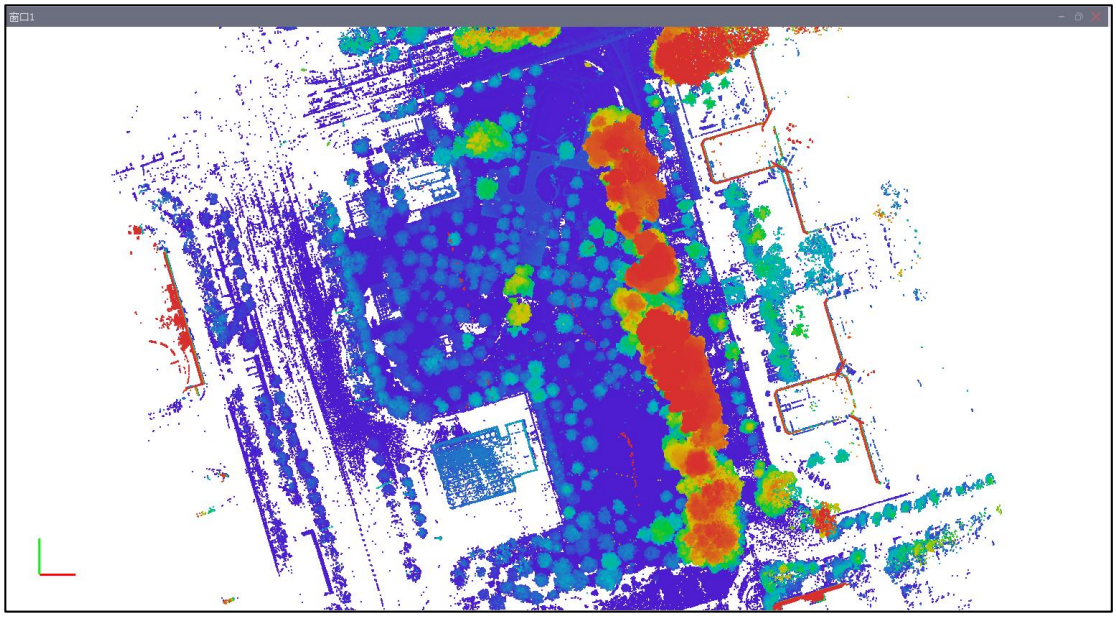
6.4.3 Attribute Information Window

The attribute information window is located in the middle area on the left side of the software, used to manage the attribute information of the opened point cloud data and adjust the point size, rendering method, and transparency.



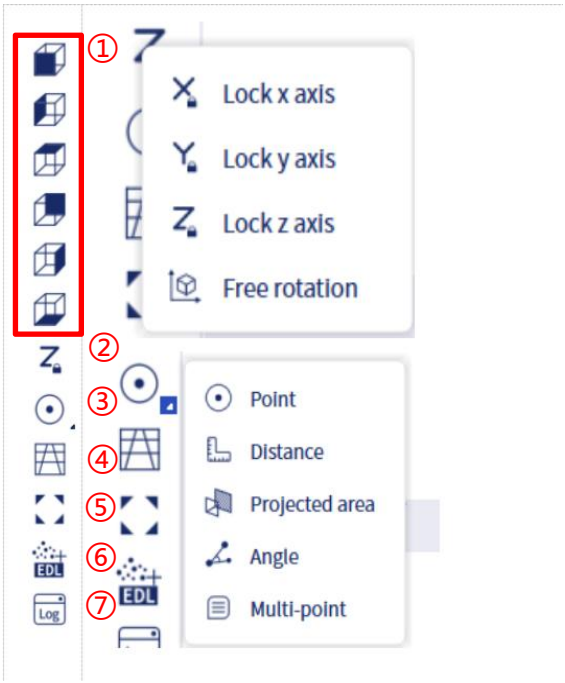
6.4.4 Data Display Window

The data display window is located in the central area of the software and is used to display the data that the user has opened. Users can process data such as point clouds and images in the window.



6.4.5 Quick access toolbar

The quick operation bar is located on the far-left side of the software and mainly includes:



①Six Views: Front, Left, Top, Back, Right, Bottom

② Coordinate Axis Locking: Includes X-axis, Y-axis, Z-axis locking, and free rotation

③ Measurement: Includes point, distance, area, angle, and multi-point measurement

④Camera Mode: Perspective mode, orthographic mode

⑤Adaptive Mode

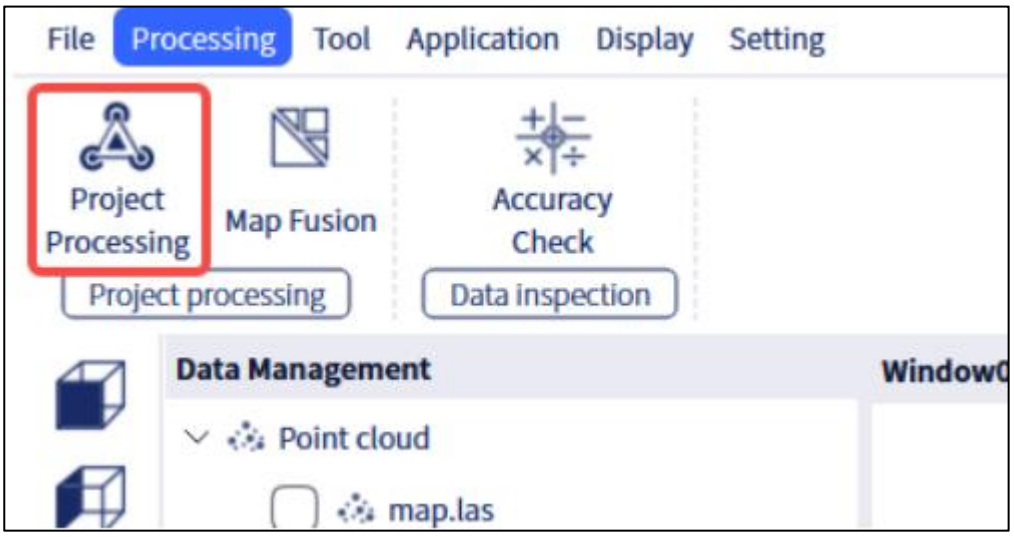
⑥EDL Display

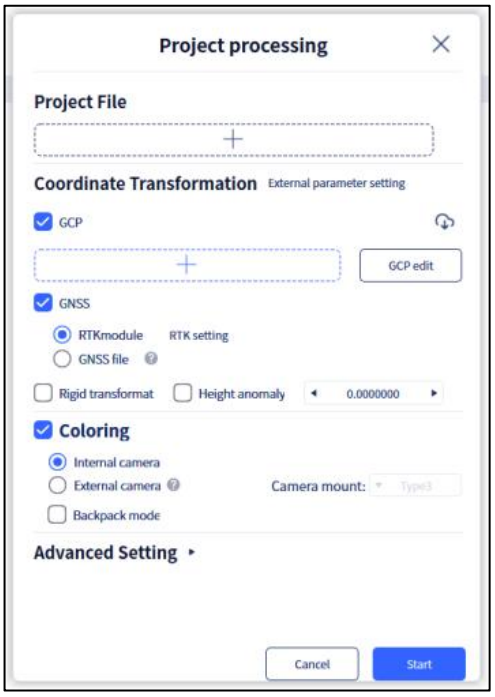
⑦Workbench Display Switching

6.5 Post-Processing operation

Project processing mainly involves post-processing the raw data obtained from LS series handheld scanners to obtain the required point cloud data. The project processing module includes functions such as SLAM mapping optimization (e.g., loop closure, dynamic object removal), coordinate transformation, point cloud coloring, and more, which are primarily

used for secondary refinement post-processing of scanned data.

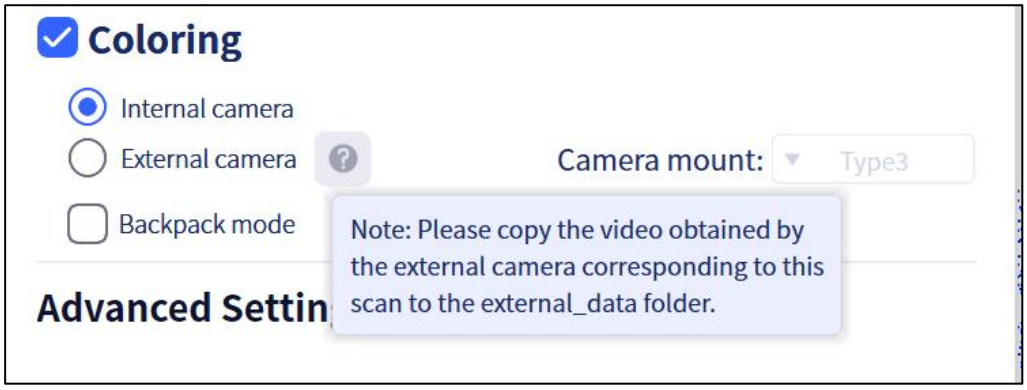




Note: During one-click processing, please do not perform other operations in the software.

Click on "Project Processing" in the menu bar to enter this function. The interface is shown in the figure below.

The "?" symbol next to a function will display the corresponding function's precautions. Moving the mouse over this symbol will automatically display them.



Click "Project File" and select the project data folder to be processed. The project file path should be selected to the corresponding project directory (i.e. the folder copied from the scanning device). After selecting the project, you can choose the processing options based on specific needs.

6.5.1 Coordinate Transformation

The coordinate transformation function primarily provides the capability to transformation point cloud data to the corresponding absolute coordinate system based on external ground control points or GNSS data. If control points were marked using instruments during data collection, you can select the control point option. If using the RTK module, you can select the GNSS option. If both modes are used simultaneously, both options can be selected at the same time.

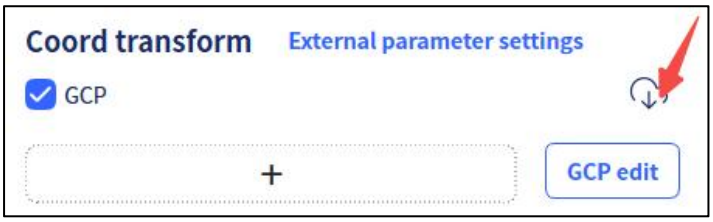
6.5.1.1 Ground Control Points

Coordinate transformation based on control points requires that control points have been marked during the field scanning process, and a corresponding control point coordinate file with the absolute coordinates is needed.

This function not only transformation the point cloud data from a relative coordinate system to an absolute coordinate system but also uses the constraint information of the control points to improve the accuracy of SLAM mapping, resulting in higher precision point cloud data.

(1) Using External Control Points for Coordinate Transformation: First, you need to select the control point file (in .txt or .csv format). The specific format should be: Point Name,

Easting, Northing, Elevation. Click the download button on the right to download the control point template. Edit the control points according to the actual field situation.

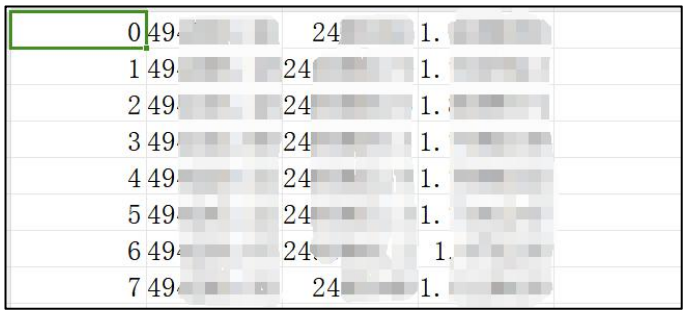


Note:

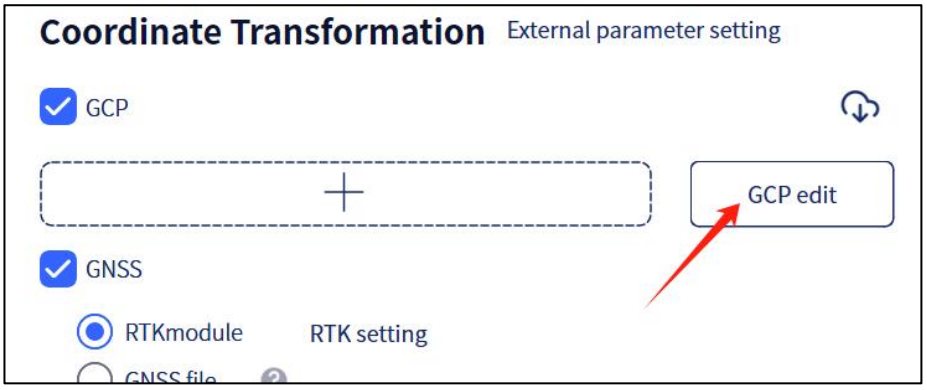
The extension of the .xls table file cannot be directly modified to .csv. It needs to be saved in csv format, otherwise it will cause the data to be unable to read normally.

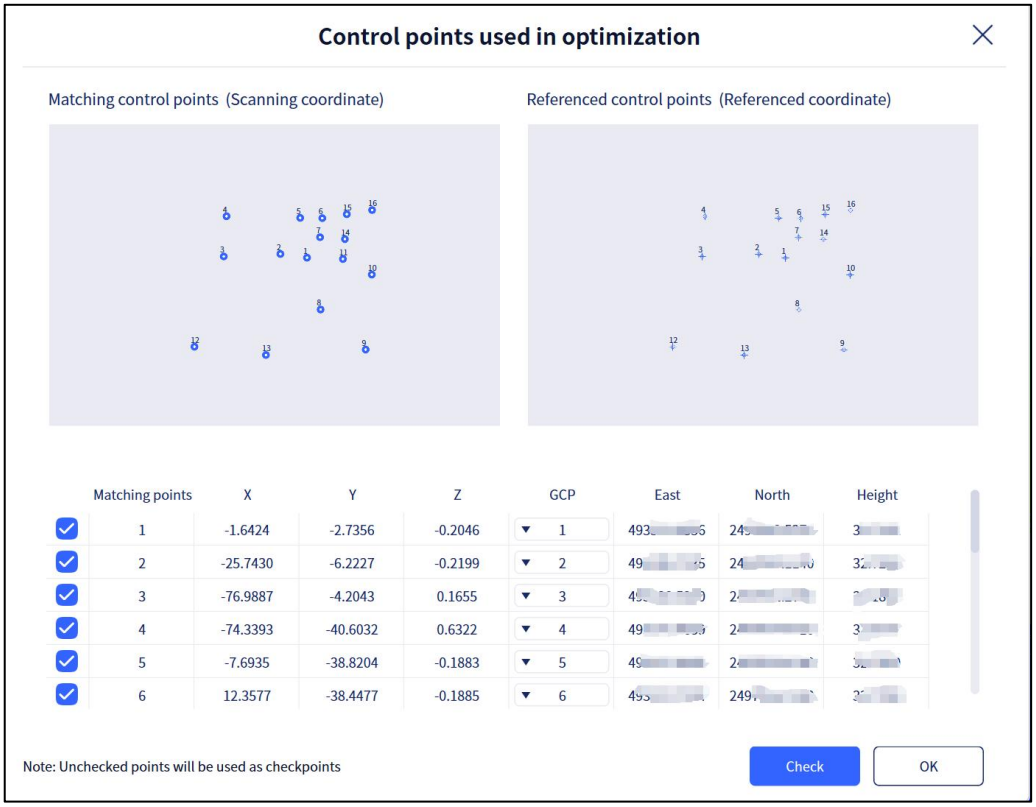
Note that the control point names must be expressed in English and numbers.

Note that the point name should be consistent with the control point number recorded on the Scanmaster app as much as possible. If they are inconsistent, enter the control point editing and make a selection.



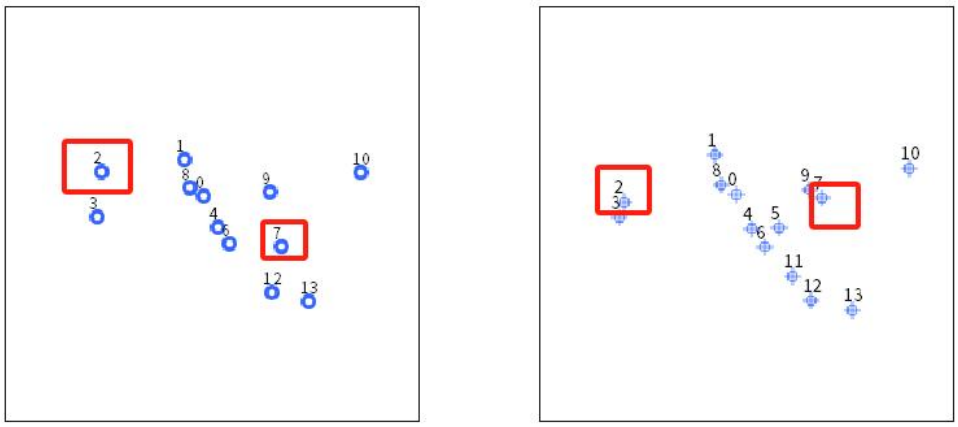
(2) Click the GPC edit button on the right to open the control point edit window. The left side of the interface displays the coordinates where your LS series handheld device marked the points (the default coordinate system is the scanning coordinate system), and the right side shows the true value coordinates of the control points (the default is the absolute coordinate system). At the bottom of the interface, the coordinate values of the control points are displayed. Users can select the corresponding control points to determine the control points be used in coordinate transformation. The checked control points will be used as conversion points for SLAM mapping, and the unchecked and matched control points will be used as check points. The output control point conversion report will simultaneously display the accuracy results of these two types of points.





(3) Click "Check" and the software will automatically verify the correspondence between the control points. If the control points are correct, it will display "Selected control point coordinates are correct." The user can then click "Confirm" to exit the control point edit window. If there is an error with the control points or if there is an issue with the correspondence, it will display "Please recheck the control point coordinate correspondence."

(4) Based on the point cloud position diagram displayed on the interface, you can make a preliminary judgment about which control points have issues. As shown in the figure below, the control point file is clearly selected incorrectly.



(5) Note: The number of selected points must be greater than 3. Otherwise, the control point transformation cannot be performed.

(6) After confirmation, click "Confirm" to return to the engineering processing interface. Upon completing the engineering processing, a control point accuracy report will be output in the "Report" folder within the project directory.

6.5.1.2 RTK

The RTK setting module mainly includes adjusting the parameters of the acquired RTK data to adjust the GNSS data involved in SLAM mapping and coordinate transformation.

After checking, you need to click Settings to enter the RTK settings module. After editing and confirming the RTK data and making sure that the RTK data is available and the

coordinate transformation settings are correct, the engineering processing can use the RTK data and process the results with the expected accuracy.

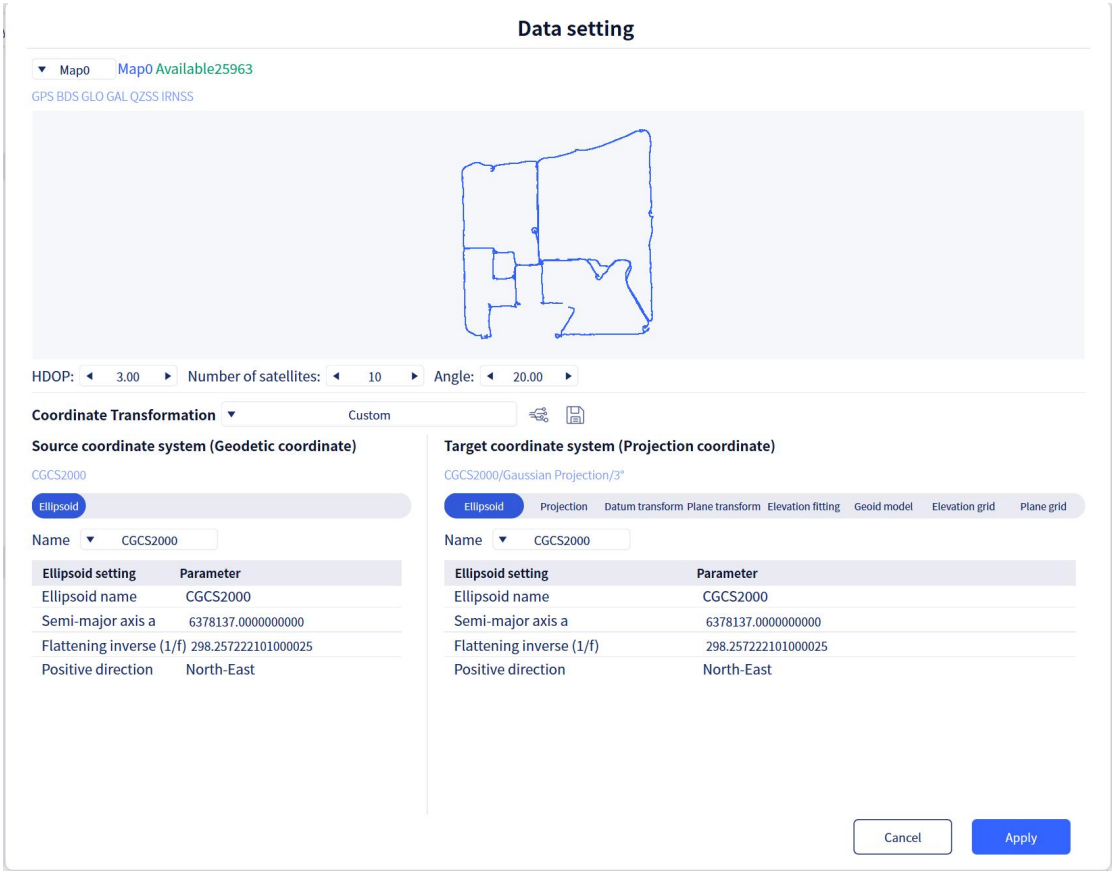
A. RTK data filtering

The RTK setting module mainly includes adjusting the parameters of the acquired RTK data to adjust the data involved in the SLAM mapping and the coordinate transformation.

The parameters of RTK data mainly include HDOP, satellite number, and tilt angle. For HDOP (Horizontal Dilution Of Precision), the smaller the HDOP value, the better the distribution intensity of satellite spatial position, which is more conducive to the calculation fixed solution. In addition, the number of satellites represents the number of satellites at the time of scanning, and the more satellites there are, the more conducive it is to the calculation of fixed solution. The tilt angle represents the tilt angle of the RTK module during scanning. The smaller the tilt angle, the more conducive it is to the accuracy of fixed solution. The tilt angle should not exceed 20 ° by default. Therefore, the smaller the HDOP value, the higher the number of satellites, the smaller the tilt angle, and the higher the Confidence Level of the obtained RTK data.

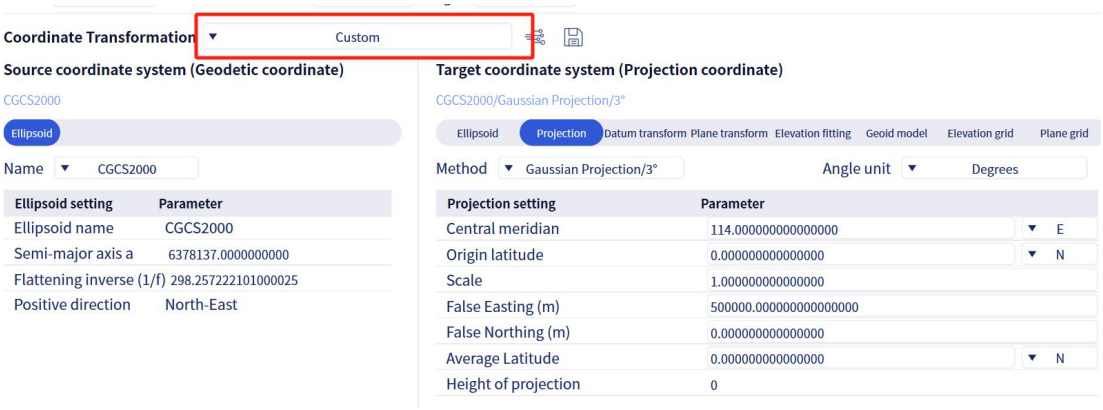
During the setup, users can make modifications based on their actual needs, but usually, the default parameter values are sufficient. While adjusting, please pay attention to the distribution of RTK data. Try not to affect the distribution, ensuring it remains evenly spread across the entire trajectory. If the RTK data is unevenly distributed, only covers a segment of the trajectory, or has excessive intervals, it will lead to issues with the final coordinate transformation accuracy.

While making adjustments, pay attention to whether the data in the top left corner of the window is in a usable state. If it shows a red unusable state, it indicates that the effective GNSS data under the current parameters is less than what the software requires for calculation. In this case, you need to increase the HDOP, decrease the number of satellites, or increase the tilt angle, or adjust all three comprehensively. Adjust until the data state turns green and is usable, only then can you use RTK for coordinate transformation. If it remains in an unusable state, coordinate transformation cannot be performed.



B. Coordinate Transformation

The coordinate transformation function supports users to transform source coordinate systems to the desired target coordinate systems. At the same time, the software has built-in coordinate systems for some countries and regions, such as Hong Kong and New Zealand. These built-in coordinate systems support use when the data source ellipsoid is WGS84 when collecting with an RTK module. That is, when the source ellipsoid is WGS84 during collection, the built-in coordinate system can be directly transformed to the corresponding country/region coordinate system. If the collected data source ellipsoid is not WGS84 or the built-in coordinate system does not contain the required target coordinate system, you need to set the coordinate transformation to custom, and then adjust the source coordinate system and target coordinate system according to actual needs.



C. Source Coordinate System

If the source coordinate system is set to WGS84 or CGCS2000 when collecting data, the corresponding coordinate system will be automatically identified. If other Operating Reference Station (CORS) Network is used during collection, the user needs to specify the ellipsoid of the source coordinate system.

If the source coordinate system is WGS84, the target ellipsoid defaults to WGS84 and the projection mode defaults to UTM projection.

If the source coordinate system is CGCS2000, the target ellipsoid defaults to CGCS2000, and the projection mode defaults to Gaussian three-dimensional zone projection.

Currently, the built-in ellipsoids include WGS84, CGCS2000, XIAN_1980, BEIJING 1954, GRS80 and INTERNATIONAL. If it is another ellipsoid, the user can select "Other", enter the major axis a, the inverse of the flattening (1/f), and confirm the source ellipsoid parameters.

D. Target Coordinate System

The target coordinate system parameter settings include the parameters of ellipsoid, projection, datum transformation, plane transformation, elevation transformation, geoid, elevation grid and plane grid. The projection coordinate system and elevation system of the output data can be adjusted by a combination of single or multiple transformation parameter settings.This software supports most coordinate systems

In order to ensure the accuracy of point cloud, when processing, it is necessary to confirm the use of a certain parameter or a combination of multiple transformation parameters based

on the projection coordinate system and elevation system of the confirmed source coordinate system and target coordinate system.

The setting and adjustment of the coordinate system generally requires surveying and mapping expertise.

① Ellipsoid

The ellipsoid of the target coordinate system currently supports CGCS2000, WGS84, ITRF2008, XIAN80, BEIJING54, GRS80 etc. Users can also select "Custom" and enter the major semi-axis a, the inverse of the flattening (1/f) and confirm the source ellipsoid parameters.

② Projection

Projection settings are used to set the parameters required for projection.

Currently Gaussian projection(3°), Gaussian projection(6°), UTM projection, Mercator projection, Transverse Mercator projection and Oblique Mercator projection is supported.

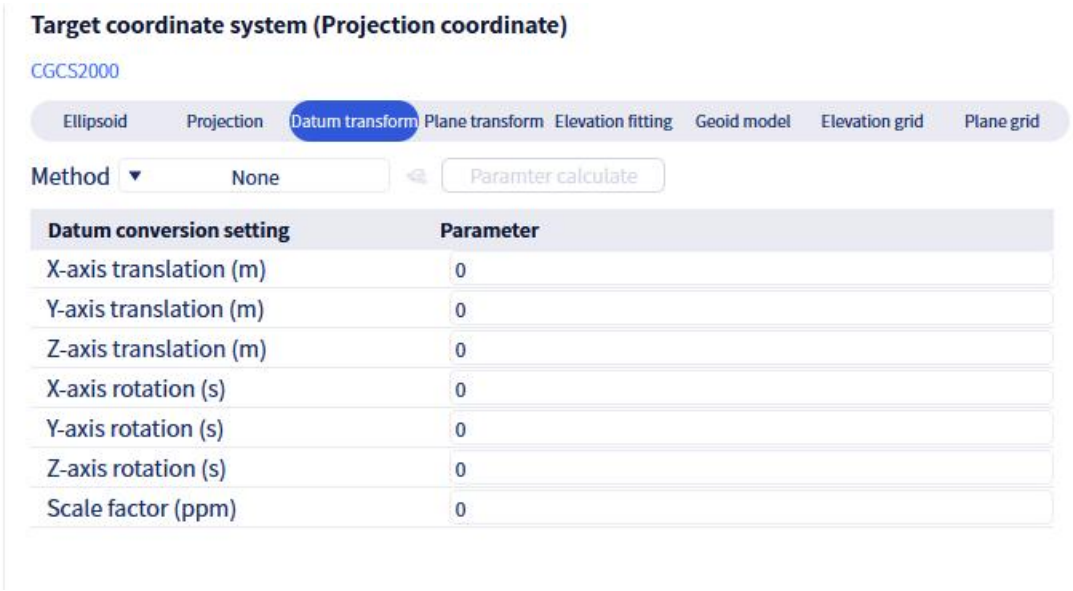
Each projection method requires the setting of the central meridian, latitude origin, scale, false easting, false northing, average latitude and height of projection. Different coordinate systems have different requirements. To ensure the accuracy of coordinate transformation, please confirm and enter these parameters. Central meridian, latitude origin, mean latitude, please note whether the area is in the southern hemisphere or northern hemisphere, eastern hemisphere or western hemisphere. If it is in the northern hemisphere, select N with the right button, if it is in the southern hemisphere, please change the right button to S. If it is in the eastern hemisphere, select E with the right button, if it is in the western hemisphere, please change the right button to W. Please enter positive numbers for longitude and latitude data.

③ Datum transformation

Datum transformation can transform the datums of two different coordinate systems. Currently, the most commonly used datum transformation method is the Bursa seven-parameter transformation method.

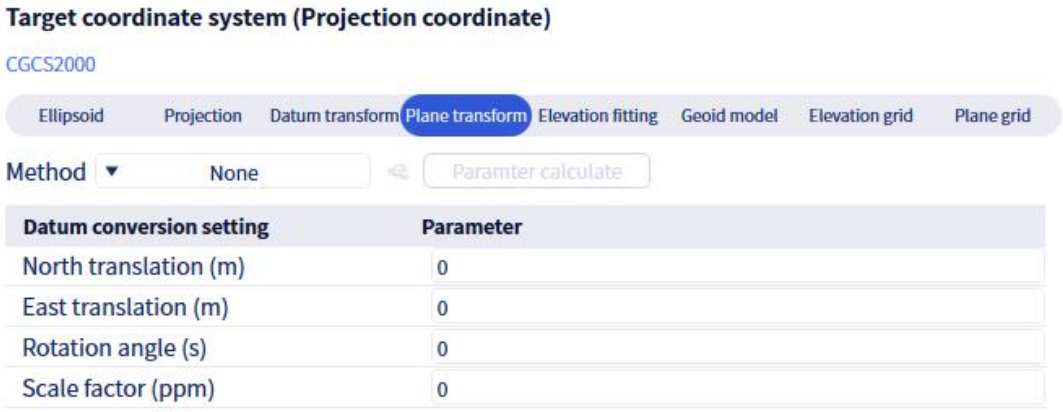
When the source ellipsoid and the target ellipsoid are inconsistent, the Bursa seven-parameter transformation method can be used to achieve relatively accurate coordinate transformation; if the source ellipsoid and the target ellipsoid are similar, the source ellipsoid can be directly considered to be the target ellipsoid for processing, which has a relatively low impact on the accuracy of the coordinate transformation. When the accuracy requirement is not high, the datum transformation can also be ignored.

Users can input the Bursa seven parameters themselves or calculate them using the "Parameter Calculate" tool. It is recommended to calculate the parameters using the "Parameter Calculate" tool.



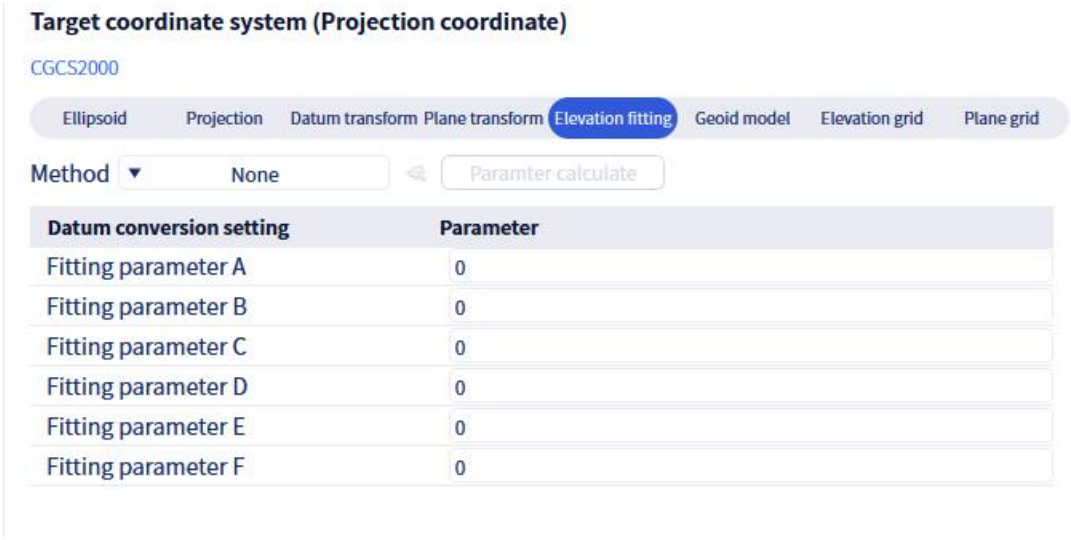
④ Plane transformation

Plane transformation is used to transform the source plane coordinate system to the target plane coordinate system. It contains a translation, rotation and scaling of the data. Currently, the commonly used four-parameter method is supported.

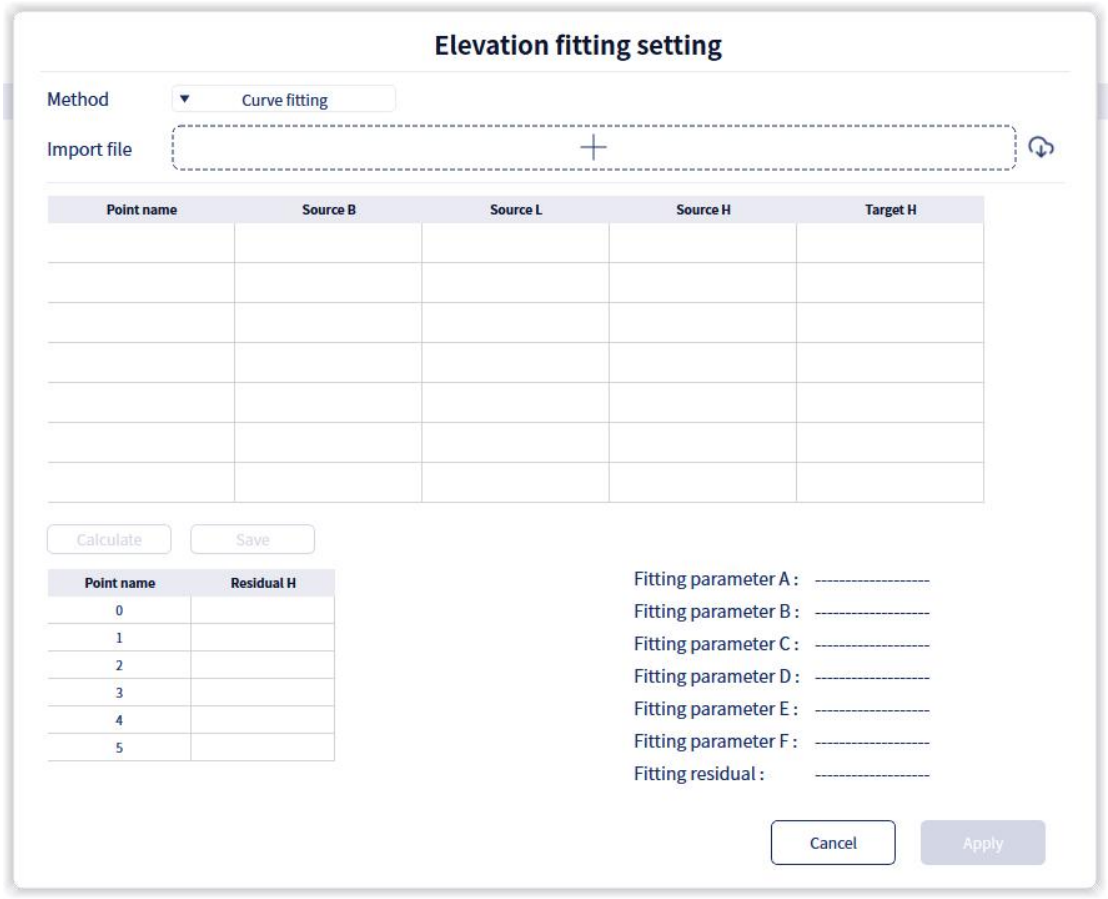


⑤ Elevation fitting

The purpose of elevation fitting is to transform the source elevation system to the target elevation system. Currently, two methods are supported: fixed difference correction using elevation anomaly and surface fitting.



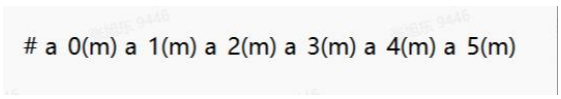
At least 6 control point pairs are required for calculation. Each control point pair needs to contain the geographic coordinates of the source coordinates (BLH latitude, longitude and height) and the elevation of the target elevation system, and needs to be stored in the surface fitting control point pair format. After importing into the parameter calculation, the surface fitting parameters A, B, C, D, E, and F can be calculated. The more points used, the more accurate the surface fitting and the higher the elevation fitting accuracy. The following figure shows the surface fitting parameter calculation interface:



Surface fitting control point pair format: It needs to include the geographic coordinates (BLH) of the source coordinate system and the elevation H of the target coordinate system, separated by spaces. The units of B and L need to be in degrees, minutes, and seconds (dd:mm:ss.ss) format. The elevation units of the source and target coordinate systems are meters. You can click the download button to download the corresponding template.

After the calculation is completed, you can also click Save to store the calculation results. By clicking the "Save" button and can be used in subsequent data through "Import File". Click "Apply" to complete the setting of elevation fitting parameters.

Surface fitting control point pair file



Surface fitting parameter file template

template

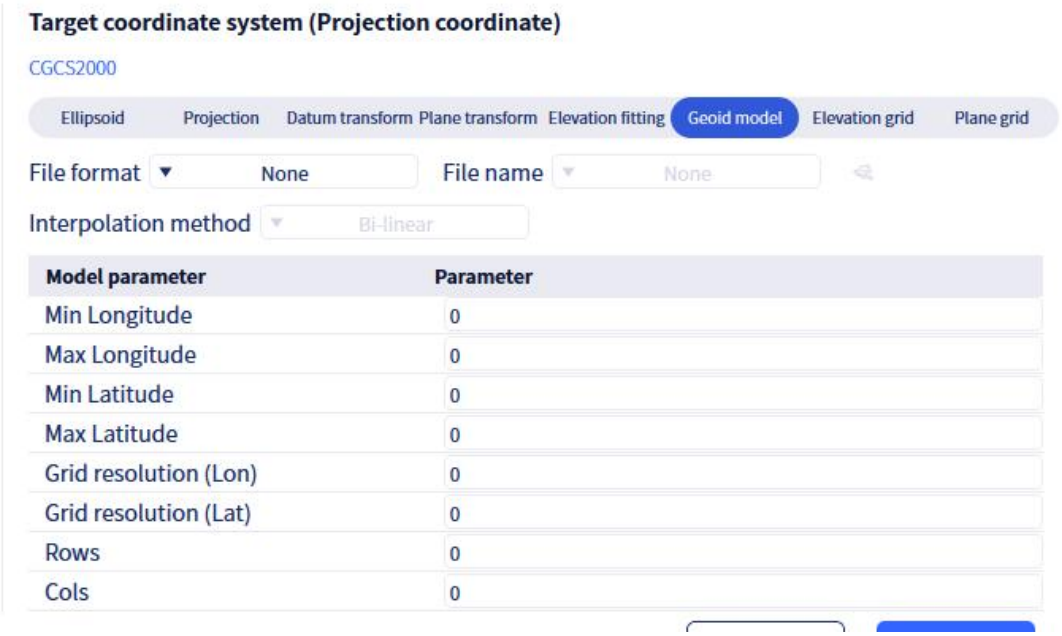
⑥Geoid

The geoid transformation parameters can be used to fit the elevation using the geoid model. The geoid model is a grid model that describes the specific geoid difference at different locations within a certain range. It is generally provided by large international non-profit organizations, or provided by national surveying and mapping bureau, and is generally stored in the form of a grid.

Multiple sets of data within a large area covered by the geoid model can be fitted using the same geoid model transformation elevation system.

Before use, please confirm whether the target elevation system corresponding to the geoid model you are using. Only when the geoid model is correct can the elevation transformation be completed accurately.

When using it, you need to select the "File Format" first. Currently, CRE supports geoid data stored in .tif/.asc/.gri/.gtx/.dat file formats. Then, select the built-in geoid model in the "File Name" or import it yourself to complete the geoid transformation parameter setting.



The built-in geoid models currently available are:

Format	Geoid Model	Description
tif	NZGD2016.tif	New Zealand geoid model. NZVD2016
	GCG2016v2023.tif	German Geoid Model DHHN2016
asc	gsigeo2011_ver2_2.asc	Japanese Geoid Model GSI 2011
gri	hybrid_geoid.gri	Korean Geoid Model KNGeoid18
gtx	NZGeoid2016.gtx	New Zealand Geoid Model NZVD2016
dat	KNGeoid18.dat	Korean Geoid Model KNGeoid18

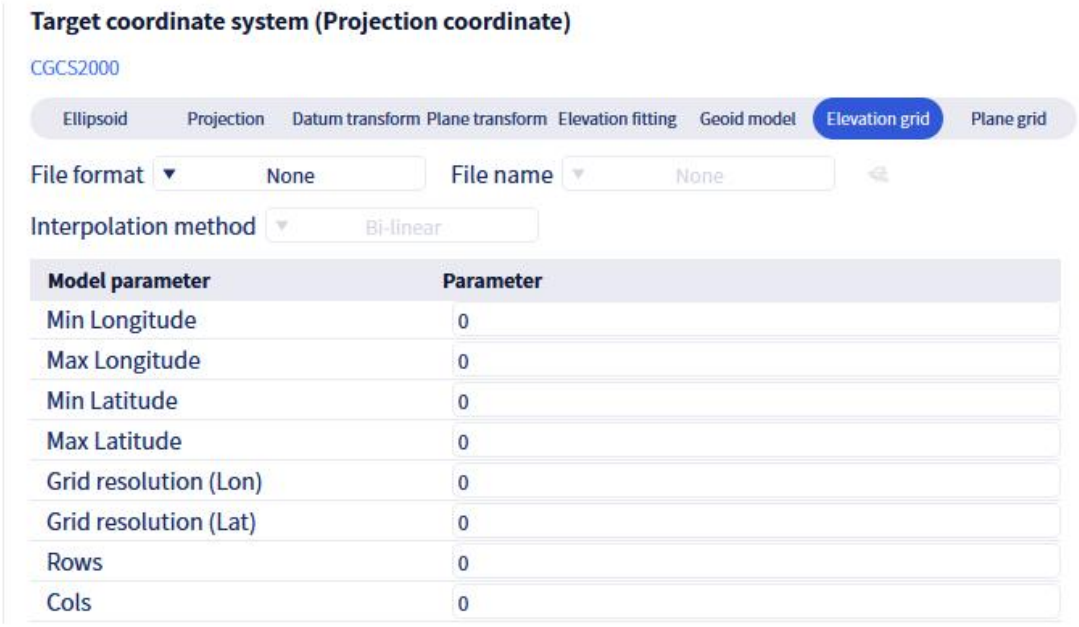
⑦Elevation grid

The elevation grid transformation parameters can be used to fit the elevation using the elevation grid model. The elevation grid model is a grid model that describes the specific elevation difference between two different elevation systems at different locations within a certain range.

Multiple sets of data within a large area covered by the elevation grid model can use the same elevation grid model to transform the elevation system for elevation fitting.

Before use, please confirm whether the target elevation system corresponding to the elevation grid model you are using. Only when the elevation grid is correct can the elevation fitting be completed accurately.

When using it, you need to select the "File Format" first. Currently, CRE supports grid data stored in .tif/.asc/.gri/.gtx/.dat file formats. Then, select the built-in elevation grid model in the "File Name" or import it yourself to complete the elevation grid transformation parameter setting.



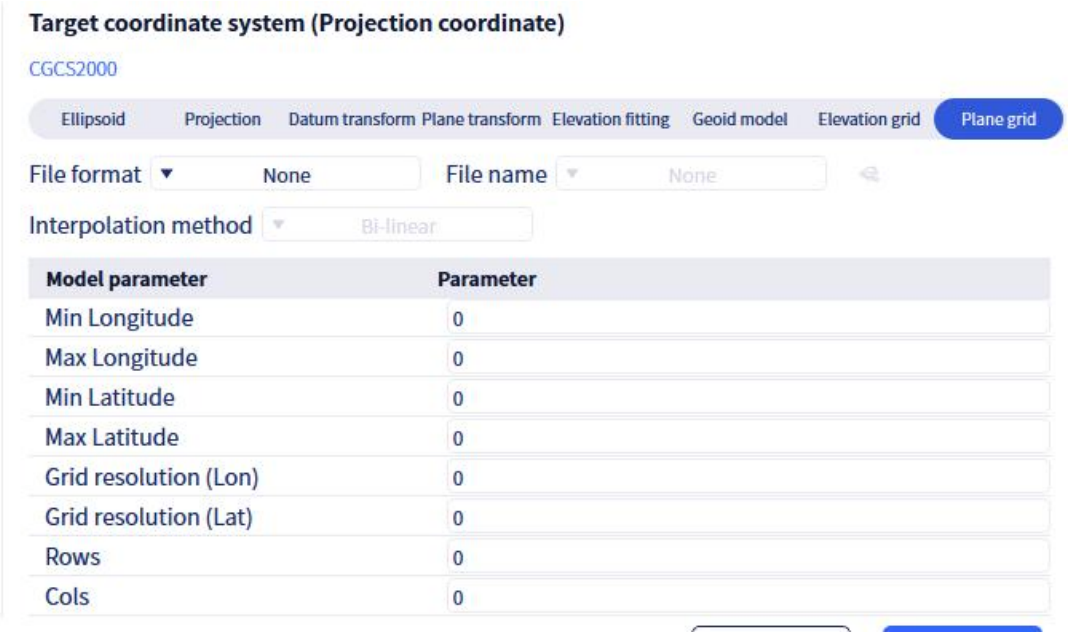
Currently, CRE has a built-in elevation grid model of AUCKHT1946.tif which is Auckland 1946 height (AUK46).

⑧ Plane grid

The plane grid transformation parameters can be transformed using the plane displacement grid model. The plane displacement grid model is a grid model that describes the difference between the plane coordinates of different locations in two different projection coordinate systems within a certain range.

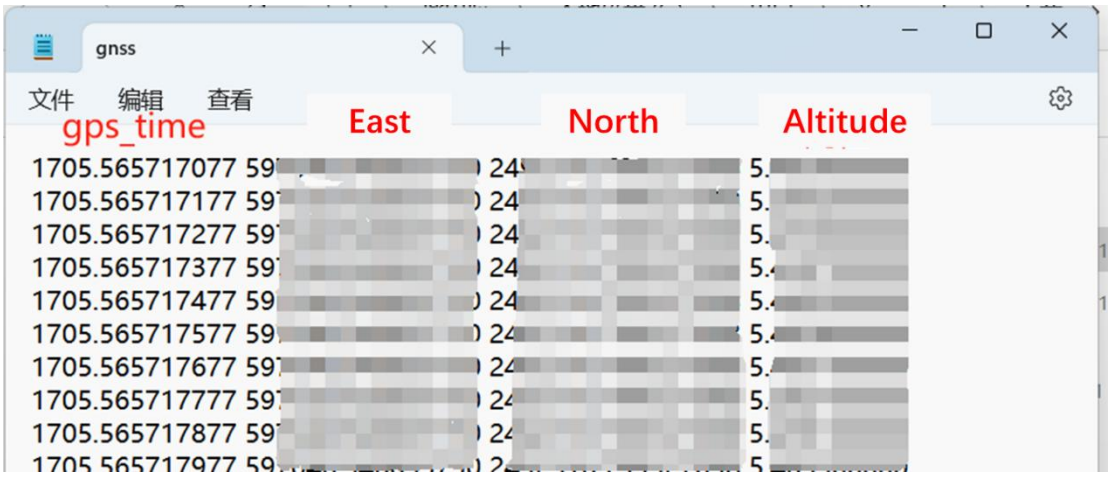
For multiple sets of data within a large area covered by a plane grid model, the same plane grid model can be used to transform the plane coordinates of different projection coordinate systems for plane transformation.

Before use, please confirm whether the target coordinate system of the plane grid model you are using are consistent with the coordinate system you expect to transform. Only when the plane grid is correct can the plane transformation be completed accurately.



E. GNSS files

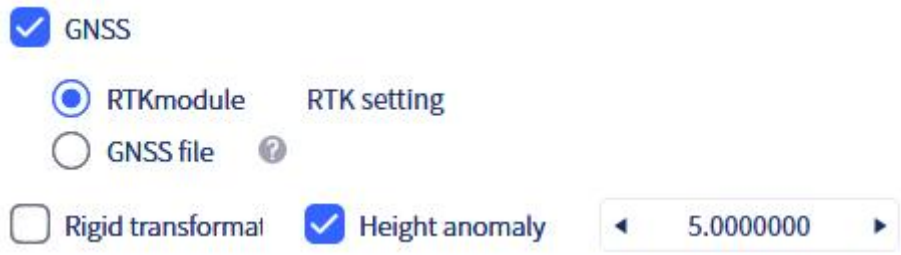
If users need to transform the point cloud data to a specific coordinate system, they can first copy the gnss.csv recorded by the scanner in the project_data folder and use other software for coordinate transformation. After transformation, save the newly transformed gnss.csv file to the external_data folder of the corresponding project directory. When the GNSS File option is checked, the software will automatically read the files in the external_data folder and use the gnss.csv file for coordinate transformation. The transformed gnss.csv format is gps_time east coordinate, north coordinate elevation, as shown in the figure below.



If you check "Rigid Transformation," the external control points or GNSS information will only be used for the rigid transformation of the point cloud and will not be used for SLAM

mapping optimization. For those who require high accuracy in point cloud data, it is recommended not to check this option.

If the user needs to transform the default ellipsoidal elevation system of the GNSS file to another elevation system, they can check this option and fill in the corresponding values.



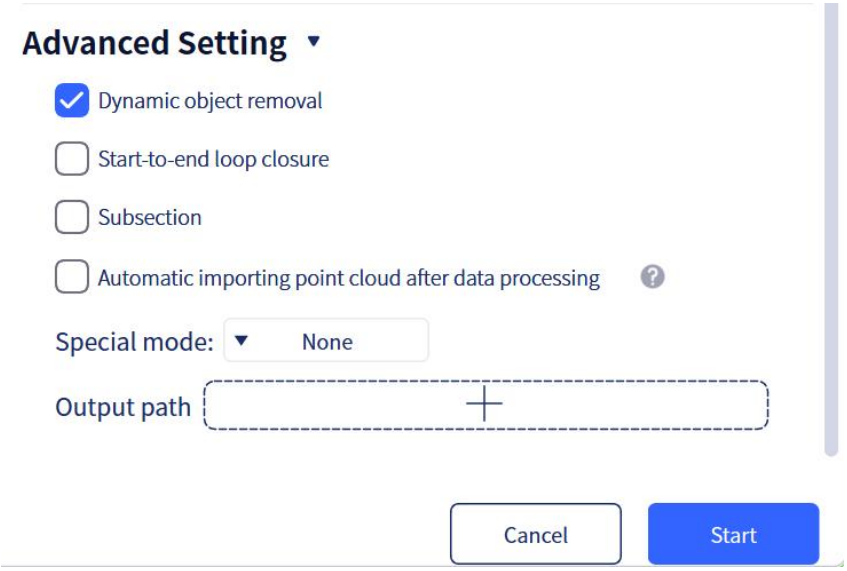
6.5.2 Coloring

The coloring function mainly uses image data from the built-in camera or external panoramic camera to color the point cloud, obtaining point cloud data with true color information. If you choose external panoramic camera coloring, you need to simultaneously start recording with the external panoramic camera during scanning.

If you need to color the collected point cloud data, you can check this option and select the appropriate coloring method.

6.5.3 Advanced Settings

The advanced settings provide users with four SLAM mapping-related parameters: Dynamic Object Removal, Start-to-end Loop Closure, Subsection, Automatic Load Point Cloud After Data Processing, and Special Mode.



A. Dynamic object removal

The Dynamic Object Removal function is designed to remove point cloud noise data of dynamic objects collected during scanning, in order to obtain better point cloud data. For better removal results, please strictly adhere to relevant collection guidelines during data acquisition.

B. Start-to-end loop closure

The Loop Closure function mainly enhances the constraints of SLAM mapping and improves the overall accuracy of point cloud data. If the walking trajectory forms a loop (i.e., the scan ends at the starting point) during data collection, you can check this option.

C. Point Cloud Subsection

The point cloud subsection function can segment the point cloud results after project processing according to the size specified by the user. It is not enabled by default. After checking, the default segment size is 1gb. The user can also select the segment size according to actual needs.

D. Point Cloud Enhancement

Using the point cloud enhancement function results in denser and more uniform point cloud data, but the efficiency of project processing will be reduced. Currently, the software offers two modes of point cloud enhancement:

5mm: If this option is selected, the point spacing in the enhanced point cloud data will be 5mm.

1mm: If this option is selected, the point spacing in the enhanced point cloud data will be 1mm.

Note: Selecting either of these options will decrease the efficiency of project processing. After point cloud enhancement, the result data will be enormous and thus will be saved at multiple tiles.

E. Robust mode

The robust mode is mainly used for mapping in scenarios with partial degradation or intense motion. If the conventional mapping mode fails and the processing report indicates "LIO too few, please try robust mode," you can select this option to reprocess the project. Note: This mode increases the success rate of mapping, but the accuracy of these scenarios may be compromised.

6.5.4 Output path

Users can specify the path to save the processing result file. If not specified, it will be output to the CRE project save folder by default.

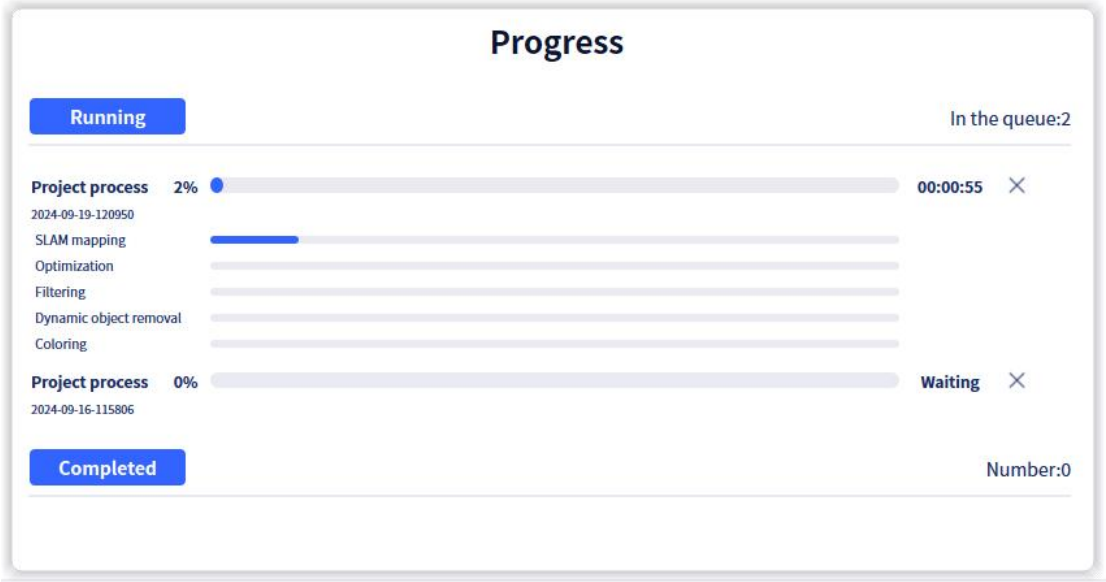
6.5.5 Progress task queue

All tasks can be found in the progress queue at the bottom of the software window. You can add a new project processing task to the queue without having to wait until your current task is finished. All tasks in the queue will be performed one by one (while your computer is still awake).

Users can select different options for different processing tasks according to their actual needs. After selecting the options, click "Start," and the software will immediately begin the processing task. The corresponding project processing tasks will be automatically added to the task queue and processed in order.

Clicking on the process bar at the bottom of the software will display the current processing,

waiting, and completed projects. For data that is being processed, all processing steps and progress will be shown.



6.5.6 Saving path of project processing

If the output path is not specified in the advanced settings, the project processing result file will be saved in the current LS project folder by default; if the output path is specified, the result folder will be saved in the corresponding path. The result folder will be saved under the name of " ResultDataproject file _0 " (after the file name, " _0 " represents the result of the first processing of the project. If the same project file is processed again and saved in the same path, the result file name of the second processing will be followed by " _1 ", and so on).

In the result folder, the corresponding post-processing point cloud file, point cloud three-view screenshots, trajectory file, image file (if coloring is checked), etc. will be saved in the folder named after the project files. The logdirXXXX folder saves the log files of project processing. The report folder saves the processing report and the control point transformation accuracy report (if the control point coordinate transformation is checked).

7. CRE ComNavRealEditor Applications

7.1 Map Fusion

Point cloud data can be accurately stitched together to form a complete map. The system supports global joint optimization, coordinate transformation, and colorization. It provides an efficient solution for large-scale 3D scene reconstruction. Depending on the scene type, users can choose between RTK mode and control point mode for stitching. These two modes can be used independently or in combination, but a valid connection must exist between the maps.

Data Collection Notes:

(1)Ensure an overlapping path of 15–30 meters between adjacent maps.

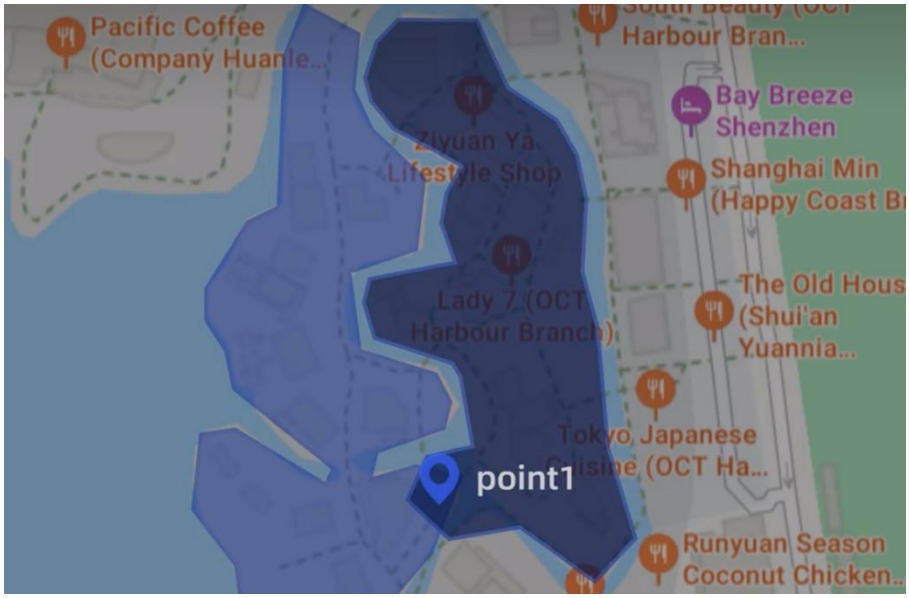
(2)It is recommended to choose feature-rich environments as overlapping paths. Avoid using open areas, long corridors, or smooth tunnels.

(3)If using two or more devices, ensure that the LiDAR heads are completely identical and use a uniform colorization method.

(4)A single project supports a maximum of 10 fused maps, and each recording session is recommended to be within 20 minutes.

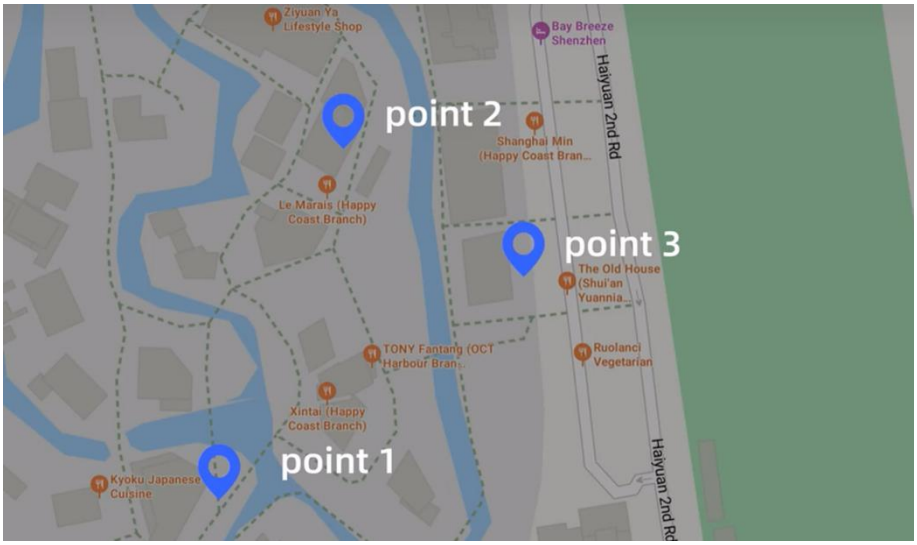
(5)In RTK mode, ensure that RTK data for each project is valid. Avoid scanning in areas with poor satellite visibility or signal obstruction.

(6)In control point mode, if absolute coordinates are not required or if operating in areas without GNSS signals, it is recommended to use the standard base to collect control points. Ensure that adjacent maps are connected using the same control point.



(7)If the stitched maps are collected in separate sessions within the same project, collect a control point after completing the first section of scanning, then stop recording. Begin scanning the second section and, after initialization, collect the same-named control point again. After successful collection, scan 15–30 meters toward the previous section to ensure sufficient overlap for stitching.

(8)To perform coordinate transformation, ensure that there are at least three absolute control points in the map, and these points must not lie on a straight line.



7.2 Panorama Overlay

Before using this feature, you need to process the data and check the "Panorama" option to use Panorama Overlay.

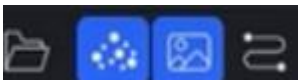
Operating Steps:

(1)Import and select the point cloud file. Then click on the Panorama Overlay function in the menu bar.

(2)Select the corresponding project processing folder. Once the correct folder is selected, the Panorama Overlay function will launch. The left window displays the overlay of panoramic images and point cloud data, while the right window displays the point cloud view.

(3)In the left window, you can pan, zoom in, and zoom out the panoramic image using the mouse. Click the white arrows in either window to switch between images.

(4)Click the trajectory icon at the top to toggle the display of the trajectory on or off. Click the point cloud icon at the top to toggle the overlay between point cloud and panoramic image.



(5)If measurement is needed, make sure the point cloud and image are overlaid, then click the Measurement button in the left-side toolbar to start measuring.