LiAir 250 PRO

UAV LiDAR System User Guide

sole discretion, to change, modify, and remove portions of this document.

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Content

About This Guide

This document is a general introduction and operation guide for GVI's LiAir 250 PRO UAV

As we continue to update and improve the product, you may find some differences between the contents of this document and your LiAir 250 PRO system. We will diligently update this guide as the product changes.

LiDAR mapping/survey systems.

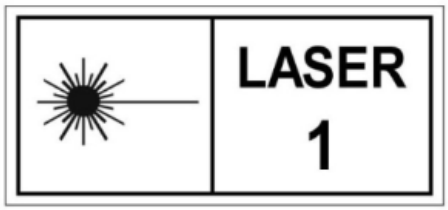
Please check with GVI for the latest release of this guide and contact GVI support at suppprt@greenvalleyintl.com if you have any questions.

Read This First

Important Notices

STOP! PLEASE READ THIS SECTION CAREFULLY BEFORE USING THE PRODUCT!

1. LiAir 250 PRO systems use Class 1 (IEC60825-1:2014) eye-safe laser sensors. If you have any concerns, please contact GVI for details.



2. System operator must be at least 18 years old.

3. Do not use the system when there is obvious noise, alarm sound, or damage, and contact GVI for maintenance in time. Forced use may cause permanent damage to the system.

4. Follow including but not limited to the operating instructions, suggestions, warnings, or precautions provided in this manual.

5. The applicable voltage of the system is 11~32V DC, and the typical power is 25W. Please do not use any power supply outside the applicable voltage range to prevent danger and damage to the system.

6. Keep the power supply, GPS, network cable, and other connector ports clean and dry, and do not insert objects other than the docking connector.

7. Please do not disassemble or install the system without authorization, do not replace parts provided by GVI without authorization, to avoid danger and damage to the system. If you need to disassemble any part of the system, please contact GVI and proceed under the guidance of the technical engineer.

8. This system is a high-precision instrument, please handle it gently. It should be stored and transported in the protective case provided with the system at the time of purchase or in a productive case authorized for use by GVI.

9. The product should be stored in a cool and dry place. It should be cleaned up after each use. The power must be turned off during cleaning. Do not clean it directly with water.

10. The working temperature of the system is -10℃~+40℃. Exceeding/below the suggestion temperature range may cause erroneous measurement results, data loss, or equipment damage.

11. Before using the system, please ensure that the operating environment is far away from electromagnetic interference sources. For specific standards, please refer to the user tutorial.

12. There are corresponding specifications for battery use and storage. For details, please refer to the lithium battery use/storage specifications.

13. After the equipment is scrapped, please do not throw it directly into the trash bin. It can be sent back to GVI for disposal or dealt with it in accordance with local regulations on recycling and disposal of waste electronic products.

There may be additional notices and warnings placed throughout parts of this document. Read each notice and warning carefully and please follow the instructions.

1. LiAir 250 PRO System

1.1 About

The LiAir 250 PRO UAV LiDAR system is lightweight professional equipment developed for multiple platforms. It integrates a LiDAR scanning system, an inertial navigation system, and a control system. It can collect high-precision point cloud data in real-time, dynamically, and massively, with the option of on-board imaging and photogrammetric information. It is widely used in the acquisition of 3D spatial information in the fields of surveying and mapping, power, forestry, agriculture, land (urban) planning, geological disasters, and mining industries.

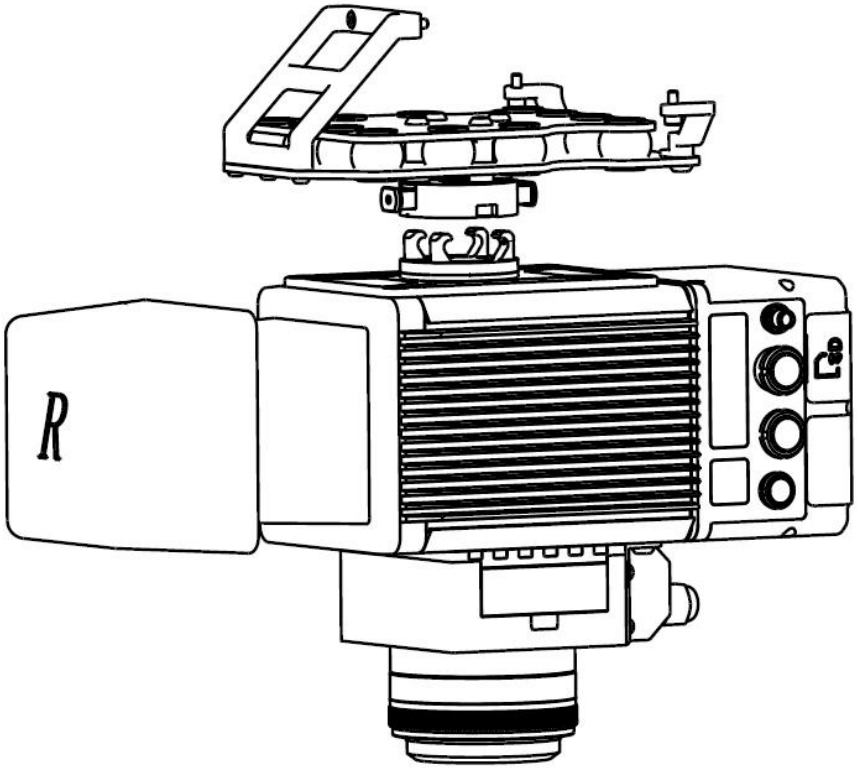
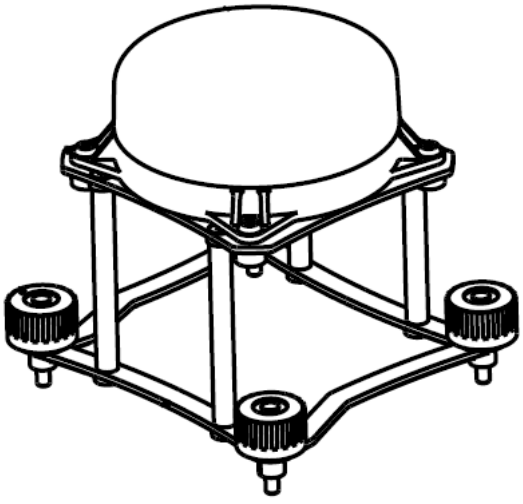
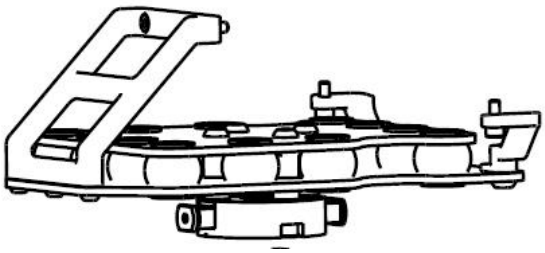


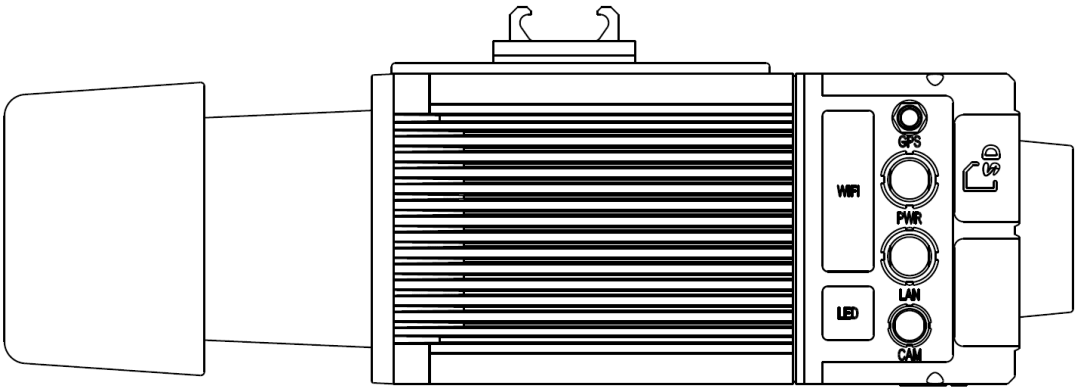
Figure 1 LiAir250 PRO system



Weight: 135g



Weight：149g



Weight：1860g

1.2 System Basics

LiAir250 PRO is comprised mainly of three major components: LiDAR scanning system, inertial navigation system, and control & storage system, including:

(1) A GPS receiver used to measure the spatial position of the LiDAR signal transmission reference point;

(2) The attitude measurement unit used to measure the attitude parameters of the main optical axis of the scanning, that is, the inertial navigation unit;

(3) A laser ranging unit used to measure the distance between the LiDAR signal emission reference point and the ground laser foot point, which is the core part of the entire integrated system, that is, the laser scanner;

(4) A storage control system, used for data storage, system control, and controlling the

parameter adjustment, data collection, and downloading functions of the system;

(5) The power supply system is used to supply power to the system.

1.3 System Principles

- ✧ The inertial measurement unit（IMU）obtains the position and attitude that meet the accuracy requirements and accurately transmits it to the laser scanner, which is a high-speed rotating laser scanner.
- ✧ According to the range information and the rotation angle, the coordinates of each laser point are quickly calculated, stored in the storage control unit.

1.4 Technical Specification

LiAir 250 PRO Specifications			
LiDAR Unit	**Max. Scan Range**	330m@80@; 170m;ρ≥20%	RIEGL standard parameters
	Relative Accuracy	10mm	RIEGL standard parameters
	System Accuracy	±3cm	AGL:80M,8M/S, FOV 60
	Scan Rate	200,000 points/sec	Refer to the miniVUX-3UAV standard (mini1-mini2)
	Laser Pulse Repetition Rate	300kHz	Refer to the miniVUX-3UAV standard (mini1-mini2)
	FOV	360°	Best FOV 90°
	Scanning Method	Channel	Parallel line scanning, even point density
	Protection Class	IP54	IP 44
	Weight	2 kg	Excluding shock absorption structure, camera (300g) and accessories
	Max. Number of Targets per Pulse	5	Refer to the miniVUX-3UAV standard (mini1-mini2)

	Temperature Range	-10°C up to +40°C (operation)	Refer to the miniVUX-3UAV standard (mini1-mini2)
Integrated Navigation System	**IMU**	APX-15 UAV	Refer to APX 15 standard, APX 20 (IMU 90) is optional
	IMU Data Rate	200Hz	
	Measurement Range:	±6g/±300dps	
	True Heading(deg)	RTK 0.18	Refer to APX 15 standard APX 20 (IMU 90) is optional
		Post-Processed 0.08	
	Poll & Pitch (deg)	RTK 0.03	
		Post-Processed 0.025	
Camera	**Number of Pixels (Effective)**	24.3 MP	SONY A7R4 is optional
	Focal Length	24mm	
	Storage	128 GB	
	Weight	0.3 kg	
Key Parameters	**System power supply**	12-32V	XT30 standard interface supports OSDK power supply
	UAV Platform	DJI M300 RTK PRO	Adapters can be customized for other UAVs
	Flight Time	25mins, Max.30mins	
	System Storage	Built-in 28GB External SD card 128GB	Provide more storage solutions
	Control Method	WEB UI	Supports Wi-Fi connection via browser (mobile phone,laptop)
	GPS	Support Trimble RTX service	Global coverage of 2-3cm positioning technology, subscription service is required
	GPS Antenna	Single Antenna	IMU built-in magnetic compass
	Multi-platform Support	Airborne Vehicle-mounted	Optional vehicle holder, support DMI free operation

2. LiAir 250 PRO System Components

2.1 Inertial navigation system

The attitude positioning system is formed by GNSS, IMU, and attitude processing software. Its main function is to provide the position and attitude information of the LiDAR system through GNSS and IMU data processing.

2.1.1 GNSS

Global satellite navigation systems mainly include GPS navigation systems (USA), Galileo (Europe), Beidou navigation systems（China）, and GLONASS (Russia）.

2.1.2 IMU

IMU: Inertial measurement unit, composed of a high-precision 3-axis gyroscope and accelerometers in the directions of 3 coordinate axes. It is also the reference center of the entire lidar system. Its main advantage is that it can obtain the attitude and coordinate position in real-time without external reference.

Main components: gyroscope + accelerometer + magnetic compass

We have built-in a 3-axis MEMS gyroscope, 3-axis built-in MEMS accelerometer, electronic magnetic compass, and GNSS receiver. Through a new generation of satellite/inertial integrated navigation algorithm, it can provide accurate, high real-time, and reliable multi-parameter navigation information.

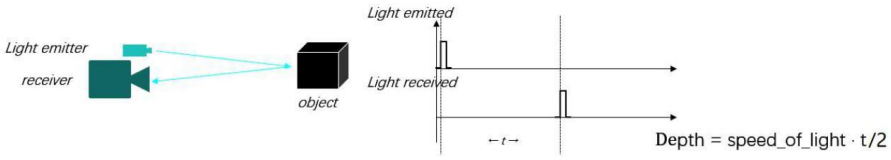
Note: *Do not install antennas or coaxial cables under lightning storms.*

2.2 Laser Scanner

The laser scanner is the core of the system. The LiDAR uses the laser as the emitting light

source and the photoelectric detection sensor as the receiving element. The distance and angle are measured and recorded according to the principle of laser ranging to determine the orientation information of the measured object.

The transmitter in the LiDAR emits an ultra-short light pulse hitting the object and diffusely reflected back to the receiver. The speed of light is known. The distance between the target object and the sensor is calculated by the flight time of the laser beam in the air.



LiDAR distance formula: $S = \frac{1}{2} \times c \times \Delta t$ (1)

* S is the distance from the sensor to the target, c is the speed of light, and △t is the laser round-trip time

Riegl miniVUX-3UAV is a special LiDAR for light and small UAVs, which uses waveform digitization and real-time waveform processing technology for high-speed data acquisition. Scanning through the rotating mirror allows 360° freely adjustable laser scanning field of view, and collection of complete surrounding environment data. At the same time, it has a multi-target detection function, and each laser beam has up to 5 target returns.

Figure 2 Riegl miniVUX-3UAV

Laser scanner specifications:

Scanning Mechanism	Rotating mirror

Scan Range	0.3 m ~ 250 m (@reflectivity≥60%)
Accuracy	± 15mm
Precision	10mm
Laser Pulse Repetition Rate	10Hz~300Hz
Angle Measurement Resolution	0.001°
Measurement Rate	200,000Pts/sec
FOV (horizontal)	360°
Laser Product Classification	Class 1 Eye-safe
Interfaces	WLAN IEEE802.11, RS232
Power Supply Input Voltage	11 - 34 V DC / typ.
Consumption	18 W @ 100 scans/sec
Temperature Range	-10°C up to +40°C (operation) / -20°C up to +50°C (storage)

***Note**: The laser scanner cannot be pointed at by direct strong light (including the beam of two sensors), to prevent the high-intensity laser from damaging the receiving sensor.*

2.3 Control and Storage Unit

The main functions of the control and storage unit:

(1) Ground control information and accurately transmit instructions to the corresponding sensors.

(2) Control and coordinate the normal operation of each sensor.

(3) Data storage: The device has a built-in storage of 25GB and supports SD card data storage (capacity depends on the size of the SD card) for storing lidar data, inertial measurement data, and log information.

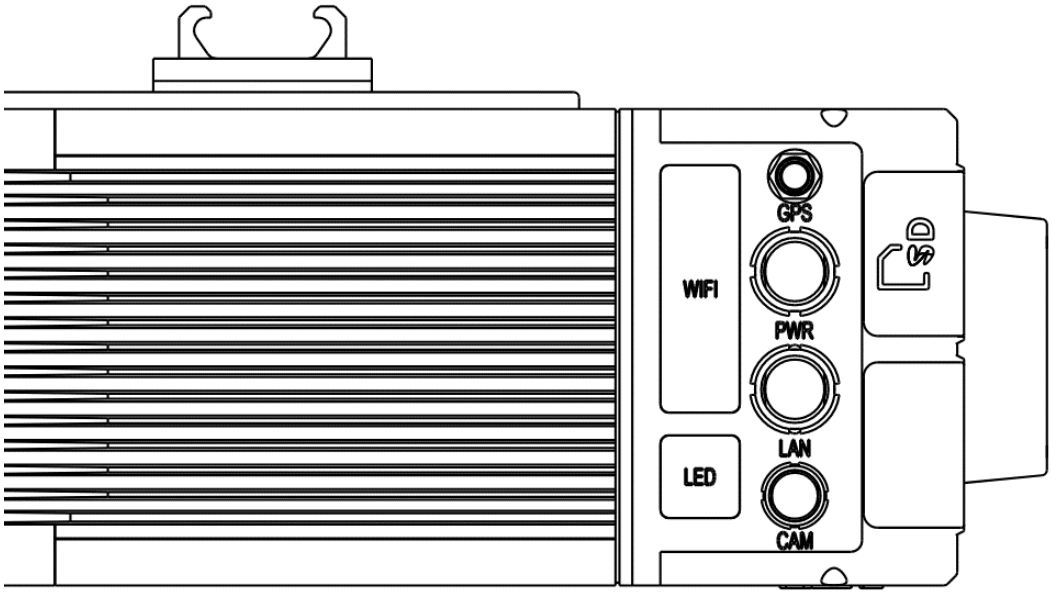


Figure 3 Control and storage unit interfaces

The main interface and panel indicator of the control and storage unit:

1. LED indicator: system power supply status.

2. Wi-Fi antenna: the location of the Wi-Fi antenna of the system

3. SD card: The current device uses a single SD card data storage mode

4. GPS: GPS connection dedicated SMA interface

5. PWR: power supply interface for the overall equipment, 12-32V power supply

6. CAM: dedicated to camera exposure feedback control

Control and storage unit LED light explanation

LED light	Status	Explanation
System	Uniform flashing Blue0.5Hz	POST, not synchronized
	Stable Blue	Scanner synchronization is normal
	Rapid flashing Blue2Hz	Start data recording

2.4 Camera Unit (Standard Module)

Modified Sony camera is integrated on LiAir 250 PRO.

Camera Specifications

Model	Key Specs.	Parameter
Sony A6000	Sensor type	APS-C type (23.5*15.6mm)
	Lens	16 mm fixed focal length lens
	Effective pixels	24.3 megapixels
	Image Sensor Type	COMS
	Exposure Mode	Timing
	Weight	0.3 kg

3. Ground GPS Base Station (Optional)

The main function of the ground GPS base station is to observe the same point for a long time, thereby having a high single-point accuracy as a differential reference for the UAV mobile station.

GPS base station composition: GPS antenna + GPS receiver + power supply

3.1 Introduction

Figure 4 Base station main body view

1—**Power interface** (9-30V, 0.3A@12V).
2—**USB interface**: Connect to a computer through a double-headed USB data cable for base station data copying.

3—**Base station status indicator**: used to indicate the status of the base station.

4—**Save button**: Base station data storage/end storage function (long press).

5—**RTK rubber rod antenna interface.**

6—**GPS antenna feeder interface**: connect the GPS antenna to the base station through the feeder cable.

7—**RTK rubber rod antenna.**

Detailed Instruction for the Base Station Indicator lights:

LED	Status	Explanation
	**Stable Red**	The power supply is normal.
	Flashing Red	The power supply voltage is low, the battery needs to be replaced.
	**Stable Blue**	Start storing GPS location information.
	Flashing Blue	System SD card installation failed or storage space is less than 1G.
	Grey	GPS location information storage has not started/has ended.
	**Stable Green**	RTK function is normal.
	**Stable Orange**	The base station location is locked.
	Flashing Orange	The base station location is locking.

3.2 Base station setup and operation process

3.2.1 Data collection

Figure 5 Assembly of the Base Station

1. Connect the GPS antenna and external power supply according to the above figure, and

power on;

2. Observe that the indicator light  is steadily on;
3. Observe that the indicator light  is off;
4. Observe that the indicator light is steadily on, which means that the base station has received the RTK data and is transmitting.
5. Wait for the indicator light  to change from slow flashing to steady on, that is, the location of the base station is successfully locked;
6. Press the button 

for more than 1 second, and the indicator  will turn to a steady status, that is, the base station starts to store GPS location information;
7. After the data collection is completed, press the button 

for more than 1 second, the indicator light  will be off, and the GPS location information will stop recording
8. Turn off the power of the base station;

3.2.2 Data download

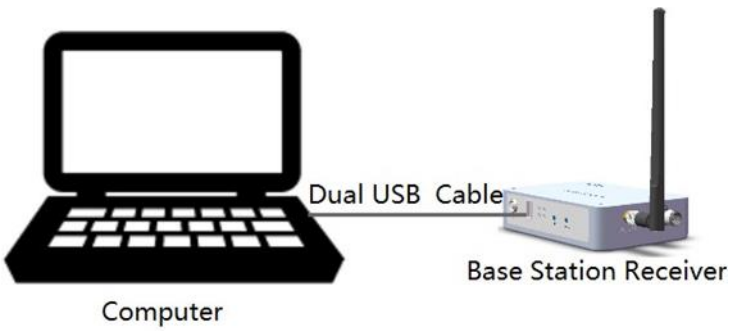


Figure 6 Connecting the Base Station to a Computer for Data Download

1. Connect the Base Station to a computer via the provided USB cable.
2. The computer should recognize Base Station as an external disk.

3. Download the base station file through direct copy.

***Note**: The base station file name composition in the SD card: UTC time + suffix (log), for example, 20170810063808.log.*

4. Data Storage and Download

4.1 Data Storage

Laser scan data and IMU data are stored inside the device or on the SD card. The project file is stored in the project storage path set during data collection (\\192.168.0.10\inter) or the data is copied through the SD card.

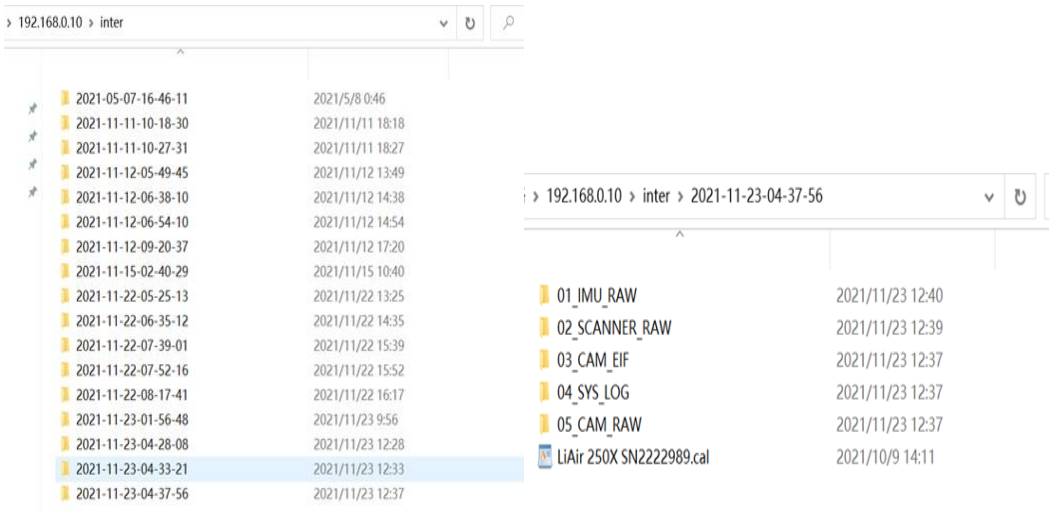


Figure 7 Project file examples

- **01_IMU_RAW**: This folder is used to store IMU raw data (*.T04).
- **02_SCANNER_RAW**: This folder stores laser data.
- **03_CAM_EIF**: Customized camera feedback file (the non-customized folder is empty)
- **04_SYS_LOG**: This folder stores system log files.
- **05_CAM_RAW**: This folder stores camera files (not common to all devices).
- **LiAir 250 PRO SN2222989.cal**: This file is the calibration parameter file of the device.

***Note:** data download via both Wi-Fi and network cable is supported. SD card data can be*

directly accessed through the network for data management on the desktop.

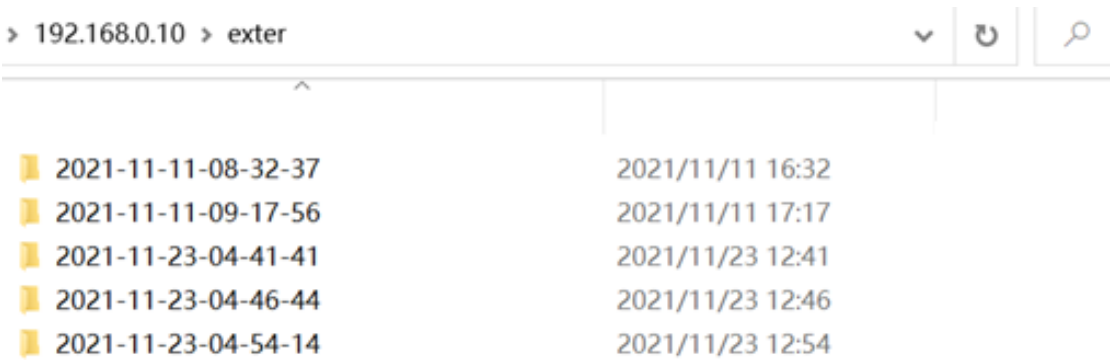


Figure 8 Direct access to SD card via Wi-Fi

4.2 Camera Data Download

The camera data is stored in the camera's SD card, and the image data download can be completed by removing the camera's SD card directly.

(1) Take out the SD card of the camera.

(2) Connect the SD card to the computer, create a new folder named "Images->Cam1" under the Cam folder in the project folder. And copy all the images collected in the SD card to the folder "Cam1".

***Note**: Only copy the image files, do not cut any system files. After the device is powered on, it will perform a self-check. When copying images, you can skip the self-check photos or delete the self-check photos after the copy is complete.*

5. Special Notes

Here are some special notes to pay attention to while operating LiAir V70. GVI has compiled these notes based on experiences and feedback from customers. The following points out details that seem small or insignificant but can, however, lead to issues that may be difficult or impossible to rectify post-mission if left unchecked.

Operation Notice & Equipment Maintenance

- The LiAir250 PRO system integrates several high-precision instruments. Please handle it with care.
- Avoid direct impact to the system. Always store all items properly in the protective case before transporting. Do not move or transport the system unprotected.
- This product should be stored and transported in the protective case provided by or authorized for use by GVI.
- Do NOT scratch the **Laser Scanner Lens**.
- Ensure the **Laser Scanner Lens** surface is clean before the mission. Only clean the lens with special cleaning agents for high-precision measurement instruments and optics with a soft cloth.
- Clean the product thoroughly after each use. Use only proper cleaning agents for the scientific instrument.
- Pull the power off softly and properly disconnect all batteries, antennas, and cables after use.
- Please perform a power-on test if the machine is not used for more than one month.
- Do NOT operate the system in rain, harsh environments, and outside its safe temperature range.
- System safe operating temperature: **-10℃ to + 40℃**.
- Storage temperature: **-20℃ to + 50℃**.
- This product is NOT water-proof. Do NOT operate in rain or snow. Water damage is NOT covered by the Product Warranty. When not in use, store the product in a cool and dry environment.

- Tampering with the product is strictly prohibited and will void the Product Warranty. Any repair, modification, or upgrade must be performed by a GVI technician or authorized service provider.
- This product is a high-precision mapping and surveying instrument that must be handled with care. Damages caused by improper handling of the product are not covered by your warranty.
- The laser sensor dust cover and camera lens cover should be covered after each use.
- Before storing, make sure that all power supplies are turned off.
- If the storage time is more than one month, it should be energized and tested.