MVP S2 Mobile Slam 3D Laser Scanner User Manual

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Content

1 Components

1.1 Master Module

For data storing, information sending and receiving.

Figure 1-1

1.2 Handheld Module

For LiDAR data and image collecting.

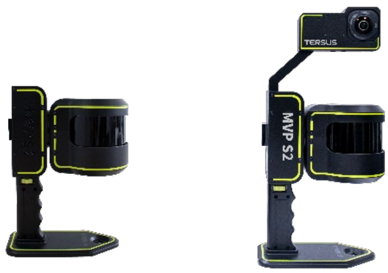


Figure 1-2 Handheld Module, without camera (left), with camera (right).

1.3 Li-ion Battery

For power supply.

Figure 1-3

1.4 Hot-swappable Hanging Board

Replacing the battery without interruption.

Figure 1-4

1.5 Charger

For battery charging.

Figure 1-5

1.6 Backpack Bracket

For carrying operation methods.

Figure 1-6

1.7 RTK Module

For receiving satellite signal and base station data (RTK)

Figure 1-7

1.8 Dongle

For TersusMVP Mapper data processing.

Figure 1-8

1.9 USB Driver

For data copy.

Figure 1-9

1.10 Controller

For device control through web UI.

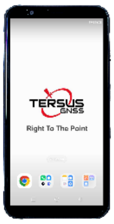


Figure 1-10

1.11 Cable

For power supply and data transmission between modules.

Figure 1-11

1.12 Target Board

For GCP grabbing.

Figure 1-12

1.13 Shoulder Strap

For Master Module carrying in Handheld method.

Figure 1-13

1.14 Carrying Case

For device transportation and storage.

Figure 1-14

2 Installation and Dismantling

2.1 Installation

1. Deploy the triangular support rod under the backpack bracket to ensure stable placement on planar surfaces.

Figure 2-1

2. Mount the battery onto the hot-swappable hanging board. If the red indicator light is illuminated, it indicates proper installation. Then integrate the complete with the Master Module.

Figure 2-2

3. Mount the complete of the battery and Master Module with the Backpack Bracket.

Figure 2-3

4. Align the master cable with the Type-C port on the Master Module, and gently insert the cable until the latch on the Type-C cable clicks and pops up, indicating that the master cable has been properly connected.

Figure 2-4

5. Press the female buckle of the latch with your palm, and push the male buckle on the mounting rod downward into the female buckle. Once the mounting rod is in the correct position, the latch will lock securely. You can run your fingers over the latch joint—if it feels flat and smooth without any bumps, and the mounting rod does not move when gently shaken, it means the latch is properly locked.

Figure 2-5

6. With one hand pressing the female buckle of the latch and the other supporting the LiDAR sensor, push the male buckle on the LiDAR into the female buckle to mount the sensor onto the upper part of the backpack brecket. After installation, run your fingers over the quick-release latch joint—if it feels flat and smooth without any bumps, and the LiDAR remains

stable when gently shaken, it means the latch is properly locked. Then, insert the master cable into the Type-C port on the LiDAR sensor. Gently push it in until the latch on the Type-C cable clicks and pops up, indicating that the main cable has been properly connected.

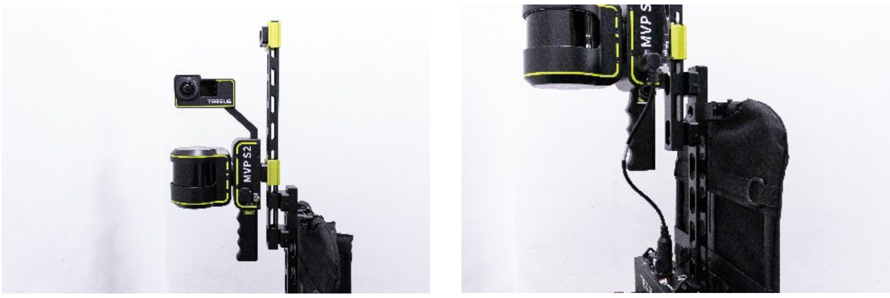


Figure 2-6

7. Mount the RTK module on the top and connect the cable. Align the red dot on the RTK cable with the red dot on the main unit's port, and gently insert the cable. Make sure to hold the cable by the metal ring, not by the black part of the cable. (All cables with red dots must be connected in this manner.)

Figure 2-7

8. Double-check that all components are properly installed, the latches are securely fastened, and there is no looseness when gently shaking by hand.

Figure 2-8

2.2 Dismantling

Note: If the device will not be used for an extended period, please disassemble it and store it in the provided transport case to prevent accidental damage from impacts or scratches.

- First, turn off the switch on the camera. After the camera's indicator light has completely gone out, then turn off the switch on the main unit.
- Disconnect all the cables and place them in their designated spots in the transport case. Then, remove the antenna disc, LiDAR module, RTK Module, Master Module, and battery in order from top to bottom, and place them properly inside the transport case.
- Remove the mounting rod and install it at the lower part of the back frame, then restore the triangular rod.

3 Operating Procedure

Note: The following points should be noted when using and storing the device:

1. Do not operate the device's connections while powered on, as it may damage the device.
2. The device's operating temperature range is from -20°C to +60°C. It should be used within the specified environmental temperature range.
3. Avoid placing the device in humid or corrosive environments frequently.
4. The device is not waterproof. Do not operate it in rainy or snowy weather.
5. During operation, keep an eye on obstacles in front of you to avoid collisions with the device.
6. When placing the device, ensure it is on a level surface and monitored to prevent it from tipping over.

3.1 Before Scanning

3.1.1 Power on the device

1. Turn on the device by pressing the SENSOR button first, followed by the MASTER button
2. Wait for 30 seconds, then turn on the camera power.

3.1.2 Connect to the control system

Note: During use, do not exceed a distance of five meters from the device to ensure a good WiFi connection signal.

- Connect to the WIFI of device
- Open the phone browser and enter the address: 192.168.95.110:8888. Wait for a moment to access the data collection interface.

3.1.3 Connect the device to an available network

If RTK mode is required, there are two ways to connect the device to the network:

① Insert a wireless USB network card.

② Click "Config", then click "Refresh" to refresh the WiFi list. Click the triangle icon to select a WiFi network, enter the password, and click "Connect" to connect the device to an available WiFi network. (It is recommended that the WiFi name be in English.)

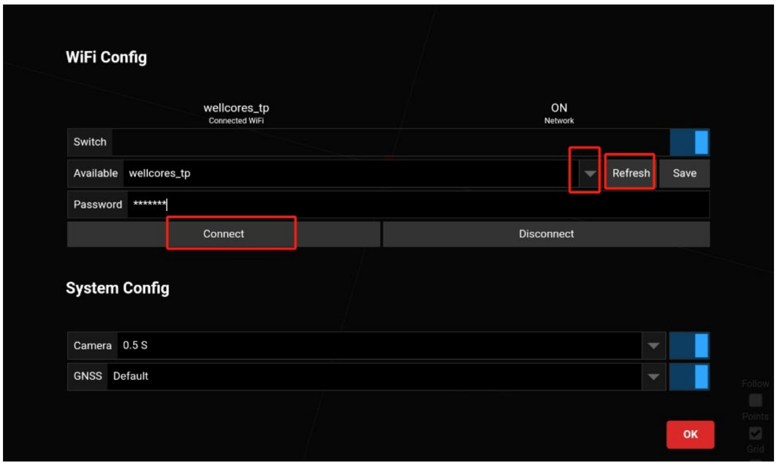


Figure 3-1

3.2 Data Collecting

3.2.1.1 TersusMVP Capture

The TersusMVP Capture Web UI includes the following five functional zones:

System： configure the device and connect to CORS to receive differential information.

Project： set project name, start/stop collecting, grab GCP, show real time pointcloud.

Data： View the collected projects.

Log： Record and display the device’s operation log information.

Status： sensor status, RTK status, image taken.

The sensor status and project information are as follows:

Network: ON-the device has connected to an available network；OFF-Network connection interrupted.

Battery: remaining battery level.

Disk: remaining disk capacity.

RTK： RTK status /HDOP/satellite number/positioning status, when the RTK status is 4, and HDOP<3.0, the positioning status will be Y (Yes), indicating that the device is fixed, or the positioning status will remain as N (NO).

DIFF： "YES" indicates that the RTK differential signal is being received normally; "NO" indicates that the RTK differential signal has not been received.

Time: collecting time.

Distance: distance from the starting position.

LiDAR: LiDAR data volume.

IMU: IMU data volume.

GNSS: GNSS data volume.

GCP: GCP count.

Camera: image count.

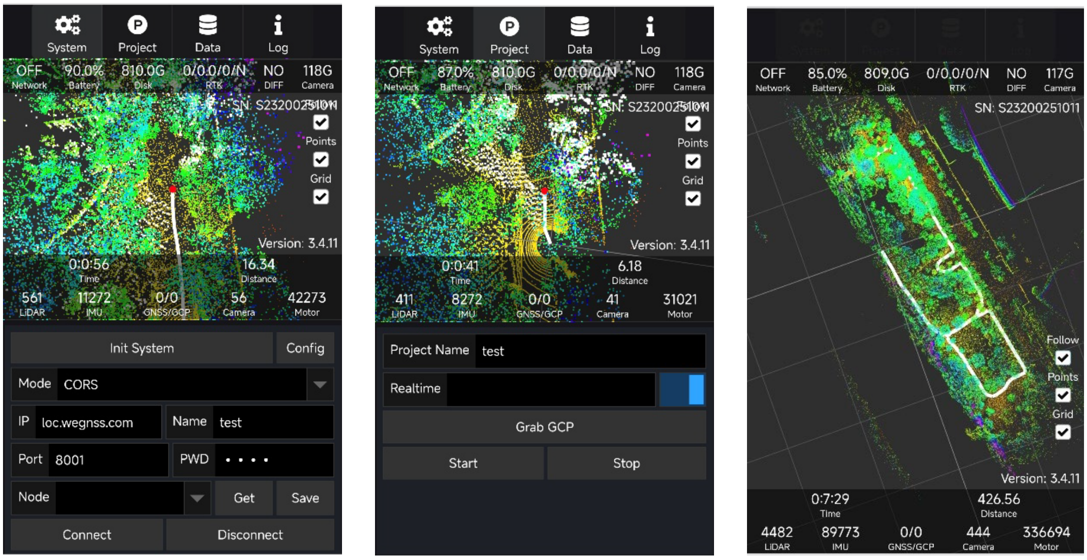


Figure 3-2

3.2.1.2 Backpack Operating Procedure

1. Place the device in an open area with the LiDAR sensor facing a fixed, stationary structure. Make sure no fast-moving objects pass in front of the LiDAR.
2. Click the MASTER and SENSOR button, and then turn on the camera. Connect your phone to the device’s Wi-Fi, open a browser, and enter the IP address 192.168.95.110:8888 to access the control interface.

3. Click "Config" to select whether to enable the panoramic camera and RTK mode. If RTK is used, you need to configure the device to connect to an available Wi-Fi network (see 3.1.3) and then connect to CORS (see 3.2.1.2 5.).
4. Click the "Initialize" button to start the system self-check. If the self-check is successful, a "Init system successfully" dialog box will pop up. Click "OK" to proceed.

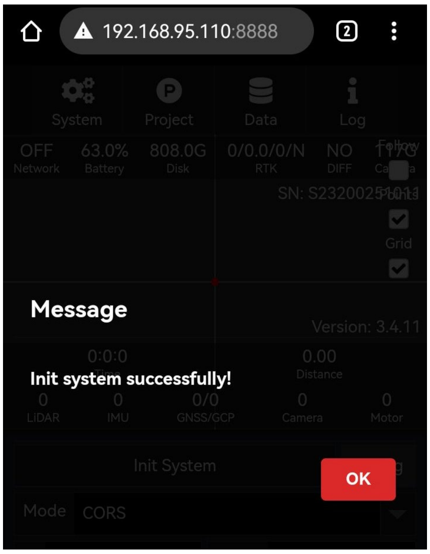


Figure 3-3

5. Enter the CORS server IP address, port, username, and password. Click “Get,” then click the downward arrow select an available mount point. After that, click “Connect.” Once connected successfully, the differential data status “DIFF” will change from “NO” to “YES”.

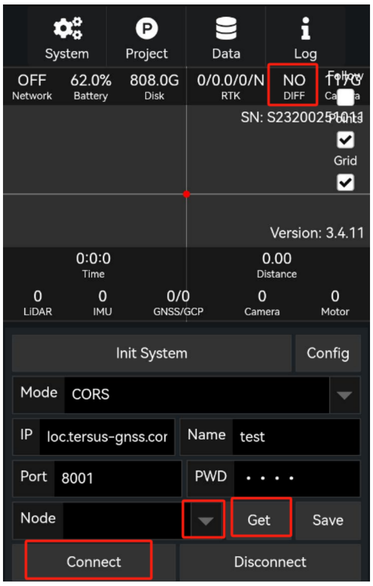


Figure 3-4

6. Move to an open area and wait until the positioning status shows 4 (Fixed) and the HDOP value is less than 3.0 before starting the data collection. Click "Project," enter the "Project Name". To view the point cloud in real time, you need to turn on the “Realtime” switch. Then click "Start". After approximately 14 seconds, a dialog box will appear indicating the beginning of the operation, and data collection will commence.

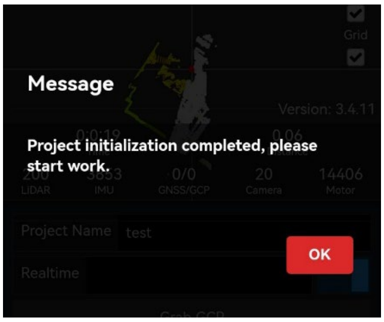


Figure 3-5

7. When data collection is complete, click the “Stop” button (you must stop the collection when the battery level is close to 0%). A “Data check successfully” dialog will appear—click “OK” to confirm.

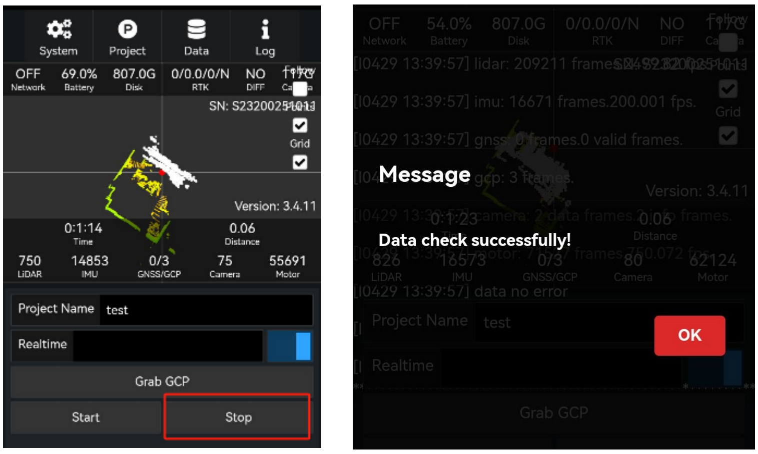


Figure 3-6

3.2.1.3 Handheld Operating Procedure

1. Screw the Target Board onto the bottom of the Handhel Module and secure it tightly with screws. Place the LiDAR horizontally on the base in an open area, facing a stationary structure. Make sure no rapidly moving objects pass above the LiDAR.

2. Attach the shoulder strap to the Master Module, and connect the data cable between the Master Module and the Handheld Module.

3．Click the MASTER and SENSOR button, and then turn on the camera. The remaining operations are the same as those for backpack operation.

3.2.1.4 Grab GCP

1．Align the cross-shaped hole on the Target Board with the ground control point (GCP). As long as the Target Board is firmly positioned on the GCP, the LiDAR module’s orientation—whether vertical or tilted—will not affect the final result. Then, tap the “Grab GCP” button on the mobile interface.

Figure 3-7

2．A dialog box will pop up to record the GCP number. Click “OK”. The GCP name cannot and should not be changed.

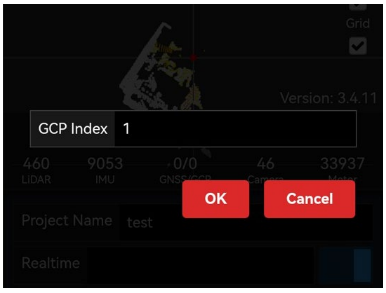


Figure 3-8

3．When you see the number of GCPs increase, it indicates that the current collection is complete.

Note: The number of GCP must not be less than four, and their positions must not lie on a straight line. They should be evenly distributed across the survey area.

Figure 3-9

3.3 Data Copying and Power Off

3.3.1 Data Copying

The USB drive used for data copying must be formatted as an NTFS file system. A USB 3.0 drive is recommended.

Insert the USB drive into the inner USB 3.0 port on the main unit panel (the port near the back frame in backpack mode).

Use the software to copy the data:

1. Click the "Data" menu tab and select "Refresh" to display project files from completed tasks.
2. Select the data file to be copied.
3. Click "Refresh" in the device panel to check the remaining storage space on the USB drive and compare it with the size of the data file.
4. Click "Copy." When the transfer is complete, a "Copy completed" dialog box will pop up.

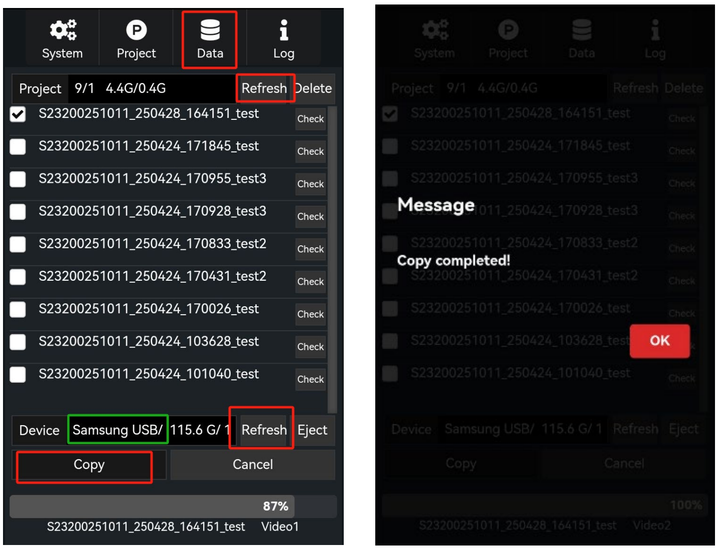


Figure 3-10

3.3.2 Power Off

Shut down the device in the following steps:

1. Press and hold the camera power button to turn off the camera.

2. Press the MASTER power button; the master power indicator (red) should turn off.

3. Press the SENSOR power button; the sensor indicator (blue) should turn off.

4 Data Scanning Guide

This chapter explains how to use the device to carry out data collection tasks to achieve optimal results. Before beginning the operation, the operator should survey the environment to identify potential problematic scenarios, such as areas with few distinguishable features, high levels of moving objects, or narrow spaces. If any of these conditions are present, please follow the recommendations in this chapter.

Additionally, the planned collection path should include as many loop closures as possible to enhance the accuracy of the final dataset.

4.1 Effective features

The SLAM algorithm used by this device relies on effective environmental features to reconstruct 3D point clouds. These effective features include static objects such as buildings, lampposts, and tree trunks.

Moving objects—such as vehicles, pedestrians, swaying leaves, and grass—are not considered effective features. In fact, they negatively impact the accuracy of the SLAM algorithm, so it's important to minimize scanning of dynamic elements.

In environments lacking sufficient features—such as smooth tunnels or open flat areas—it's recommended to add artificial features, such as parked vehicles, large boxes, umbrellas, or roll-up banners.

During scanning, also ensure the device is oriented properly, so the LiDAR continues to capture these artificial features throughout the process.

4.2 Moving Objects

As mentioned earlier, moving objects such as vehicles, pedestrians, swaying leaves, and grass are not effective features and can significantly degrade the accuracy of the SLAM algorithm. If too many dynamic elements are captured, it can even cause complete failure in reconstructing the 3D point cloud. Therefore, minimizing the presence of moving objects during scanning is essential. Please follow the guidelines below:

1. No unnecessary personnel should follow the device.

Apart from the operator, others should not walk near the device during operation. If following is necessary, maintain a distance of at least 20 meters behind the device.

2. Actively avoid scanning moving objects during collection.

If a moving object approaches—such as a car or a group of people—rotate the device to direct the LiDAR toward static objects instead. Once the moving object has passed and is more than 20 meters away, you can return the device to its original orientation and resume normal scanning. This reduces the likelihood of dynamic interference.

3. Be cautious during seasons with dense vegetation.

Swaying leaves and tall grass can severely interfere with the SLAM algorithm. Avoid scanning too many leafy or grassy areas.

Do not walk under dense low-hanging trees where leaves are closer than 1 meter to the LiDAR, as they may block the LiDAR beams entirely.

Avoid traversing through large, flower-covered or grassy fields, which often lack stable features and can introduce SLAM errors.

4.3 Narrow Spaces

A narrow space refers to environments where the LiDAR data is limited to a 1.5-meter range. In such spaces, the LiDAR’s view is often obstructed, making it challenging to capture accurate data. This is common in scenarios like entering a room through a door or moving from outdoors to indoors. When navigating narrow spaces, here are some key guidelines to follow:

1. Move slowly through the narrow space.

   Ensure that the movement through confined areas is steady and slow to give the LiDAR enough time to capture the available features.

2. Avoid getting too close to walls.

   Keep a safe distance from walls or other barriers, as getting too close may obstruct the LiDAR's scanning range and cause incomplete data collection.

3. Do not scan moving objects during narrow space traversal.

   Avoid scanning moving objects, such as people, as they can interfere with the accuracy of the LiDAR data. Try to wait until the area is clear of moving objects before scanning.

4. Pre-open all doors before entering narrow spaces.

   If you need to pass through doors, make sure they are open before starting the scan. Closed doors can block the LiDAR's view, making data collection difficult or impossible.

5. Adjust the LiDAR's orientation if necessary.

   When passing through a narrow space, it might help to rotate the LiDAR towards previously scanned areas (such as during backward walking in handheld or backpack configurations). This ensures continued data capture from areas already covered, which can improve overall data consistency.

4.4 Closed Loop

Loop closure is an important method for improving data accuracy. Whenever possible, the collection route should form a loop closure. A loop closure needs to be a circular loop, meaning it should enter the same location from different directions. Repeating data collection along a single route will not form a loop. Typical loop closure routes include walking around a building and returning to the starting point, entering the same floor in a multi-story building from different stairways, or entering and exiting a room through multiple doors.

The loop needs to have a certain degree of overlap (at least 15 meters). As shown in the figure below:

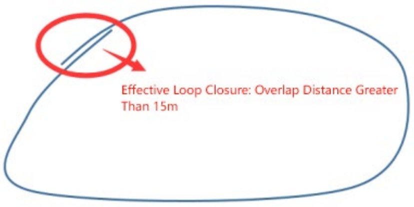


Figure 4-1

Here are examples of failed loop closures.

1. Incorrect loop closure.

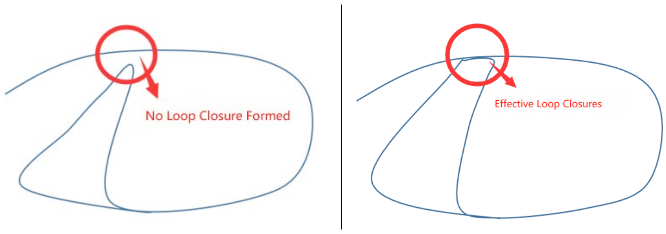


Figure 4-2

2. Overlapping distance is too short.

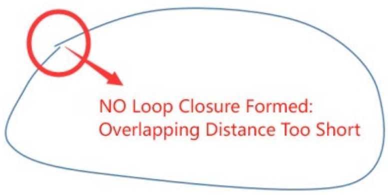


Figure 4-3

4.5 Initialization

Project initialization refers to the process at the beginning of a project, starting from the LiDAR being stationary, then beginning to spin, and finally the operator picking up the device to begin data collection. The following points should be noted:

1. The LiDAR should face a scene with rich features, and neither the operator nor others should block the sensor.
2. When the operator picks up the device or is assisted by others in wearing it, make sure the LiDAR is not fully covered, so it can scan as many effective features as possible.

4.6 RTK Data

RTK data is used to control the overall accuracy of the model, so it is important to collect as much RTK data as possible during acquisition. If, based on experience, the current location should allow for RTK but no RTK fix is present, the operator should stop and remain stationary for a while, allowing the GNSS receiver to converge to a fixed solution before resuming data collection.

4.7 Move Speed

It is recommended to operate the device at walking speed (approximately 4 km/h) to achieve optimal accuracy and point cloud density. If a higher speed is necessary, the maximum speed should not exceed 10 km/h.

5 TersusMVP Mapper

5.1 Introduction

TersusMVP Mapper is a dedicated processing software for MVP S2. It automates the processing of raw data collected by the device to generate environmental point cloud data, panoramic images, trajectory, and more.

5.2 Recommended Computer Specifications

Operating System: Windows 11 64 bit

CPU: Core i9

RAM: 128GB

Storage: 1TB

5.3 Data Processing

5.3.1 Launch TersusMVP Mapper

The interface of TersusMVP Mapper is as follows.

Figure 5-1

5.3.2 Create project

1. Click the "Create" button on the main interface to open the "Create New Project" dialog box.

2. Click the "Open" button to open “index.capproj” file and load the raw data.
3. Set the workspace and endpoint.
4. If image data is needed in the output, check the "Image" option; if colored point cloud data is needed, check the "Coloured PointCloud" option.
5. To use parameters from a template project, check "Template Project" and load the desired template.
6. Click the "Create" button to create the project, and the “process” folder will be generated in the project folder.

Note: After creating a project, do not move the project workspace folder or modify its internal directory structure. Otherwise, errors may occur when reopening the project due to missing files.

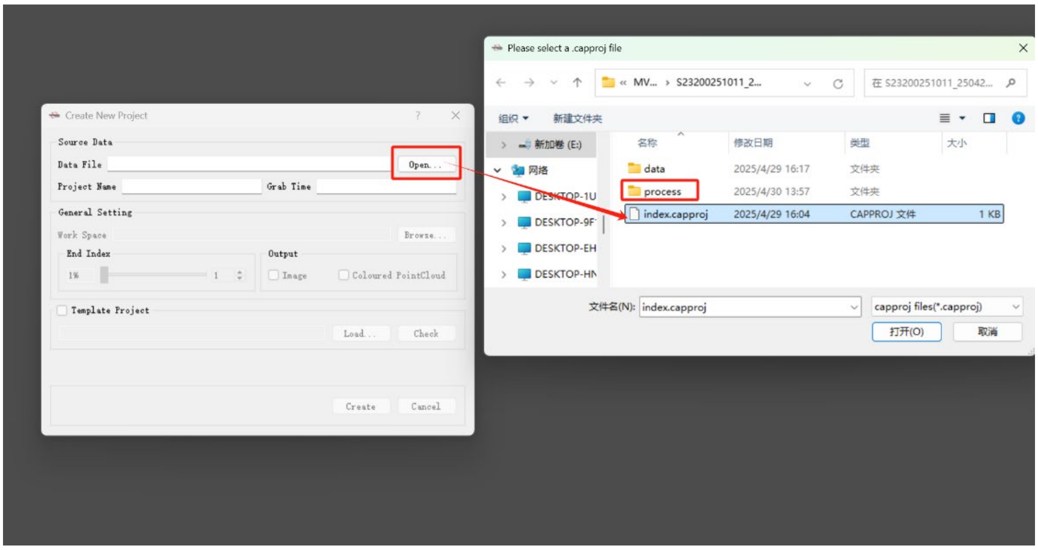


Figure 5-2

5.3.3 Open Project

Click the “Open” button in the main software interface, and load “.procproj” file to reprocess a processed project with modified parameters.

5.3.4 Processing Configuration

Click  to change the processing configurations

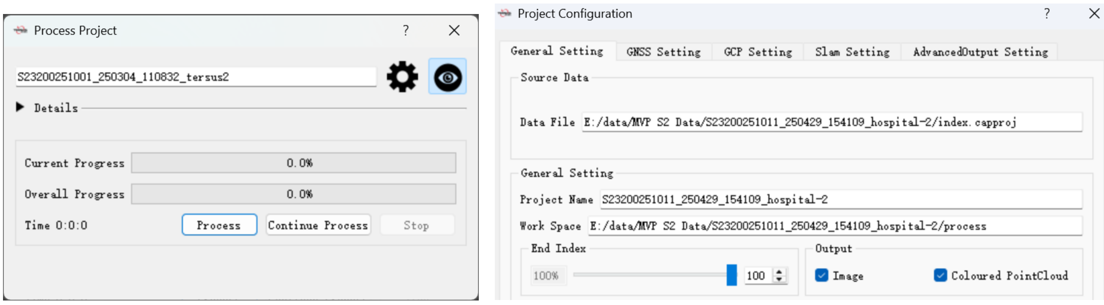


Figure 5-3

5.3.5 Start/Stop Processing

Click “Process” to start processing.

Click "Stop" to cancel project processing. Note that canceling the processing may take some time.

5.3.6 Continue Process

After changing certain setting parameters, the user can use "Continue Processing" to reduce data processing time.

Note: If a project has already been processed and you need to reset the output files or modify other configurations, please use the "Continue Processing" function.

5.3.7 Batch Create

1. Set the data directory, which should contain the project folders copied from the device.
2. Set the working directory, where corresponding processing project folders will be automatically created based on the projects in the data directory.
3. If you need to use parameters from a template project, check the option and load the template project.
4. Click "Start" to generate the processing projects.

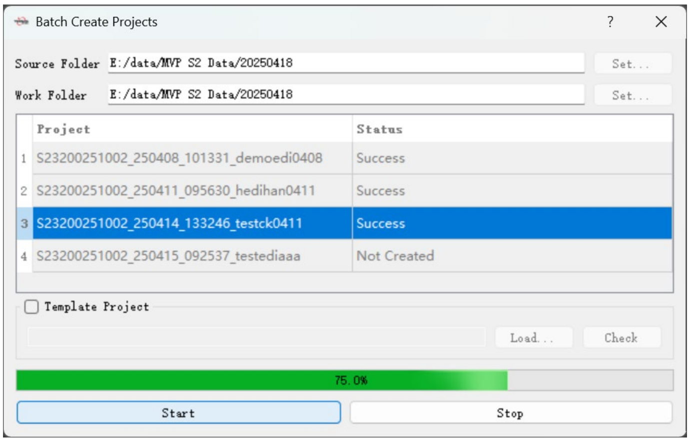


Figure 5-4

5.3.8 Batch Process

1. Batch add projects by selecting the folder that contains the processing projects.
2. Click "Process" to process all projects in sequence.
3. Click "Continue Processing" to continue processing each project in sequence.
4. Click "Terminate" to stop processing for all projects.
5. Click "Skip" to skip processing the current project.
6. Double-click a project in the project list to open the project configuration dialog and set parameters for that specific project.

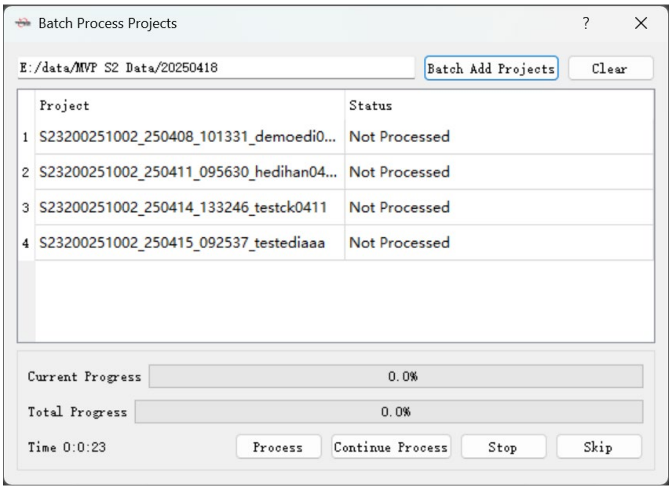


Figure 5-5

5.3.9 General Setting

In the general setting, you can set the endpoint and check the options for outputting images and colorized point cloud data. You can also set these parameters in the project creation process.

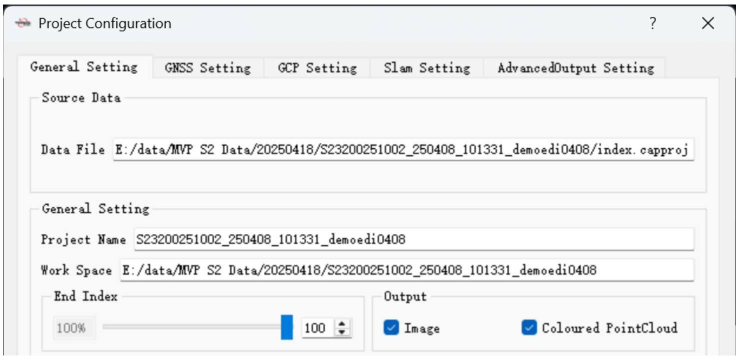


Figure 5-6

5.3.10 GNSS Setting

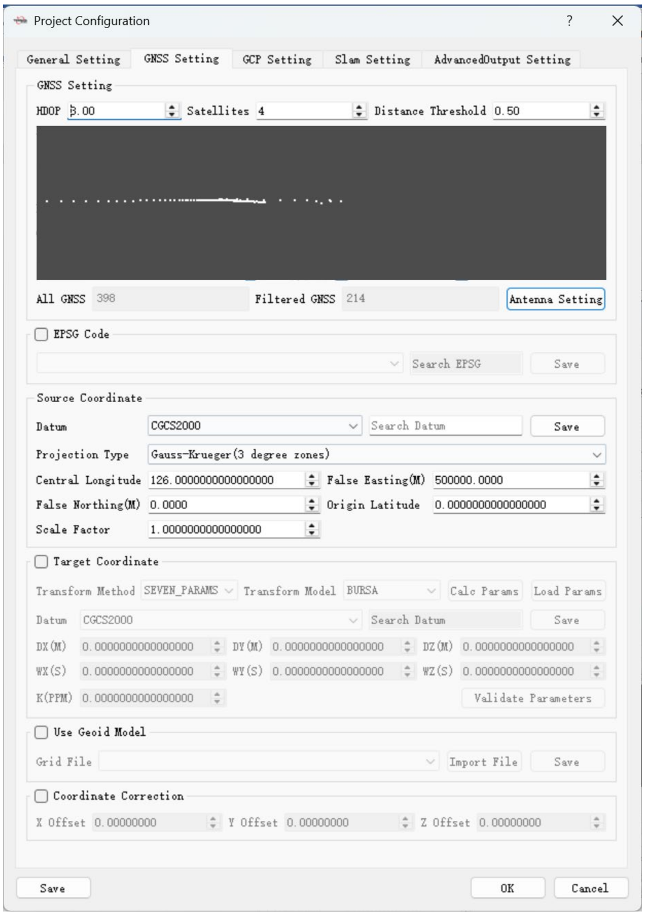


Figure 5-7

➢ HDOP: Horizontal Dilution of Precision, the smaller the value, the better the quality of the GNSS data. Set this parameter to adjust the GNSS data used in the calculation. It is typically set to 3.0.

➢ Satellites: The number of satellites available for each GNSS data, the bigger the value, the better the quality of the GNSS data. It is typically set to 4.

- Distance Threshold: Represents the distance (in meters) at which an RTK data point is used. The default is 0.5 meters.
- GNSS (white point): Represents the GNSS data points involved in the calculation. This can be used to view the distribution of GNSS points along the trajectory.
- All GNSS: Represents all the GNSS data acquired.
- Filtered: Represents the GNSS data used in the calculation. The number of GNSS data involved in the calculation can be changed by adjusting HDOP, the number of satellites, and the distance threshold.

Note: Adjusting HDOP, the number of satellites, and the distance threshold will change the GNSS data involved in the calculation. It is generally fine to use the default parameters. During adjustments, be careful not to disrupt the even distribution of GNSS data.

5.3.11 Source Coordinate

The default coordinate system is CGCS2000, and the default projection is the Gauss-Krüger 3-degree zone projection. The central meridian, false easting, false northing, origin latitude, and scale factor need to be modified according to the actual situation.

Note: Parameters such as Central Longitude must match those used in the actual project. Otherwise, calculation errors may occur.

5.3.12 Target Coordinate

If coordinate transforming is required, make sure to check the Target Coordinate selection box. The software supports two types of coordinate transforming methods as follows.

(1) If the user can provide the coordinate system and the corresponding Bursa seven parameters, enter the parameters in the designated fields. After clicking "OK," proceed with data processing according to the standard project workflow.

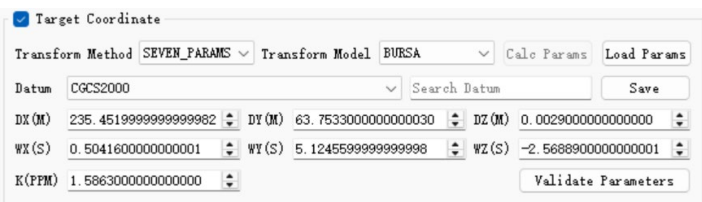


Figure 5-8

You can also click "Load Parameters" to import a CSV file containing the transformation parameters. The CSV file should follow the specified format (as shown in the figure), with values separated by commas by default.

	A	B	C	D	E	F	G	H
1	216.425	79.1212	30.3236	0.30416	2.19749	-3.04159	2.2675	

Figure 5-9

(2) If the user cannot provide the seven parameters, control points must be collected using a rover. A coordinate transformation file should then be created and imported into the software to calculate the seven parameters and complete the coordinate transformation.

Select the transformation model ONE_STEP, then click the Calculate Parameters button.

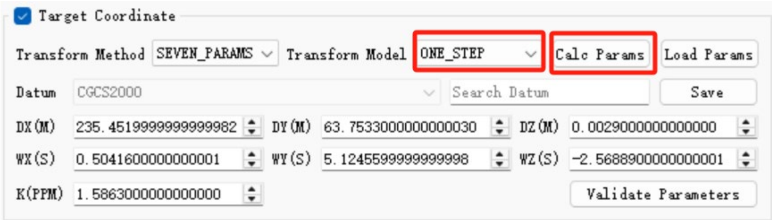


Figure 5-10

The Calculate Transform Parameters interface will pop up. Then, click the Import button to import the coordinate transformation file.

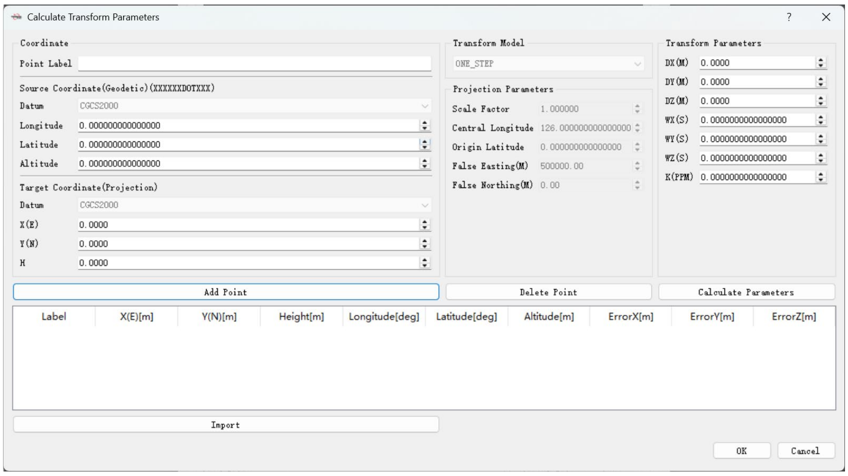


Figure 5-11

The coordinate transformation file should use the following format:

Point Name, Local Coordinate (North), Local Coordinate (East), Local Coordinate (Height), Geodetic Latitude (B), Geodetic Longitude (L), Geodetic Height (H)

	A	B	C	D	E	F	G
1	con5	4418277. 726	425257. 5103	72. 9576	395343. 349	1160733. 854	72. 9576
2	con4	4418143. 448	425204. 0319	73. 8886	395338. 9788	1160731. 659	73. 8886
3	con2	4418201. 92	425014. 3688	84. 7848	395340. 8142	1160723. 652	84. 7848
4	con1	4418296. 344	425041. 0894	73. 4816	395343. 8838	1160724. 738	73. 4816

Figure 5-12

The latitude format should be XX degrees XX minutes XX.XXX seconds, and the longitude format should be XXX degrees XX minutes XX.XXX seconds.

If the coordinate transformation is successful, the result will be displayed. After clicking "OK," proceed with data processing according to the standard workflow.

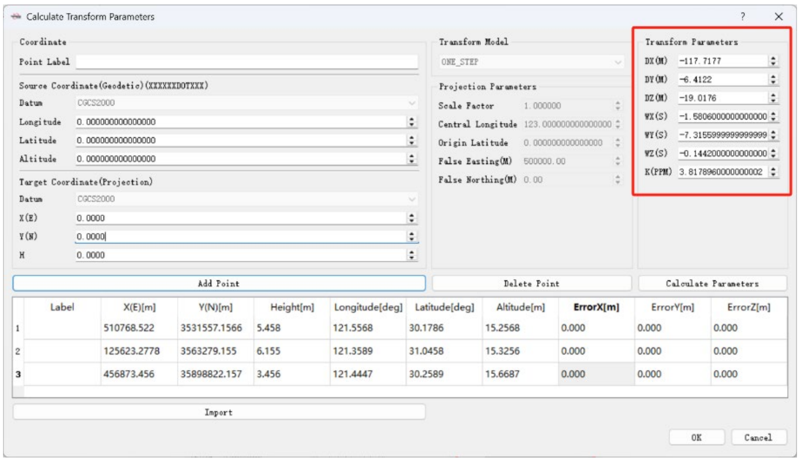


Figure 5-13

To verify the accuracy of the calculated seven parameters, follow these steps:

1. Enter the geodetic coordinates of the checkpoint into the left sidebar.

2. Click the Convert button.

3. Compare the output coordinates with the local coordinates of the checkpoint to assess the accuracy of the seven parameters.

Figure 5-14

Note: When calculating the seven parameters using this software, the transformation model must be set to ONE_STEP, otherwise, a calculation error will occur.

5.3.13 Coordinate Correction

The point cloud elevation calculated by the software is set to geodetic height by default. If the user needs to convert the geodetic height to another type of elevation, they can enter the corresponding parameters in the coordinate offset section and then perform the calculation.

Figure 5-15

5.3.14 GCP Setting

5.3.14.1 Import GCP

1. After creating a new project, if you need to import control points, click "GCP Settings", then click "Reset" to display the GCP list. The collection times of the points will be imported in sequence based on the order they were collected, labeled as "0, 1, 2, 3, 4, …".

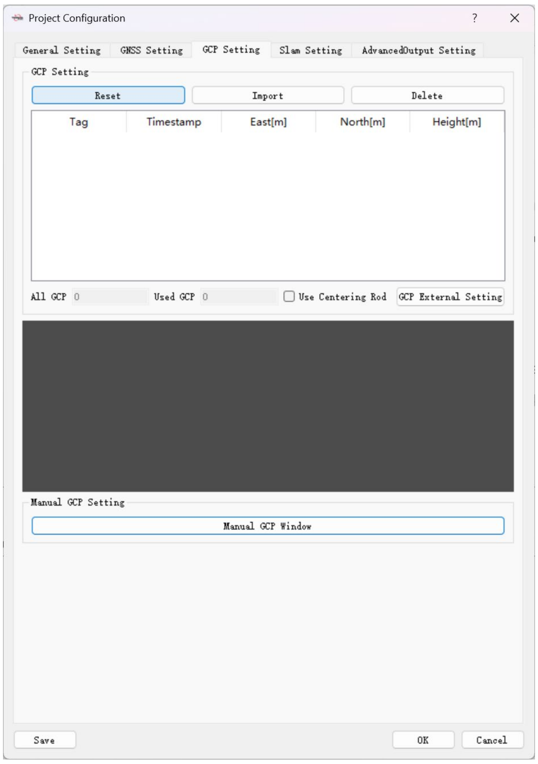
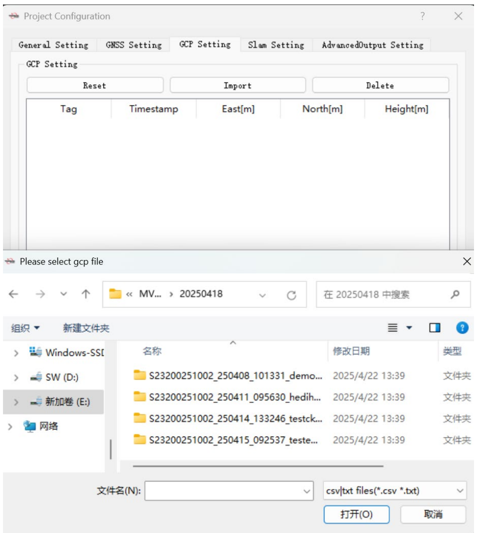


Figure 5-16

2. Store the control point coordinates in a TXT or CSV file, with each row containing the values in the order of East, North, Height, separated by commas. Click "Import " to load the coordinates based on the sequence in which the control points were collected. Finally, click "OK", then click "Process" to begin data calculation.

Note: The order of the control points must exactly match the order in which the points were collected during the survey!



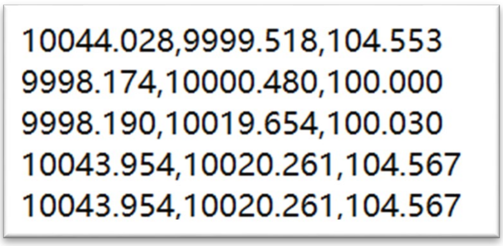

10044.028,9999.518,104.553
9998.174,10000.480,100.000
9998.190,10019.654,100.030
10043.954,10020.261,104.567
10043.954,10020.261,104.567

Figure 5-17

3. If the TXT or CSV file containing the control point coordinates uses separators other than commas between columns, or if the file includes malformed rows, irregular formatting, or non-numeric data such as Chinese characters, an error message will pop up. In this case, you need to carefully check the data and formatting of the control point file to ensure it meets the required structure.

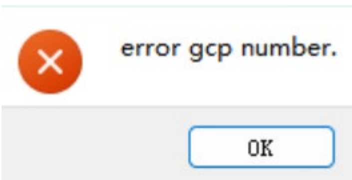


Figure 5-18

4. For control point data already imported into the TersusMVP Mapper software, if a specific row is not needed, select that row and click "Delete " to remove it from the list.

Note: The remaining number of control point entries must be no fewer than 4.

5.3.14.2 Manual GCP

1. Measure the coordinates of manual GCP in point cloud first, and then organize the target coordinates and the measured point cloud coordinates into the same table. Each row should include the point number, local coordinates (East X, North Y, Height Z), and point cloud coordinates (East X, North Y, Height Z) in that order. Finally, save the table in CSV format.

A	B	C	D	E	F	G
4	540043. 2	4617920. 7	60. 744	540043. 14	4617920. 6	60. 698
5	539864. 71	4617949. 3	60. 902	539864. 73	4617949. 2	60. 855
6	539751. 51	4617968. 8	60. 706	539751. 57	4617968. 7	60. 645

Figure 5-19

2. Click “Manual GCP Window” button, then click “Import” to import the CSV file.

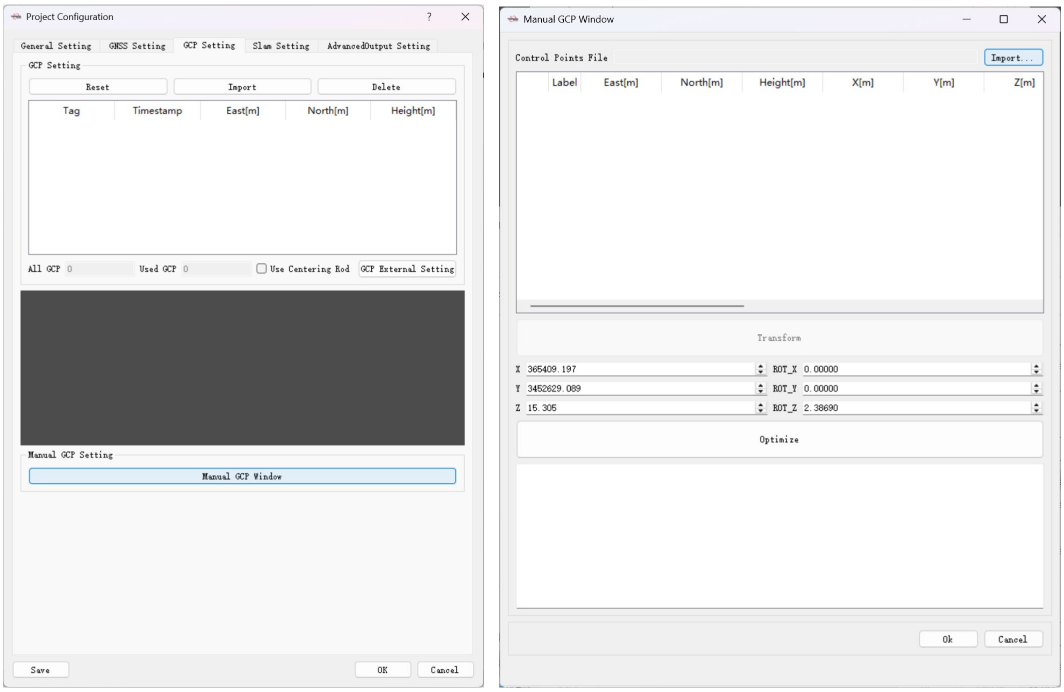


Figure 5-20

3. At this stage, there are two cases:

If the point cloud data is in relative coordinates, first click "Transform", then click "Optimize", followed by "Confirm", and finally "Continue Processing" to perform adjustment and coordinate transformation.

If the point cloud data is in absolute coordinates, directly click "Optimize", then "Confirm", and finally "Continue Processing" to proceed with adjustment and coordinate transformation.

5.3.15 SLAM Setting

The parameters here usually do not need to be changed, the default settings are typically sufficient.

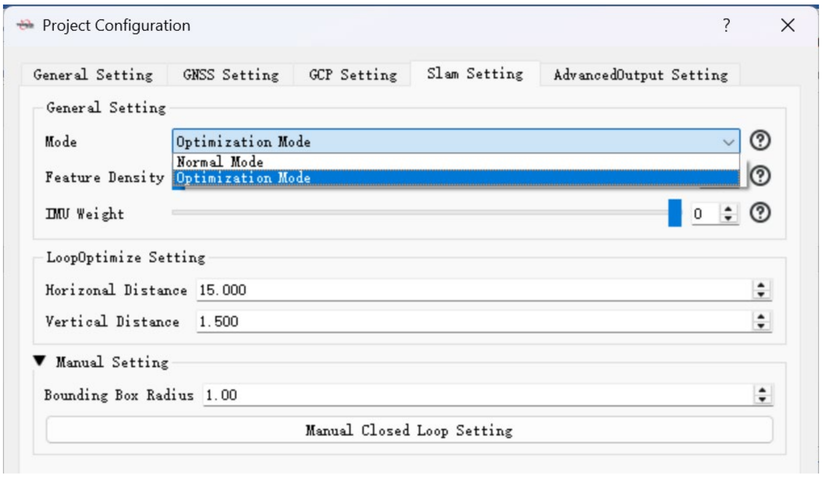


Figure 5-21

5.3.15.1 Slam Setting - General Setting

➢ Optimization Mode: When data cannot be properly processed due to a lack of features or weak textures, this function needs to be checked.

➢ Feature Density: The number of features extracted from the environment. In conditions where features are scarce or the collection speed is fast, increasing the feature density can help prevent too few features from being used in the calculation, which could otherwise lead to processing failure.

➢ IMU Weight: The confidence level of the IMU data during pose calculation. It generally does not need to be modified unless there are special circumstances.

Note: Try using the optimization mode to solve weak-texture scenes first. If it still fails, then reduce the IMU confidence value and increase the feature point density value.

5.3.15.2 LoopOptimize Setting

➢ Vertical Distance: This is the vertical distance threshold for automatically searching loop closures. The default value usually does not need to be changed. However, if processing data from a multi-story environment with small inter-floor spacing (e.g., two floors close together), it is recommended to reduce this value—typically setting it to 1.00 is appropriate.

5.3.15.3 Manual Closed Loop Setting

1．Open the project file that has already been processed, then go to Slam Setting> Manual Setting > Manual Loop Closure Setting.

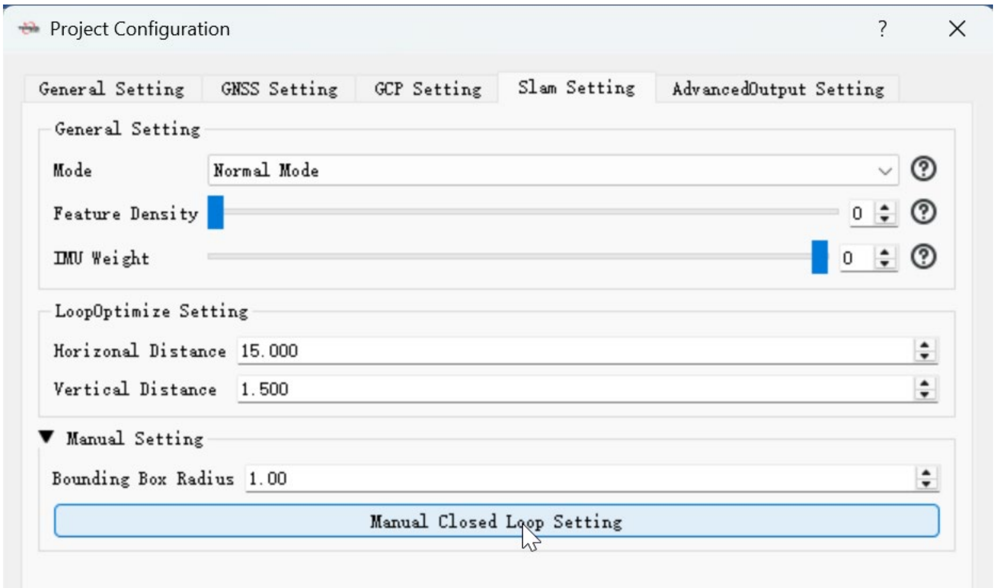


Figure 5-22

2．Select the point clouds collected from the two channels at the layering location, as shown in the figure.

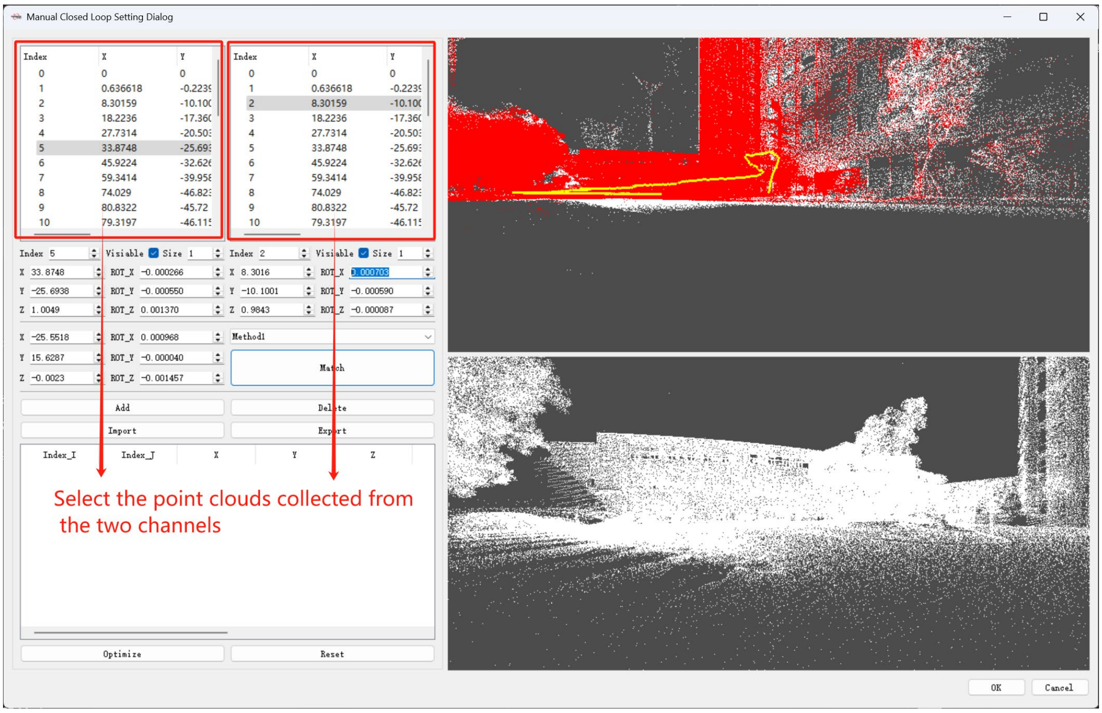


Figure 5-23

3. Then click "Match". The bottom-right window will display the alignment result of the two layered point clouds. If the point clouds appear properly aligned without any visible layering, click "Add". After that, click "Optimize", and finally, click "OK".

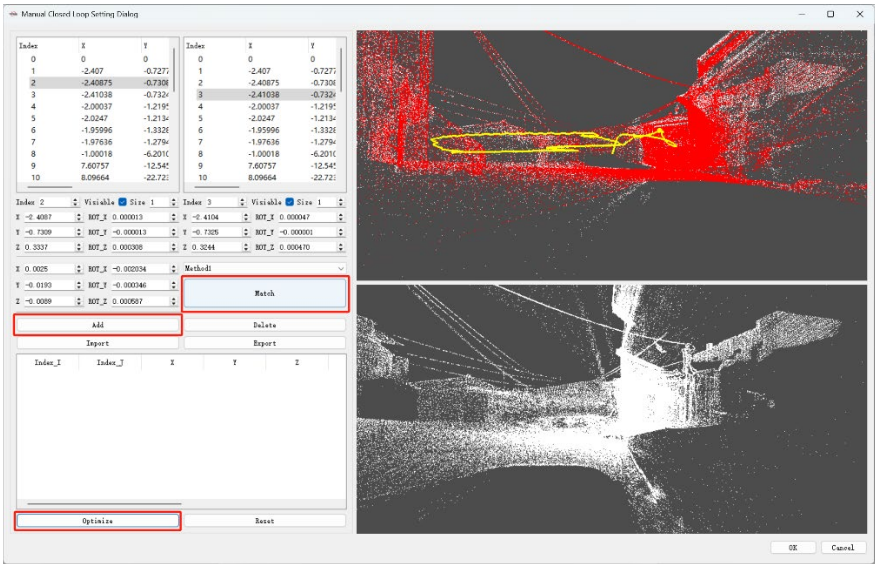


Figure 5-24

4. Click “OK” to start processing the manually optimized results. (Note: If the data is fine after the first processing, there’s no need to reprocess it later. Do not move the file location, or the software may not be able to find the files for reprocessing.)

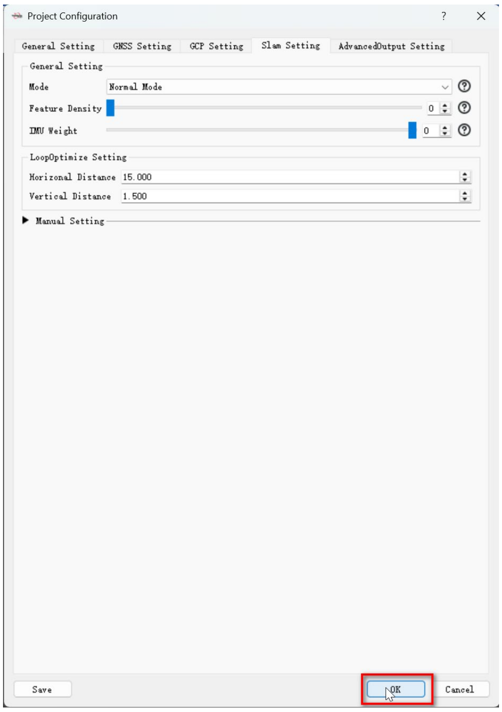


Figure 5-25

Click "Continue Process" to proceed with processing based on the manually closed loop optimized adjustments, as shown in Figure 5-26.

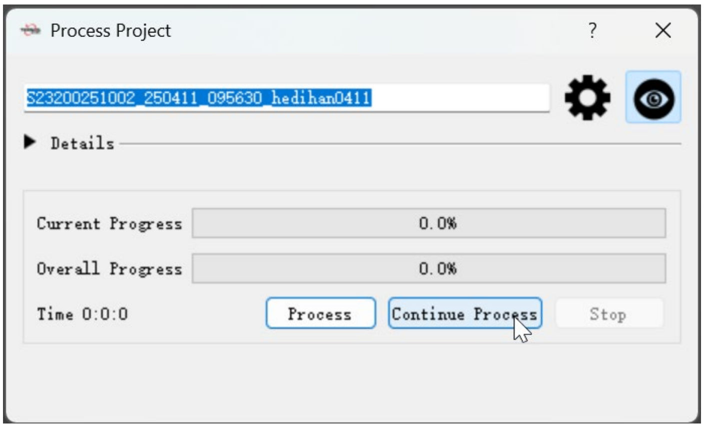


Figure 5-26

5. After matching, if the layered point clouds in the bottom-right corner still appear misaligned:

(1) Adjust the values of X, Y, or Z (translation), or Rot_x, Rot_y, or Rot_z (rotation) in the lower right column. Then click "Match" again and observe the alignment of the two point cloud segments in the bottom-right corner. If they are no longer misaligned, click "Add", then "Optimize", and finally click "OK", as shown in Figure 5-27.

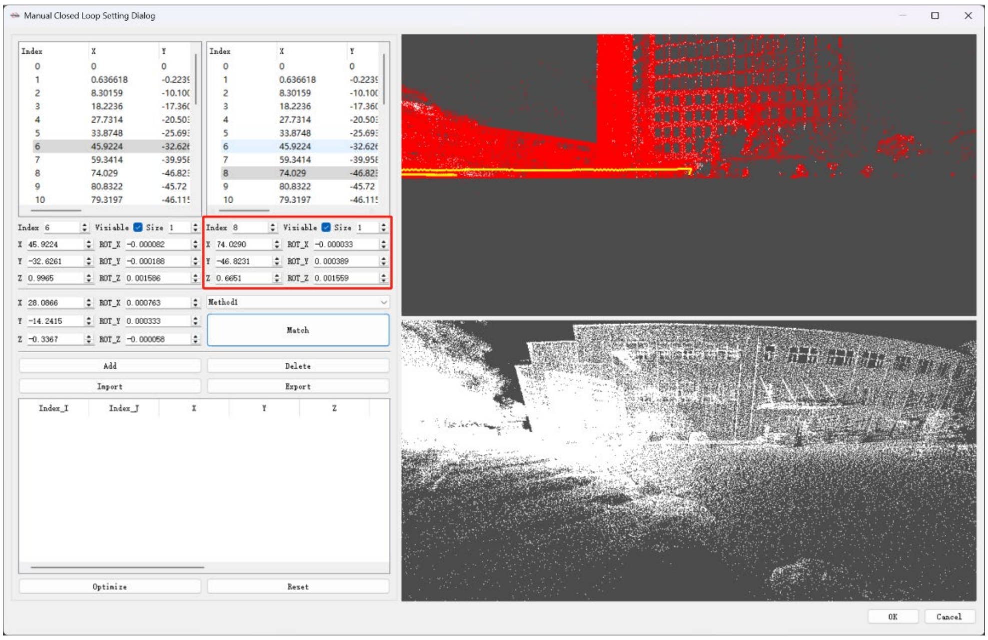


Figure 5-27

(2) The manual loop closure is set to "Method 1" by default. If the stitching effect of "Method 1" is not good, you can switch to "Method 2" for "matching," as shown in Figure 5-28.

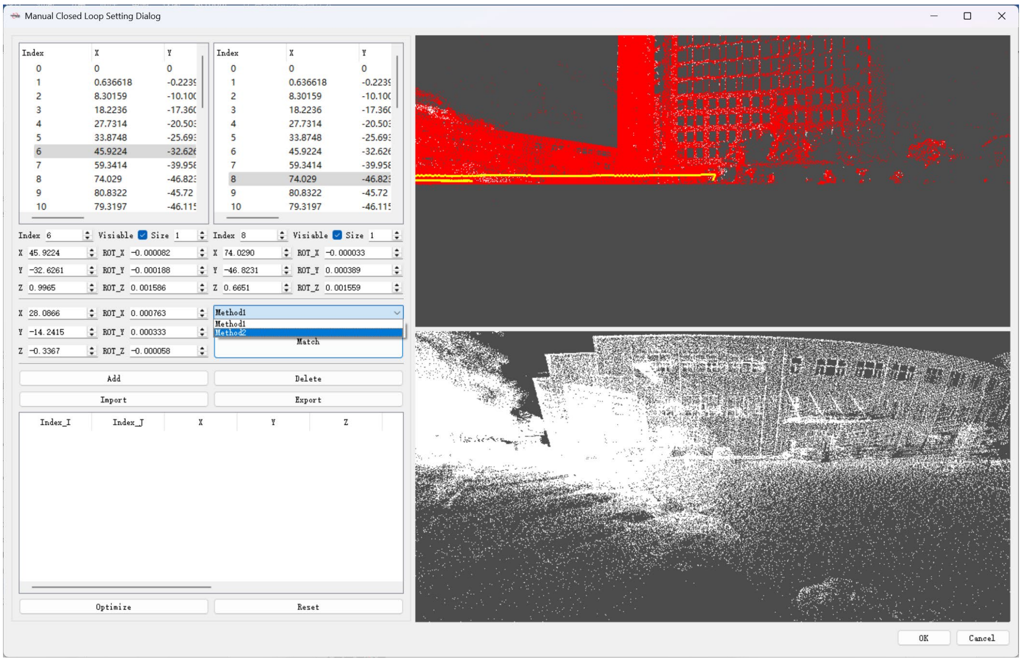


Figure 5-28

"Import" and "Export": Users can export the manually closed point cloud data in CSV format. If other locations with layering are found in the processed point cloud, the CSV data of the first layered location should be "imported" and then used to stitch and match the point cloud of the second layered location.

Note: If the manually adjusted point cloud data from the first location with layering is not imported, the second location's point cloud may be successfully matched, but the first location's point cloud will still have layering issues.

5.3.16 AdvancedOutput Setting

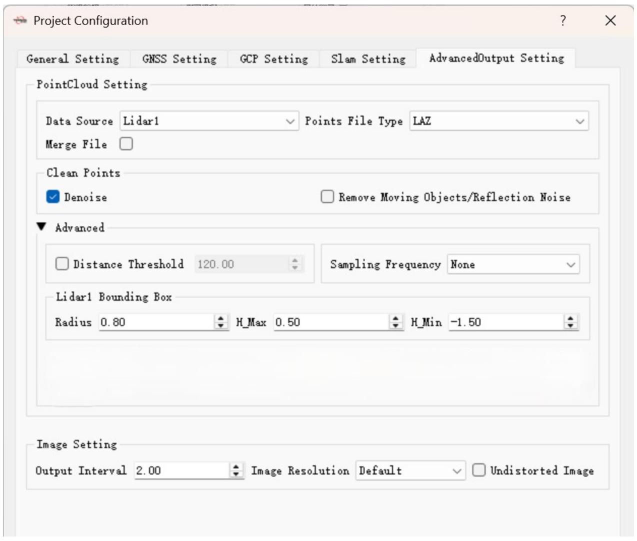


Figure 5-29

5.3.16.1 PointCloud Setting

- Data Source: The data source for point cloud modeling in the S2 series is fixed to Lidar1 and cannot be changed.

- Points File Type: Choose the output format for the point cloud data. Both LAS and LAZ formats are available, and they offer identical data quality. The LAZ format, however, requires less storage space.

- Merge File: By default, TersusMVP Mapper software outputs point cloud data in 5-minute segments in LAS/LAZ format. If the user needs a single continuous LAS/LAZ file, they can enable the "Merge File" option.(For example, for 20 minutes of data, the default output would be 4 separate segments; if merging is enabled, the output will be one complete segment.)

- Denoise: To remove noise from the point cloud.

- Remove Moving Objects/Reflection Noise

- Remove Moving Objects/Reflection Noise: Remove moving objects from the point cloud, such as pedestrians, moving vehicles, and noise caused by reflections from glass surfaces or water bodies.

5.3.16.2 Advanced

- Remove Moving Objects/Reflection Noise

- Distance Threshold: Small stratifications and noise points caused by long-range LiDAR scans can be removed. The larger the parameter setting, the more points will be deleted.

- Lidar Bounding Box

Radius: This refers to removing point cloud data within a cylindrical area centered around the LiDAR, with a default radius of 0.8 meters.

H_Max: By default, point cloud data within 0.5 meters above the LiDAR is removed.

H_Min: By default, point cloud data within 1.5 meters below the LiDAR is removed.

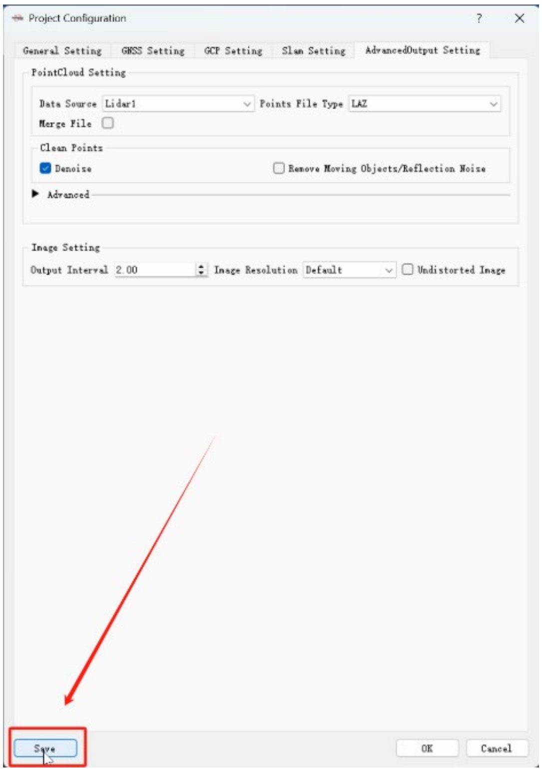
5.3.16.3 5.3.16.3 Image Setting

- Output Interval: The default value is 2, meaning one image is output for every two images.

- Image Resolution: Adjust the resolution of the output panoramic image.

5.3.17 Template Project

Users can save project parameters as a template. When creating a project or batch creating projects, loading the template project will automatically set the project parameters to those of the template, improving efficiency. Click the "Save Template" button in the dialog box to save.


Project Configuration
General Setting
GNSS Setting
GCP Setting
Slam Setting
AdvancedOutput Setting
PointCloud Setting
Data Source
Lidar1
Points File Type
LAZ
Merge File
Clean Points
Denoise
Remove Moving Objects/Reflection Noise
Advanced
Image Setting
Output Interval
2.00
Image Resolution
Default
Undistorted Image
Save
OK
Cancel

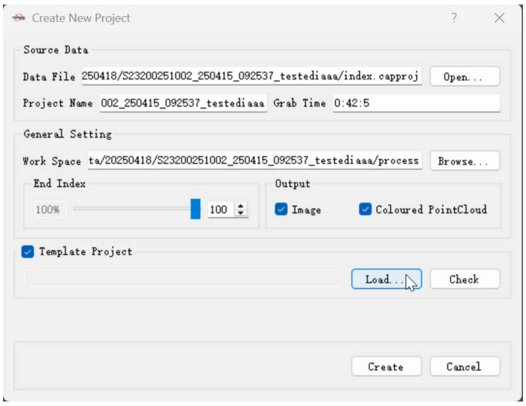

Create New Project
Source Data
Data File
Open...
Project Name
Grab Time
General Setting
Work Space
Browse...
End Index
Output
Image
Coloured PointCloud
Template Project
Load...
Check
Create
Cancel

Figure 5-30

6 TersusMVP Viewer

6.1 Introduction

TersusMVP Viewer is the companion visualization software for the MVP S2. It enables the display of processed results from the Mapper software, supports ultra-fast loading of massive point cloud datasets, and allows real-world imagery to be overlaid and synchronized with point cloud data. The software also supports real-world measurements, point cloud clipping, and various display modes including color, intensity, and elevation views.

6.2 Recommended Computer Specifications

Operating System: Windows 11 64 bit

CPU: Core i7

RAM: 32GB

Storage: 1TB

6.2.1 Launch TersusMVP Viewer

The interface of TersusMVP Viewer is as follow.

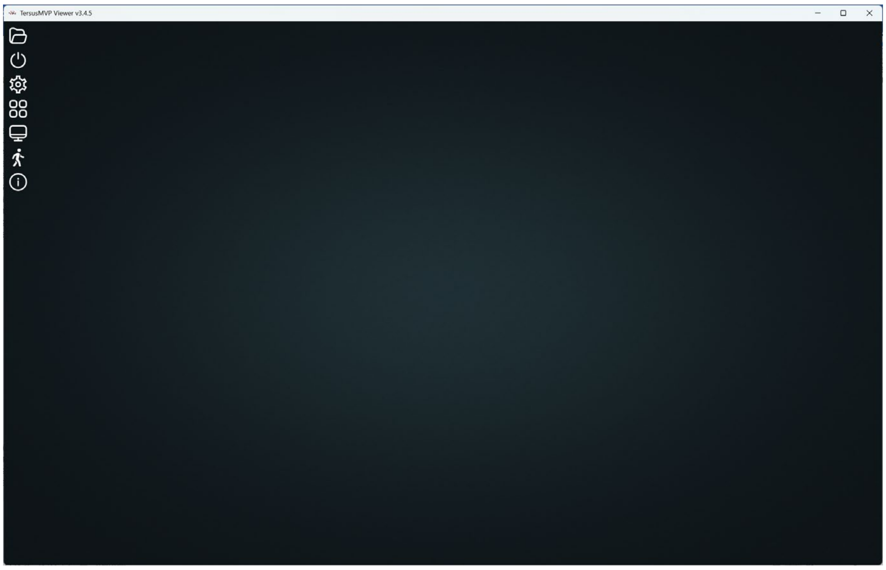


Figure 6-1

6.2.2 Open Point Cloud Data

Click the "Open Point Cloud" button on the main interface and select the “Process\output” folder.

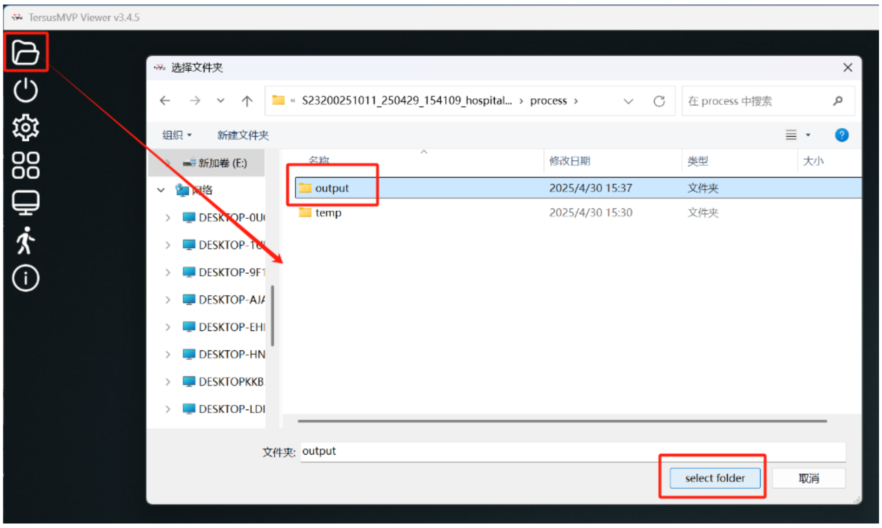


Figure 6-2

Note:

1. Do not select any folder other than the output folder, otherwise an error message will appear indicating the folder selection is incorrect.

2. If you've already loaded the data into the Viewer software and need to update the .las/.laz point cloud files in the output folder, please delete the automatically generated “tiles_data” folder inside the output directory first.

3. The point cloud file names in the output folder must contain the word "points", such as “xxxx points xxxx.las”.

6.2.3 Overlay Panoramic Images with Point Cloud Data

1. Left-click to pan, right-click to rotate, and scroll the mouse wheel to zoom in and out.

2. Double left-click on the panoramic sphere to view the panoramic image at the current location.

3. Right-click to exit the panoramic sphere.

4. Drag the gray square block to adjust the transparency of the panoramic image, enabling overlay display with the point cloud data.

Figure 6-3

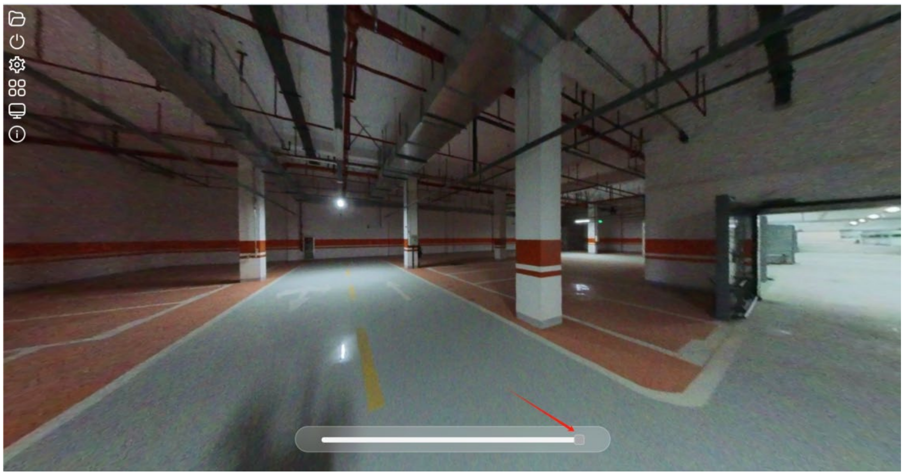


Figure 6-4

6.2.4 Reset Point Cloud

Click the "Reset Point Cloud" button to clear the current data.

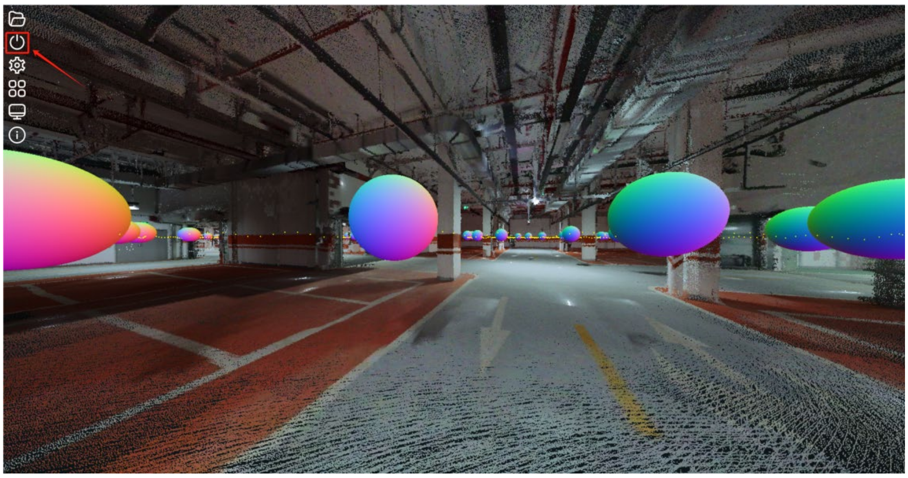


Figure 6-5

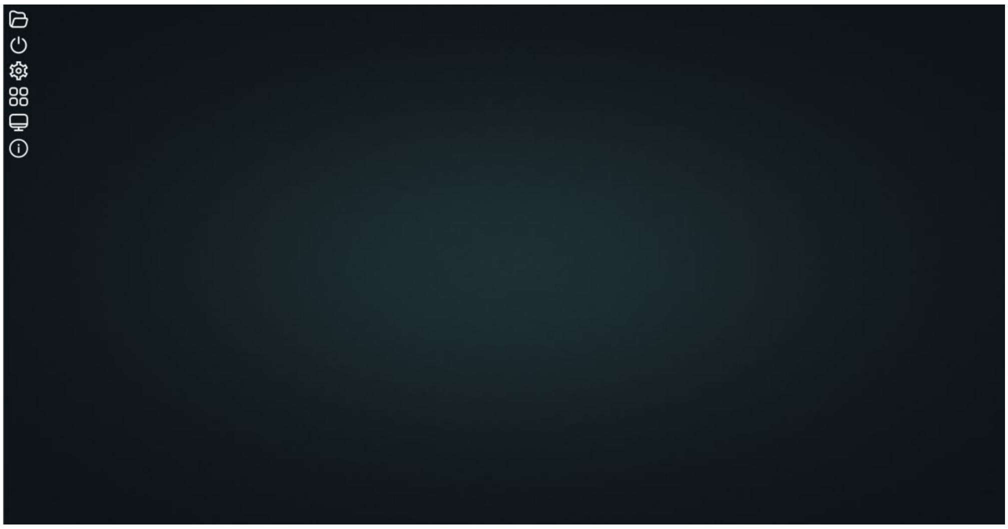


Figure 6-6

6.2.5 Set The Point Cloud Display Mode.

The point cloud display mode can be set to: intensity, colored intensity, classification, rgba, elevation.

Gamma: Also known as the grayscale coefficient, it is used to adjust the ratio of brightness and contrast. Increasing the gamma value enhances the grayscale contrast, while decreasing it reduces the contrast. In most cases, the default gamma value works well and does not require adjustment.

Brightness: Adjusts the overall lightness or darkness of the point cloud display.

Contrast: Modifies the difference between the light and dark areas in the display to enhance visual clarity.

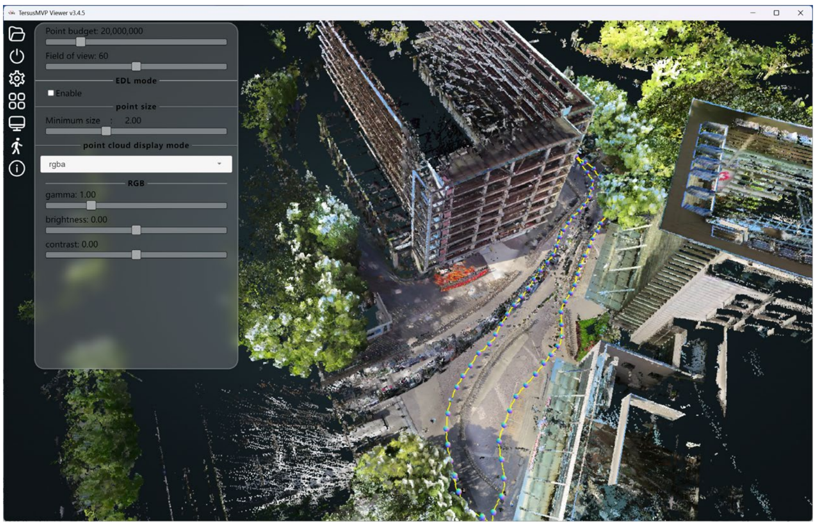


Figure 6-7

6.2.6 Point Cloud Tools

The point cloud tools include: measurement tool, slicing tool, display tool.

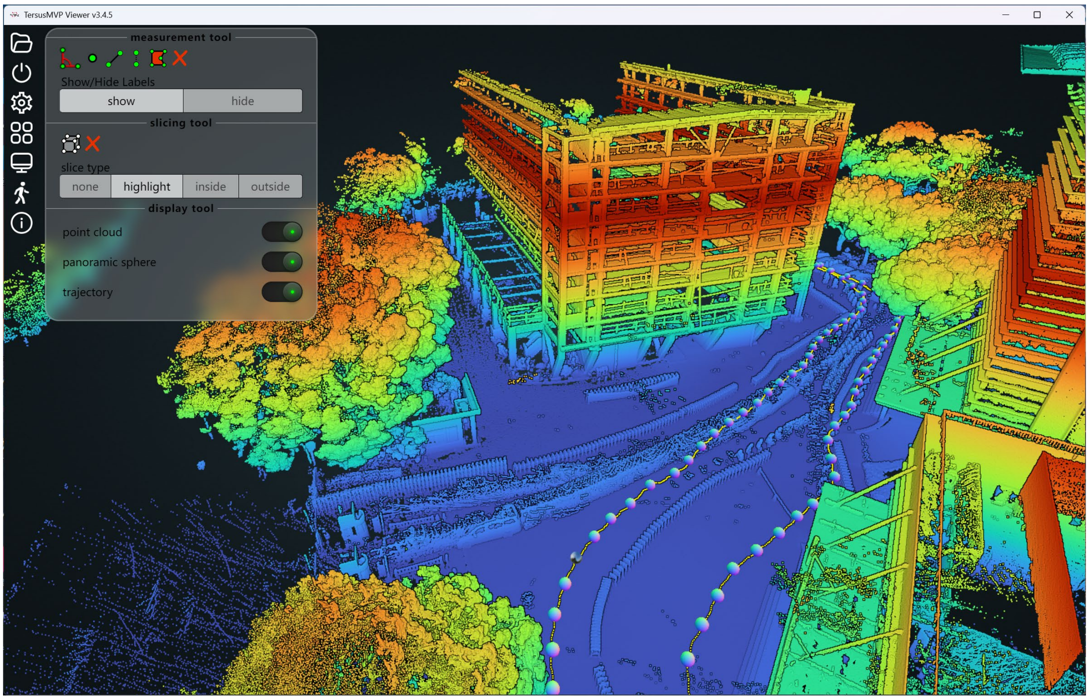


Figure 6-8

6.2.6.1 Measurement Tool

Measurement tool include: Angle measurement, Point measurement, Distance measurement, Height measurement, Area measurement.

Click to clear any measurement results.

Click “Hide” to hide measurement values.

6.2.6.2 Slicing tool

Left-click with the mouse to activate the clipping bounding box. Adjust the size of the bounding box by dragging the colored spheres in each direction.

Inside: show the point cloud inside the clipping bounding box.

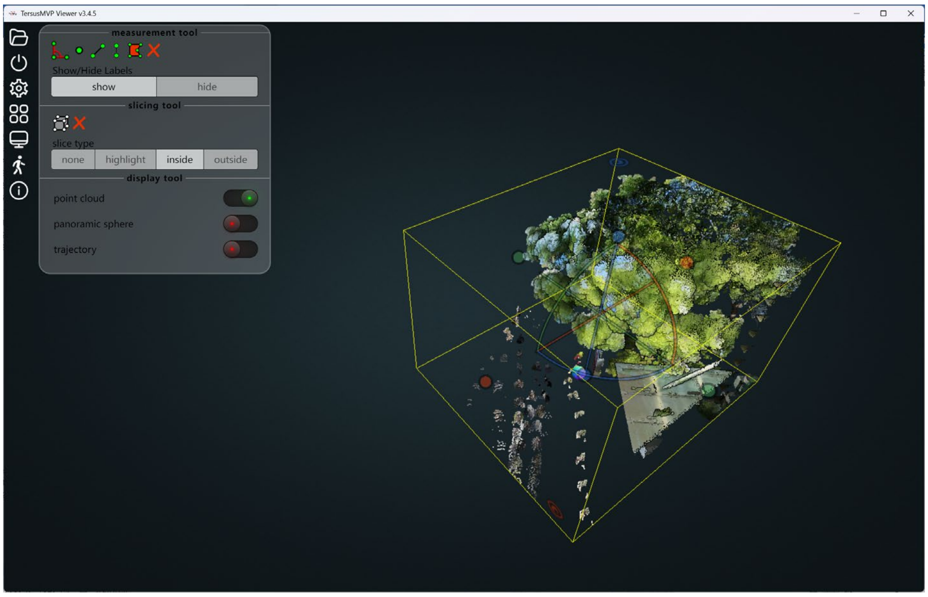


Figure 6-9

Outside: show the point cloud outside the clipping bounding box.

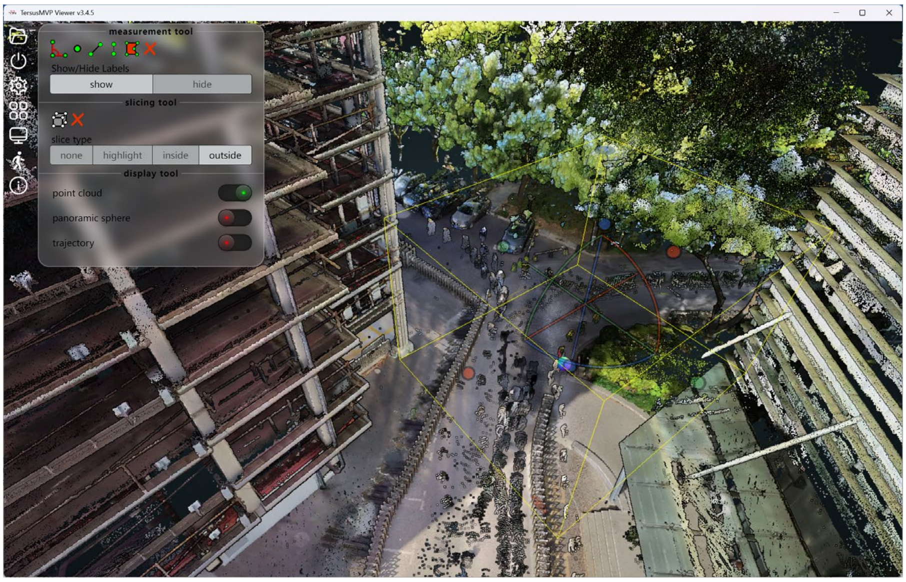


Figure 6-10

: Cancel clipping

6.2.6.3 Display tool

Control whether to display the point cloud, panoramic spheres, and trajectory.

Figure 6-11

6.2.7 Split-screen Display of Panoramic Images and Point Cloud.

Click , then click the panoramic sphere with the left mouse button to view the corresponding real-world image on the right side. The current field of view (highlighted in yellow) will be displayed on the left side.

Figure 6-12

7 Others

7.1 Update for Capture

1. Power on the device host.

2. Use the handheld terminal to connect to the device's Wi-Fi, then log in to the page at IP address: 192.168.95.110:8889.

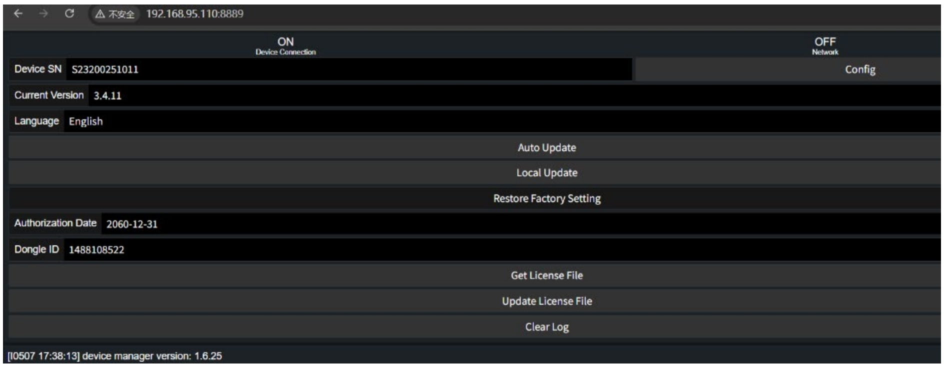


Figure 7-1

3. Click “Config”, then Refresh, select the network, enter the password, click Connect to join the network, and finally click OK.

Figure 7-2

4. Click “Auto Update”, the latest available version will be displayed, click OK to update. If the device is already up to date, the message will appear as shown below.

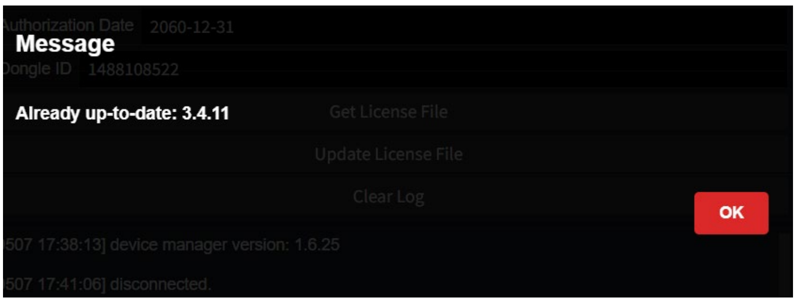


Figure 7-3

5. For any other issues that cannot be resolved, please contact [Tersus technical support team.]

7.2 Real Time Point Cloud Display

1. Update the TersusMVP Capture to version to 3.4.3 or above.
2. Switch on “Realtime” button.

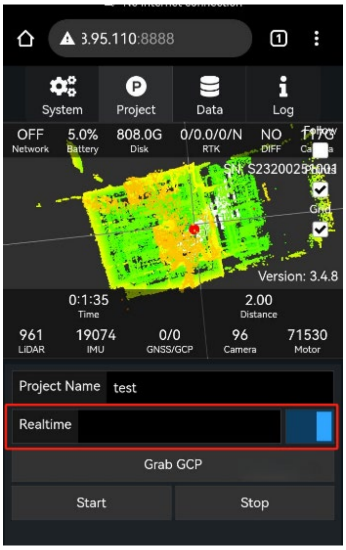


Figure 7-4

3. Real-time mapping data output: After data collection is completed, the real-time mapping data will be copied to the "data" folder along with the original data, in LAS format.

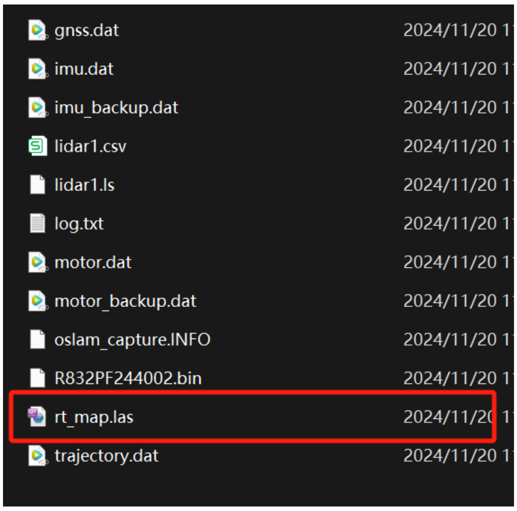


Figure 7-3