ComNavTech

ML300
Mobile Laser Scanning system

User Guide



Reading instructions

Dear user:

Thank you for using the ML300 mobile laser scanning system. We are pleased to provide you with vehicle-mounted mobile measurement data collection and processing services. ComNav Technology Ltd. is committed to continuously improving our products. We welcome your valuable comments and suggestions on our hardware equipment, processing software, training and documentation materials. Sincerely thank you.

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, ComNav 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, ComNav 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 ComNav, ComNav will not bear all relevant responsibilities if the instrument is damaged due to self-assembly or self-disassembly operations without the support of ComNav Users need to use the original battery and accessories of ML300. 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, ComNav will not bear the relevant responsibilities and the warranty qualification will be invalid.

The user manual of ML300 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 ComNav or contact our technical support staff to obtain it.

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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	ComNav 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 ComNav. • 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

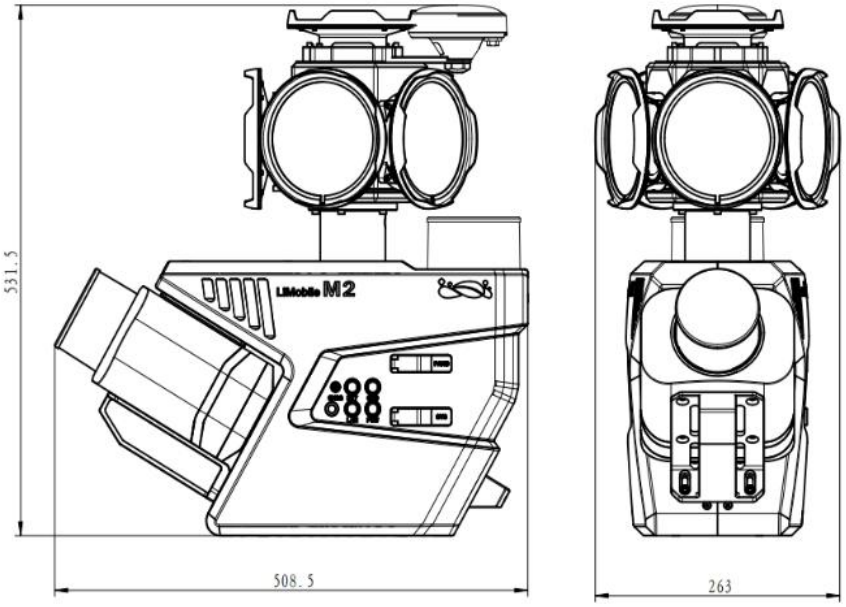
⚠ **Warning**	Although the device is manufactured in strict accordance with relevant regulations and standards, the possibility of interference with other equipment or effects on people and animals cannot be completely ruled out. • Do not use the device for operation near gas stations, chemical facilities, 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

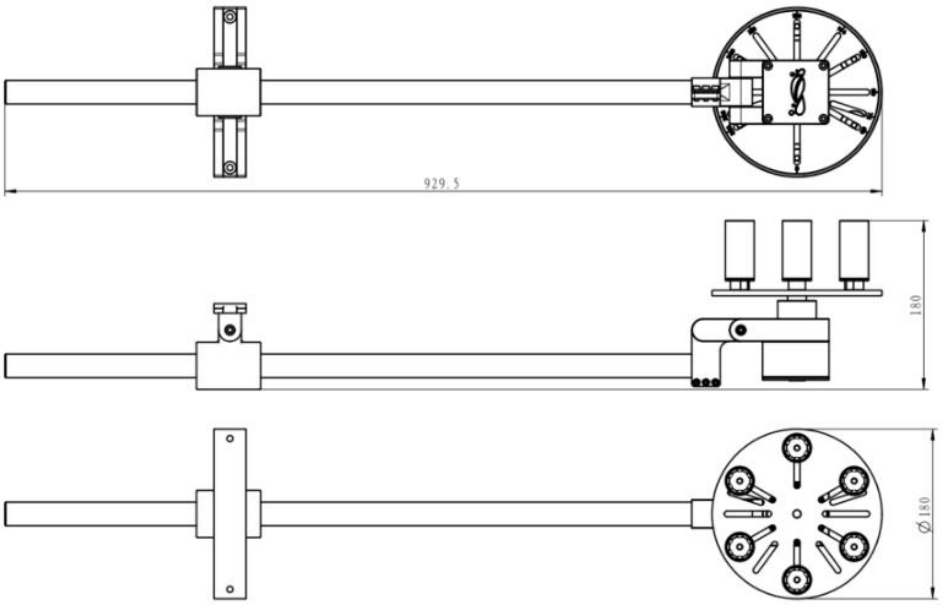
The ML300 affordable mobile laser scanning (MLS) system is equipped with two LiDAR sensors (one tilted at a 30-degree angle and one positioned horizontally) and a Ladybug5+ panoramic camera, enabling efficient 3D mapping of roads and surrounding environments. Even in GPS-denied areas, high-precision 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 ComNav'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

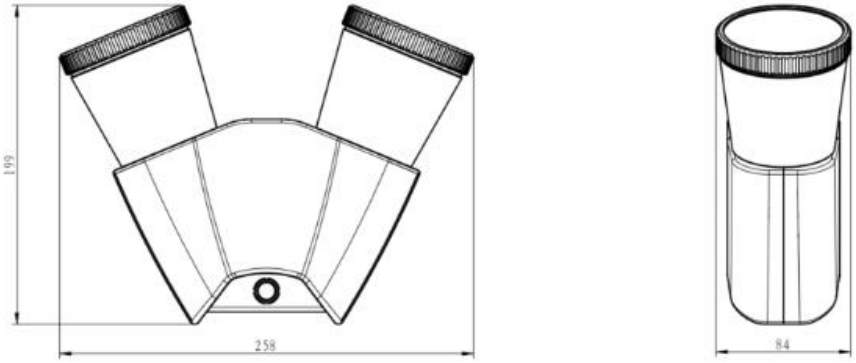
As shown in the figure below, the structure diagrams of the main unit, planar cameras (pavement camera and front camera are identical), and DMI are provided (dimensions are in millimeters).



(1) Sensor Unit

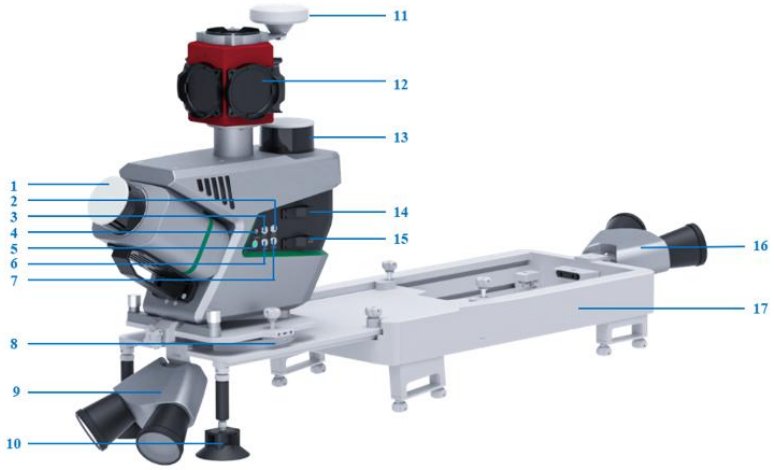


(2) DMI



(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:	ML300_xxxx
Default Password	Comnav

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 ML300 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 Attachment 2: "ML300_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 3: "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

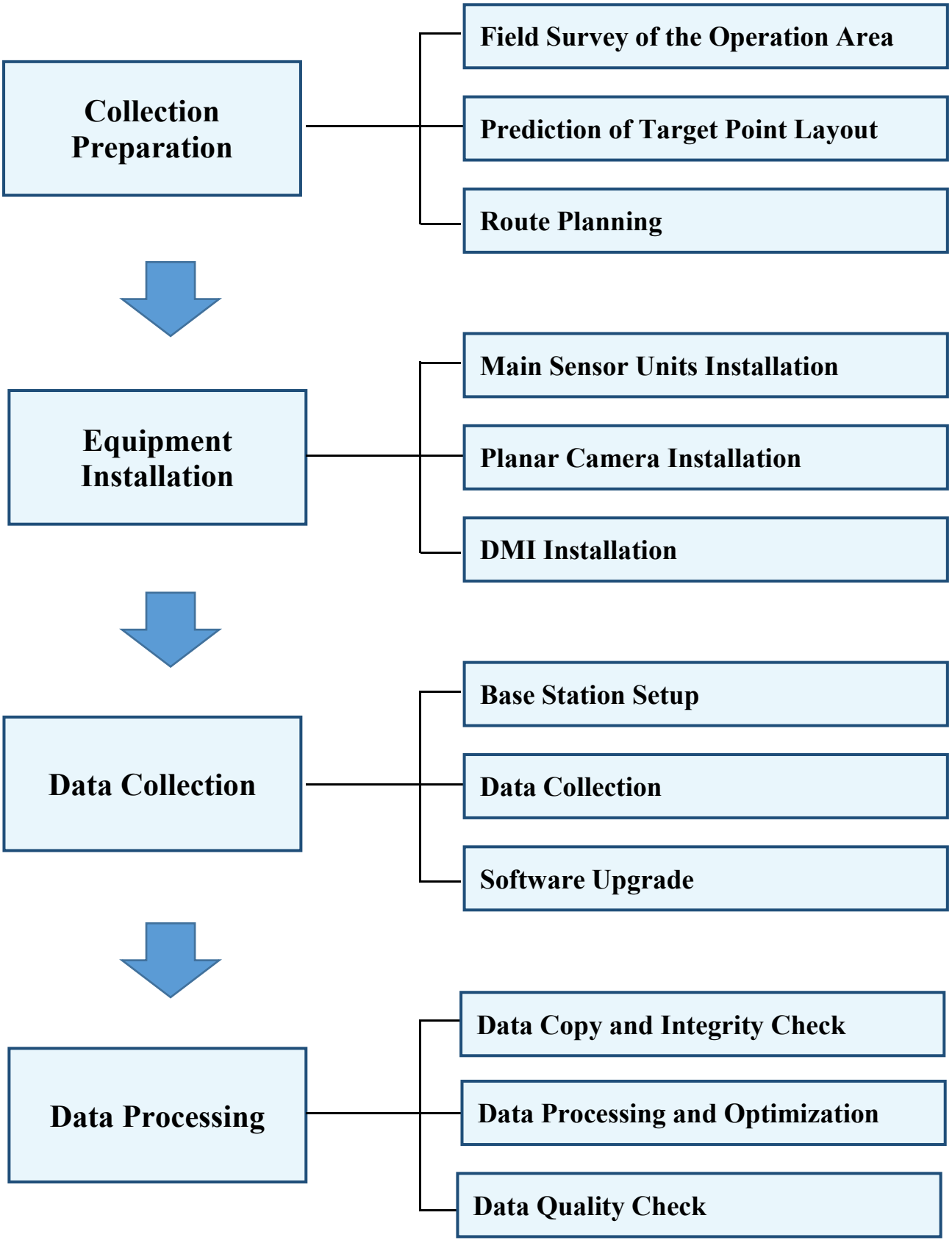
The device needs to be initialized in an open area with good GPS signal.
The data collection duration must be greater than 10 minutes.
Make sure that the inertial navigation system is initialized with more than 15 satellites and PDOP is less than 2.
After the device is powered on, please ensure first 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.

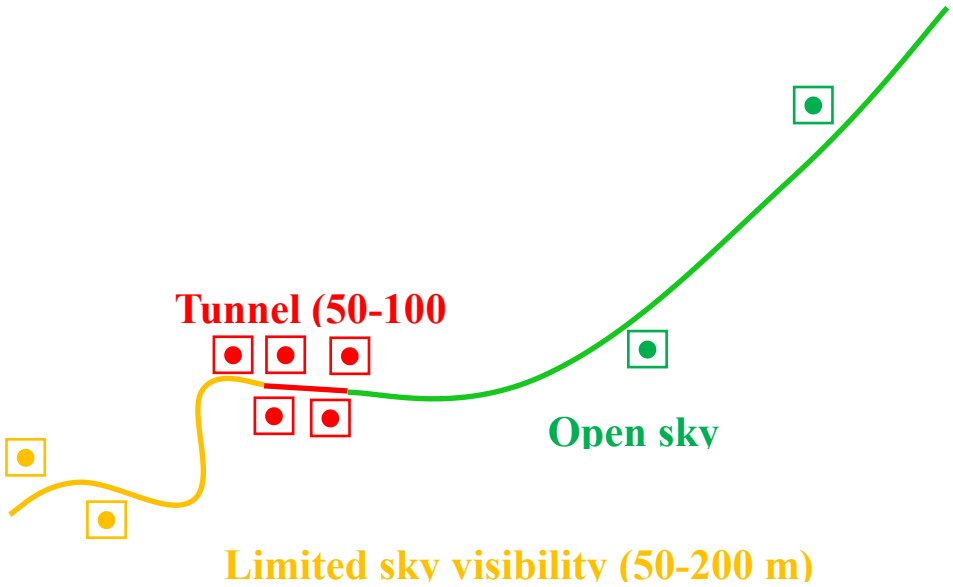
5.2 Prediction of target point layout

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.

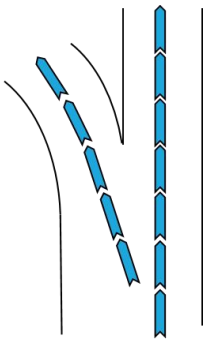
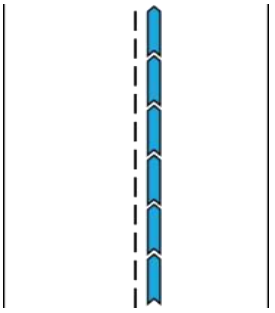
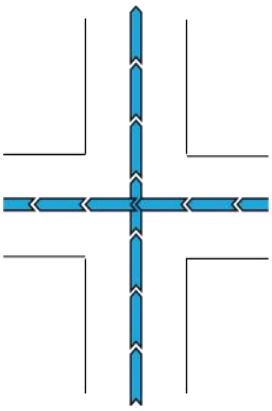
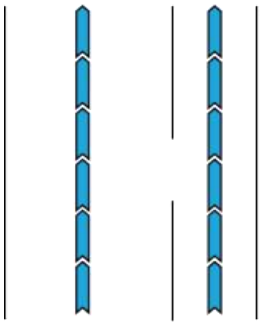
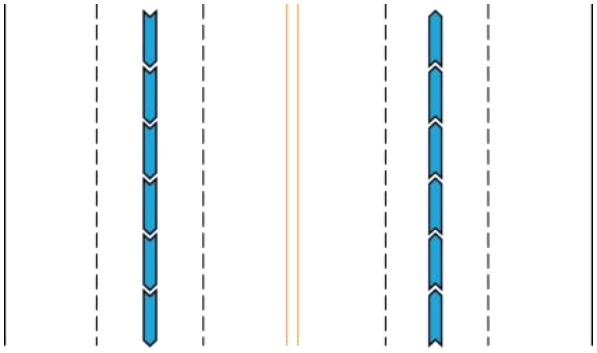
3. Layout specification: as shown in the figure below. Target points should be appropriately increased in places where there are dense trees on both sides of the road, under bridges and tunnels, etc., which may cause satellite signal loss.

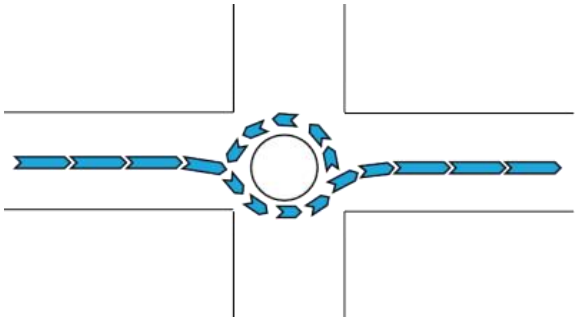
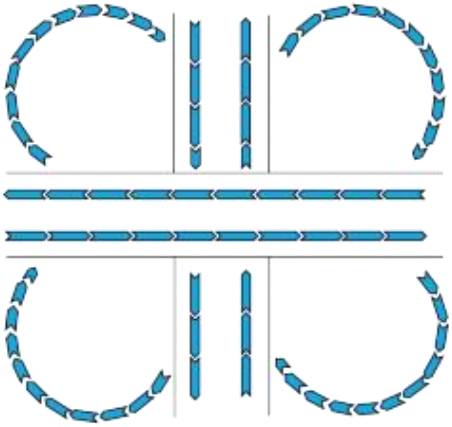
4. Surveying instruments: RTK, total station.



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

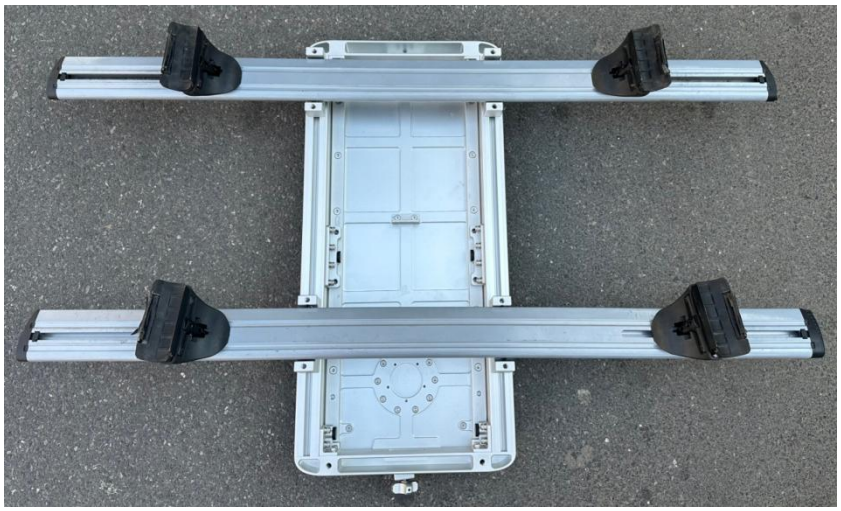
6.1 Main Sensor Unit Installation

6.1.1 Roof Rack and Luggage Rack Crossbar Installation

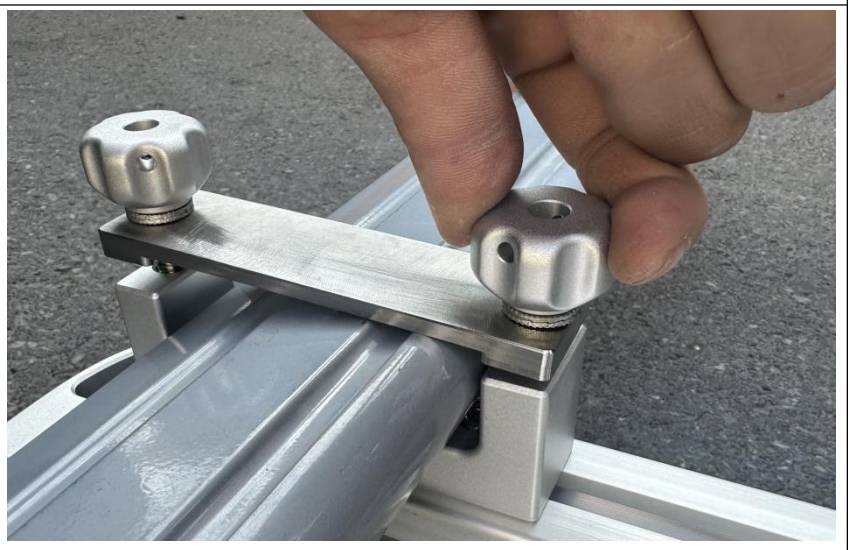
1. Place the roof rack upside down on the ground and place the luggage rack crossbar in the positioning slot underneath it.

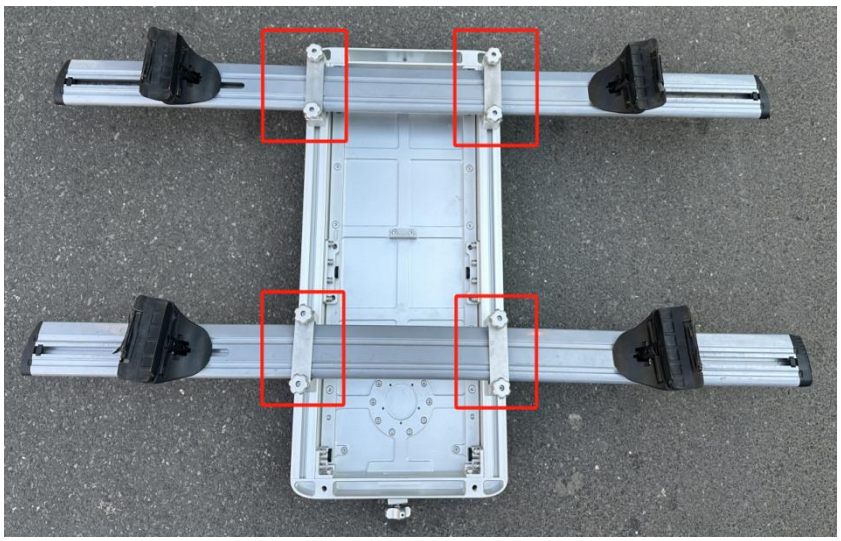
☆ Notes:

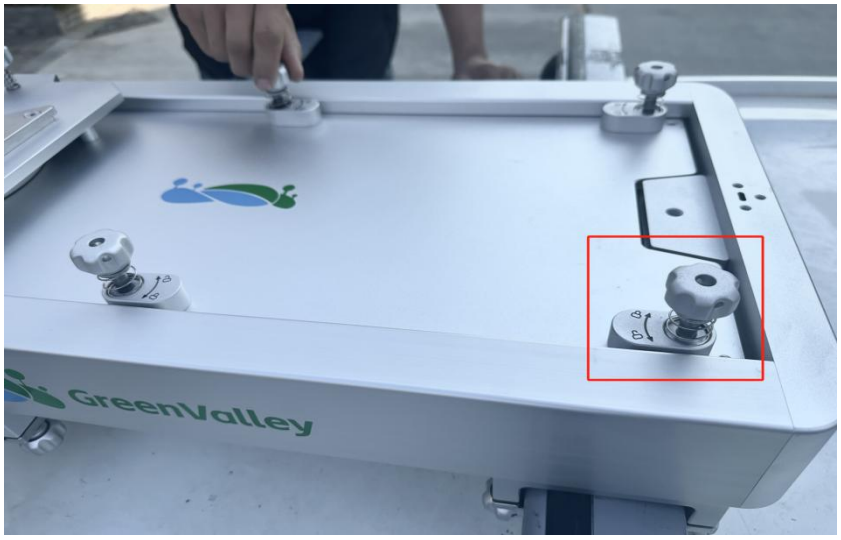
1. The roof rack crossbars are not included in the delivery. Users need to prepare them by referring to Attachment 4: " Vehicle and Luggage Rack Crossbar Selection Guide".
2. Position the roof rack as centrally as possible on the luggage rack crossbar.



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.

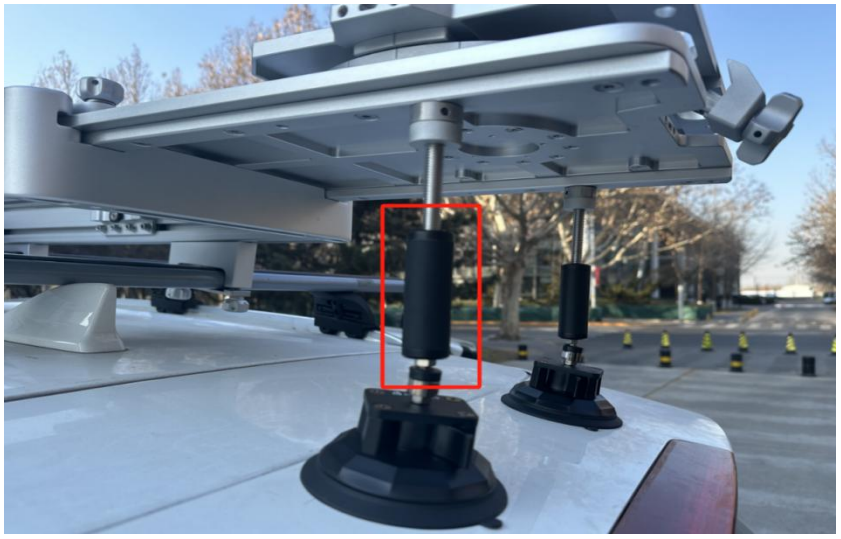




3. Place the luggage rack crossbar and roof rack on the vehicle roof, and use an Allen wrench to tighten the four mounting clamps on the luggage rack crossbar. ☆ Notes: 1.Install the equipment towards the rear of the vehicle to minimize obstruction. 2.The distance between the positioning slots of the 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.	

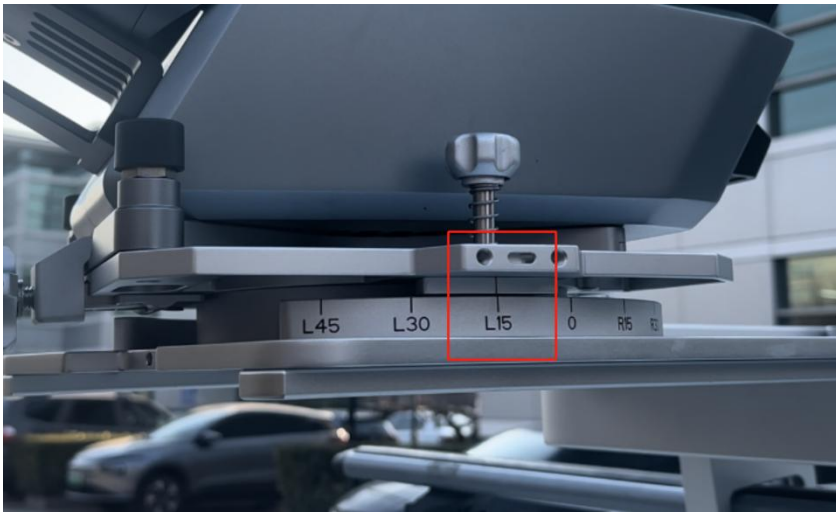


6.1.4 Rotation of the Sensor Unit (Optional)

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



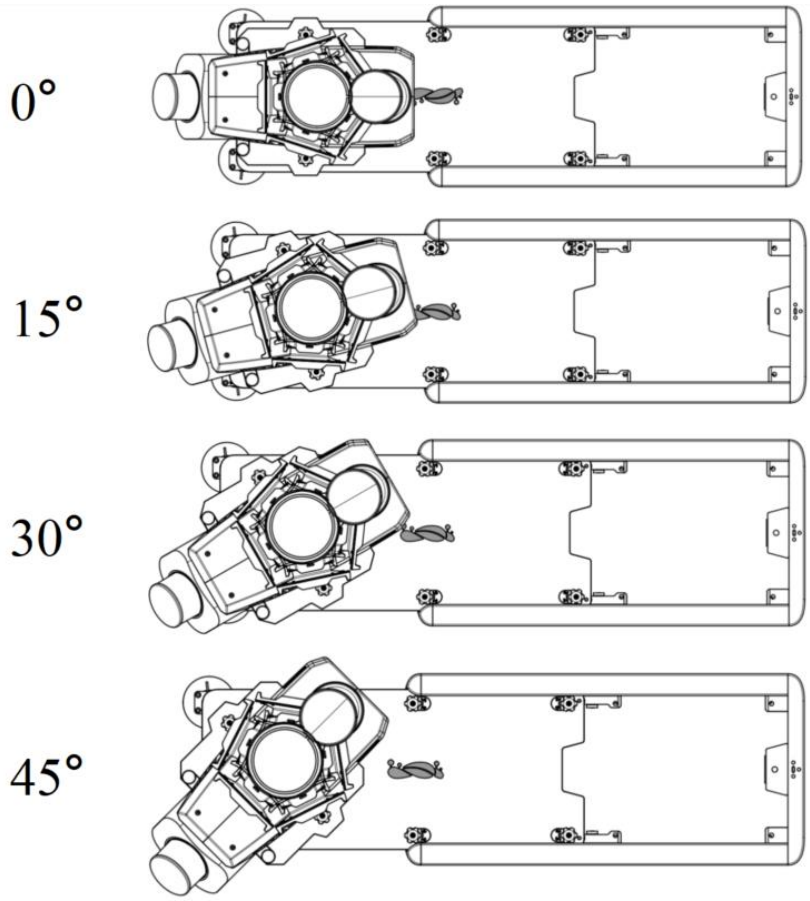
2. Choose an appropriate angle based on the scale on the side of the swivel plate to rotate the equipment.



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.

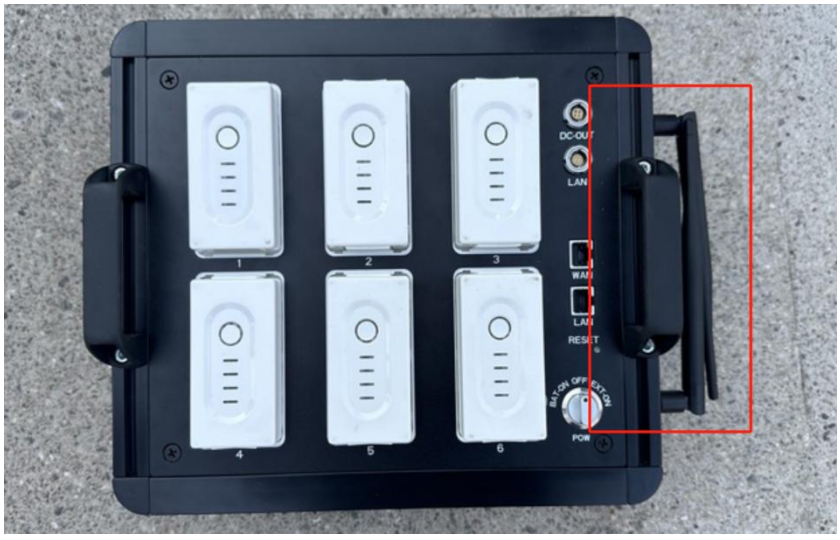


6.1.6 Wi-Fi Antenna Installation

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

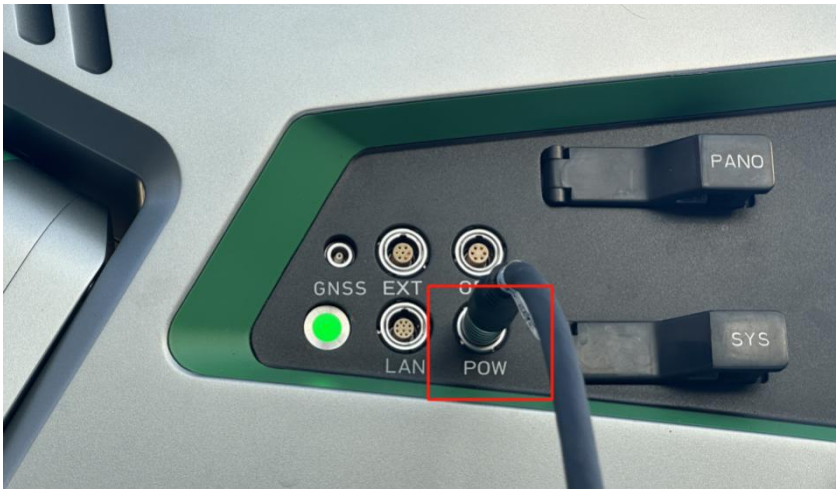


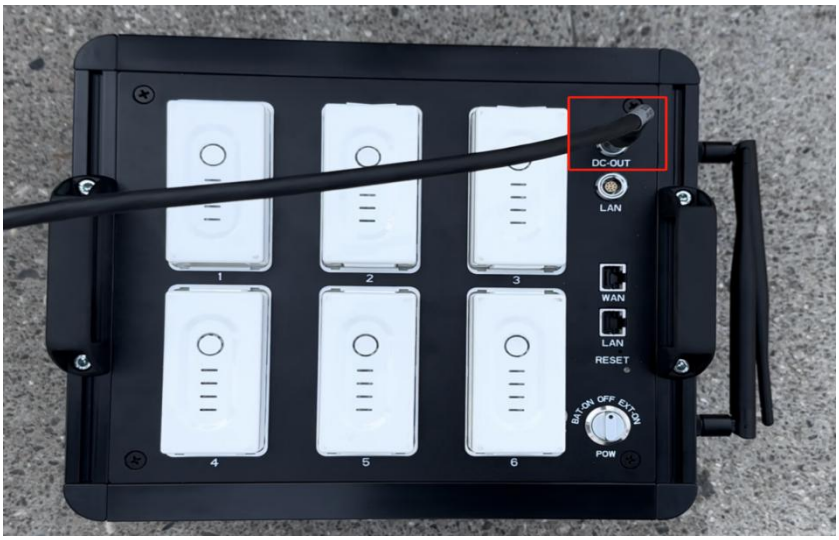
2. To reduce the risk of breakage from external force, bend the antennas inward.



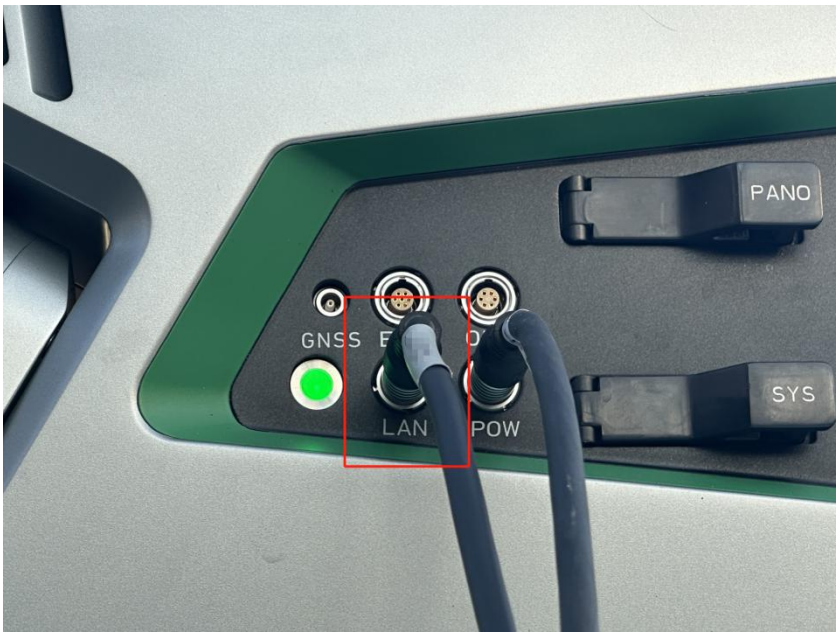
6.1.7 Cable Connection

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





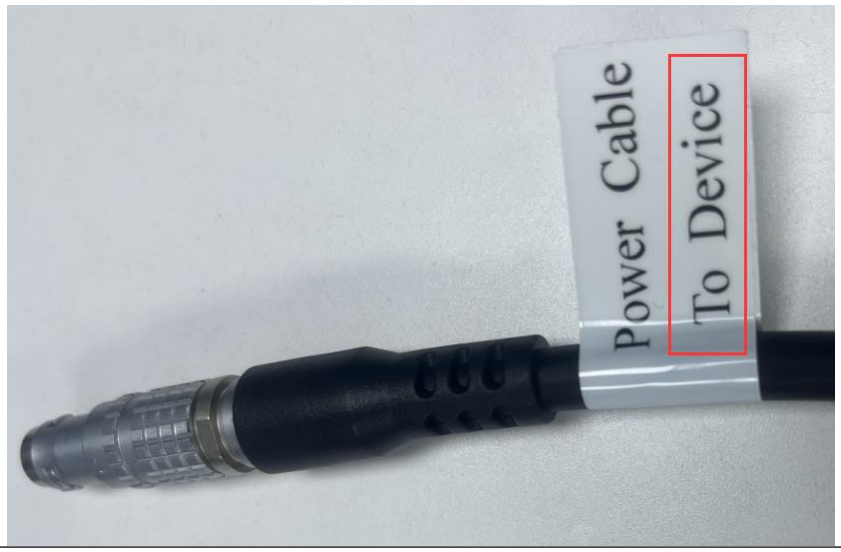
2. Use the network cable to connect the LAN port of the multifunctional battery compartment to the LAN port of the main equipment system.



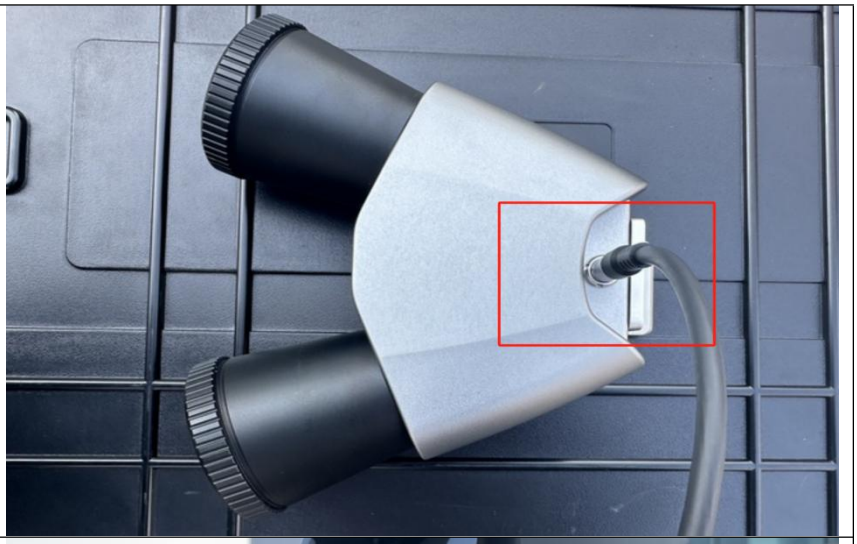




☆ Note: Ensure to distinguish between the network cable ports at both ends to prevent equipment damage due to incorrect plugging.



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.



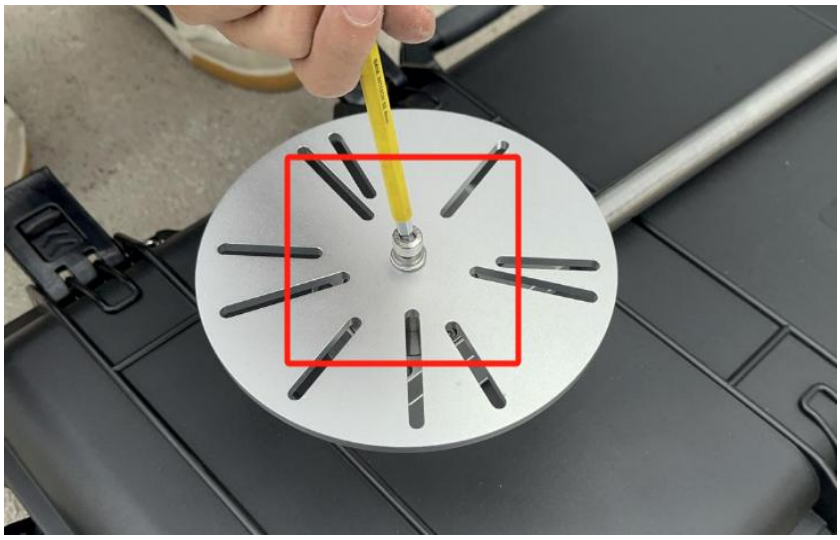
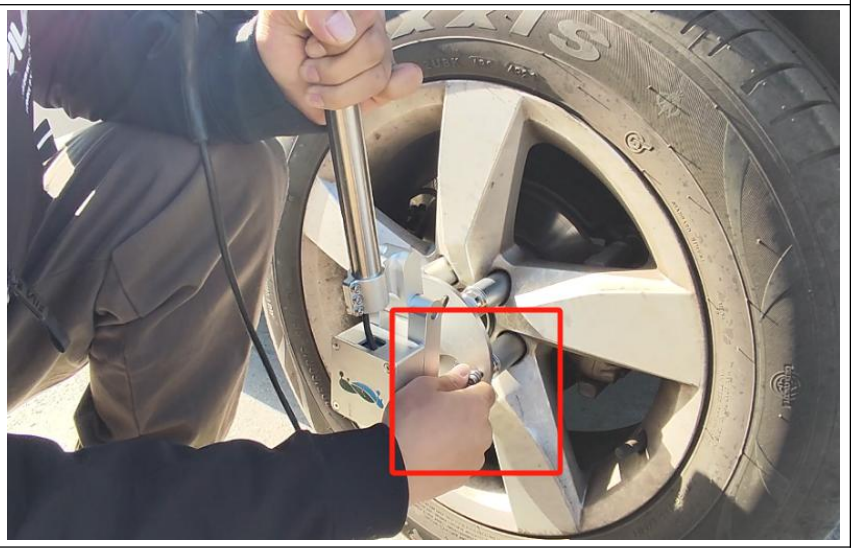
☆ Note: When the resistance of the screw increases, users can reverse the screw half a turn before continuing to tighten. During the tightening process, keep your hands steady to ensure that the outer wall of the socket and the hub are always in snug contact.



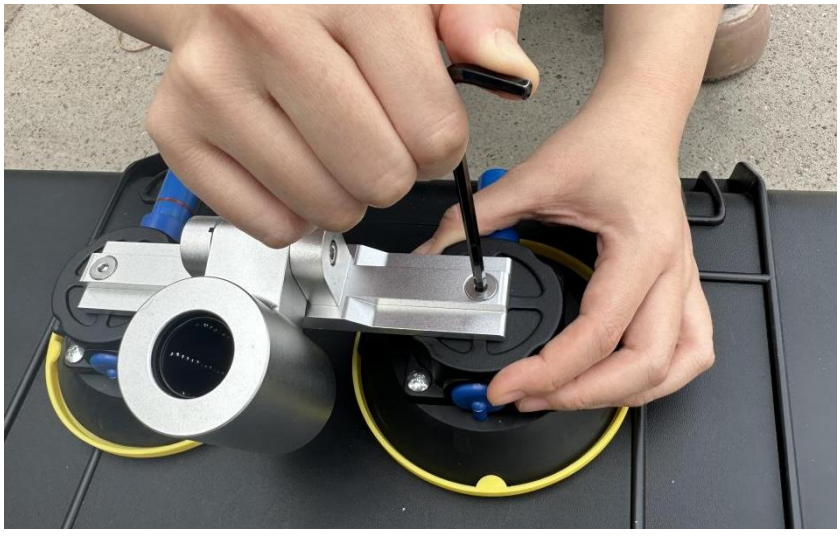
3. Repeat the above steps to complete the installation of all sockets.

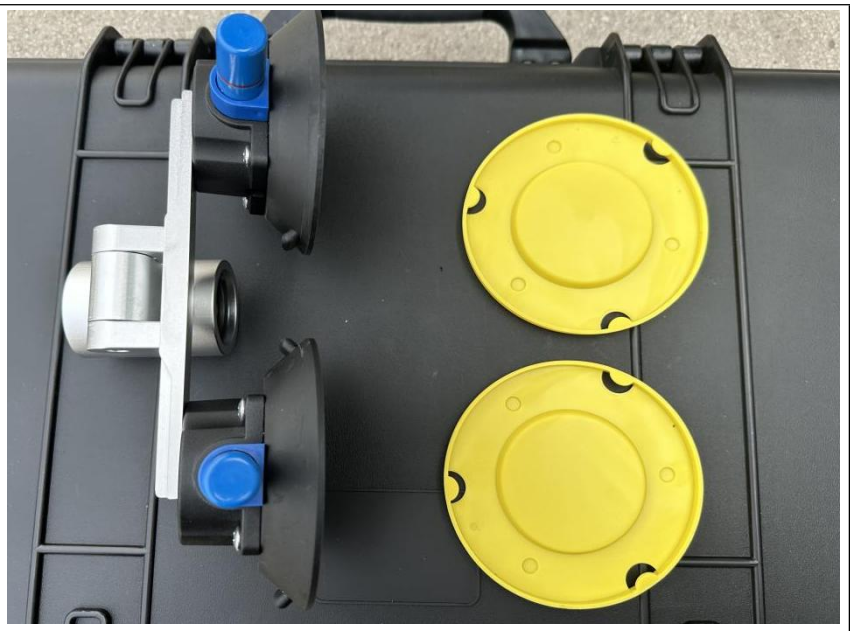


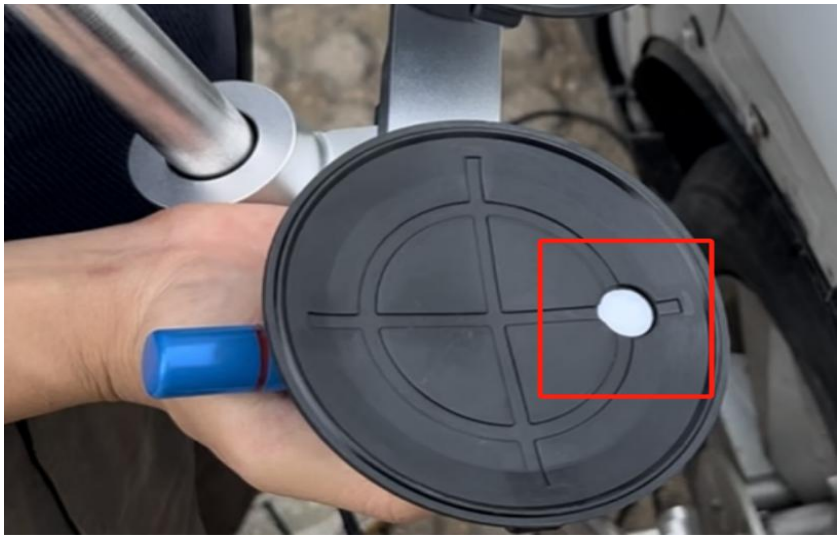
6.4.3 Main Component of the DMI Installation

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.	

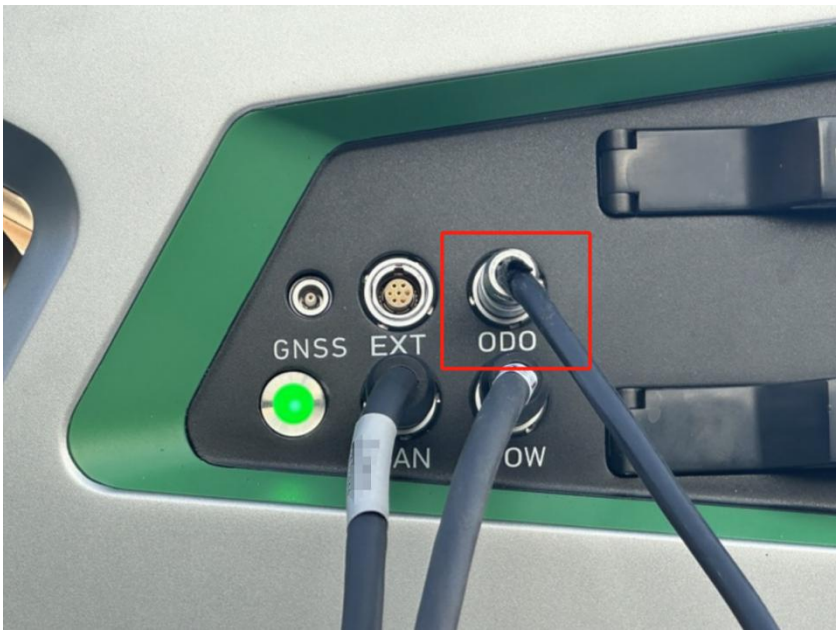
6.4.4 Suction Cup Fastener Installation

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.	

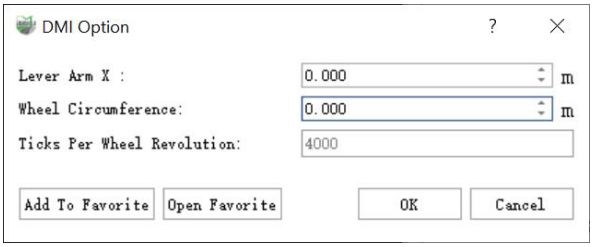
5. Press firmly on the suction cup, continuously pressing down on the blue piston until the suction cup is fully attached.	
☆ Note: Please remove the white cotton pad before pressing the blue piston.	

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.

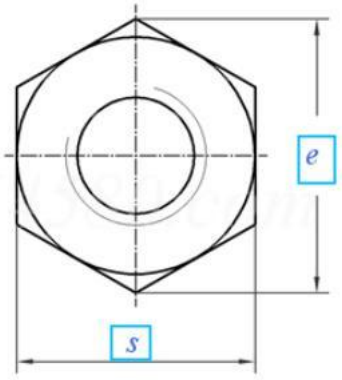




☆ Notes:

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

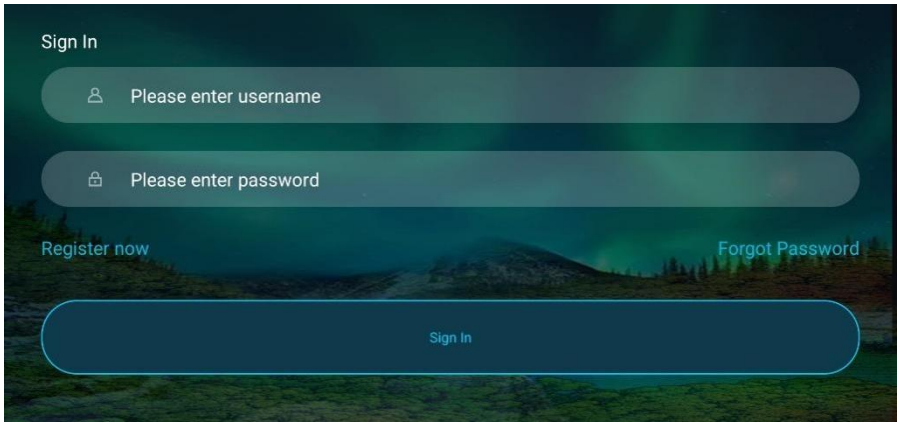
Before data collection, users need to plan and set up the base station location appropriately. If using our LiBase equipment, specific operations can be found in the "LiBase Quick Guide" and "LiSurvey User Manual."

☆ Note:

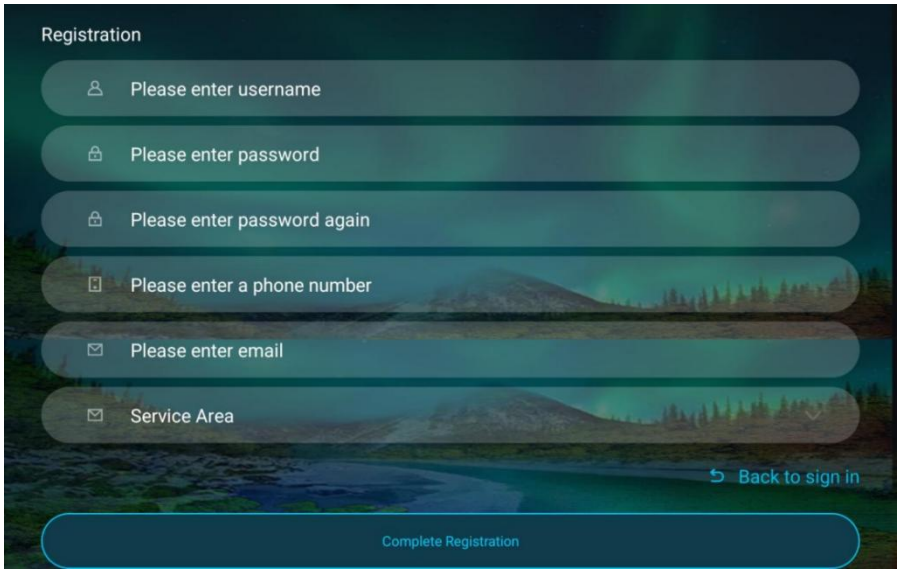
1. To ensure data accuracy, plan the base station location reasonably. The base station setup range should not exceed 20 km.
2. The base station setup time must fully cover the data collection time, with an additional 15 minutes before and after.
3. Multi-base station data trajectory resolution requires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

7.2 User Registration and Sign In

1. The ML300 device requires signin to the ComNav 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.



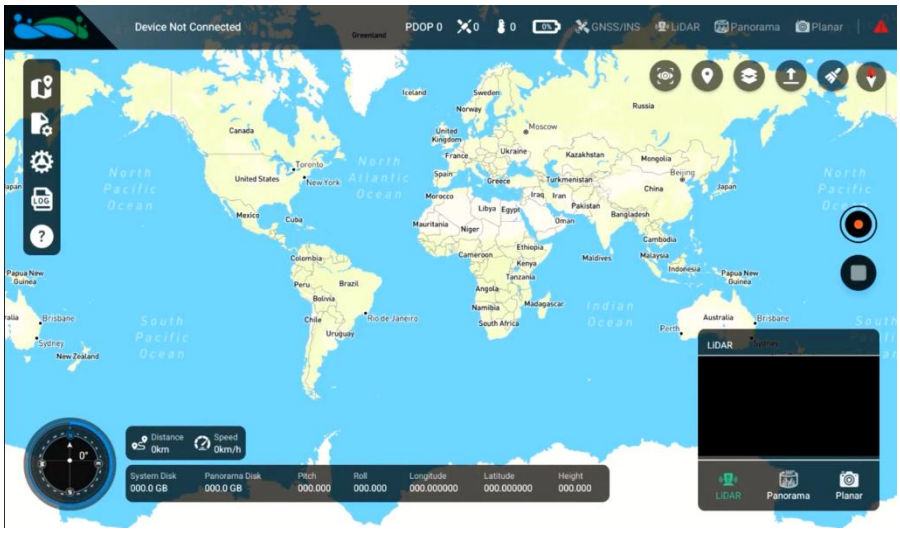
2. After filling in the information, click the **Complete Registration** button, and the app will automatically return to the Sign In interface.



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

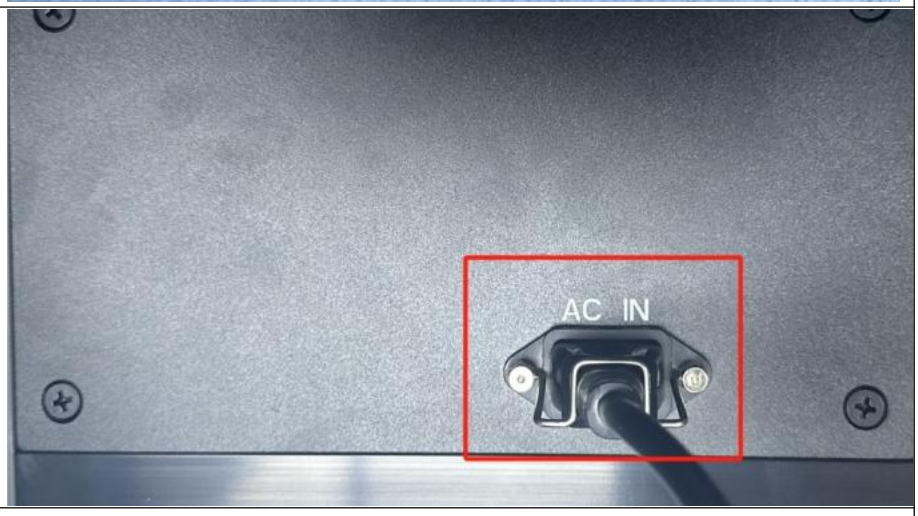
7.3.1 Battery Power Supply

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.	

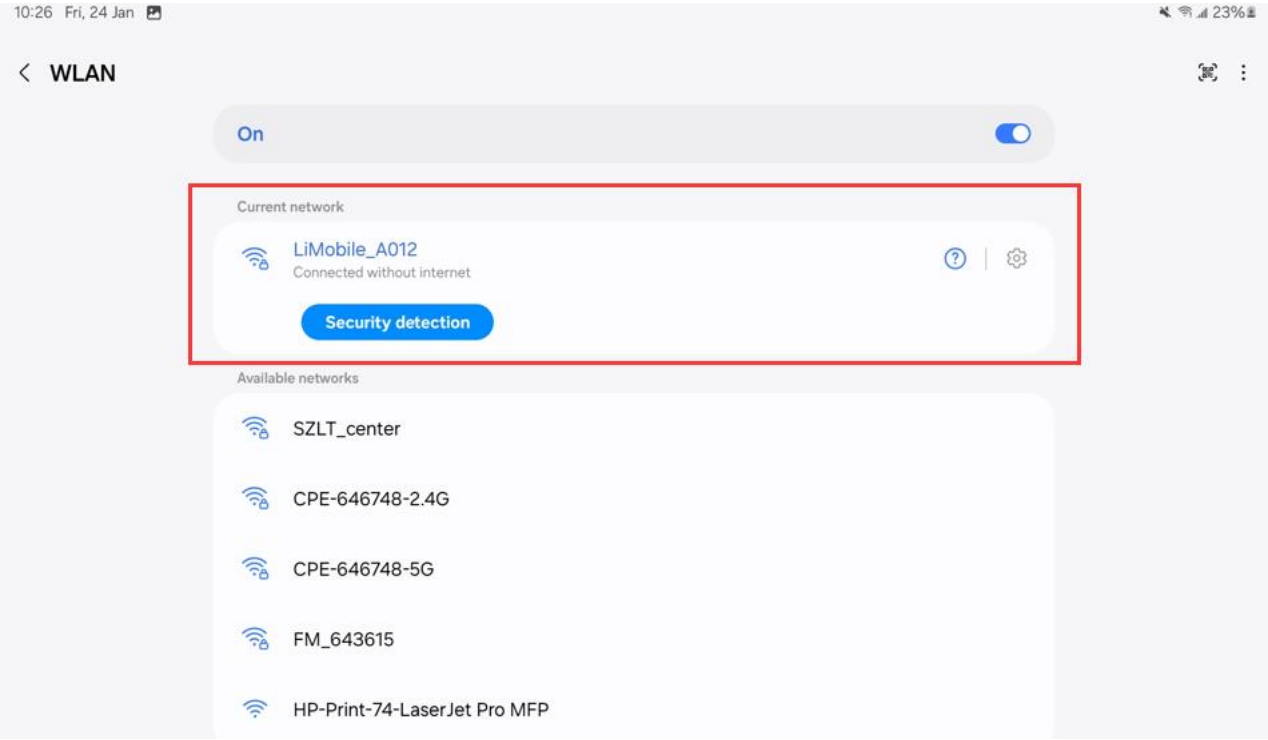
7.4 Device Connection

7.4.1 Wi-Fi Connection

Search for the Wi-Fi name: ComNav ML300_xxxx on the mobile device.

Enter the default Wi-Fi password: comnav.

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

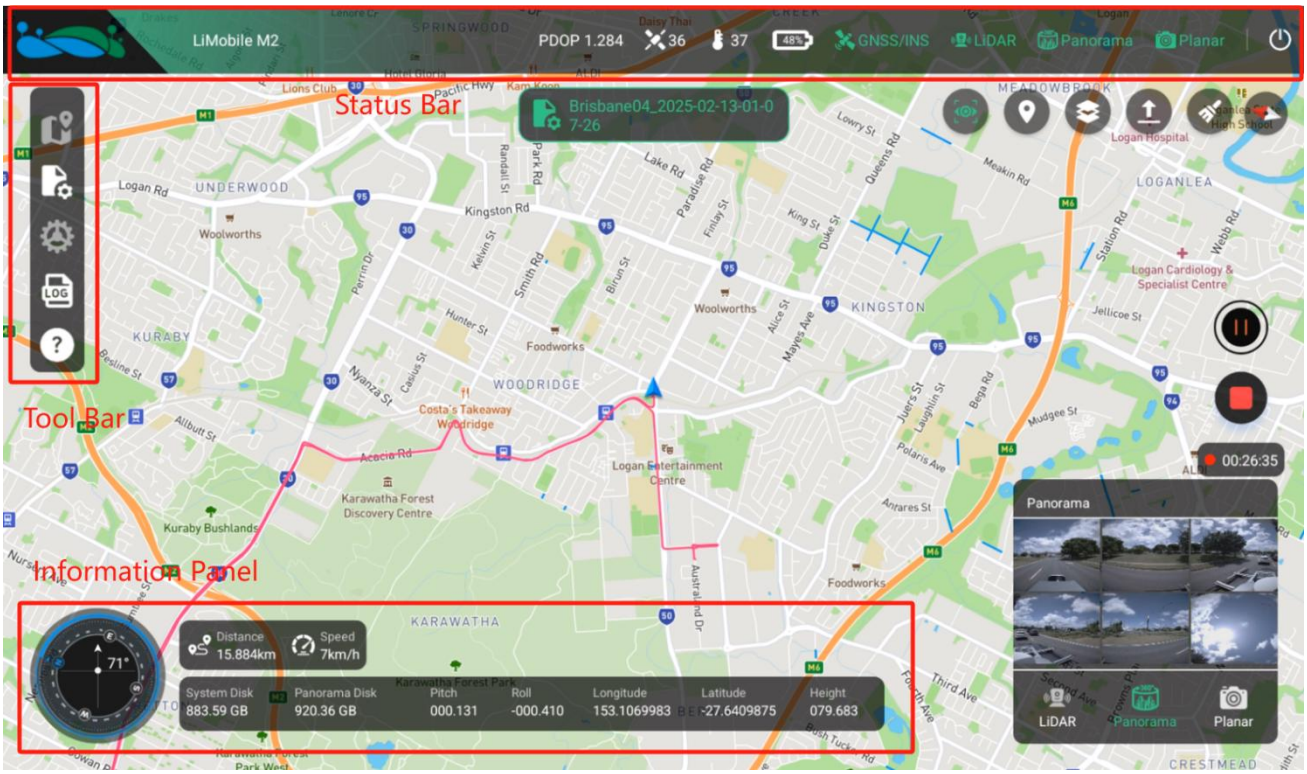


7.4.2 Wired Connection

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.	

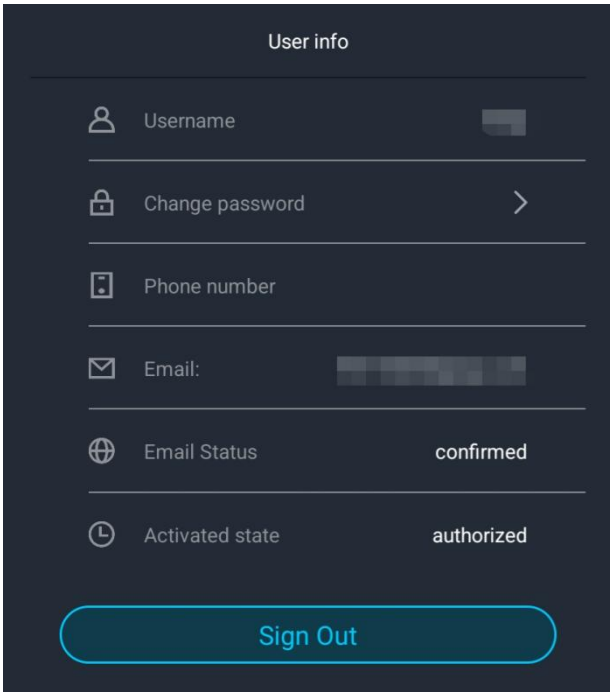
7.5 APP Interface Overview



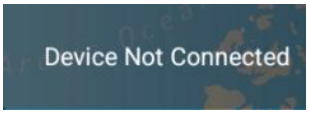
7.5.1 Top Device Status Bar

1. Account Management Button

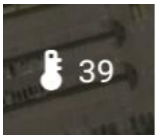
	User Management Interface: Users can view account information, activated status, and perform operations such as **Sign Out**.



2. Device Connection Status

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

3. Device Status Information

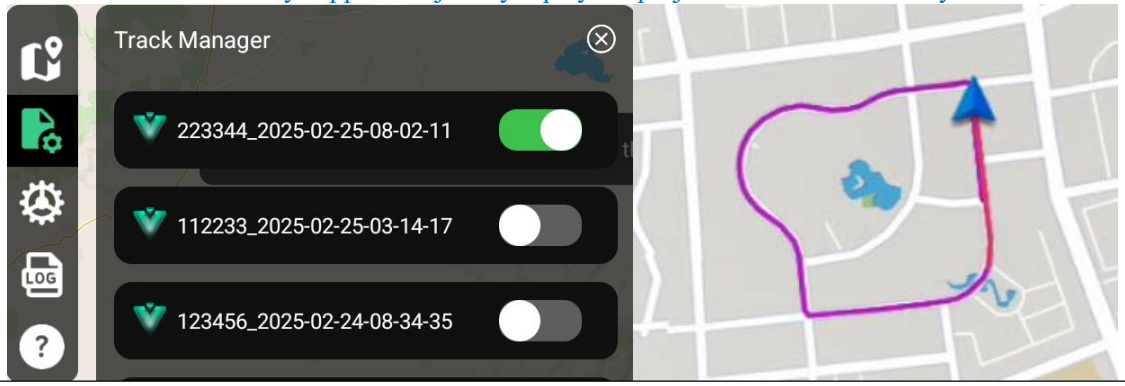
	PDOP Value: Generally, a value less than 2 indicates good signal quality, suitable for data collection.
	Satellite Count: Displays the number of satellites tracked by the device.
	Device Temperature: Displays the internal temperature of the device.
	Battery Level: Displays the remaining battery level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

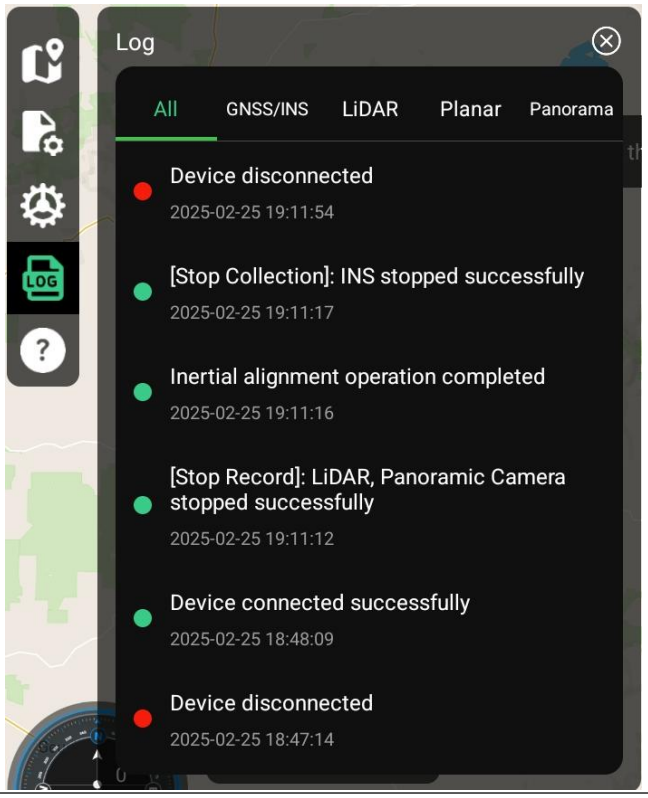
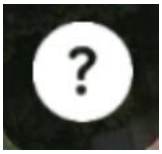
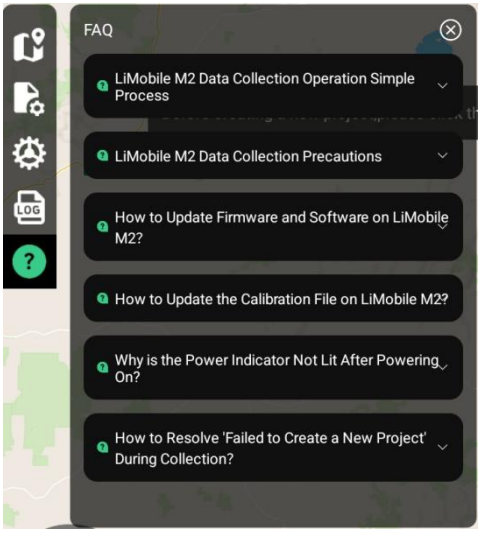
	Sensor Connection Status (IMU, LiDAR, Panoramic Camera, Planar Camera). Green: Sensor is synchronized and ready for collection. Yellow: Sensor is activated but not synchronized. Red: Sensor is connected but not activated. Gray: Sensor is not connected.

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. 

<table>
<tr><td></td><td>Configuration Button: Refer to Sections 7.6.2, 7.7.3, 7.7.4, and 7.7.5 for detailed settings.</td></tr>
<tr><td></td><td>Log Button: Users can view real-time operation logs. The app supports voice alerts for important reminders.

</td></tr>
<tr><td></td><td>FAQ Button: Users can quickly access common device issues.

</td></tr>
</table>

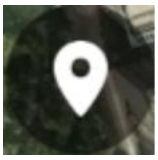
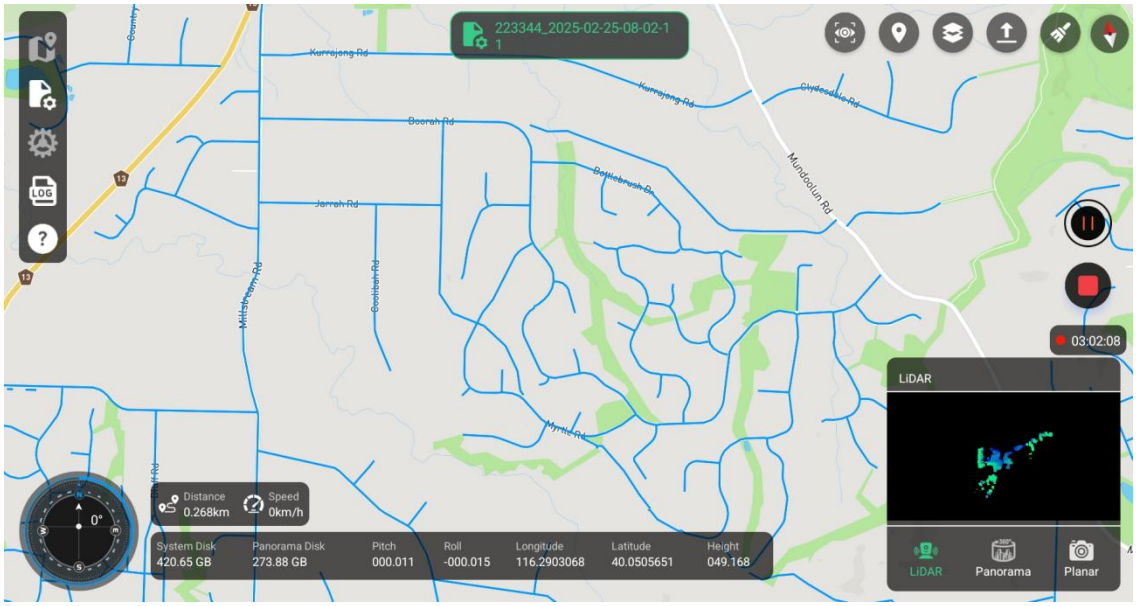
7.5.3 Bottom Information Panel

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

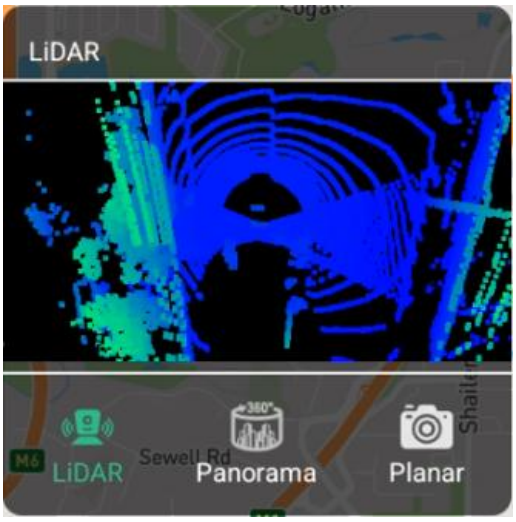
	Follow Button: Click to rotate the map according to the driving direction.
	Location Button: Click to jump to the current device location on the map.
	Map Switch Button: Click to switch between satellite and navigation maps.
	Trajectory Upload Button: Click to upload planned trajectory files (.kml/.kmz/.ovkml/.ovkmz/*.txt) 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

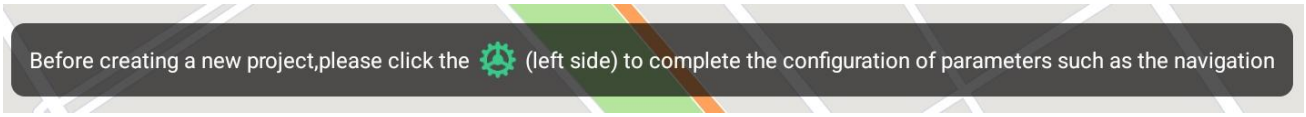
	New Project Button
	Start Data Recording Button
	Pause Data Recording Button
	Stop Data Recording Button
	Project Collection Time

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.

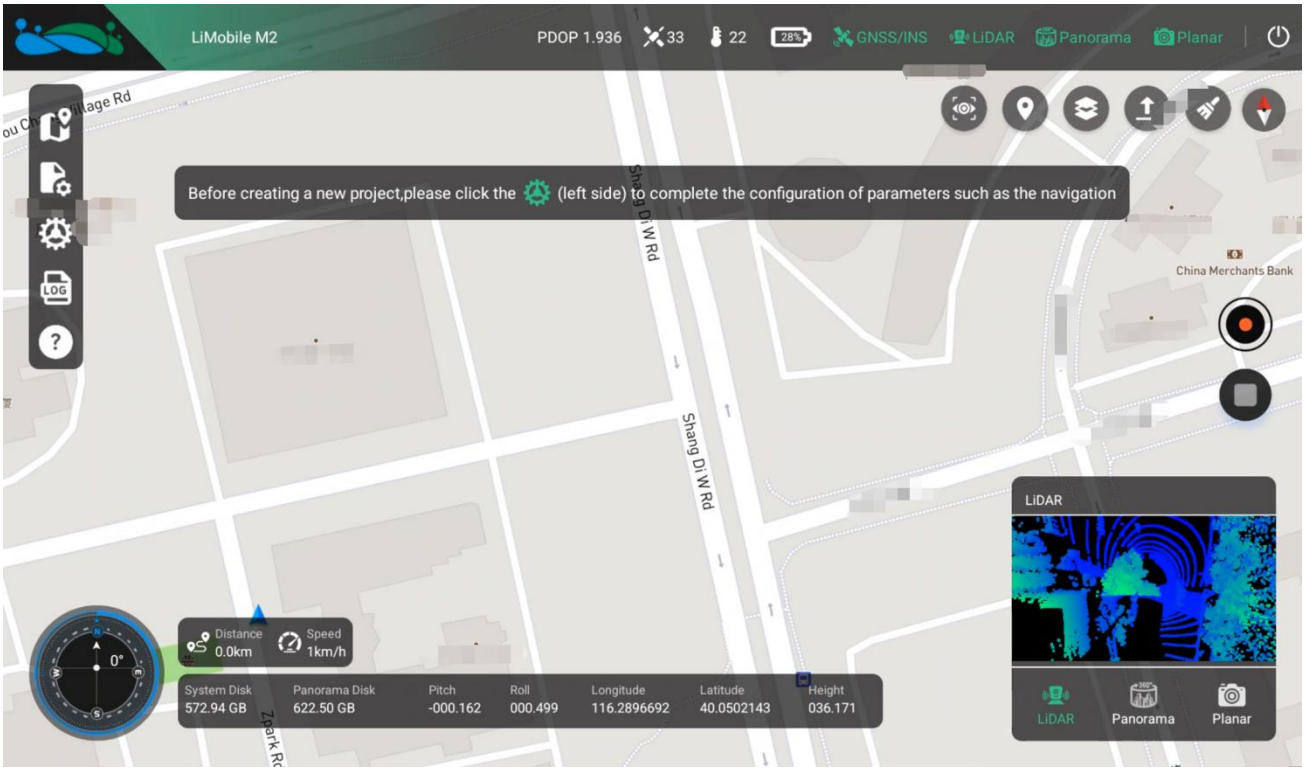
4. User Prompt



7.6 Quick Data Collection

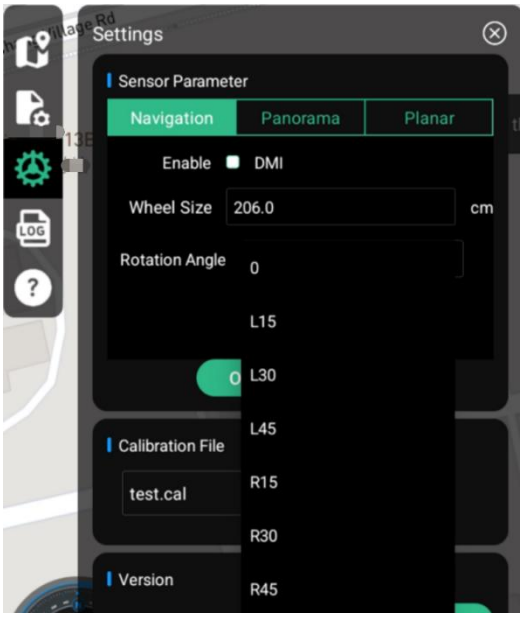
7.6.1 Device Initialization

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.



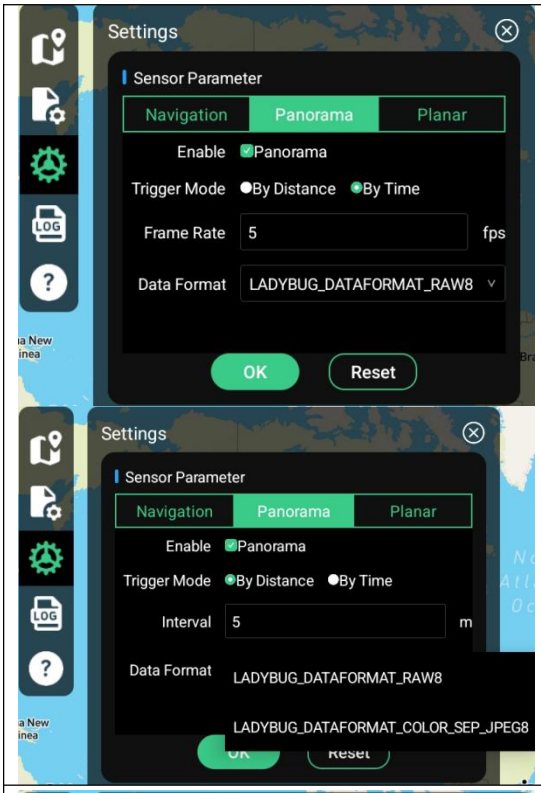
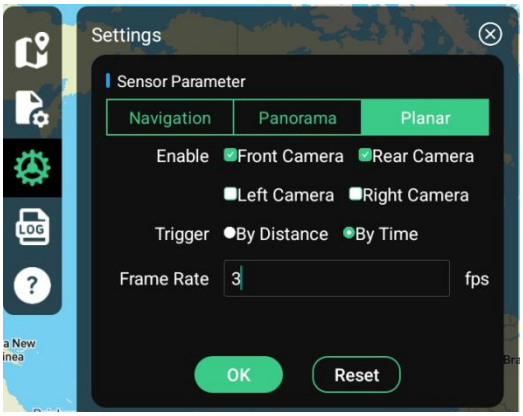
Navigation

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.

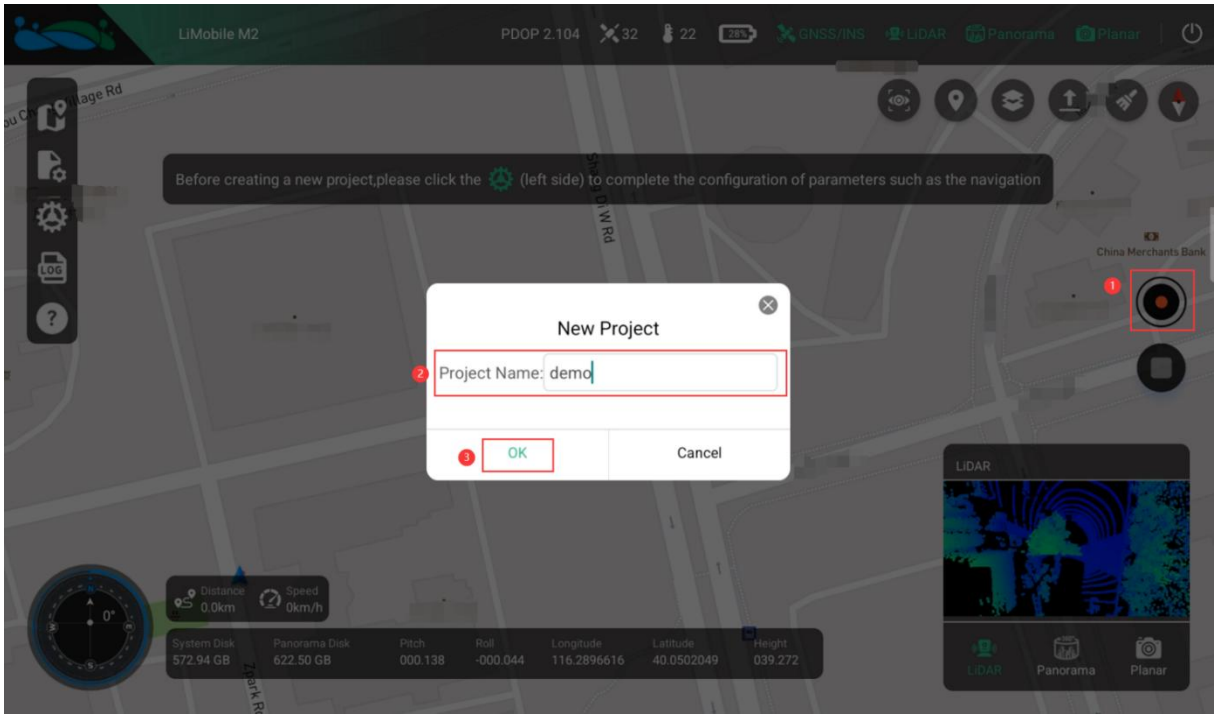
<table>
<tr>
<td>
</td>
<td>Panorama
Panorama Enable Settings: The device will record data only after it is enabled.
Trigger Mode: supports By Time and By Distance trigger modes.
1. By Time
Frame Rate: default parameter 5 FPS.
2. By Distance
Interval: default parameter 5 m.
Data Format: supports LADYBUG_DATAFORMAT_RAW8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

☆ 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.



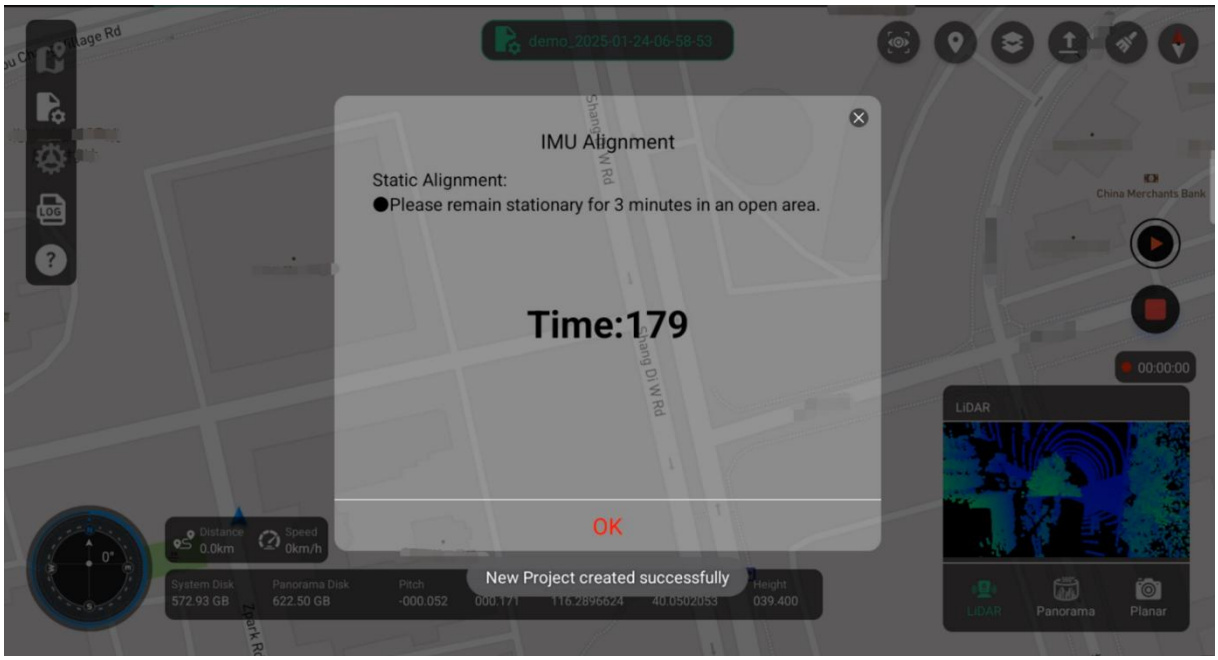
☆ Notes:

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

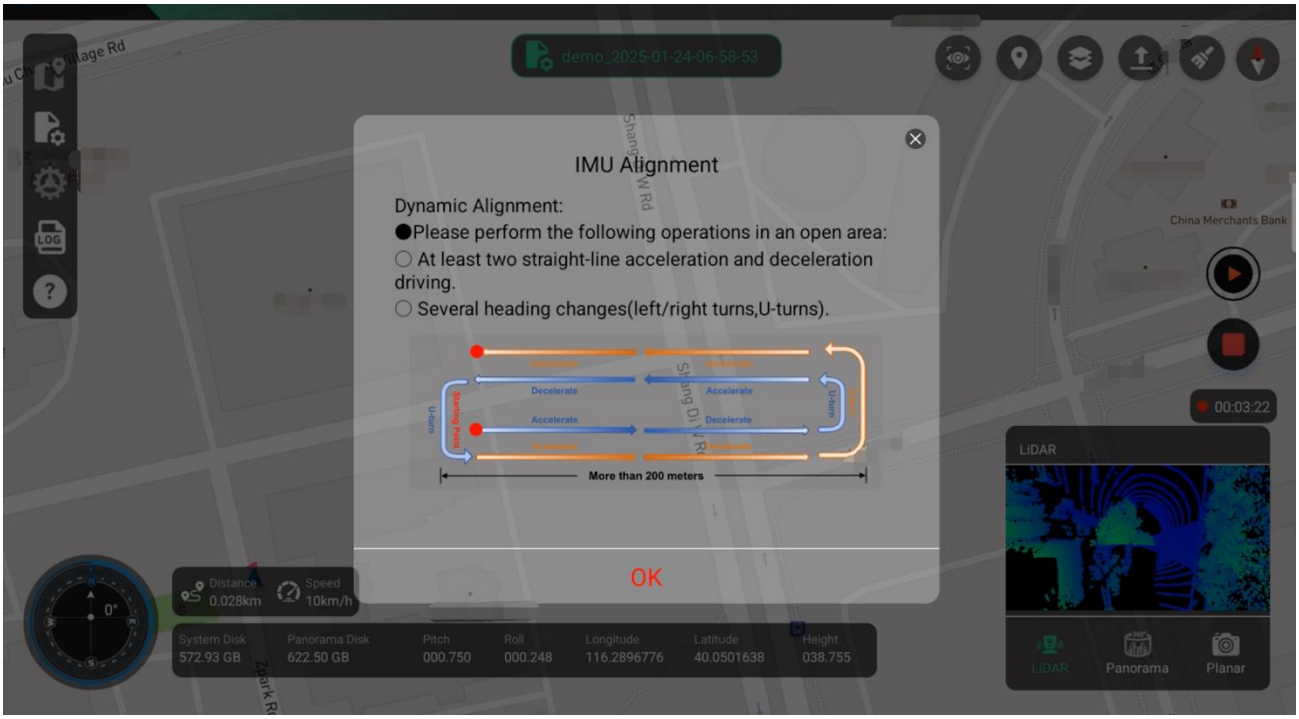
After creating a new project, the IMU Alignment pop-up window will automatically pop up on the interface. The IMU Alignment operation is divided into two steps: Static Alignment and Dynamic Alignment.

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.



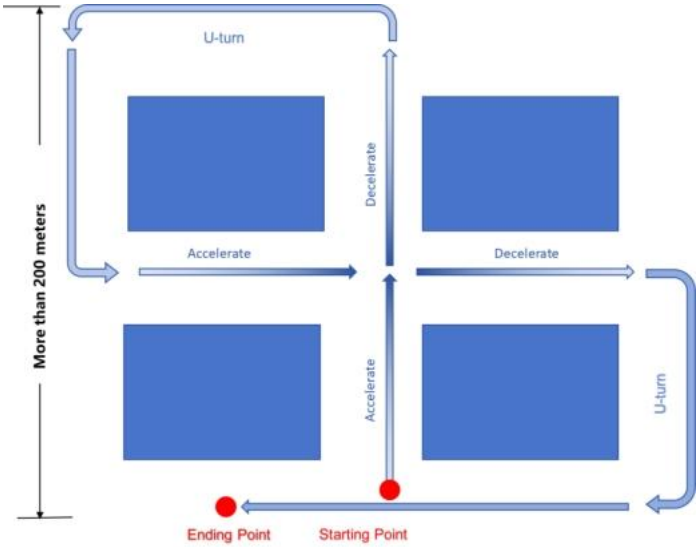
Dynamic Alignment: The user needs to follow the diagram and first accelerate forward to 40 km/h and

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:

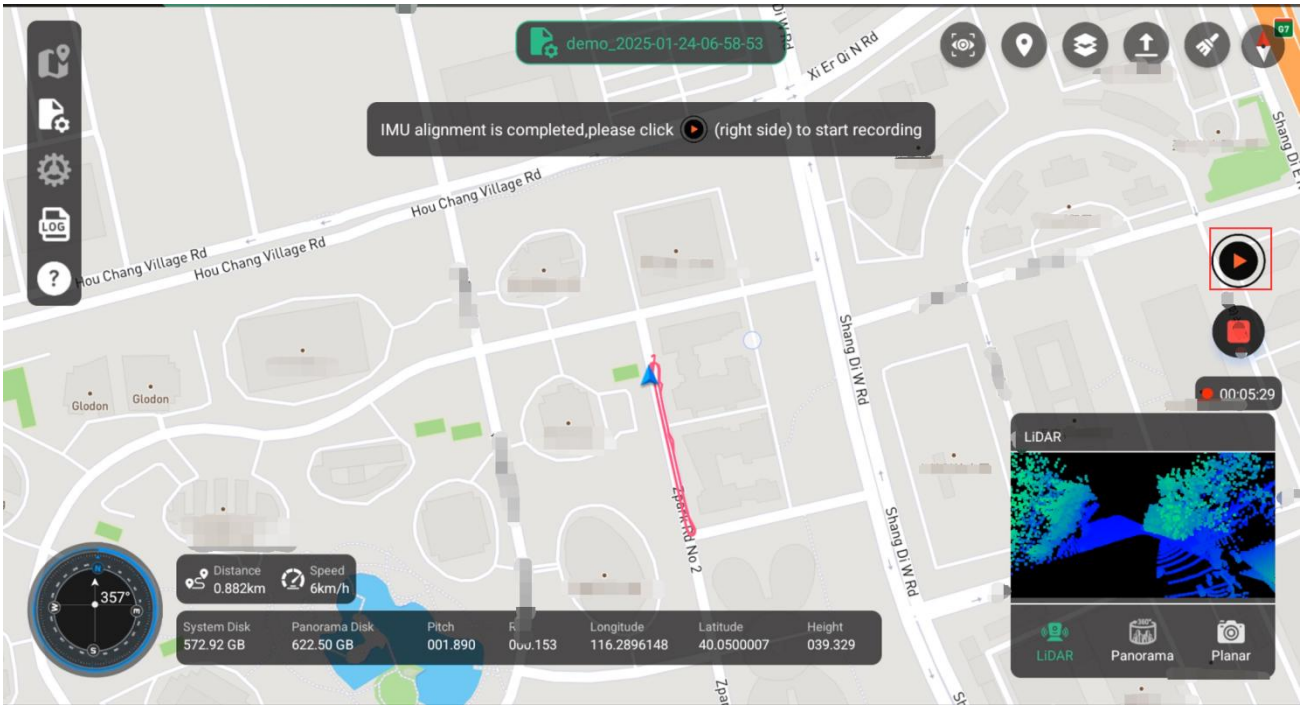
1. If the INS alignment operation is not carried out, there will be a high risk that some data cannot be processed.
2. If users are under tight schedules and need to shorten the waiting time for the static alignment step, the manual provides other alignment criteria, that is, when the PDOP value is below 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.



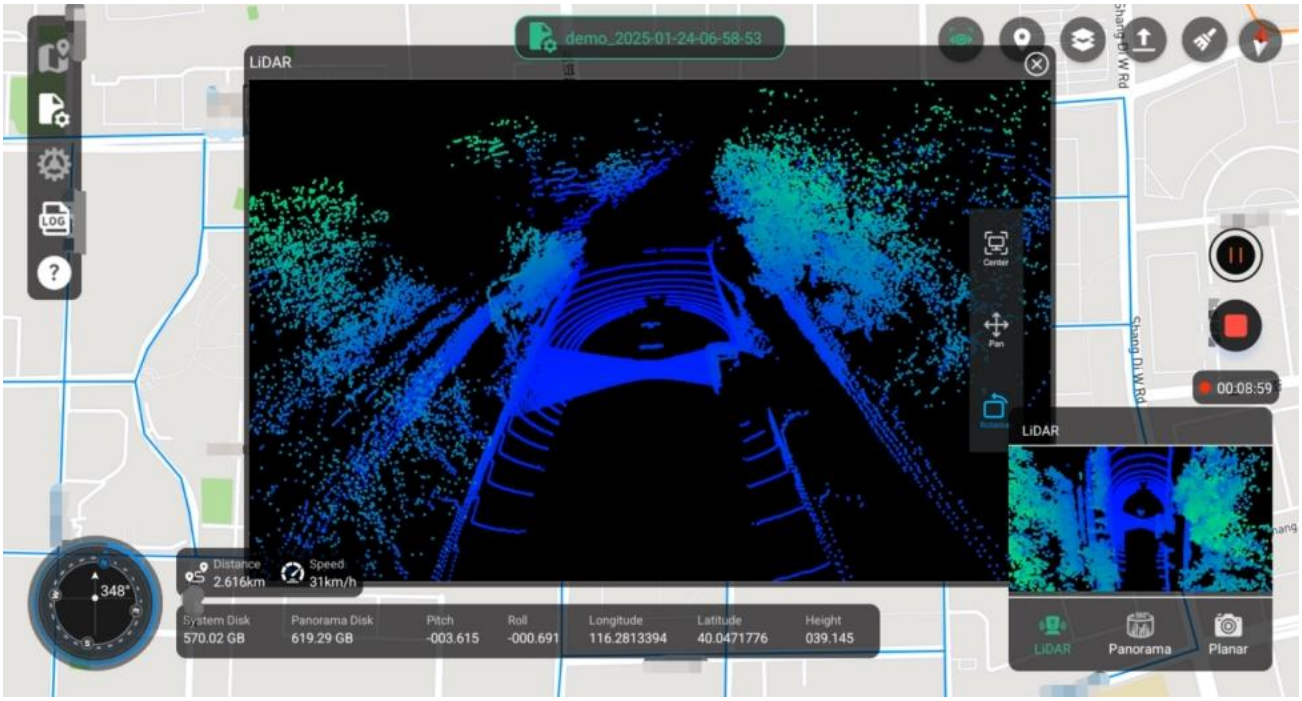
7.6.5 Start Data Recording

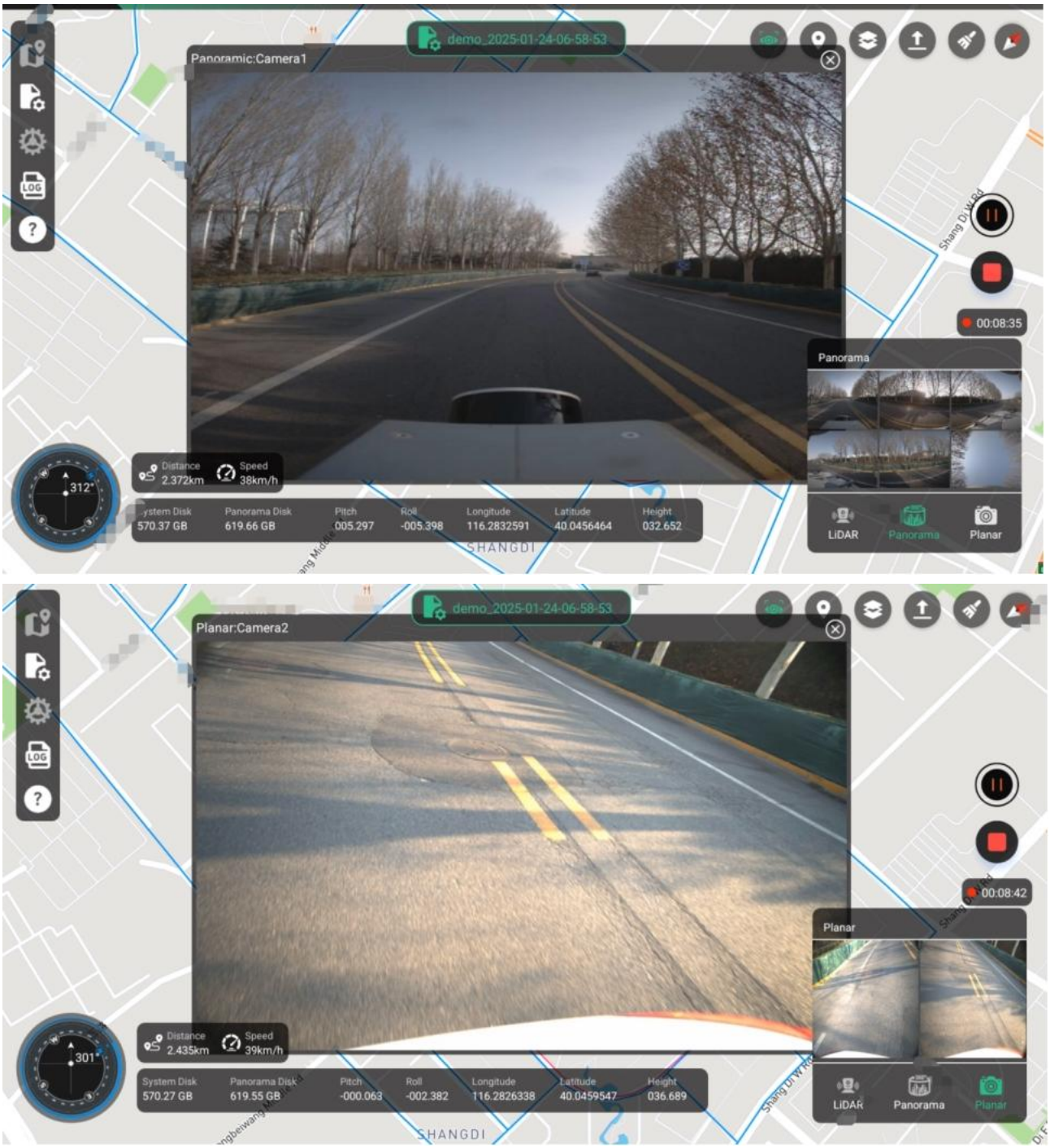
According to the prompt at the top of the main interface, click the Start Recording button, and the device will

begin recording sensor data.



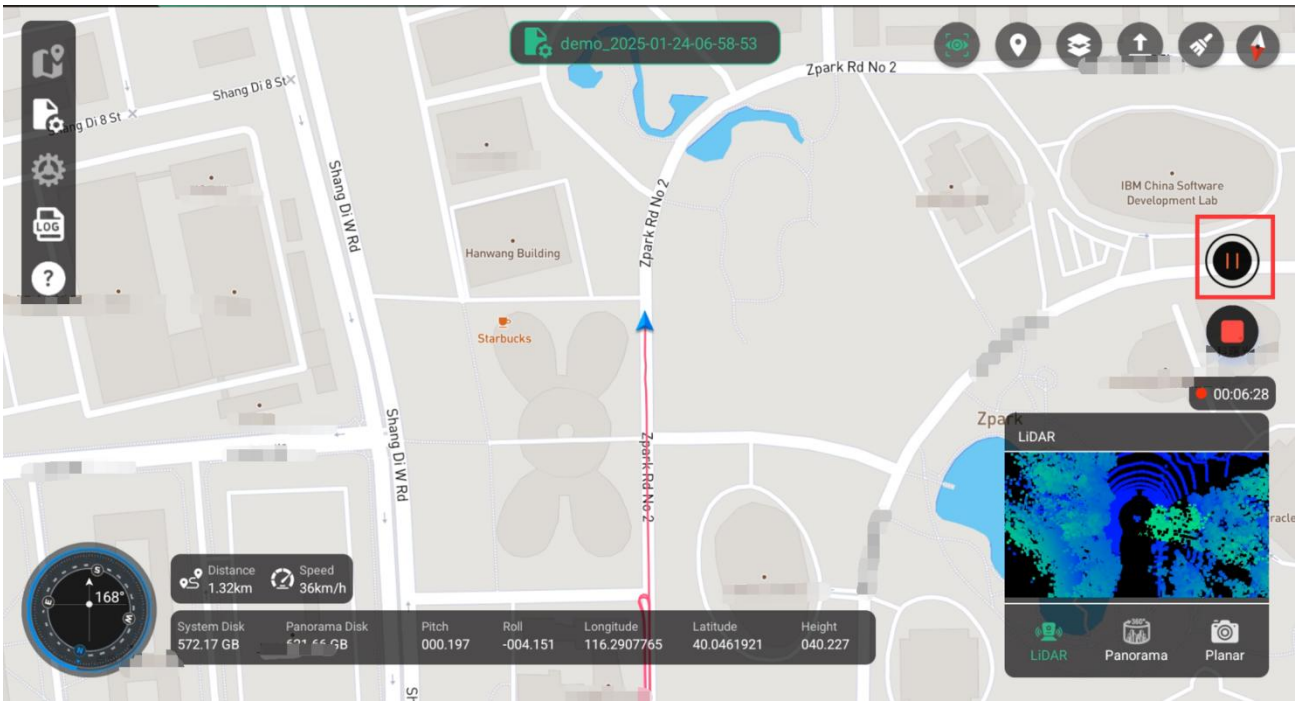
Users can view the driving route of the equipment in real time on the map, and can also view the collected single-frame point cloud data and image data in real time.





☆ Notes:

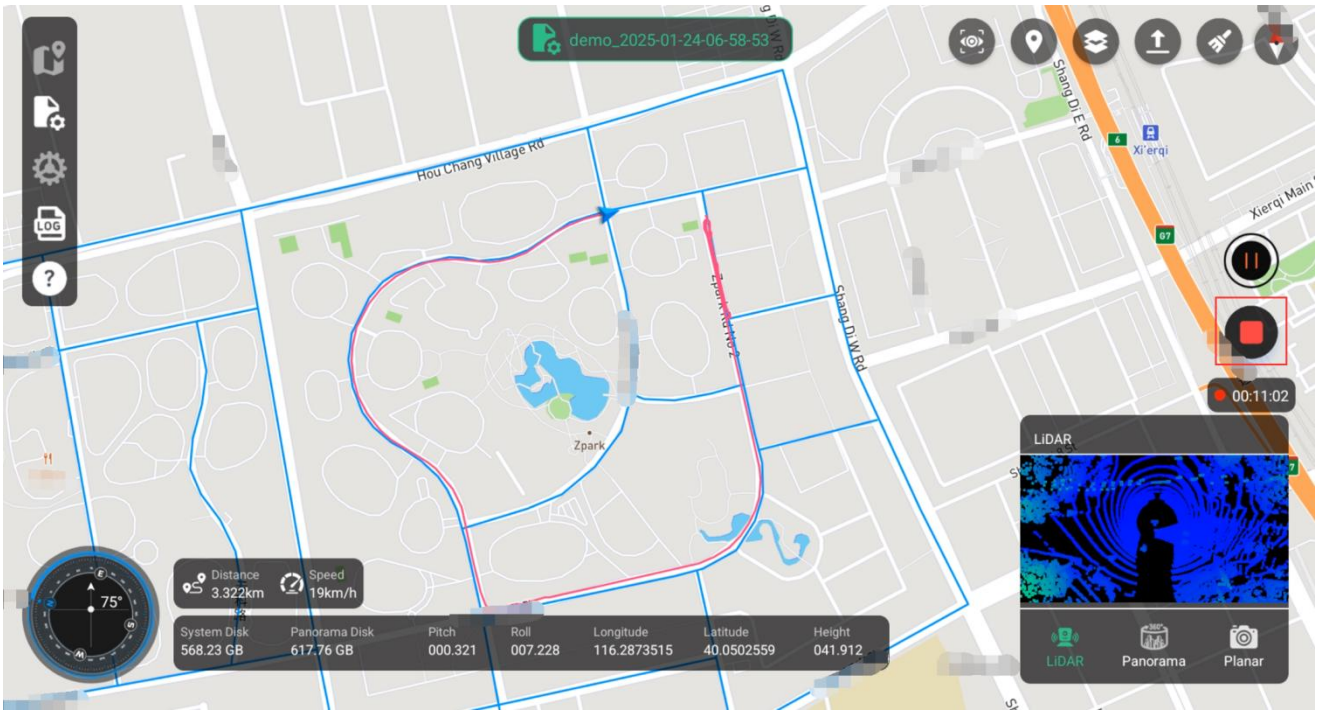
1. When users encounter situations such as the need to transfer the work area or traffic jams during data collection, they can click the "Pause Recording" button to pause data recording.



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.

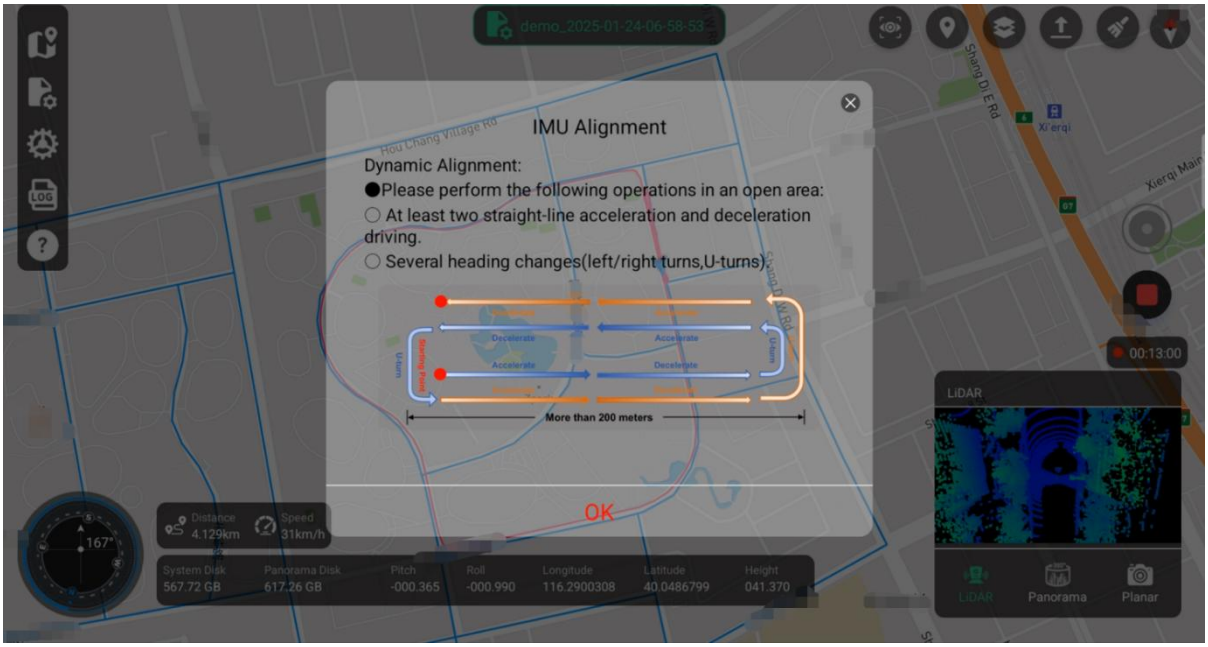


7.6.7 IMU Alignment and Close Project

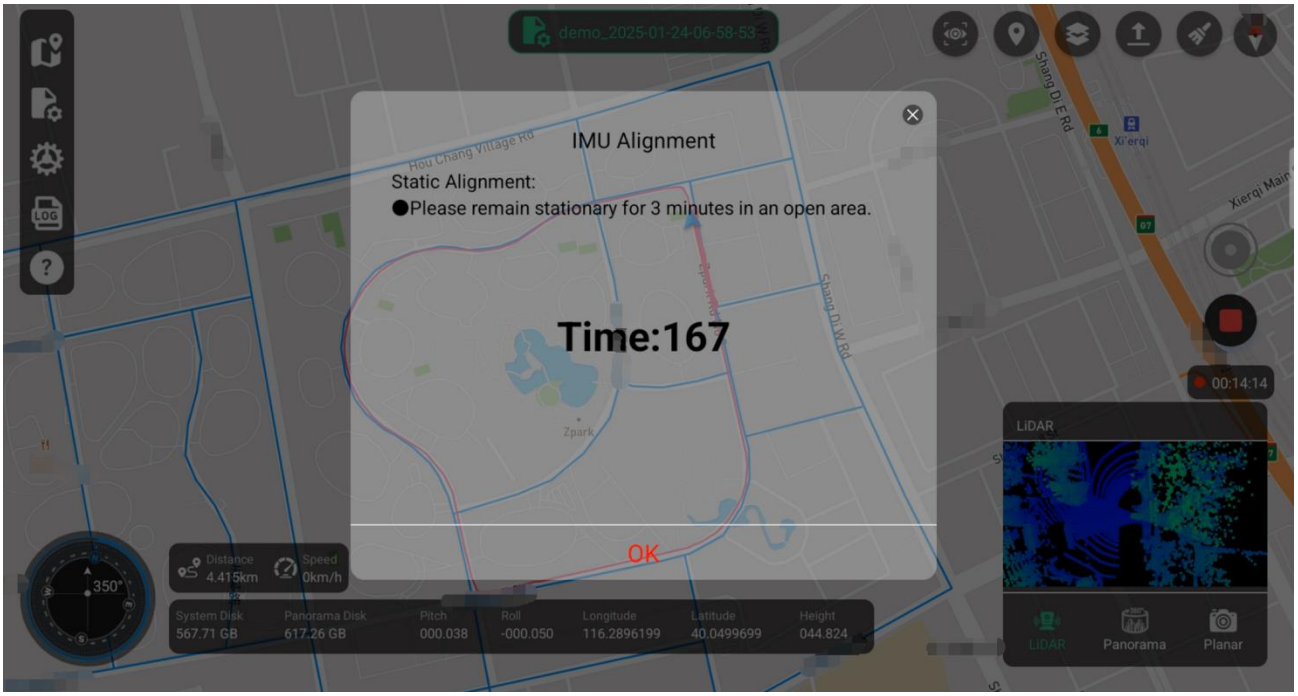
After stopping data recording, the interface will automatically pop up the INS Alignment window. The INS alignment operation consists of two steps: Dynamic Alignment and Static Alignment.

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.

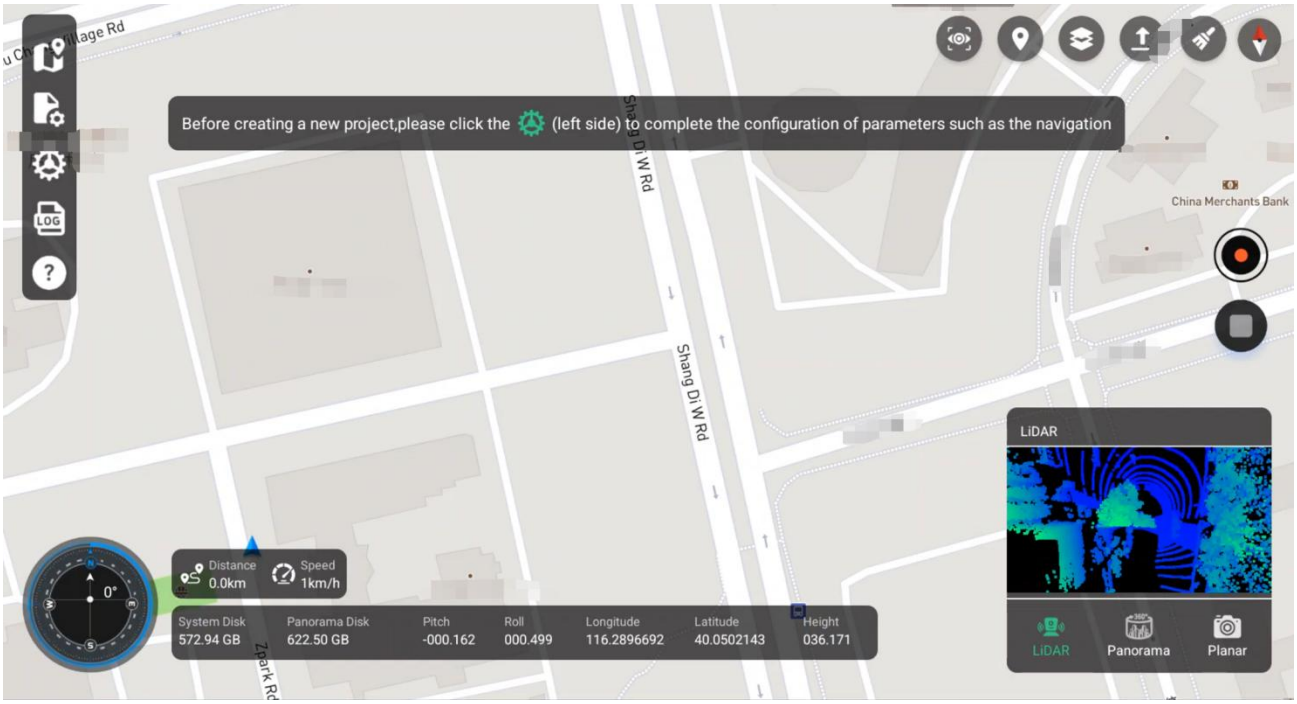


Static Alignment: Remain stationary in an open area for 3 minutes. Wait for the countdown to end, then click the Confirm button to finish the current project.



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:

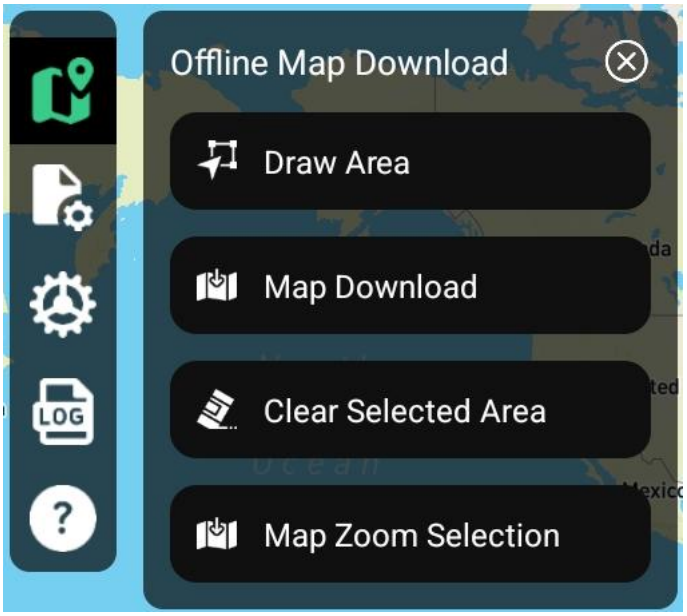
1. Please wait patiently for 30 seconds (the time required for the equipment system to be completely shut down). Do not perform any operations until the interface shows that the equipment connection is disconnected, and then turn off the equipment power.

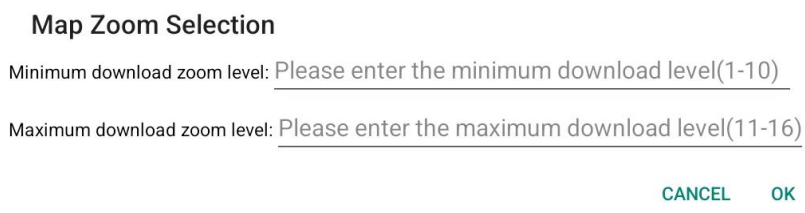
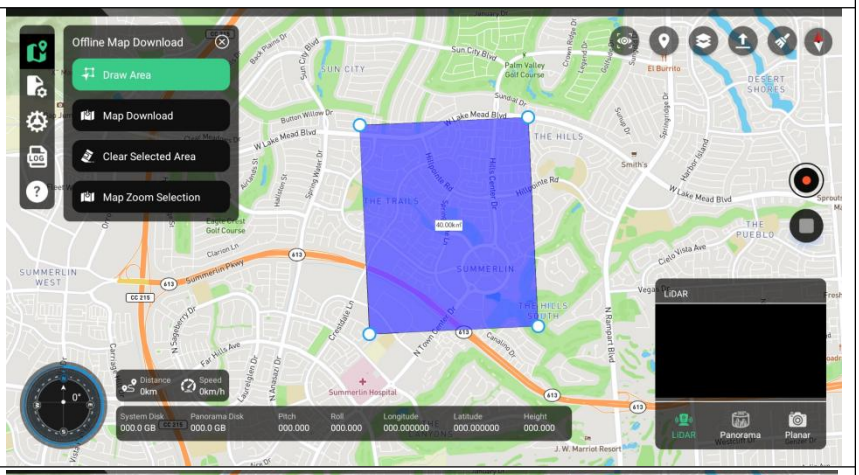
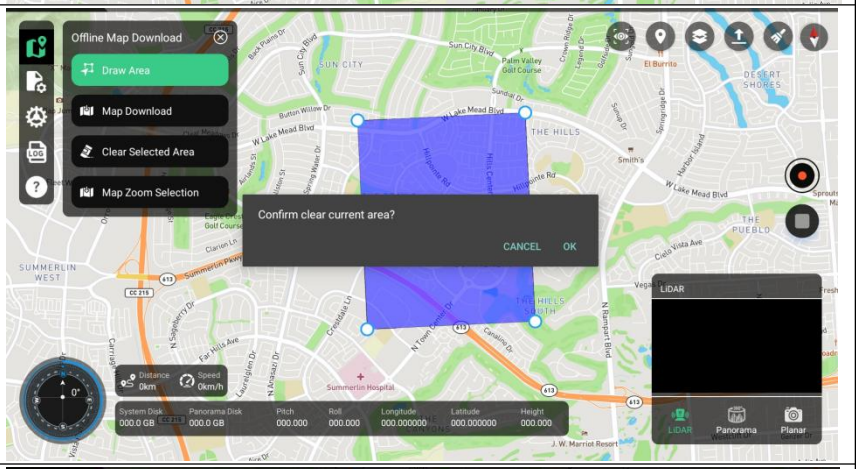
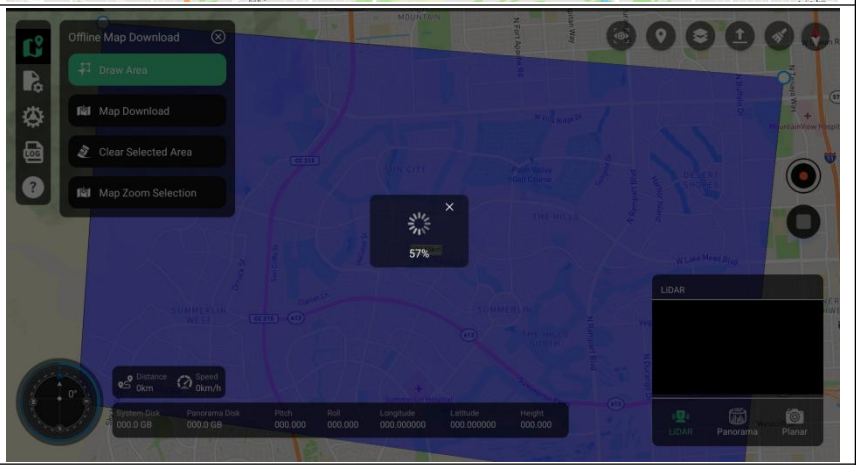
2. Please cut off the power in advance before plugging or unplugging the disk.

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.

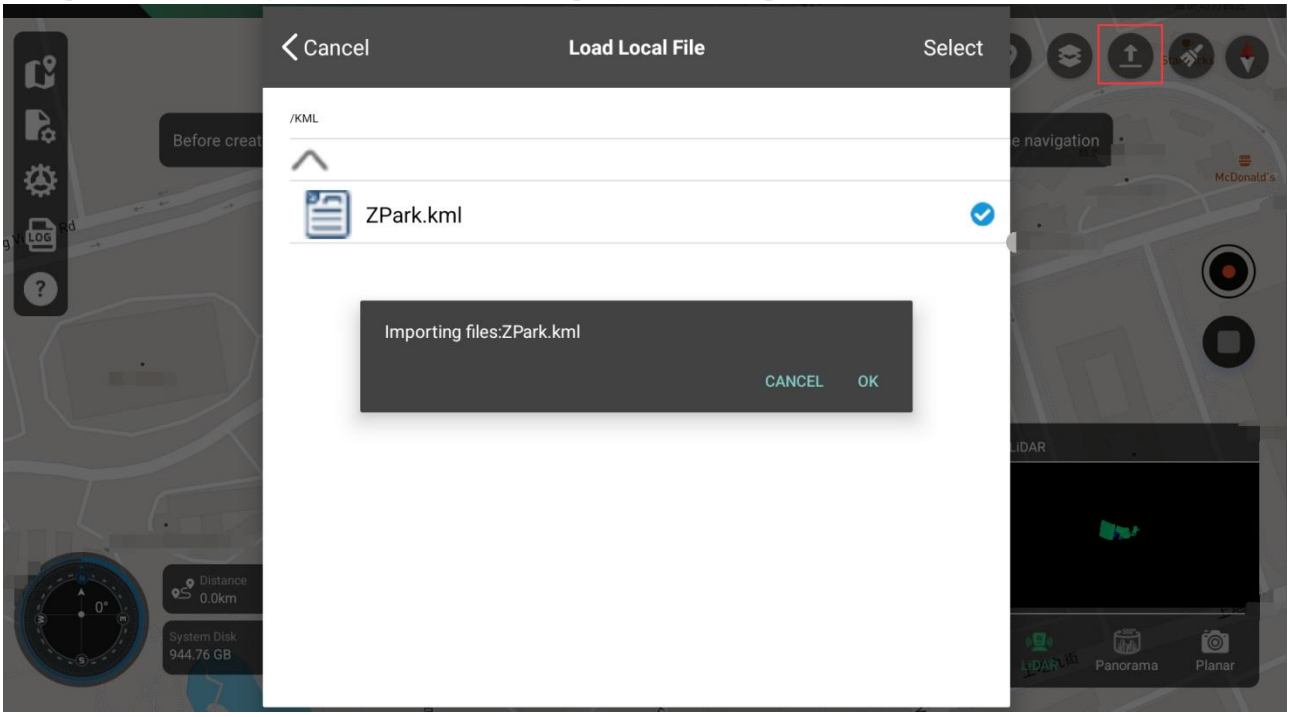


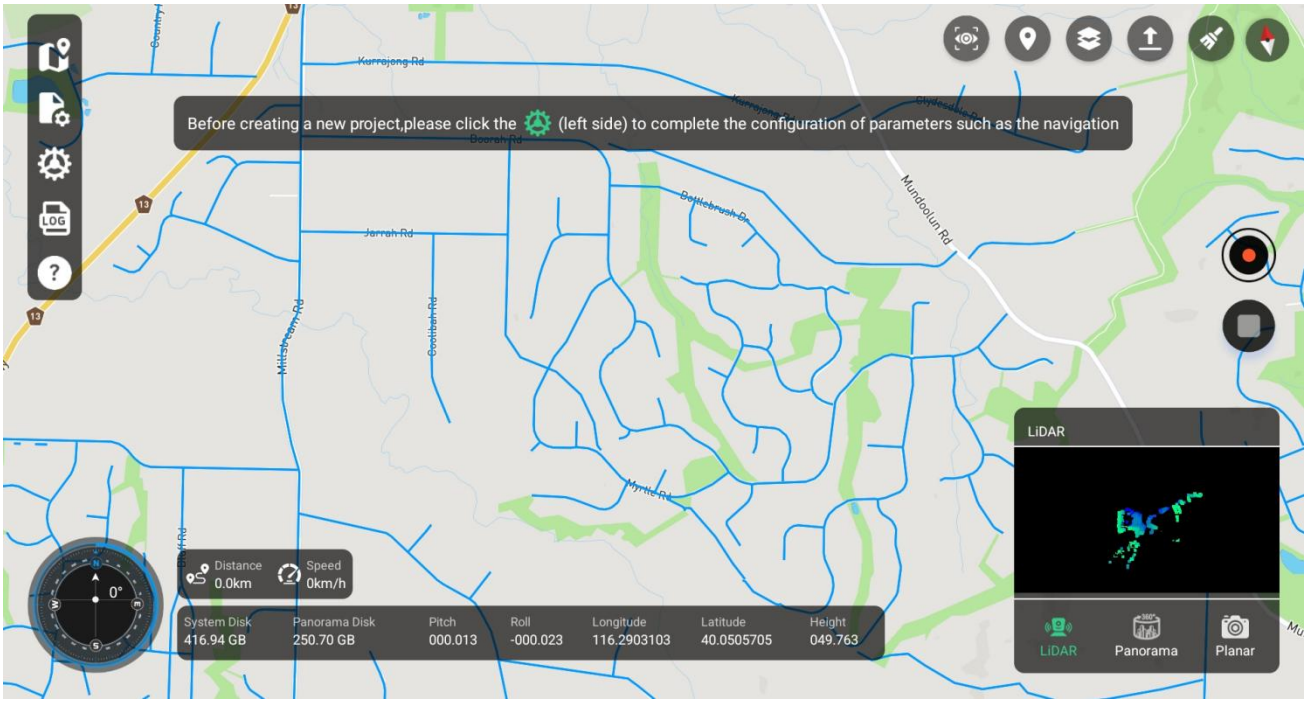
2. Click the **Map Zoom Selection** button to set the map level range.	
3. Click the **Draw Area** button to delineate the download area.	
4. If the selected area is incorrect, click the **Clear Selected Area** button and redraw the download area.	
5. Click the **Map Download** button to complete the 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.

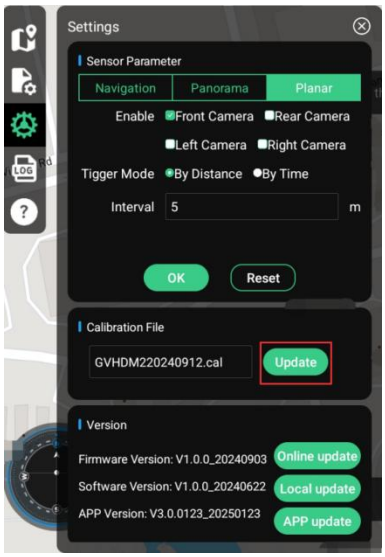




7.7.3 Calibration File Update

1. Users need to save the new calibration file (SN.cal) in the ML300System->Cal directory under the root directory of the ML300_SYS disk and insert the disk into the device.

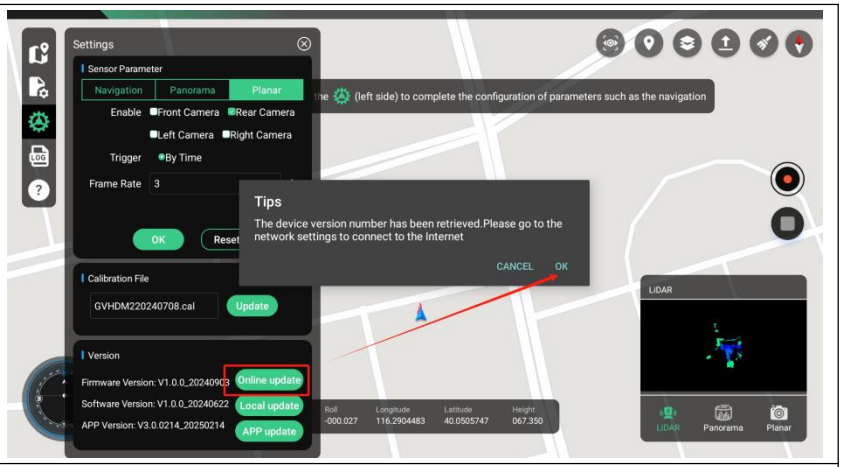
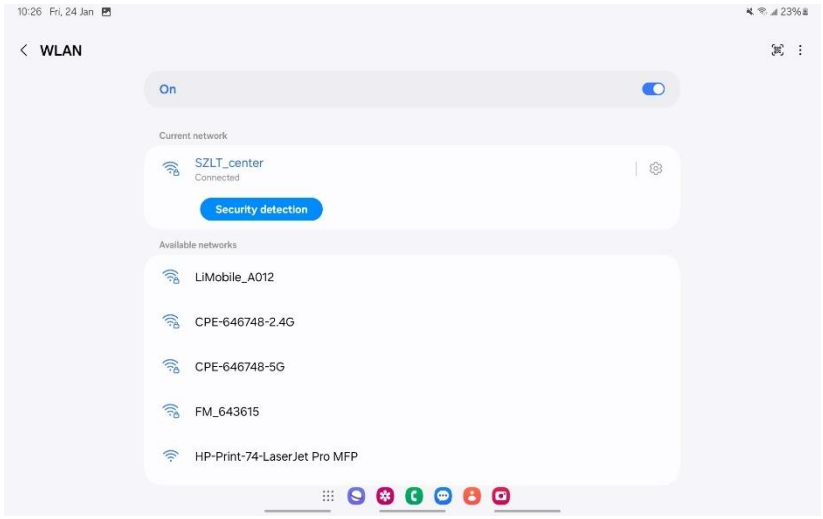
2. Open the APP and connect to the device, then click the **Update** button on the Calibration File settings interface. The system will automatically recognize the calibration file in this path and complete the update.

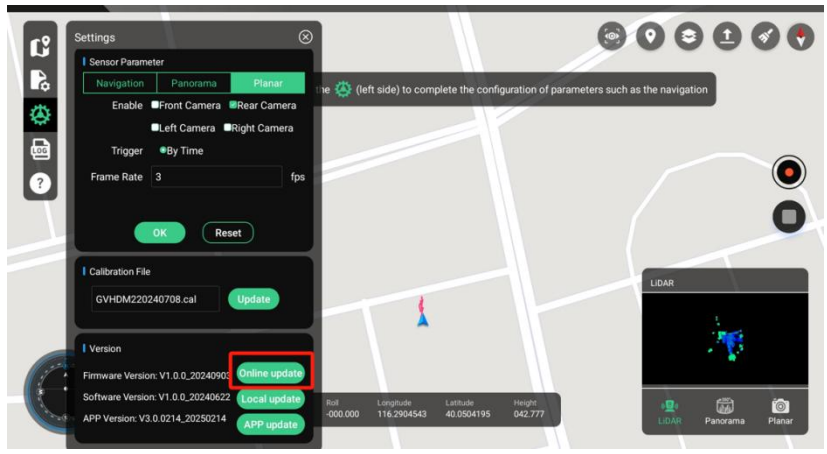
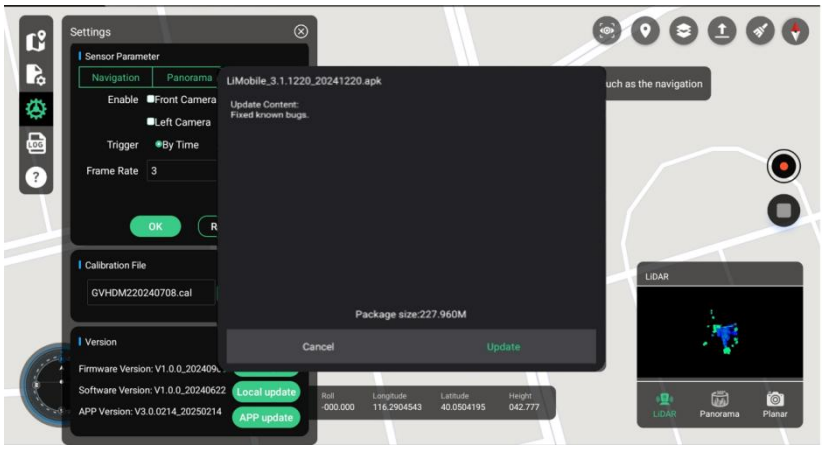
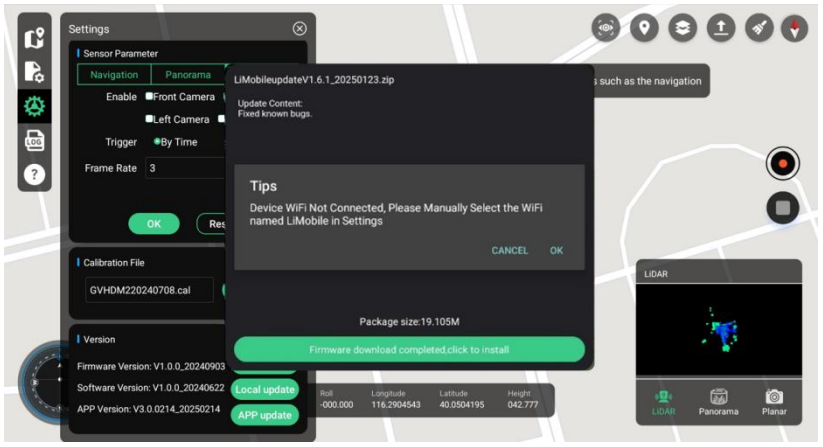


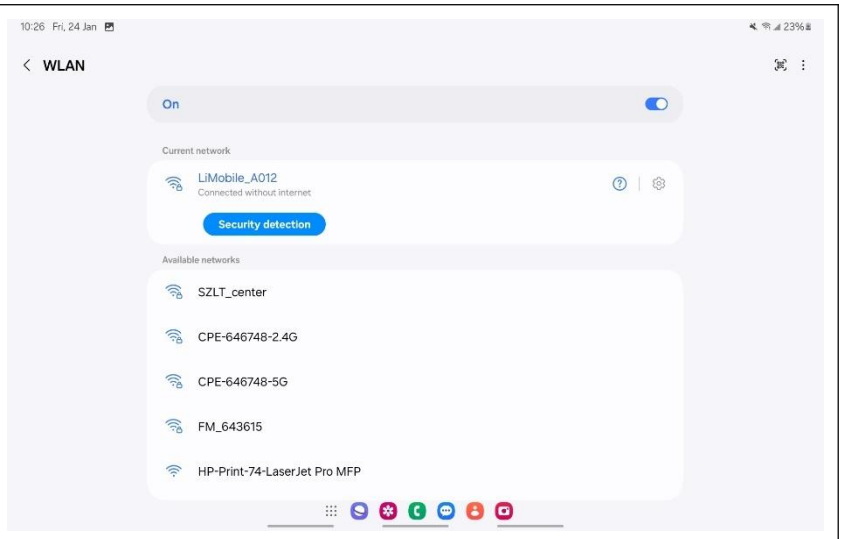
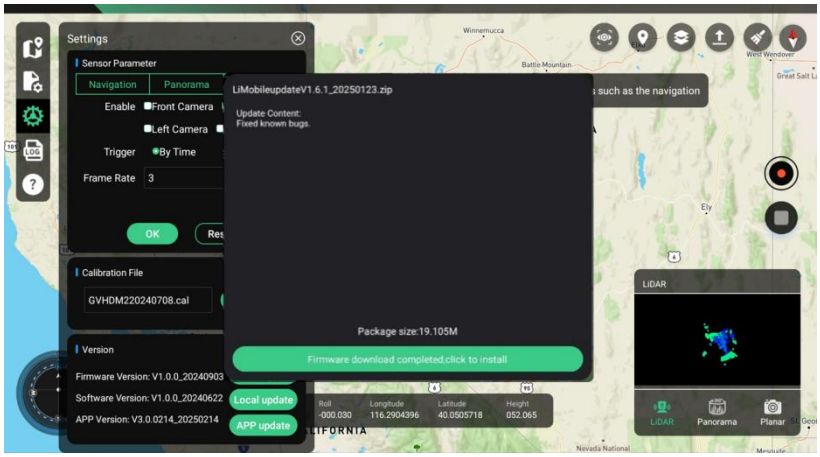
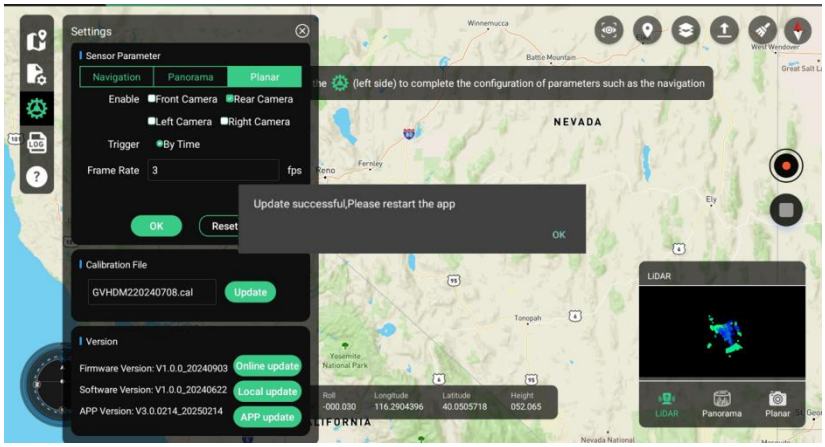
7.7.4 Firmware and Software Version Update

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.	

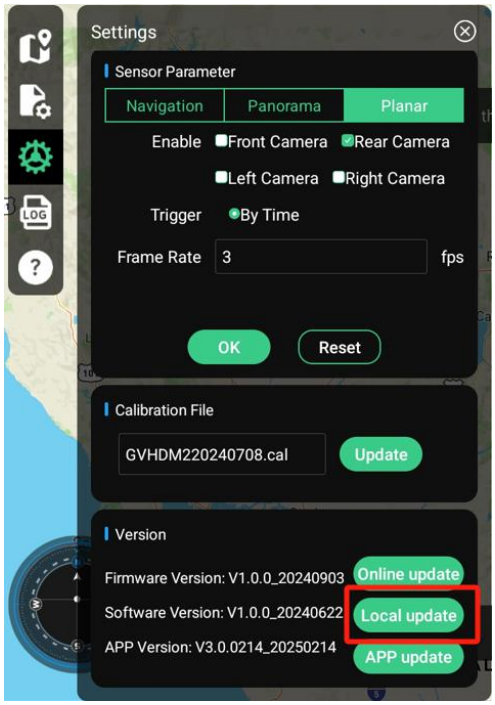
5. Follow the prompts to switch networks.	
6. Switch back to the APP interface, click the **Firmware download completion, click to install** button again.	
7. After the update is successful, click the **OK** button and restart the APP. ☆ Note: 1. After the firmware and software update, the device will 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. Enterong https://licloud.ComNavintl.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 folder in the root directory of the ML300_SYS disk and insert the disk into the device.

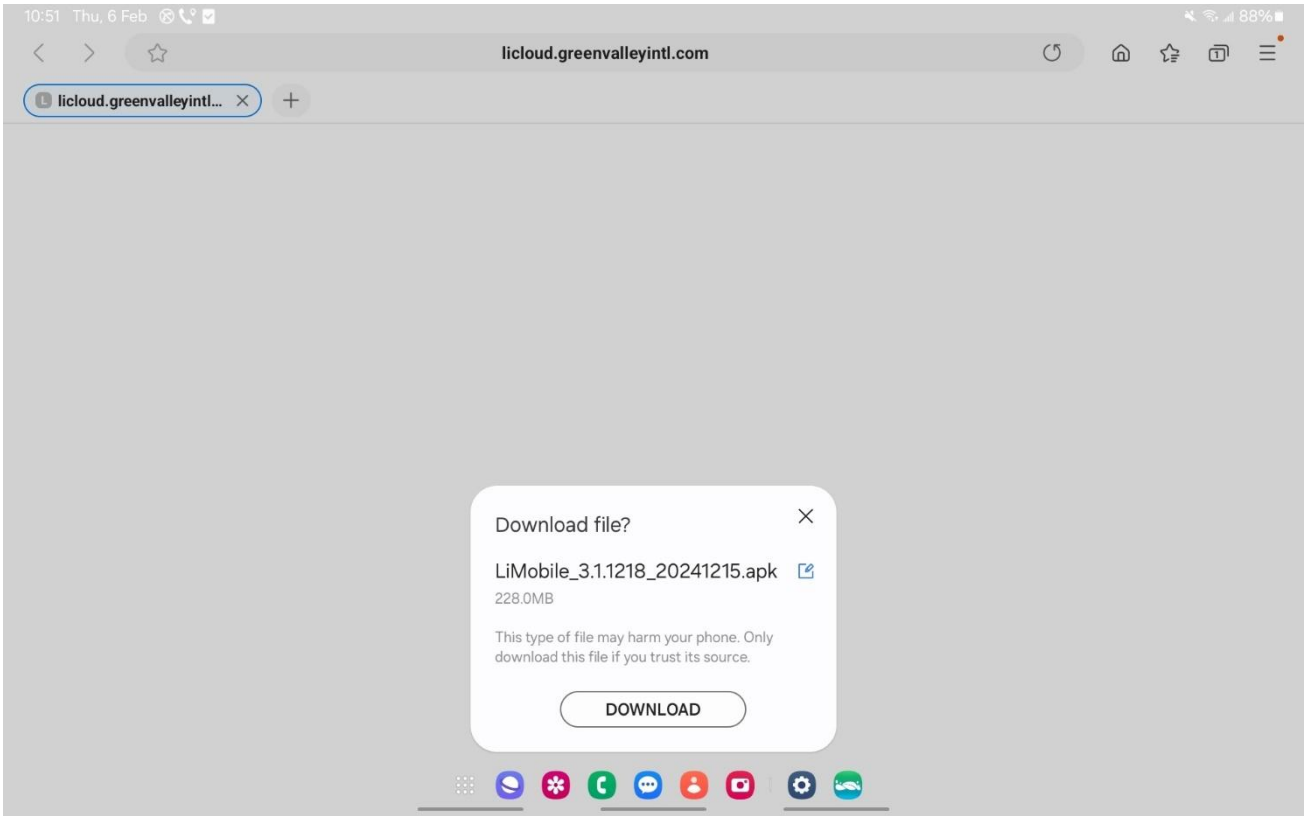
3. Open the APP and connect to the device, click the **Local update** button on the version number interface. The system will automatically start the update and will shut down automatically when completed, and the APP will prompt to restart.

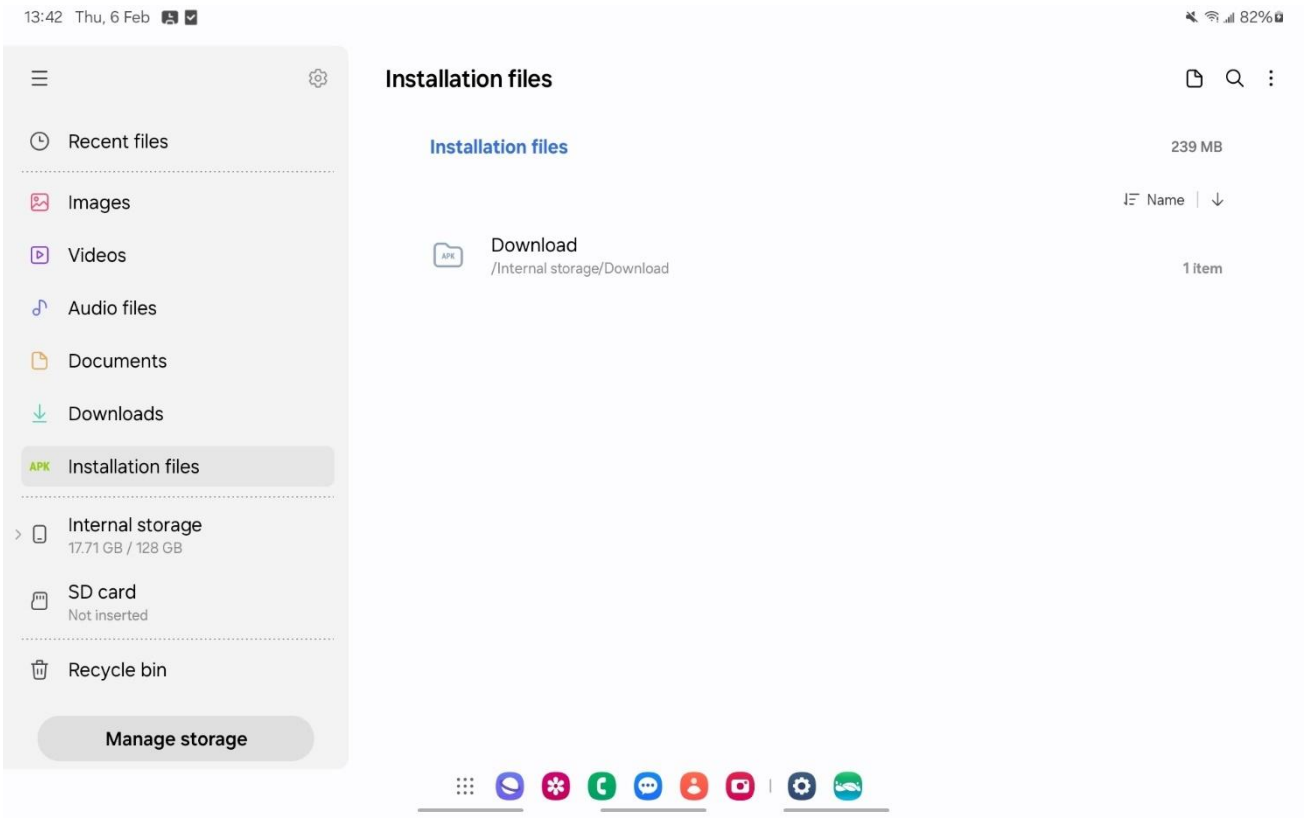


4. After waiting ten seconds, turn off the power and power on again. After waiting for about a minute and a half, the user starts the device again and opens the APP to check whether the version number of the configuration interface has been updated successfully.

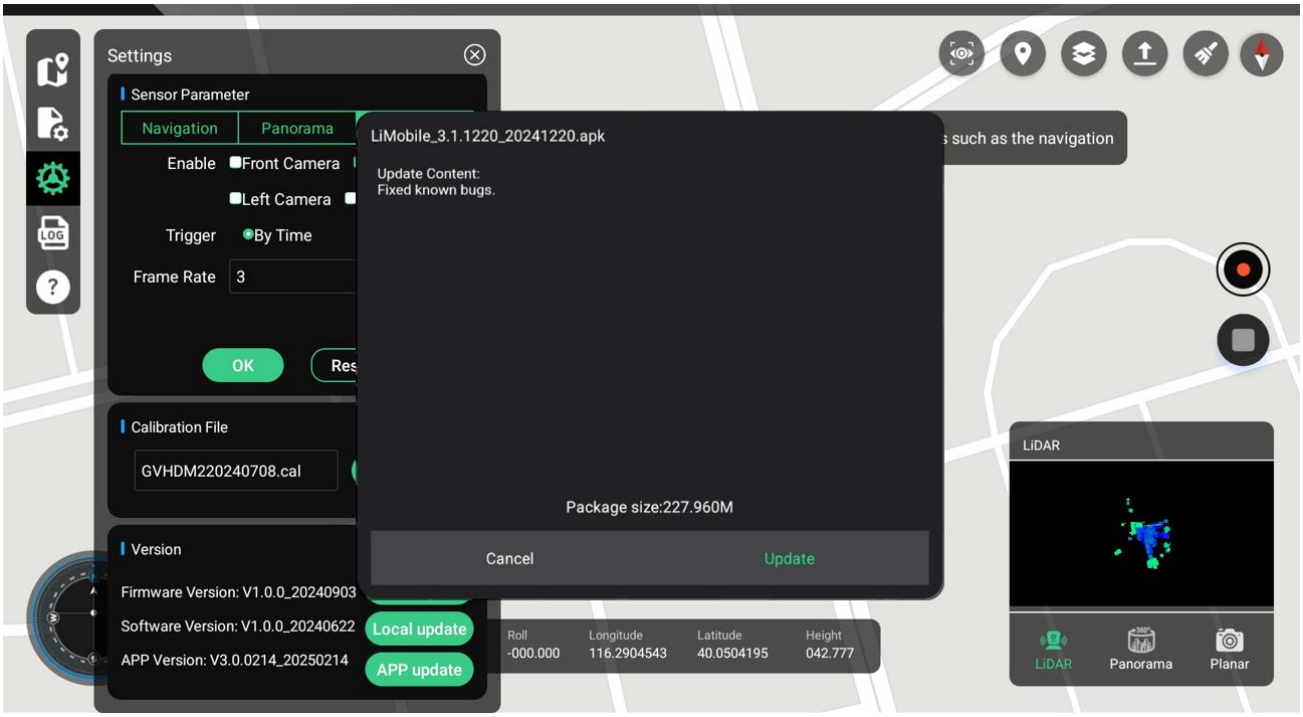
7.7.5 APP Update

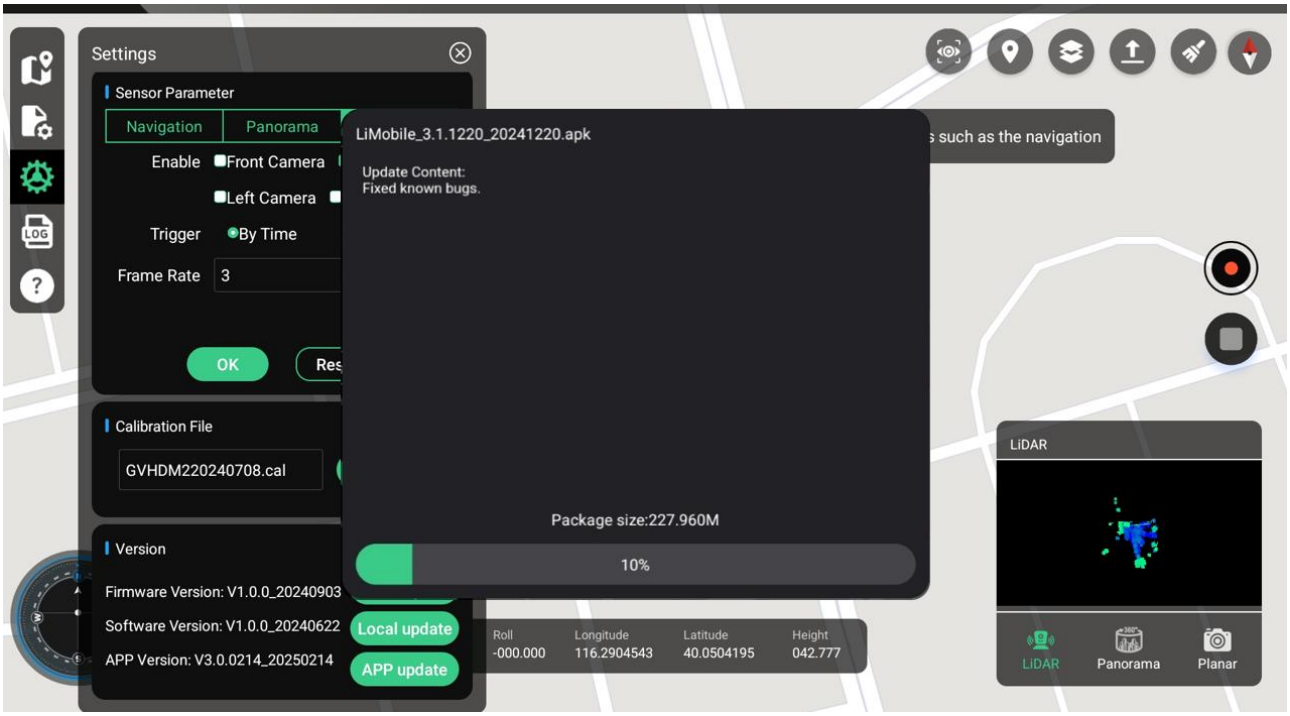
1. Entering the URL https://licloud.ComNavintl.com/api/v1/softwares/184/package in the browser and click the download button to download the APP installation package.



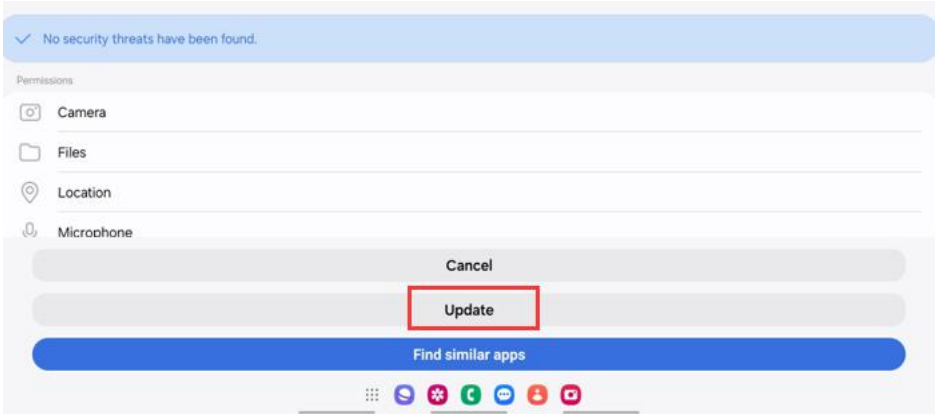


2. Open the APP and connect to the device, click the APP update button on the version number interface, the user can view the update information in the pop-up window, click the Update Now button, and the software will automatically start updating.





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 ML300_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 ML300 is equipped with two 1 TB data storage disks: ML300_SYS and **M2_PANO**.

- ML300_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.

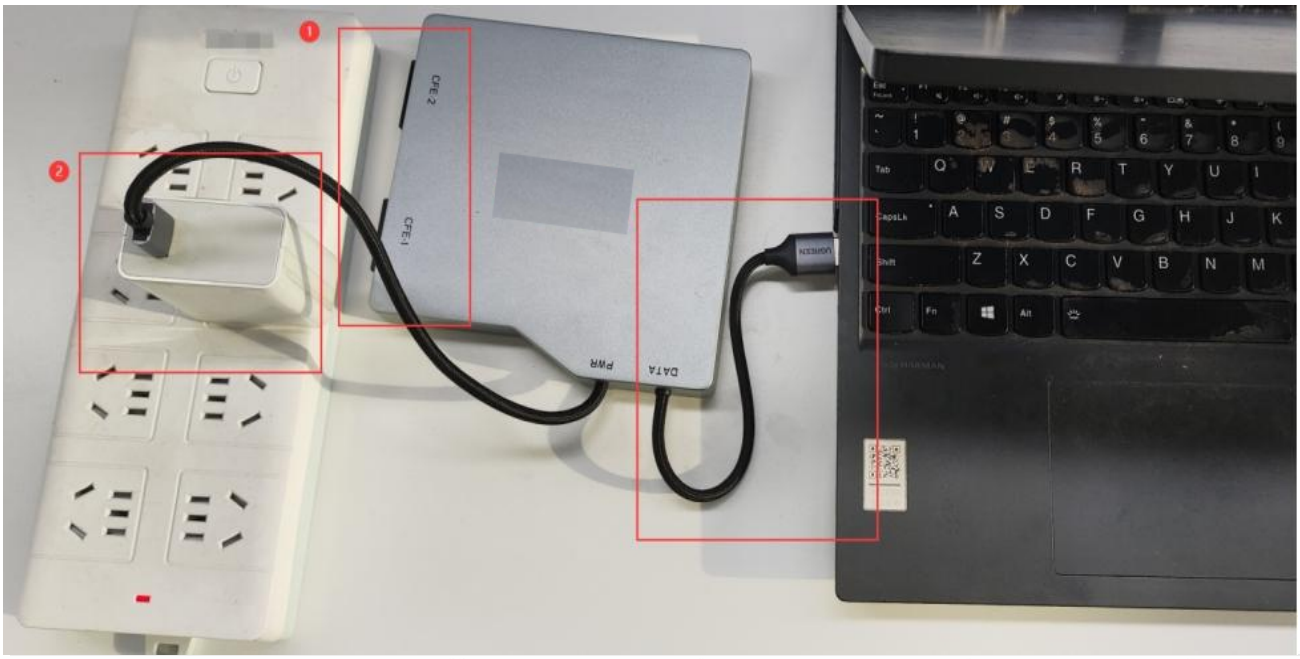
During ML300 data collection, a project folder with the same name is created in the data folder on both disks for data integration. The project folder name is the custom project name entered during data collection in the APP, followed by the UTC time.

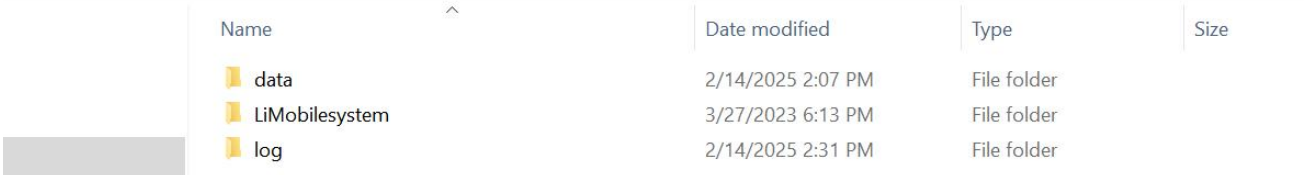
Before copying data and performing raw data quality check, connect the hardware as follows to allow the computer to recognize the ML300_SYS and M2_PANO disks:

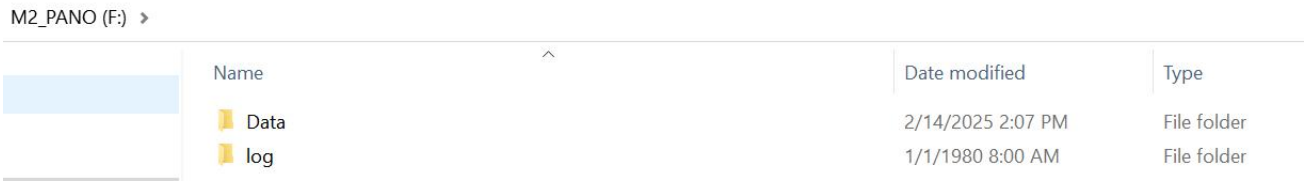
①Insert both disks into the card reader.

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).





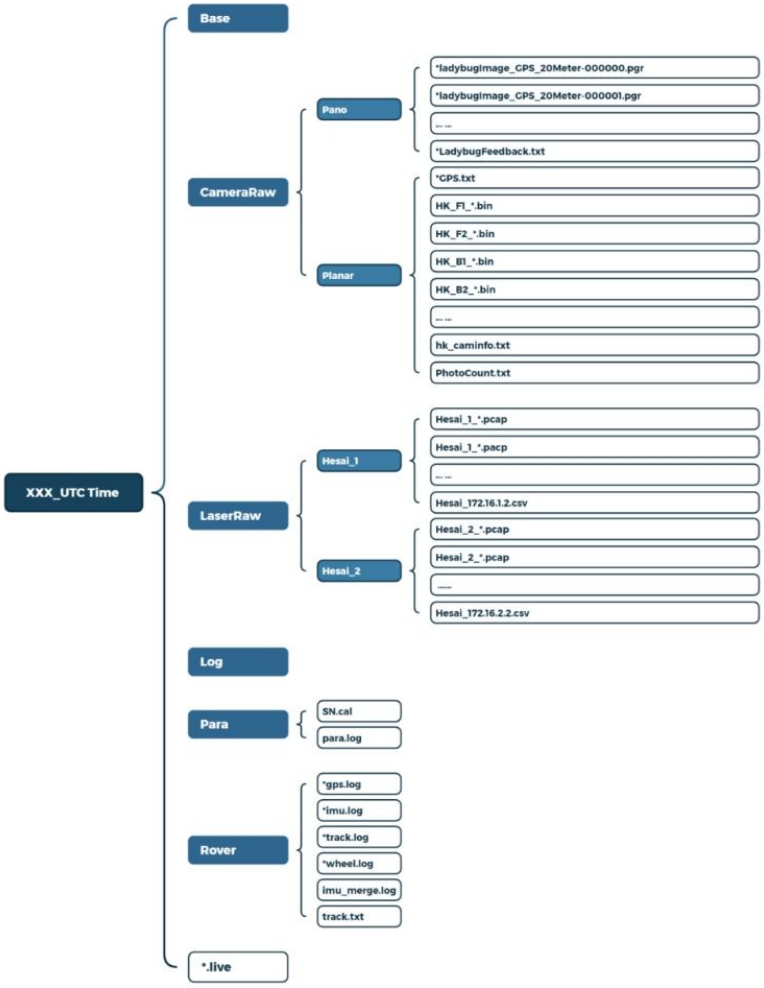


☆ Notes:

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 3: "Disk Formatting Instructions".

8.1.2 Data Structure Overview

The complete data structure of ML300 is shown in the figure below.



The ML300 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.

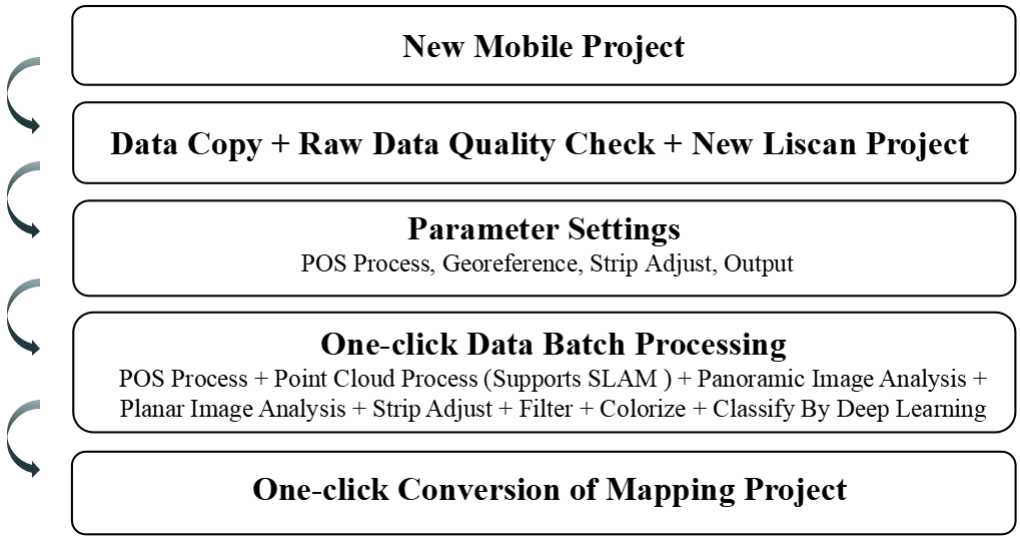
▫ imu_merge.log: Merged mobile station file from gps.log and imu.log, automatically recognized by LiDAR360MLS.

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

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

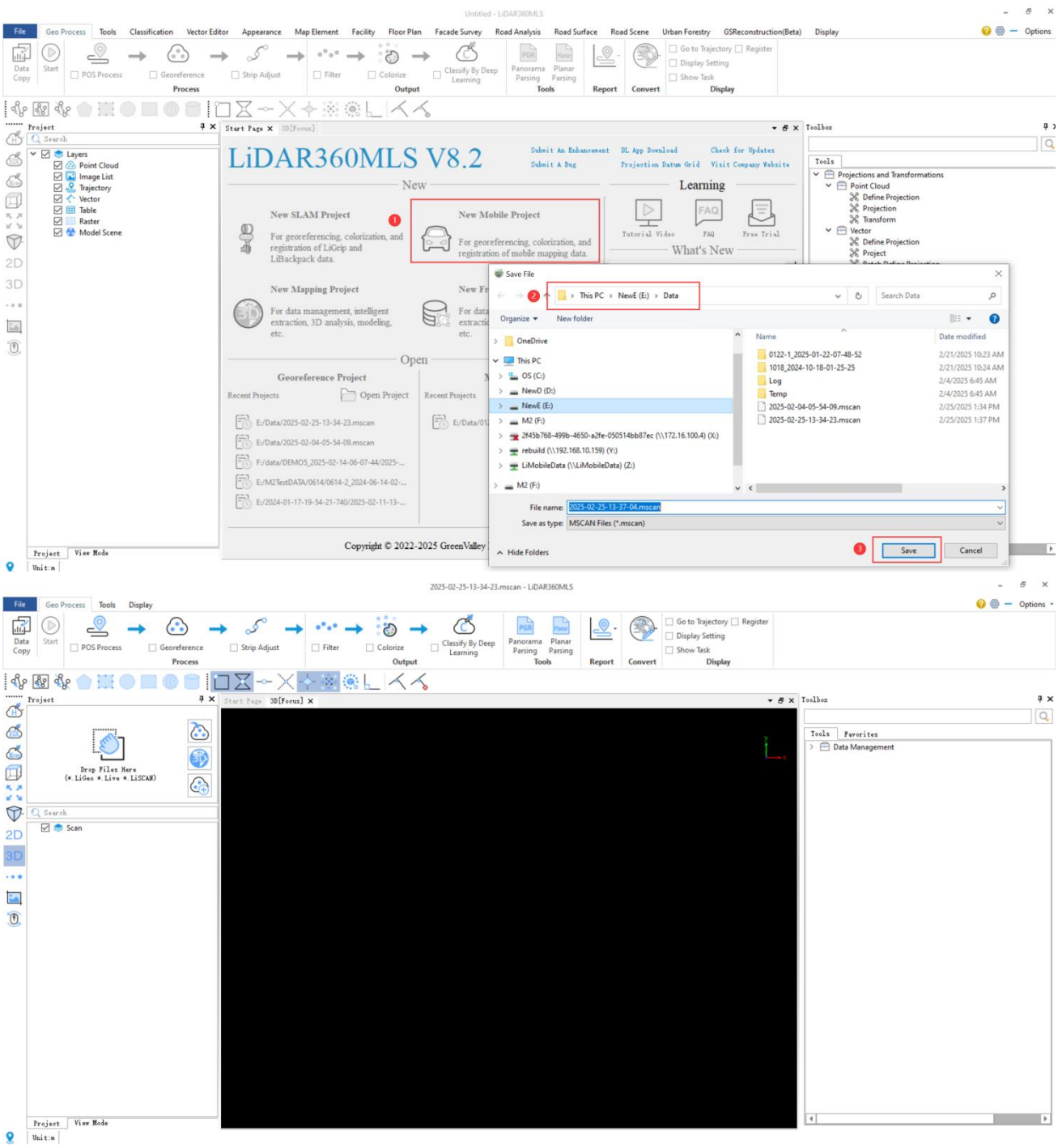
8.2 Data Processing and Output

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



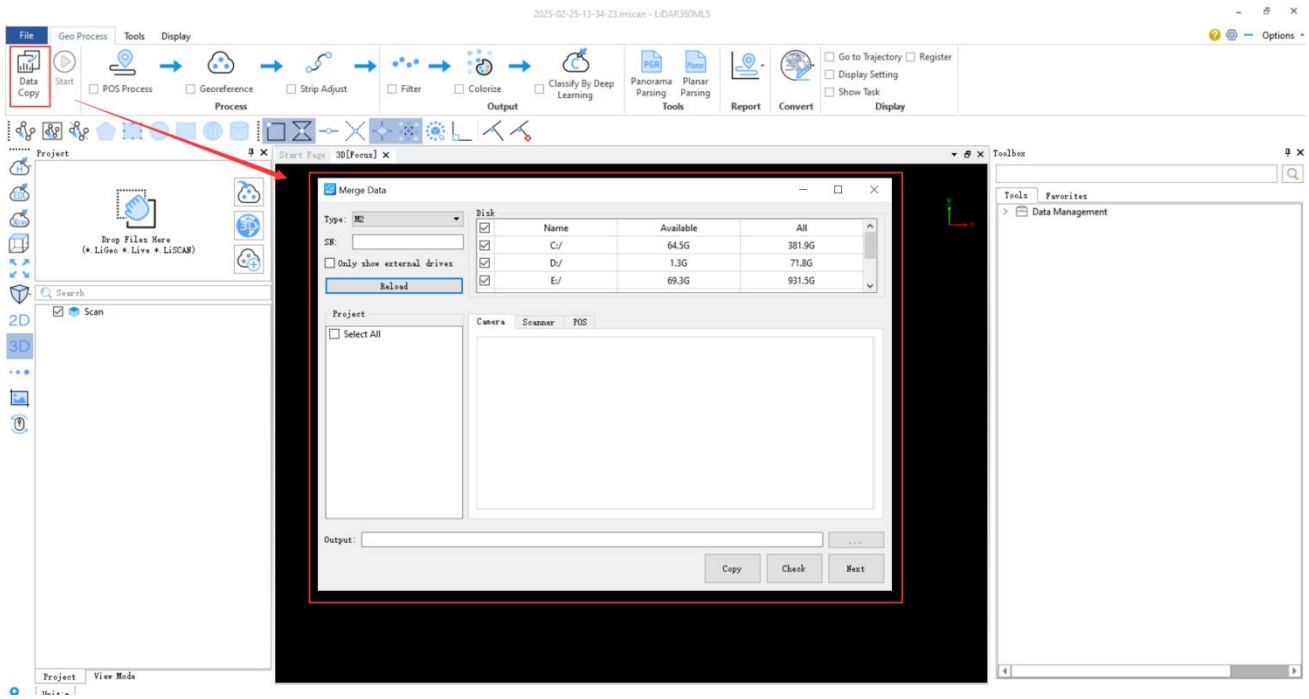
8.2.1 New Mobile Project

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.

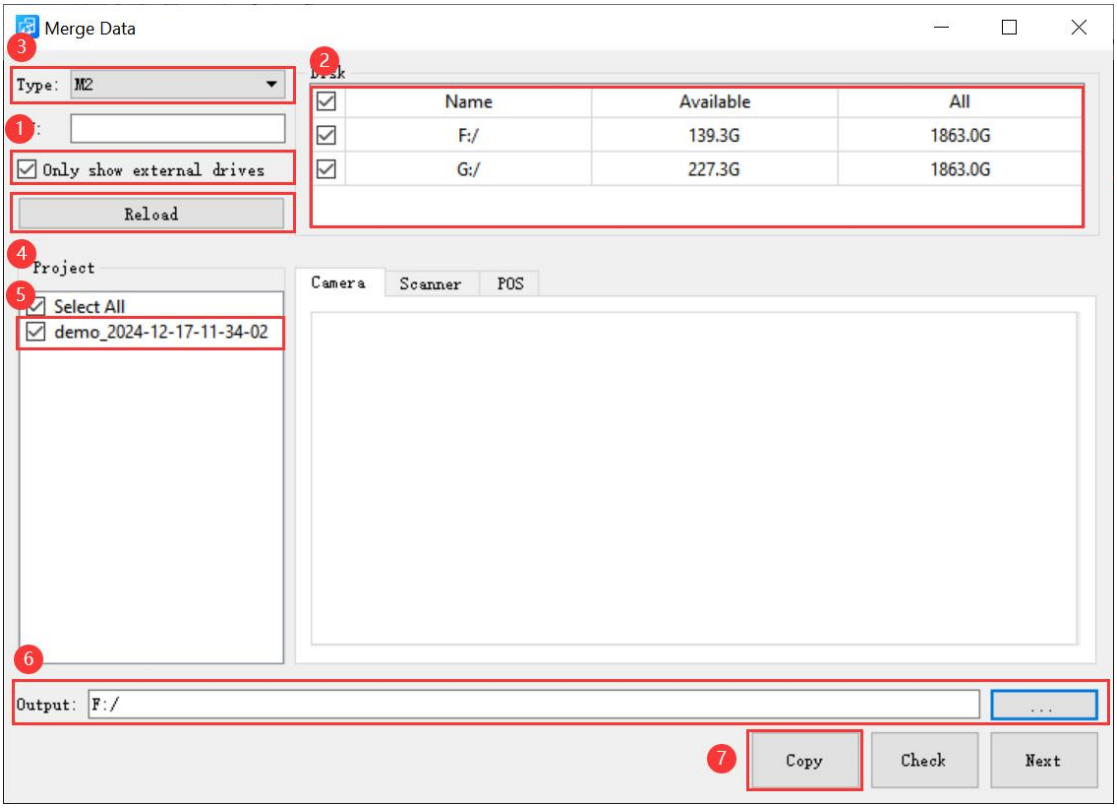
(3) Choose the device type.

(4) Click **Reload**.

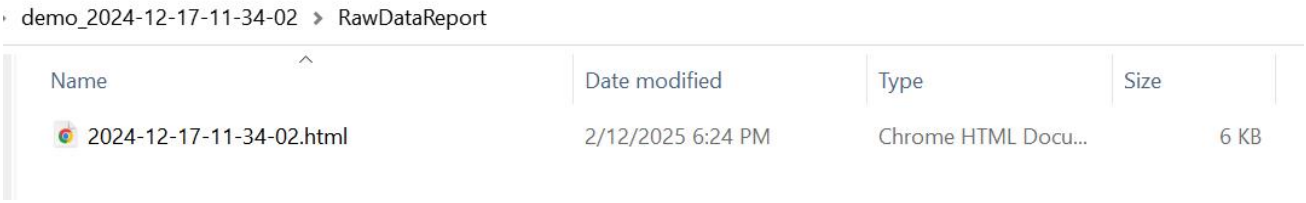
(5) Select the data to copy.

(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.



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:

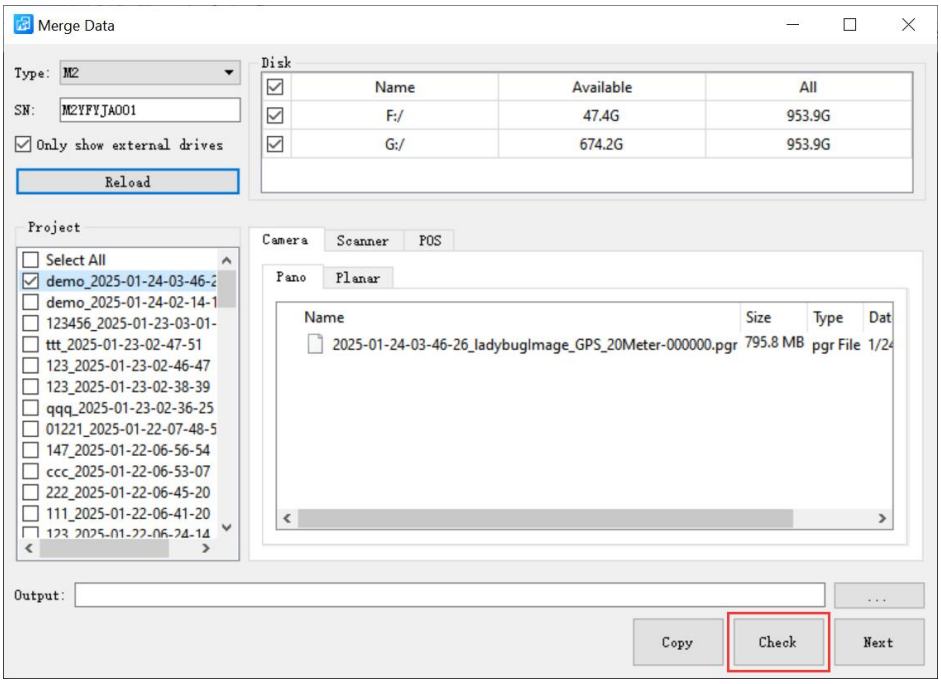
Scanner	LiDAR File	Start Time (UTC)	Stop Time (UTC)	Status
Scanner1	F:/test/demo/demo_2025-01-24-03-46-25/LaserRaw/Hesai_1/Hesai_1_2025-01-24-03-46-51-0.pcap	2025-01-24 03:46:51	2025-01-24 03:48:04	pass
Scanner2	F:/test/demo/demo_2025-01-24-03-46-25/LaserRaw/Hesai_2/Hesai_2_2025-01-24-03-46-51-0.pcap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

4. IMU Statistics:

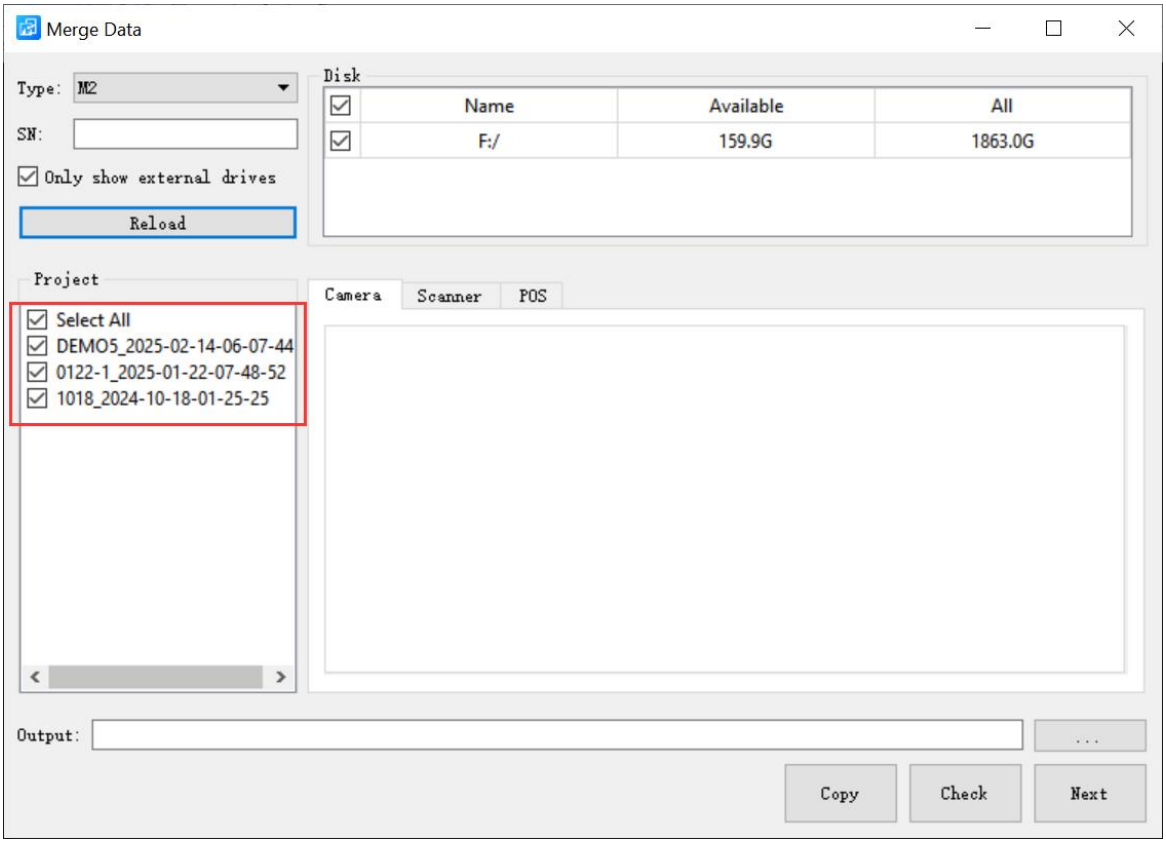
IMU File	Status
F:/test/demo/demo_2025-01-24-03-46-25/Rover/imu_merge.log	pass

☆ Notes:

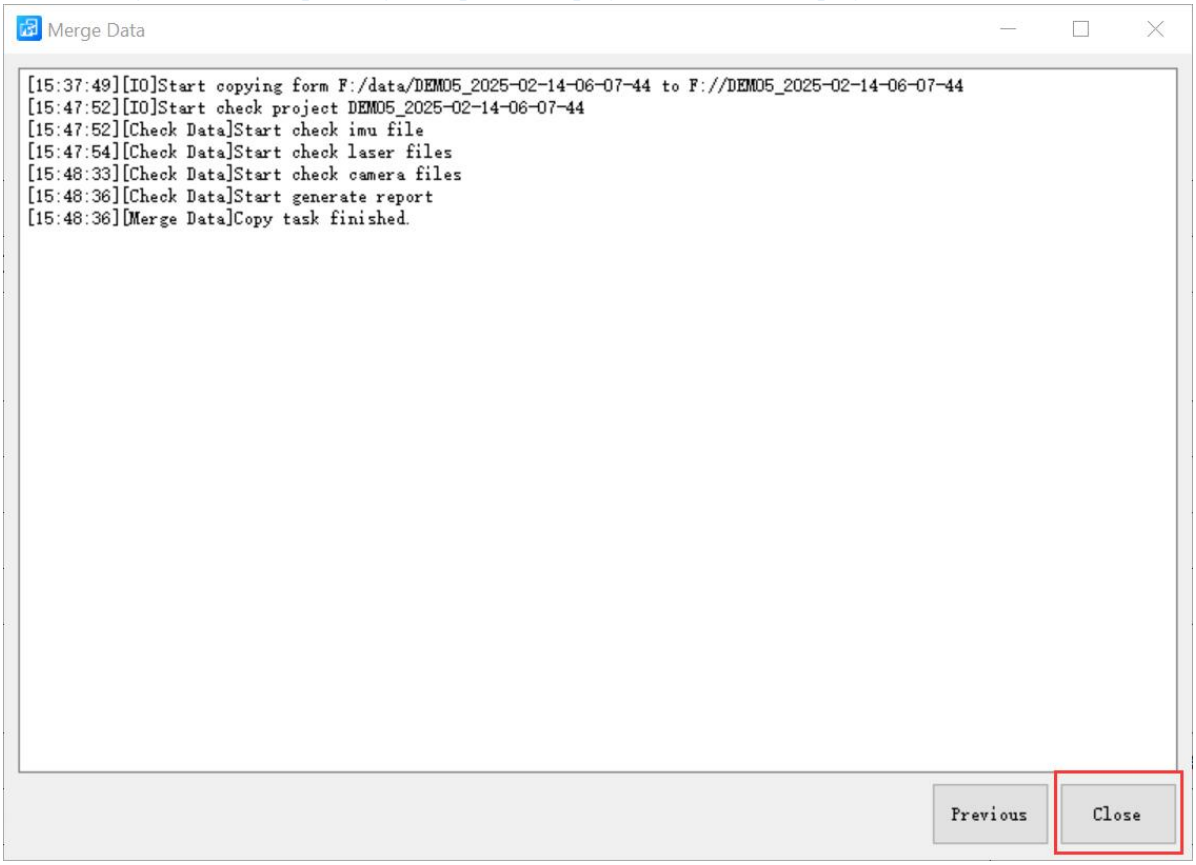
1. The data copying function also supports raw data quality checks without actually copying the data. The raw data quality report will be saved in the project path on the ML300_SYS disk.

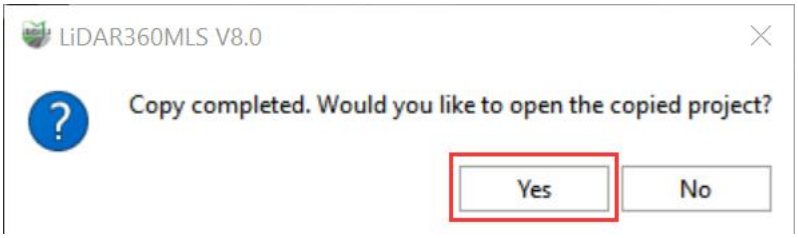


2. This function supports batch processing of data. Simply select multiple projects simultaneously at this step.

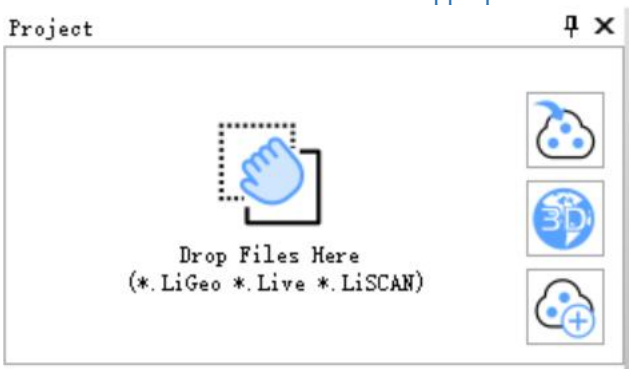


3. After the copying process is completed, clicking the **Close** button will bring up a dialog box. Clicking the **Yes** button will generate corresponding multiple liscan projects in the mscan project.



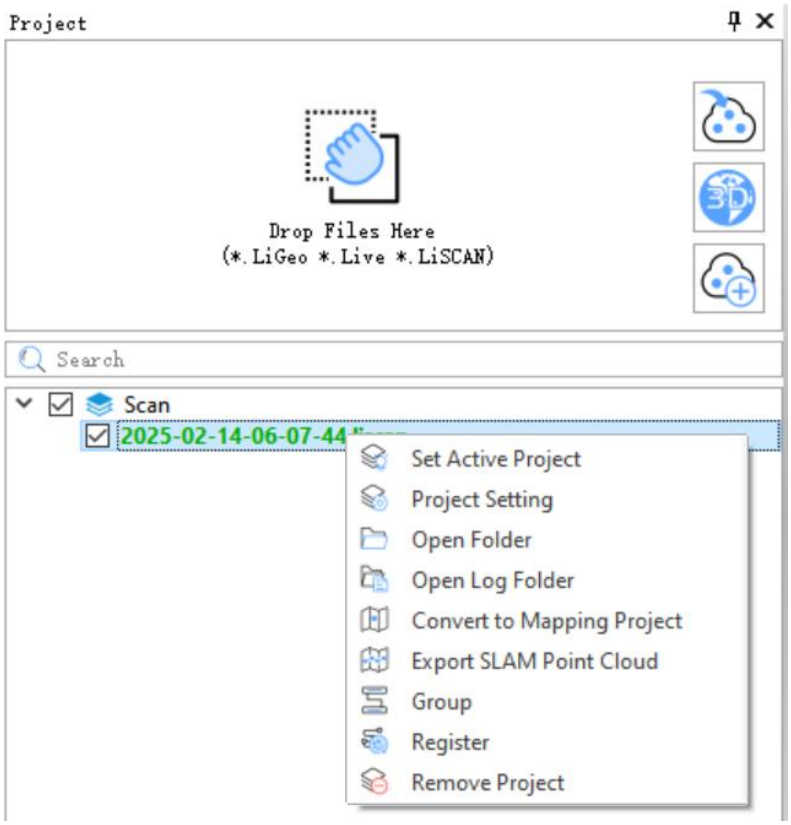


4. If the data copying function is not used, the software also provides multiple ways to create new liscan projects, including dragging and dropping *.live files, importing *.live files, adding existing data files, and creating based on calibration files. Users can choose the appropriate method according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

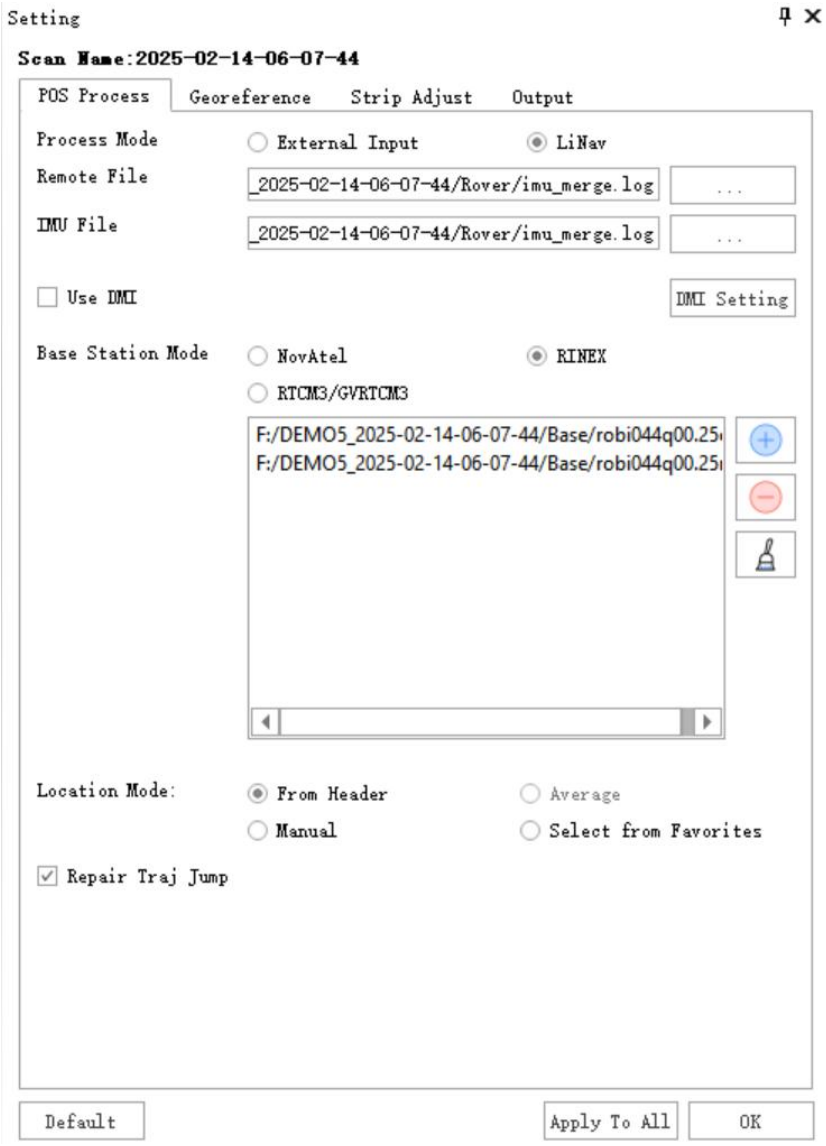


8.2.3 Parameter Settings

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.

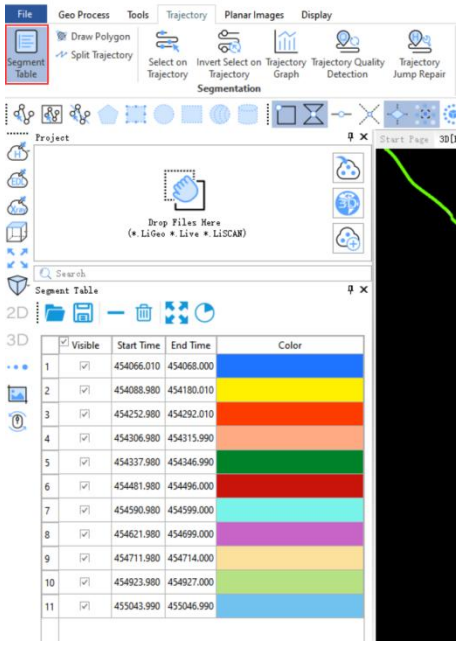


POS Process

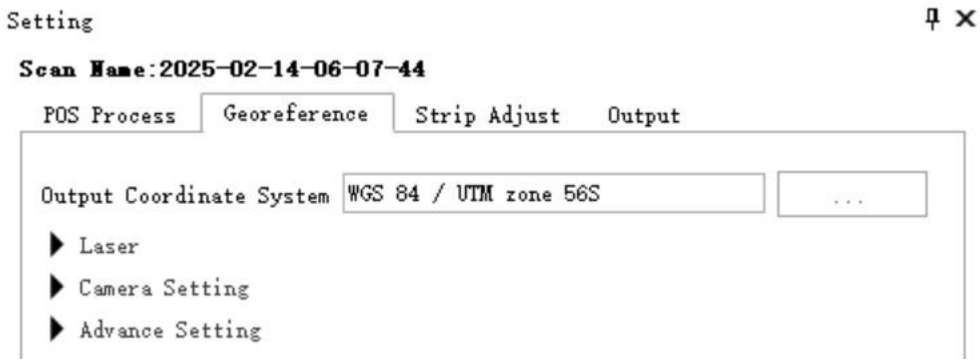


1. The software will automatically recognize the mobile station file and IMU file.
2. If a DMI is used, check the **Use DMI** option and click the **DMI Setting** button to set the parameters.
3. Add the base station file.
4. Select the **Location Mode**. The software supports two modes: automatic parsing 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.

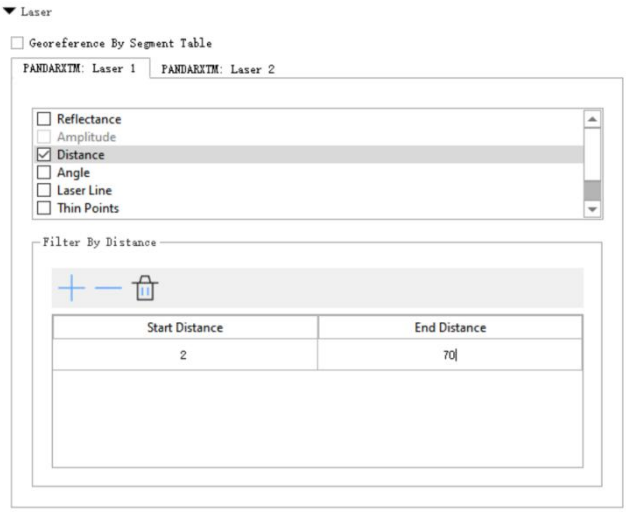
☆ Note: Users can view jump segments by clicking the trajectory segment table in the trajectory menu bar.

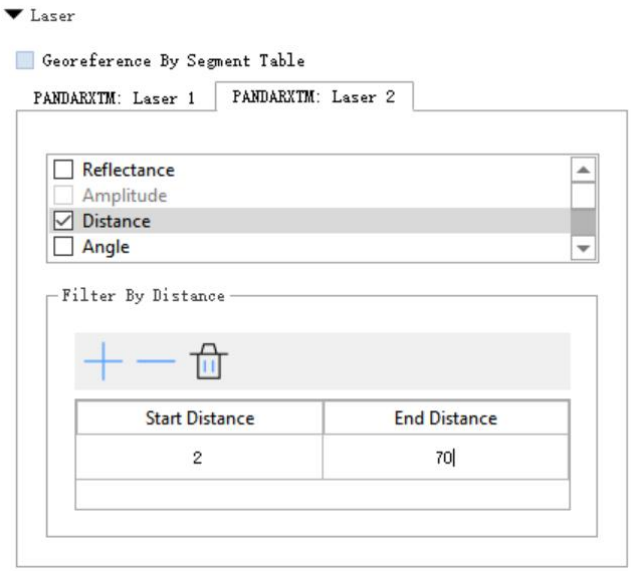


Georeference



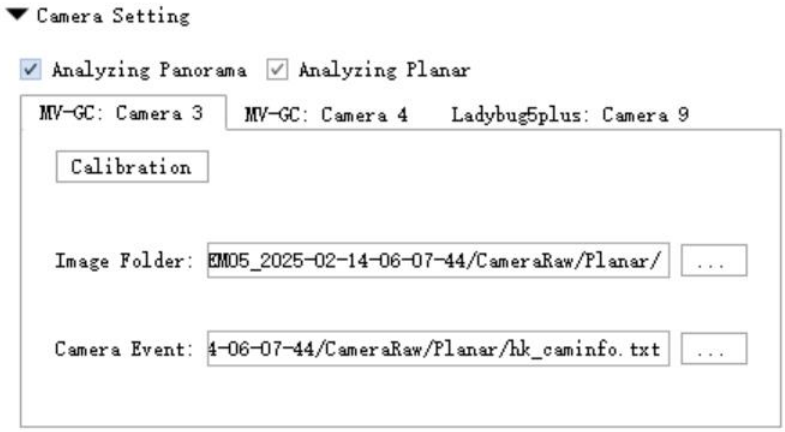
1. Output Coordinate System: Set the target coordinate system for the POS file imported or generated in the previous step. By default, the WGS 84 / UTM 6-degree zone coordinate system where the data was collected is recommended. Click the button on the right to edit.
2. Laser: Users need to set distance 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.



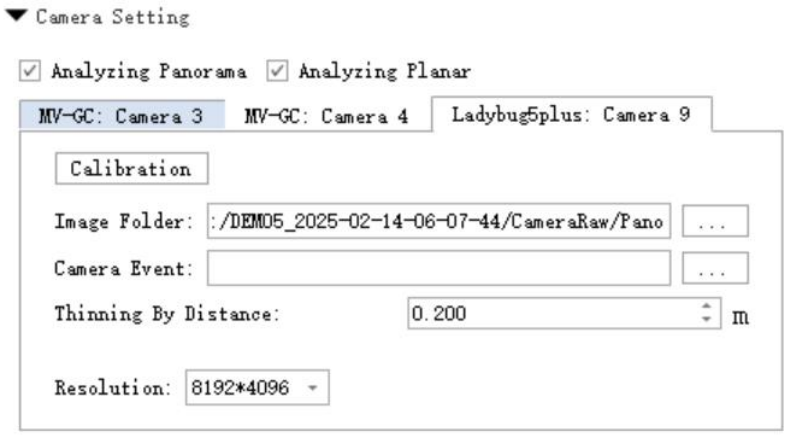


3. Camera Setting: Use the default parameters.

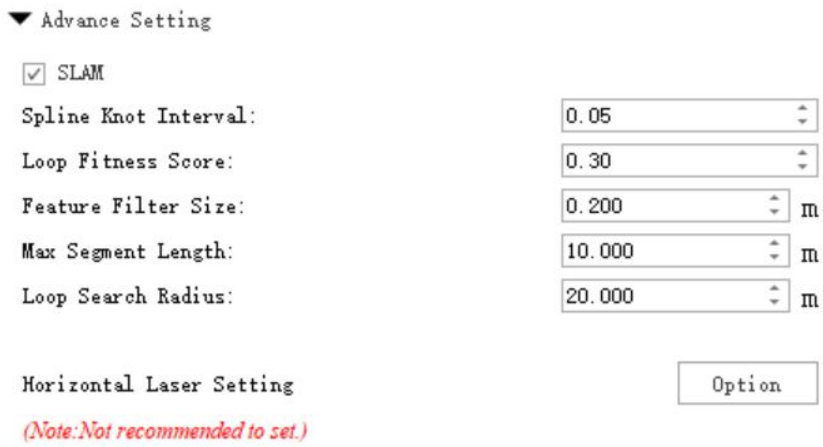
Planar Camera Settings: The software will automatically recognize the image folder and camera file. Check **Analyzing Planar** to enable the software to automatically parse planar camera data during the Georeference step.



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.



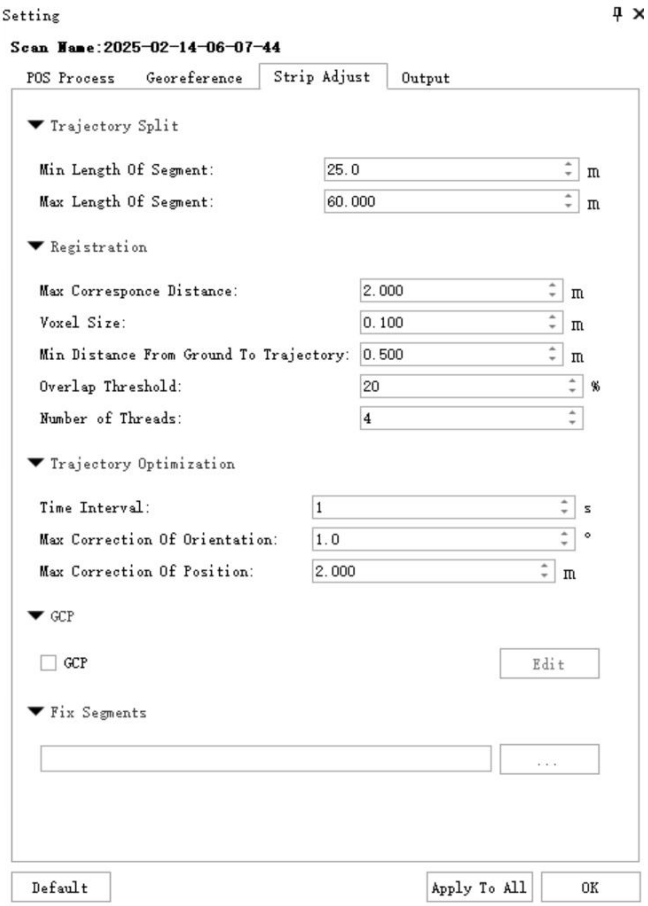
☆ Notes：

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.

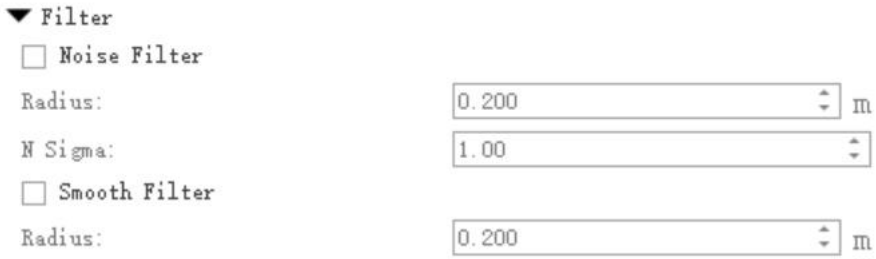
Strip Adjust

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.

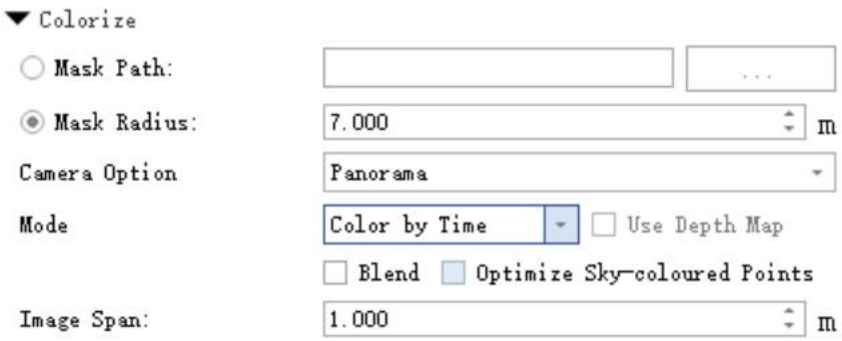


Output

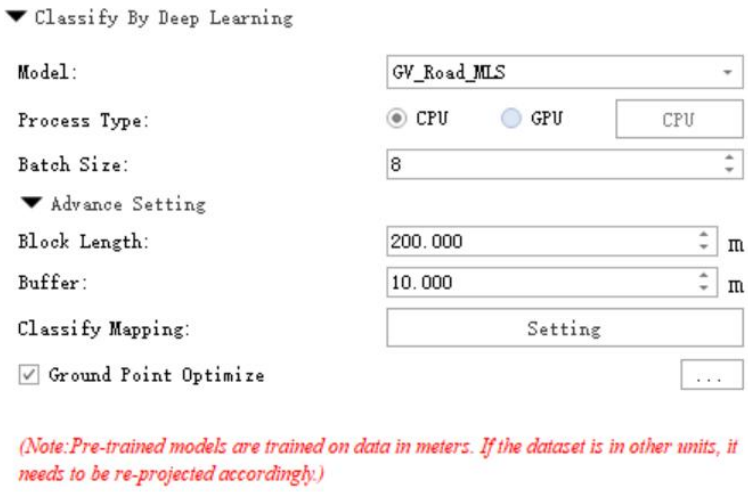
1. Filtering: Users can optionally enable **Noise Filter** and **Smooth Filter**. It is recommended to use the default parameters.



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.



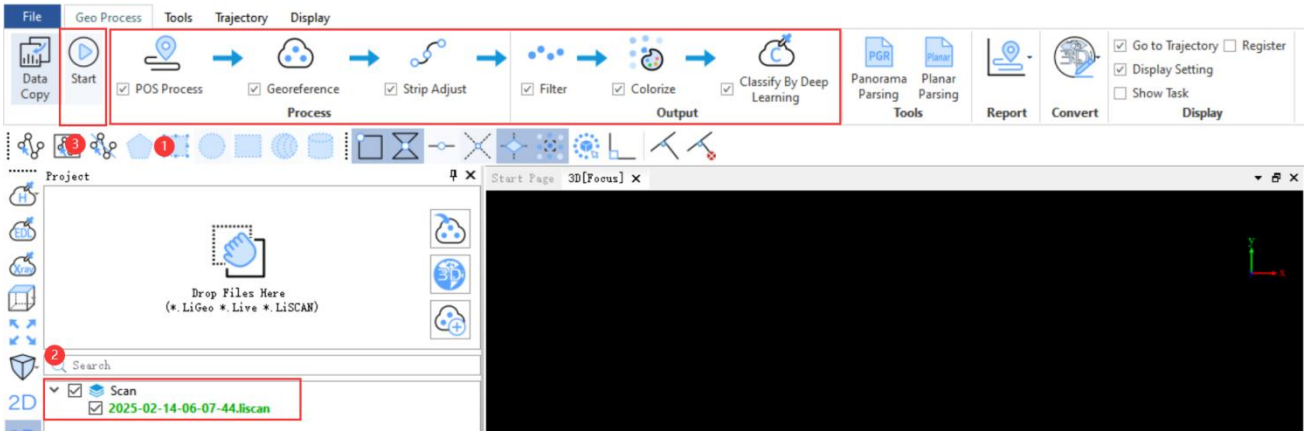
8.2.4 One-Click Batch Data Processing

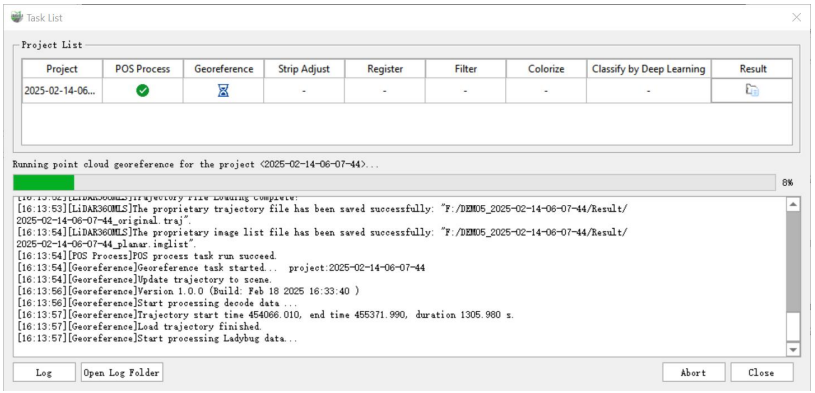
The specific steps are as follows:

(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:

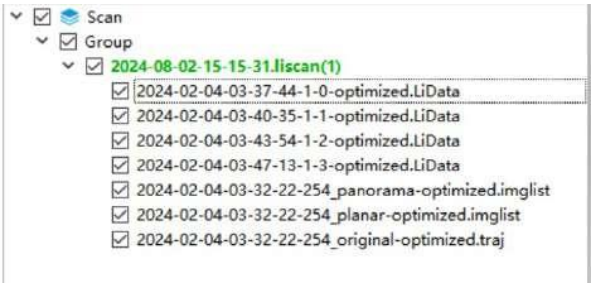
POS Process: Post-processes the original POS file to obtain high-precision POS data. This step will automatically perform a base station check. If users import external POS data, this step can be skipped.

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:

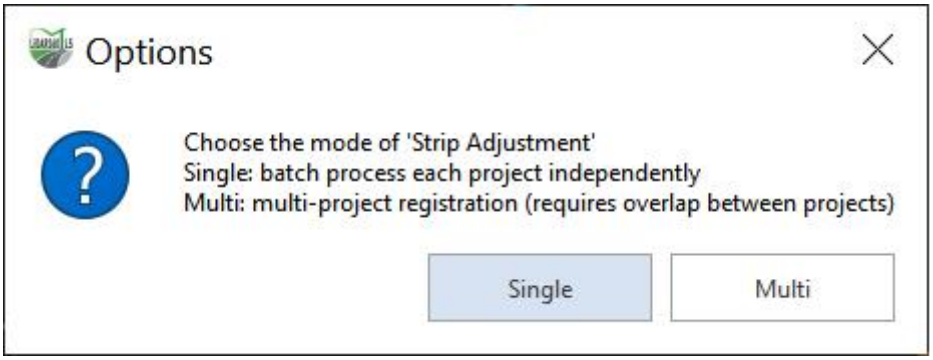
1. This step will regenerate point cloud, trajectory, and image data.



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.

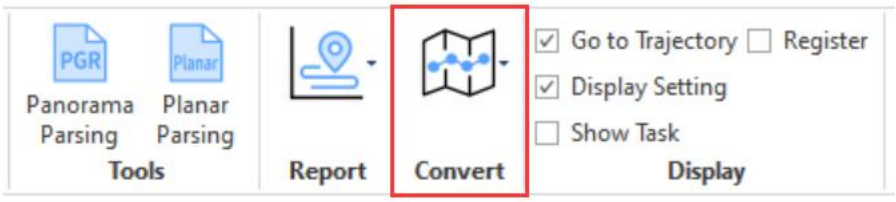
Convert to Mapping Project: Convert the single activated *.liscan project into a mapping project to facilitate subsequent data post-processing operations.

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.

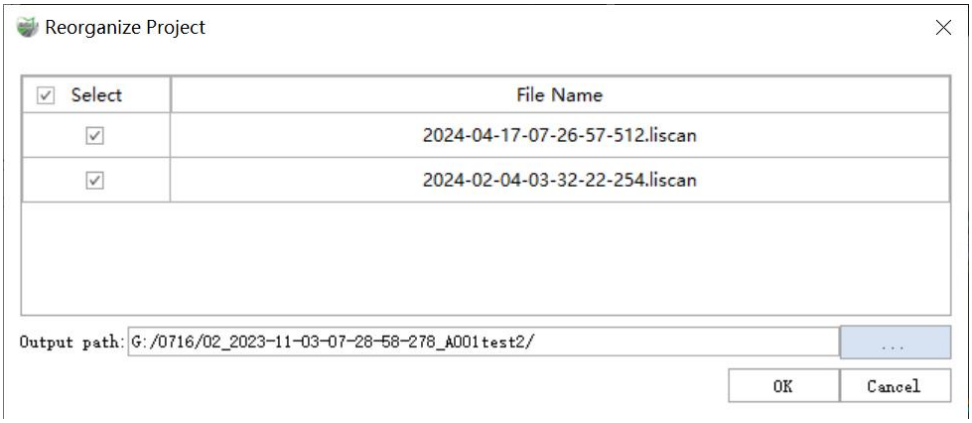


Organize into Mapping Project: Converts multiple *.liscan projects into a mapping project simultaneously.

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 5: "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 ComNav, 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 6: "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

Attachment 2 ML300_Data Size Calculator

Attachment 3 Disk Formatting Instructions

Attachment 4 Vehicle and Luggage Rack Crossbar Selection Guide

Attachment 5 B60 Battery Safety Usage Guidelines

Attachment 6 Calibration Field Data Collection Tutorial

Attachment 7 Mask File Creation Tutorial