LiMobile M2
Mobile Laser Scanning system

User Guide

Reading instructions

Dear user:

Thank you for using the LiMobile M2 mobile laser scanning system. We are pleased to provide you with vehicle-mounted mobile measurement data collection and processing services. GreenValley International (GVI) is committed to continuously improving our products. We welcome your valuable comments and suggestions on our hardware equipment, processing software, training and documentation materials. You can contact us at info@lidar360.com. Sincerely thank you.

▷ Related services and technical support

Related services and technical support: www.greenvalleyintl.com

Inquiry hotline: +1 (510) 345-2899

Contact email: info@greenvalleyintl.com

▷ Disclaimer

This manual contains important safety instructions to guide you to safely install and operate this product, so please read this user manual carefully before using this product.

Users need to use and maintain the device in accordance with the requirements. If the instrument's lifespan is affected by improper operation or maintenance by the customer, GVI will not bear the relevant responsibility, and all repair services will be charged at standard rates.

If the instrument is damaged by the logistics company during transportation, GVI will not bear the relevant responsibility.

During use, in order to avoid damage to the equipment and violation of the warranty terms, please do not disassemble the equipment at will. If the product fails, it must be repaired by qualified maintenance personnel authorized by GVI, GVI will not bear all relevant responsibilities if the instrument is damaged due to self-assembly or self-disassembly operations without the support of GVI Users need to use the original battery and accessories of LiMobile M2. If users use non-dedicated batteries or chargers, it may cause accidents such as unstable voltage, explosion and combustion of the equipment system. Once used, GVI will not bear the relevant responsibilities and the warranty qualification will be invalid.

The user manual of LiMobile M2 vehicle-mounted mobile laser scanning system will be updated in real time as product technology evolves. The content of this document is subject to modification without further notice. The latest version can be downloaded from the official website of GVI or contact our technical support staff to obtain it.

▷ Product logo and trademark

The product model and production serial number are marked on the device label. The production serial number is the unique identification number of the device. Please provide this number accurately when contacting our technical support personnel.

GreenValley International® and LiMobile® are registered trademarks of GVI. Other product names, company names and brand names mentioned in this document may be the trademark property of their holders.

▷ Copyright and trademark

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Version number: 1.0.0

Contents

1 Safety Instructions

1.1 Overview

The following instructions clearly define the responsibilities of the product owner and the actual user of the equipment, as well as how to prevent and avoid dangerous operations. For user safety considerations, the product owner and the actual user of the equipment must read this manual carefully and follow the operating specifications in the manual before use.

▷ About Warning Information

Type	Description
⚠ **Danger**	Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **Warning**	Indicates a potentially hazardous situation or situation caused by improper operation which, if not avoided, may result in death or serious injury.
⚠ **Carefulness**	Indicates a potentially hazardous situation or situation caused by improper operation which, if not avoided, may result in minor or moderate injury.
Attention	Indicates a potentially hazardous situation or situation caused by improper operation which, if not avoided, may result in economic loss and damage to the environment.
★	Indicates that special precautions are required in actual use so that the equipment can be used correctly and effectively.

1.2 Responsibilities

Equipment Manufacturer	GVI assumes quality responsibility for the equipment and original accessories provided under the conditions of user specification use.
Personnel Responsible for the Equipment	• Understand the safety instructions and operating methods in the user manual • Ensure that the equipment is operated in accordance with the relevant instructions in the user manual •If there is a safety problem with the equipment, please stop operating the system immediately and notify the technical support personnel of GVI. • Ensure that the national laws, regulations and operating conditions regarding the operation of this equipment are followed

1.3 Usage Environment Restrictions

⚠ **Danger**	Suitable for use in environments suitable for permanent human habitation. Not suitable for use in corrosive or explosive environments.
⚠ **Warning**	Do not work in hazardous areas, near electrical installations or similar areas.
⚠ **Warning**	The device has an IP65 protection rating, which protects it from prolonged exposure to moisture. The device is intended for use in dry environments only and should not be used in harsh conditions.

1.4 Laser Safety

Description of Laser Type	According to the international standard IEC 60825-1:2014, the laser used in this device is a Class 1 laser product and does not require personal protective equipment. The risk of eye damage is low if the device is used and operated in accordance with the user manual.
⚠ **Warning**	Do not open the laser instrument housing.

⚠ **Warning**	Do not operate an obviously damaged instrument.
⚠ **Warning**	Do not point the emitter aperture at the human eye.

1.5 Battery and Cable Safety

⚠ **Warning**	Please use the specific charger provided to charge the battery.
⚠ **Warning**	It is recommended to use the provided AC/DC power solution and battery charger to power the device.
⚠ **Warning**	It is strictly forbidden to expose the battery to any liquid, do not immerse the battery in water or wet it. Never use the battery in rain or humid environment.
⚠ **Warning**	The internal battery may decompose upon contact with water, causing the battery to spontaneously combust or even explode.
⚠ **Warning**	Do not disassemble, puncture, impact, knock, short-circuit, or incinerate the battery, and do not use damaged batteries.
⚠ **Warning**	Do not use the battery in a strong static or magnetic field environment. Otherwise, the battery protection board will fail, causing serious malfunctions of the LiDAR device.
⚠ **Warning**	The instrument and accessories should not be disposed of with household waste. They should be properly disposed of in accordance with the regulations implemented in your country. 
⚠ **Warning**	Do not short-circuit the positive and negative poles of the battery with wires or other metal objects.
⚠ **Warning**	If any electrolyte leaks from a damaged battery, avoid skin contact and direct inhalation of the gas.
⚠ **Warning**	If the skin or eyes come into direct contact with the electrolyte leaking from the battery, wash it thoroughly with clean water and contact a doctor immediately.
⚠ **Warning**	Do not modify the cables.
⚠ **Carefulness**	Do not unplug the battery when the battery power is turned on, otherwise the power interface may be damaged.
⚠ **Carefulness**	If there is dirt on the battery interface, clean it with a dry cloth. Otherwise, it will cause poor contact, resulting in energy loss or failure to charge.
Attention	Pay attention to the operating specifications when installing the equipment and do not damage the cable interface.

1.6 General Operational Safety

⚠ **Danger**	Please obey traffic rules. The speed of the car should not exceed 100 km/h. The recommended maximum speed is 80 km/h.
⚠ **Warning**	Turn off the vehicle engine during the installation of the equipment.
⚠ **Warning**	The driver should remember that the equipment will add extra height to the vehicle, so the total height of the vehicle should be carefully monitored.
⚠ **Warning**	It is recommended that another person besides the driver is responsible for operating the system during the collection to prevent traffic accidents.

⚠ **Warning**	Avoid using this device in snow, rain, fog, thunderstorms, or strong sunlight.
⚠ **Warning**	Pay attention to the operating temperature of the device.
⚠ **Warning**	To avoid the risk of suffocation, keep plastic foil, bags and bubble wrap away from infants and children.
⚠ **Warning**	Do not use the device if it has obvious noise, alarm or is damaged, and contact the manufacturer's technicians for repair in time. Forced use may cause permanent damage to the device.
⚠ **Warning**	Do not attempt to repair damaged parts of the device without authorization.
⚠ **Carefulness**	Do not open the device without authorization.
⚠ **Carefulness**	Install the device carefully to avoid the risk of being hit or pinched.
Attention	Perform safety tests on the device installation regularly, especially before and after the device is used for important tasks.

1.7 Electromagnetic compatibility

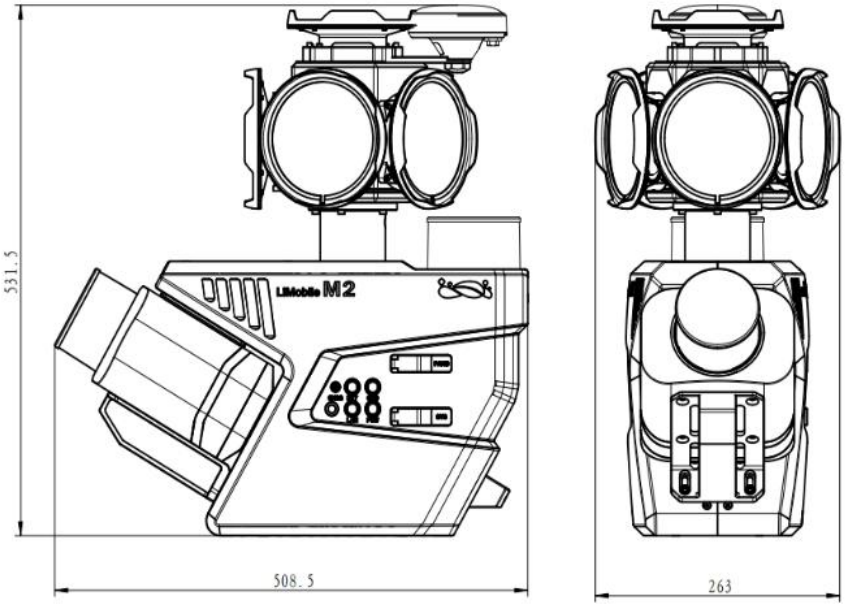
⚠ **Warning**	Although the device is manufactured in strict accordance with relevant regulations and standards, the possibility of interference with other equipment or effects on people and animals cannot be completely ruled out. • Do not use the device for operation near gas stations, chemical facilities, and other explosive and hazardous places. • Do not use the device for operation near medical equipment. • Users can take appropriate measures according to the situation.
⚠ **Carefulness**	Please use original factory accessories for operation. If you use other PC, two-way radio communication equipment or other electronic equipment accessories, please pay attention to the electromagnetic compatibility information provided by the manufacturer.
⚠ **Carefulness**	Two-way radio communication equipment or diesel generators, it cannot be ruled out that the equipment may be interfered with in the electromagnetic environment. The measurement results should be verified for reliability.
⚠ **Carefulness**	If the device is only connected to one of the two ports of the cable and the other end is left bare, it may emit excessive electromagnetic radiation. Therefore, when using the device, the connectors at both ends of the cable should be connected.

2 Product Introduction

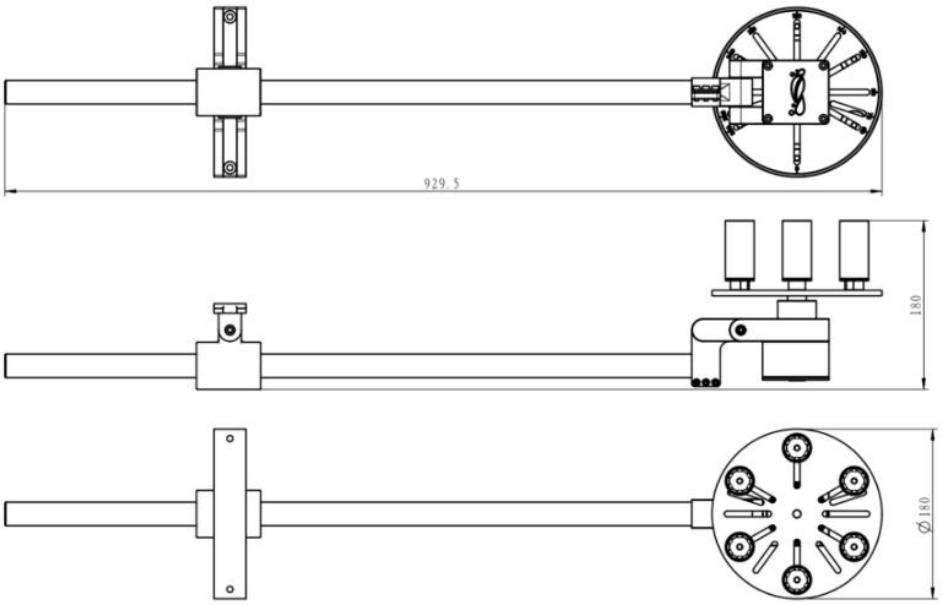
The LiMobile M2 affordable mobile laser scanning (MLS) system is equipped with two LiDAR sensors (one tilted at a 30-degree angle and one positioned horizontally) and a Ladybug5+ panoramic camera, enabling efficient 3D mapping of roads and surrounding environments. Even in GPS-denied areas, high-precision scanning can be achieved with the help of laser SLAM. It also provides multiple expansion interfaces and can be installed on various types of vehicles. Paired with GVI's self-developed LiDAR360MLS software, it enables a one-stop data processing to deliver industry results, supporting applications such as road asset extraction, urban power distribution line analysis, urban forestry management, smart transportation, and more.

2.1 Equipment Structure Diagram

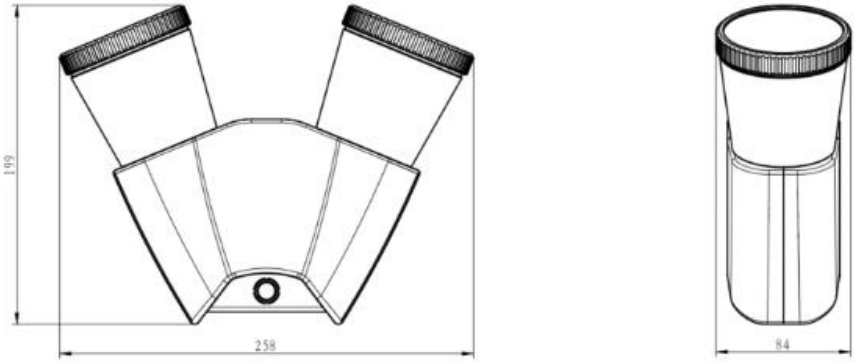
As shown in the figure below, the structure diagrams of the main unit, planar cameras (pavement camera and front camera are identical), and DMI are provided (dimensions are in millimeters).



(1) Sensor Unit

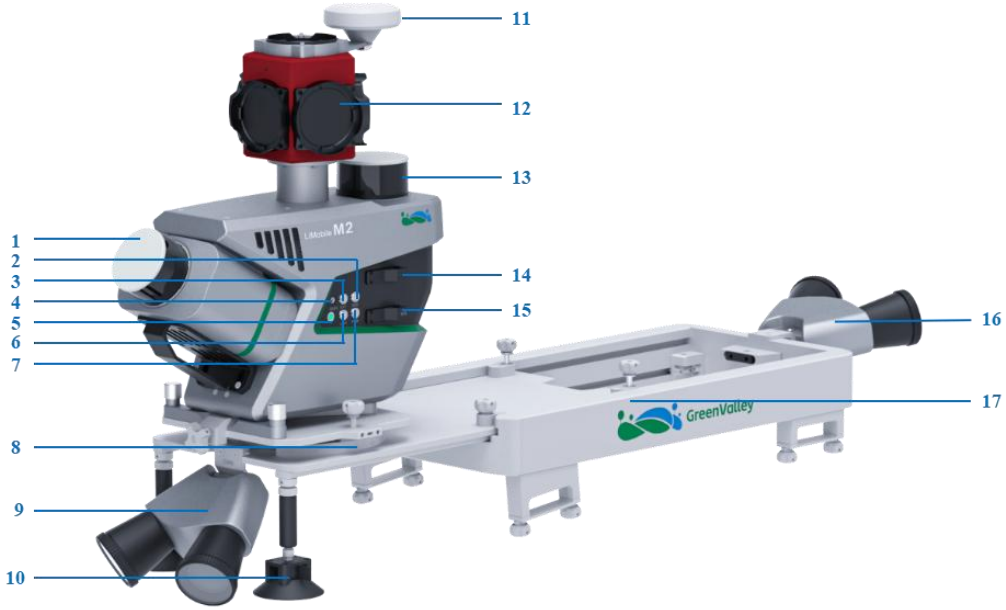


(2) DMI



(3) Planar Camera

2.2 Device Description



1. LiDAR	2. EXT: Extended Debugging Port
3. ODO: DMI Sensor Port	4. GNSS: Backup Antenna Port
5. Device Power Indicator	6. LAN: Ethernet Port
7. POW: Power Cable Port	8. Swivel Plate
9. Pavement Camera	10. Support Structure Component
11. GNSS Antenna	12. Panoramic Camera
13. SLAM LiDAR	14. System Disk Interface
15. Panoramic Camera Disk Interface	16. Front Camera
17. Roof Rack	18. CAM1：Front Camera Port
19. CAM2：Pavement Camera Port	20. CAM3：Camera Debugging Port
21. CAM4：Camera Debugging Port	

2.3 Device List

2.3.1 Sensor Unit Case

No.	Items	Quantity
1	Tablet	1
2	Tablet Charger	1
3	Type-C to Ethernet Adapter	1
4	RJ45 Ethernet Cable	1
5	LEMO Ethernet Cable	1
6	External Power Cable	1
7	LiDAR Protector Cover	2
8	CFE Card Reader	1
9	Cleaning Set	1
10	Hook and Loop Fastener	1
11	CFE Card Set (2 Disks)	2
12	Sensor Unit	1
13	Sensor Unit Rain Cover	1

2.3.2 Battery Accessory Case

No.	Items	Quantity
1	Wi-Fi Antenna	2
2	Battery Box	1
3	Tool Kit	1
4	Battery Charger	3

2.3.3 Roof Rack Case

No.	Items	Quantity
1	Support Structure Component	2
2	Dust Removal Tool Kit	1
3	Roof Rack	1
4	Roof Rack Knob Screw	4

2.3.4 DMI Case (Optional)

No.	Items	Quantity
1	Socket Gripper	6
2	Universal Chuck	1
3	Guide Mounting Bracket	1
4	DMI Main Component	1
5	Suction Cup	2
6	Adjustable Wrench	1
7	DMI Storage Bag	1
8	DMI Protection Rope	1
9	Socket Fixing Screw	12
10	Suction Cup Fixing Screw	4
11	Chuck Fixing Screw	2

2.3.5 Planar Camera Case (Optional)

No.	Items	Quantity
1	T-Handle Hex Key Tool	1
2	Pavement Camera Set	1
3	Front Camera Set	1
4	Pavement Camera Cable	1
5	Front Camera Cable	1
6	Pavement Camera Mounting Screw	6
7	Front Camera Mounting Screw	6

2.4 Technical Specifications

2.4.1 System Parameters

Performance Indicator	Parameter
Dimensions	508.5×263×531.5 mm
Roof Rack Dimensions	730×350×95 mm
Planar Camera Dimensions	258×199×84 mm
DMI Dimensions	929.5×180×180 mm
Weight	14 kg
Roof Rack Weight	17.5 kg
Planar Camera Weight	1.7 kg
DMI Weight	4.8 kg
Battery	6000 mAh×6
Operating Time	≥ 6 h
Storage	1 TB×2
System Control	Tablet
Interface Connection	Wi-Fi/Ethernet
Operating Temperature	-10 ℃ ~ 50 ℃
Storage Temperature	-30 ℃ ~ 60 ℃
Power Supply Input Voltage	24 V-DC
Power Consumption (Typical)	75 W
Power Consumption (Max.)	125 W
Raw Point Cloud Format	*.pcap
Raw Panoramic Camera Image Format	*.pgr
Raw Planar Camera Image Format	*.bin

2.4.2 Laser Parameters

Performance Indicator	Parameter
Detection Range	0.05 ~ 300 m
Scanning Frequency	20 Hz
FOV (Vertical)	40.3° (-20.8°~ +19.5°)

FOV (Horizontal)	360°
Range Accuracy	± 1 cm
Laser Class	Class 1 (Eye-safe)
Scan Rate: Single Return	Dual Return: 1,280,000 pts/s

2.4.3 Integrated Navigation Parameters

Performance Indicator		**Parameter**	
GNSS Systems:		GPS; GLONASS; GALILEO; BEIDOU; QZSS; SBAS	
IMU Update Frequency		100 Hz	
Roll/Pitch Accuracy (RMS 1σ)	Horizontal：0.01 m	Roll/Pitch Accuracy (RMS 1σ)	0.01°
	Vertical: 0.02 m	Heading Accuracy (RMS 1σ)	0.04°

2.4.4 Panoramic Camera Parameters

Performance Indicator	**Parameter**
Pixel	3000 W (500W*6)
Maximum Stable Capture Frame Rate	10 FPS
Resolution	8192×4096
Sensor Type	CMOS
Power Consumption	Maximum 13 W
Trigger Mode	Time/Distance Trigger

2.4.5 Planar Camera Parameters

Performance Indicator	**Parameter**
Pixel	2400 W (1200W*2)
Maximum Stable Capture Frame Rate	5 FPS (4096×2160) 3 FPS (4096×3000)
Resolution	4096 × 3000
Sensor Type	CMOS
Power Consumption	3.8 W
Trigger Mode	Time/Distance Trigger

2.4.6 Wi-Fi Parameters

Performance Indicator	**Parameter**
Current Frequency Band	2.4~2.4835GHz、5.15~5.85GHz
Communication Standard	IEEE 802.11 a/b/g/n/ac/ax, CSMA/CA
Security Type	WPA2-PSK (Encryption Mode)
Effective Connection Distance	5 m
Wi-Fi SSID:	LiMobile_xxxx
Default Password	greenvalley

2.4.7 Tablet Parameters

Performance Indicator	**Parameter**
Resolution	1920*1200
Screen Size	11 inches
Network Type	5 GB + Wi-Fi

Storage Capacity	128 GB
RAM	8 GB

☆ Notes:

1.Our company reserves the right to update the manual content at any time to reflect the latest product information. The hardware specifications and detailed technical parameters of the LiMobile M2 equipment are subject to the actual product and packing list.

2.For more detailed parameters of the laser and camera sensors, please refer to the information released by the original equipment manufacturer.

3 Equipment Requirements

3.1 Collection Environment Requirements

For the sake of car driving safety, it is not recommended to use the equipment in weather conditions such as rain, snow or fog. In addition, under such weather conditions, the point cloud data will also have more noise.
It is not recommended to use it frequently in strong winds, dusty environments, or other similar conditions which will affect the service life of the equipment and cause the point cloud data to have more noise.
It is forbidden to expose or use the equipment in extreme temperatures. The ambient temperature must not exceed the operating temperature range of the equipment.
Due to the changes in temperature and air pressure during air transportation, the rapid increase in temperature after unpacking may cause condensation on certain components inside the equipment. Water inside the components may cause short circuits and damage the instrument when it is turned on. Therefore, when the equipment is transferred from a cold environment to a warm environment, it is recommended to leave the equipment for 24 hours in a place with constant temperature and air pressure.
Daytime data collection should avoid periods when the light is too weak.
When collecting in the city center, the rush hours in the morning and evening should be avoided to improve collection efficiency. In good weather conditions, it is recommended to select the following time period: 09:00-17:00. Due to different seasons, time zones or latitudes, the above time can be flexibly adjusted according to actual conditions.
Drive in as open an area as possible and stay away from trees, buildings, high-voltage transmission lines and other places with complex electromagnetic environments.
If you need to use the device for a long time or in special conditions such as high humidity, please consult our technical support personnel for relevant precautions. Our company will not assume equipment warranty responsibility if the instrument fails when used in special environments.

3.2 Collection Preparation

Please check carefully whether the accessories are complete according to Chapter 2.3 or the packing list of the shipment.
Check whether the battery is sufficient for the collection task.
Check whether the tablet computer power meets the collection task requirements.
When working in a large area, it is necessary to plan the work area in advance for block collection to reduce the amount of data generated in a single operation. It is best to have two blocks of overlap between blocks.
According to "LiMobile M2_Data Size Calculator ", please check the remaining storage capacity of the device's hard drive and perform data cleanup in a timely manner.
If the project requires continuous collection work, it is recommended to format the collection disk every 10-15 days. Before formatting, you need to back up the data to avoid data loss. For detailed steps on disk formatting, please refer to Attachment 2: "Disk Formatting Instructions".
Please plan a reasonable route with reference to the street view map and conduct on-site surveys when necessary.
Please check the height limit.
According to the project engineering requirements, confirm that control points that meet the accuracy are arranged during data collection.
Ensure that the base station is set up before data collection.

3.3 Equipment Installation

Check that the connections between the luggage rack crossbar, the roof rack, and the car are stable, and ensure that the bayonet or screw is tightened.
Check whether there are cracks on the roof rack and the luggage rack crossbar.
After pulling out the roof rack, ensure that the knob is tightened.
Check whether the screws between the device body and the roof rack are tightened.
Check whether the device body has no obvious damage.
Check whether the antenna and the antenna support bracket are stably connected.
Check whether the cable is connected and plugged in normally, and check whether the cable has no obvious damage.
Check whether there are foreign objects blocking the interfaces of each connector and whether the pins are deformed.
Before the device is powered on, check whether the acquisition disk is correctly inserted and the buckle is fastened.
Check whether the battery box is turned on normally.
After the device is powered on, check whether the device indicator light is on.
Check whether the surface of the laser glass is clean and dust-free. If there is dust, please use the cleaning kit to clean it in time.
Please avoid placing the battery box and battery in a sealed trunk during data acquisition. It is recommended to place them on the back seat of the vehicle.

3.4 Collection Operation

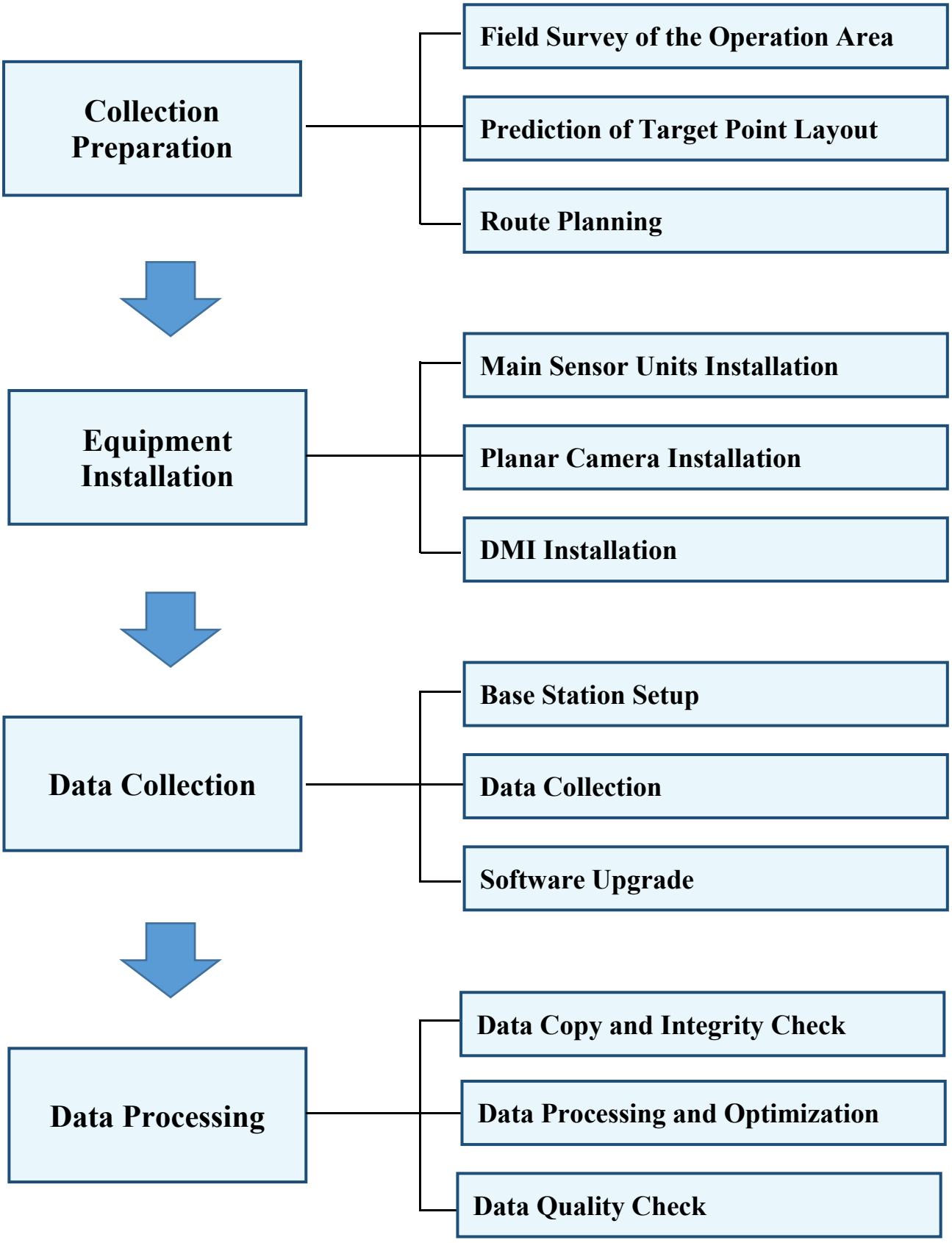
The device needs to be initialized in an open area with good GPS signal.
The data collection duration must be greater than 10 minutes.
Make sure that the inertial navigation system is initialized with more than 15 satellites and PDOP is less than 2.
After the device is powered on, please ensure first that the tablet is successfully connected to the device's Wi-Fi first.
After turning on the device, please follow the status prompts on the APP interface to ensure that the sensor is connected normally.
Check whether the sensor acquisition parameters are correct (enabled configuration, installation angle, camera acquisition frame rate, etc.).
During the device power-on period, it is forbidden to unplug or plug in the data acquisition disk.
Before the engineering data is collected, the inertial navigation system needs to be aligned. The inertial navigation system alignment process needs to be stationary for 3 minutes, and then accelerate and decelerate twice, turn around, and then accelerate and decelerate again. This process is to ensure data quality, please follow it carefully.
After the engineering data collection is completed, the inertial navigation system still needs to be calibrated to ensure data quality.
After the collection is completed, please make sure to click the shutdown button on the APP interface first, and then disconnect the power supply after the device is shut down. Do not turn off the power directly, as this abnormal operation will cause data loss.
During the device power-on period, it is forbidden to plug and unplug the connecting cables.
When replacing batteries during the acquisition process, replace them one by one. Do not unplug multiple batteries at the same time.

Do not use the device if it has obvious noise, alarm sound or is damaged, and contact the manufacturer's technicians for repair in time. Forced use may cause permanent damage to the device.
Do not attempt to repair damaged parts of the device without authorization.
Please do not upgrade the tablet's operating system.

3.5 Collection Completion

When disassembling and assembling the device, make sure that the contents of the packing list are complete.
After the day's collection task is completed, check whether the equipment is intact. Check whether the structural screws and plug-in interfaces are loose. Check whether the cables are damaged.
If there are damaged parts, discontinue the collection operation to avoid further damage to the equipment. Contact our technical staff for troubleshooting and repair operations.
Please use the data copy tool to check the data integrity and back up the data in time.
Before cleaning the disk, make sure that the data has been backed up and is available.
Please keep the equipment properly. It is recommended to cover the laser head with a laser protective cover or put the device back into the equipment box for storage after the collection is completed.

4 Overall Description of the Mobile Laser Scanning System Workflow



5 Collection preparation work

5.1 Field Survey of the Operation Area

Investigate the actual traffic conditions of the road section to be measured (including but not limited to objective traffic congestion, vehicle speed limits, whether both main and auxiliary roads can be collected, traffic restrictions, etc.).
Determine the scanning range and object (clearly define the number of kilometers of roads to be scanned by the equipment, the types of roads, and the number of lanes on the driving route).
Mark on the map for corresponding prompts (such as driving route direction, turns, connections, etc.).
Find a relatively suitable location for setting up base stations and plan a certain number of targt point locations.

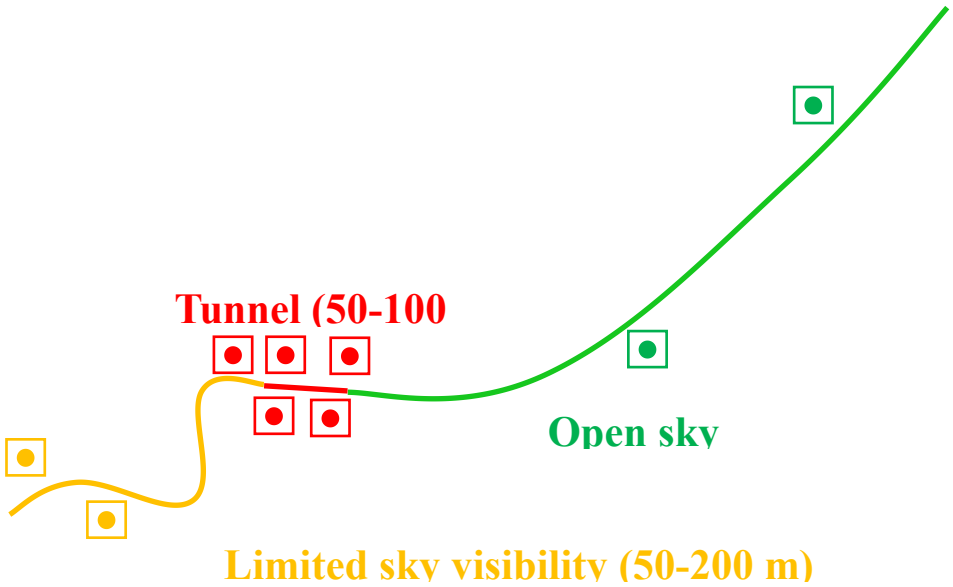
5.2 Prediction of target point layout

1.Purpose: To correct the positioning error of the equipment and reduce the impact of cumulative errors on the measurement results, thereby improving the accuracy of the data results.This is an indispensable step in the operation.

2. Target point type: (1) Road marking corner point; (2) High reflective paint point; (3) Checkerboard target point.

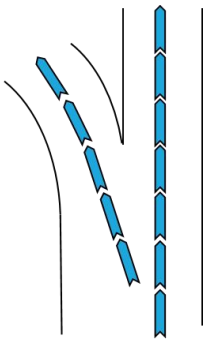
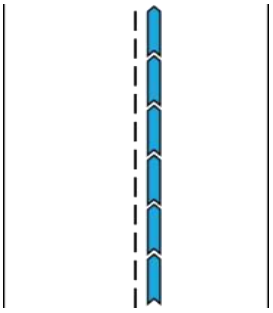
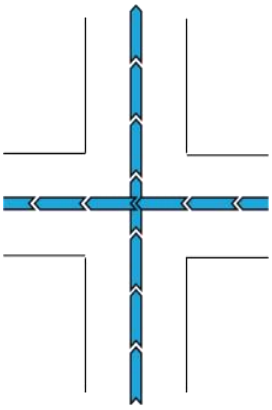
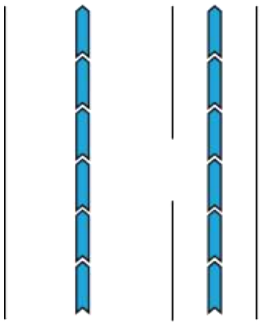
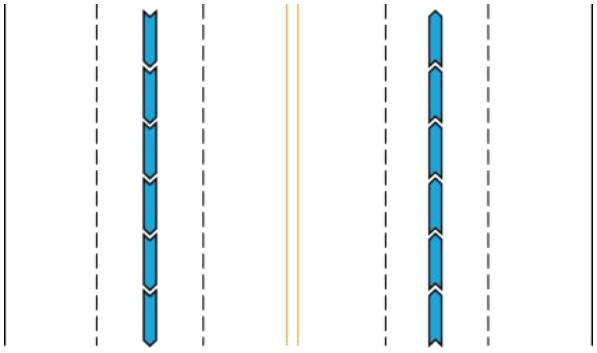
3. Layout specification: as shown in the figure below. Target points should be appropriately increased in places where there are dense trees on both sides of the road, under bridges and tunnels, etc., which may cause satellite signal loss.

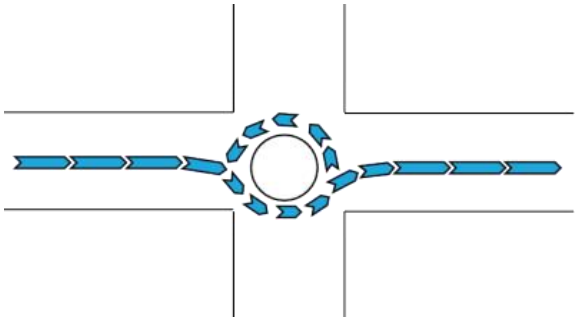
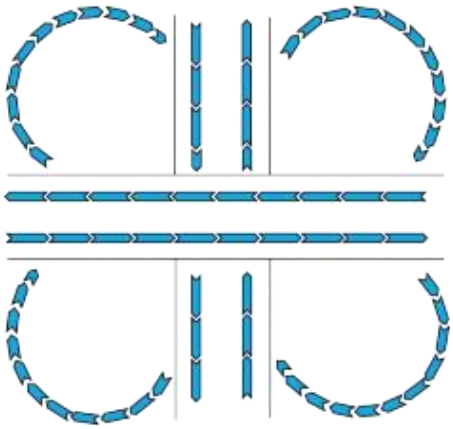
4. Surveying instruments: RTK, total station.



5.3 Route Planning

5.3.1 Collection of Driving Route Requirements

During the collection process, the entire road must be captured (including turning lanes), with no missing sections.	
The road data should be collected by driving along the centerline of the road.	
Long, straight sections should be prioritized, avoiding frequent turns or loops. Lane changes should also be minimized. When turning, try to minimize the turn radius.	
When there are main and auxiliary roads, prioritize collecting data from the main road. For expressways, elevated roads, and ring roads, auxiliary lanes must be collected. Main and auxiliary roads should be collected separately and not mixed. Roads connecting main and auxiliary roads do not need to be collected.	
Bidirectional roads must be collected in both directions. For a bidirectional three-lane road, the center lane should be used. For a bidirectional four-lane road, both directions should be collected by passing through twice to capture enough laser point clouds. For a bidirectional six-lane road or more, multiple passes in both directions are needed to ensure sufficient data collection.	

When collecting data from a roundabout, the entire roundabout must be enclosed. The vehicle needs to drive along the innermost lane of the roundabout to capture the actual shape of the roundabout.	
Interchanges are more complex, so to ensure road connectivity, every ramp of the interchange must be fully collected. The collection method is as follows: first, collect data along the main line of the interchange, then separately collect each ramp.	
If there is a median or a green belt separating the lanes, for bidirectional two-lane roads, both directions must be collected by passing through once in each direction.	

5.3.2 Vehicle Driving Requirements

Reversing is prohibited during the collection process.
Try to drive at a constant speed throughout, maintaining a speed of 40 km/h, and without exceeding 80 km/h.
Minimize stops during the drive.
Sudden braking is prohibited, avoid abrupt stops or movements.
Avoid accelerating too quickly; when speeding up, do so gently and gradually.
When approaching an intersection, pay attention to the traffic lights. If the light is yellow, it is acceptable to reduce speed until the light turns green. Try to avoid stopping and waiting for the red light.
When driving on straight sections, maintain a constant speed and avoid frequently steering to change lanes.
Avoid driving alongside other vehicles. Choose to overtake or slow down to allow the other vehicle to pass, thus preventing obstruction of the scanned area.
When passing through tunnels, do so quickly and smoothly.

6 Device Installation

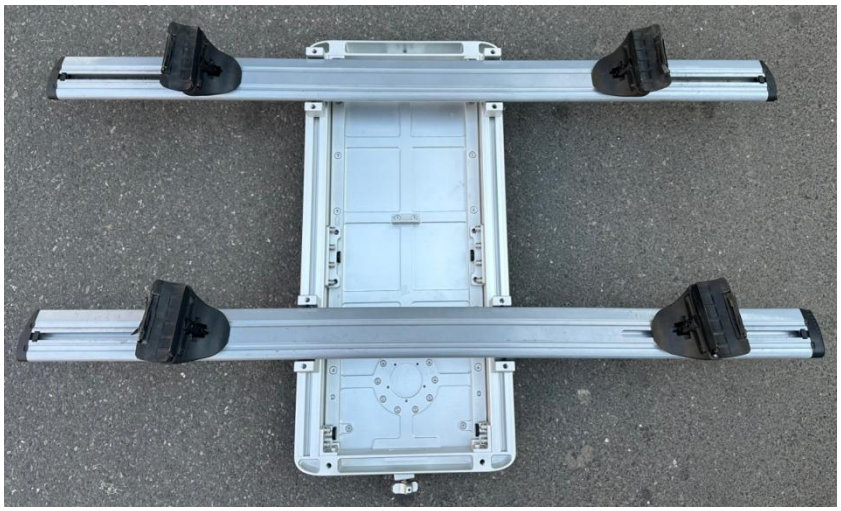
6.1 Main Sensor Unit Installation

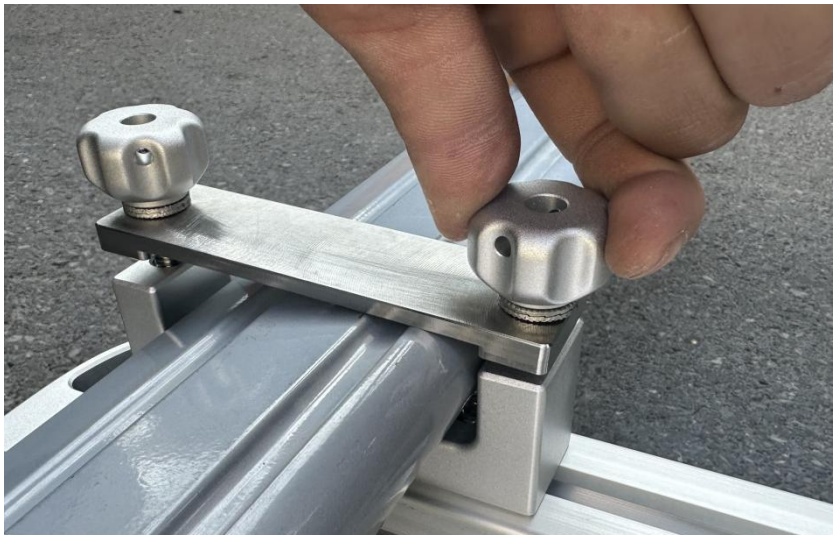
6.1.1 Roof Rack and Luggage Rack Crossbar Installation

1. Place the roof rack upside down on the ground and place the luggage rack crossbar in the positioning slot underneath it.

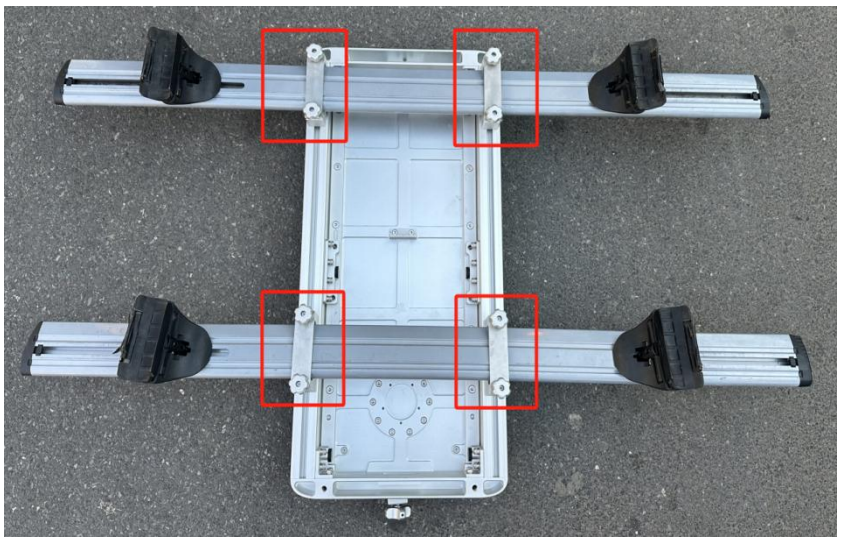
☆ Notes:

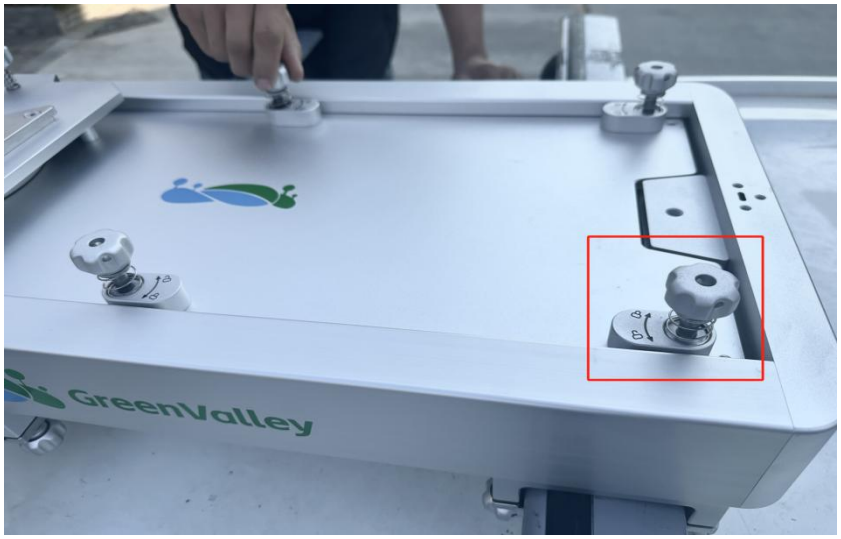
1. The roof rack crossbars are not included in the delivery. Users need to prepare them by referring to Attachment 3: " Vehicle and Luggage Rack Crossbar Selection Guide".
2. Position the roof rack as centrally as possible on the luggage rack crossbar.





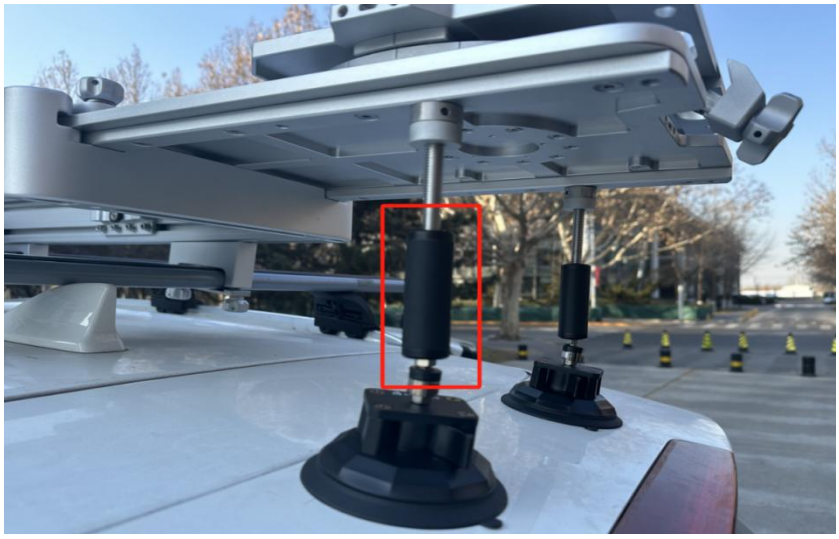
2. Manually tighten the fixing screws on the positioning slot at the bottom of the roof rack to secure the luggage rack crossbar to the roof rack.



3. Place the luggage rack crossbar and roof rack on the vehicle roof, and use an Allen wrench to tighten the four mounting clamps on the luggage rack crossbar. ☆ Notes: 1.Install the equipment towards the rear of the vehicle to minimize obstruction. 2.The distance between the positioning slots of the roof rack can be adjusted based on the vehicle model. 3.When disassembling the roof rack, there is no need to remove the roof rack crossbars. Simply unscrew the fixing screws of the roof rack.	
4. Manually loosen the four fixing screws on the upper part of the roof rack in the unlocking direction.	
5. Pull the roof rack completely in the direction of the arrow.	

6. Manually tighten the four fixing screws in the locking direction.	

6.1.2 Support Structure Component Installation

1. Align the support structure with the holes under the roof rack and tighten the top fixing knob.	
2. Rotate the black knob at the bottom to lower the suction cup of the support structure until it touches the vehicle body.	

3. Rotate the light gray knob in the middle to the top of the black knob to secure it.	
4. As shown in the diagram, turn the switch on the suction cup to the locked position.	

6.1.3 Main Sensor Unit Installation

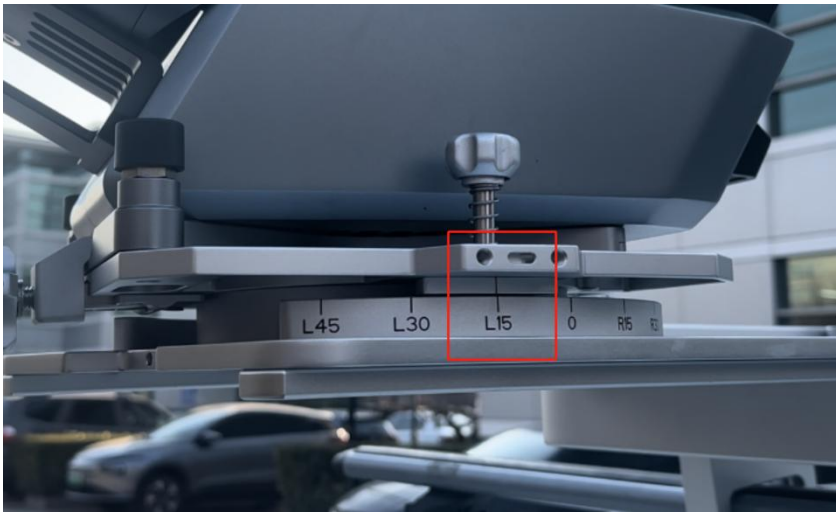
1. Before installing the main sensor unit, install the GNSS antenna feeder cable.	

2. Lift the main equipment and place it on the roof rack, then push it in the direction of the arrow until it reaches the limit.	
3. Press the safety buttons on both sides downward.	
4. Lift the central locking block of the roof rack and rotate it clockwise to tighten the lock. ☆ Notes： 1.Shake the luggage rack crossbar, roof rack, and sensor unit firmly to ensure stability. 2.The device is calibrated before leaving the factory. Minor scratches may occur during installation and use, which is normal and will not affect performance.	

6.1.4 Rotation of the Sensor Unit (Optional)

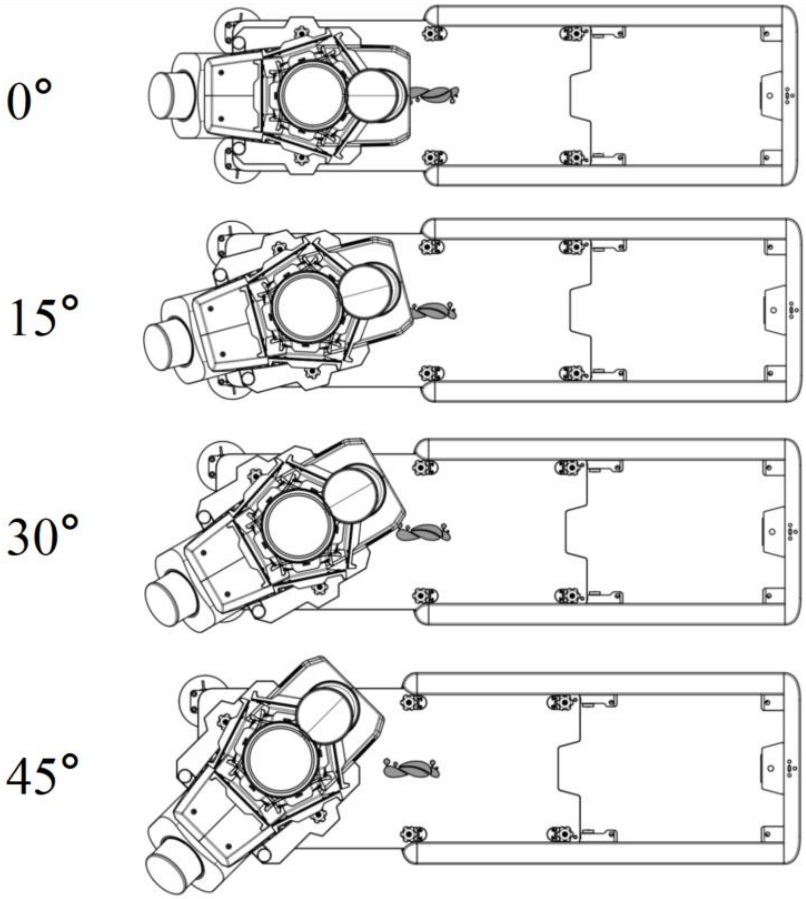
1. Manually loosen the fixing screws on both sides of the swivel plate.

2. Choose an appropriate angle based on the scale on the side of the swivel plate to rotate the equipment.



3. Manually tighten the swivel plate fixing screws on both sides of the equipment.

☆ Note: The device supports multi-angle installation and can be adjusted horizontally at 0, ±15°, ±30°, ±45°.



6.1.5 Battery Installation

1. As shown in the diagram, insert the battery into the battery compartment.

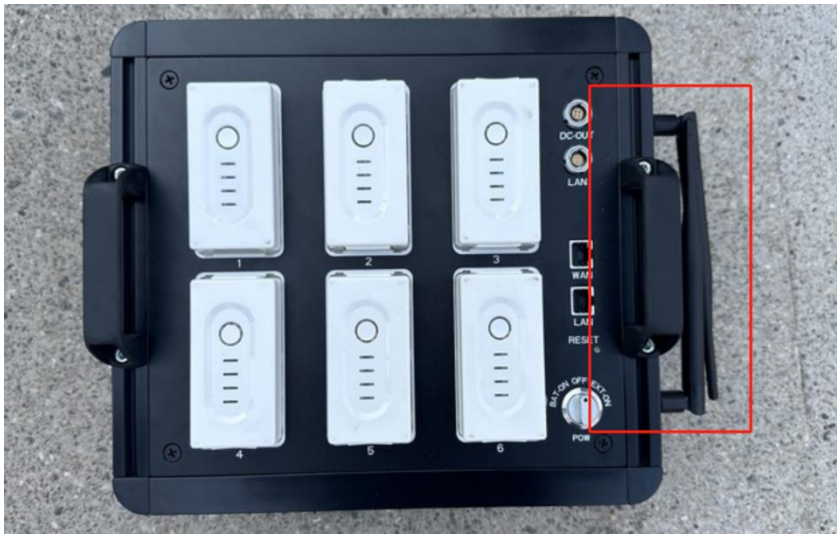
☆ Notes:

1. Ensure the battery is installed in the correct direction as shown in the diagram. Reverse insertion is prohibited.
2. Press down on the battery to check if it is securely installed.
3. To remove the battery, press the top buckle inward and pull it out simultaneously.

6.1.6 Wi-Fi Antenna Installation

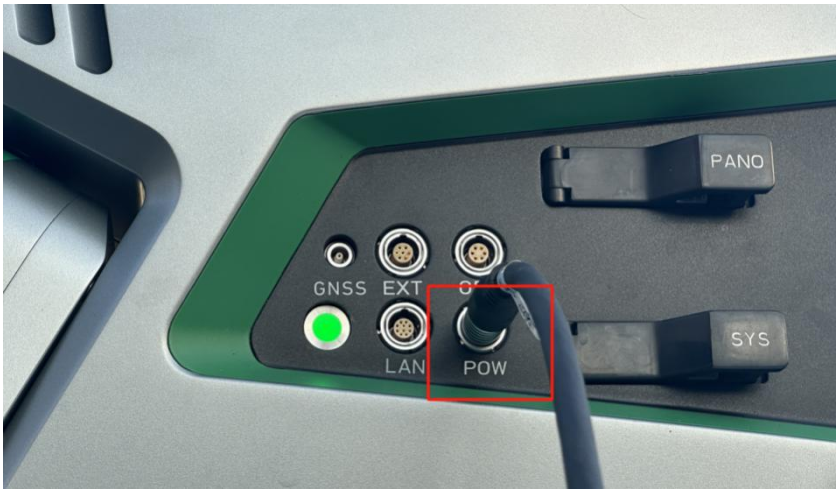
1. Manually screw the two Wi-Fi antennas onto the right side of the battery compartment.

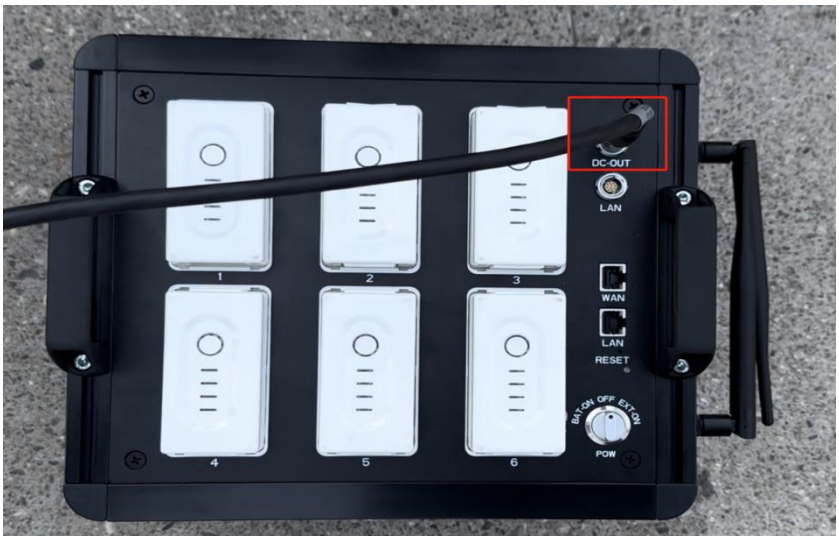
2. To reduce the risk of breakage from external force, bend the antennas inward.



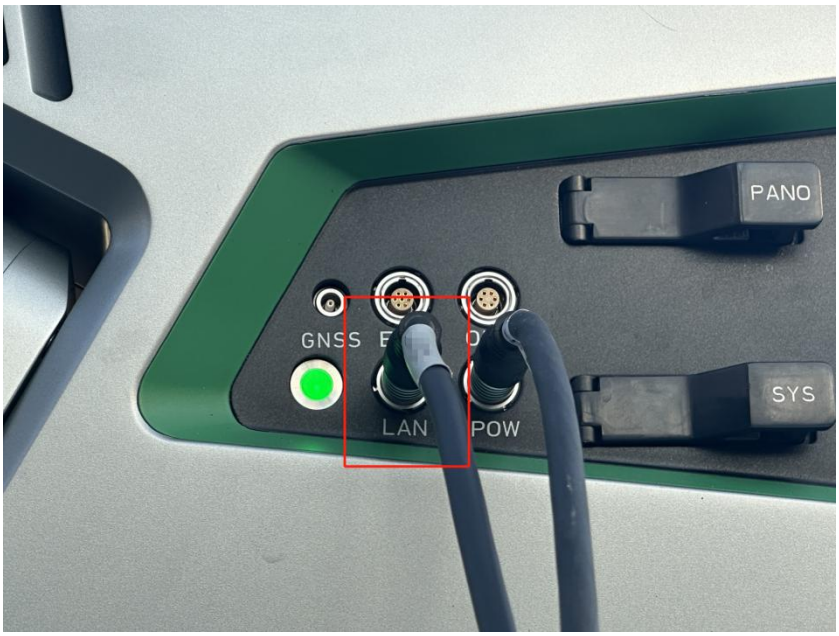
6.1.7 Cable Connection

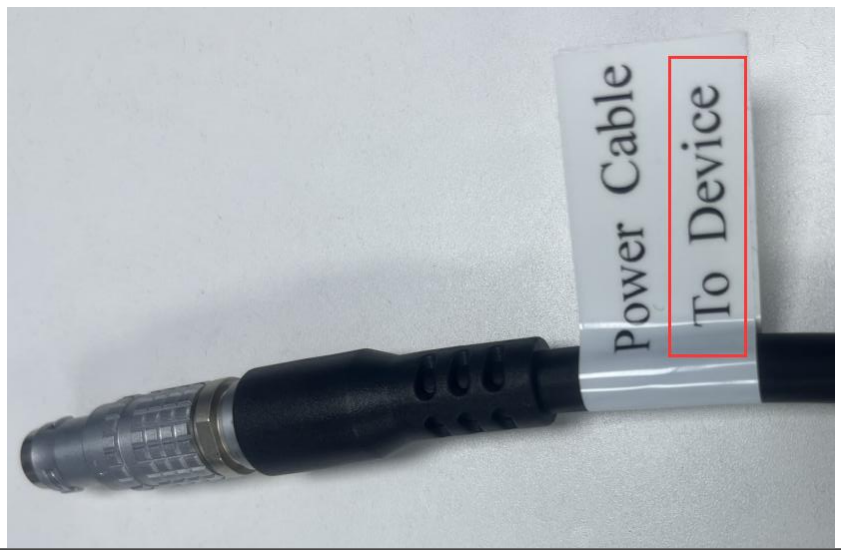
1. Use the power cable to connect the DC-OUT port of the battery compartment to the POW port of the main equipment.





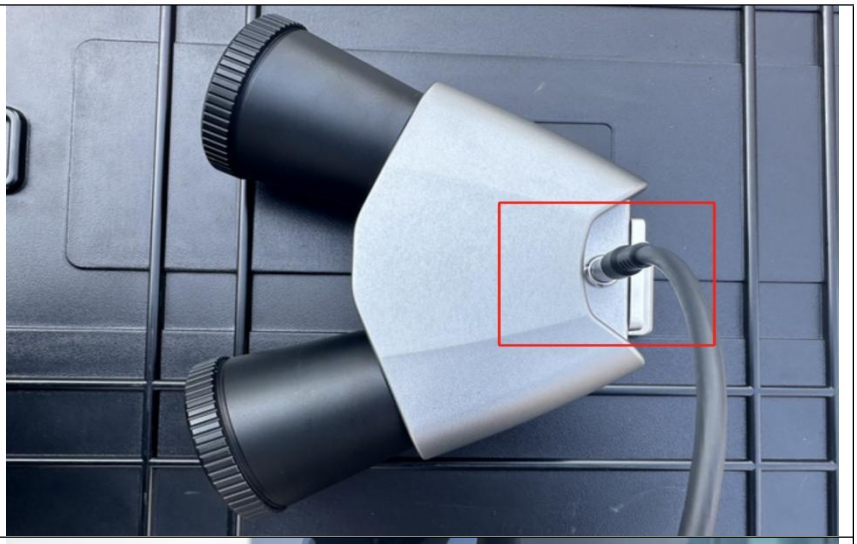
2. Use the network cable to connect the LAN port of the multifunctional battery compartment to the LAN port of the main equipment system.





☆ Note: Ensure to distinguish between the network cable ports at both ends to prevent equipment damage due to incorrect plugging.

6.2 Pavement Camera Installation (Optional)

1. As shown in the diagram, connect the pavement camera cable.	
2. Use an Allen wrench to tighten the two fixing screws and secure the road surface camera to the roof rack.	
3. Insert the other end of the pavement camera cable into the device's CAM2 port. ☆ Note: Please remove the lens protection cover before installation.	

6.3 Front Camera Installation (Optional)

1. As shown in the diagram, connect the front camera cable.	
2. Use an Allen wrench to tighten the three fixing screws and secure the front camera to the front end of the roof rack.	
3. Insert the other end of the flat camera trigger power cable into the device's CAM1 port. ☆ Note: Please remove the lens protection cover before installation.	

6.4 DMI Installation (Optional)

6.4.1 Preparatory Work

1. Use tools to remove the screw protective cap on the right rear wheel hub of the data collection vehicle.

☆ Note: The DMI must be installed on the right rear wheel of the collection vehicle.

6.4.2 Socket Installation

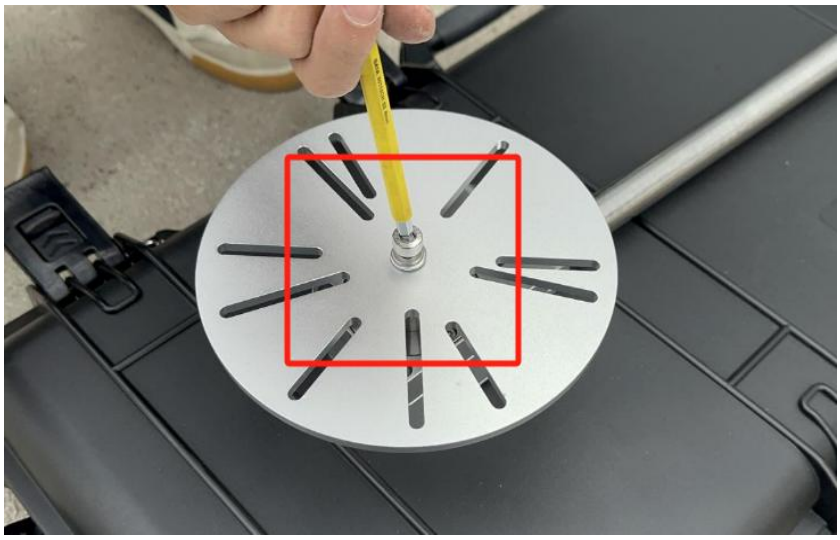
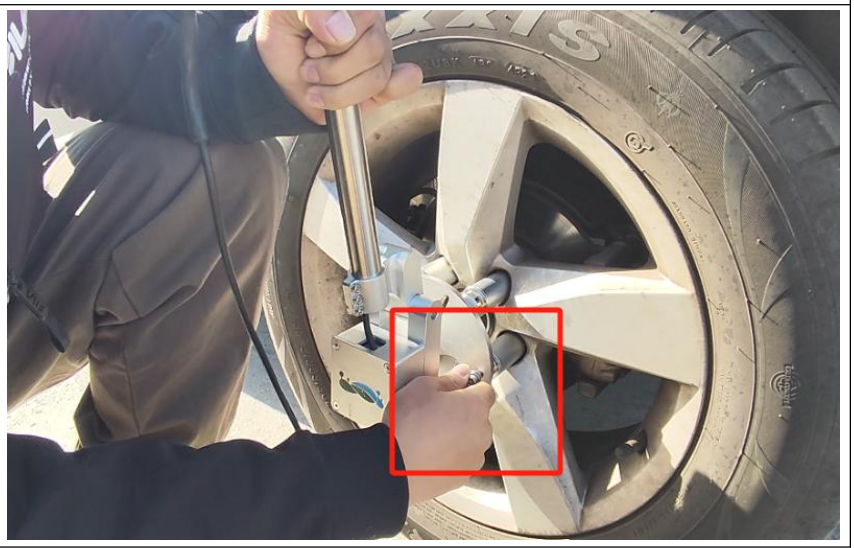
1. Push the end of the internal claw of the socket to align with the end of the outer wall of the socket.

2. Tighten the internal claw of the socket around the hub screw, use a tool to tighten the front screw of the socket until the entire socket assembly fits snugly against the hub screw.

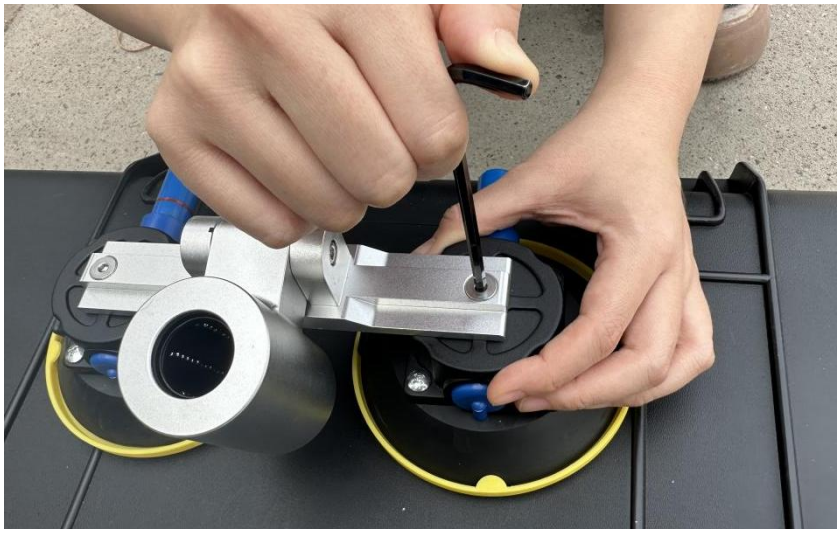
☆ Note: When the resistance of the screw increases, users can reverse the screw half a turn before continuing to tighten. During the tightening process, keep your hands steady to ensure that the outer wall of the socket and the hub are always in snug contact.

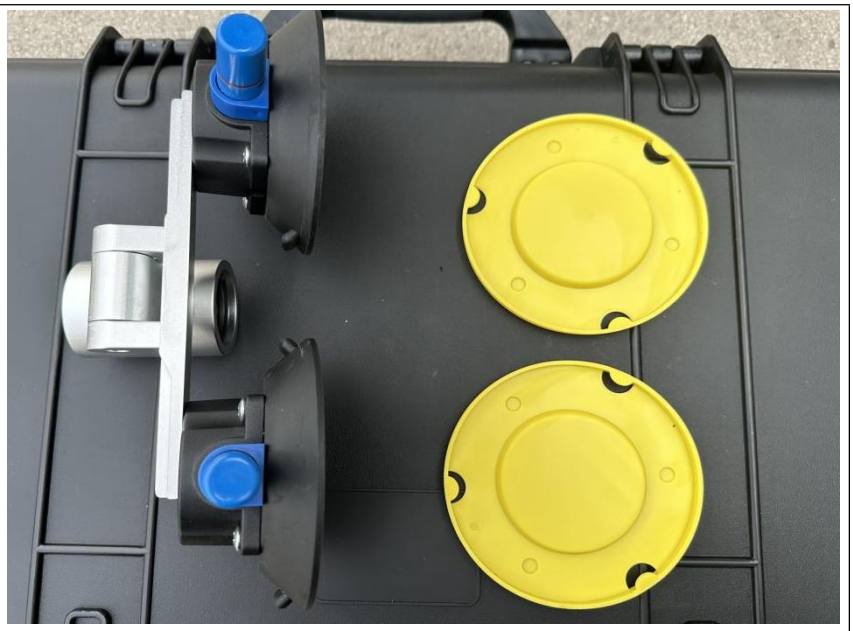
3. Repeat the above steps to complete the installation of all sockets.

6.4.3 Main Component of the DMI Installation

1. Tighten the chuck fixing screw with an Allen wrench to secure the chuck to the main component of the DMI.	
2. Align the holes of the chuck with the screw holes at the top of the socket. Once aligned, use the socket fixing screws to secure them together.	

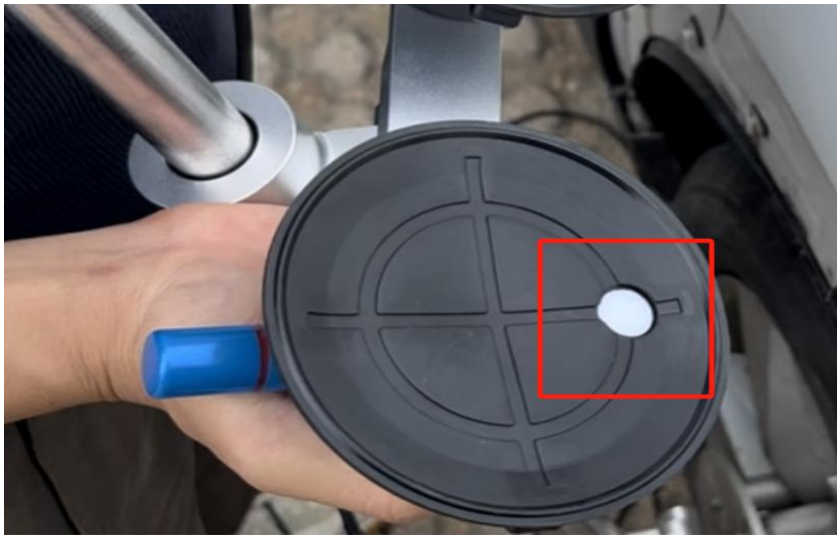
6.4.4 Suction Cup Fastener Installation

1. Align the screw holes of the suction cup with the holes on both sides of the fastener. Once aligned, use the suction cup fixing screws to secure them one by one.	

2. After tightening the screws, remove the yellow protective cover from the bottom of the suction cup.	
3. Thread the DMI cable and cable conduit through the socket of the fastener.	
4. Move the suction cup fastener to a suitable position so that the wire harness is vertical to the ground, and adjust the position of the suction cup so that the air valve faces upward.	

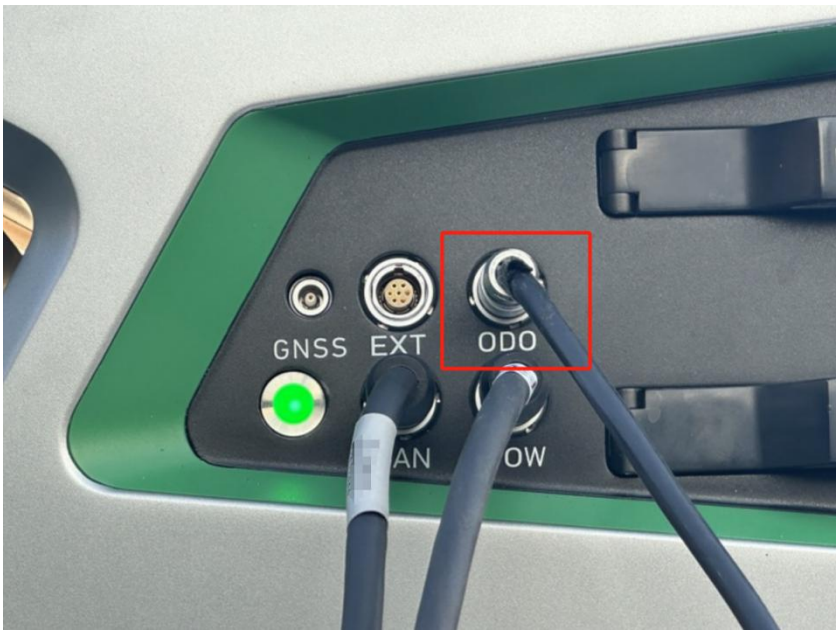
5. Press firmly on the suction cup, continuously pressing down on the blue piston until the suction cup is fully attached.

☆ Note: Please remove the white cotton pad before pressing the blue piston.



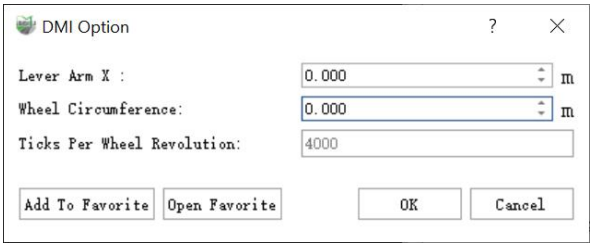
6.4.5 Cable Connection

1. Insert the DMI cable into the ODO port on the side of the device main body.



6.4.6 Parameter Measurement

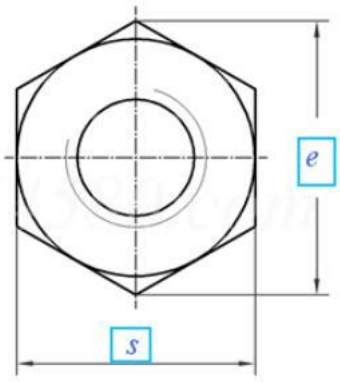
1. When calculating the wheel speed sensor data, it is necessary to add the lever arm value x of the wheel speed sensor and the wheel circumference. Therefore, users need to measure these after installation.



☆ Notes:

1.As shown in the figure, the lever arm value x is the horizontal distance between the center position of the device and the center position of the wheel.

2.The wheel speed sensors provided by our company are currently all external, and users must install them locally by themselves. To ensure successful installation of the wheel speed sensor, users need to provide the specific model of the vehicle or the accurate size of the wheel hub nuts before purchasing.



7 Field Data Collection

7.1 Base Station Setup

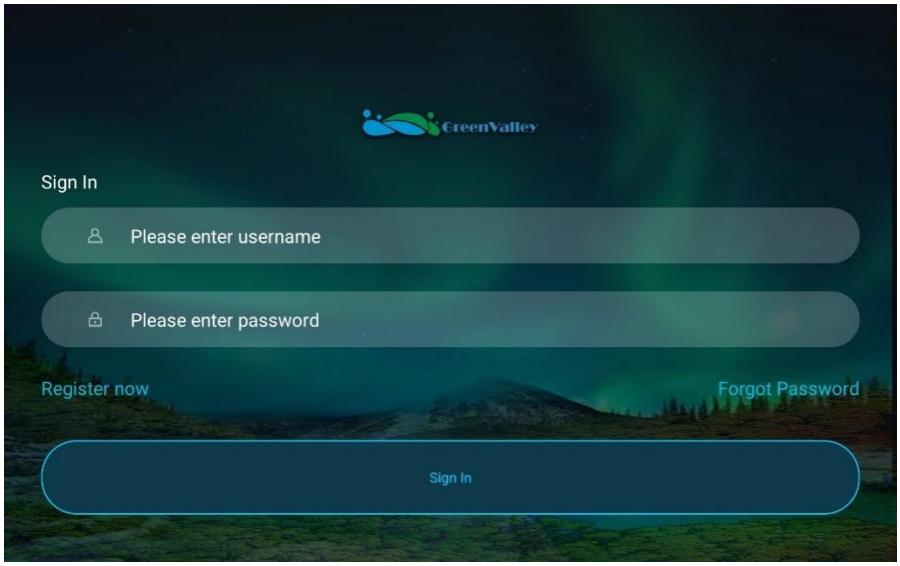
Before data collection, users need to plan and set up the base station location appropriately. If using our LiBase equipment, specific operations can be found in the "LiBase Quick Guide" and "LiSurvey User Manual."

☆ Note:

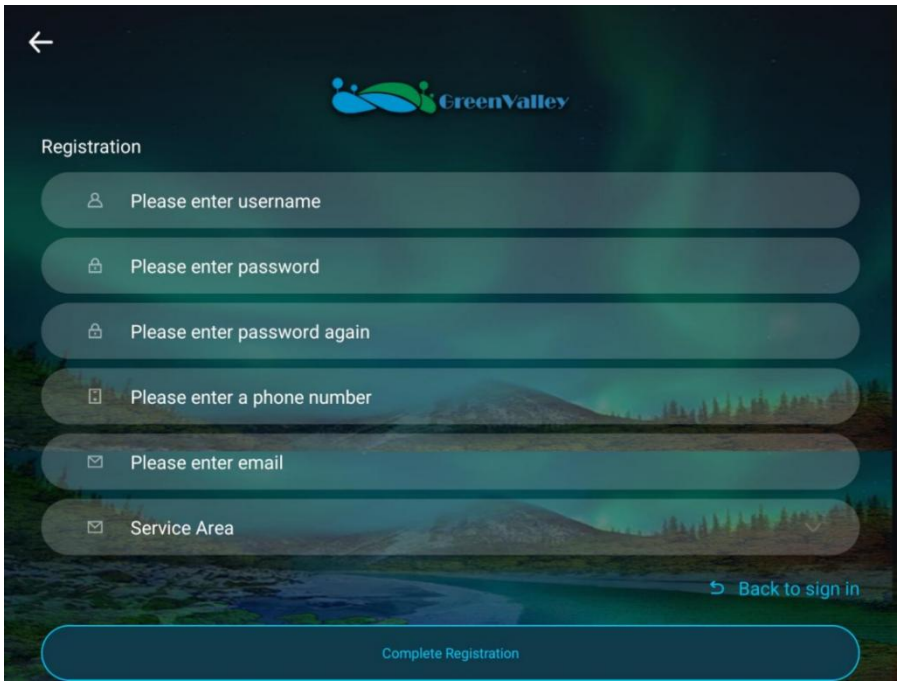
1. To ensure data accuracy, plan the base station location reasonably. The base station setup range should not exceed 20 km.
2. The base station setup time must fully cover the data collection time, with an additional 15 minutes before and after.
3. Multi-base station data trajectory resolution requires assistance from third-party software.

7.2 User Registration and Sign In

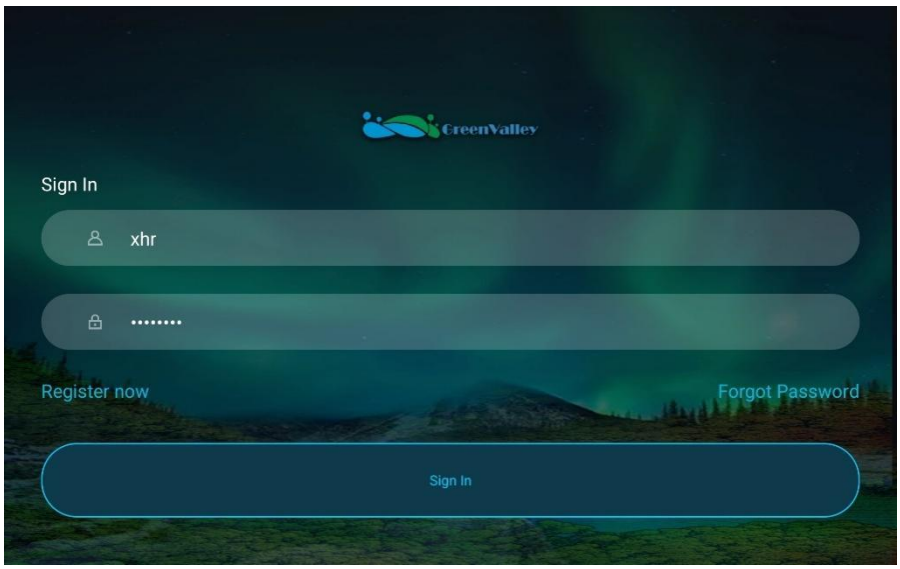
1. The LiMobile M2 device requires signin to the GreenValley account. Connect the tablet to the internet. After opening the APP, the Sign In interface will appear. Click the **Register now** button to proceed to the Registration page.



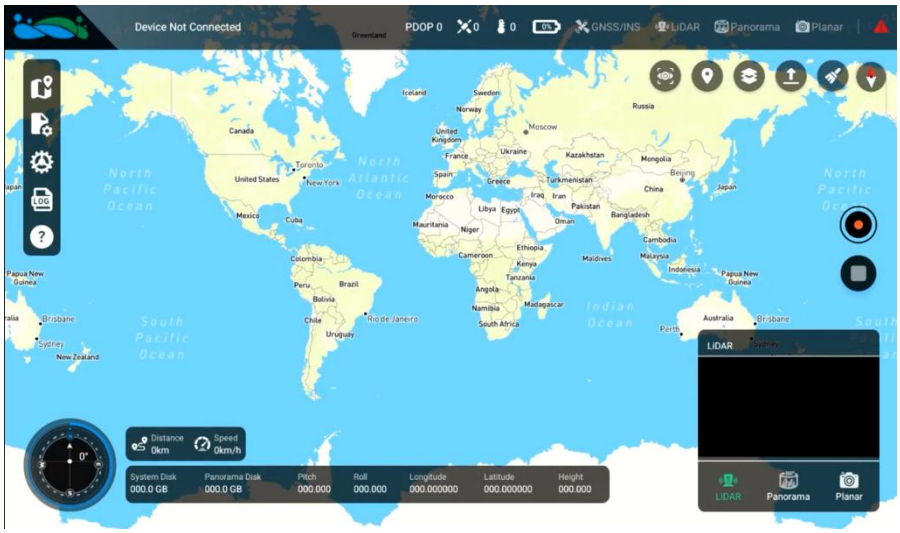
2. After filling in the information, click the **Complete Registration** button, and the app will automatically return to the Sign In interface.



3. Enter the username and password, then click the **Sign In** button to complete the login.



4. After successful login, the app will redirect to the **Device Not Connected** interface, indicating a successful login.



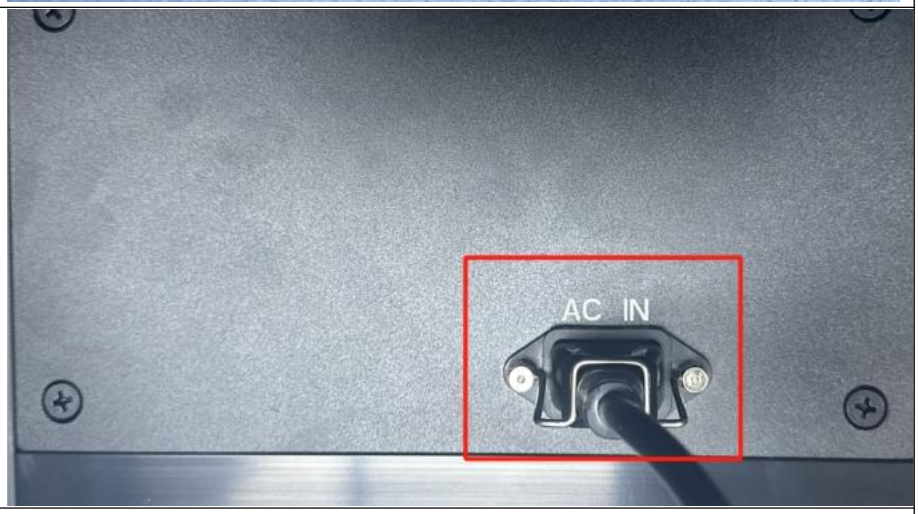
7.3 Power on the Device

7.3.1 Battery Power Supply

1. Rotate the power switch POW on the battery box to the **BAT-ON** position, and the green indicator light will illuminate.

7.3.2 External Power Supply

The device also supports external power supply mode. If using external power, it is recommended to use an AC voltage of 110 V~220 V outdoor power source (with a power rating of 1000W or higher).

1. Connect the device battery box and the outdoor power source as shown in the diagram.	
2. Secure the cable by fastening the lock downward.	
3. Turn on the outdoor power source and rotate the power switch POW on the battery box to the EXT-ON position.	

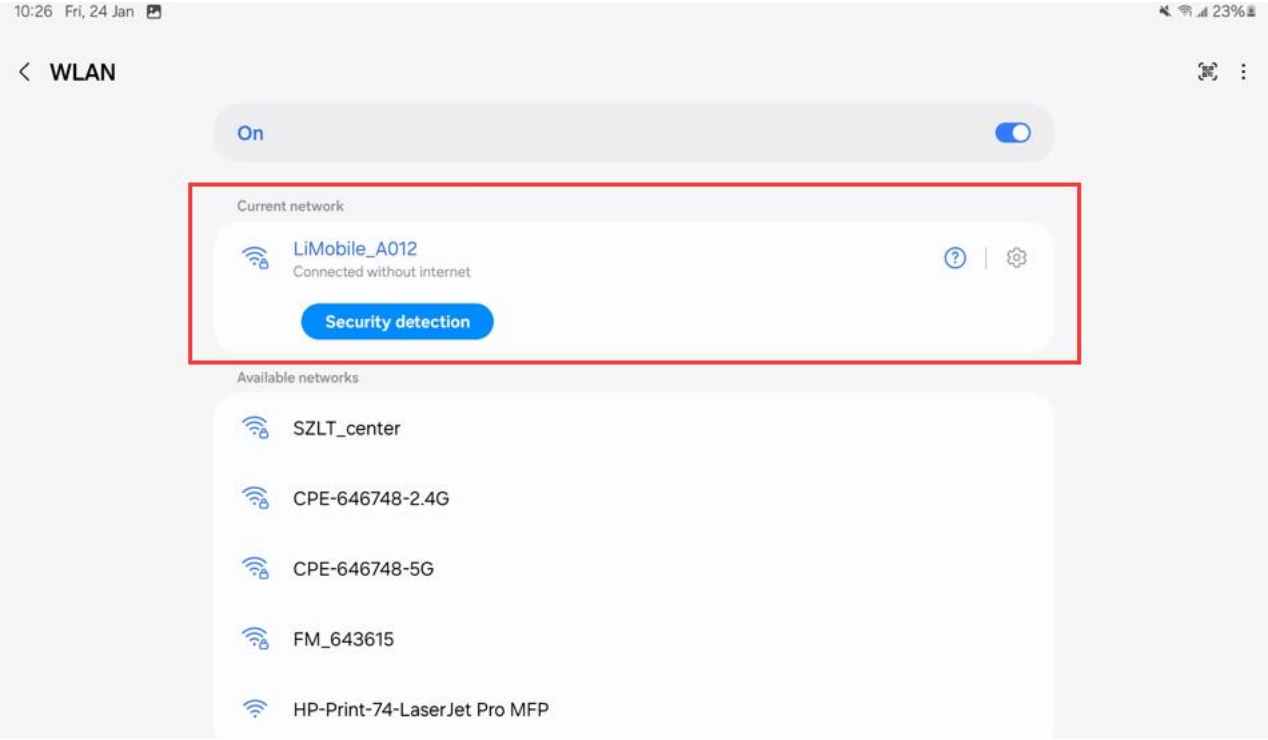
7.4 Device Connection

7.4.1 Wi-Fi Connection

Search for the Wi-Fi name: LiMobileM2_xxxx on the mobile device.

Enter the default Wi-Fi password: greenvalley.

☆ Note: "xxxx" refers to the last four digits of the device's serial number (SN).

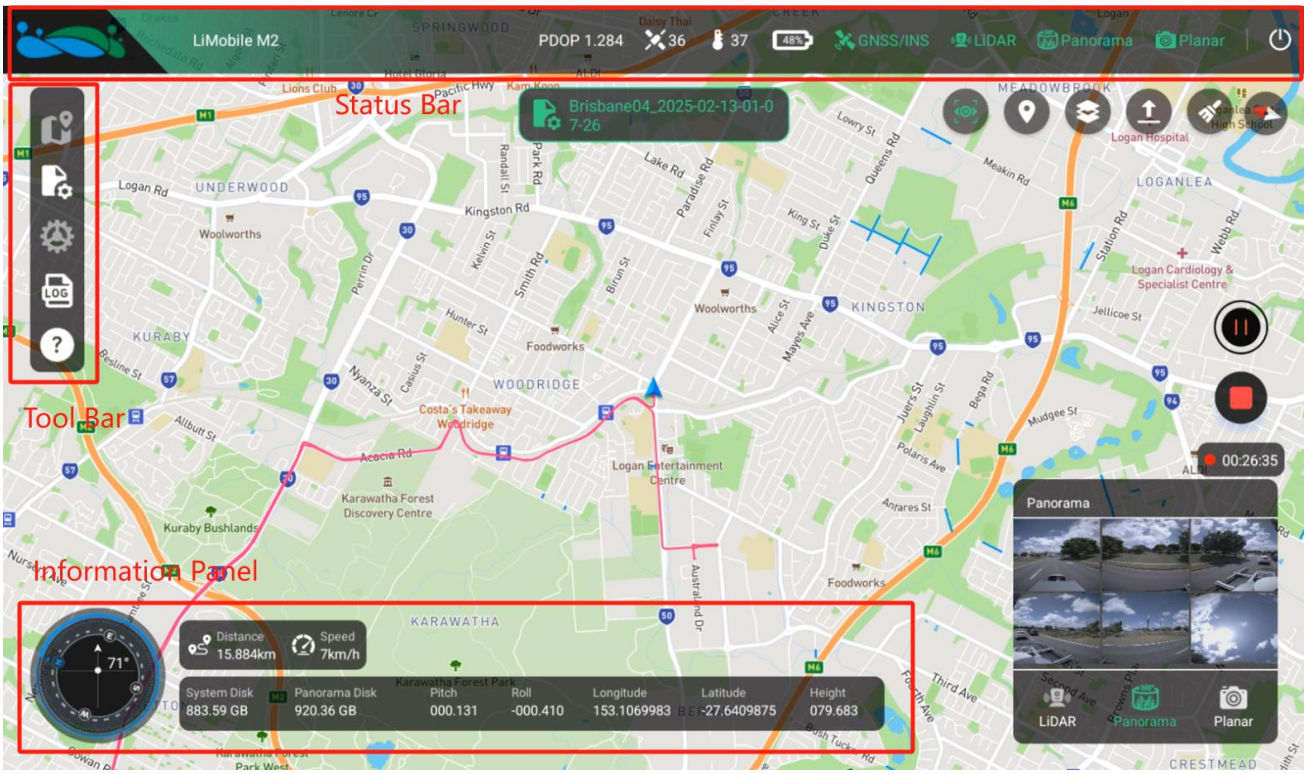


7.4.2 Wired Connection

1. Use an adapter to connect one end of a RJ45 Ethernet cable to the mobile device's Ethernet port.	

2. Connect the other end of the RJ45 Ethernet cable to the battery box's Ethernet port.

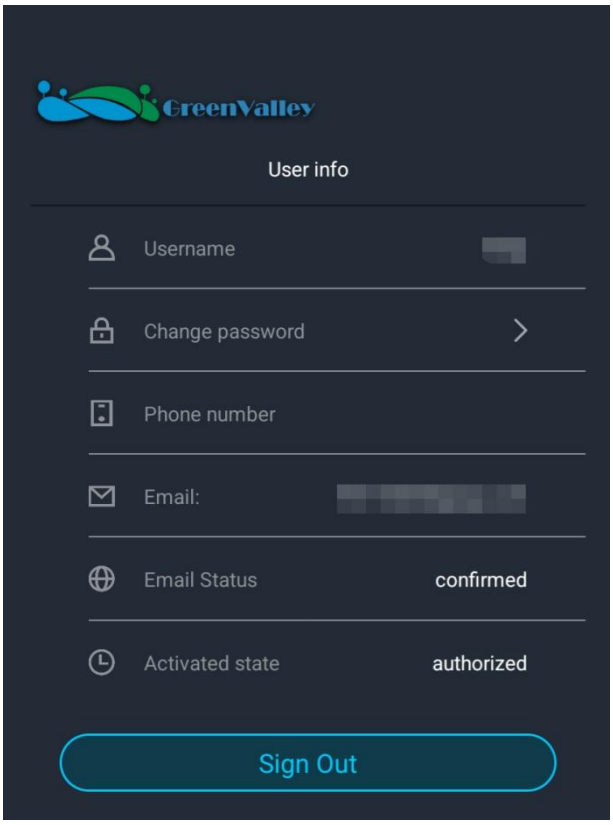
7.5 APP Interface Overview



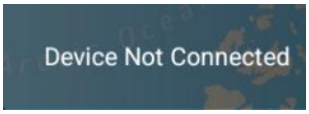
7.5.1 Top Device Status Bar

1. Account Management Button

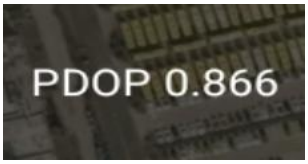
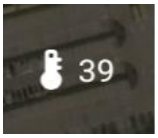
User Management Interface: Users can view GreenValley account information, activated status, and perform operations such as **Sign Out**.



2. Device Connection Status

	Tablet disconnected from the device.
	Tablet successfully connected to the device.

3. Device Status Information

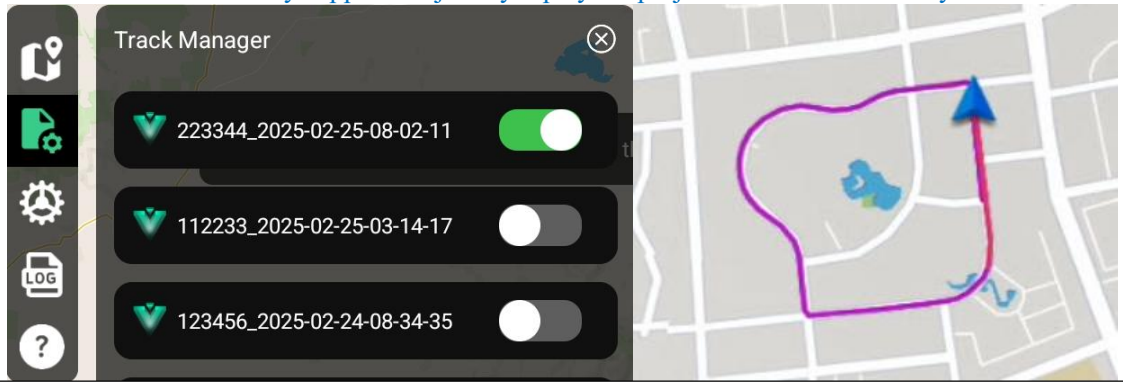
	PDOP Value: Generally, a value less than 2 indicates good signal quality, suitable for data collection.
	Satellite Count: Displays the number of satellites tracked by the device.
	Device Temperature: Displays the internal temperature of the device.
	Battery Level: Displays the remaining battery level of the device. A red warning icon appears when the battery level is below 20%.

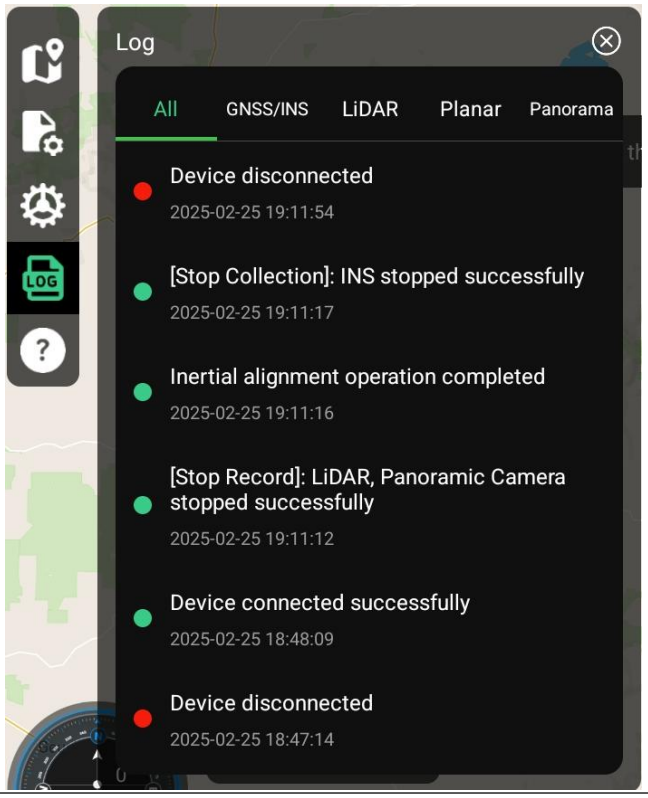
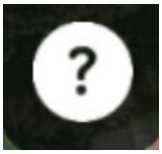
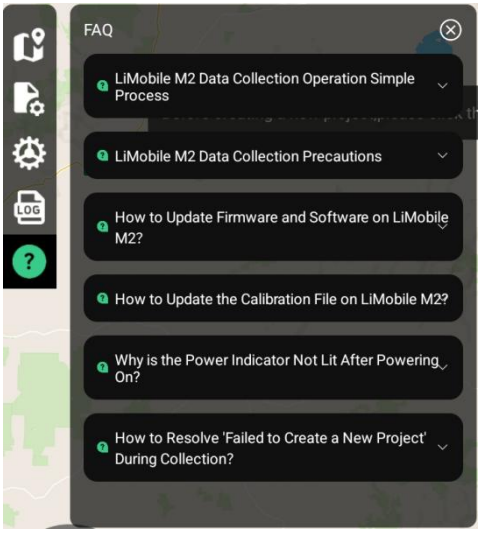
	Sensor Connection Status (IMU, LiDAR, Panoramic Camera, Planar Camera). Green: Sensor is synchronized and ready for collection. Yellow: Sensor is activated but not synchronized. Red: Sensor is connected but not activated. Gray: Sensor is not connected.

4. Device Power Button

	Power Button
	Disabled when the device is not connected.

7.5.2 Left Toolbar

	Offline Map Download Button: Refer to Section 7.7.1 for detailed steps.
	Track Management Button: Users can replay trajectory files from historical projects. Swipe the trajectory slider to the right, and the corresponding trajectory (purple) will be automatically replayed on the map. ☆ Note: This feature only supports trajectory replay for project data stored on the system disk. 

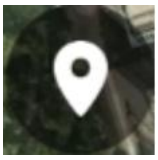
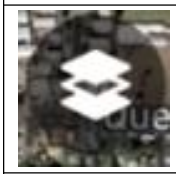
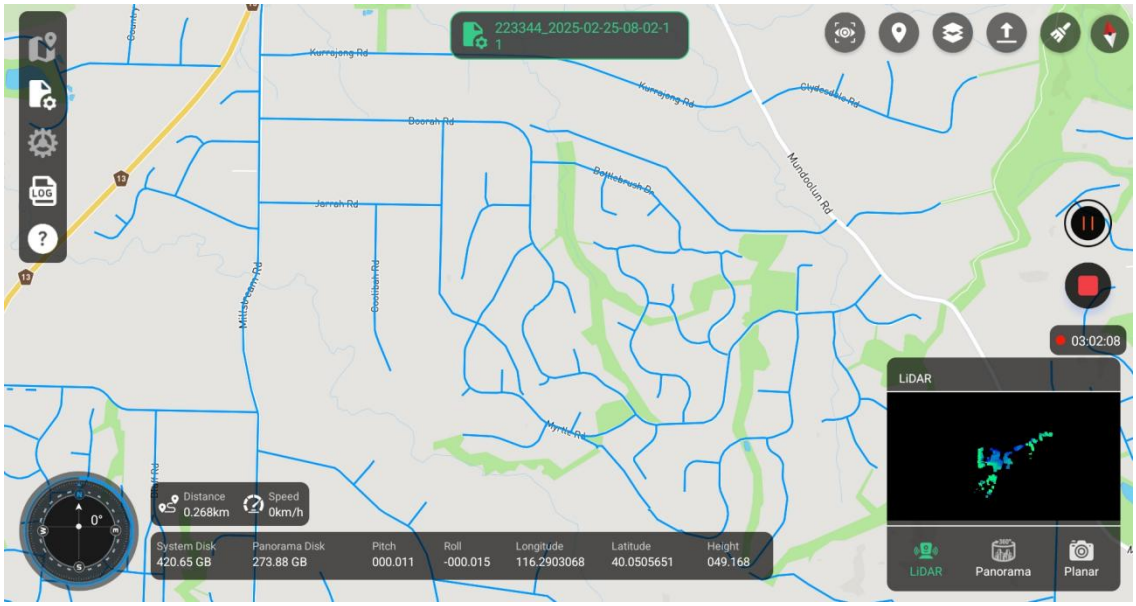
	Configuration Button: Refer to Sections 7.6.2, 7.7.3, 7.7.4, and 7.7.5 for detailed settings.
	Log Button: Users can view real-time operation logs. The app supports voice alerts for important reminders. 
	FAQ Button: Users can quickly access common device issues. 

7.5.3 Bottom Information Panel

Displays information such as Distance, Speed, available disk space (yellow warning if below 10%, red warning if below 3%), Pitch, Roll, Heading, Latitude, Longitude, and Height.

7.5.4 Main Interface

1. Map Function Buttons

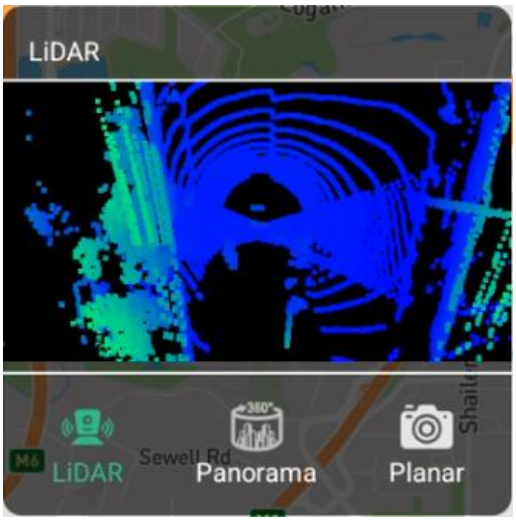
	Follow Button: Click to rotate the map according to the driving direction.
	Location Button: Click to jump to the current device location on the map.
	Map Switch Button: Click to switch between satellite and navigation maps.
	Trajectory Upload Button: Click to upload planned trajectory files (.kml/.kmz/.ovkml/.ovkmz/*.txt) from the tablet. The planned trajectory (blue) will appear on the map. 
	Trajectory Clear Button: Click to remove all trajectories from the map, including real-time, uploaded, and replayed trajectories.

	Pointer Button: Click to reset the map orientation to north.

2. Collection Operation Buttons

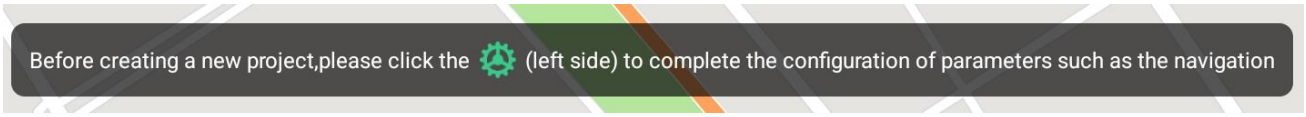
	New Project Button
	Start Data Recording Button
	Pause Data Recording Button
	Stop Data Recording Button
	Project Collection Time

3. Data Preview Window

	Single-frame Point Cloud Preview: Click the thumbnail to enlarge. Displays data from both LiDARs.

	Panoramic Image Preview: Click the thumbnail to enlarge. Camera 1-5 correspond to the side cameras (starting from Camera 0, counterclockwise when viewed from above). Camera 6 corresponds to the top camera.
	Planar Image Preview: Click the thumbnail to enlarge.

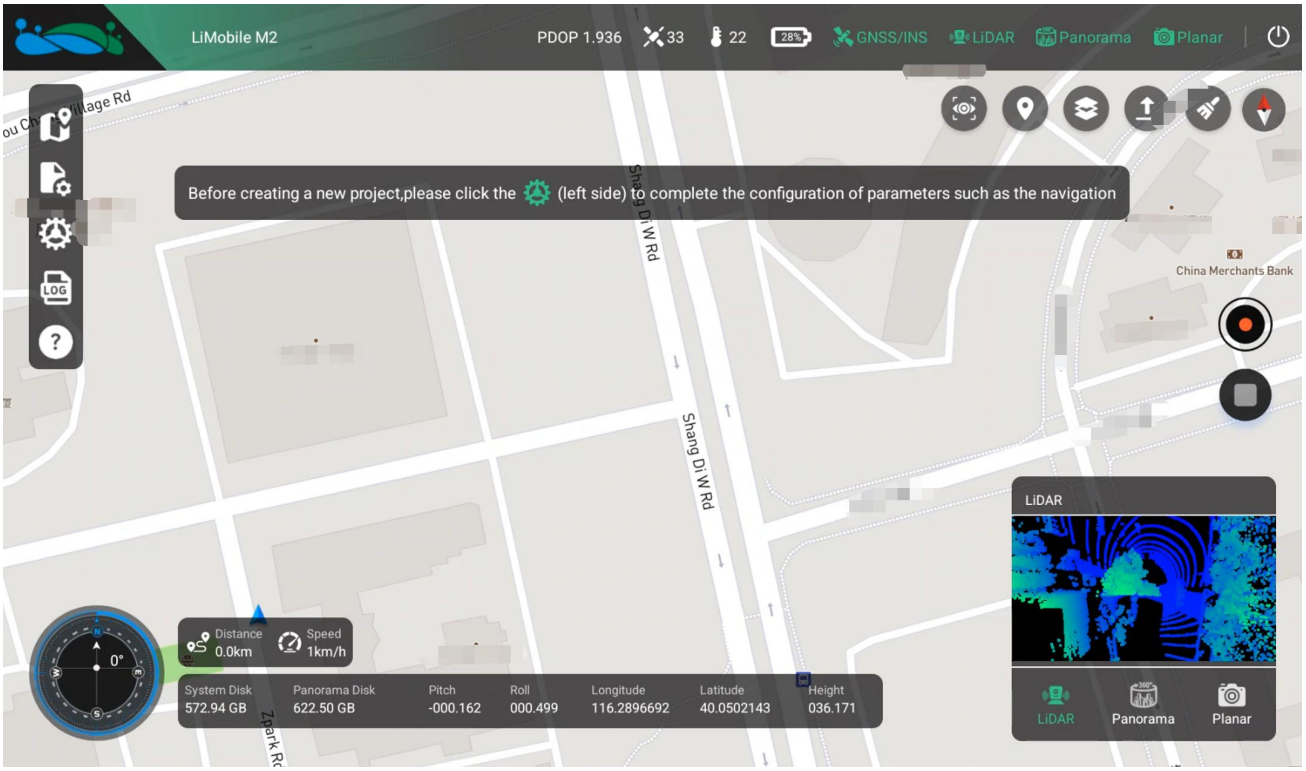
4. User Prompt



7.6 Quick Data Collection

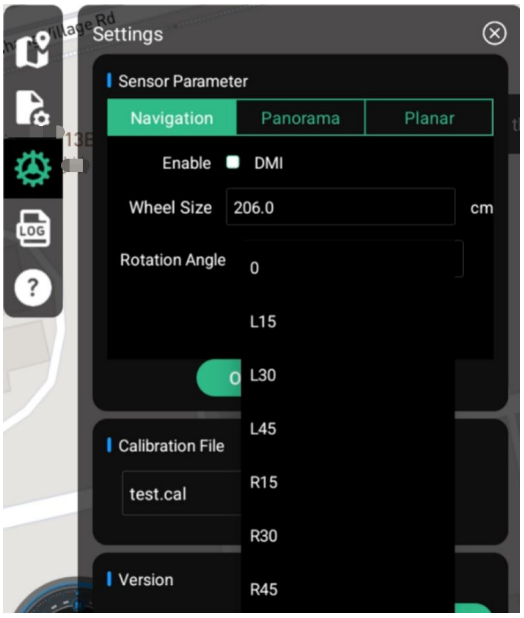
7.6.1 Device Initialization

After powering on the device, establish communication between the device and the tablet. When the device connection status in the top-right corner turns green, the device is successfully connected. The device will automatically initialize after powering on, requiring no user intervention. Wait until all sensor status indicators turn green before starting data collection.



7.6.2 Sensor Parameter Settings

After device initialization, click the Settings button in the toolbar to configure parameters for the navigation system, panoramic camera, and planar camera.



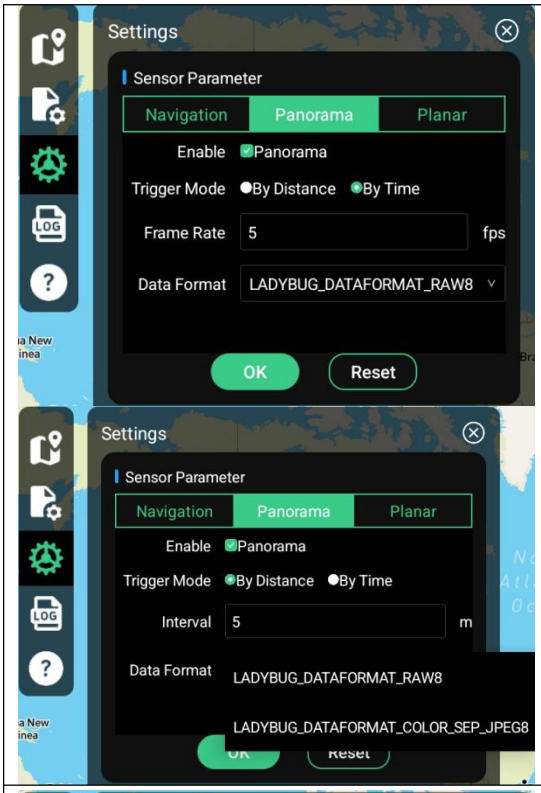
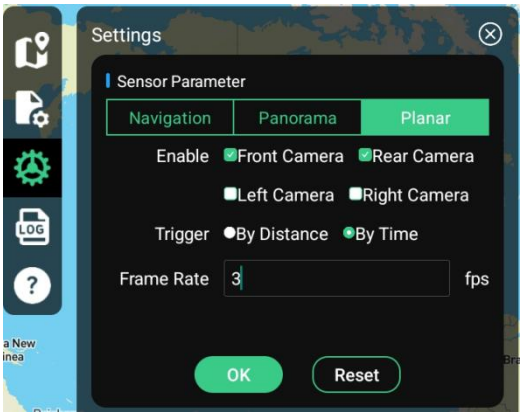
Navigation

DMI Enable Settings: The device will record data only after it is enabled.

Wheel Size: Used to calculate driving distance.

Rotation Angle: Supports multi-angle installation, and can be adjusted to 0, ±15°, ±30°, ±45° in the horizontal position. Users need to choose according to the actual installation angle.

☆ Note: The distance trigger mode for the cameras is only enabled when the wheel speed sensor is activated.

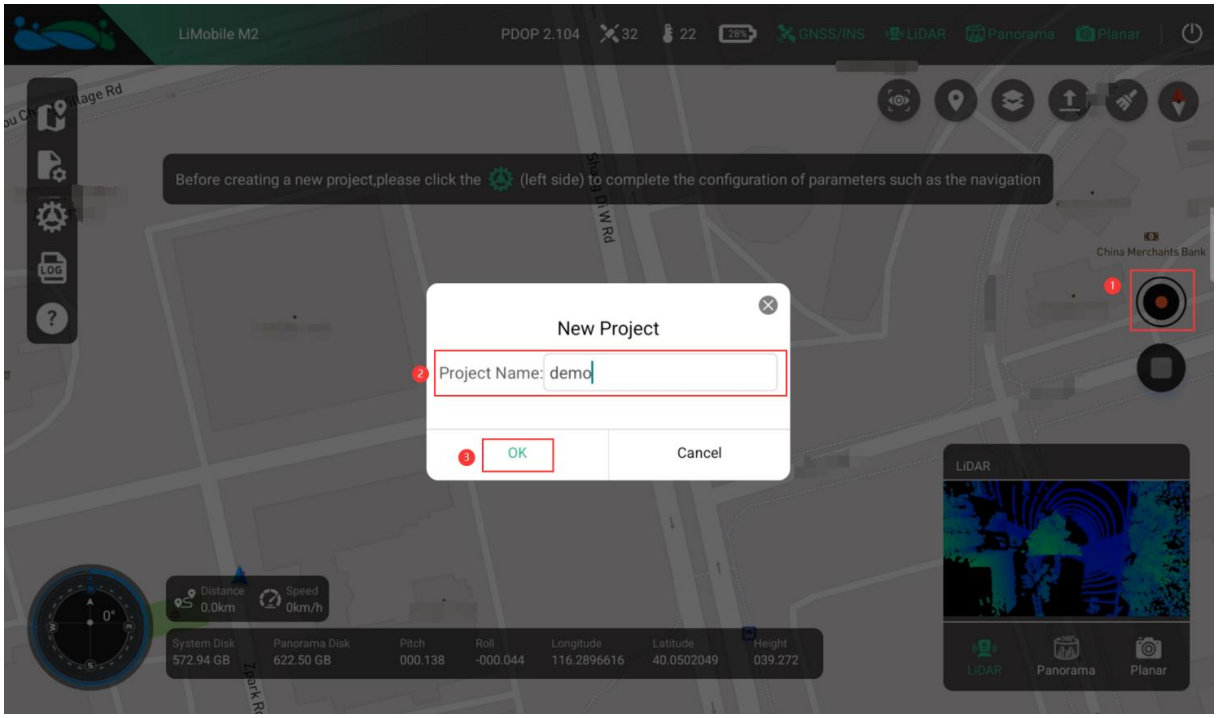
	**Panorama** **Panorama Enable Settings**: The device will record data only after it is enabled. **Trigger Mode**: supports By Time and By Distance trigger modes. 1. By Time Frame Rate: default parameter 5 FPS. 2. By Distance Interval: default parameter 5 m. **Data Format**: supports LADYBUG_DATAFORMAT_RAW8 and LADYBUG_DATAFORMAT_COLOR_SEP_JPEG8 formats.
	**Planar** **Planar Enable Settings**: The device will record data only after it is enabled. **Trigger Mode**: supports By Time and By Distance trigger modes. 1. By Time Frame Rate: default parameter 3 FPS. 2. By Distance Interval: default parameter 5 m.

☆ Notes:

1. After settings are complete, click the "OK" button to make the parameters effective.
2. The "Reset" button will restore all sensor parameters to factory defaults.

7.6.3 New Project

Click the **New Project** button, enter a custom project name, and then click the **OK** button.



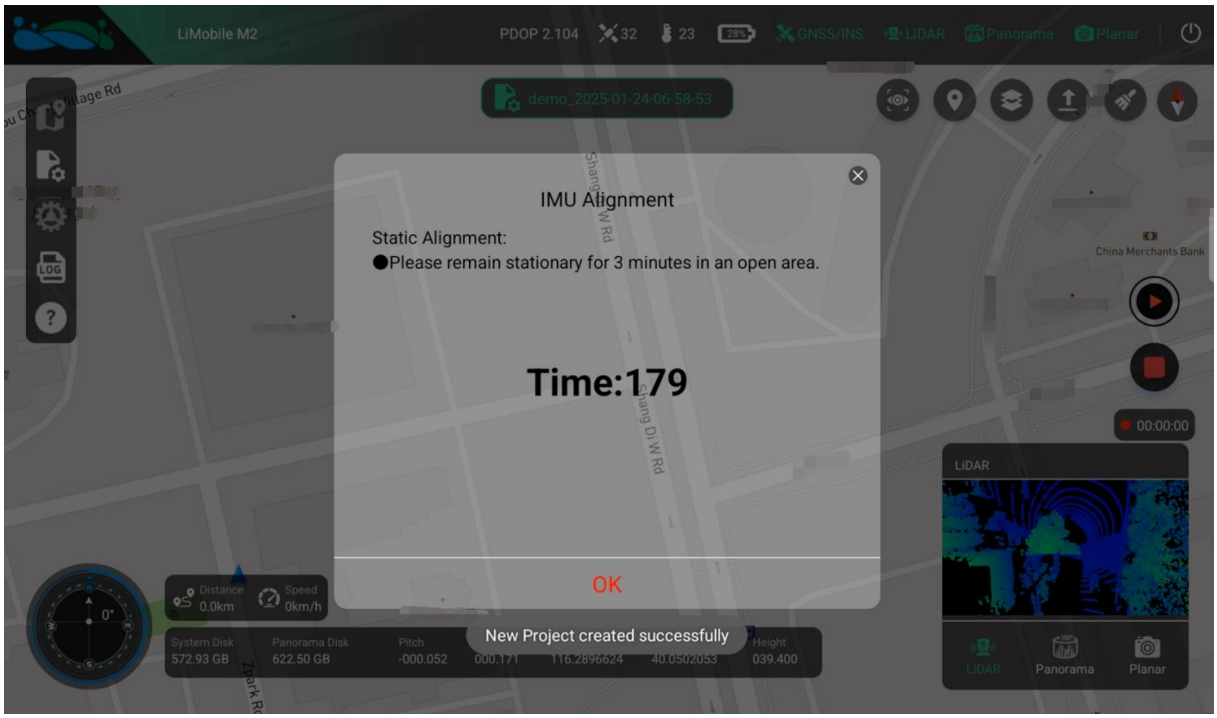
☆ Notes:

1. The name of the newly created project should not contain special characters.
2. The final project name is: User-defined name_UTC time.

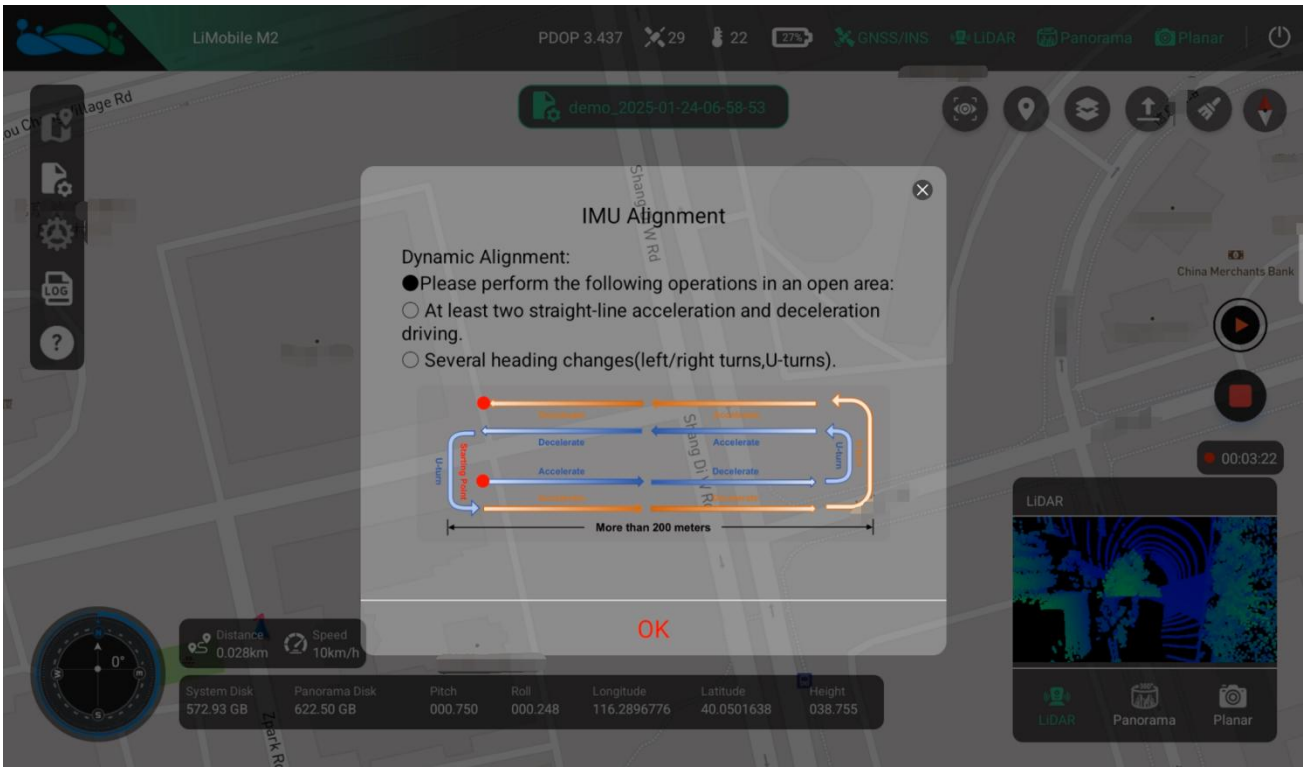
7.6.4 IMU Alignment

After creating a new project, the IMU Alignment pop-up window will automatically pop up on the interface. The IMU Alignment operation is divided into two steps: Static Alignment and Dynamic Alignment.

Static Alignment: Please remain still for 3 minutes in an open area. The user needs to wait for the countdown to end and click the OK button.

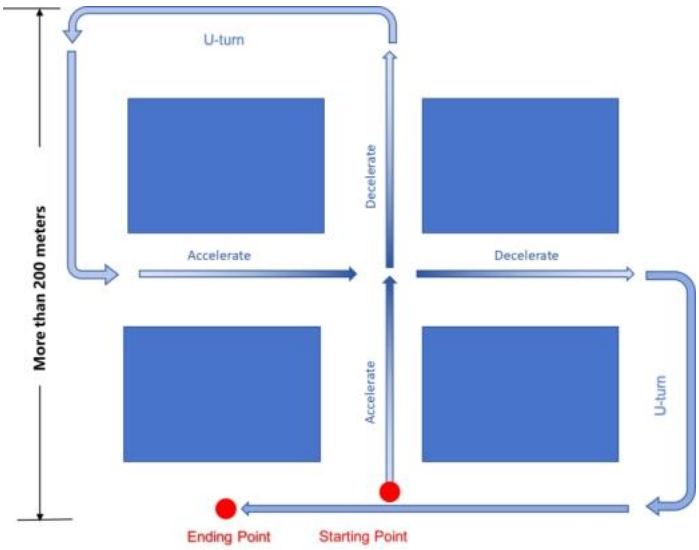


Dynamic Alignment: The user needs to follow the diagram and first accelerate forward to 40 km/h and decelerate to 10 km/h, and then turn around. Then accelerate forward to 40 km/h, decelerate to 10 km/h, and turn around again. Finally, repeat the above acceleration, deceleration, and U-turn operations. Click the OK button when finished.



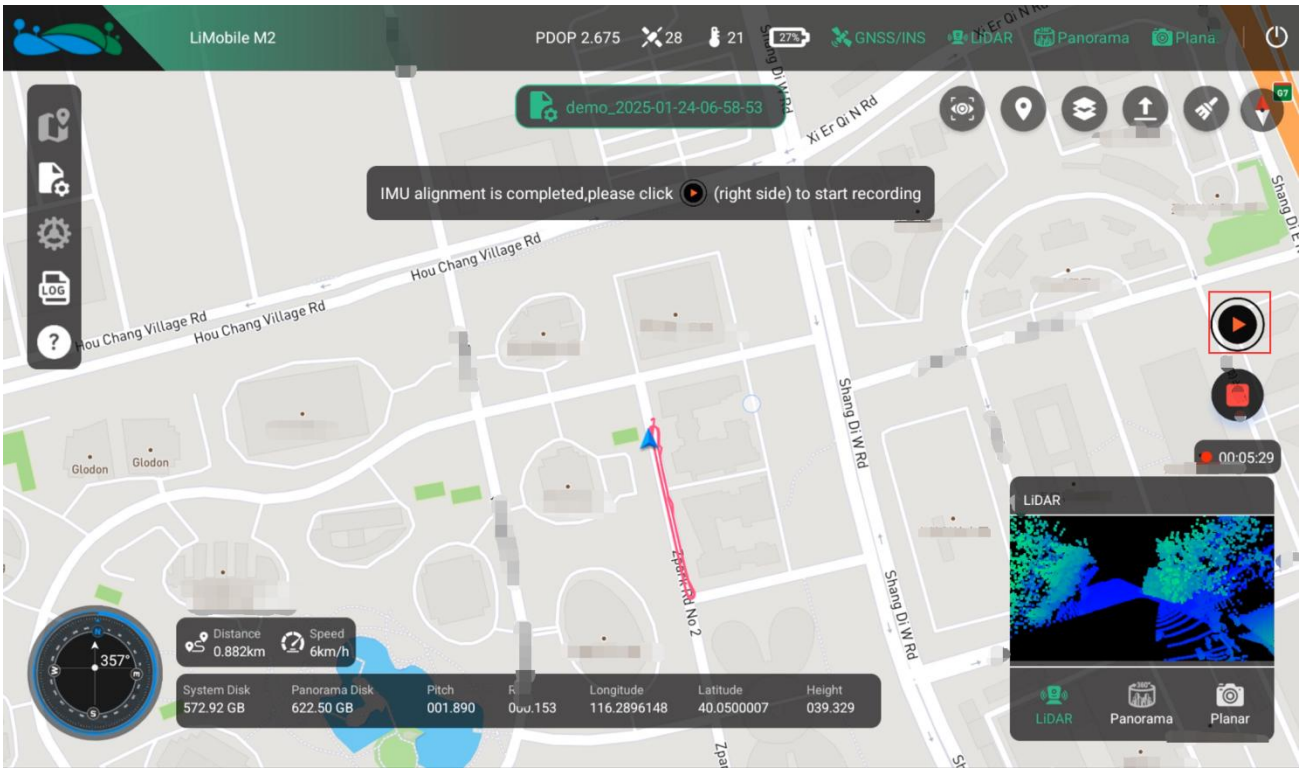
☆ Notes:

1. If the INS alignment operation is not carried out, there will be a high risk that some data cannot be processed.
2. If users are under tight schedules and need to shorten the waiting time for the static alignment step, the manual provides other alignment criteria, that is, when the PDOP value is below 2 and the number of satellites is above 15, and this state remains stable for 30 seconds, dynamic alignment can be carried out.
3. If the user's acquisition environment permits, it is recommended to conduct the dynamic alignment operation as shown in the following figure.

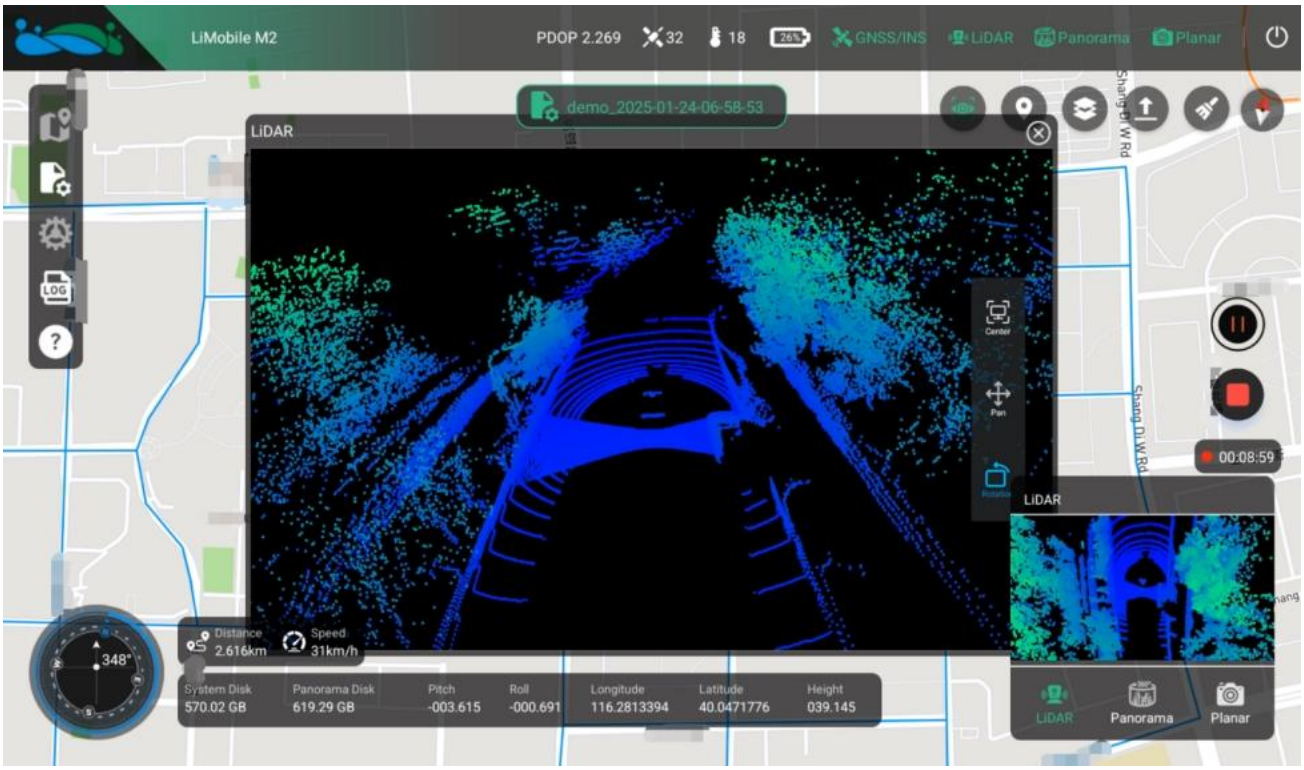


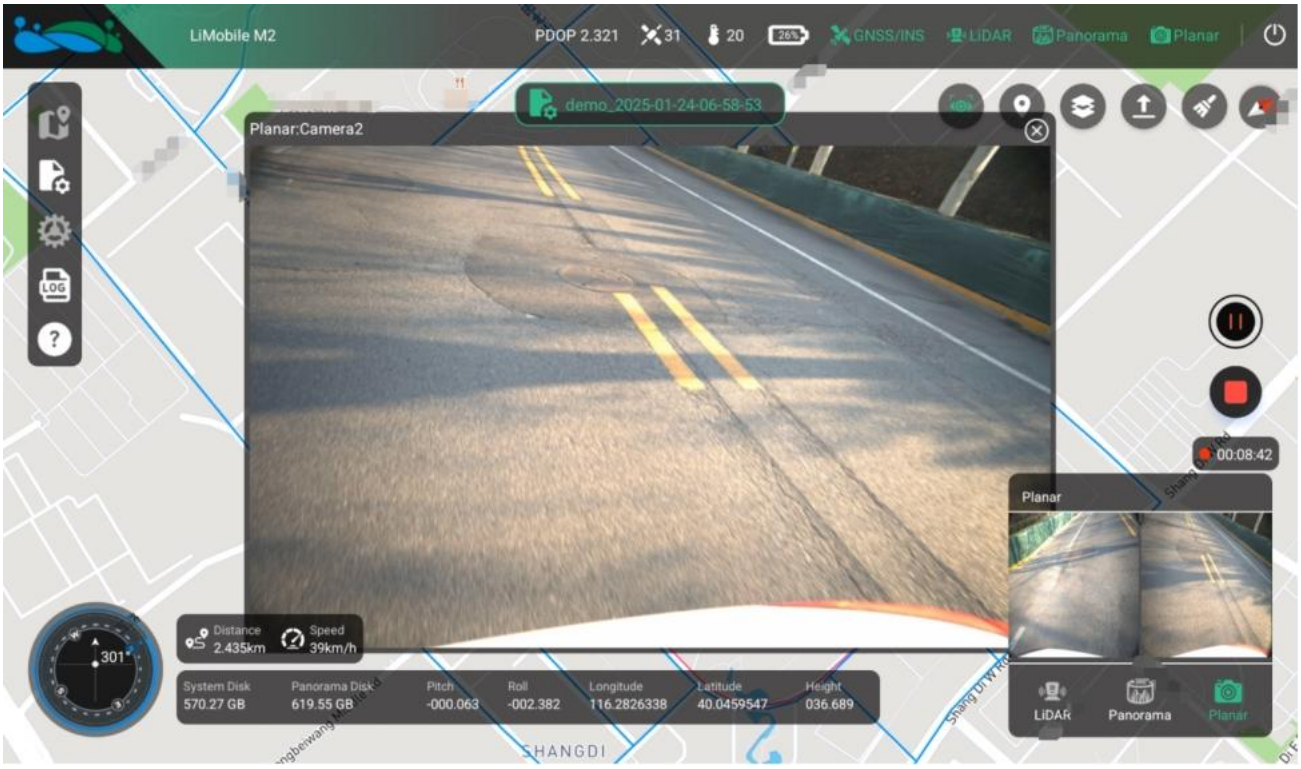
7.6.5 Start Data Recording

According to the prompt at the top of the main interface, click the Start Recording button, and the device will begin recording sensor data.



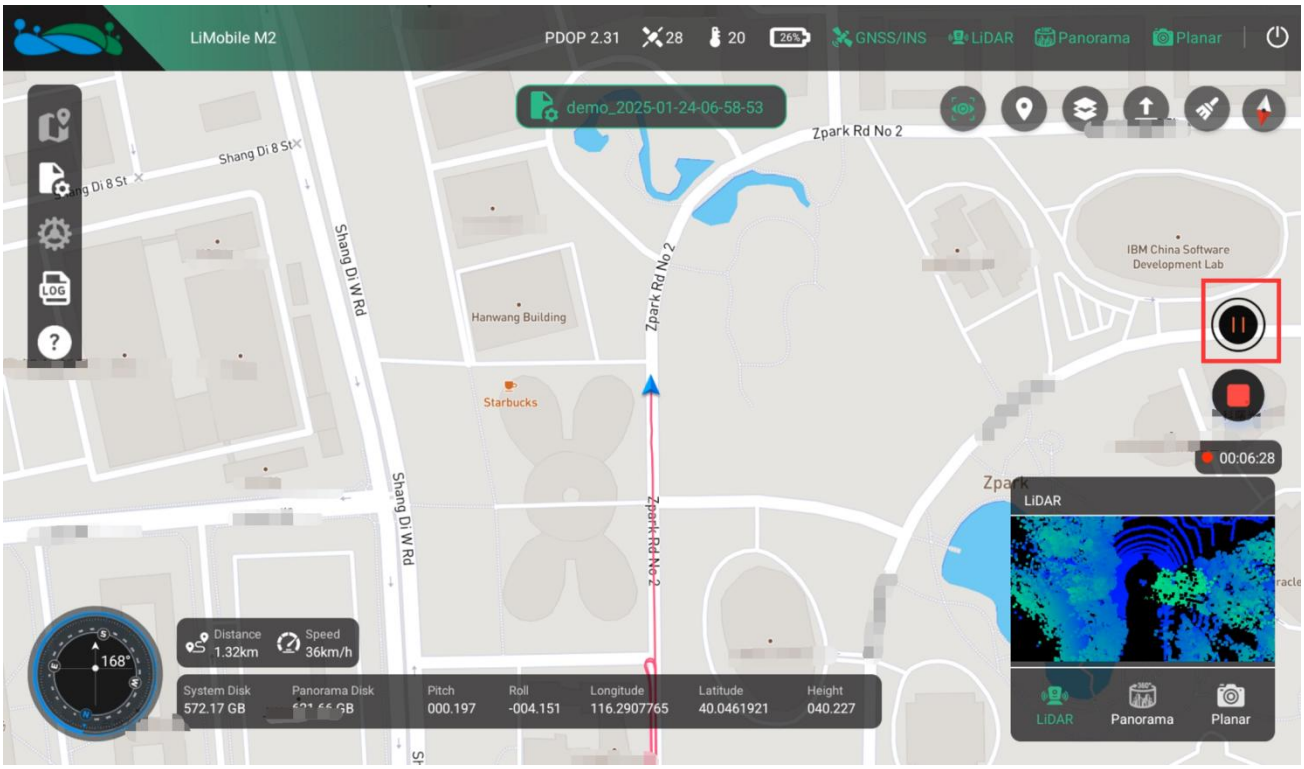
Users can view the driving route of the equipment in real time on the map, and can also view the collected single-frame point cloud data and image data in real time.





☆ Notes:

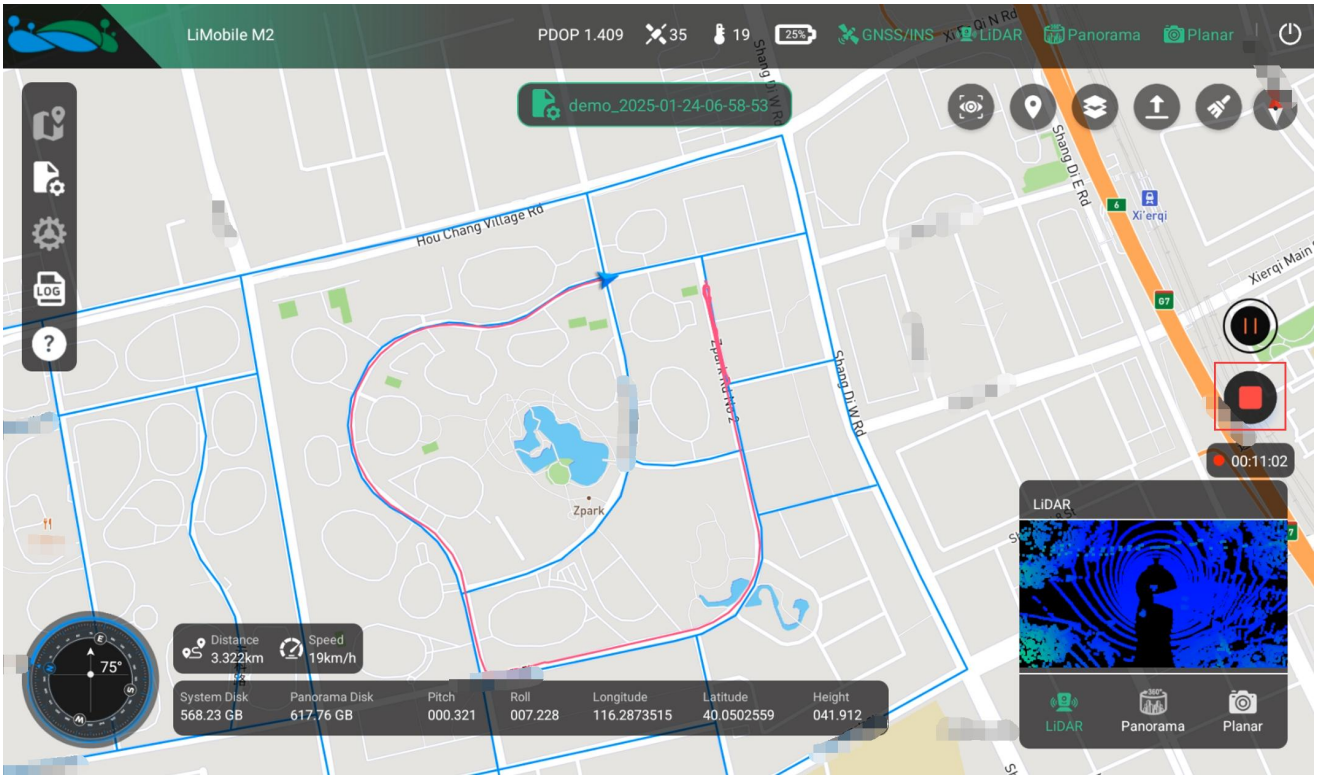
1. When users encounter situations such as the need to transfer the work area or traffic jams during data collection, they can click the "Pause Recording" button to pause data recording.



2. After the pause of data recording ends, users can click the "Start Recording" button again to obtain data.

7.6.6 Stop Data Recording

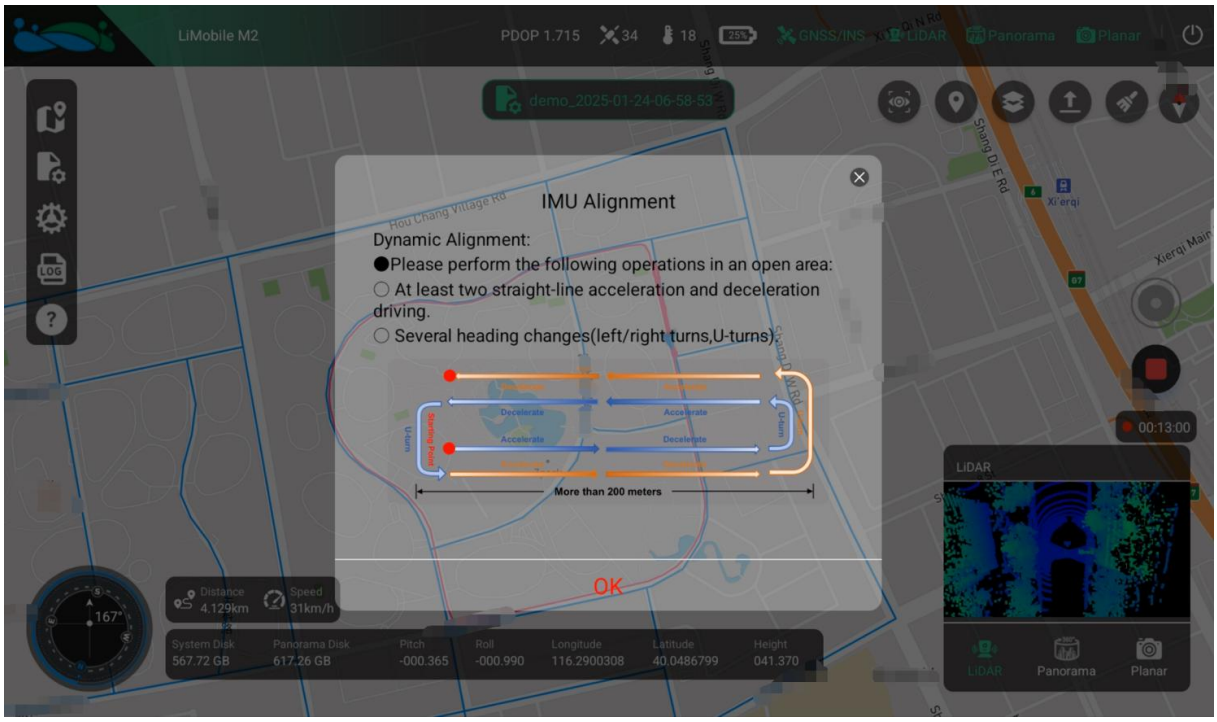
After the collection is completed, click the "Stop Recording" button.



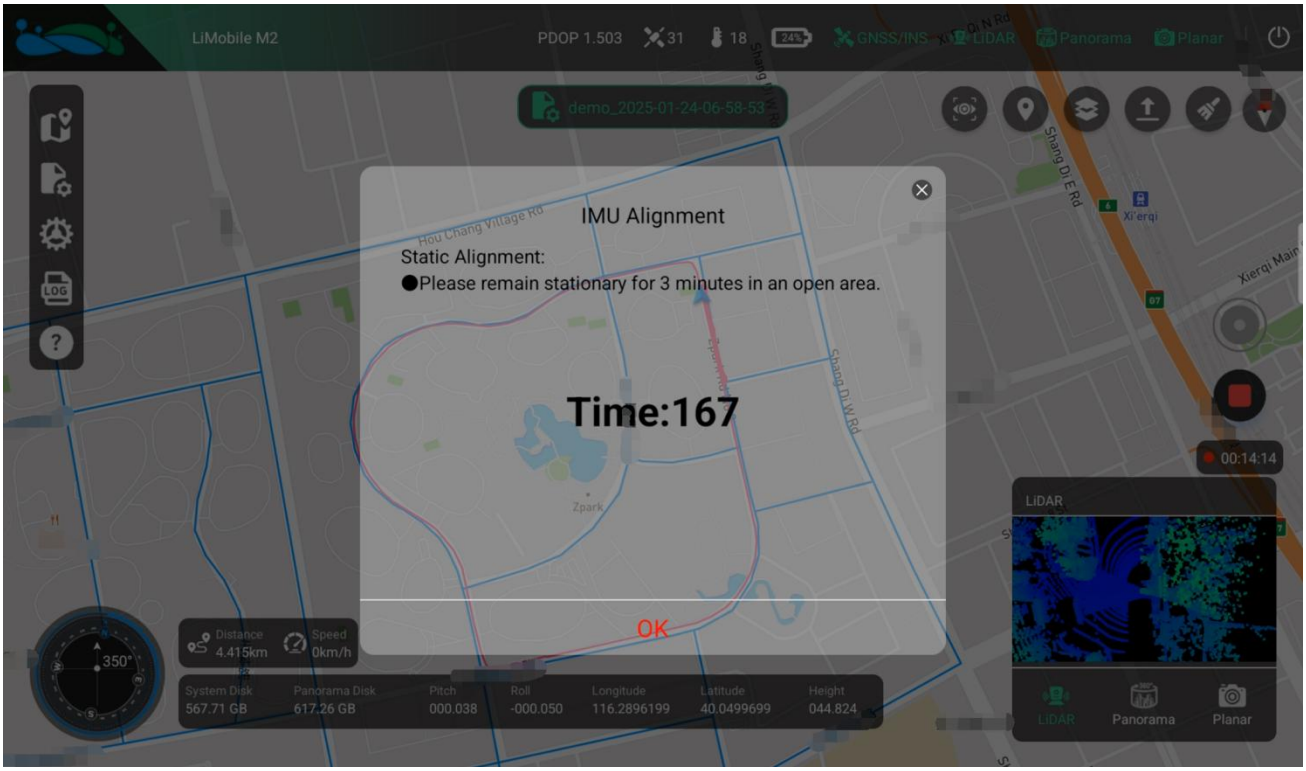
7.6.7 IMU Alignment and Close Project

After stopping data recording, the interface will automatically pop up the INS Alignment window. The INS alignment operation consists of two steps: Dynamic Alignment and Static Alignment.

Dynamic Alignment: The user needs to follow the diagram and first accelerate forward to 40 km/h and decelerate to 10 km/h, and then turn around. Then accelerate forward to 40 km/h, decelerate to 10 km/h, and turn around again. Finally, repeat the above acceleration, deceleration, and U-turn operations. Click the OK button when finished.

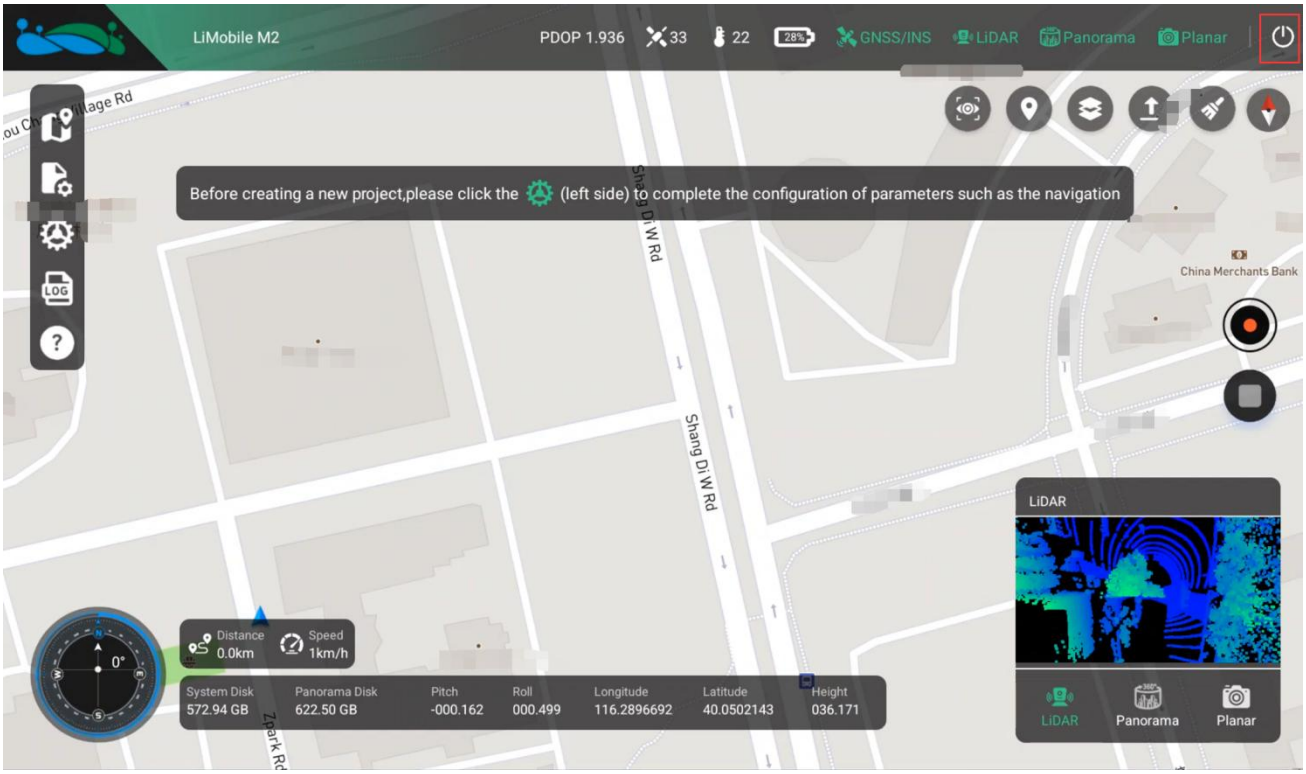


Static Alignment: Remain stationary in an open area for 3 minutes. Wait for the countdown to end, then click the Confirm button to finish the current project.



7.6.8 Device Shutdown

After completing all data collection tasks, click the power button in the upper right corner to shut down the device.



☆ Notes:

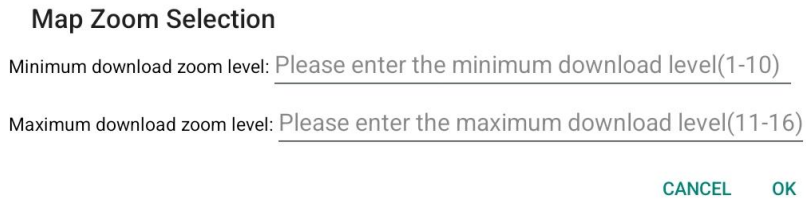
1. Please wait patiently for 30 seconds (the time required for the equipment system to be completely shut down). Do not perform any operations until the interface shows that the equipment connection is disconnected, and then turn off the equipment power.
2. Please cut off the power in advance before plugging or unplugging the disk.

7.7 Other Operational Instructions

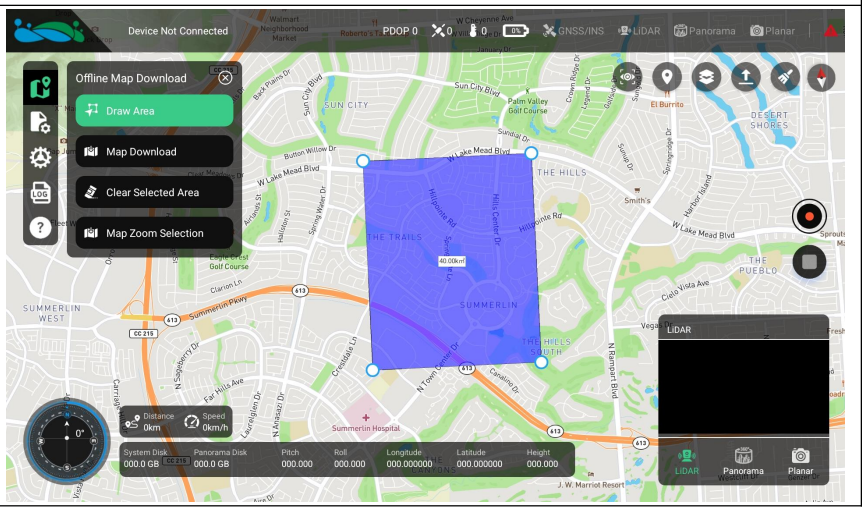
7.7.1 Offline Map Download

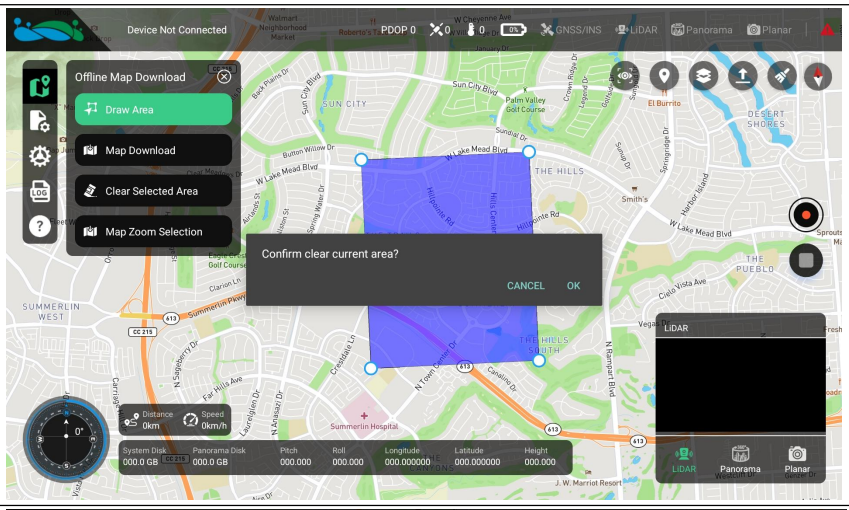
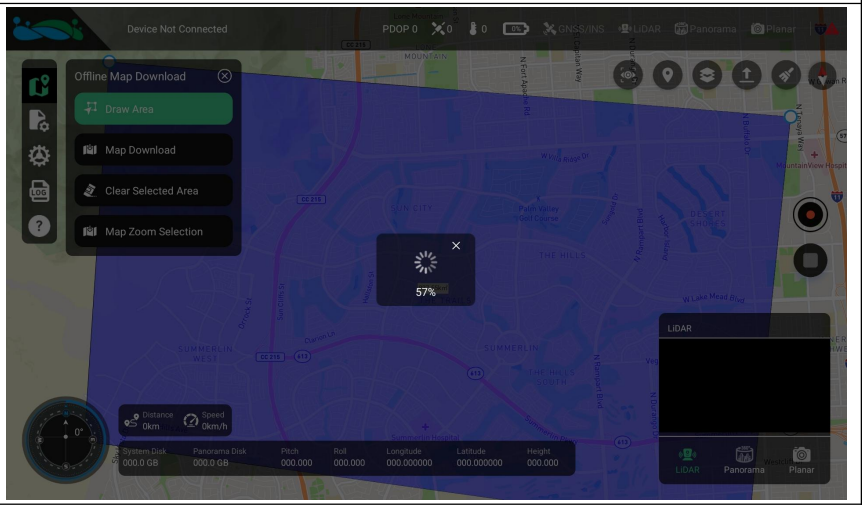
1. Connect the tablet to an internet-enabled network and click the offline map download function button on the left to bring up the function menu.

2. Click the **Map Zoom Selection** button to set the map level range.



3. Click the **Draw Area** button to delineate the download area.

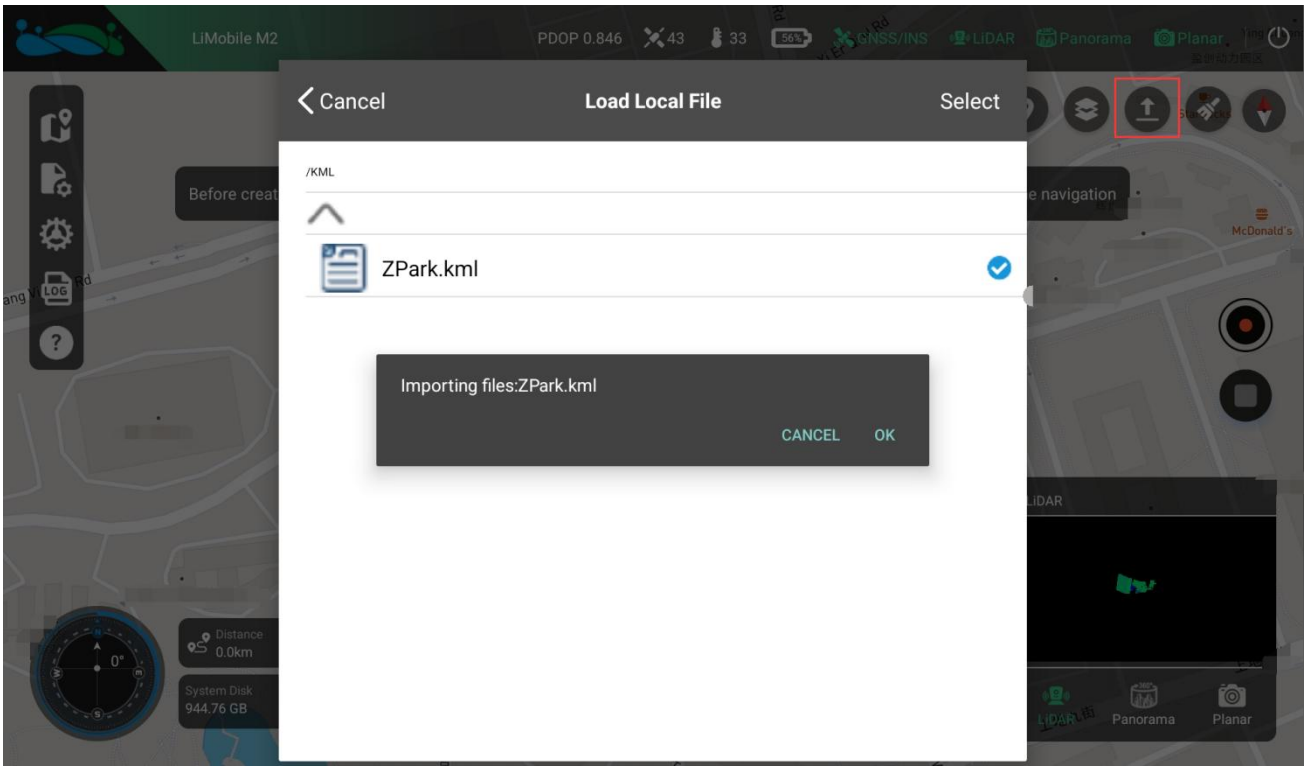


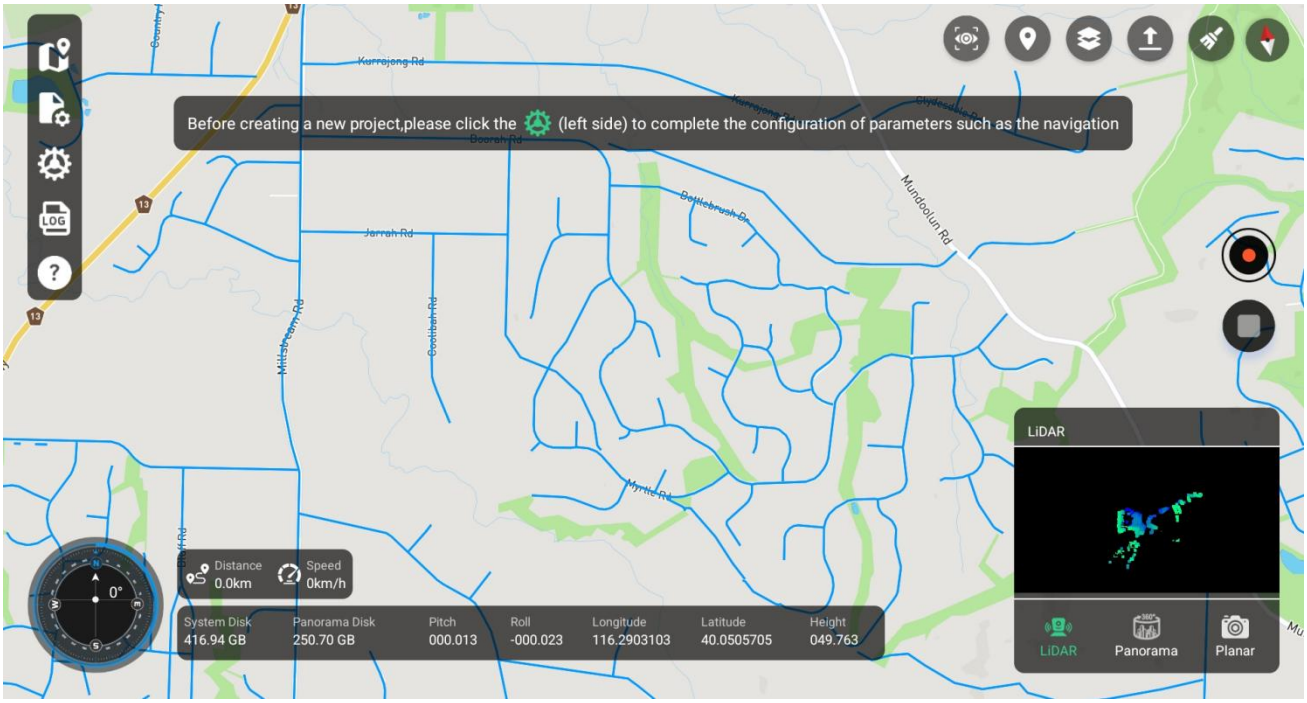
4. If the selected area is incorrect, click the **Clear Selected Area** button and redraw the download area.	
5. Click the **Map Download** button to complete the map download.	

7.7.2 Route Planning

1. Users need to generate a collection planning route file in advance using online mapping software such as Google Earth or professional GIS software like ArcGIS, QGIS, or LiDAR360MLS (the software supports formats such as *.kml, *.kmz, *.ovkml, *.ovkmz, *.txt, etc.), and import the generated file into the tablet.

2. Click the trajectory upload button in the upper right corner of the main interface, select the trajectory file to be imported, and the trajectory (in blue) will be displayed on the map interface.

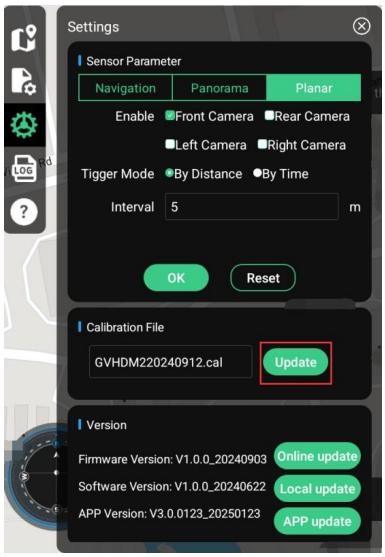




7.7.3 Calibration File Update

1. Users need to save the new calibration file (SN.cal) in the LiMobileSystem->Cal directory under the root directory of the M2_SYS disk and insert the disk into the device.

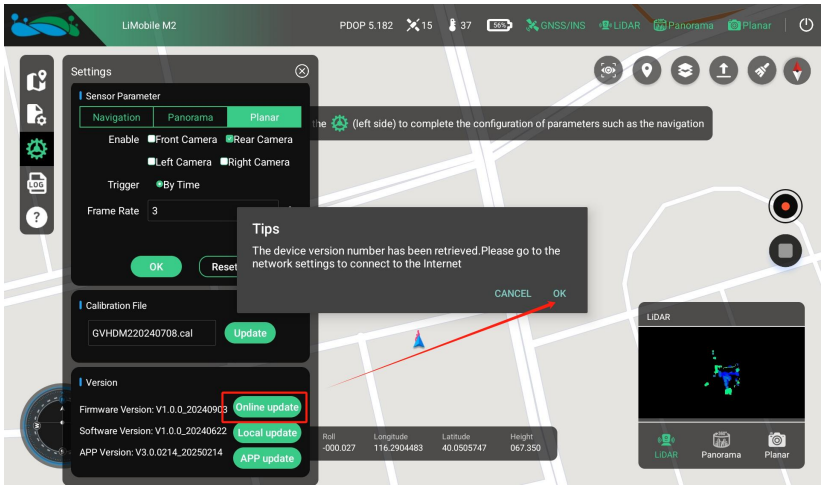
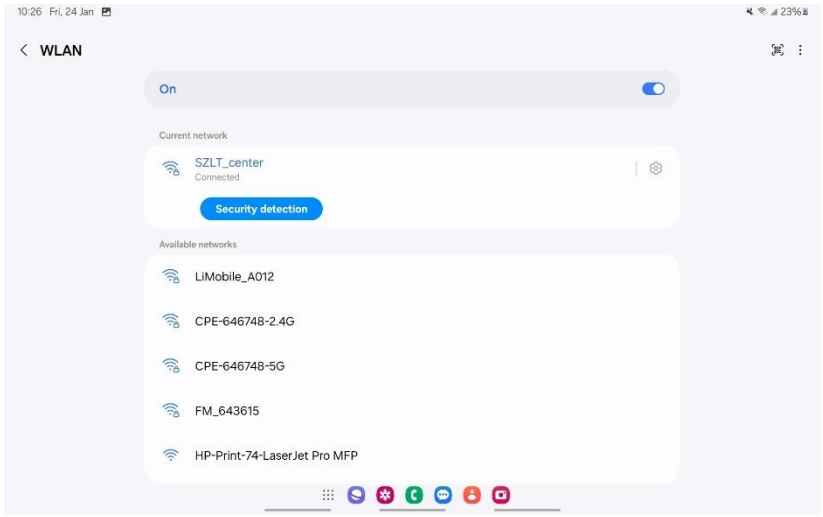
2. Open the APP and connect to the device, then click the **Update** button on the Calibration File settings interface. The system will automatically recognize the calibration file in this path and complete the update.

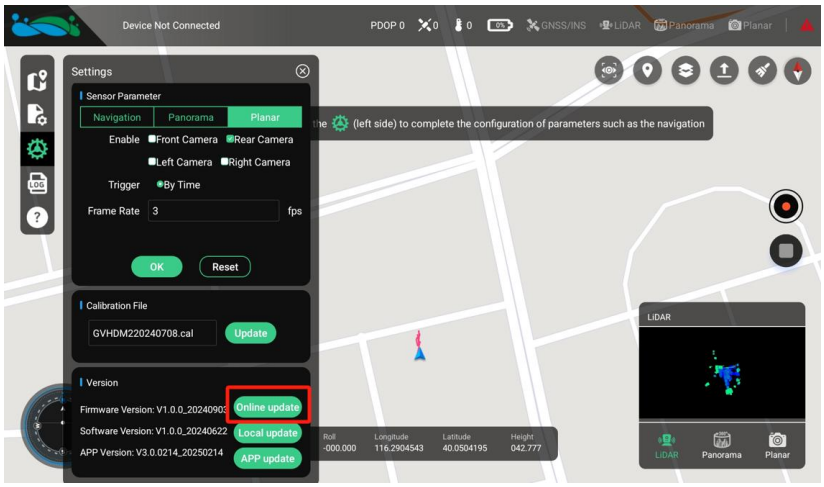
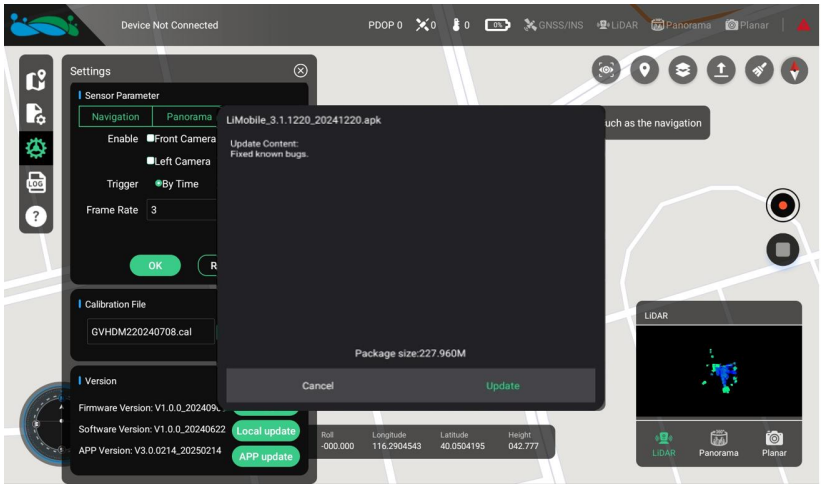
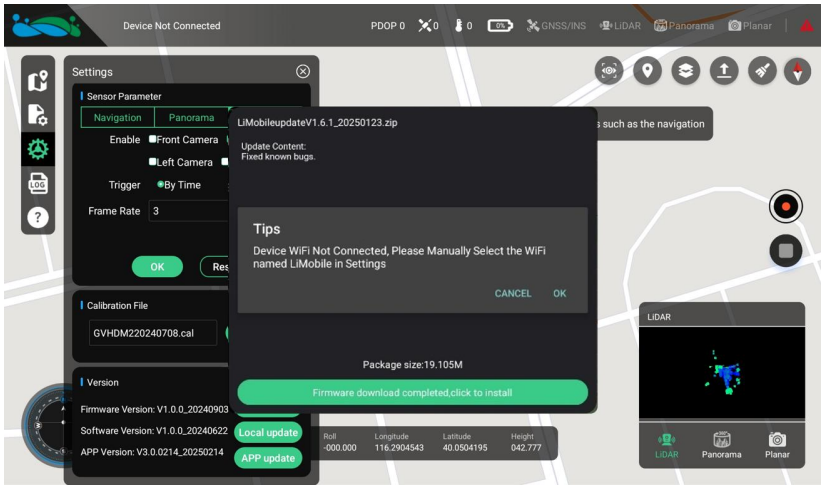


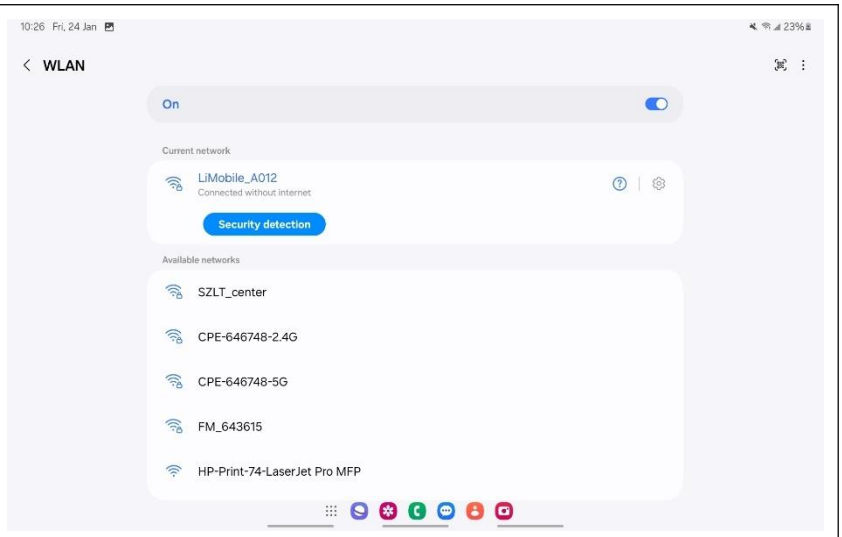
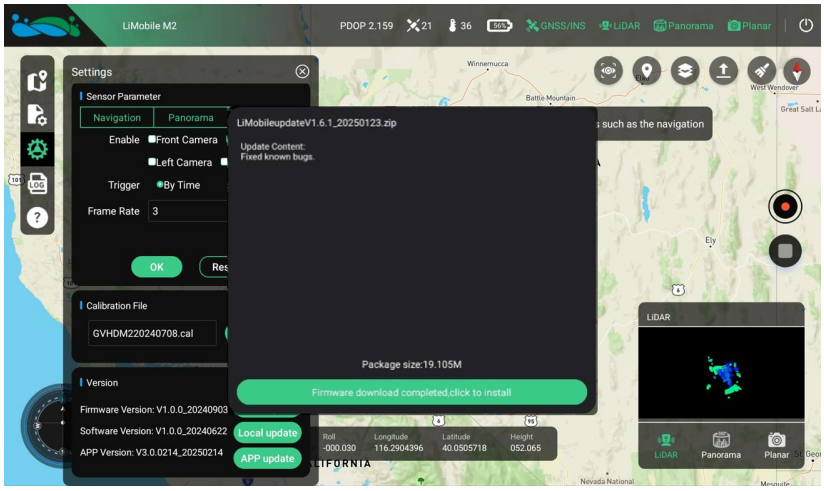
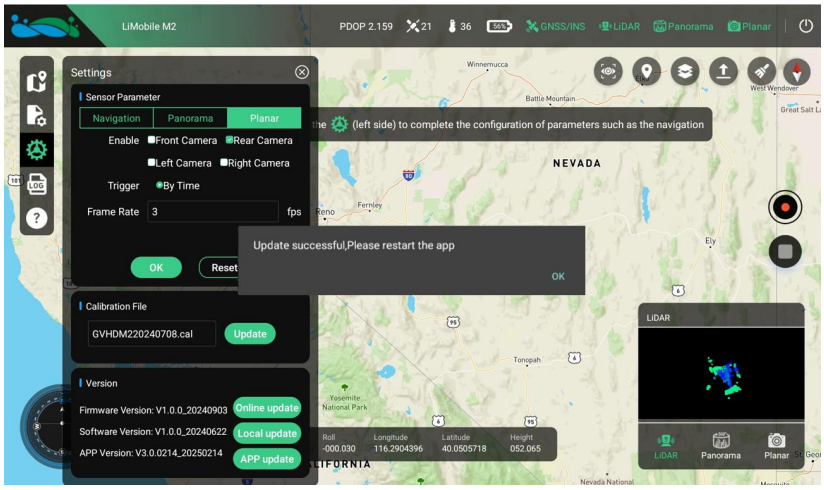
7.7.4 Firmware and Software Version Update

The device software and firmware will be packaged into a comprehensive update package for version updates. The device supports both local and online update modes, allowing users to choose flexibly.

- **Online Update**

1. Open the APP and connect to the device, click the **Online Update** button on the **Version** interface. Get the current device firmware version information, and then click the **OK** button. The tablet will jump to the network switching interface.	
2. Users need to be connected to a network with Internet access.	

3. Switch back to the APP interface, click the **Online Update** button again, the update dialog box will pop up, and click the **Update** button to download the comprehensive update package of firmware and software.	 
4. After the download is complete, click **Firmware download complete, click to install** button, and then click the **OK** button.	

5. Follow the prompts to switch networks.	
6. Switch back to the APP interface, click the **Firmware download completion, click to install** button again.	
7. After the update is successful, click the **OK** button and restart the APP. ☆ Note: 1. After the firmware and software update, the device will automatically shut down. Please power on the device again. 2. Restart the device and open the app to check the version number in the configuration interface to confirm the update was successful.	

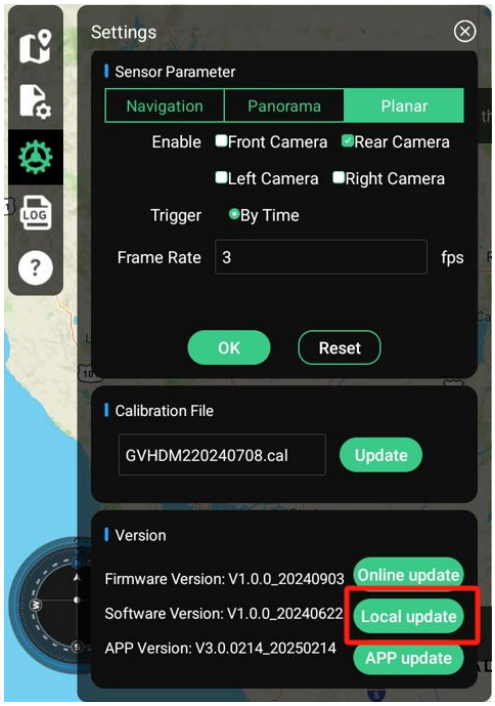
- Local Update

1. Scan the QR code , or enter

https://licloud.greenvalleyintl.com/api/v1/softwares/185/package in the browser to download the comprehensive update package for firmware and software.

2. Users need to place the update package in the LiMobileSystem folder in the root directory of the M2_SYS disk and insert the disk into the device.

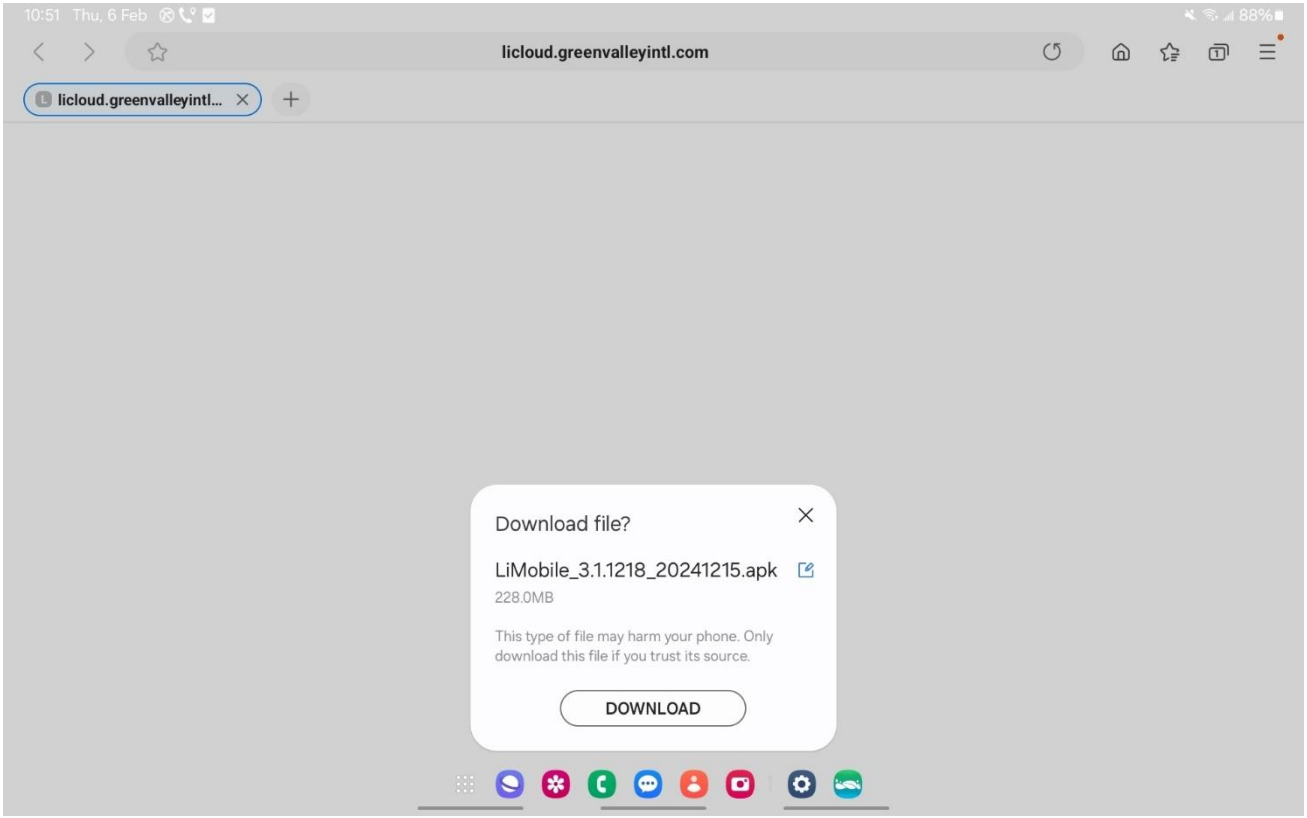
3. Open the APP and connect to the device, click the **Local update** button on the version number interface. The system will automatically start the update and will shut down automatically when completed, and the APP will prompt to restart.

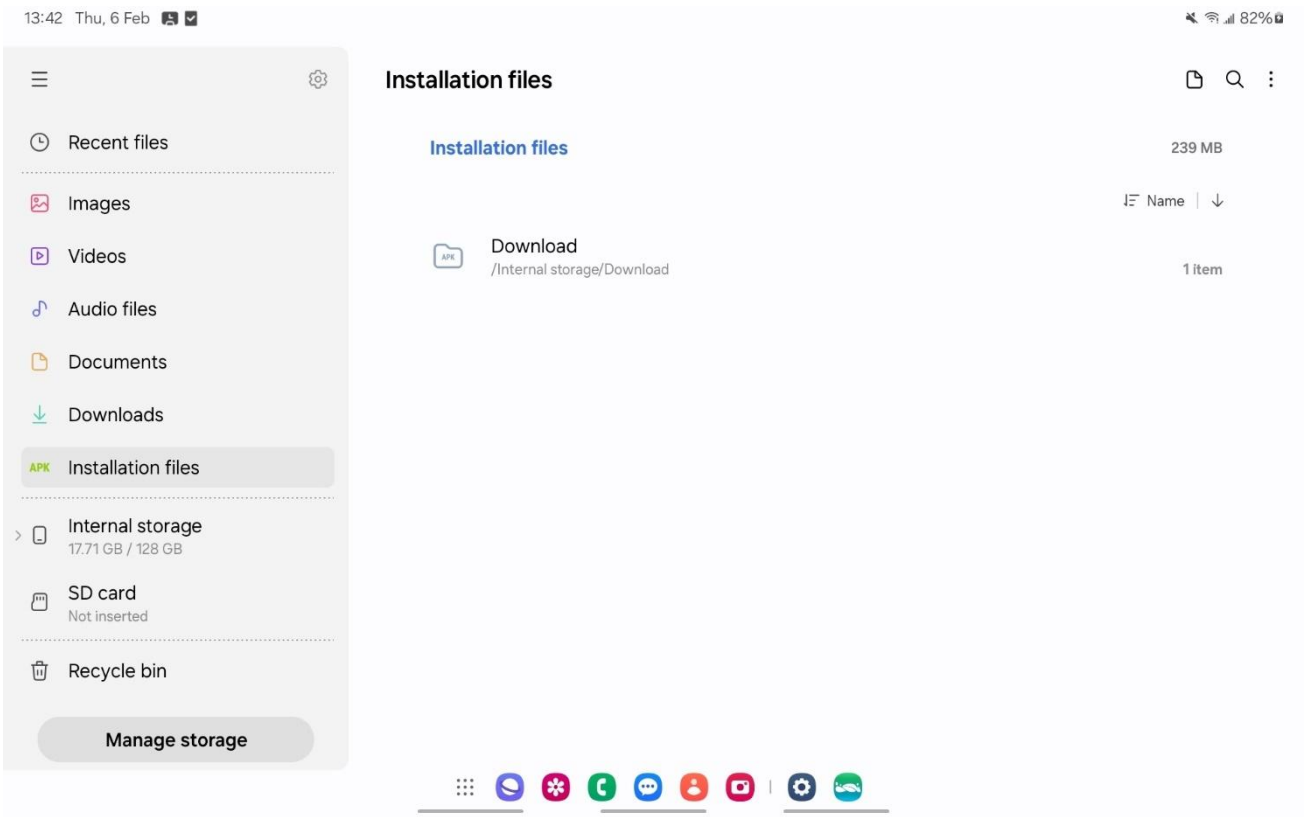


4. After waiting ten seconds, turn off the power and power on again. After waiting for about a minute and a half, the user starts the device again and opens the APP to check whether the version number of the configuration interface has been updated successfully.

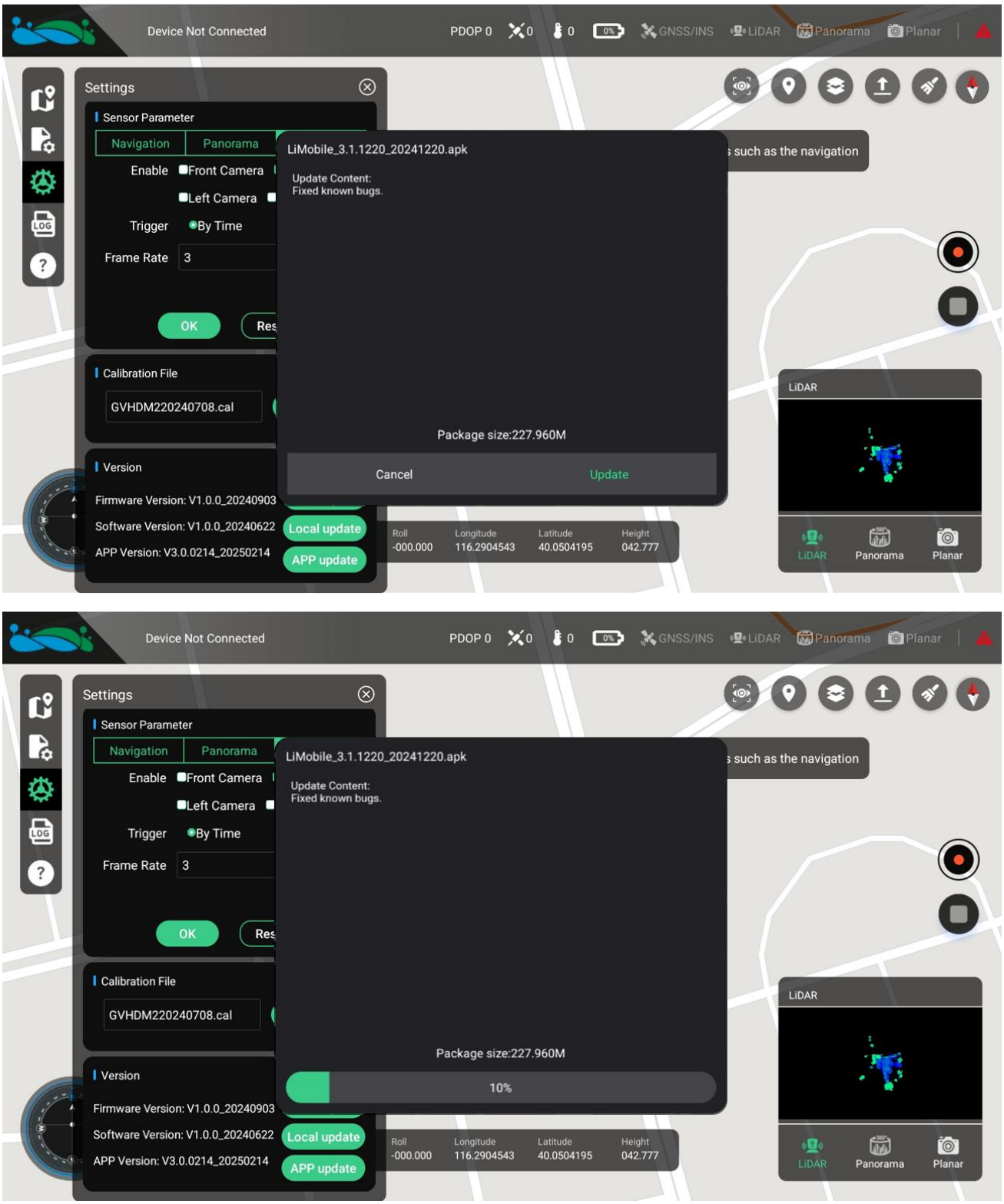
7.7.5 GreenValley APP Update

1. Use a tablet to scan the QR code , or enter the URL https://licloud.greenvalleyintl.com/api/v1/softwares/184/package in the browser and click the download button to download the APP installation package.

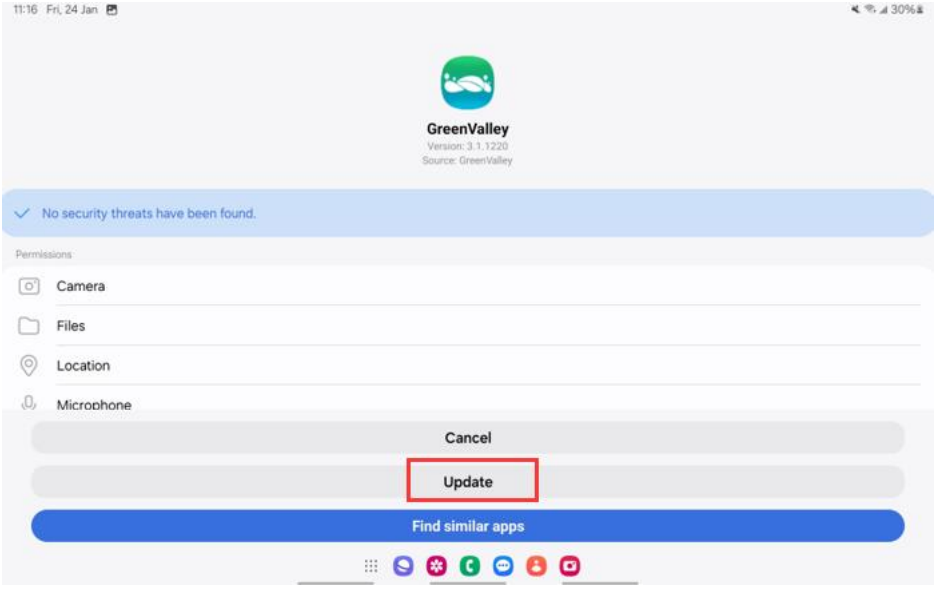




2. Open the APP and connect to the device, click the APP update button on the version number interface, the user can view the update information in the pop-up window, click the Update Now button, and the software will automatically start updating.



3. After the progress bar completes, the following interface will pop up. Click the **Update** button.



☆ Notes:

1.Uninstallation is required before installation.

2.The installation package name is LiMobile_3.x.xxxx_xxxxxxxx.apk.

3.Users should use the shipped tablet for APP upgrade installation. Our company will not be responsible for any collection issues caused by changing the collection mobile device.

4.After the APP is successfully installed, the first time it is launched, application permission prompts will appear. Users need to enable application permissions on the tablet.

8 Data Processing

8.1 Preparation

8.1.1 Hardware Preparation

The LiMobile M2 is equipped with two 1 TB data storage disks: **M2_SYS** and **M2_PANO**.

- M2_SYS Disk: Stores mobile station data, raw point cloud data, raw planar camera data, calibration files, system parameters, logs, etc.
- M2_PANO Disk: Stores raw data collected by the panoramic camera.

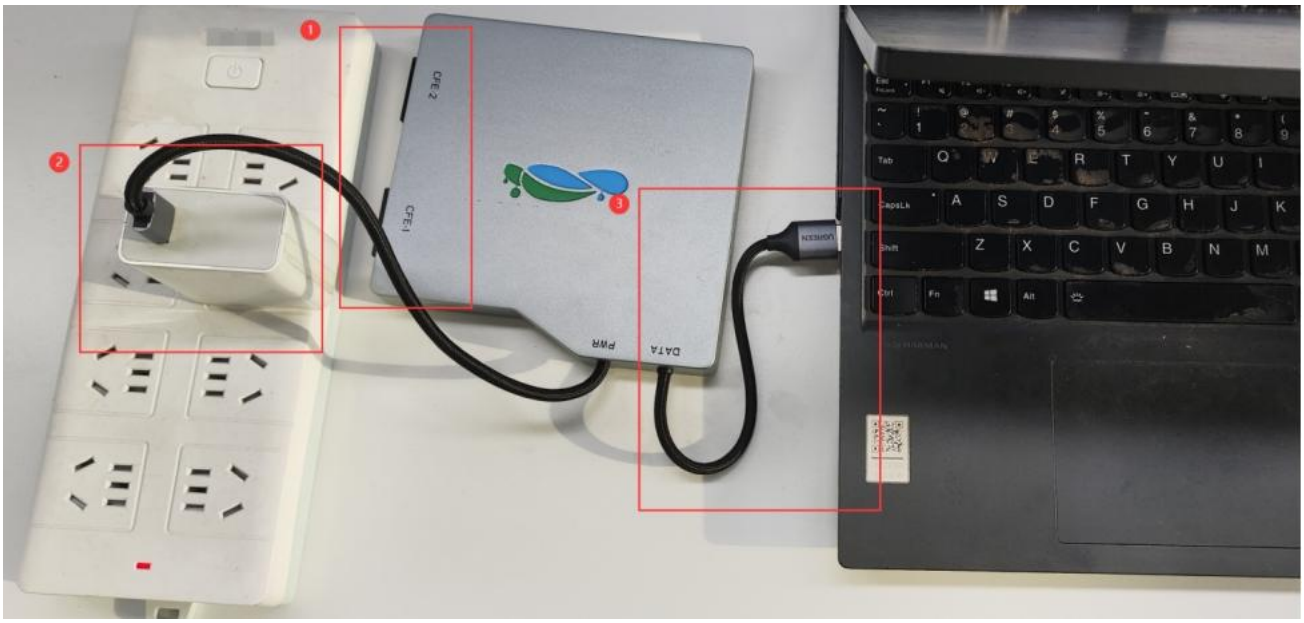
During LiMobile M2 data collection, a project folder with the same name is created in the data folder on both disks for data integration. The project folder name is the custom project name entered during data collection in the APP, followed by the UTC time.

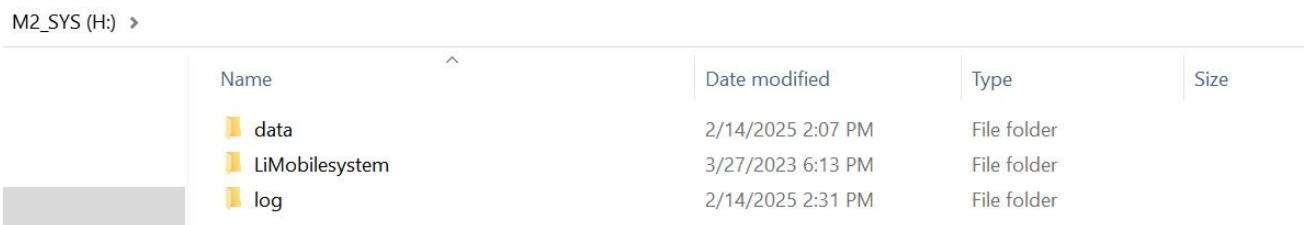
Before copying data and performing raw data quality check, connect the hardware as follows to allow the computer to recognize the M2_SYS and M2_PANO disks:

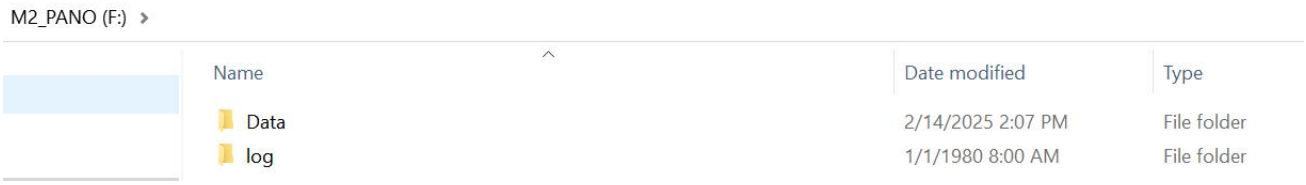
①Insert both disks into the card reader.

②Connect the power cable at the **PWR** port of the card reader to a power source.

③Connect the data cable at the **DATA** port of the card reader to the computer (preferably to a USB 3.0 port, usually
blue).





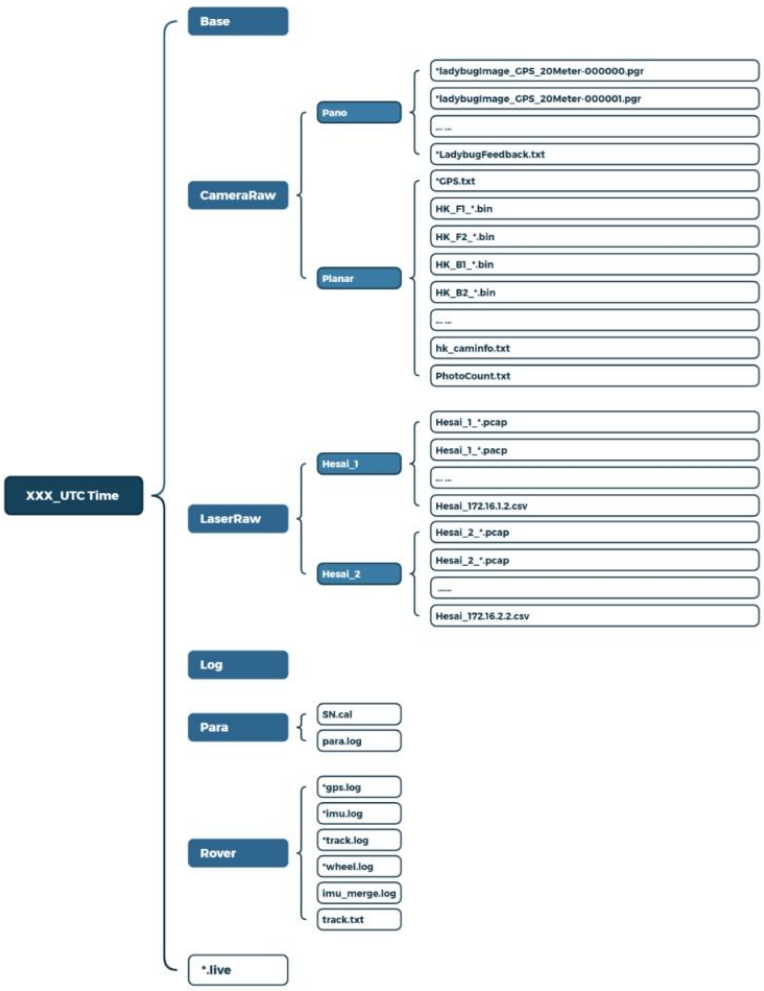


☆ Notes:

1. Ensure the correct orientation when inserting the disks.
2. Do not rename the project folder before completing data copying and merging to avoid errors.
3. Safely eject the disks from the computer after data copying to prevent damage.
4. Connect the card reader to a power source for stable data transfer.
5. Avoid processing raw data directly on the storage disks to prevent damage.
6. Copy the data twice: one copy for processing and one for archiving.
7. The charger plug is not included in the delivery; users must prepare it themselves.
8. After each data copy, promptly check the remaining disk space and clear the data as needed. Additionally, users should regularly and timely perform disk formatting operations. For specific steps, please refer to Attachment 2: "Disk Formatting Instructions".

8.1.2 Data Structure Overview

The complete data structure of LiMobile M2 is shown in the figure below.



The LiMobile M2 project folder contains six folders and a *.live file:

▪ Base: Empty by default. Users can manually copy base station data files here. The LiDAR360MLS software will automatically recognize them during preprocessing.

▪ CameraRaw: Stores image data collected by the cameras. Contains two subfolders:

▫ Pano: Stores raw panoramic camera data (*.pgr) and trigger feedback files.

▫ Planar: Stores raw planar camera data (*.bin), trigger feedback files, camera files, and photo count files (PhotoCount.txt).

▪ LaserRaw: Stores raw point cloud data (.pcap) and internal parameter files (.csv). Contains two subfolders:

▫ Hesai_1: Stores raw point cloud data from the tilted LiDAR, mainly for mapping.

▫ Hesai_2: Stores raw point cloud data from the horizontal LiDAR, mainly for SLAM trajectory optimization.

▪ Log: Stores device and sensor logs, data check files (dataCheck.txt), and valid trajectory truncation files (LiDeviceCheck.ini). Send this folder to technical support if data collection issues arise.

▪ Para: Stores calibration files (SN.cal) and sensor parameter logs (para.log).

▪ Rover: Stores mobile station data, including:

▫ * gps.log: GNSS data.

▫ * imu.log: IMU data.

▫ * track.log: Real-time GNSS data with latitude, longitude, and elevation.

▫ * wheel.log: DMI data.

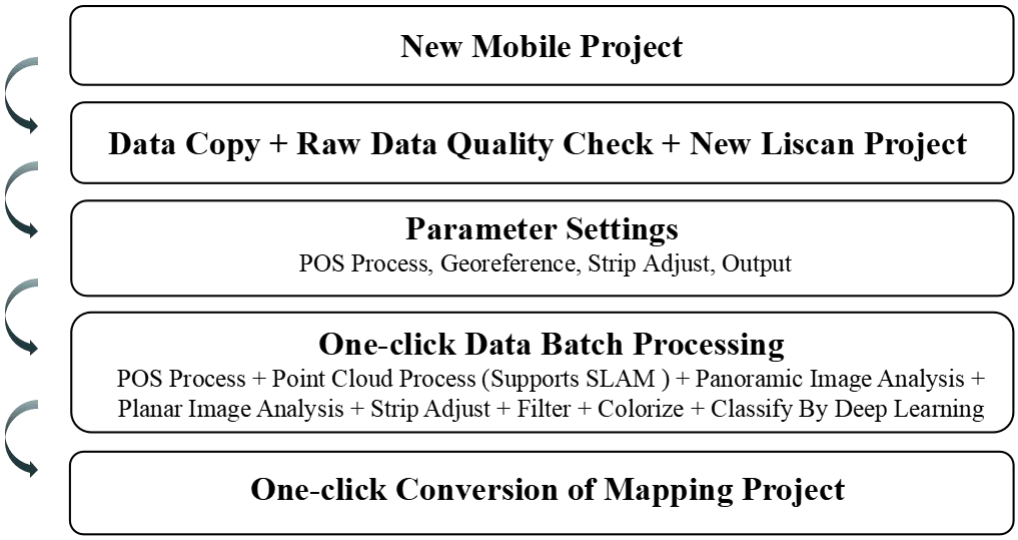
▫ imu_merge.log: Merged mobile station file from gps.log and imu.log, automatically recognized by LiDAR360MLS.

▫ track.txt: Used for trajectory replay in the APP.

▪ *.live file: Records device sensor models, calibration parameters, and file paths for quick new project.

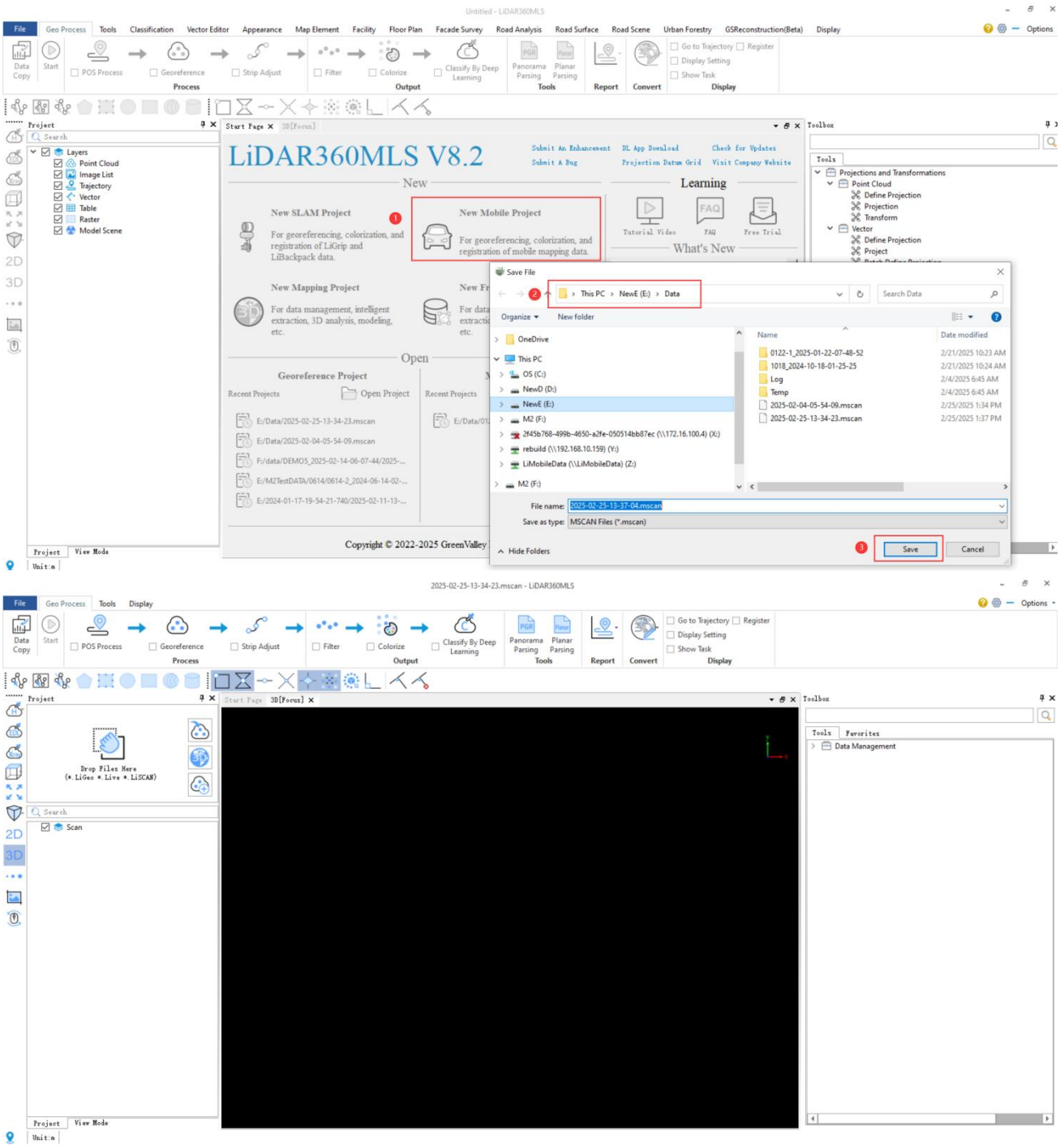
8.2 Data Processing and Output

This section provides a quick guide for data processing. For detailed parameter settings, refer to the LiDAR360MLS User Guide.



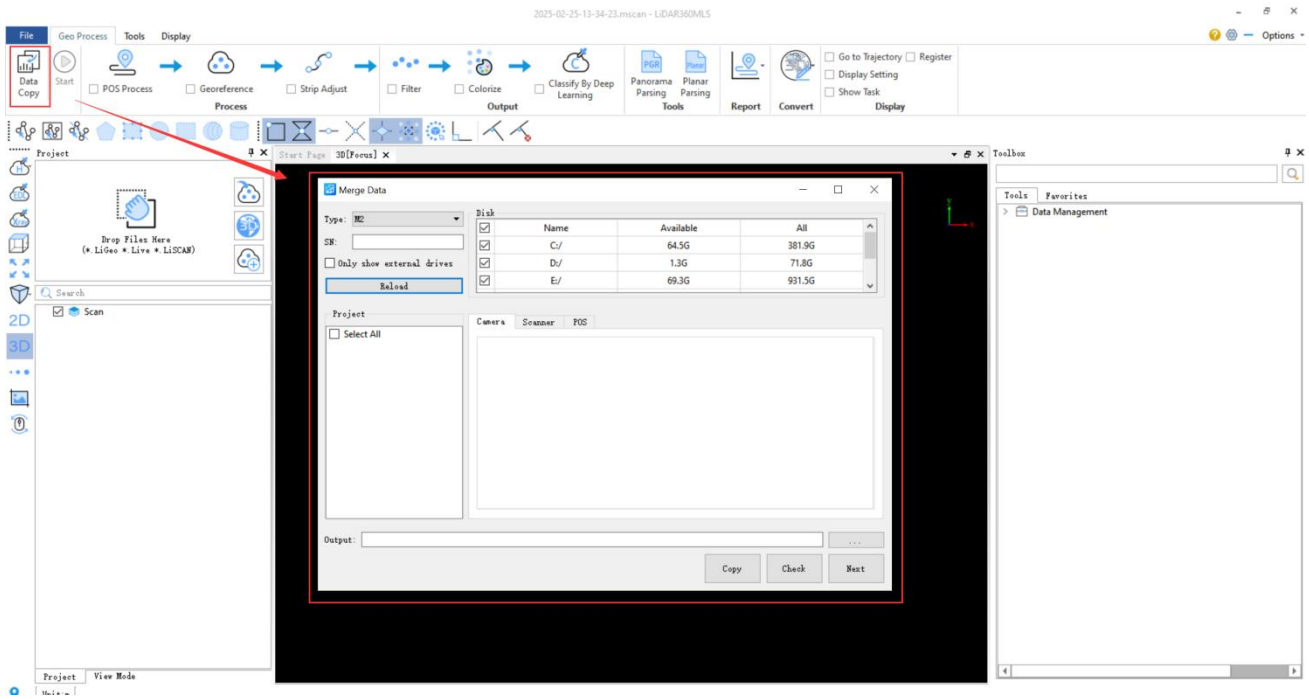
8.2.1 New Mobile Project

To improve data manageability and enable batch processing, create a mobile processing project (*.mscan) before data processing. Click the **New Mobile Project** button on the startup page, set the storage path, and save.



8.2.2 Data Copy and Quality Check

1. Click the **Data Copy** button in the top-left corner of the software interface to open the **Merge Data** dialog.



2. Follow these steps:

(1) Check **Only show external drives.**

(2) Select the disk drive corresponding to the device.

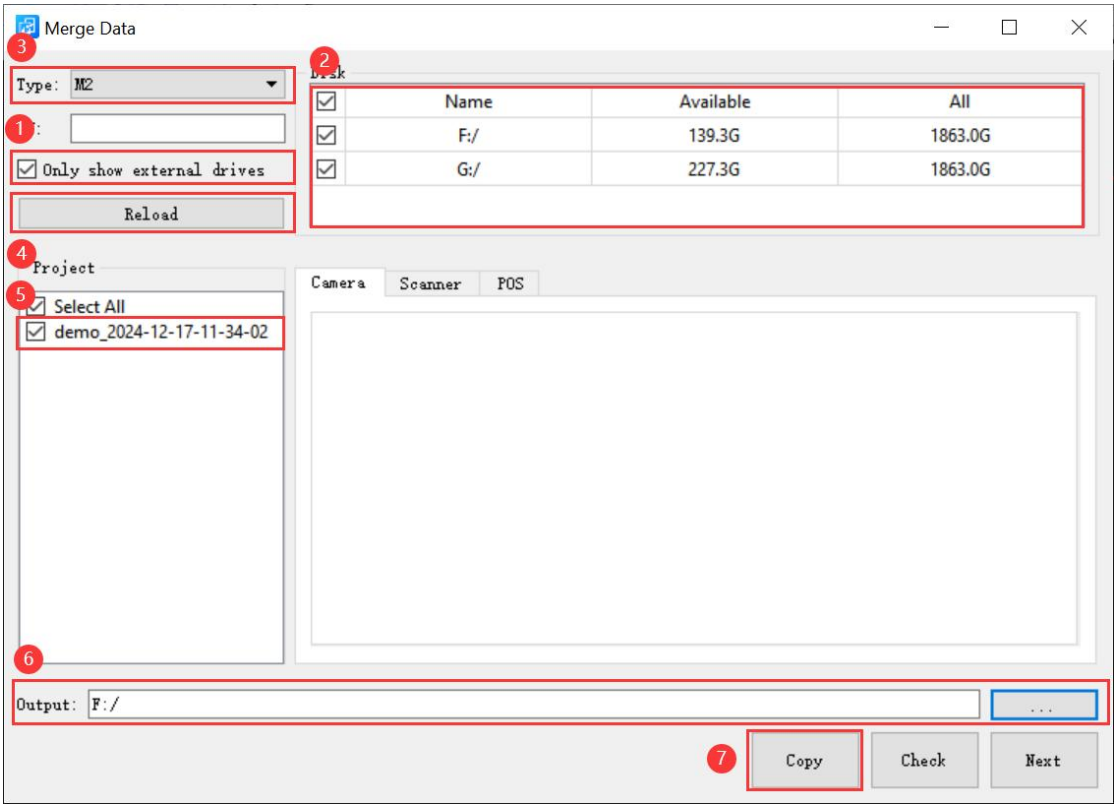
(3) Choose the device type.

(4) Click **Reload**.

(5) Select the data to copy.

(6) Set the output storage path.

(7) Click **Copy**.



3. After the copying process is completed, the software will generate a **Raw Data Quality Report** and save it in the corresponding project path. The report will also automatically pop up in the browser. If the data status is abnormal, please re-collect the data promptly.

demo_2024-12-17-11-34-02 › RawDataReport

Name	Date modified	Type	Size
2024-12-17-11-34-02.html	2/12/2025 6:24 PM	Chrome HTML Docu...	6 KB

Raw Data Quality Report

2025.02.11

GreenValley International

1. Project Summary:

Project Name	Collect Time (s)
demo_2025-01-24-03-46-25	120.089

2. Camera Statistics:

Camera	Number of Images	Number of Triggers	Deviation
Planar_F1	217	218	1
Planar_F2	217	218	1
Planar_B1	0	0	Unreadable
Planar_B2	0	0	Unreadable
Panorama	318	318	0

3. Scanner Statistics:

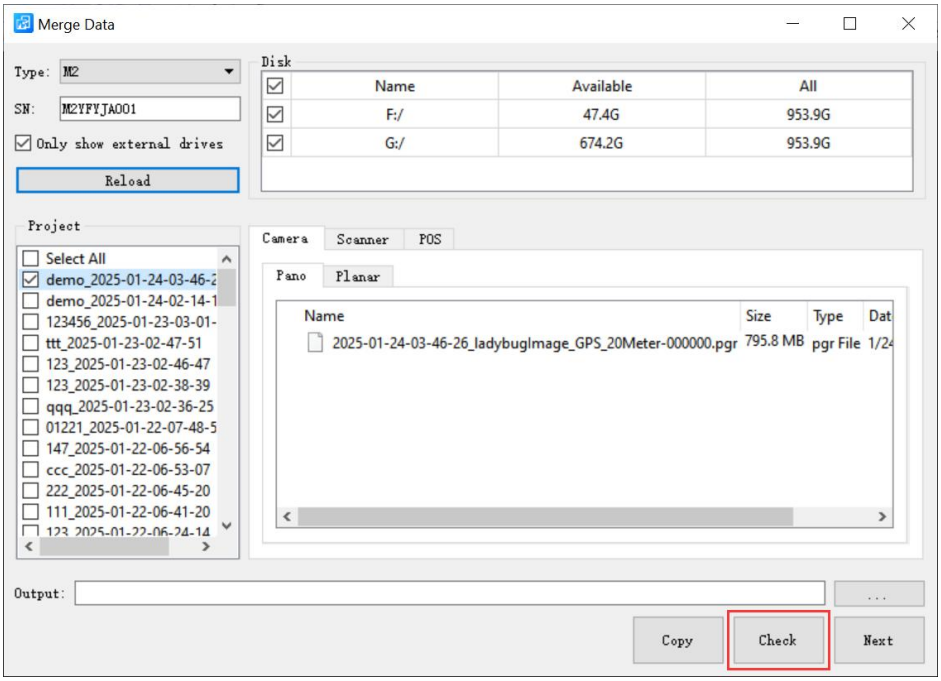
Scanner	LiDAR File	Start Time (UTC)	Stop Time (UTC)	Status
Scanner1	F:/test/demo/demo_2025-01-24-03-46-25/LaserRaw/Hesai_1/Hesai_1_2025-01-24-03-46-51-0.pcap	2025-01-24 03:46:51	2025-01-24 03:48:04	pass
Scanner2	F:/test/demo/demo_2025-01-24-03-46-25/LaserRaw/Hesai_2/Hesai_2_2025-01-24-03-46-51-0.pcap	2025-01-24 03:46:51	2025-01-24 03:48:04	pass

4. IMU Statistics:

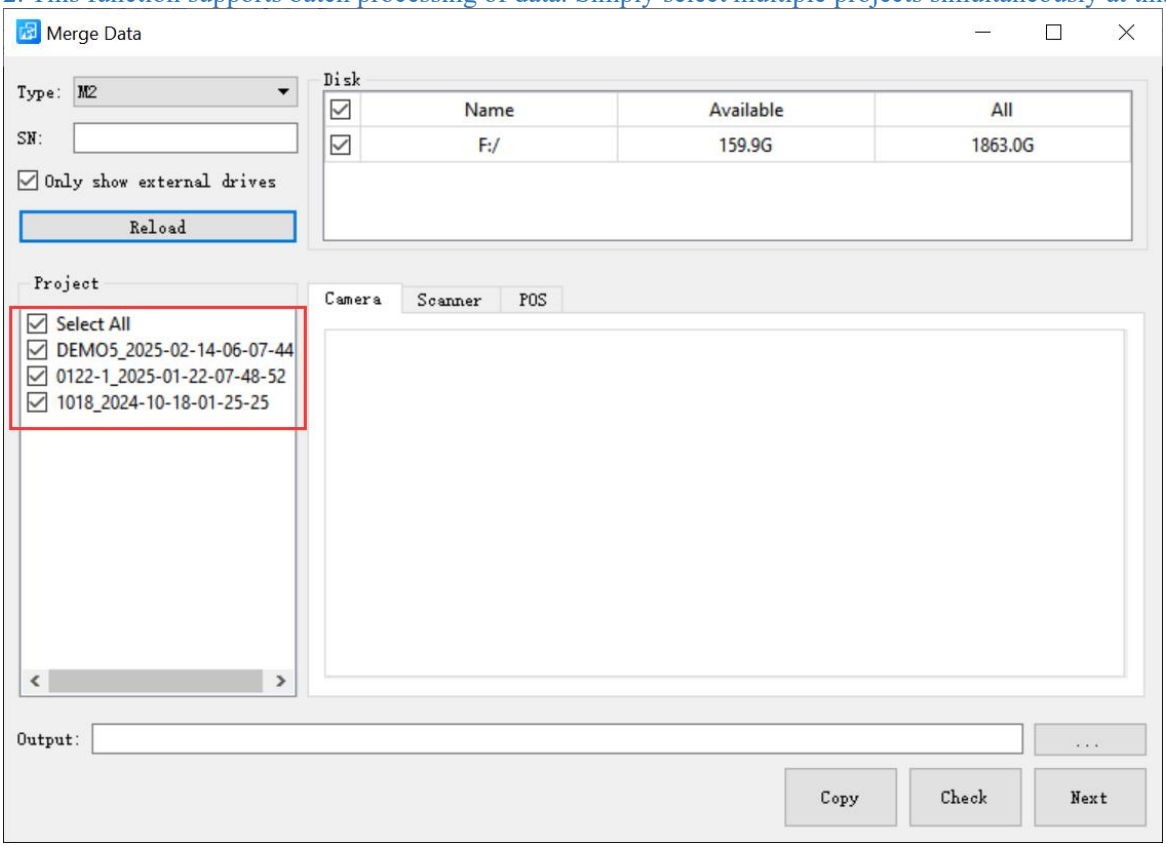
IMU File	Status
F:/test/demo/demo_2025-01-24-03-46-25/Rover/imu_merge.log	pass

☆ Notes:

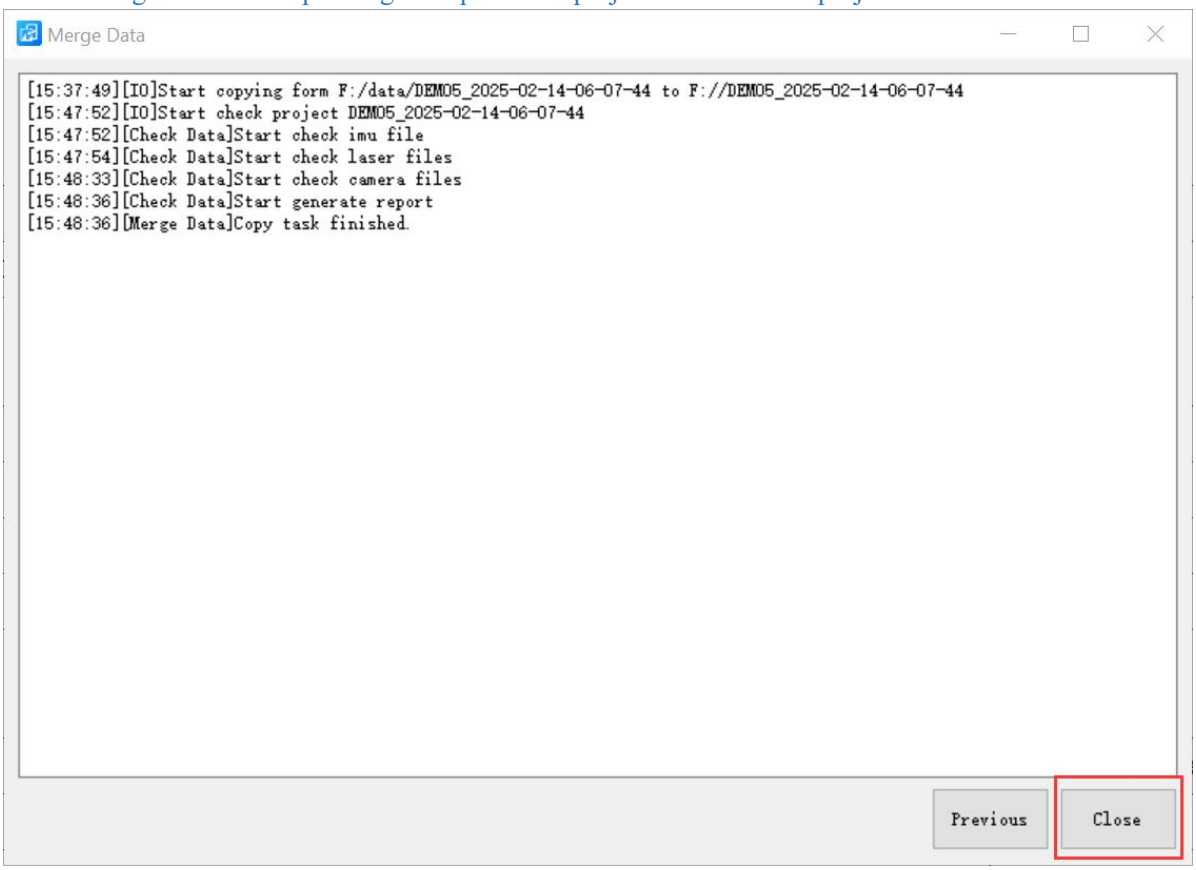
1. The data copying function also supports raw data quality checks without actually copying the data. The raw data quality report will be saved in the project path on the M2_SYS disk.

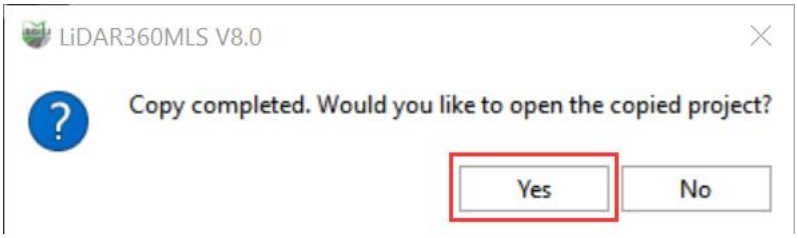


2. This function supports batch processing of data. Simply select multiple projects simultaneously at this step.

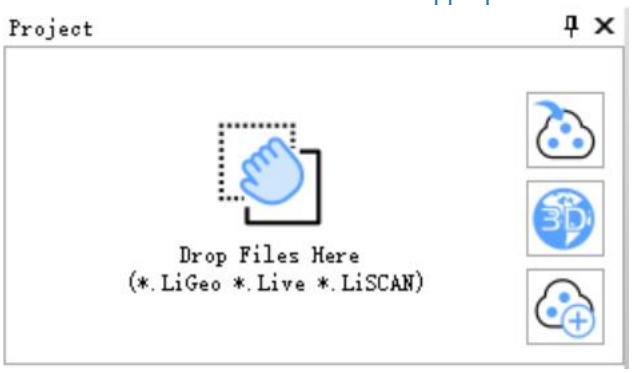


3. After the copying process is completed, clicking the **Close** button will bring up a dialog box. Clicking the **Yes** button will generate corresponding multiple liscan projects in the mscan project.



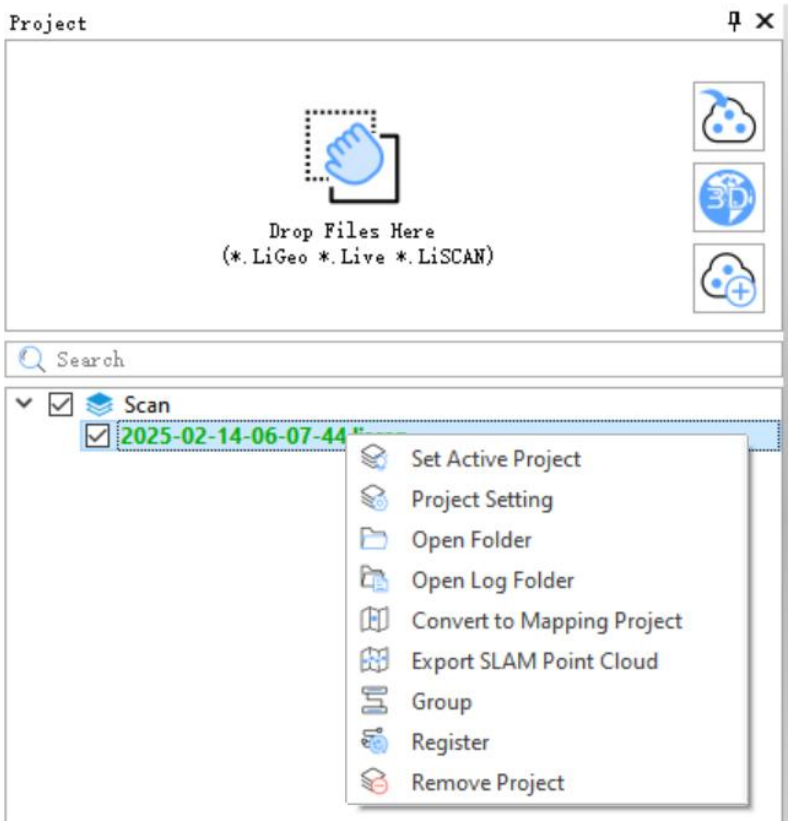


4. If the data copying function is not used, the software also provides multiple ways to create new liscan projects, including dragging and dropping *.live files, importing *.live files, adding existing data files, and creating based on calibration files. Users can choose the appropriate method according to their data situation.

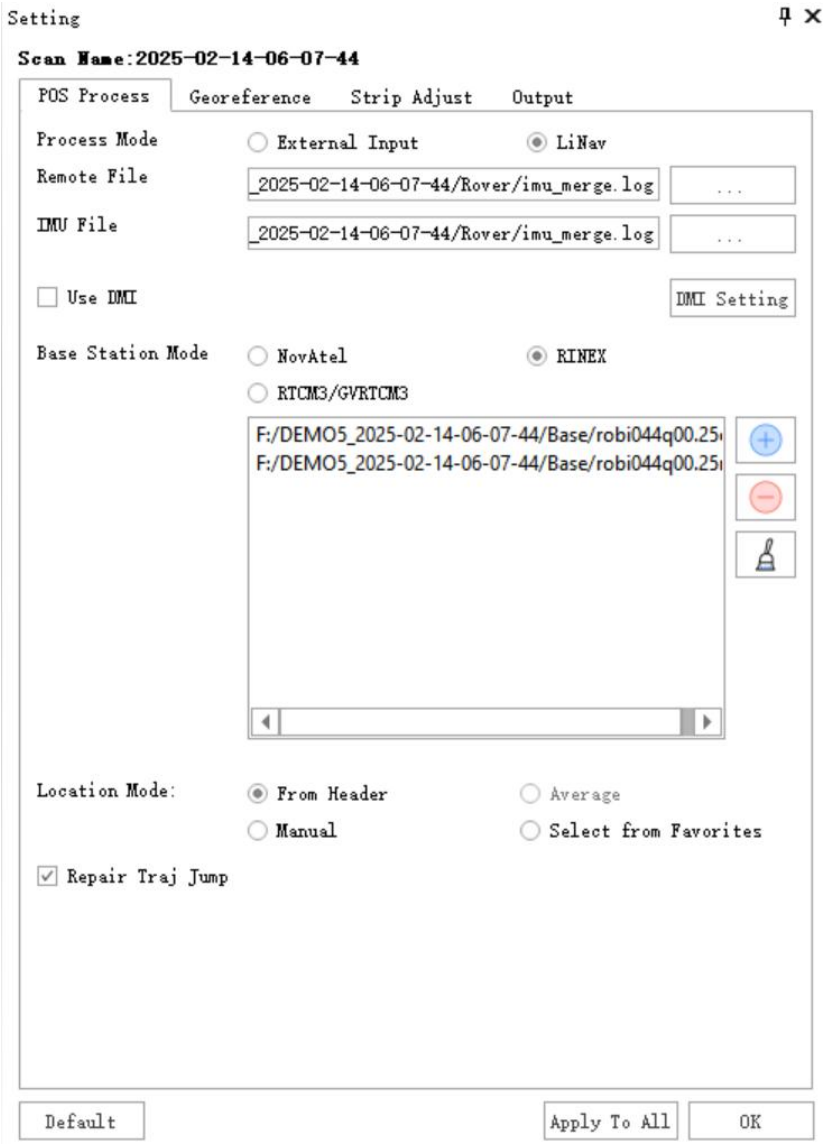


8.2.3 Parameter Settings

Before setting the parameters for the process steps on the right side of the interface, users need to activate the target project. In the directory tree of the project window, right-click on the *.liscan project name that requires parameter settings, and then click the **Set Active Project** button in the dropdown menu. The name of the project will be highlighted.

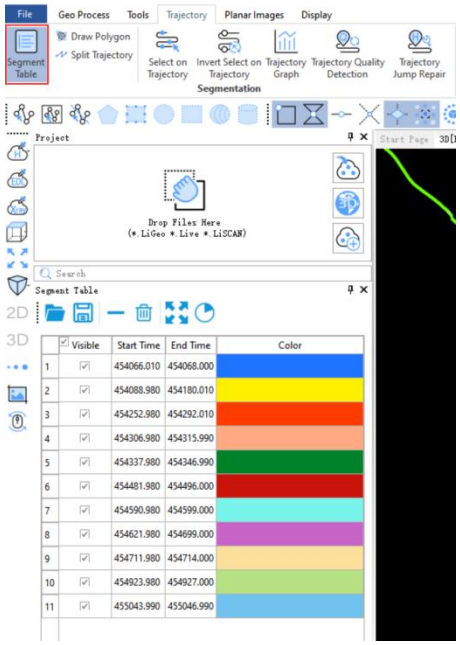


POS Process

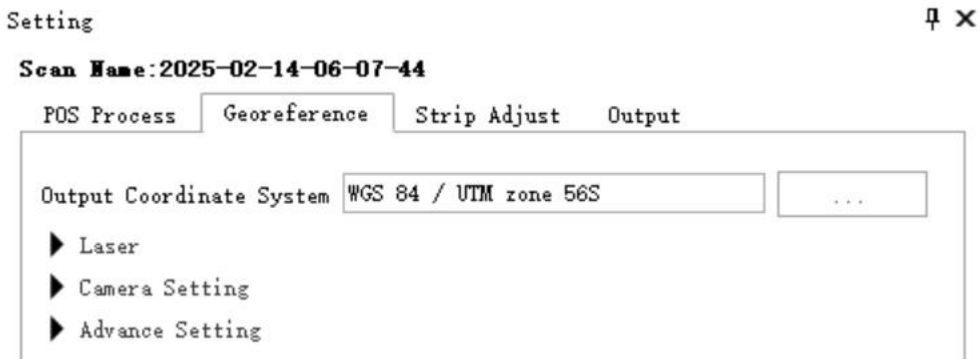


1. The software will automatically recognize the mobile station file and IMU file.
2. If a DMI is used, check the **Use DMI** option and click the **DMI Setting** button to set the parameters.
3. Add the base station file.
4. Select the **Location Mode**. The software supports two modes: automatic parsing from the data header and manual mode.
5. Repair Traj Jumps: Used to detect and repair trajectory segments with horizontal/elevation jumps. If unchecked, the software will only detect jump segments during the POS process step.

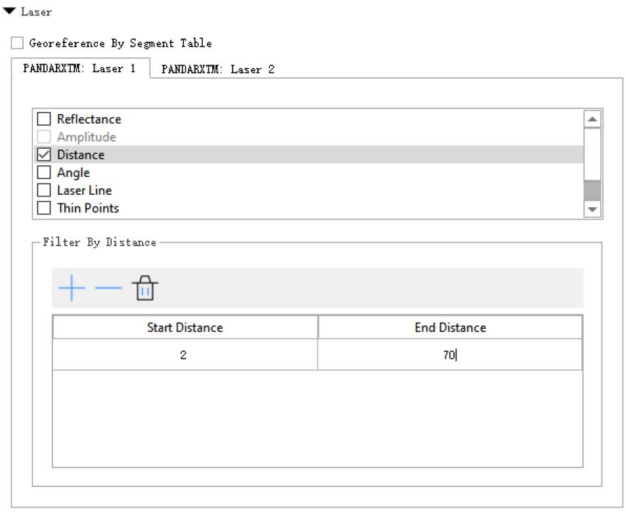
☆ Note: Users can view jump segments by clicking the trajectory segment table in the trajectory menu bar.

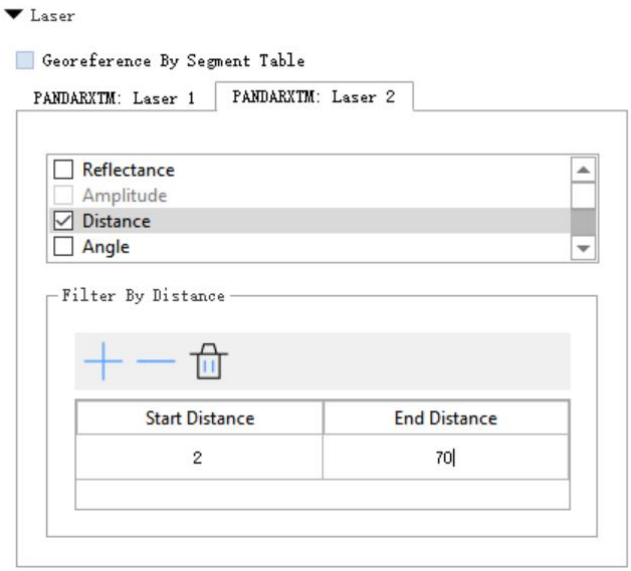


Georeference



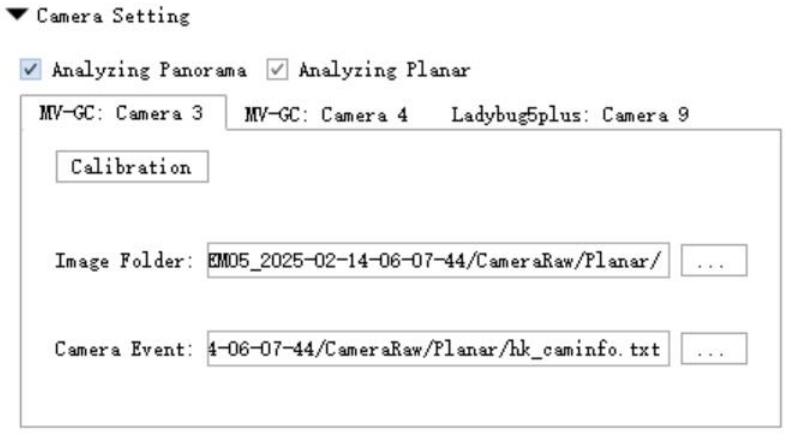
1. Output Coordinate System: Set the target coordinate system for the POS file imported or generated in the previous step. By default, the WGS 84 / UTM 6-degree zone coordinate system where the data was collected is recommended. Click the button on the right to edit.
2. Laser: Users need to set distance filtering parameters for both lasers separately. The starting distance is used to filter out the vehicle's shadow, and it is recommended to set it to 2.



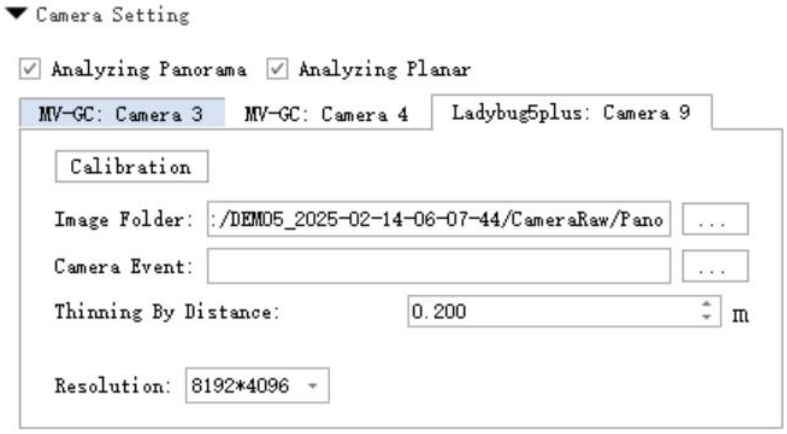


3. Camera Setting: Use the default parameters.

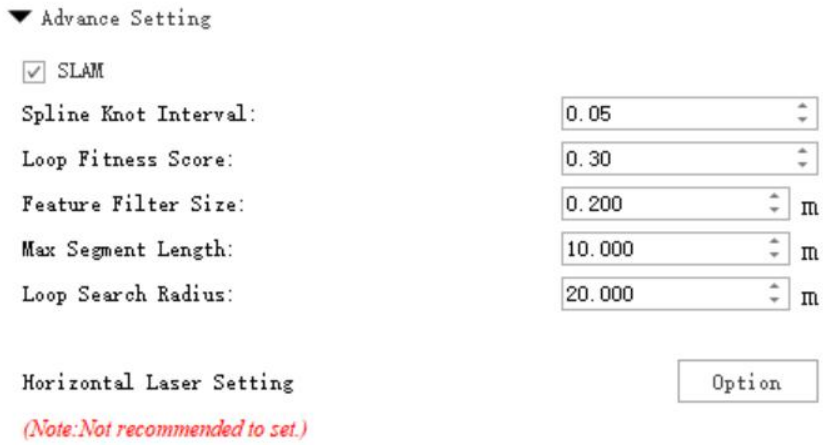
Planar Camera Settings: The software will automatically recognize the image folder and camera file. Check **Analyzing Planar** to enable the software to automatically parse planar camera data during the Georeference step.



Panoramic Camera Settings: Check **Analyzing Panoramic** to enable the software to parse panoramic images in parallel during the Georeference step. The original *.pgr format panoramic image data will be converted to *.jpg format, and a panoramic camera file (ladybug_caminfo.txt) will be generated for functions such as point cloud and panoramic image overlay display and colorization.



4. Advanced Settings: Used for SLAM process. The default parameters are recommended.



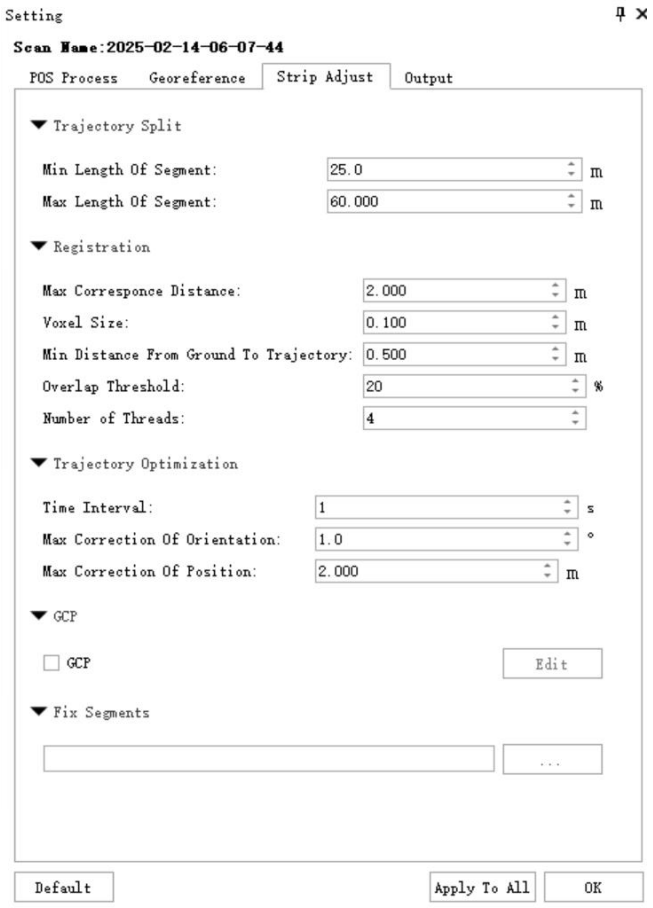
☆ Notes：

1. Usage scenario: Vehicle mounted SLAM point cloud calculation is used to assist in the calculation of point clouds for integrated navigation. In response to the problem of insufficient accuracy in integrated navigation calculation caused by GNSS signal obstruction environments such as urban canyons, dense tree lined roads, and underground parking lots, SLAM and integrated navigation pose fusion algorithm are adopted to optimize the pose calculation accuracy in satellite signal obstruction environments, thereby improving the accuracy of point cloud calculation. It should be noted that SLAM only optimizes the trajectory segments selected by the user and automatically detects low-quality trajectory segments after trajectory calculation. Users can add or delete other low-quality trajectory segments based on this.

2. Attention: The accuracy of SLAM is greatly affected by environmental features. In environments with sparse features or a large number of dynamic targets, it is easy to encounter problems such as pose estimation drift or error accumulation. Therefore, it is recommended to avoid selecting certain open scenes (such as highways, elevated bridges, etc.) for calculation. If the engineering collection scene is completely open, it is not recommended to check the SLAM option, otherwise it may reduce the accuracy of point cloud calculation. The SLAM algorithm has a high demand for computing resources, especially in large-scale environments where real-time mapping and localization have a high computational complexity, which may affect the solution speed.

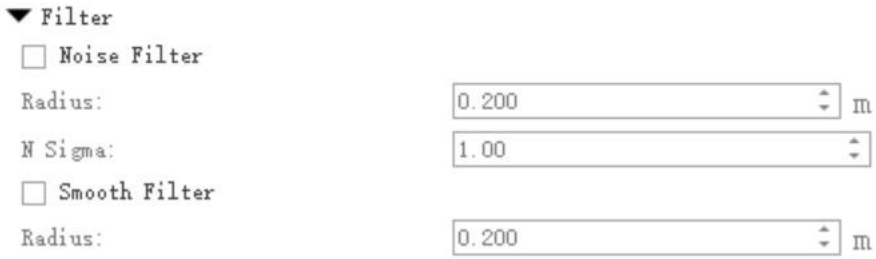
Strip Adjust

The default parameter settings can be used, and users can customize the fixed segments for Strip Adjust. Checking the **GCP** option allows control points to participate in **Strip Adjust**. Users need to click the **Edit** button to edit the control points.

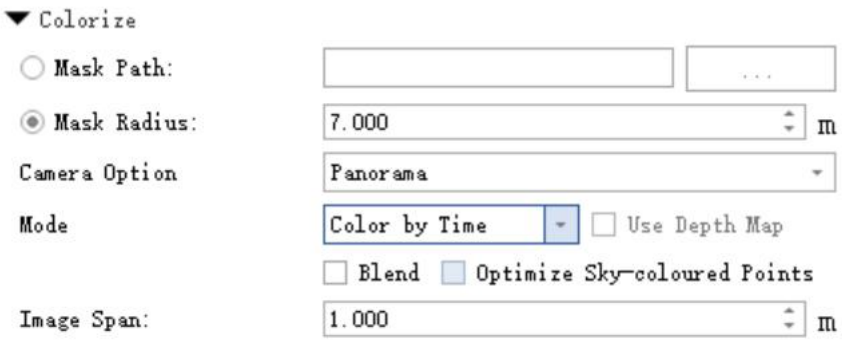


Output

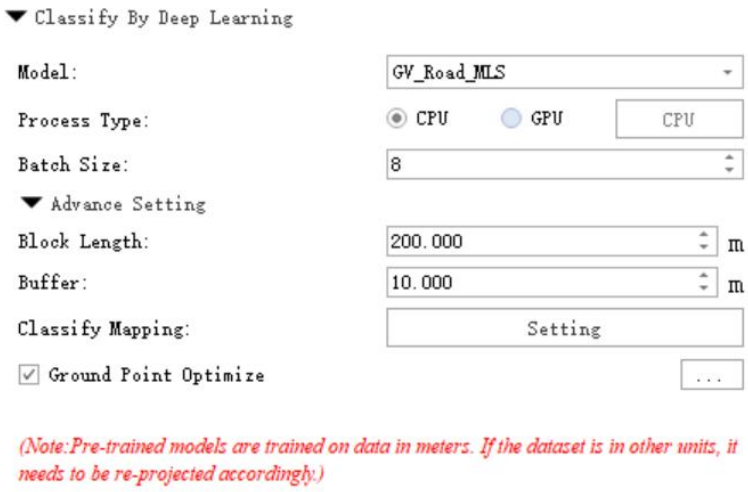
1. Filtering: Users can optionally enable **Noise Filter** and **Smooth Filter**. It is recommended to use the default parameters.



2. Colorize: Supports user-defined addition of mask files (refer to Appendix 7 "Mask File Creation Tutorial") or selection of a preset mask radius mode. It offers two color assignment modes: Color by Time and Color by Distance, with the Color by Time mode being recommended. The feature also supports Blend and Optimize Sky-coloured Points functions.



3. Classify By Deep Learning: Select the GV_Road_MLS mode. Supports both CPU and GPU processing types. When using GPU for computation, it is not recommended to set the batch size too large.



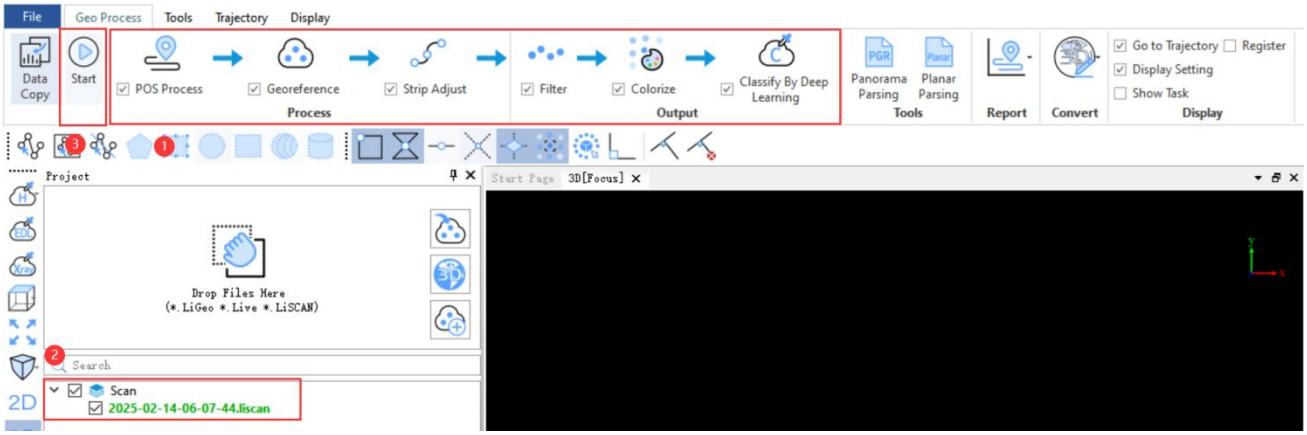
8.2.4 One-Click Batch Data Processing

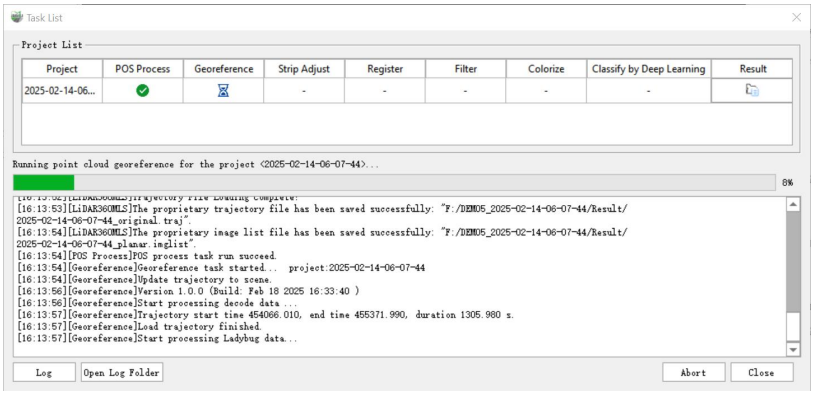
The specific steps are as follows:

(1) In the directory tree on the left side of the interface, check the *.liscan projects that need to be processed.

(2) Select the processing steps to be performed.

(3) Click the **Start** button. The software interface will automatically pop up the B**atch Processing - Project List** window and begin executing the selected processing steps. Users can click the right side of the pop-up window to view the result data.





The software supports the following processing steps for one-click batch data processing:

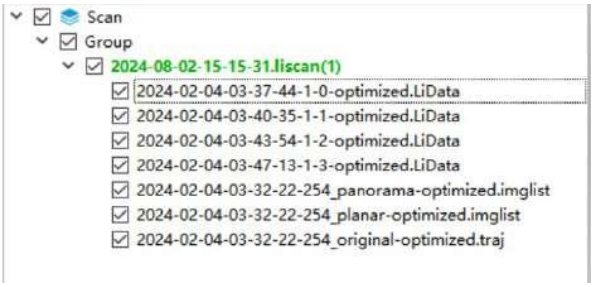
POS Process: Post-processes the original POS file to obtain high-precision POS data. This step will automatically perform a base station check. If users import external POS data, this step can be skipped.

Georeference: Processes the original point cloud data to obtain a high-precision point cloud with real geographic coordinates. This step also analyses planar image data and panoramic image data simultaneously. SLAM process can also be performed in this step.

Strip Adjust: Supports internal adjustment of point cloud revisit areas for single-project data; supports adjustment for multiple projects to reduce stratification errors in revisit areas; and supports the participation of control points in the adjustment.

☆ Notes:

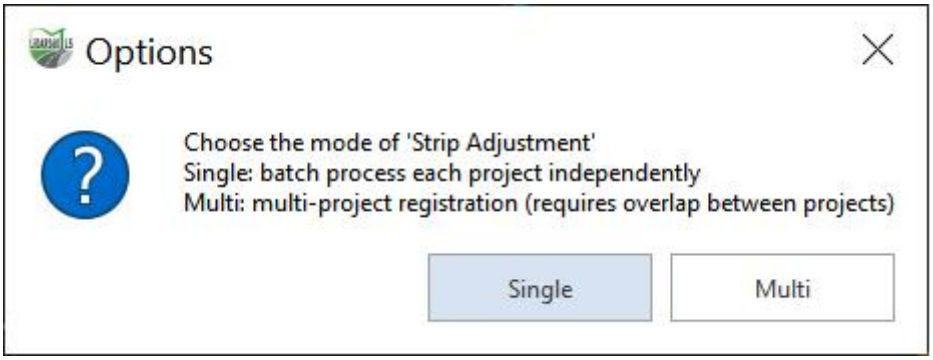
1. This step will regenerate point cloud, trajectory, and image data.



2. Strip alignment has two modes: **Single** and **Multi**.

Single: Each liscan project performs internal strip adjusting operations separately.

Multi: Not only each liscan project performs internal strip adjusting operations separately, but also strip adjusting operations are performed between liscan projects.



Filter: Used to filter noise in the point cloud and thin the point cloud.

Colorize: Assigns color information to the point cloud based on the point cloud and images.

Classify By Deep Learning: Uses deep learning methods to classify point cloud data. (This feature is not included as a complimentary function with the purchase of the device. If needed, please contact our company for additional purchase authorization.)

☆ Notes:

1. Prior to point cloud process, it is necessary to generate a trajectory first. Therefore, the Georeference button will only be activated after the POS Process is checked; once Georeference is checked, the Strip Adjust and subsequent buttons will be activated.

2. After point cloud process, if the camera images have not been parsed, the Colorize step cannot be selected.

3. If only the point cloud needs to be obtained, select POS Process and Georeference will be sufficient.

4. The data collected in GNSS signal obstructed environments such as urban canyons and dense tree lined roads may exhibit layering. If better quality point cloud data is needed, it is recommended to check the option of Strip

Adjust. However, this step is slow and should be carefully checked.

5. It is not recommended to check the option of 'Strip Adjust' for data collected in open areas.

6. The filtering option can be used to denoise and thin point clouds, but this step is time-consuming and should be carefully checked.

7. To obtain colored point cloud output, you need to check the Colorize step.

8. The Optimize sky-colored points option is time-consuming and is only supported for color assignment based on panoramic images.

9. To obtain point cloud with classification information, you need to check the Classify by Deep Learning.

10. If any issues or anomalies arise during data process, please click to open the log folder, and send the log files along with screenshots of the software's abnormal behavior to our technical support team, providing as detailed a description of the operating steps as possible.

8.2.4 Convert to Mapping Project

LiDAR360MLS software supports two modes for converting mobile projects into mapping projects: Convert to Mapping Project and Organize into Mapping Project.

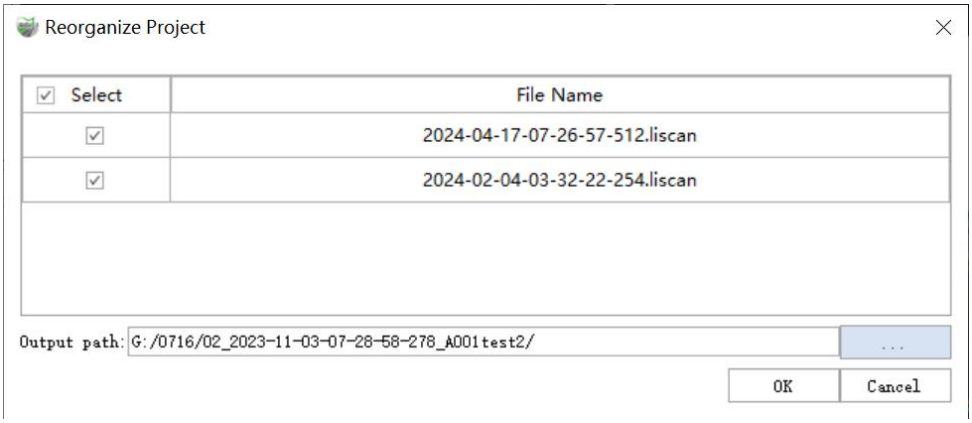
Convert to Mapping Project: Convert the single activated *.liscan project into a mapping project to facilitate subsequent data post-processing operations.

1. Activate the *.liscan project that needs to be converted into a mapping project.
2. In the Convert panel, click the dropdown arrow next to the button icon, and then click the Convert to Mapping Project button. The software will automatically switch to the mapping project interface.

Organize into Mapping Project: Converts multiple *.liscan projects into a mapping project simultaneously.

1. In the Convert panel, click the dropdown arrow next to the button icon, and then click the Organize into Mapping Project button.

2. **Reorganize Project** dialog box will appear, allowing users to configure parameters. Please select at least two sets of liscan projects that need to be converted and set the output path.
3. Click the **OK** button, and the software will switch to the mapping project interface.



9 Equipment Maintenance Instructions

9.1Equipment Cleaning

The equipment should be cleaned regularly (3-5 days) using a cleaning kit.
Before starting the cleaning operation, ensure that the scanning system is turned off and the power is turned off.
Never touch the camera lens or the lidar protective glass directly with your hands.
Must wash your hands before cleaning to prevent stains on your hands from getting on the lens cleaning cloth or wiping paper.
Choose a place with less dust and use a mini clean air blower to blow away dust on the laser head, camera lens, and device body.
Do not use air from the pneumatic system to clean the lens, as it contains a trace of oil. Use the provided professional lens cleaning air blower to clean the lens.
Use the brush end of the lens end to remove dust from the laser head, camera lens, and gaps.
Please only use a dedicated lens cleaning cloth or lens cleaning wipes to gently wipe the LiDAR protective glass. Wipe in a circular motion from the inside out, avoiding excessive force.
Do not use alcohol or other corrosive liquids to wipe the device to avoid damage to the device.
A soft cloth can be used to clean the device housing and tablet screen.

9.2 Equipment Transportation

During transportation and use, the device should be handled with care to avoid soiling and scratching its surface. Staff should not sit on the device and packaging box.
The instrument is a precision instrument. Avoid violent impacts during transportation and handling to avoid damage to the optical components in the instrument or deviation from the direction.
When transporting this device in the field, ensure that the product is placed in the original equipment box.
Do not transport this product in a road vehicle in a scattered manner, as it may be subjected to shock and vibration.
For products that do not have an equipment box to be placed, use equivalent packaging and affix labels such as "precision instrument", "handle with care", and "fragile" on the outside of the box to avoid damage to the equipment.
If the equipment is carried and transported by staff, avoid damage due to improper handling. The staff should be informed that the equipment is a precision instrument and should be handled with care. It must be placed carefully when carrying the equipment in a car, and the equipment must not be subject to shock without supervision.
If the device is transported by express delivery, the device box needs to be additionally shockproof (such as filling with shock-absorbing cotton or foam), and a small amount of insurance should be purchased and marked as fragile.
The battery should be discharged to the storage level when transporting, and the battery must be properly protected during transportation to avoid collision, extrusion or puncture.
Before taking the battery on the flight, ensure that it is discharged to less than 5% power.

9.3 Equipment Storage

The storage temperature range for the device is -10℃-50℃. Please store it according to the temperature range.
Before storage, ensure that all power is turned off, and store the device and accessories neatly in the original device box. Do not stack them.
Please place the device in a clean, ventilated and dry place to avoid condensation inside the components causing short circuits and damaging the instrument when it is turned on for use.
When the device is transferred from a cold environment to a warm environment, water vapor may condense on the components of the device. To avoid this, place the device in a sealed plastic bag before transferring it. Wait until the temperature of the device is basically the same as the outside temperature and the condensation has played out before turning on the device.
If the device is installed on a vehicle and stored outdoors, cover the device with a protective cover when not in use to prevent dust and water accumulation on the lens.
Batteries should be stored in a well-ventilated, dry and cool place, and avoid storage or display in direct sunlight or places exposed to rain. High temperature will damage battery performance; high humidity may cause gradual corrosion of the battery surface; exposure to rain can reduce resistance, and may cause self-discharge and rust.
Batteries that have been soaked or dampened must be dried before storage and use.
Please avoid keeping the tablet in a low-power state for extended periods. It is necessary to charge the tablet regularly.
Do not stack batteries randomly to avoid short circuits and damage.
Do not store batteries for a long time after they are completely discharged to avoid over-discharge of the batteries, causing damage to the battery cells and making them unusable. Please discharge the batteries to 40%-65% for storage to extend the battery life.
It is not recommended to store the batteries for a long time when fully charged, as this may cause sudden discharge of the batteries, thereby damaging the batteries.
Recharge and discharge the batteries every 3 months or so to keep the batteries active.
Please ensure that the battery is charged using the matching battery charger provided with the equipment. Do not use any other charger arbitrarily.
If the battery cannot be charged (e.g., the light does not flash during charging), press and hold the button for 10 seconds to initiate charging. After charging is complete, press and hold the button for another 10 seconds.
For additional detailed precautions regarding the battery, please refer to Attachment 4: "B60 Battery Safety Usage Guidelines".

9.4 Maintenance

Regularly check and maintain the equipment, including its appearance and other components.
When the equipment structure is loose or disassembled, the equipment parameters should be recalibrated.
Product calibration must be performed by the after-sales department of GVI, and it is recommended to calibrate the equipment every 12 months. Users can collect calibration field data for feedback, and our technical support will update the calibration file parameters. For detailed steps, please refer to Attachment 5: "Equipment Calibration Field Data Collection Specifications".
If there are any problems with the equipment, please contact our technical support personnel in time for processing.
Users are prohibited from disassembling the equipment by themselves. If you encounter any problems during this process, please contact our technical support personnel in time and inform the details truthfully.

10 Appendix

Attachment 1 FAQ

★ Data Collection

1. Key Precautions for Data Collection
Solution:
1. For driving safety, it is not recommended to use the device in weather conditions such as rain, snow, or fog. Additionally, point cloud data may contain more noise under such conditions.
2. Strictly adhere to the operational guidelines mentioned in the manual.
3. Plan the route reasonably by referring to street view maps, and conduct on-site surveys if necessary. Pay attention to height restrictions.
4. Ensure the base station is set up before data collection.
5. Perform IMU Alignment strictly before and after data collection.
6. Check if the battery level is sufficient. Replace the battery promptly if it is low.
7. Monitor the remaining battery level and disk storage space during collection.
8. Avoid reversing and sudden braking during data collection.
9. Do not unplug any components, such as disks, while the device is powered on.
10. Do not process data directly on the data collection disk.
11. Do not turn off the power directly. Shut down the device properly before cutting off the power to avoid data
loss.
12. Ensure data collection lasts more than 10 minutes to guarantee post-processing POS accuracy. Wait for more
than 3 minutes after initialization before collecting data. Within a dataset, the vehicle speed should exceed 10 m/s (36 km/h) for at least one minute, and there should be at least three turns greater than 45 degrees (to ensure attitude convergence accuracy).
13. Ensure all screws or knobs are tightened during installation to keep the device stable.

2. How to Update Calibration Files?
Solution:
Refer to Section 7.7.3 of the user manual for detailed steps.

3. How to Update Device Firmware and Software?
Solution:
The device supports both local and online updates. Refer to Section 7.7.4 of the User Guide for detailed steps.

4. Power Indicator Does Not Light Up After Powering On.
Solution:
1. Check if the power cable is connected correctly.
2. If the device is operational and data collection is normal, the indicator light may be faulty.
3. If the device is not working, try restarting it.

4. If the issue persists, contact our technical support for remote troubleshooting.

5. After the Tablet is Turned On, the Device's Wi-Fi Signal Cannot Be Searched or the Wi-Fi Signal is Constantly Interrupted During Collection.

Solution:

1. Check if the Wi-Fi antenna is installed correctly.
2. The battery box routing module may occasionally start slowly. Please wait patiently.
3. Check if the battery box Wi-Fi signal indicator is flashing. If it is flashing but the signal is still not detected, restart the device and try again.
4. It is recommended that users place the battery box in the back seat of the collection vehicle to minimize the distance between the battery box and the tablet computer.
5. If the issue persists, contact our technical support for remote troubleshooting.
6. Do not press the reset button on the battery box, as this will require reconfiguring the router. If the reset button is accidentally pressed, contact our staff for router configuration.

6. Why Do LiDAR, Panoramic Camera, and Planar Camera Show Out-of-Sync Status?

Solution:

1. Check the camera activation status in the APP configuration interface.
2. Check the camera trigger mode in the APP configuration interface. If the camera is set to distance trigger mode, the camera will only sync after the vehicle has traveled a certain distance to receive the pulse signal from the wheel speed sensor.
3. If the issue persists, contact our technical support for remote troubleshooting.

7. How to Resolve "Failed to Create New Project" During Collection?

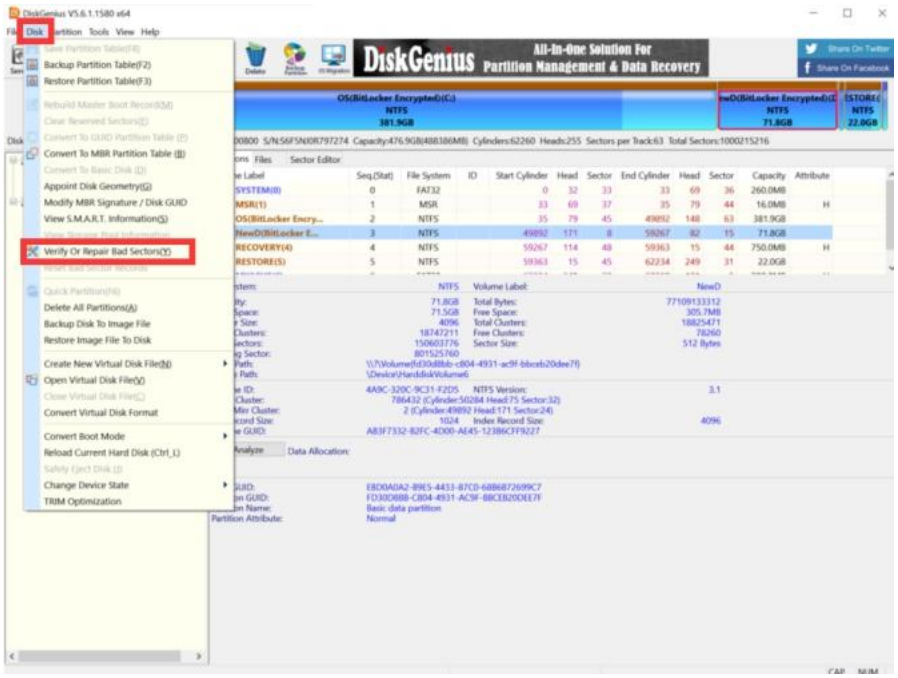
Solution:

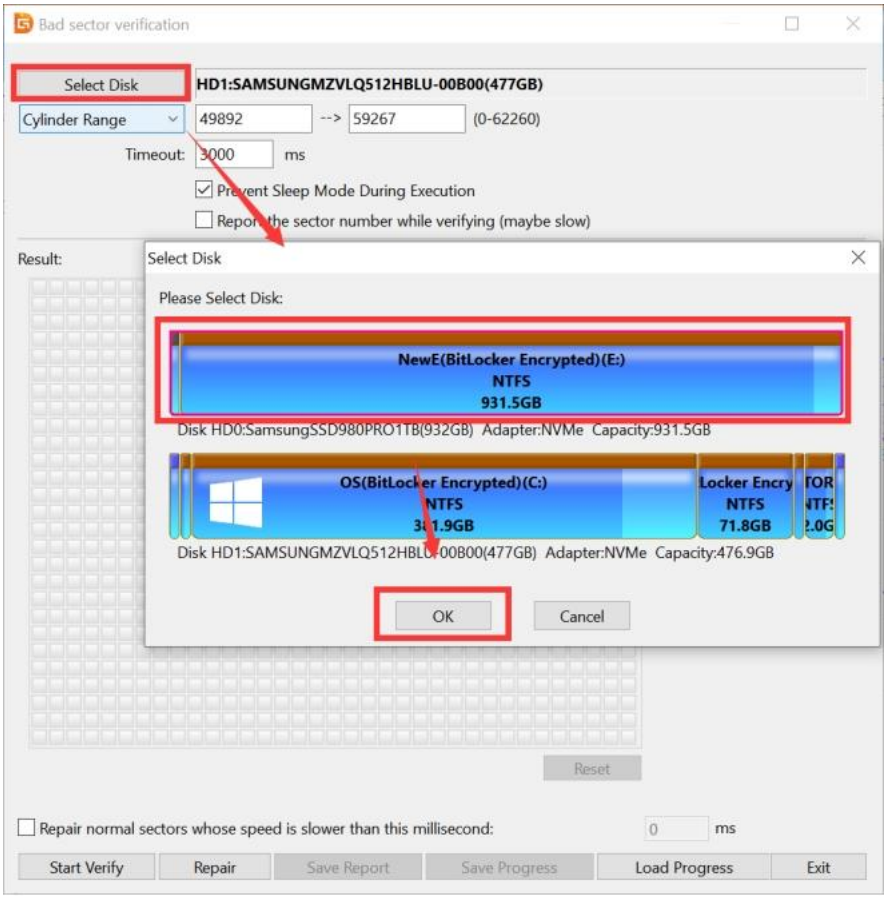
1. Check if the disk space displayed at the bottom of the collection interface is normal. If not, check if the disk is inserted correctly or if it is damaged. Refer to Solution 8 for disk check steps.
2. If the user has formatted the disk by himself, please check whether the disk is set to exFAT format.
3. Ensure the disk has sufficient space. If the remaining space is below 10%, a new project cannot be created. Clear the disk promptly.
4. If the disk space is normal, check if the integrated navigation and LiDAR are synchronized.
5. Ensure no special characters are used when naming the project.
6. Check the APP settings interface to see if the calibration file version is correct.
7. If the issue persists, contact our technical support for remote troubleshooting.

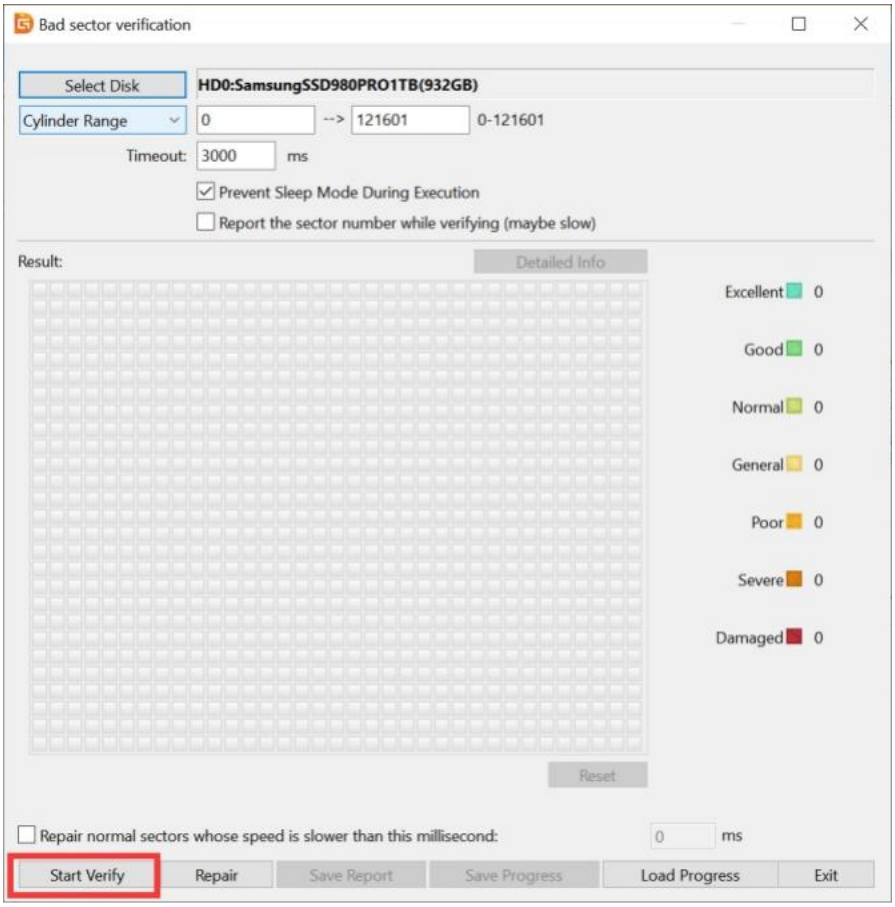
8. How to Check if the Collection Disk Is Damaged?

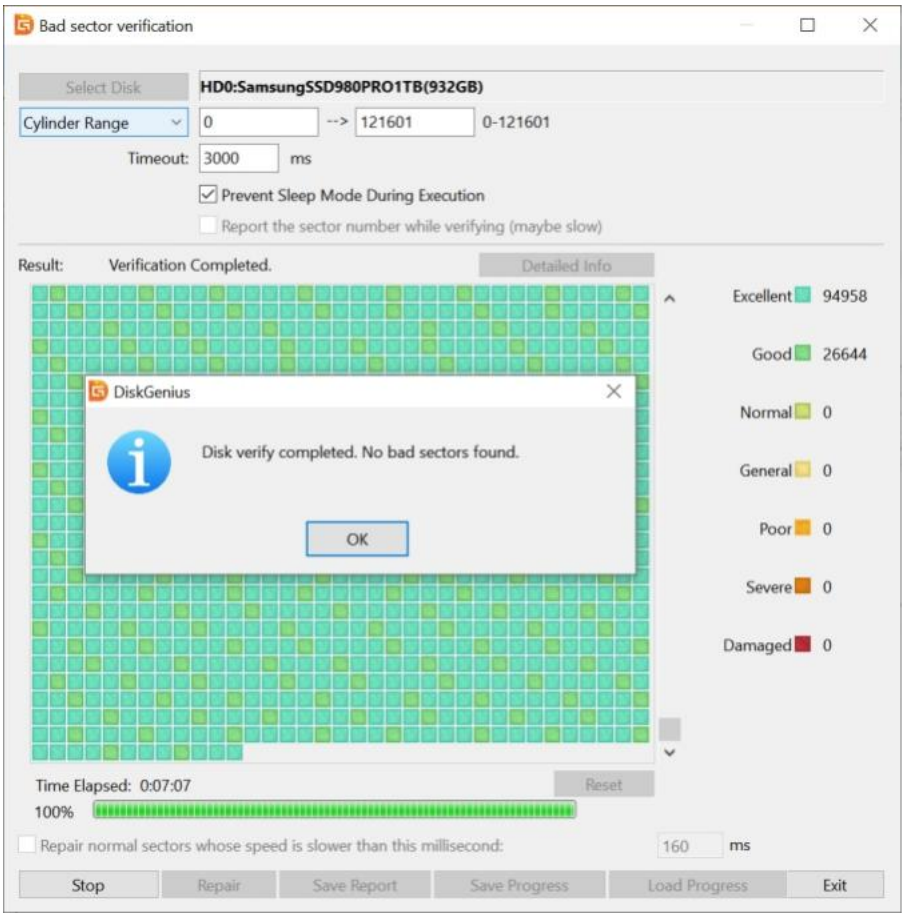
Solution:

Use third-party disk management software to check the disk status. If the test fails, replace the disk. For example, using DiskGenius, follow these steps:


DiskGenius
All-In-One Solution For
Partition Management & Data Recovery
Backup Partition Table(F2)
Restore Partition Table(F3)
Verify Or Repair Bad Sectors(Y)
Delete All Partitions(A)
Backup Disk To Image File
Restore Image File To Disk
Convert Virtual Disk Format
Reload Current Hard Disk (Ctrl_L)
Change Device State
TRIM Optimization


Bad sector verification
Select Disk
HD1:SAMSUNGMZVLQ512HBLU-00B00(477GB)
Cylinder Range
49892
59267
(0-62260)
Timeout:
3000
ms
Prevent Sleep Mode During Execution
Report the sector number while verifying (maybe slow)
Result:
Select Disk
Please Select Disk:
NewE(BitLocker Encrypted)(E:)
NTFS
931.5GB
Disk HD0:SamsungSSD980PRO1TB(932GB) Adapter:NVMe Capacity:931.5GB
OS(BitLocker Encrypted)(C:)
NTFS
Locker Encry
NTFS
71.8GB
Disk HD1:SAMSUNGMZVLQ512HBLU-00B00(477GB) Adapter:NVMe Capacity:476.9GB
OK
Cancel
Reset
Repair normal sectors whose speed is slower than this millisecond:
0
ms
Start Verify
Repair
Save Report
Save Progress
Load Progress
Exit


Bad sector verification
Select Disk
HD0:SamsungSSD980PRO1TB(932GB)
Cylinder Range
0
--> 121601
0-121601
Timeout: 3000 ms
Prevent Sleep Mode During Execution
Report the sector number while verifying (maybe slow)
Result:
Detailed Info
Excellent 0
Good 0
Normal 0
General 0
Poor 0
Severe 0
Damaged 0
Reset
Repair normal sectors whose speed is slower than this millisecond: 0 ms
Start Verify
Repair
Save Report
Save Progress
Load Progress
Exit


Bad sector verification
Select Disk
HD0:SamsungSSD980PRO1TB(932GB)
Cylinder Range
0
--> 121601
0-121601
Timeout: 3000 ms
Prevent Sleep Mode During Execution
Report the sector number while verifying (maybe slow)
Result: Verification Completed.
Detailed Info
Excellent 94958
Good 26644
Normal 0
General 0
Poor 0
Severe 0
Damaged 0
DiskGenius
Disk verify completed. No bad sectors found.
OK
Time Elapsed: 0:07:07
Reset
100%
Repair normal sectors whose speed is slower than this millisecond: 160 ms
Stop
Repair
Save Report
Save Progress
Load Progress
Exit

9. Precautions for Device Shutdown.

Solution:

To prevent data corruption, wait 10-15 seconds after successfully issuing the shutdown command. After the APP prompts that the device is disconnected, turn off the battery box power switch to stop the power supply.

10. APP Prompts Disconnection During Collection.

Solution:

1. If the disconnection is due to Wi-Fi network fluctuations, the APP will reconnect within 1-3 seconds.
2. Check if the battery box Wi-Fi indicator is flashing. If the indicator light is not flashing, please use a wired connection method for data collection.
3. Check if the network cable is loosely connected, causing network interruption.
4. Check the device power indicator to determine if the device shut down automatically due to low battery.
5. If the issue persists, contact our technical support for remote troubleshooting.

11. IMU Alignment (Stop Data Recording) Interrupted by Accidentally Closing the Window.

Solution:

Click the Stop Data Recording button again to reopen the IMU Alignment window.

12. Planar Camera Shows It is not Connected.

Solution:

1. Check if the cables are plugged into the correct ports: road camera to CAM2, front camera to CAM1.
2. Check if the camera is enabled in the APP configuration interface.
3. If all checks are correct, try restarting the device.
4. If restarting does not work, check if the firmware and software are updated to the latest version.
5. If the issue persists, contact our technical support for remote troubleshooting.

13. Panoramic Camera Shows It is not Connected.

Solution:

1. Check if the panoramic camera is enabled in the APP configuration interface.
2. Try restarting the device.
3. If restarting does not work, check if the firmware and software are updated to the latest version.
4. If the issue persists, contact our technical support for remote troubleshooting.

14. Data Copying Precautions.

Solution:

1. Pay attention to the insertion direction when inserting the disk.
2. Do not change the project folder name before completing data copying and merging to avoid errors.
3. After data copying, ensure the disk is safely ejected before removing it from the computer to prevent damage.
4. For stable data transfer, connect the card reader to a power source to ensure stable power supply.
5. Do not process raw data directly on the data storage disk, as this may risk disk damage.
6. It is recommended to make two copies of the data: one for processing and one for archiving.
7. For continuous collection projects, format the disk every 10-15 days, ensuring data is backed up before formatting to avoid data loss. Refer to Appendix 3 for disk formatting steps.

15. How Long Can LiMobile M2 Collect Data Continuously?

Solution:

A fully charged set of 6 batteries can support 6 hours of continuous data collection. For longer operations, purchase additional battery sets for rotation. Alternatively, the LiMobile M2 supports external power solutions. There is a pin-shaped interface on the side of the battery box, which supports input AC voltage of 110 V~220 V. If you are collecting data for a long time, it is recommended to use an external mobile power supply with a rated power greater than 1000 W.

16. Is LiMobile Collected Data Secure?

Solution:

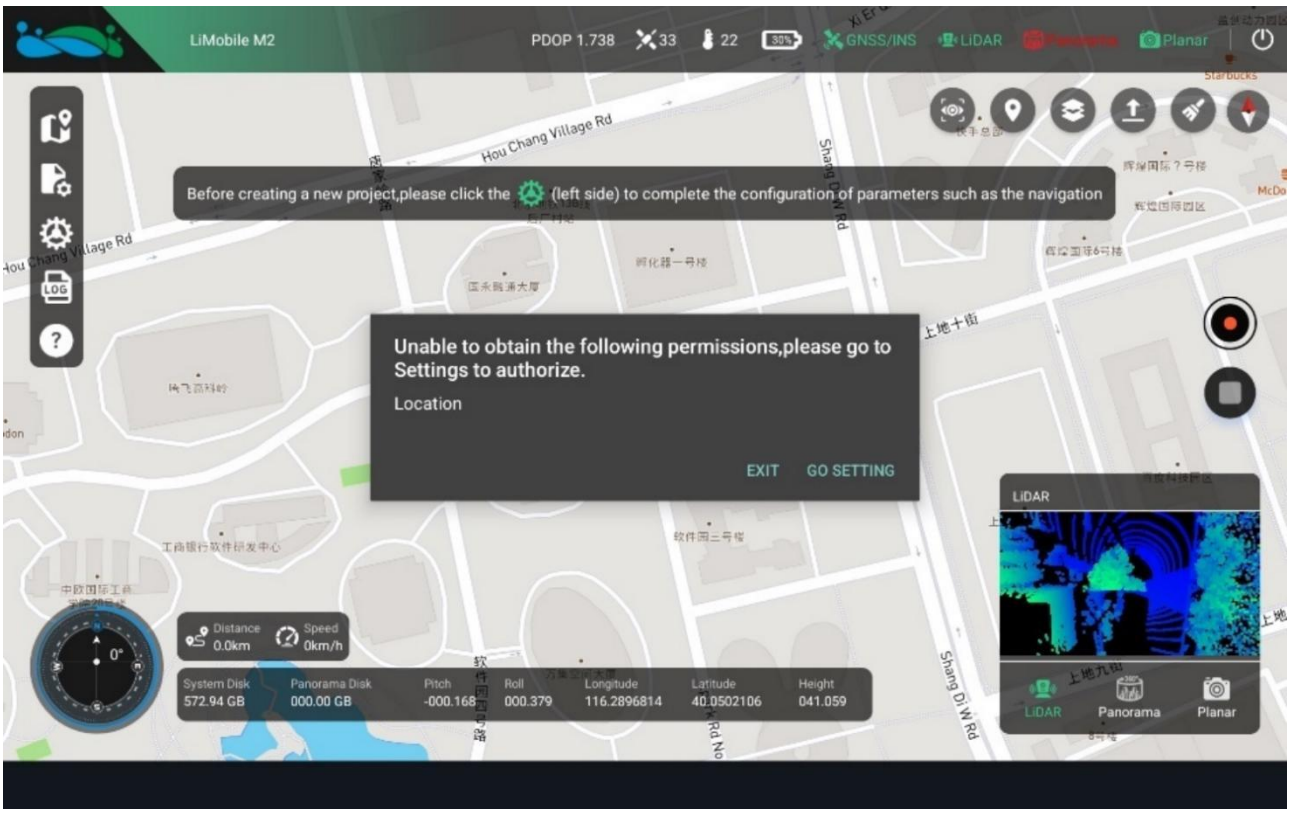
All data collected by LiMobile is stored locally on the device and is not uploaded to the internet.

17. How to Use the Pause Function?

Solution:

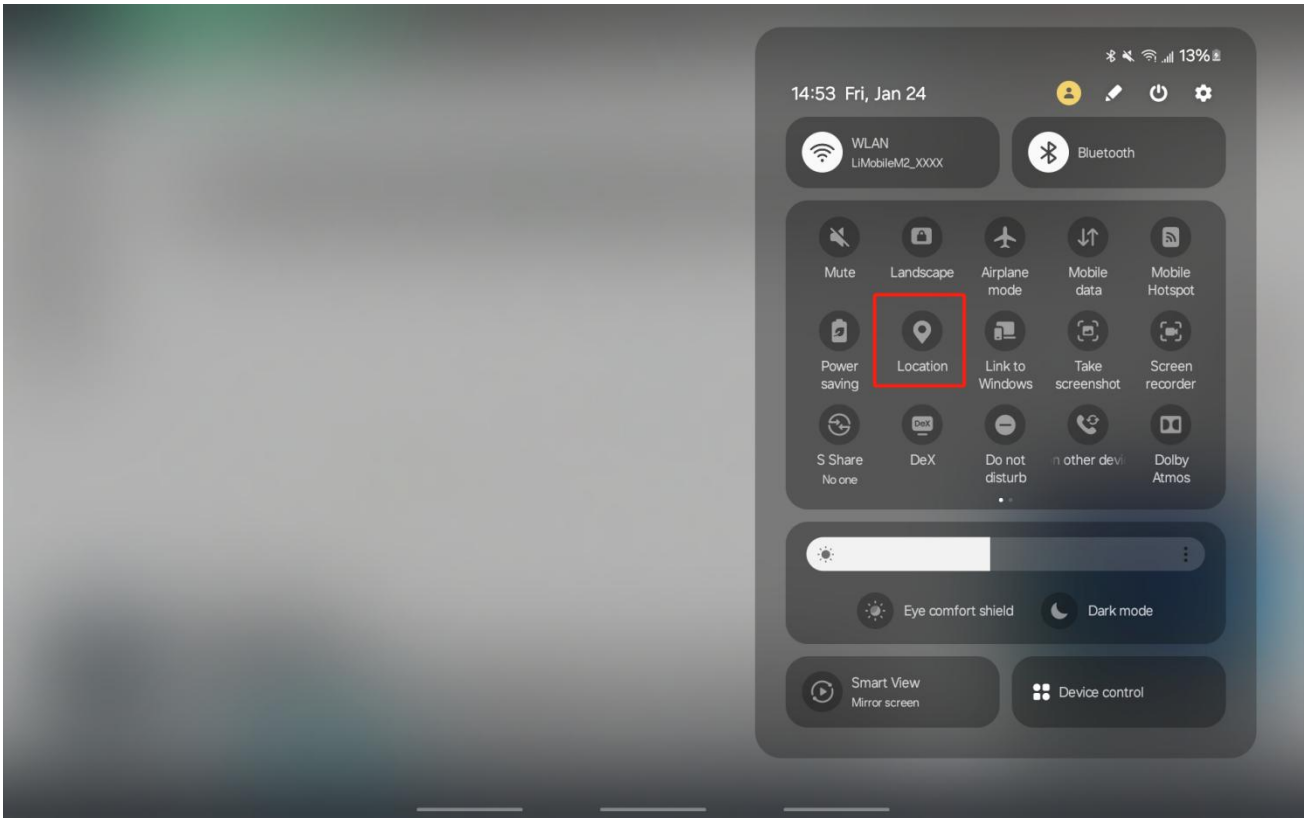
The pause function can effectively avoid data redundancy during stops such as traffic lights. Before resuming driving, ensure the collection command is restored (check if the disk space is decreasing).

18. APP Displays "Unable to obtain the following permissions, please go to Settings to authorize."



Solution:

This is caused by the lack of location service authorization. Enable location service permissions in the tablet's system settings.



19. Does Swapping SYS Disk and PANO Disk Affect the Device?

Solution:

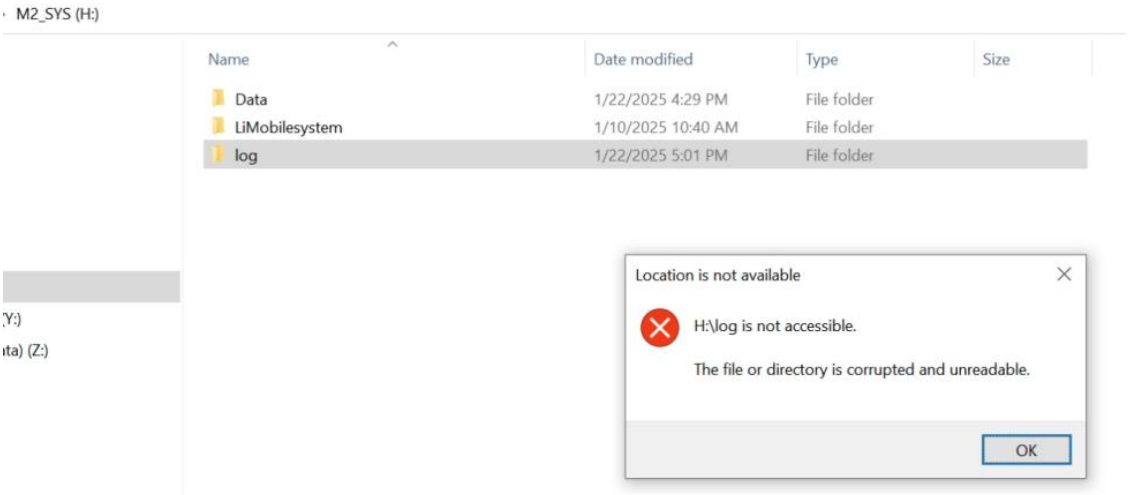
The current collection data will not be affected. However, since the disks contain calibration files, swapping them may cause other functions to fail. Do not swap the disks.

20. Precautions for Switching Power Supply Modes.

Solution:

Before switching, click the power button to shut down the device. After the APP prompts that the device is disconnected, switch the battery box rotary button to EXT-ON.

21. Unable to Recognize Disk or Display "Write Protected, No Access Permission"



Solution:

1. Check if the card reader is abnormal.

2. Try using the chkdsk tool to repair the disk. Press WIN+R, type CMD, and enter chkdsk g:/f (replace "g" with the damaged disk letter). This method maximizes data retention.
3. If the above method fails, format the disk (note: this will erase all data).
4. If the disk still does not work after formatting, use disk inspection tools to check for damage.
5. If the disk is damaged, replace it promptly.
6. If it still cannot be solved, please contact our technical support personnel in time.

22. Battery Unable to Charge.

Solution:

If the battery cannot be charged (the light does not flash during charging), press and hold the button for 10 seconds to initiate charging. After charging is complete, press and hold the button for another 10 seconds.

23. The System Takes a Long Time to Boot Up. How to Resolve This?

Solution:

1. Check if the disk is properly inserted into the device.
2. Power on the device again and restart the system to try again.
3. If the issue persists, please contact our technical support team promptly.

24. The Status of the Planar Camera Sensor Remains Red.

Solution:

1. Check if the cable is damaged or if the device interface is faulty.
2. Check the APP parameter settings interface to confirm if the planar camera is enabled.
3. Power on the device again and restart the system to try again.
4. If the issue persists, please contact our technical support team promptly.

25. The File Modification Date Does not Match the Actual Data Collection Time.

Solution:

In rare cases, this issue may occur. This is caused by the folder modification time being based on the device's internal clock. This issue does not affect data processing and will be resolved after the device is restarted.

26. The Camera Image Timestamp is Misaligned with the Trajectory.

Solution:

This is a relatively complex abnormal situation. Please contact our technical support team promptly for remote troubleshooting.

27. The Camera Distance Trigger Mode is not Working.

Solution:

This is a relatively complex abnormal situation, which may be related to the DMI device. Please contact our technical support team promptly for remote troubleshooting.

28. How to Resolve Fogging Inside the Camera Lens?

Solution:

This is a normal natural phenomenon. Please contact our technical support team for a solution tailored to your specific situation.

29. The Laser Suddenly Stops Working.

Solution:

One possible reason is that the ambient temperature is too high, causing the laser to activate self-protection.

30. What causes damage to panoramic camera files (*.pgr) or image frame loss?

Solution:

1. Camera overexposure may lead to image frame loss, such as when the device exits a tunnel.
2. Slow disk read/write speeds, causing buffer overload.
3. Damage to the data transmission cable during device operation.
4. Please contact our technical support team promptly for troubleshooting.

★ Data Processing

1. Common error messages and solutions

[Analyze Images] Please generate the trajectory file first!

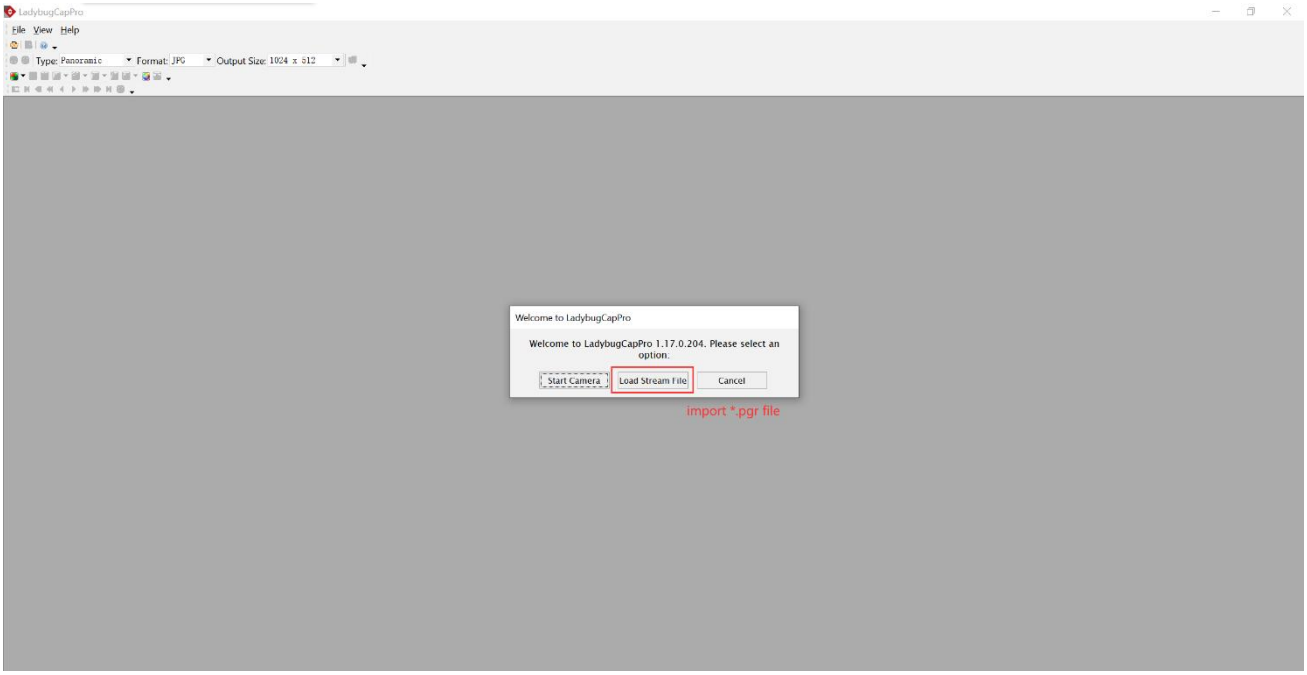
Error reason: No *.traj file was generated in the project.

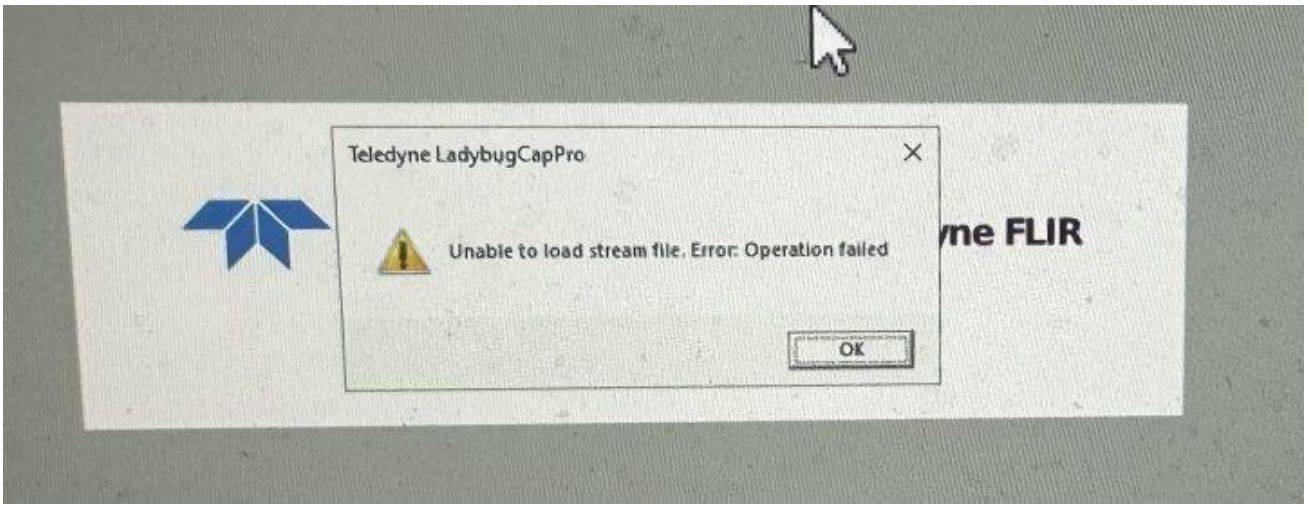
Solution: The Thinning By Distance function when analyzing images and generating *.imglist files require trajectories, so the trajectories need to be processed before performing these operations.

[Analyze Image] Maybe something is wrong with command line parameters for Ladybug.

Error reason: *.pgr files do not exist or are damaged.

Solution: Check if the *.pgr files exist in the Cam folder. If the file exists, it is considered damaged. Users need to send the *.pgr files to our technical support, and they will use ladybugCapPro software to view it. As shown in the figure, the data is damaged.

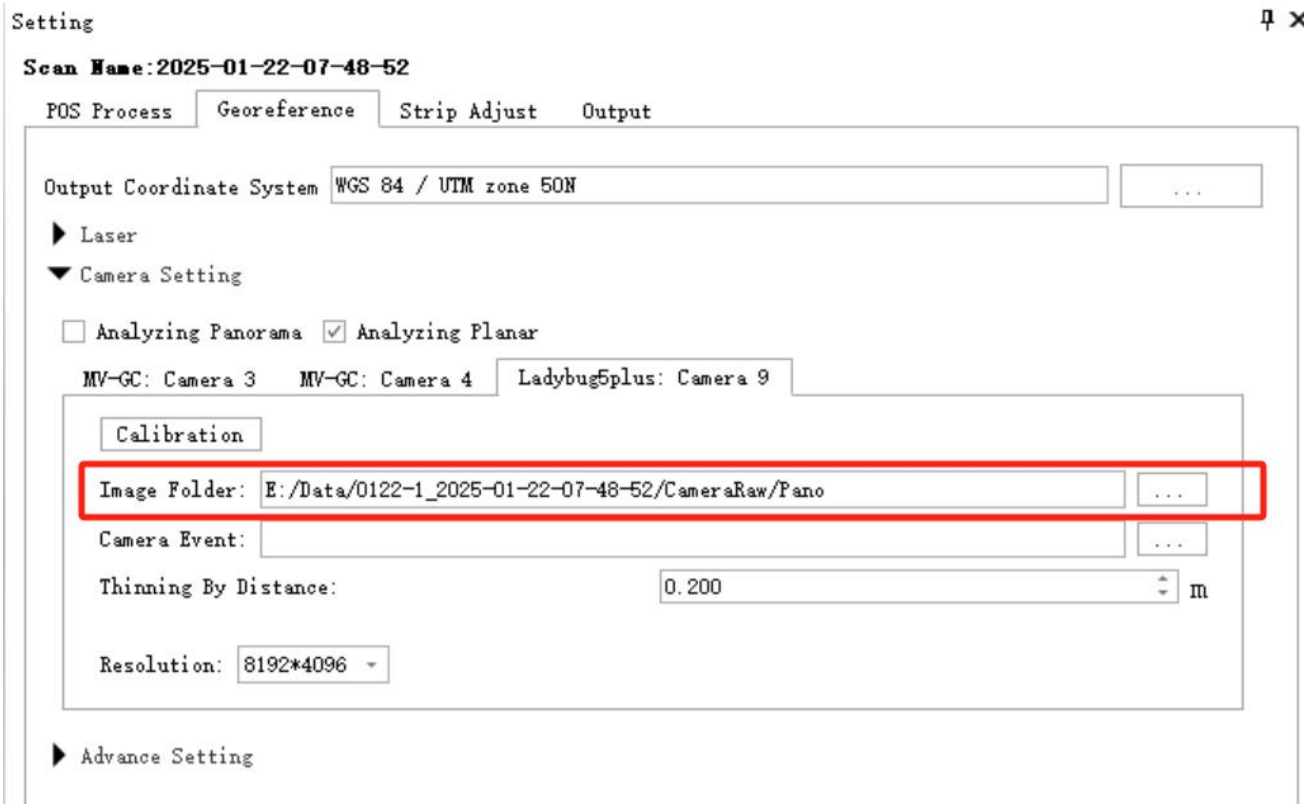




[Analyze Image] Folder doesn't exist *.pgr file! F:/Data/0625/2024-06-25-07-12-28/Result.

Error reason: The panoramic Image Folder path is set incorrectly.

Solution: Check the Image Folder path and whether there are *.pgr files under the path.



Error Num = -41, The quality of the satellite navigation processing is poor (Fix ratio is 0%), and the solution is terminated.

Error reason: Data quality is poor, fix rate is 0.

Solution: Check if the base station is too far away.

[Open Project] The project has been occupied.

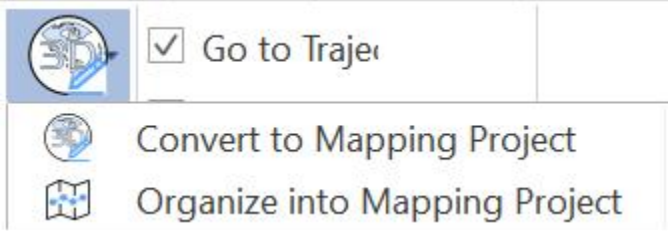
Error reason: The project file is open.

Solution: Check whether multiple software interfaces are open and the project is open in other interfaces.

[LiDAR360MLS] Please switch to the mapping project to use this function.

Error reason: This function can only be used in mapping projects.

Solution: Click the button to convert the project.



[LiDAR360MLS] The base station file 'R:/20240914/onig258l00,24o' does not exist.

Error reason: The base station file is lost in the project.

Solution: Check whether the base station file is lost. It is strongly recommended to put the base station file into the project to reduce the risk of data omission when copying data.

[IO]Failed to build G:/2023-06-21-07-26-10/laser12023-06-21-06-36-37-1-optimized.LiData!

Error reason: The LiData file is not completely generated or is damaged.

Solution: Please check if the solution disk space is insufficient.

[IO] Load project file F:/1021_2024-10-21-05-09-40/2024-10-21-05-09-40.live failed!

Error reason: There is an error in the live project file.

Solution: Open the live file and check if it is normal.

[IO]Recover project data failed, please copy the original project data to current project directory!

Error reason: The project folder is not copied completely.

Solution: Compare and check whether the copied data is inconsistent with the original data.

[LiDAR360MLS] Failed to load project file path from F:/1021_2024-10-21-05-09-40/2024-10-21-05-09-40.liscan

Error reason: liscan project file corruption and other JSON format issues.

Solution: Check whether the liscan file is abnormal. If it is an empty file, try to create a new liscan project for solution. If it is not an empty file, it is recommended to contact our technical support for file repair.

[Strip Adjust] Initialization: Failed reading E:/2024-10-13-07-37-29-199/202410-13-07-37-29-199_original.traj

Error reason: The trajectory file was moved, deleted, or the file format was incorrect, resulting in a failure in reading the trajectory file.

Solution: Check if the trajectory file is under the specified path.

"E:/M2/10182024-10-18-01-25-25/LaserRaw/Hesai1/Hesai12024-10-18-01-35-13-0/Temp/pointCloudList.json" is not found.

Error reason: Geo process task run failed.

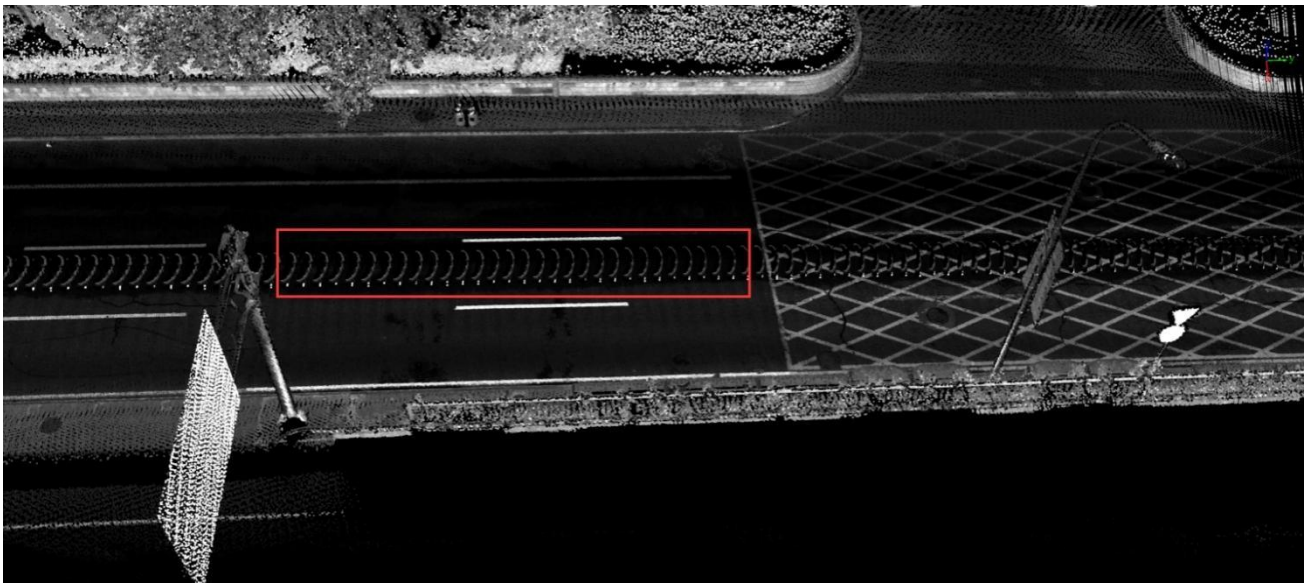
Solution: Try to update the software version or try to change the processing computer equipment.

No point cloud input for colorization.

Error reason: There is no LiData point cloud data in the liscan project.

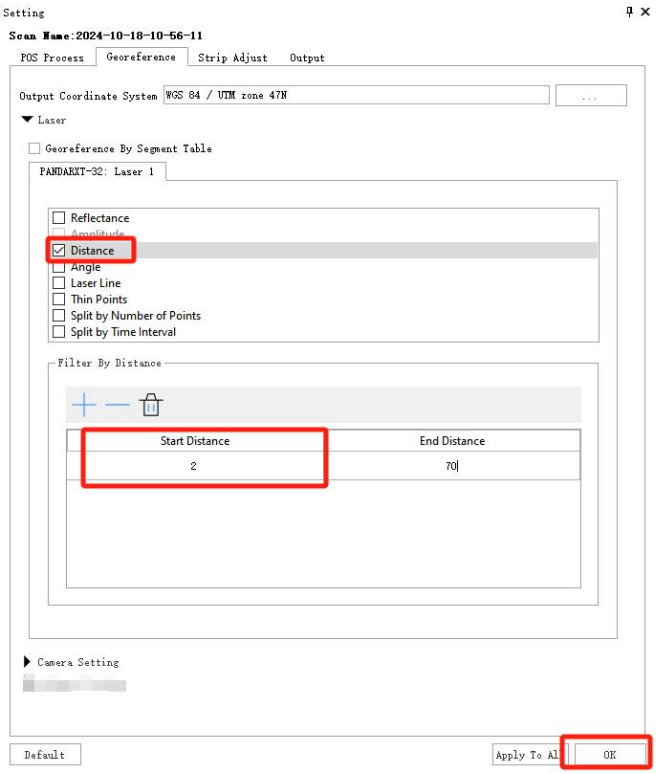
Solution: Coloring after processing the point cloud.

2. Why are there noise points along the trajectory after processing as shown in the figure?



Solution:

The distance filter option is not set when processing the point cloud. Please note that you need to click the OK button after setting it so that the configuration takes effect.



3. How to solve the problem of point cloud stratification after georeference?

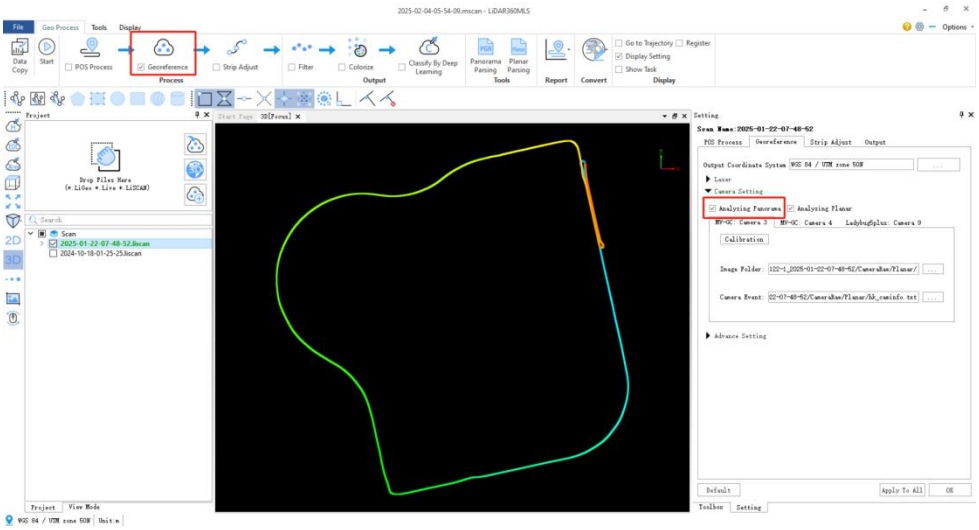
Solution:

1. Check whether the trajectory has jumps. If there are jumps, repair the trajectory jumps, re-process the point cloud and check whether it is stratified.
2. Use the Strip Adjust function for automatic optimization.
3. In special scenarios, if the above methods cannot meet the requirements, you can further use the Register function to perform manual point cloud adjusting

4. How to analyze panoramic camera photos?

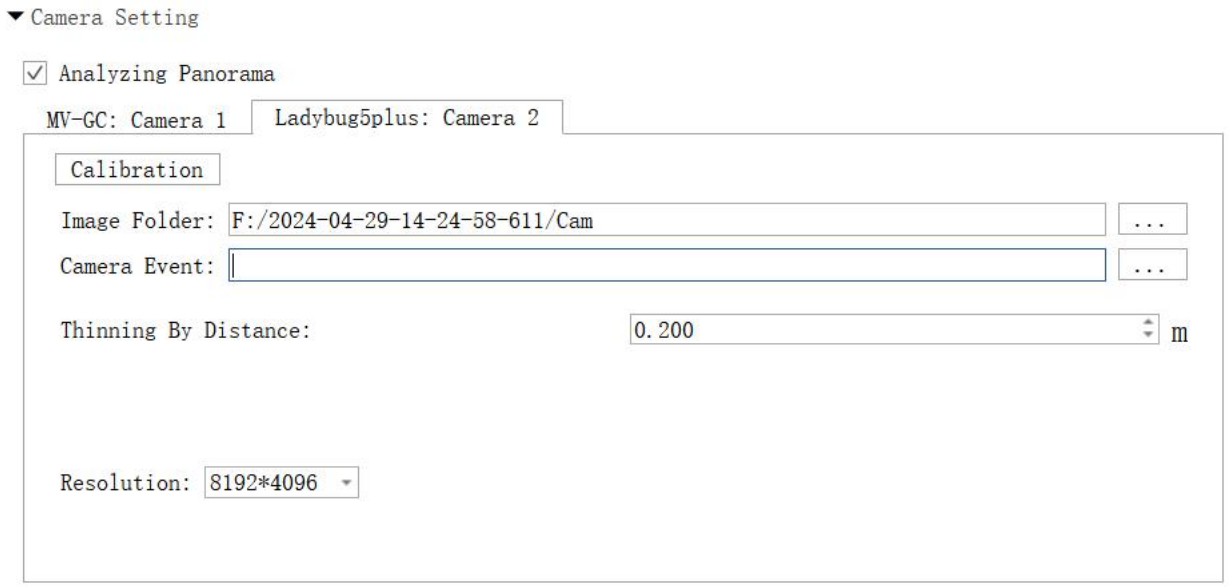
Solution:

1. In the Georeference interface, the software defaults to check the Analyzing Panorama option, and lit will analyze the panorama simultaneously when performing the point cloud Georeference step.



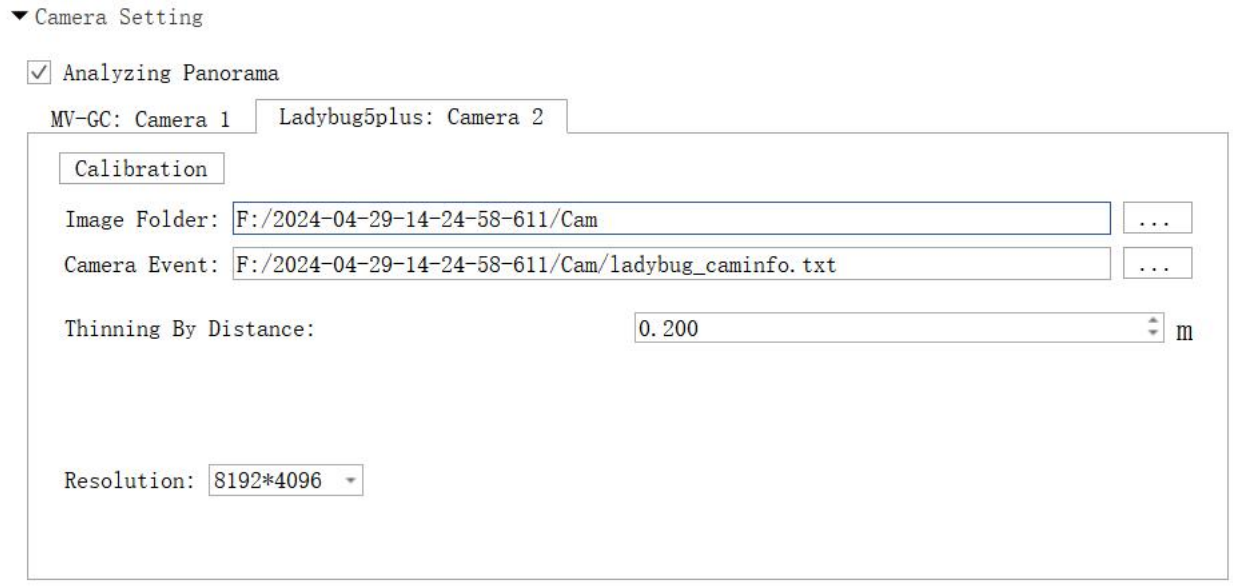
2. After processing the POS, the user can also click the Panorama Parsing button to analyze the panoramic photo.

5. Is the panoramic camera setting interface normal as shown in the figure?



Solution:

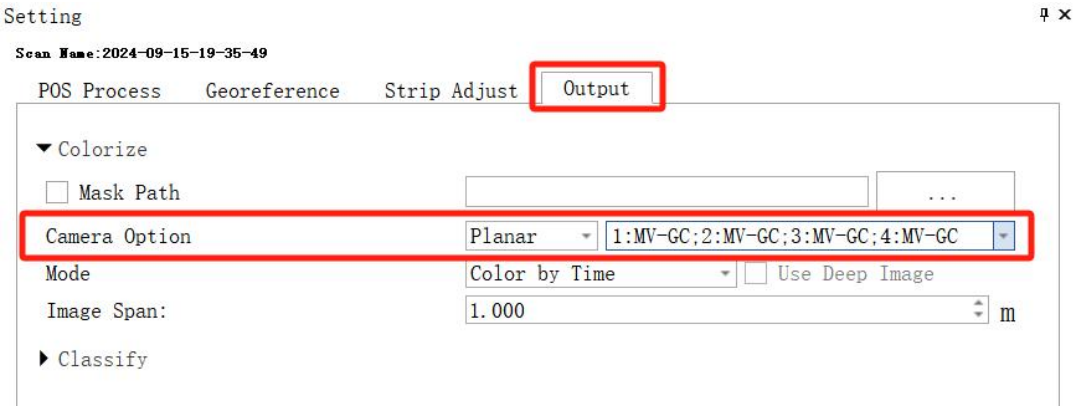
The settings in the picture are correct. After analyzing Panorama, the software automatically generates the ladybug_caminfo.txt file and displays the path in the Camera Event.



6. How to select the planar camera for coloring?

Solution:

Set it in the Output interface, and then run the Colorize steps. It should be emphasized that the planar camera of the M2 series equipment is not used for coloring.



7. Can the LiMobile M2 planar camera be used for point cloud colorization?

Solution:

No, the angle of the planar camera is not suitable for point cloud colorization tasks.

8. How to make a panorama mask file?

Solution:

Please refer to Attachment 6.

9. After adding control points, the position of the point cloud is greatly offset. What is the reason?

Solution:

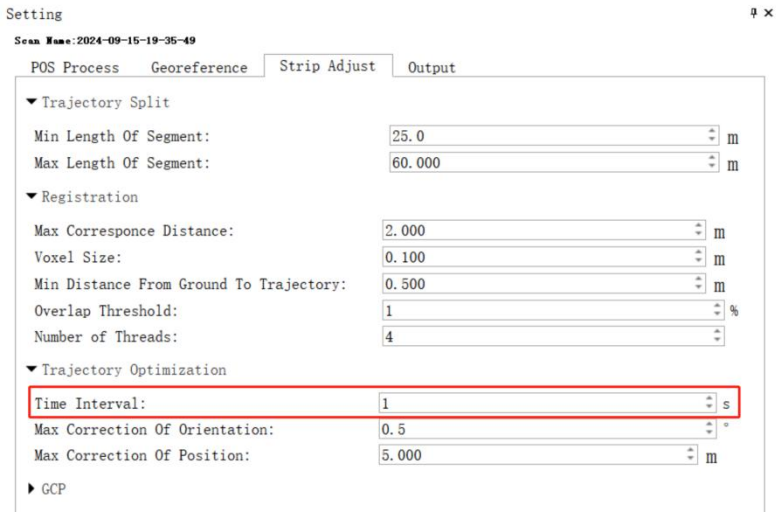
1. Check whether the coordinate system of the point cloud processing is set correctly and is consistent with the control points.
2. Check whether the X and Y coordinate columns are selected correctly when importing the GCP file.

10. If the Strip Adjust effect is not ideal, how to further optimize the data?

Solution:

This is a normal phenomenon. You can refer to the following steps for optimization:

1. Check the trajectory for any jumps. If jumps are present, repair trajectory jumps first.
2. Try to change the Time Interval to 1 and try to run Strip Adjust task again.

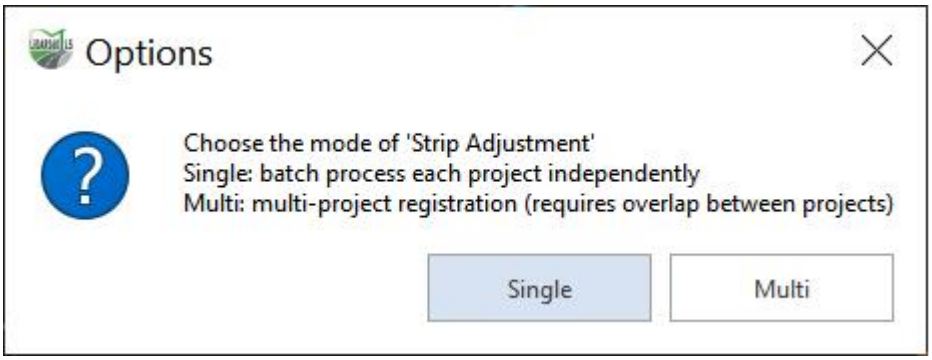


3. Add control points.
4. Use the Register function to edit the Links according to the manual's specifications. Ensure the Links are correct, and then re-optimize.

11. When running Strip Adjust step, how to select the pop-up window option?

Solution:

1. Single: Each liscan project performs internal strip adjusting operations separately.
2. Multi: Not only each liscan project performs internal strip adjusting operations separately, but also strip adjusting operations are performed between liscan projects.



12. Relationship between mscan project and liscan project.

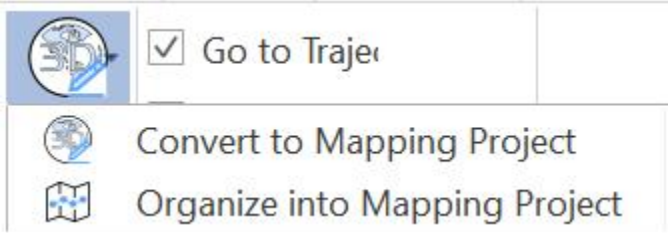
Solution:

An mscan project can contain multiple liscan projects, each of which corresponds to a set of raw data collected. An mscan project can be compared to outer folders, and liscan project to inner folders. This project organization structure can facilitate batch processing.

13. How to convert to mapping project to complete other data post-processing operations?

Solution:

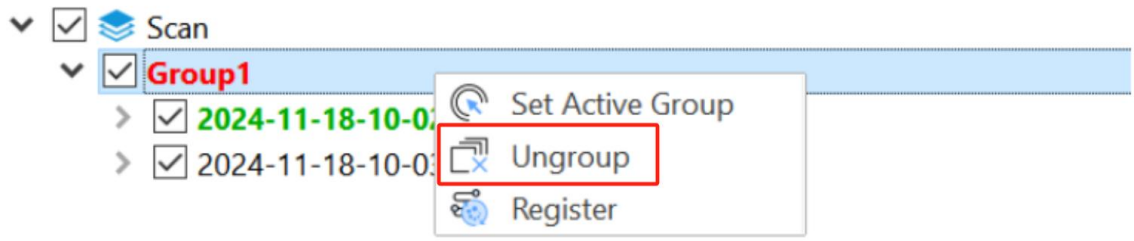
The software has a function button for converting mapping project with one click. They are Convert to Mapping Project button and Organize into Mapping Project button. The Convert to Mapping Project function can convert a single activated *.liscan project into a mapping project, and the Organize into Mapping Project function can convert multiple *.liscan projects into mapping projects together.

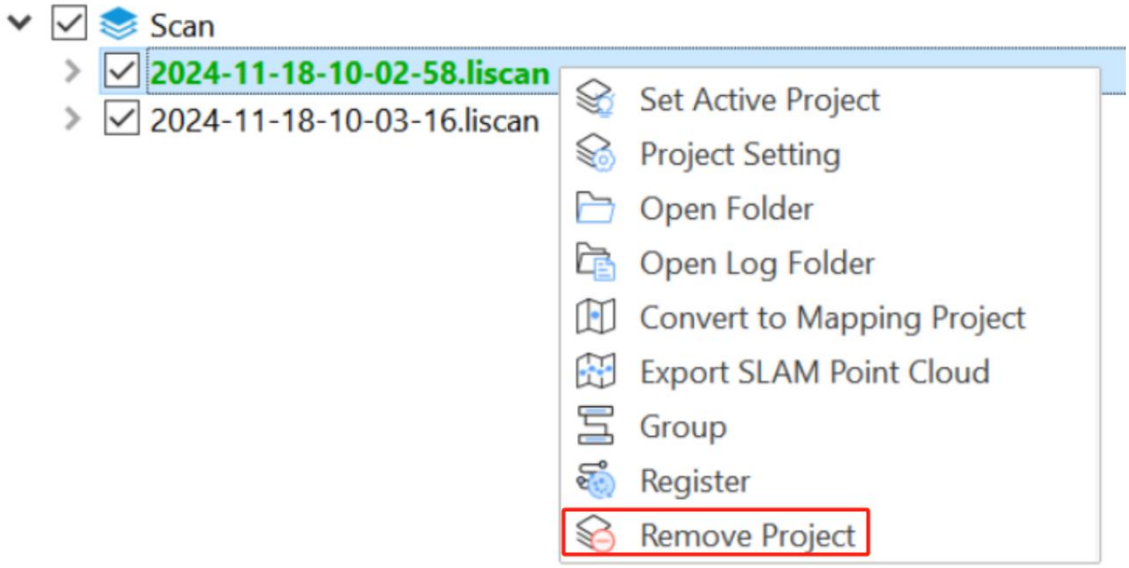


14. Why can't I remove the project?

Solution:

This may be because the liscan project is grouped. You need to cancel the grouping before removing it.

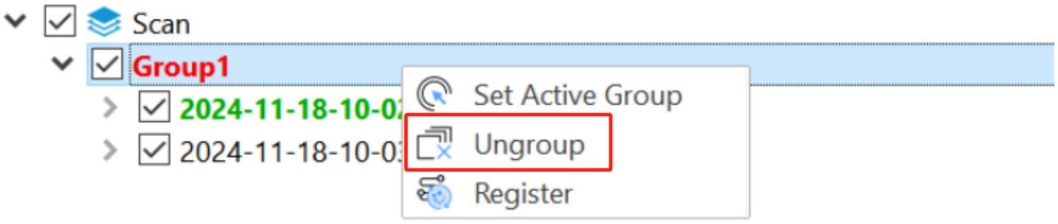


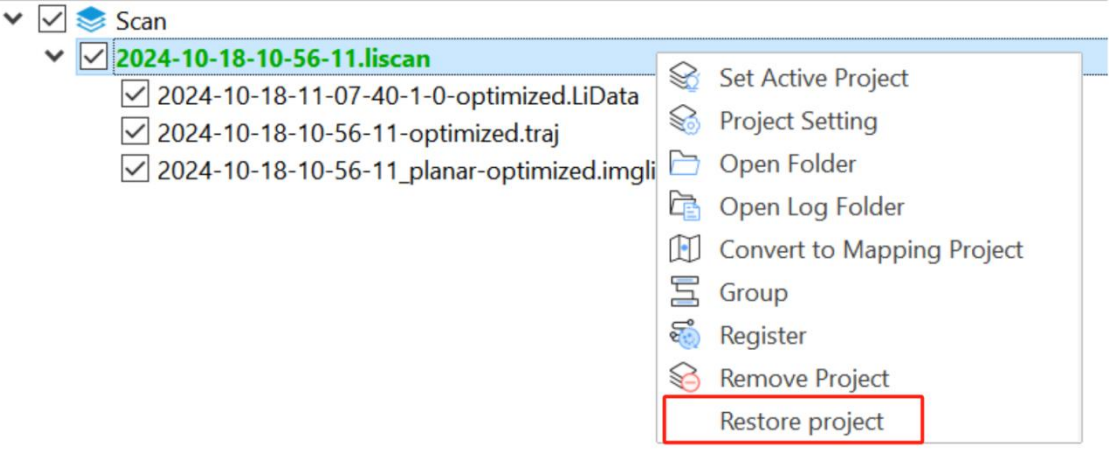


15. How to restore the project after the Strip Adujst are spliced?

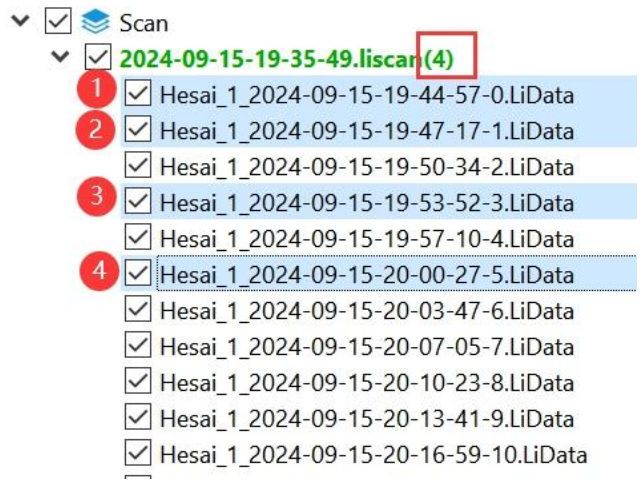
Solution:

First ungroup the projects, then right-click the project name and click the Restore Project button.





16. What do the brackets after the liscan project name represent?



Solution:

It represents the number of selected LiData files, and after the user selects, he can right-click to change the display mode and display settings of the selected point cloud.

17. Why is the SLAM option in the advanced settings checked and the resulting point cloud quality is worse?

Error reason:

The accuracy of SLAM is greatly affected by environmental features, and in environments with sparse features or many dynamic targets, it is easy to encounter problems such as pose estimation drift or error accumulation

Solution:

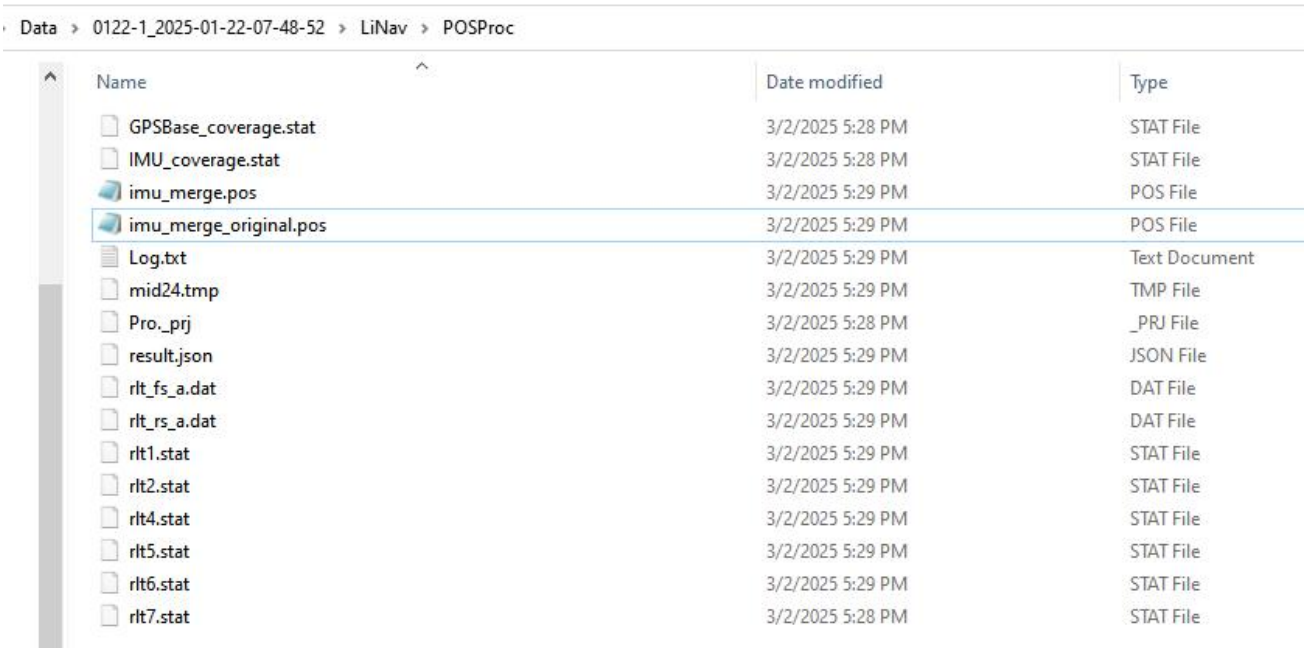
Avoid selecting certain open scenarios (such as highways, elevated bridges, etc.) for calculation; If the entire process of engineering collection is open, it is recommended not to check the SLAM option, otherwise it may reduce the accuracy of point cloud solution.

18. Precautions for selecting each step in the process.

Solution:

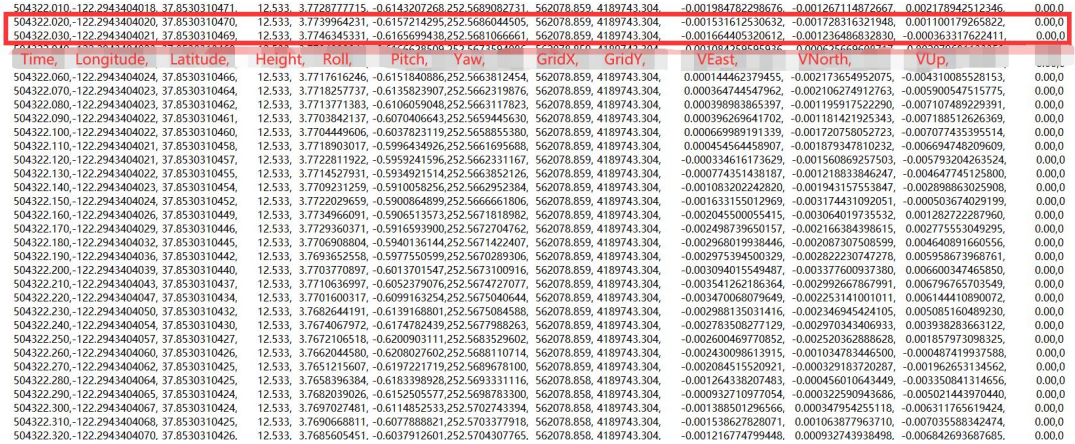
1. If only the point cloud needs to be obtained, selecting 'POS Process' and 'Georeference' will be sufficient.
2. The data collected in GNSS signal obstructed environments such as urban canyons and dense tree lined roads may exhibit layering. If better quality point cloud data is needed, it is recommended to check the option of 'Strip Adjust'. However, this step is slow and should be carefully checked.
3. It is not recommended to check the option of 'Strip Adjust' for data collected in open areas.
4. The filtering option can be used to denoise and thin point clouds, but this step is time-consuming and should be carefully checked.
5. To obtain colored point cloud output, you need to check the 'Colorize' step.
6. To obtain point cloud with classification information, you need to check the 'Classify by Deep Learning'.

19. As shown in the figure, what do the columns represent in the file generated by the software for data processing?



Solution:

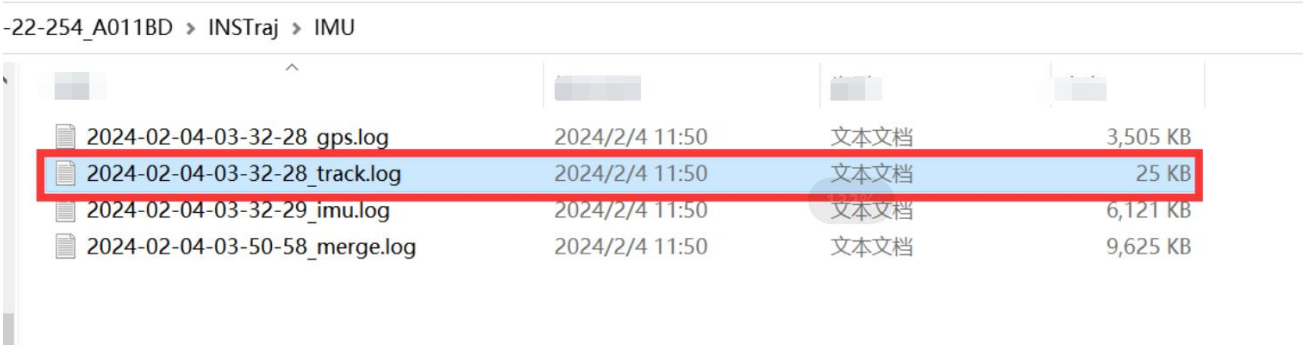
The meanings of the columns have been annotated in the diagram below, where Grid X and Grid Y represent the eastward and northward coordinates, respectively, in the Universal Transverse Mercator (UTM) projection system.



20. Are the real-time displayed trajectory data recorded?

Solution:

LiMobile M2 will record the latitude, longitude, and altitude information of the real-time displayed driving trajectory in the text file shown below.



21. Purpose of the LiDeviceCheck.ini File.

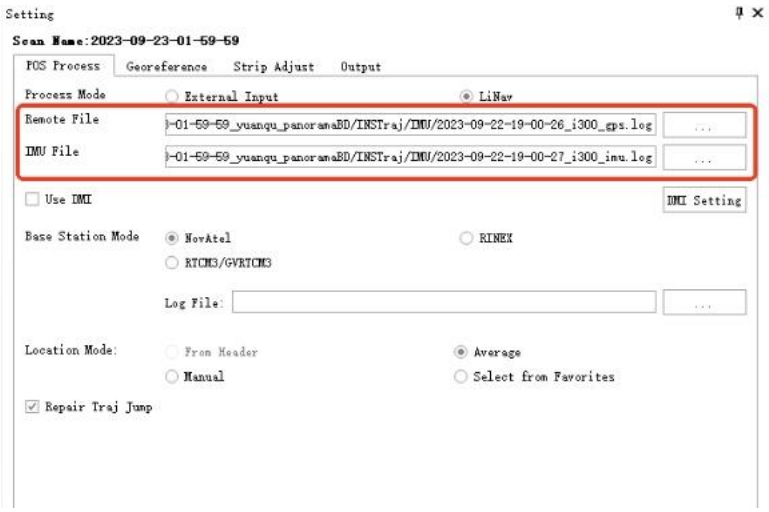
Solution:

The LiDeviceCheck.ini file in the LiMobile M2 project data is used to record the start and stop times of the laser, panoramic camera, and planar camera. Based on this file, corresponding KML files are generated and stored in the Result folder, allowing users to efficiently check the trajectory range of valid data.

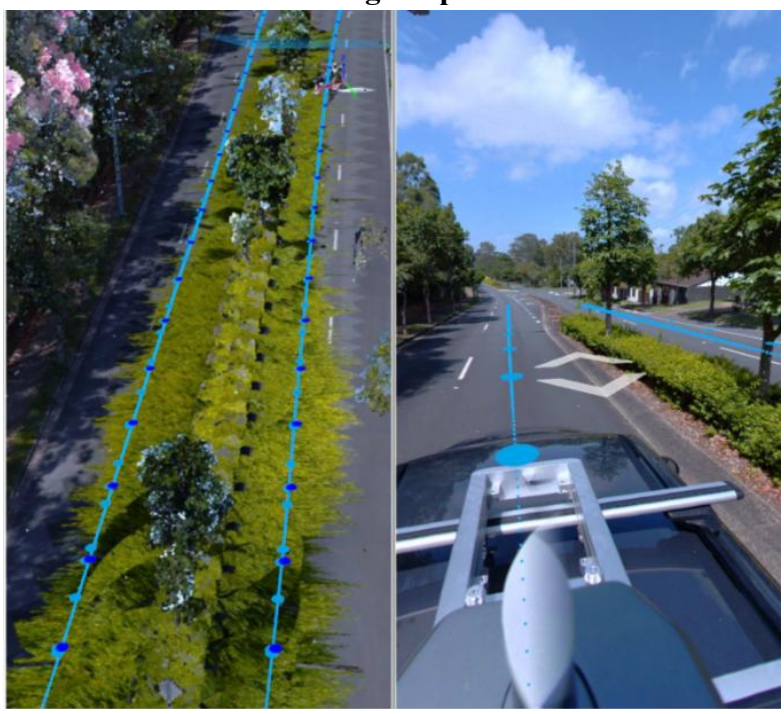
22. How to Resolve the Issue of merge.log Not Being Generated?

Solution:

1. We provide the merge.cmd tool and the tutorial videos, enabling users to merge *gps.log and *imu.log files on their own.
2. When using LiDAR360MLS software for processing, users can also add *gps.log and *imu.log files separately in the settings interface on the right side of the software for processing.

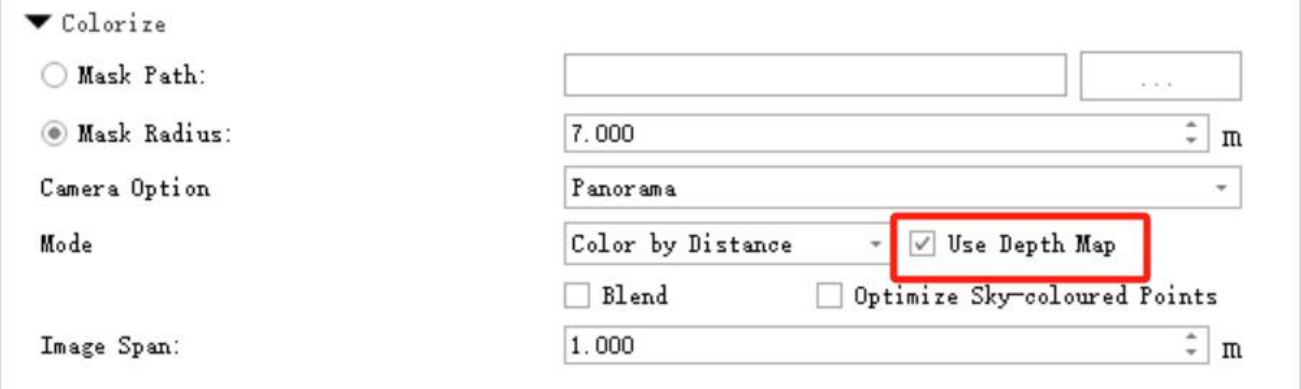


23. The effect after coloring the point cloud is as shown in the figure. How to solve it?

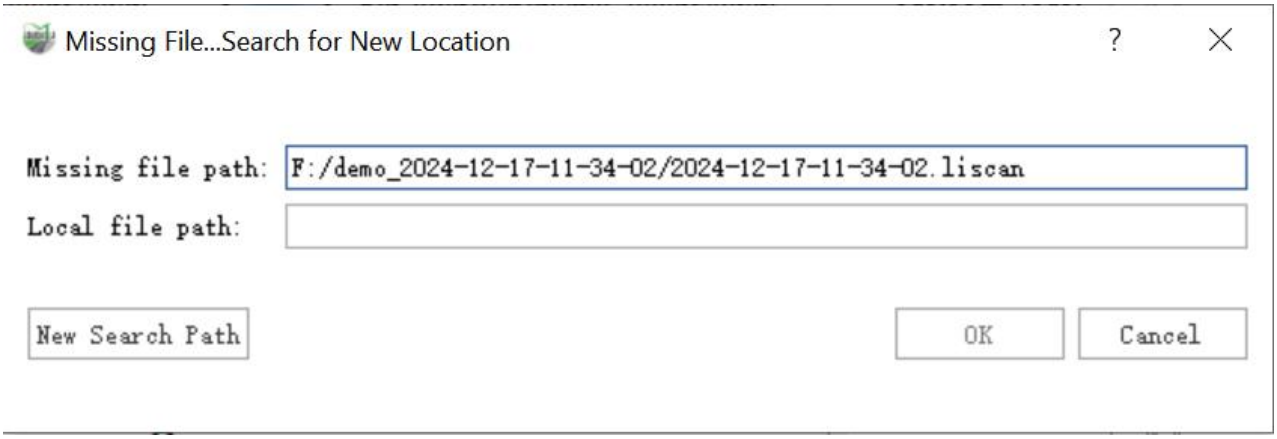


Solution:

After selecting distance coloring, you need to check the depth map option to alleviate this problem.



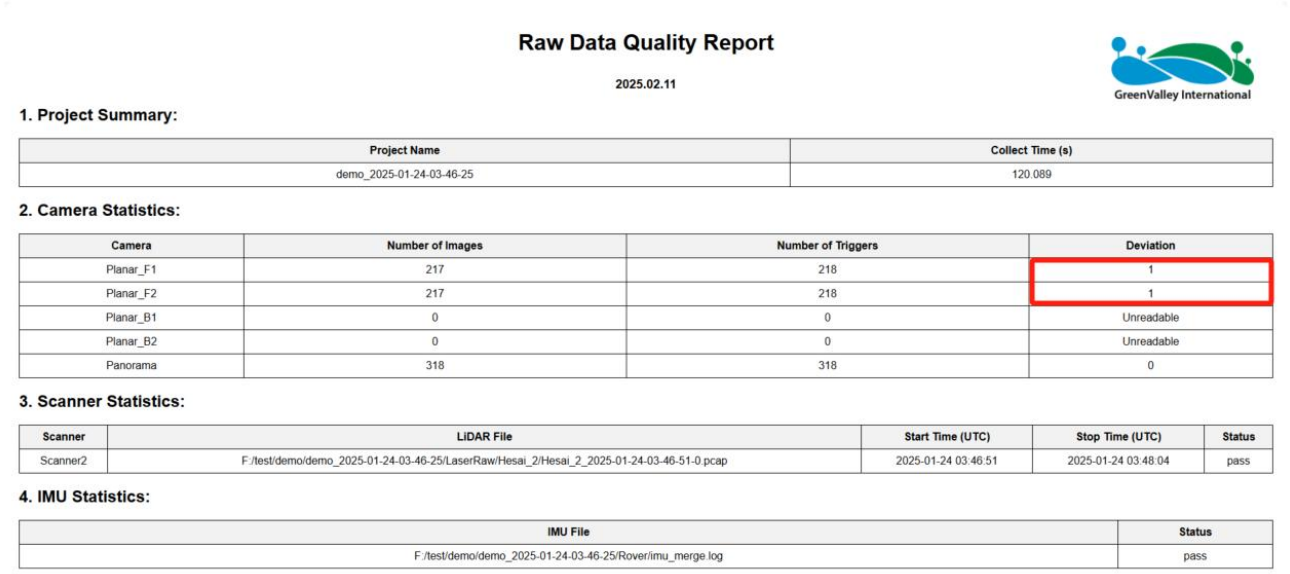
24. When reopening the mscan project, the following prompt appears. Is this normal?



Solution:

This is normal. Due to a change in the drive letter name, the software cannot retrieve the liscan file. Simply click the New Search Path button and re-add the liscan file. Note that for batch processing projects, the paths need to be re-added sequentially.

25. In the Raw Data Quality Report, the camera deviation is not 0. Does this have any impact?



Raw Data Quality Report

2025.02.11

GreenValley International

1. Project Summary:

Project Name	Collect Time (s)
demo_2025-01-24-03-46-25	120.089

2. Camera Statistics:

Camera	Number of Images	Number of Triggers	Deviation
Planar_F1	217	218	1
Planar_F2	217	218	1
Planar_B1	0	0	Unreadable
Planar_B2	0	0	Unreadable
Panorama	318	318	0

3. Scanner Statistics:

Scanner	LiDAR File	Start Time (UTC)	Stop Time (UTC)	Status
Scanner2	F:/test/demo/demo_2025-01-24-03-46-25/LaserRaw/Hesai_2/Hesai_2_2025-01-24-03-46-51-0.pcap	2025-01-24 03:46:51	2025-01-24 03:48:04	pass

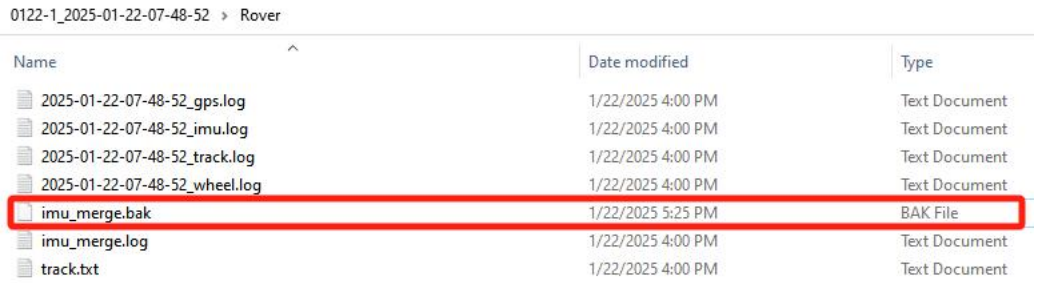
4. IMU Statistics:

IMU File	Status
F:/test/demo/demo_2025-01-24-03-46-25/Rover/imu_merge.log	pass

Solution:

If the deviation is greater than 2, there is a frame drop issue in the raw camera data. Please contact our technical support team promptly to check if the camera is functioning abnormally.

26. As shown in the figure below, what is this file in the project after data copying?



Solution:

During data copying, a raw data quality check is performed. If the IMU file contains a maximum gap exceeding 0.1 seconds, the imu_merg.log file will be automatically repaired. The original unrepaired file will be saved as imu_merge.bak.

Attachment 2 Disk Formatting Instructions

★ Preparation

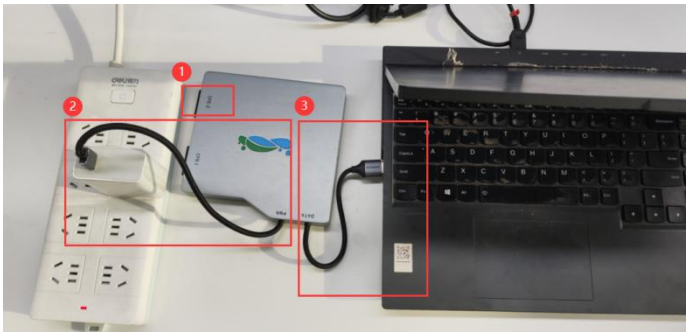
1. **Disk Description**: The LiMobile M2 is configured with two 1 TB data storage disks: M2_SYS and M2_PANO. (The surface of the disk card sleeve is engraved with markings for distinction. It is recommended to format them separately to avoid confusion.)
2. **Data Backup**: Reformatting the disk will delete all data on it and cannot be recovered, so it is essential to back up the data from the disk before proceeding to avoid data loss.
3. **Hardware Preparation**:

· A computer (operating system must be Windows 7 or higher).
· The CFE card to be reformatted.
· CFE card reader (provided in the equipment main box).
· USB charger plug (must be prepared separately).

★ Formatting Method

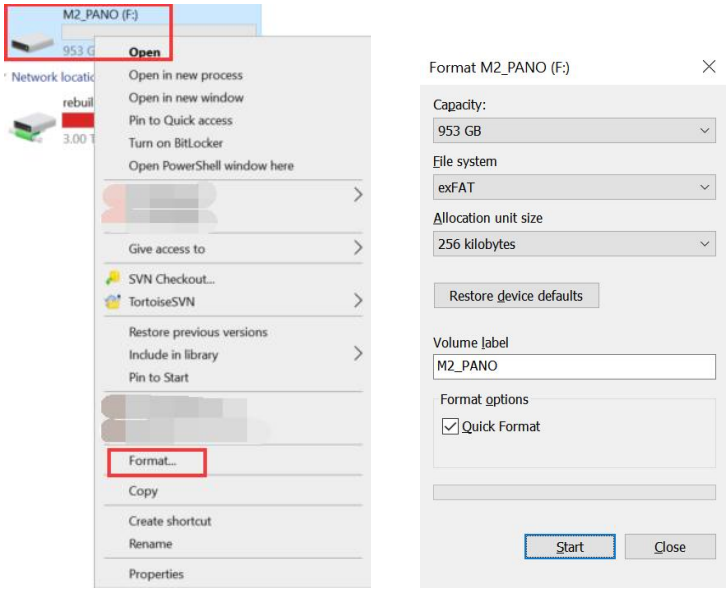
1. Hardware Device Connection

①Insert the CFE card that needs to be reformatted into the card reader.
②Connect the power cable to the PWR port of the card reader.
③Connect the DATA port of the card reader to the computer using the data cable, ensuring that the connection remains stable (it is recommended to connect to the blue-colored USB 3.0 port on the computer).

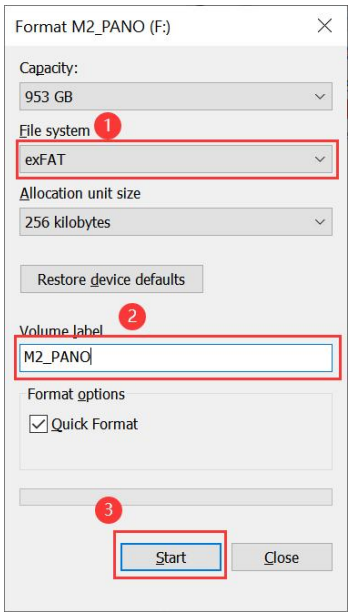


2. In the "This PC" interface, observe the drive letter that appears, which corresponds to the CFE card that needs to be reformatted. Typically, the drive name will be **M2_SYS** or **M2_PANO**.

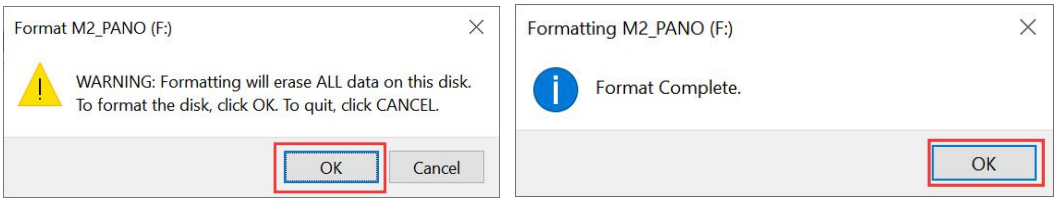
3. Right-click on the CFE card drive letter and select the "Format" option. A formatting dialog box will pop up.



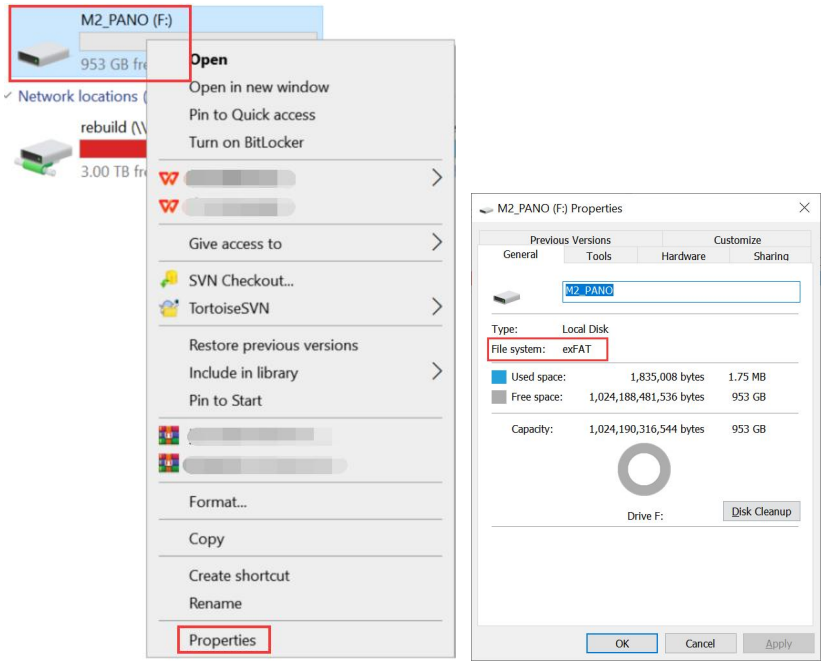
4. Follow the settings as shown in the diagram:
①Select the file system as **exFAT**.
②Set the volume label to match the markings on the disk card sleeve.
③After the settings are complete, click the "Start" button.



5. Click "OK" on the confirmation dialog as shown in the diagram.



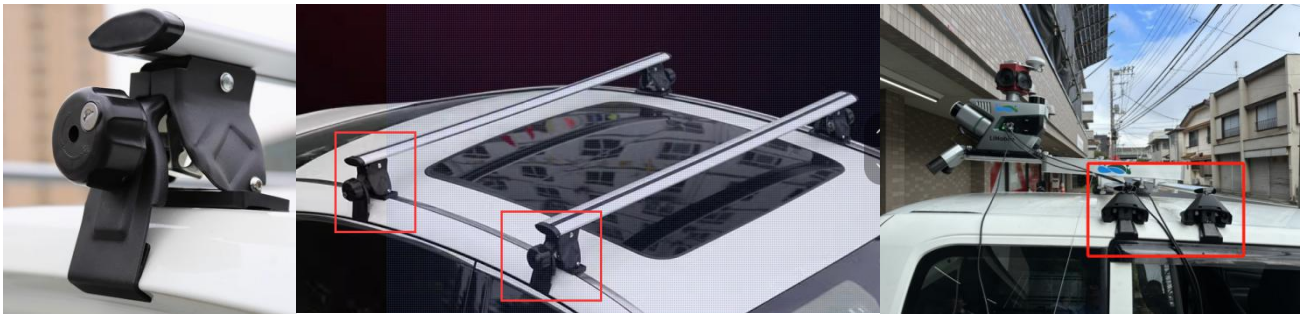
6. Right-click the reformatted CFE card drive again, select "Properties", and check the file system. If the format is **exFAT**, the formatting was successful. Additionally, the disk should be reinstalled in the LiMobile M2 device for data collection validation.


M2_PANO (F:)
953 GB fr
Network locations (
rebuild (\\
3.00 TB fr
Open
Open in new window
Pin to Quick access
Turn on BitLocker
Give access to
SVN Checkout...
TortoiseSVN
Restore previous versions
Include in library
Pin to Start
Format...
Copy
Create shortcut
Rename
Properties
M2_PANO (F:) Properties
Previous Versions
Customize
General
Tools
Hardware
Sharing
M2_PANO
Type: Local Disk
File system: exFAT
Used space: 1,835,008 bytes 1.75 MB
Free space: 1,024,188,481,536 bytes 953 GB
Capacity: 1,024,190,316,544 bytes 953 GB
Drive F:
Disk Cleanup
OK
Cancel
Apply

Attachment 3 Vehicle and Luggage Rack Crossbar Selection Guide

★ Vehicle Selection for Collection

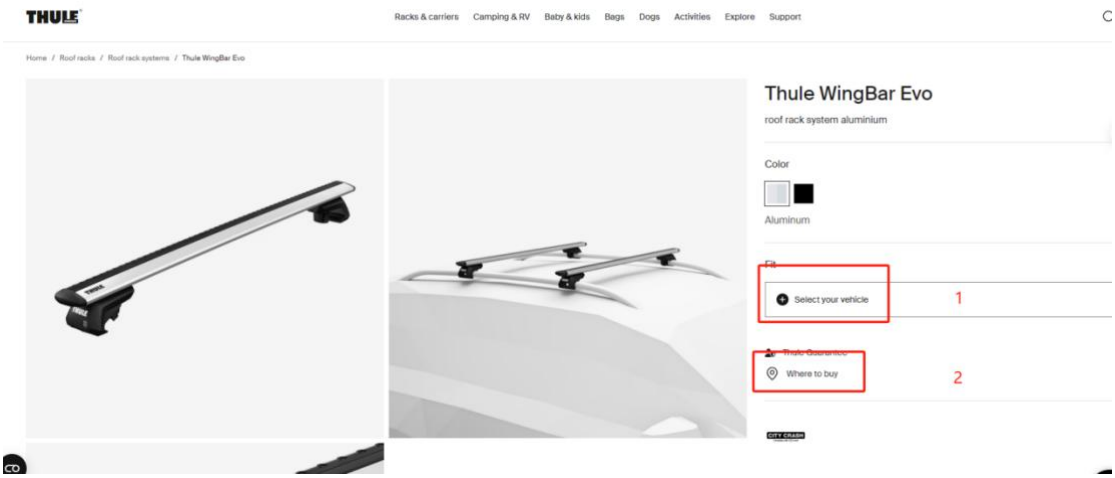
1 Try to choose an SUV model with a relatively short rear to minimize obstruction of sensors by the vehicle's rear end.
2 It is recommended to choose a vehicle with a factory-installed roof rail (which must support a weight capacity of over 100 kg and not be purely decorative) for easier installation of the luggage rack crossbar.
3 If the selected vehicle does not have a roof rail, you must first purchase a luggage rack crossbar, as shown in the diagram, for installation.



4 It is recommended to choose a vehicle with sufficient trunk space for the main equipment box, battery accessory box, and other equipment to facilitate storage and transportation.

★ Luggage Rack Crossbar Selection

1 The luggage rack crossbar is not included in the delivered contents. The user needs to select an appropriate crossbar based on the vehicle model. The crossbar must support a weight capacity of over 100 kg.
2 After screening various pre-made luggage rack crossbars available on the market, it is recommended to use the Thule WingBar Evo, which has high compatibility. Users can check the compatibility of their vehicle model on the Thule website and find where to purchase the luggage rack crossbar.
Official website link:
https://www.thule.com/en-hk/roof-rack/car-roof-racks/thule-wingbar-evo-_-711xxx


THULE
Racks & carriers
Camping & RV
Baby & kids
Bags
Dogs
Activities
Explore
Support
Thule WingBar Evo
roof rack system aluminium
Color
Aluminum
Select your vehicle
1
Where to buy
2

Attachment 4 B60 Battery Safety Usage Guidelines

These Safety Usage Guidelines (this "**Guide**") include instructions on the safety, operation and maintenance of the B60 Intelligent Rechargeable Battery (the "**Battery**"). To avoid accident, injury or adverse effects or damage caused by improper use of the Battery, please read this Guide carefully before assembling, setting up, and using the Battery, and keep this Guide properly. We suggest that you read this Guide and familiarize yourself with the features of the Battery before operating the Battery.

Improper use of the Battery (including but not limited to improper charging, discharging, etc.) may result in fire, serious injury to oneself or others, or damage and loss of the Battery. Before operating the Battery, please make sure to read this Guide carefully, as it will help you use the Battery more effectively. GreenValley International ("GVI") will not be responsible for any damages or losses incurred due to operating the Battery without following the required procedures or due to misunderstandings of the instructions provided in this Guide. GVI is committed to continuously improving the functionality and performance of the Battery, enhancing service quality, and GVI reserves the right to update or adjust the content of this Guide without prior notice.

When using this Battery, do not use components that are not provided or recommended by GVI. Please strictly follow the instructions of GVI when installing and using the Battery.

This Battery is not suitable for use by children.

This Guide uses the following terms to classify and explain potential hazards that may arise from improper operation.

- ATTENTION: Failure to follow the instructions may result in property damage and minor injury.
- WARNING: Failure to follow the instructions may result in property damage, major accidents, and serious injuries.

WARNING

Use

1. It is strictly prohibited to allow the Battery come into contact with any liquid. Do not put the Battery in water or wet it. Do not use the Battery in rainy or humid environments. When the inside of the Battery coming into contact with water, it may trigger certain decomposition reaction, causing the Battery to self ignite or even potentially lead to an explosion.
2. It is strictly prohibited to use Battery which is not provided by GVI. Please go to the official website of GVI for relevant information if you need to replace the Battery. GVI shall not be liable for any accidents, malfunctions, or other losses or damages caused by the use of batteries which are not provided by GVI.
3. It is strictly prohibited to use Battery with bulging, leaking, or damaged packaging. Please contact GVI or our designated resellers for further handling if any of the above situations occur.

4. Before installing or removing the laser radar device from the Battery, please keep the Battery power off. Do not plug/unplug the Battery while the power is turned on, as it may damage the power interface.
5. The Battery should be used at an ambient temperature between -10℃ and 40℃. Excessive temperature (above 50℃) may cause the Battery to catch fire or even explode. Temperature below -10℃ will severely damage the Battery's lifespan.
6. Do not use the Battery in environments with strong static electricity or magnetic fields. Otherwise, the protection board of the Battery may malfunction, resulting in serious malfunctions of the LiDAR equipment.
7. Do not disassemble or puncture the Battery with sharp objects in any way, which may cause the Battery to catch fire or even explode.
8. The liquid inside the Battery is highly corrosive. Please stay away if there is any leakage. If internal liquid splashes onto human skin or eyes, please rinse immediately with clean water for at least 15 minutes and seek medical attention immediately.
9. If the Battery falls off from the LiDAR equipment or is impacted by external forces, it must not be used again.
10. If the Battery accidentally falls into the water during the operation of the LiDAR equipment or in other situations, please immediately remove the Battery and place it in a safe and open area. Meanwhile, keep away from the Battery until it is completely dry. Dried Battery should not be reused and should be disposed of properly according to the following Disposal methods in this Guide. If the Battery catches fire, it is recommended to use solid fire extinguishing equipment in the following order: sand, fire blanket, dry powder, carbon dioxide fire extinguisher.
11. Do not place the Battery in microwave or pressure cooker.
12. Do not place the battery cell of the Battery on conductive surfaces.
13. Do not use wires or other metal objects to cause a short circuit between the positive and negative terminals of the Battery.
14. Do not impact the Battery. Do not place heavy objects on the Battery or its charger.
15. If there is any dirt on the Battery interface, please wipe it clean with a dry cloth. Otherwise, it may cause poor contact, and may further resulting in energy loss or failure to charge.

Charging

1. The Battery must be charged with the dedicated charger provided by GVI. GVI will not be held responsible for any consequences arising from the use of charger provided by non official sources.
2. When charging, please place the Battery and its charger on a cement floor or other environments without surrounding flammable or combustible materials, and please pay attention to the charging process to prevent accidents.
3. After operating the LiDAR equipment, please confirm the Battery temperature before charging. If the Battery is in a high temperature state, charging will cause serious damage to the Battery's lifespan. We suggest waiting for the Battery to cool down to room temperature before charging. The ideal charging environment temperature (5℃ - 40℃) may significantly extend the lifespan of the Battery.
4. After charging, please disconnect the charger from the Battery. Please regularly exam and maintain the charger, and frequently inspect the appearance of the Battery and other components. Do not use alcoholic sprays or other flammable agents to clean the charger. Do not use damaged charger.

Storage and Transportation

1. Please store the Battery where it is unreachable for children. If children accidentally swallow any parts of the Battery, please seek medical assistance immediately.
2. Do not place the Battery near a heat source, such as in a car under direct sunlight or hot weather, a fire source, or a heating furnace. The ideal storage temperature for the Battery is 22℃ - 28℃.
3. The environment for storing the Battery should be kept dry. Do not place the Battery in water or in areas where water leak may happen.
4. It is prohibited to mechanically impact, crush, or puncture the Battery, and it is prohibited to drop or manually short-circuit the Battery.
5. Do not store or transport the Battery together with glasses, watches, metal necklaces, hair clips, or other metal objects.
6. Do not transport damaged Battery. Once the Battery needs to be transported, please make sure to discharge it to about 50% of its capacity.

Disposal

1. Please make sure to completely discharge the Battery before placing it in the designated battery recycling bin. Batteries are hazardous chemicals and are strictly prohibited from being disposed of in ordinary garbage bins. Please follow local laws and regulations regarding battery recycling and disposal for relevant details.

Maintenance

1. Do not use the charger in environments with excessive high or low temperatures.
2. It is prohibited to store the Battery in environments with room temperature exceeding 60℃.

Transportation Precautions

1. Before carrying the Battery on an airplane, please make sure to discharge it to below 5% of its capacity. Please stay away from fire sources before discharging.

ATTENTION

Use

1. Please make sure the Battery is fully charged before each use.
2. If the Battery indicator light enters a single cell flashing state, it is necessary to stop using the Battery as soon as possible and shut it down, replace or charge the Battery.

Charging

1. The Battery will automatically stop charging when fully charged. It is recommended to disconnect the charger after the Battery is fully charged.
2. Please keep the Battery turned off while charging.

Storage and Transportation

1. If the Battery is not used for more than 10 days, please discharge it to about 40%-65% of its capacity for storage, which can extend the Battery's lifespan. A fully charged Battery that is not used for a long time will automatically execute a discharge process. During the discharge process, the temperature of the Battery may rise, which is normal. It is recommended to store the Battery in a dedicated compartment.
2. It is prohibited to store the Battery for a long time after completely discharging it, in order to avoid the Battery entering an over-discharge state, causing damage to the battery cell and even making it unusable.
3. If the Battery is severely low-battery and idle for too long, it will enter deep sleep mode. To wake up the Battery from deep sleep mode, you need to charge it.
4. If long-term storage is required, the Battery needs to be removed from the LiDAR equipment.

Disposal

1. If the Battery cannot be completely discharged due to a power switch malfunction, please do not dispose of the Battery directly in the battery recycling bin. Please contact professional battery recycling company for further handling.
2. Please replace the Battery when the battery life is 0%.

Maintenance

1. Do not overcharge, otherwise it will cause damage to the battery cell.
2. Leaving the Battery idle for a long time will have an impact on its performance.
3. Please recharge and discharge the Battery every three months or so to maintain its activity.

Transportation Precautions

1. Please make sure to store the Battery in a well ventilated and dry environment.

Attachment 5 Calibration Field Data Collection Tutorial

★ Collection Area

Select an open intersection area with good satellite reception for data collection. The intersection must have clear road markings, and there should be traffic signs or reference objects such as buildings around three to four stories high nearby for calibration.

★ Collection Time

Data collection must be conducted on clear days with sufficient light conditions. Additionally, avoid collecting data during peak traffic hours to minimize the impact of surrounding vehicles on the data.

★ Driving Route

Ensure the vehicle drives straight through the intersection. Do not make turns within a 200-meter radius of the intersection, and ensure that all four roads are collected as shown in the diagram.

Carefully plan the route to avoid passing through the intersection multiple times, which could interfere with the data.

★ Collection Operational Standards

Strictly follow the data collection process and guidelines mentioned in the manual, paying attention to inertial navigation alignment (both stationary and acceleration/deceleration operations). During the collection process, maintain a vehicle speed around 40 km/h. Reversing, abrupt braking, and other such actions are prohibited.

★ Number of Collections

It is necessary to collect 2-3 sets of calibration field data, with one set for calibration and others for validation.

★ Upload the Collected Data

Please upload the raw files and simultaneously upload the base station data.

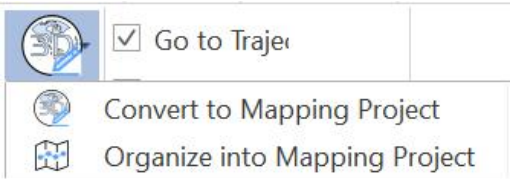
Attachment 6 Mask File Creation Tutorial

The software comes with a built-in universal mask file. If the mask file does not fit well with the captured panoramic photos or if you want to achieve better coloring effects, it is recommended that users utilize the Make Mask function button under the Raster module in the mapping project to create a custom mask.

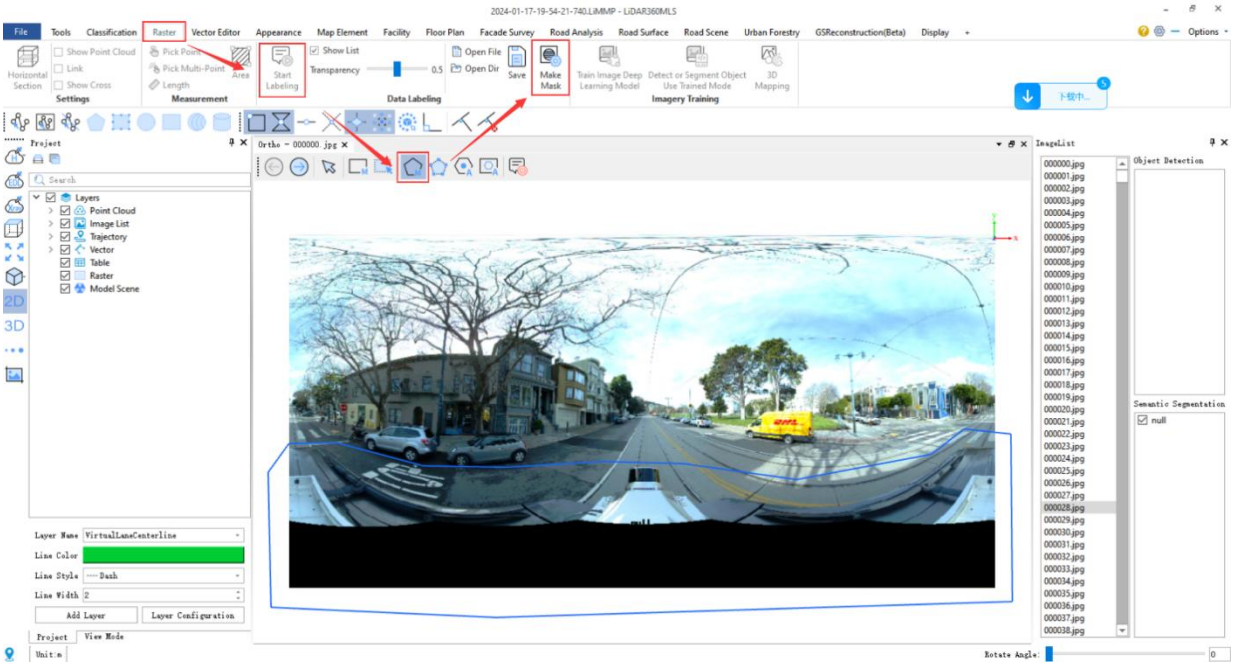
The specific steps are as follows:

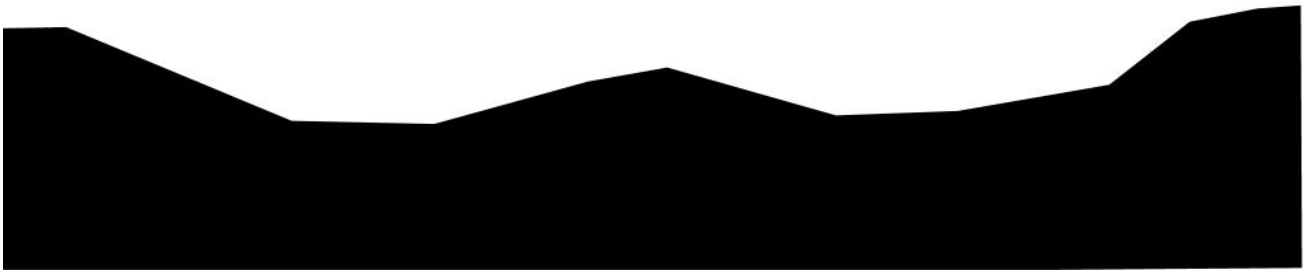
1. Users need to first parse the panoramic photos.

2. Convert to the mapping project.



3. As shown in the diagram, under the Raster module, draw the mask range and make the mask.





To achieve better coloring effects and alleviate the jagged coloring of lane lines, please draw the mask as shown in the figure below to cover the lane line position as much as possible.