LiBackpack DGC50H

Mobile Backpack 3D Mapping System

User Guide

GreenValley International

www.greenvalleyintl.com

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User Guide

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Dear Users,

Thank you for using our LiBackpack DGC50H laser scanning system. We are pleased to be of service to you with LiDAR point cloud collection and manipulation solutions. At GreenValley International, we constantly strive to improve our products. We therefore appreciate all comments and suggestions for improvements concerning our hardware, software, training, and documentation. Feel free to contact us via info@greenvalleyintl.com. Thank you.

Legal Notes

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1. Safety Warning

Please read this manual carefully before using the product and follow the operating instructions in the manual. This manual will be updated in real time as the product technology upgrades. Users can get the latest user manual from the official website of Greenvalley International or the technicians of Greenvalley International.

LiBackpack DGC50H is a precision instrument. Please take extra care when using it. Impact on and strong vibration of the device is extremely prohibited. When transporting the device, be sure to put all items in the protective case properly. Do not transport or move the device that is not under protection.

> Note: If the device will not be used for a long time or be transported for a long distance, please remove the power supply battery from the LiBackpack device.

In order to avoid equipment damage and violation of the warranty terms, please do not disassemble the LiBackpack equipment without GVI technician's permission. If the equipment fails, it must be repaired at an authorized repair facility.

2. Introduction

LiBackpack DGC50H is a backpack LiDAR 3D scanning system, which is suitable for both indoor and outdoor scanning and with high absolute geographic coordinates. With the GNSS information and the SLAM (Simultaneous Localization And Mapping) technology, LiBackpack DGC50H can acquire point cloud data with high absolute coordinates and panoramic images simultaneously. Even if the GNSS signal is insufficient in some parts on the scanning route, the geographic coordinates information can be obtained. This equipment can be widely used for indoor and outdoor integrated measurement, underground space information acquisition, tunnel engineering, digital factories, digital mines, forestry resource census, BIM and other fields.

2.1 Product Name

LiBackpack DGC50H backpack LiDAR 3D scanning system

2.2 Major Technical Parameters

Item	Parameter
Scanner	XT16
Safety Class	Class 1 (IEC60825-1:2014) eye-safe laser sensors
LiDAR Ranging Accuracy	±1 cm
Relative Accuracy	3 cm*
Absolute Accuracy	5 cm*
Weight	8.6kg
Dimensions	1135*318*315mm(extended); 960*318*315mm(closed)
Max Ranging Distance	120 m
Laser Wavelength	905 nm
Scanning Rate	640,000 pts/s
Horizontal FOV	0° ~ 360°
Vertical FOV	-90° ~ 90°
POS	Integrated SLAM System
Point Cloud Format	.las,.laz,.ply,.LiData
Storage Capacity	512GB
Ports Available	HDMI, USB, Ethernet
Battery Capacity	5875 mAh*2
Battery Life	≥2.5 h
Working Temperature	-10℃ ~ 40℃
Max Moving Speed	20 km/h
Video Resolution	5760*2880
Video Recording Method	Time-lapse photography 2s/frame
Camera Type	Panoramic Camera
Photo Pixels	1800W
Control and Display	Control and display through network (smart phone or tablet); Wired data transmission (tablet)

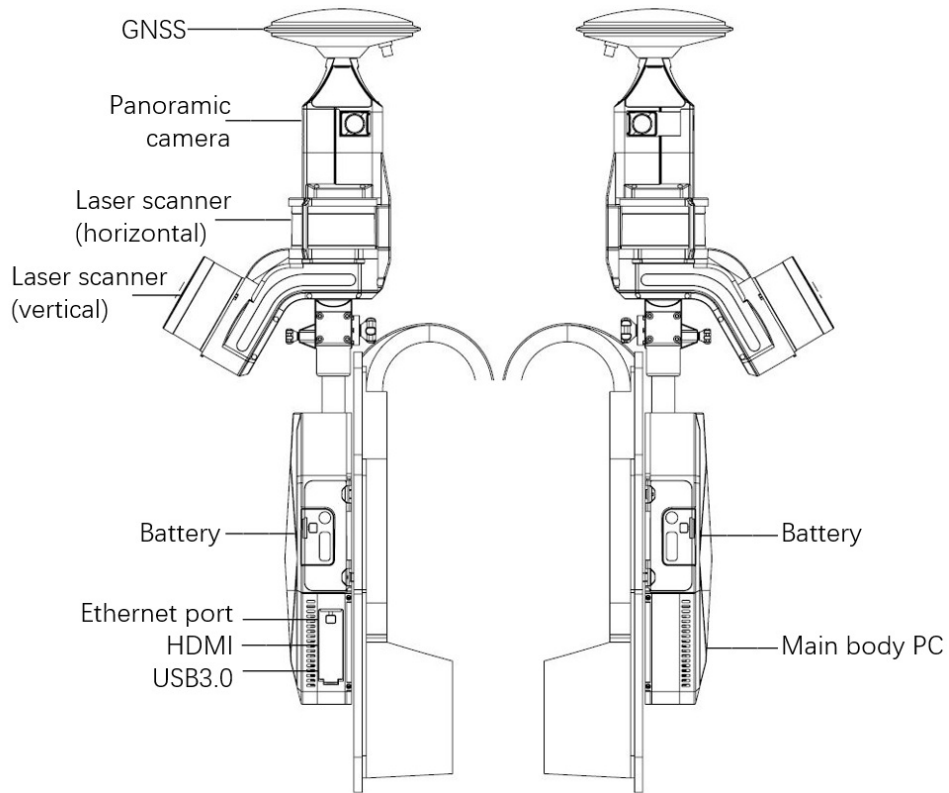*Affected by acquisition environment and route.

3. Components

LiBackpack DGC50H Components

Optional accessory: iPad Mini tablet

LiBackpack DGC50H Details

3.1 Laser Scanner

Laser Scanner	XT-16
Max Ranging Distance	120 m
Laser Wavelength	905 nm
Scanning Rate	640,000 pts/s
Horizontal FOV	360°
Vertical FOV	±15°
LiDAR Ranging Accuracy	±1cm
Working Temperature	-20℃~ 65℃

3.2 Camera Unit

Camera Type	Panoramic Camera
Video Resolution	5760*2880
Video Recording Method	Time-lapse photography 2s/frame
Photo Pixels	1800W

## 3.3 GNSS Receiver

Channels	GPS: L1 C/A, L1C, L2C, L2P, L5 GLONASS: L1 C/A, L2C, L2P, L3,L5 Galileo: E1, E5a, E5b, E5 AltBOC, E6 BeiDou: B1,B2
Positioning Accuracy	1cm+1ppm

3.4 Onboard Computer

- Operating Voltage: 19V
- Hard disk storage space: Solid State Drive 512G
- CPU performance: Four cores/eight threads

3.5 Wifi Information

- Frequency Range: 2.4 GHz
- Protocol: IEEE 802.11n
- Security: WPA2-Personal
- Gateway address: 192.168.12.1:8090
- Connections allowed: 1
- Connection Range: 5 meters
- Wifi SSID: LiBackpack (default password: greenvalley)
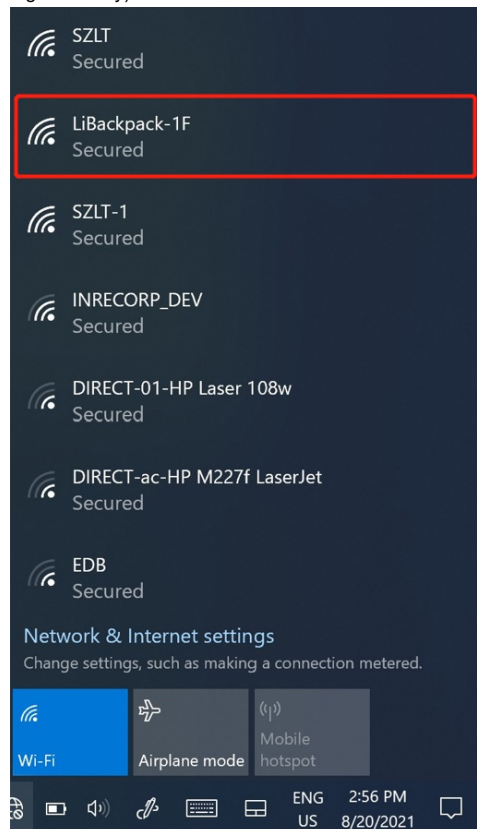
LiBackpack Wifi information

4. Setup Instructions

Data collection with LiBackpack DGC50H is carried out in Backpack Scanning Mode.

1. Place the LiBackpack DGC50H's storage control unit and scanner arm on the desktop.

LiBackpack DGC50H Storage and Control Unit and Scanner Arm

2. Plug the scanner arm into LiBackpack DGC50H storage and control unit. The tilted laser scanner should be opposite to the main body.

Mount the scanner on main body

3. You can hear a click sound when locking the scanner on to the main body. Then, tighten the screw to secure mounting.

Secure the device

4. Loosen the two locking rings of the scanner rod counterclockwise, the scanner rod can rise and fall freely.

Try telescopic rod

5. Adjust the rod length using both hands.

Extend the rod

6. Secure the adjustment by screwing the locking rings tightly.

Secure the locking ring

7. Plug in the connection cable into the scanner arm and main body seperately. Note: Align the port by the corresponding red dots.

Connect the scanner arm with main body

8. Assembly done.

Assembly done.

5. Equipment Operation Procedure

Please follow these instructions closely to operate the system correctly and safely.

Making plans for the acquisition routes to take before actual collection can help improve the quality and accuracy of collected data in the operation. See section 6.2 Route Planning for advice on the topic.

5.1 Set up the Base station

1. Base station erection: place the libase base station in an open area or on a known control point, without vibration, away from signal interference sources. For projects with high precision requirements, a tripod should be set up according to the surveying and mapping specifications, and the base station should be set up on the tripod.


LiBase GNSS Receiver

2. Device connection: Press and hold the power button of the base station to turn on the device, then open the LiSurvey software, and go to Device > Connection, then select Connection type >Bluetooth and Target device. When Available devices appears, click it to connect with bluetooth.
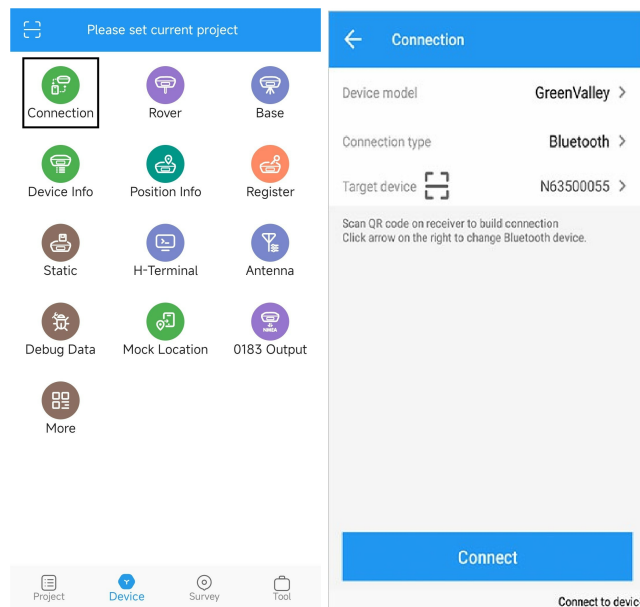
Device connection

3. Coordinate system setting: In the "Task" interface, click "Task Management" to create a custom coordinate system, as shown in the figure, it is a WGS84 ellipsoid, UTM projection, and the central meridian is 117°, that is, a 50-degree zone.

    Note: The Transverse Mercator projection is the Gauss Kruger projection, and the Universal Transverse Mercator projection is the UTM projection.
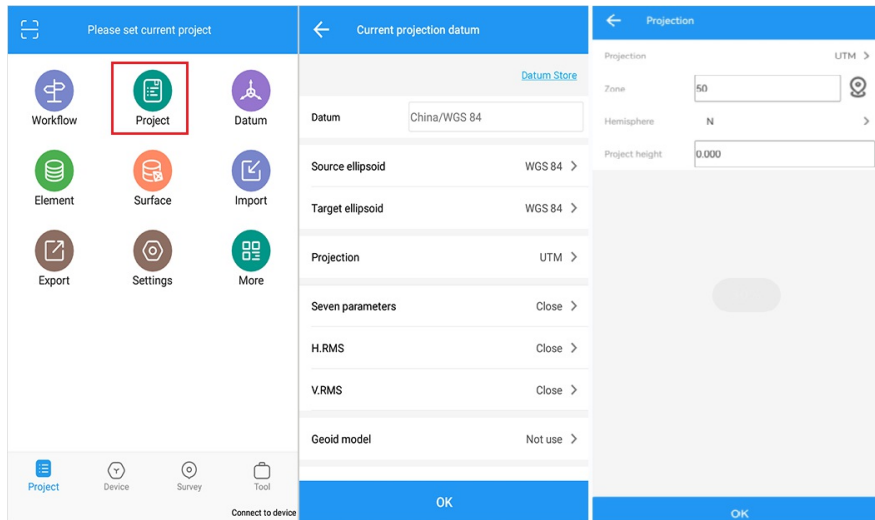
Coordinate system setting

4. Static recording: On the "Device" page, open "Static Collection", customize the file name, site and storage path, set the sampling frequency and antenna height, and after confirming that the settings are correct, click "Start Recording" to record static data.

   Note: The sampling frequency is recommended to be set to 1Hz.
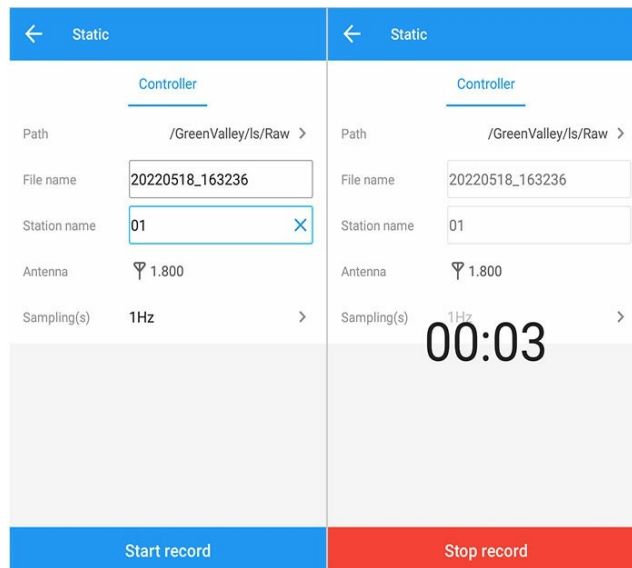

Static collection

5.2 Initialize the System

Open the Battery Compartment Cover and insert a charged Battery. Turn on the Battery by pressing its button once, and then press and hold for 2 seconds. The red light on the button will light on, which indicates the laser scanner and system are ready for operation. To turn off the device, repeat this step.

Power on the laser scanner and system

Power on the camera by pressing the camera button shortly. Notice a "ding" sound, which indicating that the camera is ON, and the camera screen will light up.
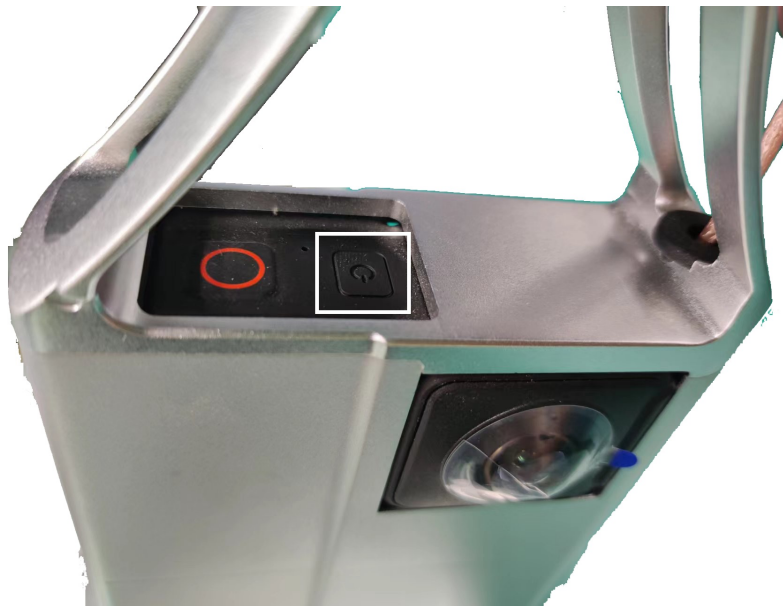
Power on the camera

When initialization is done, the signal light (Run) will be steady, while signal light (GNSS) will be flashing.


Signal light

5.3 Connect to a mobile device

Wait for one minute before connecting a mobile device with Google Chrome installed to LiBackpack's Web-Browser Based User Interface through Wifi or cable.

- Connecting to the LiBackpack User Interface via Wi-Fi:
    - From the list of networks available to your device select the network named "LiBackpack".
    - When prompted to do so, enter the default password "greenvalley".
    - Launch Google Chrome and navigate to 192.168.12.1:8090 and load the LiBackpack User Interface. If unsuccessful, double check that the Wifi is connected to LiBackpack.
    - Users using the included tablets can open up the UI straight from the desktop shortcut.

- Connecting to the LiBackpack User Interface via Ethernet Network:
    - Connect LiBackpack and the tablet with the included Ethernet Cable.
    - Navigate to the Network settings on the tablet. Set the IP address and subnet mask to the following values:
    IP address: 192.168.1.99
    Subnet mask: 255.255.255.0
    - Launch Google Chrome and navigate to http://192.168.1.200:8090 to load the LiBackpack User Interface.

Note: The system currently supports UI through Chrome and Safari.

The browser-based UI looks like this:
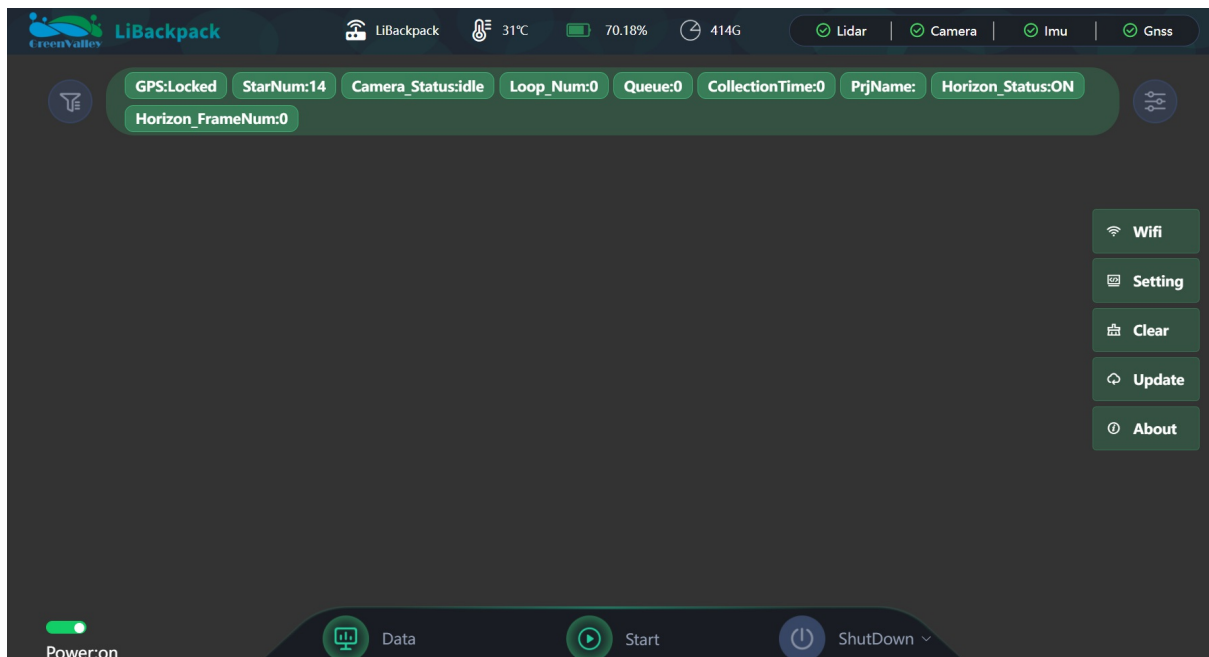
User Interface on mobile device

5.4 Start Scanning

Keep the LiBackpack DGC50H horizontally stable, find an outdoor open area, and make sure there are no tall buildings around it. After the device is powered on, enter the web interface, wait for the status of the gps interface to be **"Locked"** , and the number of satellites reaches more than **20**, keep the system still for **1 minute**, and then click the **"Start"** button at the bottom of the user interface, when the main window of the display screen appears as a point cloud as shown above , IMU and GPS information, please keep still for **at least 1 minute**, and then start to walk a **figure-8 route** for about **1 minute** with the detour radius not less than **2 meters**, then you can start scanning according to the planned route.

Note: Before starting, make sure the GPS status is "Locked". Try to start collecting in an open area where SatNum is no less than 20.
Note: Please pay attention to the status of the camera displayed on the UI. If it is idle, it means that the camera is ready. Otherwise, please wait till it changes to "idle".
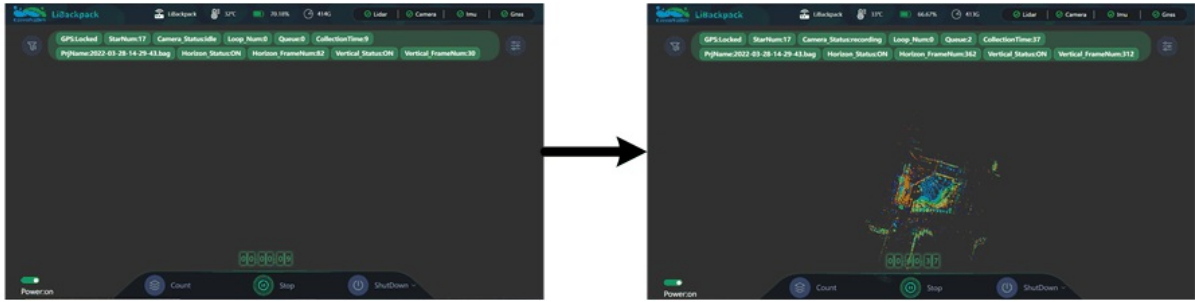
Start Scanning

5.5 Data Collection

As the LiBackpack begins acquiring data, the Main Viewer of the web-based UI will display a realtime 3D point cloud as well as the current movement trajectory. Below is a screenshot of the Main Viewer in the LiBackpack UI during data collection.

GPS Status:

- **GPS**: Whether GPS is currently on and sync status. Off indicates GPS is off; NotSync means the system is not fully synced and needs to move to an open area to finish syncing; Locked means the GPS is on and synced with the laser scanners. Please only start collecting data when this status is "Locked".
- **State**: Method of solving for real-time positioning. "Single" means single-point positioning.
- **SatNum**: Number of satellites currently connected to.

Camera Status:

- **Camera**: Camera Status. OFF means that the camera is off, idle means the camera is free and ready, and recording means the camera is working.
- **Electricity**: The remaining battery power.
- **Space**: The remaining storage space of the camera.

Collection Information:

- **Real Time Processing**: The switch of real-time processing. ON means the real-time processing is on and the real-time processed point cloud and trajectory will be exported. And OFF means the real-time processing is off and no real-time result will be exported.
- **Collection Time**: current collection time in seconds.
- **Acceleration (m/s^2)**: IMU acceleration.
- **Angle (°)**: roll, pitch, and yaw.
- **File Name**: name of current .bag file.
- **File Size**: size of current .bag file.
- **Queue Size**: point cloud latency in frames.
- **Loop Number**: current loops closed.
- **Distance Accumulated (m)**: current distance covered.
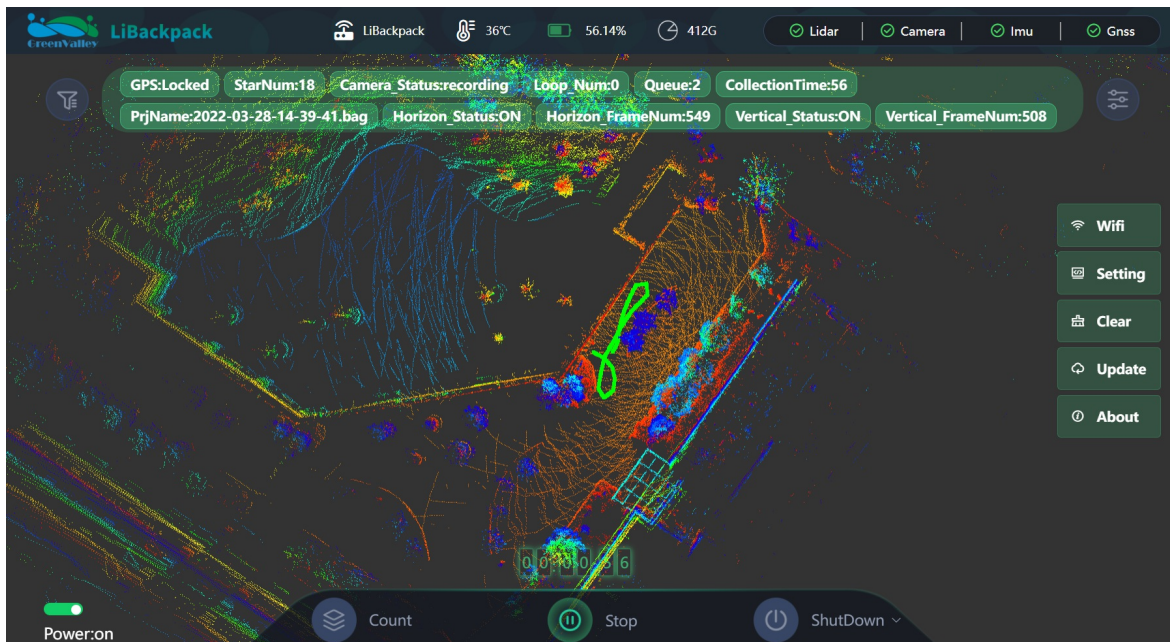
Data collection in progress

To end LiBackpack data collection, walk into an open area where satellite number is more than **20**. Walk an **"8"-shaped** pattern for about **1 minute**, then stand still for **at least 1 minute**, and finally press the **"Stop"** Button on the bottom left corner of the web-based UI. Wait for the countdown window to close and the current collection session is completed.

To start a new data collection, repeat the above steps. Otherwise, click the **shut down** button on the mobile terminal to turn off the computer and then turn off the battery.
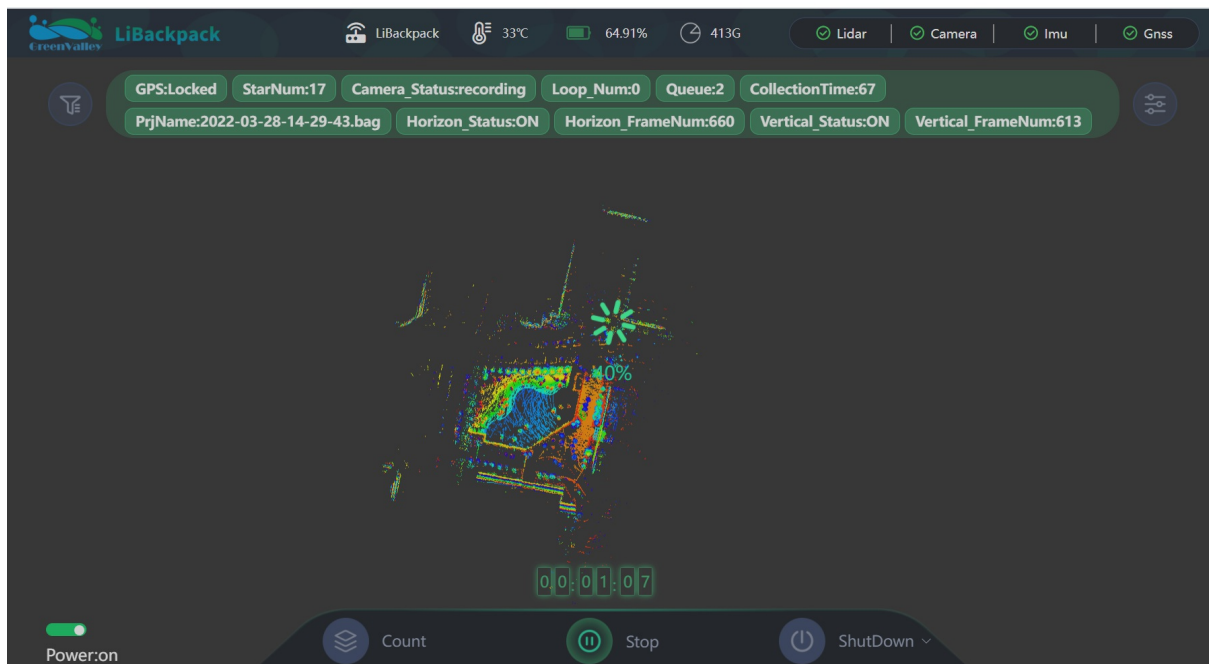
Stopping the collection operation

Note:

(1)As shown below, tap on the **Reboot** button on the UI to reboot the PC, **Shut Down** to shut it down.

(2)The battery can be powered off only after the computer is turned off through the **shut down** button.
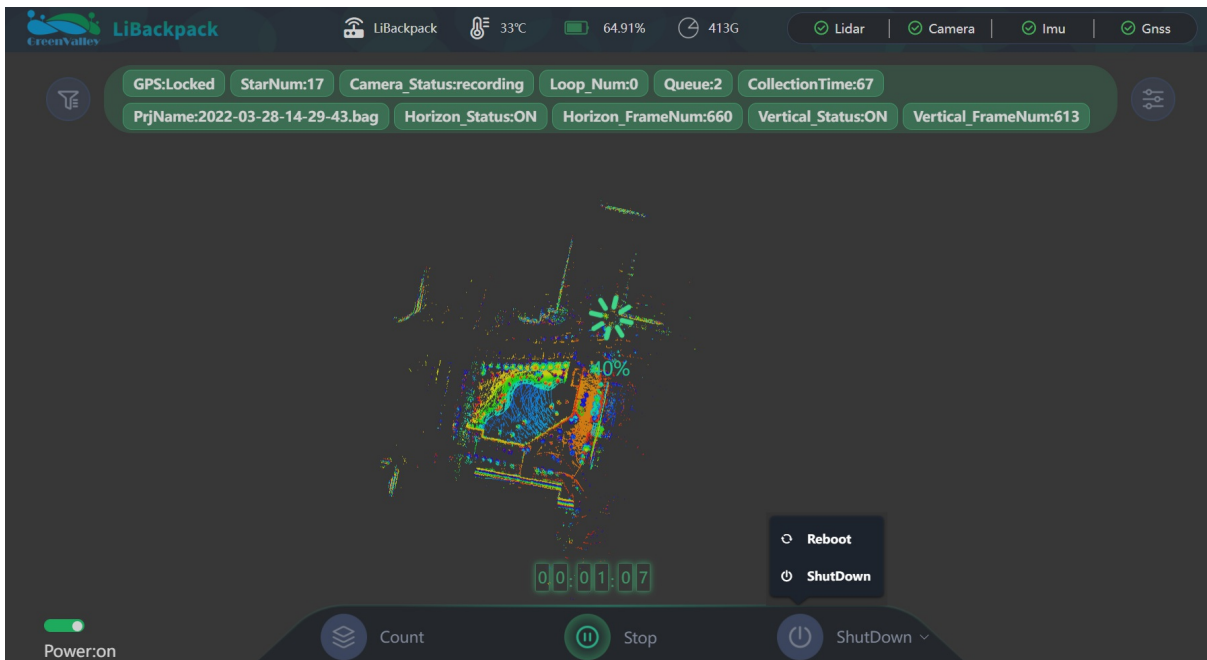
Shutting down the main system

5.6 Export Data

### 5.6.1 Export raw point cloud, real-time processing results, and GNSS data

1.USB flash disk transmission: Make sure the main system PC is on and connected to a mobile device. Launch the UI. Insert a USB storage device into any one of the USB ports located on the Main Body. Then click the **Copy** Button on the web-based UI. Select the .ply, .bag, and log files to be transferred to the USB storage device. Details of the data transfer will display in the dialog window, along with the total storage space and space available of the system and the USB drive.
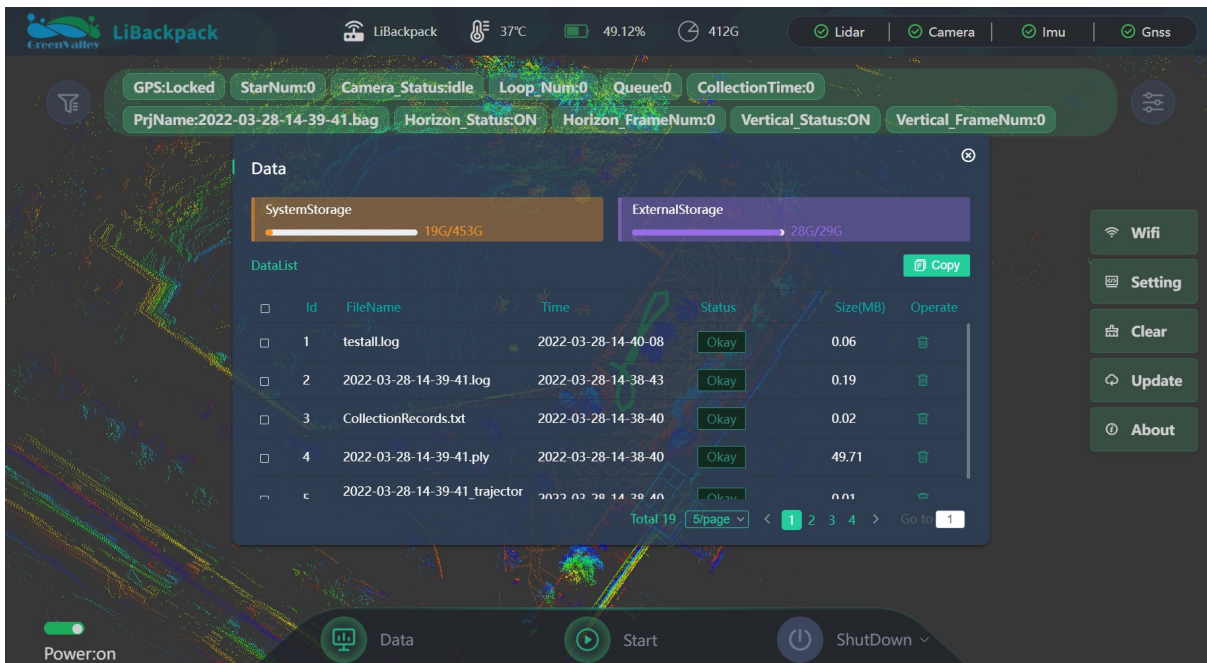
Copying data

After the data has finished writing to the external storage device, the message bar will say so and a new pop-up dialog box will appear confirming the completion. Click the OK button and disconnect the USB storage device.

Note: When large amounts of data are transferred from the LiBackpack to an external storage device, the progress bar on the file-transfer pop-up may stay at 99% for a long time. Wait until the dialog box pops up indicating that the file transfer has completed to prevent data corruption.
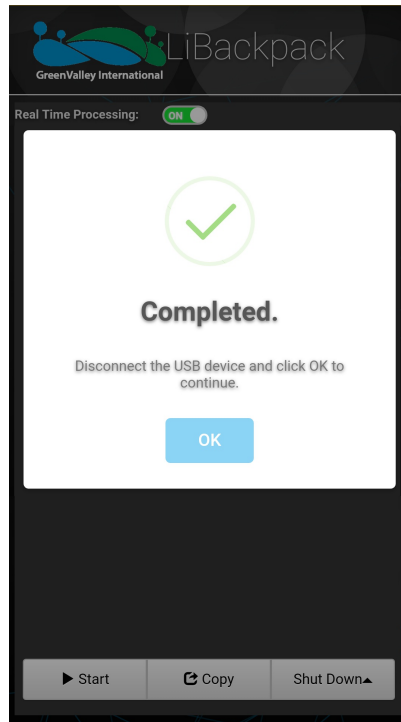
Removing the USB drive

2.Data cable transmission: When the device is turned on, connect one end of the network cable to the device and the other end to the computer, and set the computer "IP address: 192.168.1.99, subnet mask: 255.255.255.0", Enter the URL "\\192.168.1.200" at the computer network, enter the internal storage space of the device, open the "share" folder, and select the collected .ply files, .bag files and . Log files according to the collection time, copy it to the computer, and then complete the data export.

Name	Date modified	Type	Size
testall.log	10/26/2022 2:22 PM	Text Document	280 KI
config.json	10/26/2022 4:08 PM	JSON File	7 KI
CollectionRecords.txt	10/26/2022 2:13 PM	Text Document	5 KI
2022-10-26-14-08-34log_libackpack.log	10/26/2022 2:13 PM	Text Document	565 KI
2022-10-26-14-08-34_trajectory.xyz	10/26/2022 2:13 PM	XYZ File	68 KI
2022-10-26-14-08-34.ply	10/26/2022 2:13 PM	3D Object	793,698 KI
2022-10-26-14-08-34.log	10/26/2022 2:13 PM	Text Document	544 KI
2022-10-26-14-08-34.bag	10/26/2022 2:13 PM	BAG File	745,134 KI
2022-10-26-14-01-44log_libackpack.log	10/26/2022 2:07 PM	Text Document	709 KI
2022-10-26-14-01-44_trajectory.xyz	10/26/2022 2:07 PM	XYZ File	84 KI
2022-10-26-14-01-44.ply	10/26/2022 2:07 PM	3D Object	808,763 KI
2022-10-26-14-01-44.log	10/26/2022 2:07 PM	Text Document	635 KI
2022-10-26-14-01-44.bag	10/26/2022 2:07 PM	BAG File	927,197 KI

Data Export

The first time you enter the **"share"** folder, you will generally be prompted to enter the user name and password: **"User name: share, password: 111111"**

5.6.2 Export image data

1.Copy CollectionRecords.txt with.bag file, it records the corresponding camera file name to.bag.

2.To copy camera data, make sure that the camera is ON. Then, connect it to your computer with a dual USB cable. And copy the corresponding camera data.

Name	Date modified	Type	Size
VID_20230216_154521_00_005.mp4	7/30/2021 10:07 AM	MP4 File	27,590,603 KB
VID_20230216_154521_10_005.mp4	7/30/2021 10:07 AM	MP4 File	1,211,323 KB

USB Drive (D:) > DCIM > Camera01

Images Export

Note:

- The data format recorded in CollectionRecords.txt is .mp4. And there is no need to consider the difference of the suffix name when copying the camera file corresponding to the .bag.

- Record 4k video and you will get two .mp4 file, copy the .mp4 designated in txt file. However, record 5.7k video and you will get two.mp4 or.insv file, you need to copy them all.

- The camera file is usually large, please make sure there is enough disk space.

- Please clear camera memory card in time, to make sure there's enough space in camera.

- Note: If the USB-Type-C data cable is inserted, it prompts "The drive disc needs to be formatted before using it. Do you

  want to format the disk?"

  Please use "win+R" to open the command line interface, and input "chkdsk d: /f" to repair the disk. (d is the drive letter

  of the disk, /f is the modification command)

5.7 File Formats

After each collection session, three files are generated as follows:

5.7.1 .bag file

Raw data file. If data collection result is not ideal and enhancement is needed, you may send this file to GVI for further processing, which will create data collection path file and point cloud dataset. Please create a readme txt file to send along with the .bag file and provide the following information in the readme file:

1. Data collection location: xxxxxx (address or latitude&longitude);
2. Scanning equipment: LiBackpack DGC50H;
3. Scanning scene description: xxxxxx (e.g., indoor, forest, factory, etc.);
4. Purpose of scanning: xxxxxx.

5.7.2 .ply file

Real-time scanning result, for data previewing.
Naming convention: file is named by the system time when data collection started (e.g., 2018-05-16-17-24-53.ply is the file for data collection started at 2018/05/16 17:24:53).

5.7.3 .xyz file

The collection trajectory file processed in real-time with relative coordinates.
Naming convention: start time +_trajectory. Each row represents the x, y, z coordinates of a trajectory point. The starting point is the origin of the coordinate system.

Note: If the users turn off the real-time processing, only the .bag file will be generated after data processing. The real-time scanning result and trajectory file will not be generated.

5.7.4 .log file

Raw GNSS record file. Along with the base station file, this file can be imported to a project created by LiBackpack-Desktop/LiFuser-BP software for post-processing and georeferencing the point cloud.

5.7.5 CollectionRecords.txt file

For each collection session, one entry will be added to this text file to record the associated .bag file name, collecting time, number of closed loops, queue numbers, accumulated distance, etc., as shown below on the right:
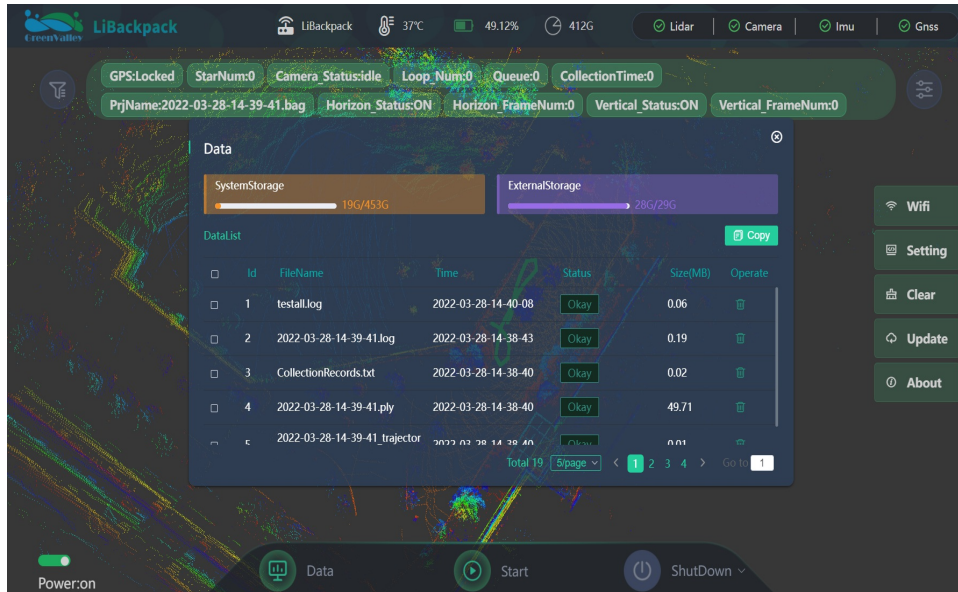
Data Collected by the LiBackpack System

5.7.6 .mp4 file

Raw panoramic video data collected by the camera module. This .mp4 data can be imported to LiBackpack Desktop/LiFuser-BP to colorize the point cloud.

5.8 Browse Data in LiDAR360

Launch LiDAR360 software and add in the acquired data. In the example .ply file below, click on Apply all.
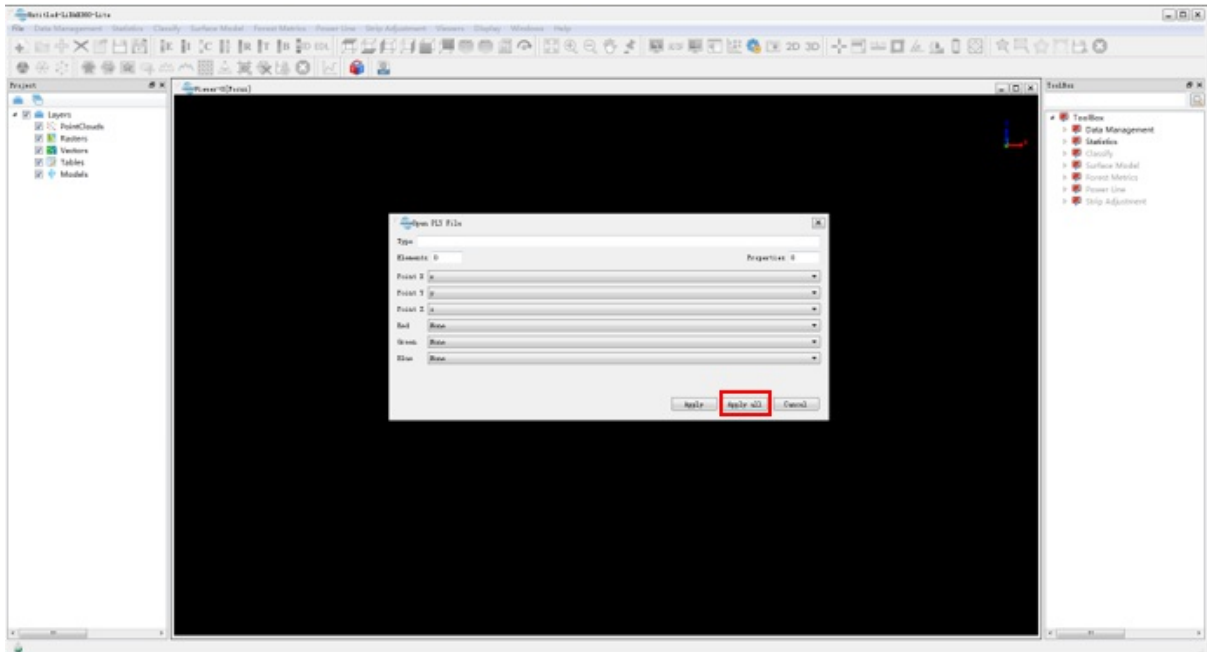
Add Data in LiDAR360

Click on the EDL button and the display by height button in the LiDAR360 toolbar. The display changes to the following:
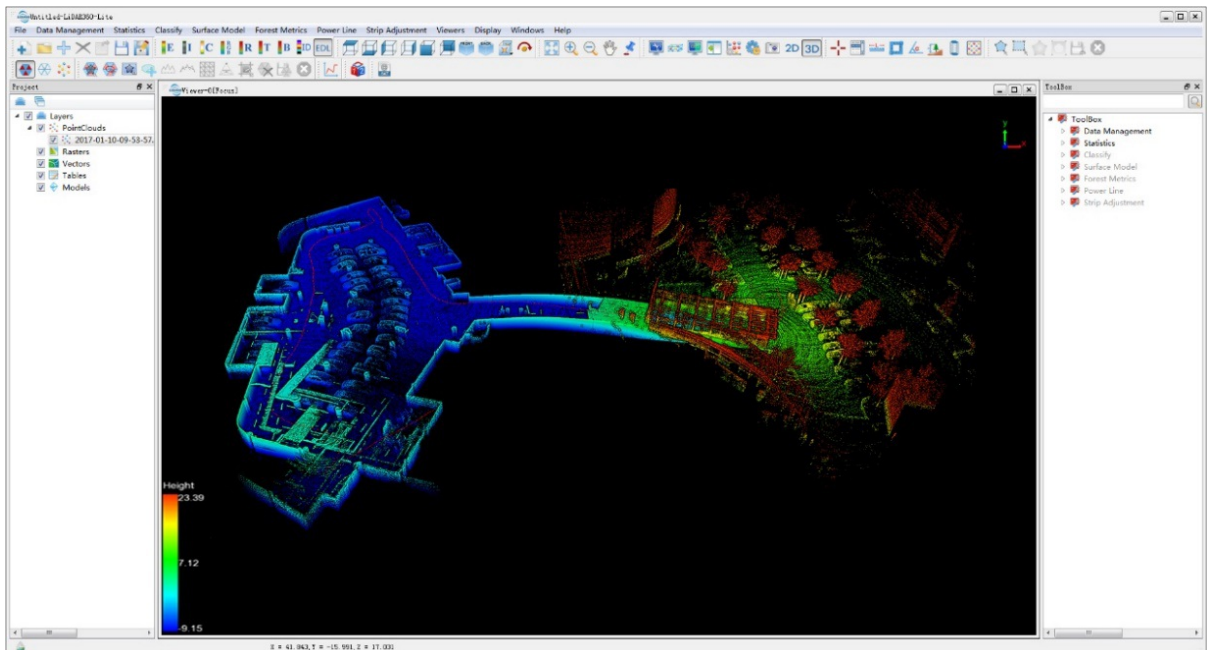
Display by height and with EDL effect

5.9 Clear Data

When system storage space is low (shows in the Copy interface) or old data is no longer needed, tap on the **Clear** button to clear data from the system.

> Note: This operation will delete all acquired data from storage.
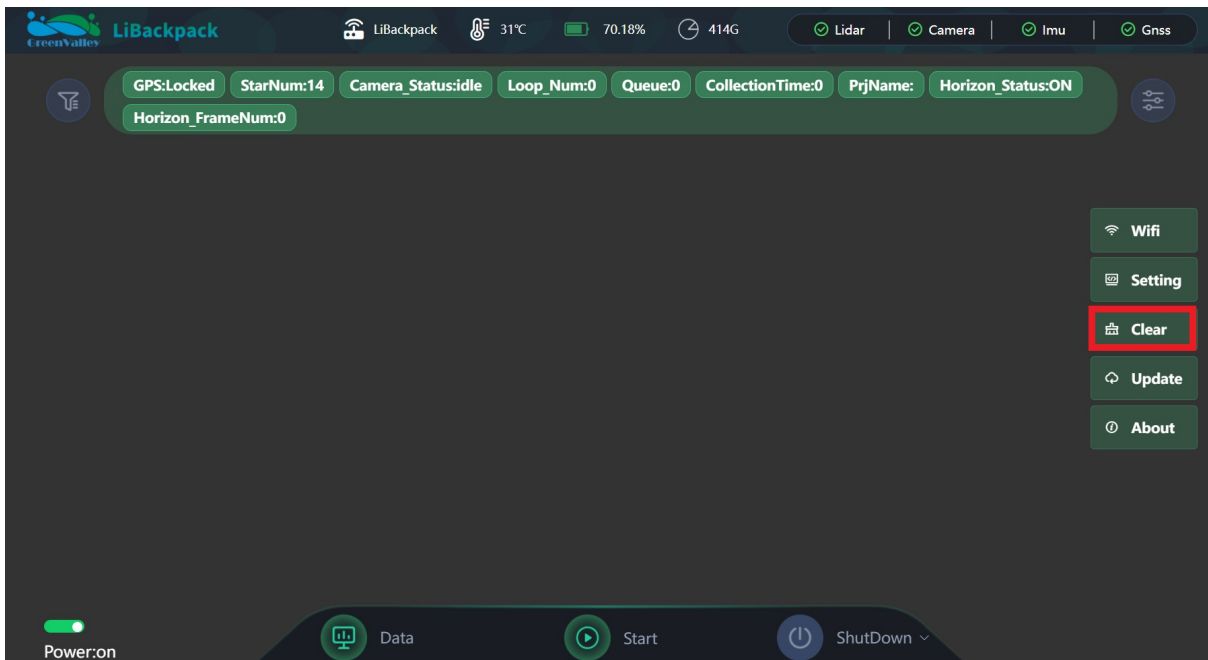
Clear Data

5.10 System Firmware Update

Firmware updates are available through USB drive installation. Users can request update packages from GVI and store them in the root folder of a USB drive. Tap on the **Update** button to update through a plugged-in USB drive. If an update package is not existed, in an incorrect location, or with an altered filename, the system will not see it. The following interface will show up showing current system version information.
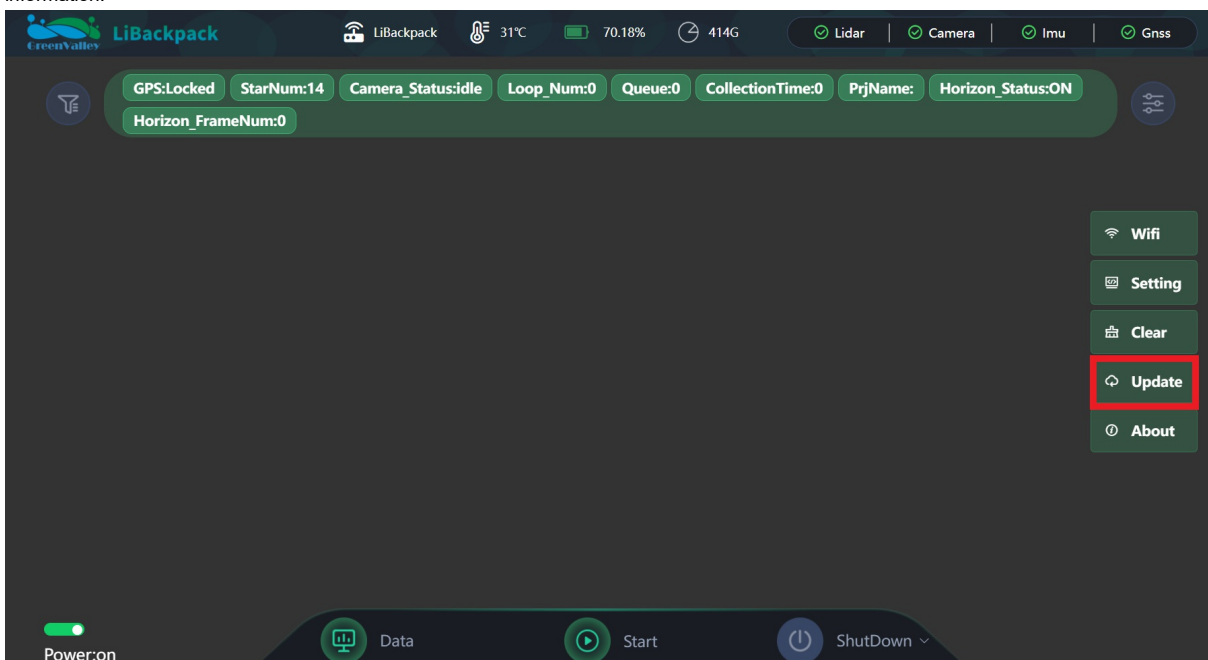

System update

Note: If there is no update package in the U disk, the location of the update package is incorrect, or the name of the update package is modified, the system will not recognize it.

Note: After updating the firmware, users may need to clear the cache of the browser to apply this update.

5.11 System Version Information

Use the **About** button to check the current firmware version information and our contact information.
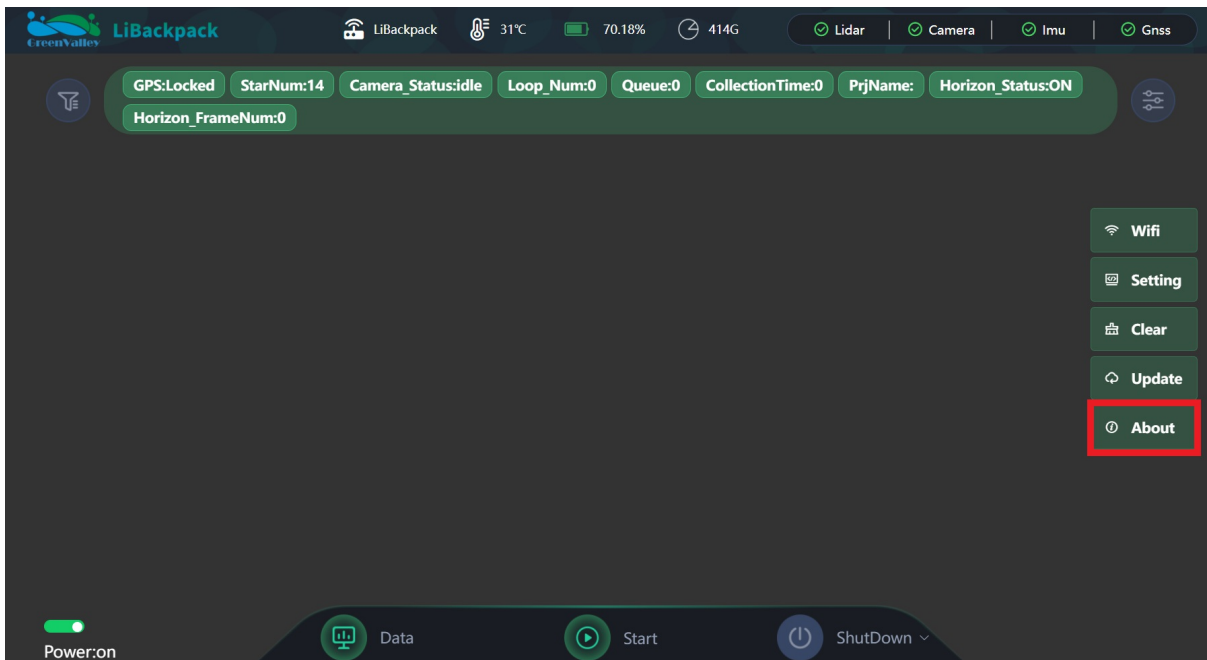
System Information

5.12 System Settings

Before collecting data, tap on the Setting button to preset some preprocessing parameters, including minimum point number per frame, maximum/minimum point distances per frame, output file suffixes, etc. - **Min Point Num**: Minimum number of points per frame to use in SLAM; - **Max Distance**: Maximum distance of points to the center of the scanner in each frame; - **File Name Suffix**: Suffix to .bag files for more readable file name. >Note: Set these parameters before tapping Start to start collection. File suffixes currently don't support Chinese characters. Please use alphabetic characters instead.
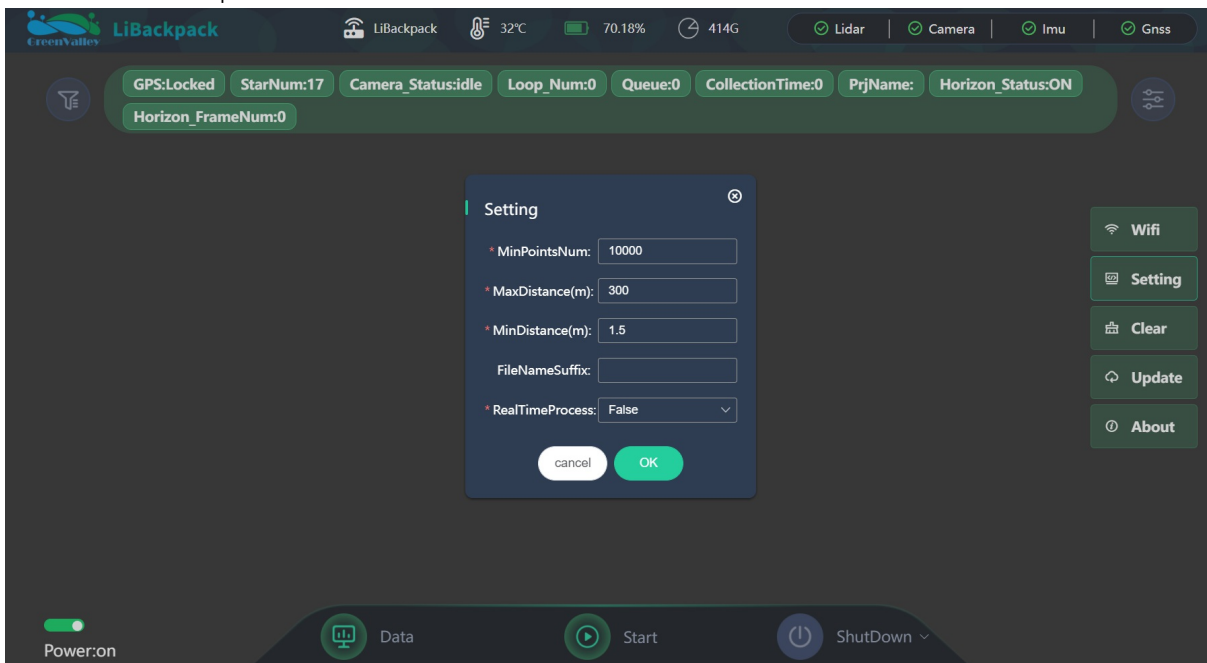
System Settings

5.13 Wifi Settings

Before or After a scanning process, press the Wi-Fi Button in the extension menu to set Wi-Fi name and password. - **Wi-Fi Name Suffix:** Set the Suffix of the Wi-Fi name. The default Wi-Fi name is LiBackpack. And the suffix will be added after that.
- **Password**: Set the name of the Wi-Fi connection. The default password is greenvalley.
>Note: the password will be reset to the default after system update.
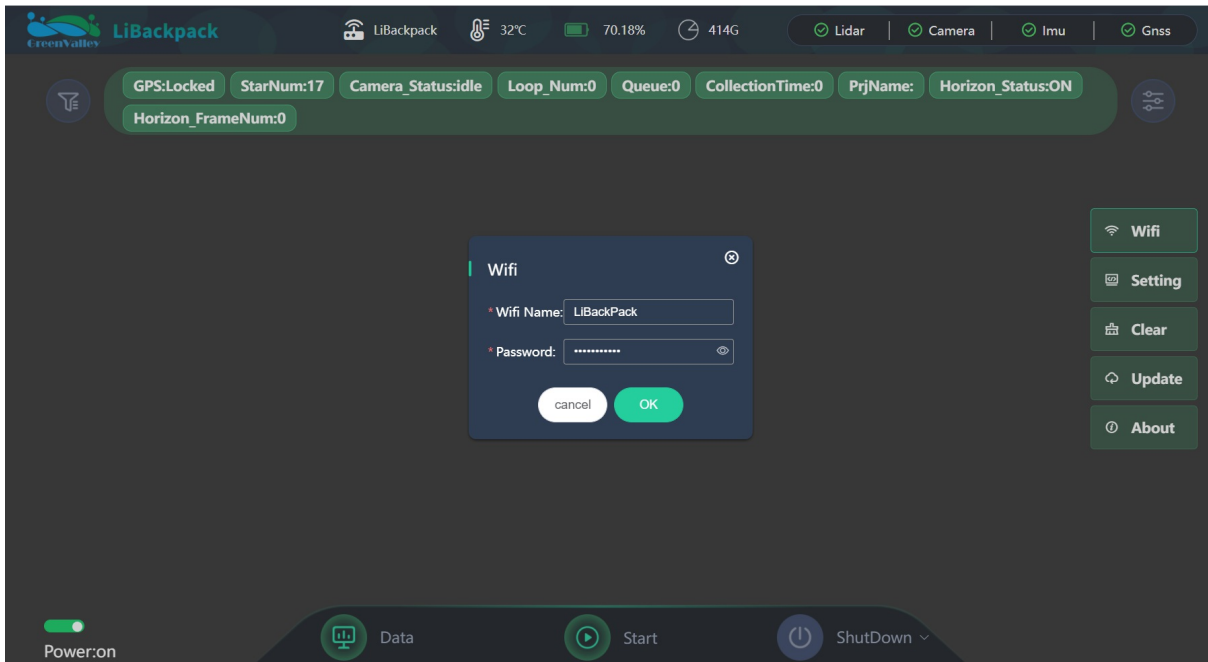
Wi-Fi Settings

6. Best Practice Guideline

For best result, the environment to be scanned needs to be feature-rich and not contain too many moving objects. Set screen auto-lock mode on the mobile device to 'Never', as the WIFI connection between LiBackpack and mobile device may be interrupted if the screen is locked. If the screen is locked, unlock it and reload the page to refresh the real-time data processing. The following guidance is recommended for using the LiBackpack system.

6.1 Data Collection

1. When starting data collection, stand still and keep the scanner horizontal. Make sure to follow instructions given in Chapter 5 on system setting up, booting up, connecting mobile devices, and starting data collection. Start moving after point cloud shows up on the screen for 5 seconds.
2. Start scanning in a relatively open area. Do not start scanning in corner or close to walls. For data collection indoor, start scanning at room center. For outdoor scanning, start at a place with minimum bl ocking from close features.
3. Do not operate when battery level is below 30%.
4. When connecting via WIFI, do not connect to more than one mobile device to avoid transmission latency and control errors.
5. When in WIFI mode, keep the mobile device within 5 meters of the LiBackpack system to avoid transmission latency and connection errors.
6. The size of the data LiBackpack DGC50H collects can grow large quickly. Therefore, it's recommended to keep each collection session under 20 minutes and within 2km. If the ambient temperature is higher than 30°C, please shorten the collection time and check the data in time.
7. Before collection:

    ○ If users need to set up base stations, please complete the setup 10 minutes before collection starts.
    ○ Plan for collection routes and start in an open area. After clicking Start, stand still at least for 1 minute to make sure that GPS satellite number is more that 20. Walk in an "8"-shaped pattern then to synchronize the point cloud data and GPS data.
    ○ Refer to Section 5.5 for instructions on checking the UI for GPS, satellite, and sync status before starting collection.
8. During a collection session:

    ○ During the data collection, if GPS status remains as "unlocked", users need to walk into open area every 1 km or less and stand still for 1-3 minutes, to ensure enough GPS signals. This is very important to adjust absolute geographical coordinates.
    ○ It's normal to see GPS status turns into "unlocked" when GPS signal is weak.
    ○ 20 or more satellite number is recommended to ensure the accuracy of GPS data.
    ○ Please keep an eye on camera status, if disconnection problem happens on the camera, don't be in panic. It may be caused by interference on camera wifi. We strongly recommend to check if camera file is OK after data collection.
    ○ If there are electromagnetic interference, wifi disconnection tends to happen. Please do not power off the device in such area. We suggest to power off the device when wifi connection is stable.
9. After collection:

    ○ To ensure satellite connection quality, after each collection session, walk "8" patterns in an open area again and then stand still at least for 1 minute before hitting Stop.
    ○ After a single data collection, please check data performance with a laptop. If data accuracy is not satisfactory, user may want to recollect.

6.2 Route Planning

1. Closing loops will improve data quality.
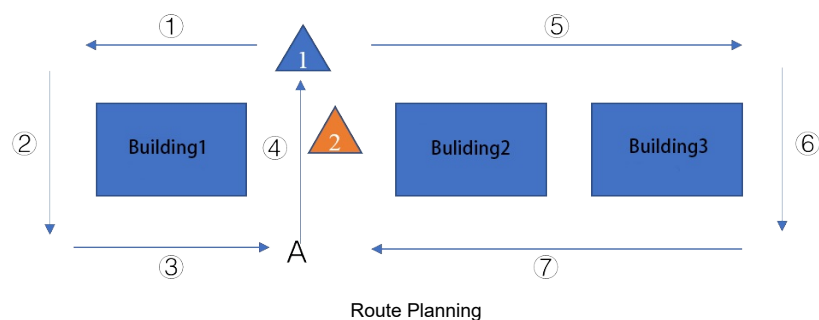
Route Planning

As shown above, building 1, 2, 3 are the scanning targets. Recommended route is ①②③④⑤⑥⑦ or ⑤⑥⑦④①②③. Always plan the route carefully before mission and follow the route when scanning.

2. Loop closure will help to reduce drift error. For example, if the scanning route is ①②③④⑤⑥⑦, then make sure you pass and go beyond position A to overlap segment ③ or ④ for at least 5 meters.

3. Slow down (ideally 1/5 of usual speed) when going around corners or moving from one room to another.

4. It is strongly recommended to NOT rotate the laser scanner. If have to, rotate very slowly (rotation speed < 30°/S). The environment must have rich and evenly distributed objects. For example, do NOT attempt to rotate the scanner at the center of an empty room.

5. When performing indoor scanning, open all the doors along the route before start scanning. Do not move the doors during scanning.

6. Maintain a straight path when possible. Otherwise, walls may produce unusually thick point cloud.
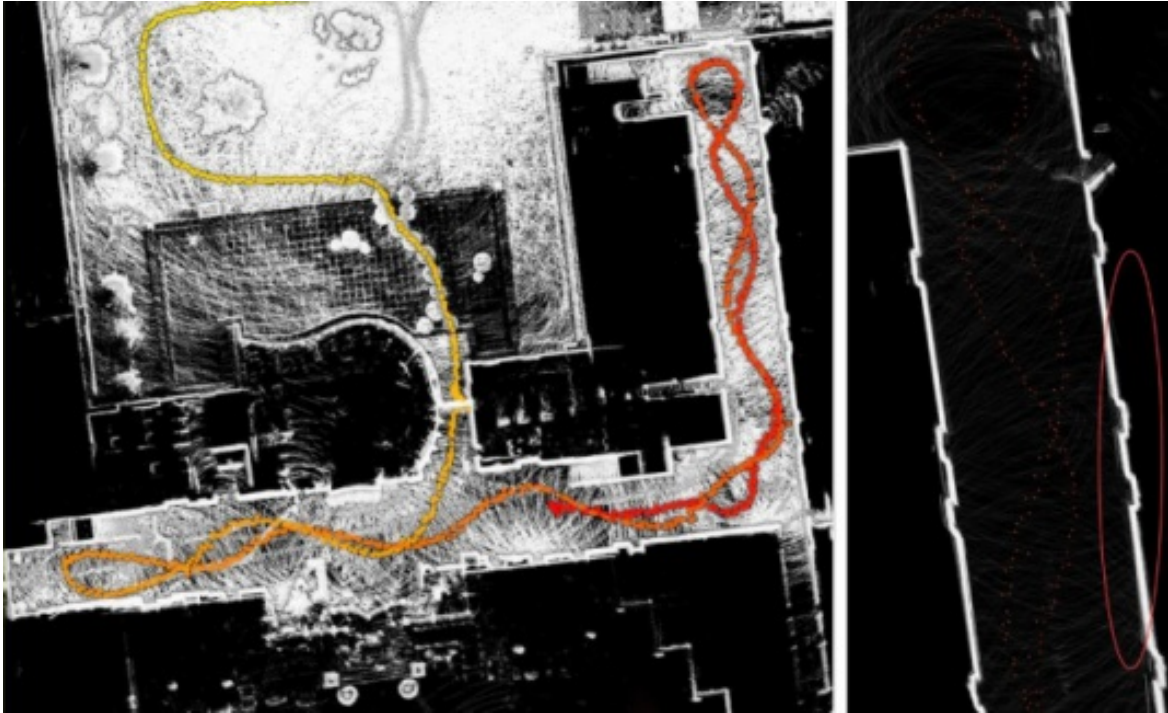
winding routes are not recommended

7. Avoid repeated scanning of the same area multiple times.
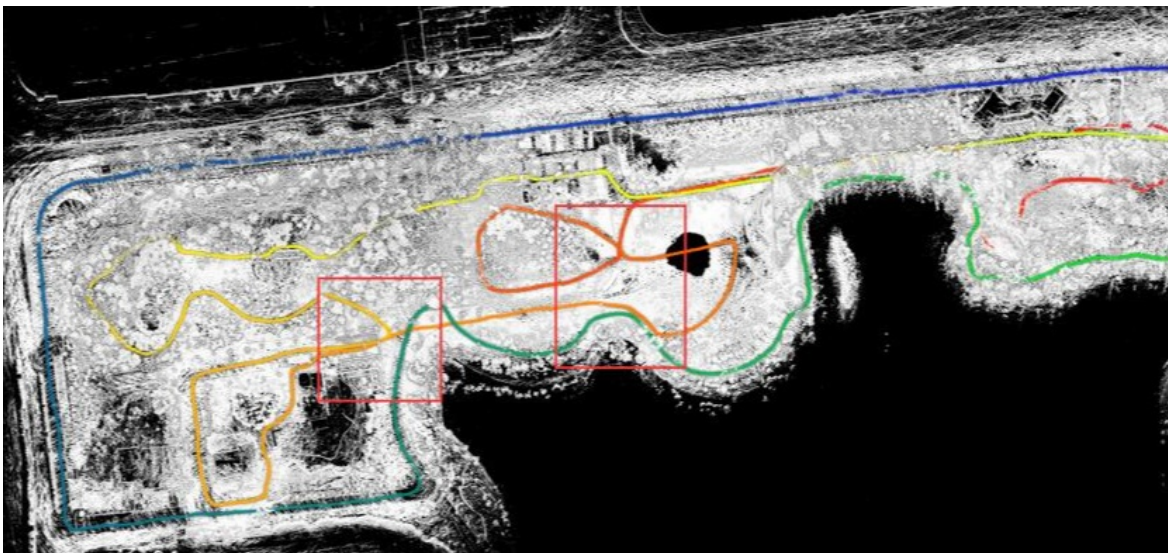
same area scanned multiple times

8. For a large target site, break the site into small sections. Move from one section to another and close loop for each section.

9. Walk on the same side of a road to close the loop in a round trip. Walking on two different sides back and forth would result in mismatch of point clouds due to uneven distribution of point density in two trips. To scan both side of the road, create two separate projects, and merge the point cloud in post processing.
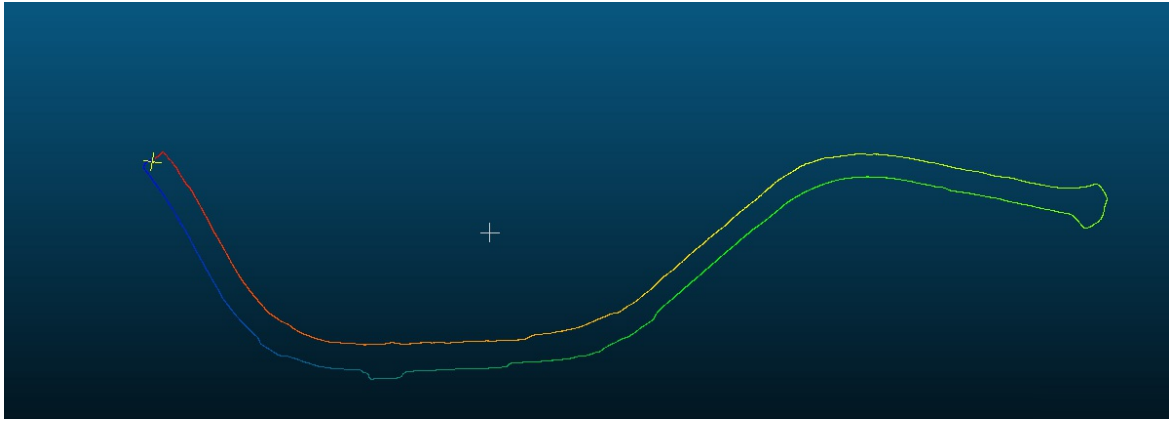
avoid roundtrips on different sides of a road

**Example**: Route planning for a 30*30m forest site.

Plan for routes so that all useful information is captured by the acquisition with minimal redundancy. For a plot of 30m by 30m, use the route plan on the left for dense vegetation, or the one on the right for sparse vegetation.
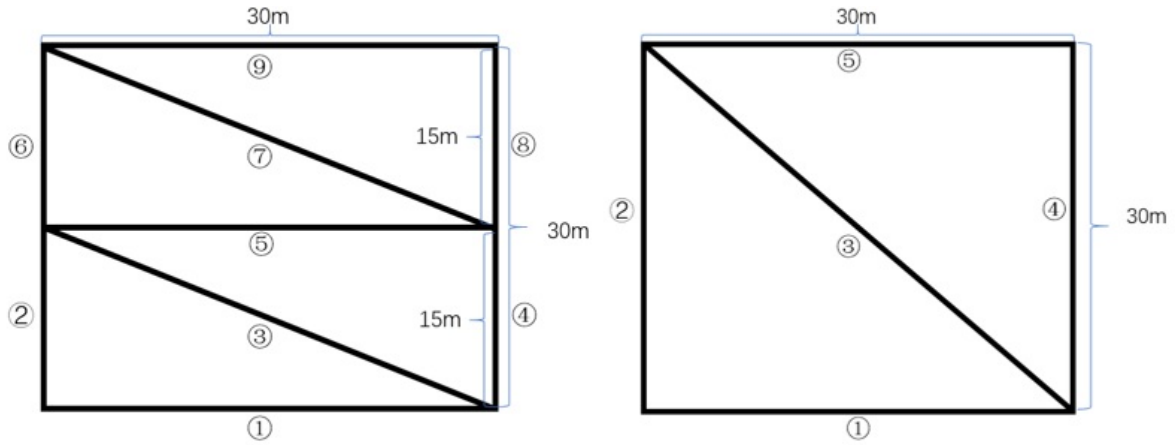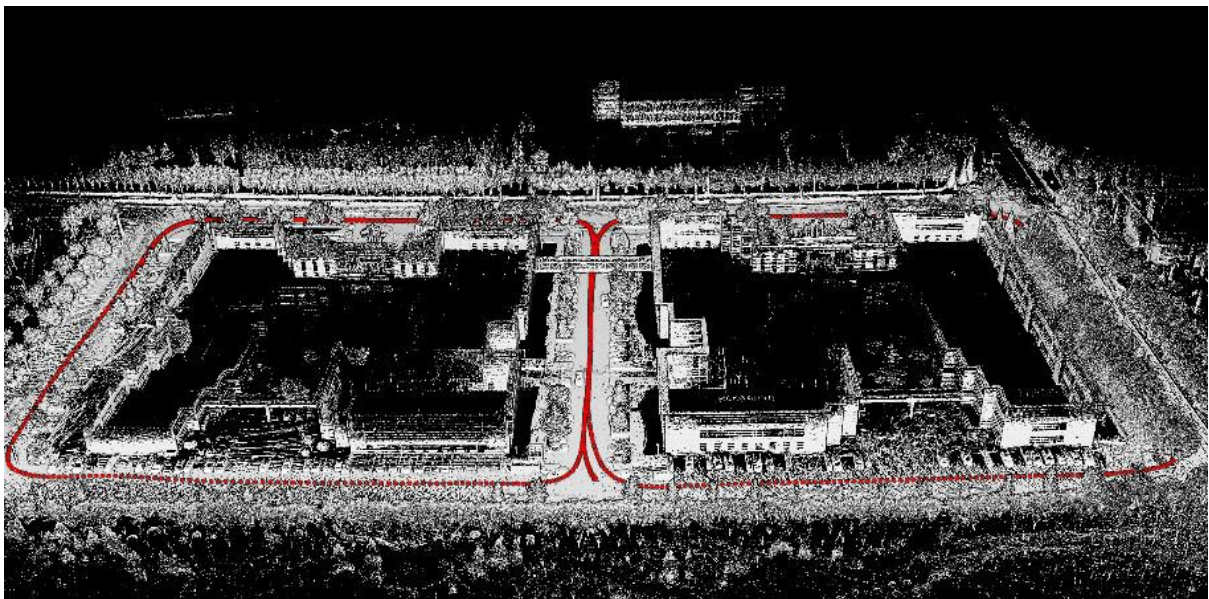

Route Planning (dense forest: left; sparse forest: right)
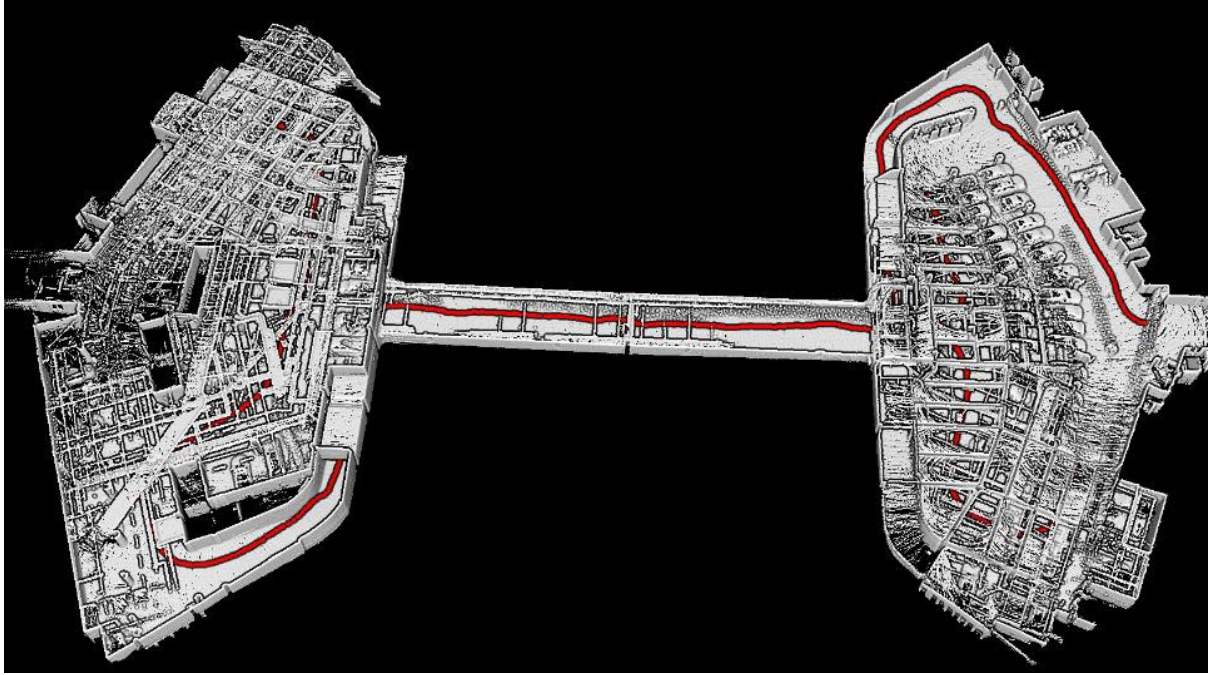
6.3 Suitable Environments

Environment with rich 3D structures will produce good scanning results e.g. furnished offices, forests, residential neighborhoods, etc.
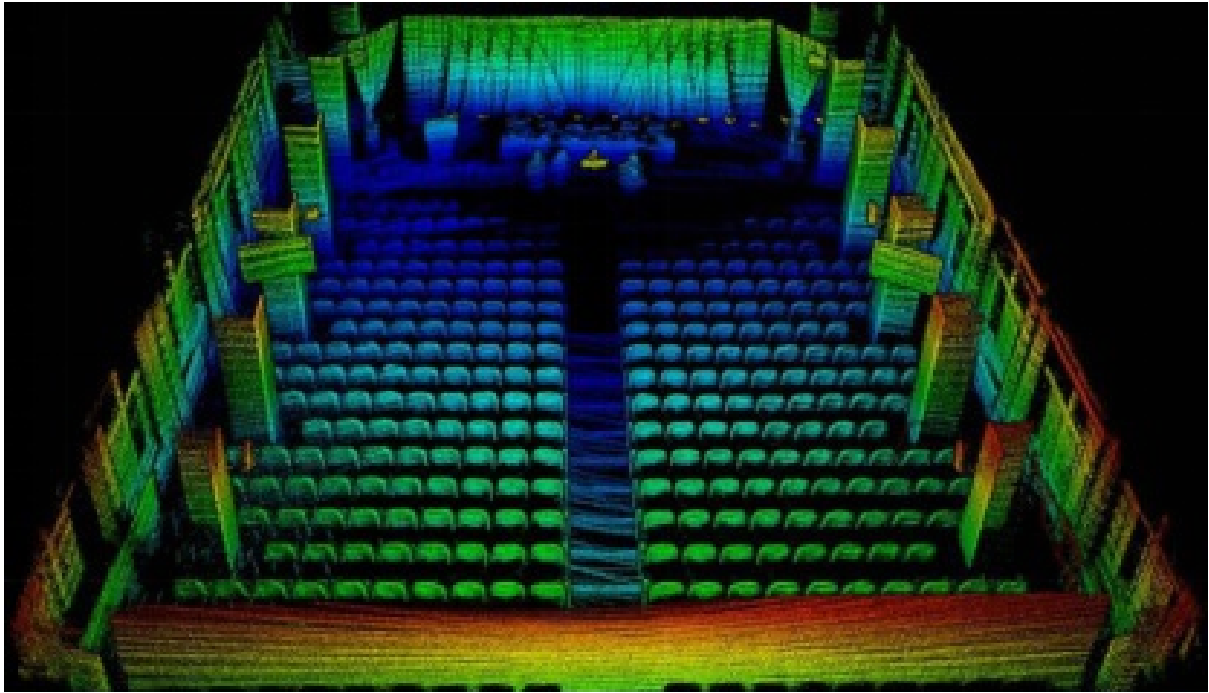
Class Room

Office Building

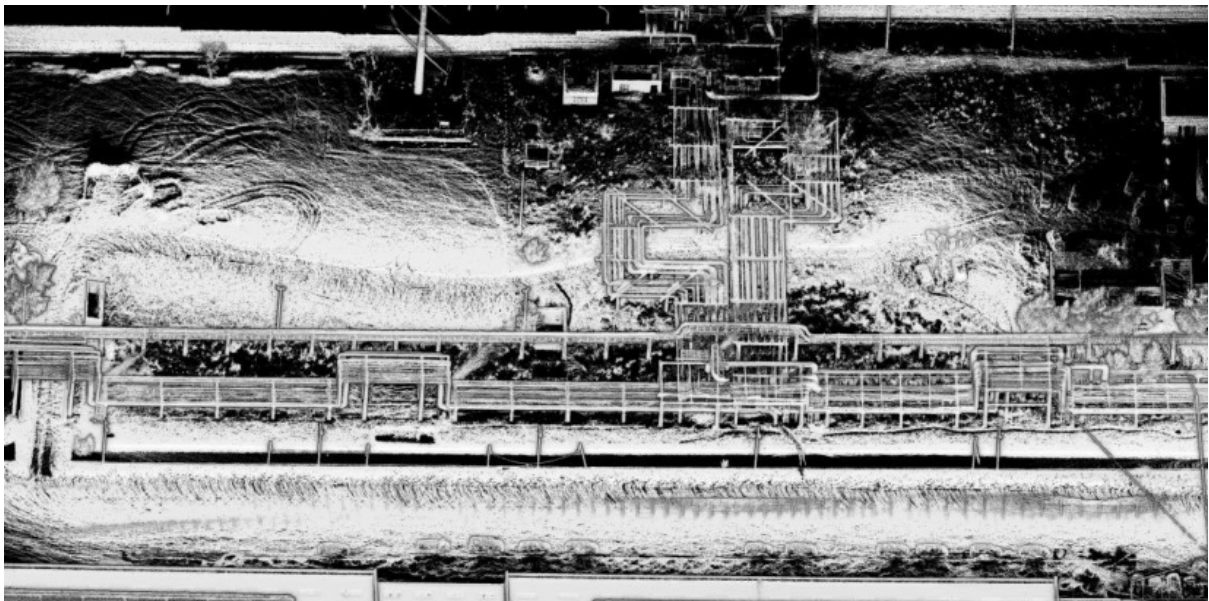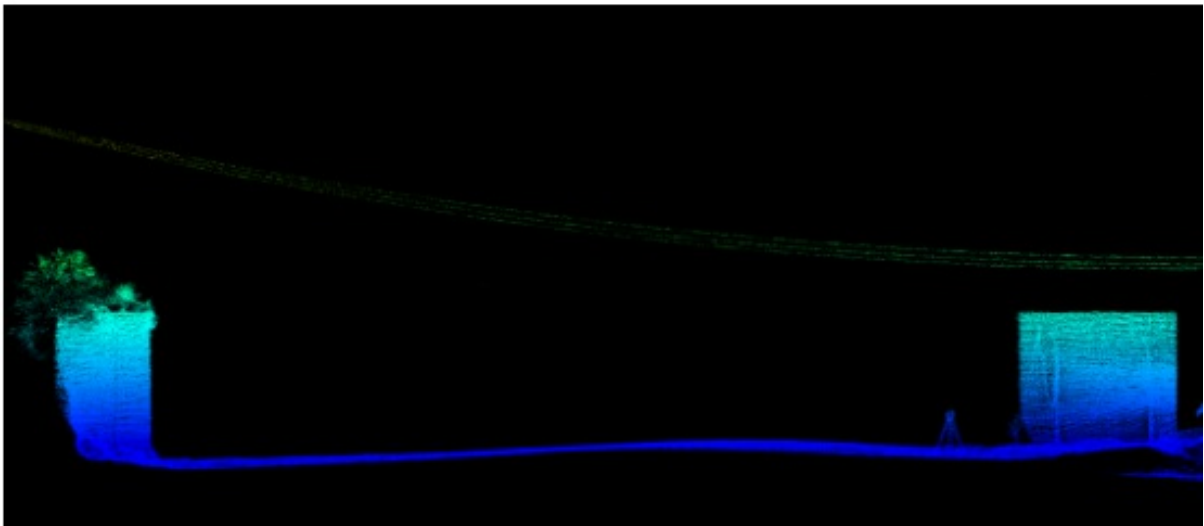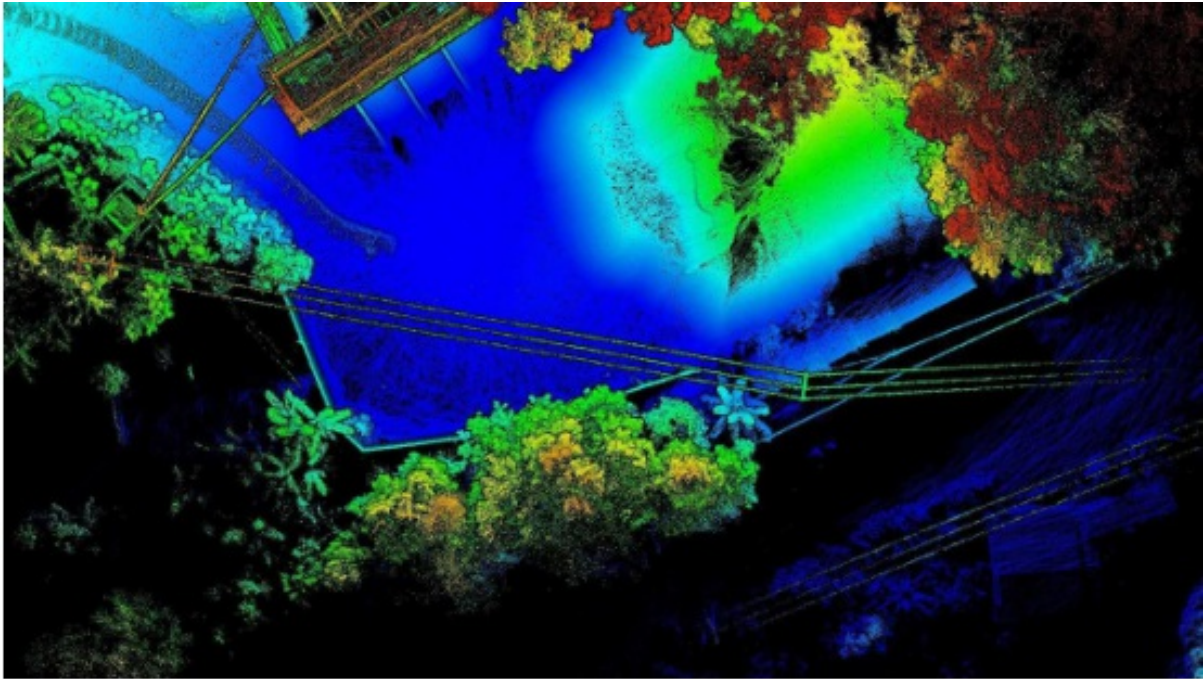Parking Garage
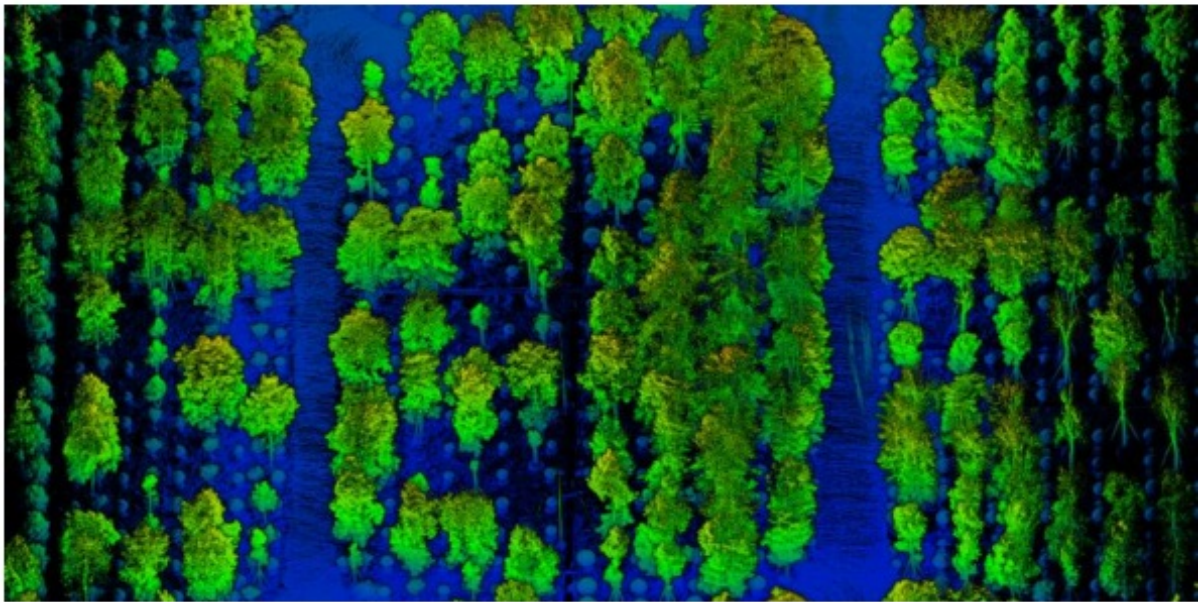
Forest

Sand Barge

Construction Site
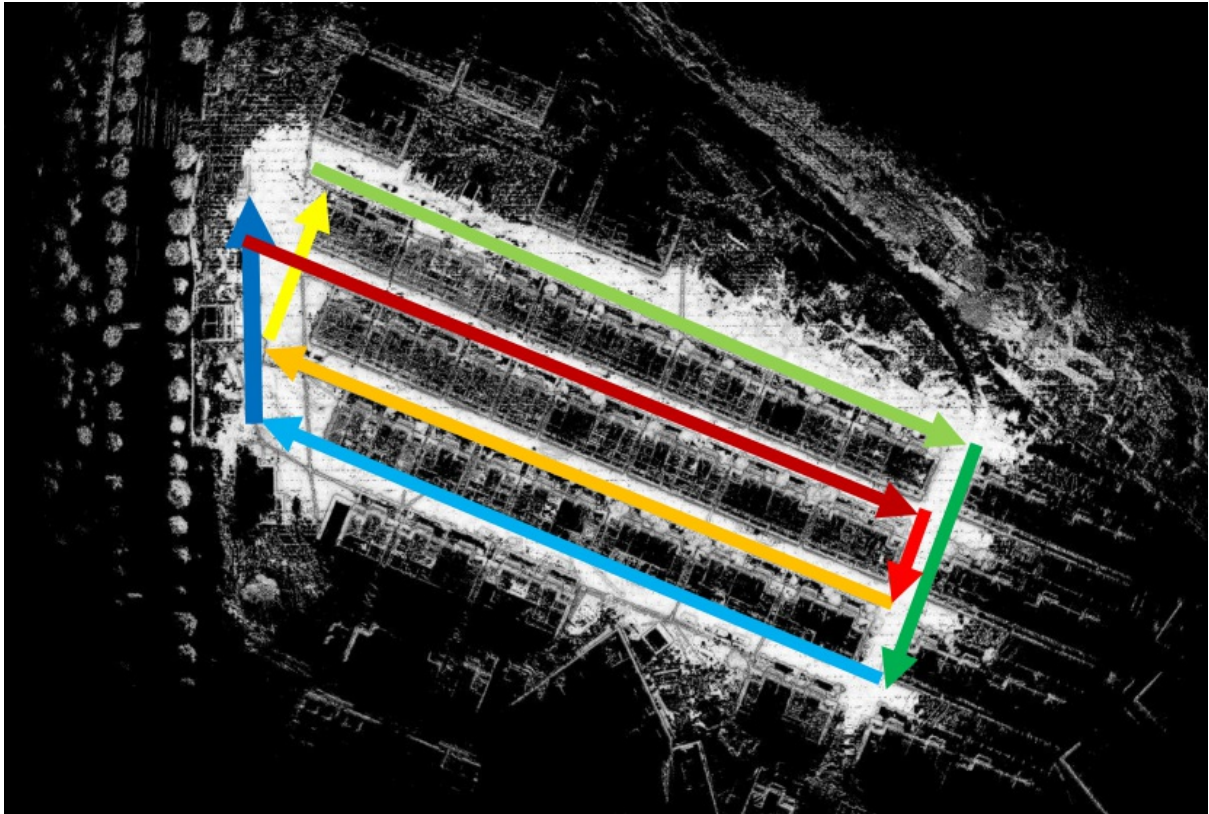
Building Foundation. Recommended acquisition route: start with red arrow and follow through blue.

Pipelines
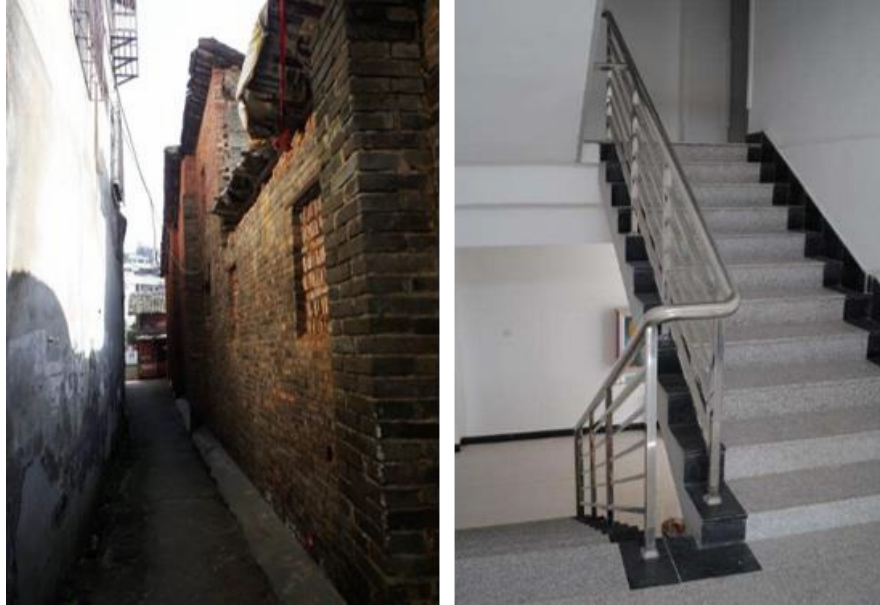
Power Line Corridor

6.4 Less suitable environments

Environments with insufficient features are not suitable for LiBackpack scanning, including but not limited to:

- Grassland, snowfield, barren lands, etc.

Scenes with Few Features

- Narrow roads, stairwells, and other tight spaces.

Narrow Space

- Surfaces with very strong reflectance such as painted glasses.

- Environments with strong geomagnetic interference.

6.5 Other Guidelines

1. Avoid scanning when there are too many moving objects.
2. When scanning large areas, raise the scanner above the operator's head to give the scanner a 360-degree view.
3. To merge data from multiple scans, use specialized Target Spheres as control points. Place Target Spheres above ground, preferably on tripods, to ensure the spheres are fully scanned. A minimum of 4 Target Spheres present in both scans are required to merge the two separate scans successfully. Don't place Target Spheres in a straight line or at the same height.
4. For airborne acquisition, flight height should not exceed 15m.
5. For automobile acquisition, movement speed should not exceed 20km/h (12.5mph) with a slow turning speed under 30°/S.
6. Keep the scanner as steady as possible to ensure best quality.
7. When downloading data, do **NOT** remove the flash drive until the **'Completed'** message is displayed.
8. Do not use the provided Surface tablet for other uses.
9. Direct sunlight may cause extra noise.
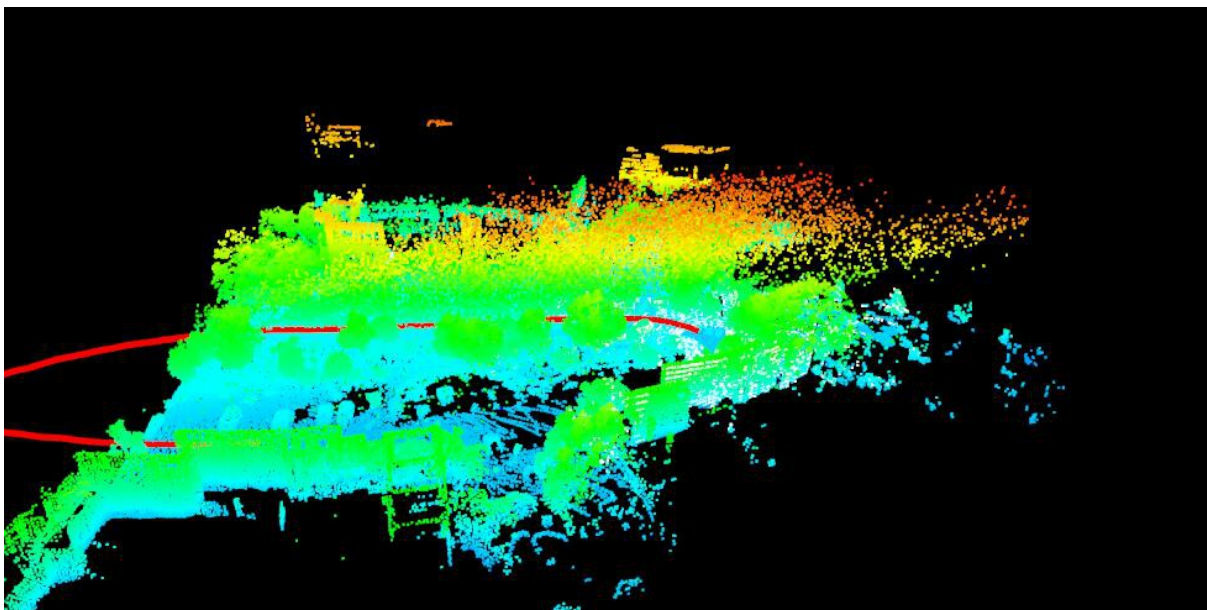
Noise caused by direct sunlight hit.

1. When solving data with BP for the customised version of the backpack, after building the project, you need to change the maximum scan

distance and maximum filter distance at the project settings as shown below. It is recommended that noise filtering is checked.
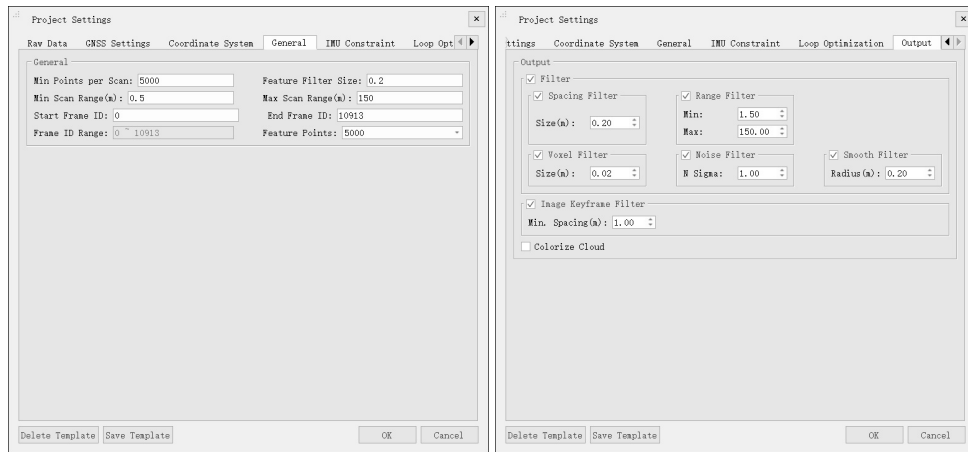
Modify parameters

7. FAQ

What should I do if I cannot find the LiBackpack Wi-Fi connection after powering on the system?

In general, in 1 minute after powering on the LiBackpack system, a Wi-Fi connection called 'LiBackpack' should be available. If not, try refreshing your phone or tablet. If the problem is not resolved after 5 minutes, please power off the system, reboot the computer, and then search for the Wi-Fi connection again. If the problem still exists, please contact our support team (info@greenvalleyintl.com) to diagnose the issue.

What should I do if no point cloud is displayed after clicking Start on the system control UI?

Please ensure that: 1. The laser scanner is powered on; 2. The cable is plugged in completely if the wired Ethernet connection mode is being used; 3. The light on the Ethernet port is flashing. If not, it is likely that either the Ethernet cable is not plugged in completely or the port is not functioning correctly.

What should I do if after clicking "start" button, only the point cloud data is displayed on the UI and the status information is not shown on the upper left of the screen?

Please reboot the system. If the problem remains, please contact GVI by email (info@greenvalleyintl.com).

Is there a limit on the time duration for data collection?

The recommended time duration for a single collection project is 30 minutes. While working, LiBackpack DGC50H produces raw data at a rate of roughly 10M/s. Longer data collection time may result in large data file size, which might slow down the system's data copying and processing speeds.

## Why is there lag in point cloud display on the UI?

Please: 1. Check if there is more than one UI device connected to the LiBackpack Wi-Fi. Multiple connections will slow down the data transfer process. 2. Check if the connected UI device is located far away from the LiBackpack system. If so, please ensure that the device is moved closer to the system. 3. Check the queue size on the upper left of the display. If the queue is larger than 50, that means that the data is being processed and there will be lags on point cloud display.

Why does not the system boot up/the screen light up after powering on?

Make sure the battery is correctly connected. Please check if the battery percentage is low. If yes, please charge the battery. It is recommended that the battery is charged or changed when the battery percentage is lower than 30%. Overdischarging can cause damage to the battery.

What should I do when LiBackpack Wi-Fi is found but the UI device cannot connect to it?

- If the device is an iPad or iPhone, please refer to Apple's instructions for resetting the network settings, or follow these steps (Settings->General->Reset->Reset Network Settings):
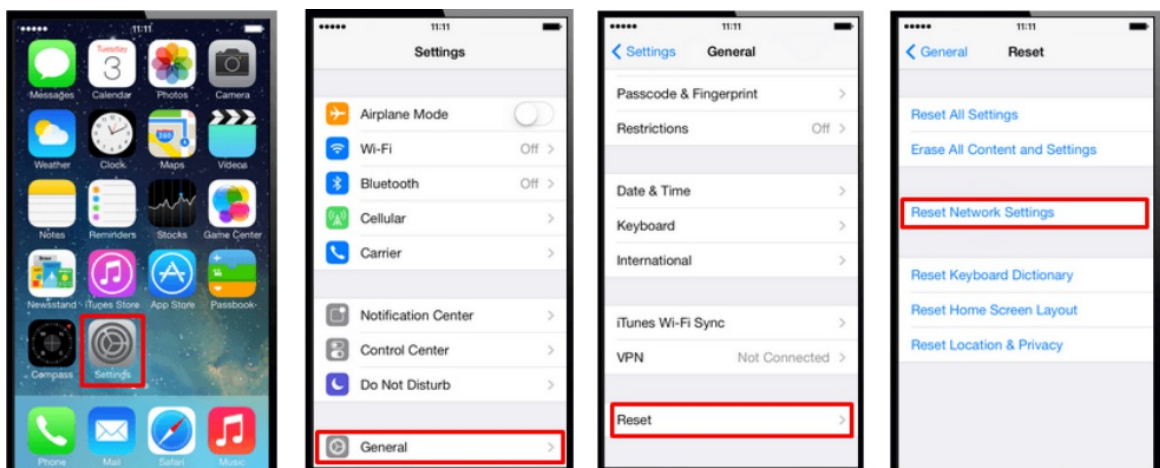
- If the device used is an Android device, please follow these steps to reset and reconnect to the LiBackpack Wi-Fi (Settings->System->Reset->Network settings reset; steps may vary with make and model):

What should I do when 'Unable to connect' popup appears during data collection?

The appearance of this popup is most likely to be caused by Wi-Fi interference. This does not affect the data collection process. Check the Wi-Fi connection. Reboot the Wi-Fi on the UI device if the problem remains, and then reconnect to the LiBackpack Wi-Fi.

What should I do when I cannot open the copied data?

Make sure that: 1. the U Disk used to copy data is in NTFS format; 2. Do not unplug the U disk until the progress bar shows that the copy is 100% complete.

## What should I do when the copy process bar remains at 99% for a long time?

This is likely to occur when large quantities of data are being copied. You should wait for the message that file transfer is completed before removing the USB drive or shutting down the system to avoid data loss and/or damage to the drive.

Does LiBackpack come with a point cloud post-processing tool?

We recommend using LiDAR360, a comprehensive point cloud post-processing suite developed by GreenValley International. LiDAR360 provides comprehensive toolsets for point cloud visualization, processing, analysis, and other tasks.

Is the output point cloud calibrated to be vertical to the ground?

Yes, LiBackpack point cloud processing will adjust the tilt angle of the scanner based on analysis of the IMU data. The tilt angle accuracy is in a 1–3° range.
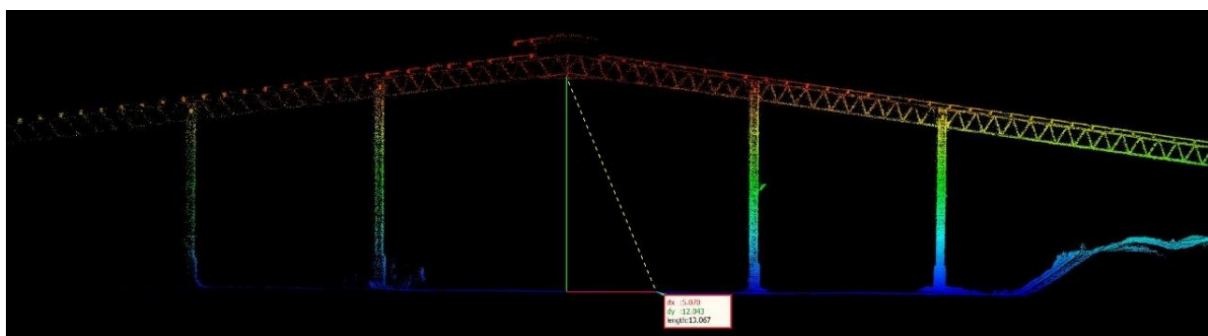

Why are there large amounts of high-level noise points observed in the point cloud?

These noise points are highly likely to be caused by direct sunshine. You can consider performing the scanning when there is no direct sunshine, or you can use the "Remove Outliers" tool in LiDAR360 to remove these noise points.

Why can repeated scanning of the same area or closed-loop scanning cause mismatch of the point cloud?

Closed-loop scanning refers to walk through the route with closed loops while collecting data with LiBackpack.
LiBackpack performs real-time processing and closed-loop optimization. However, because of environmental factors, the closed loops may not be detected automatically in certain scenarios. Optionally, please send the .bag file along with a data introduction to GVI for further analysis and processing.
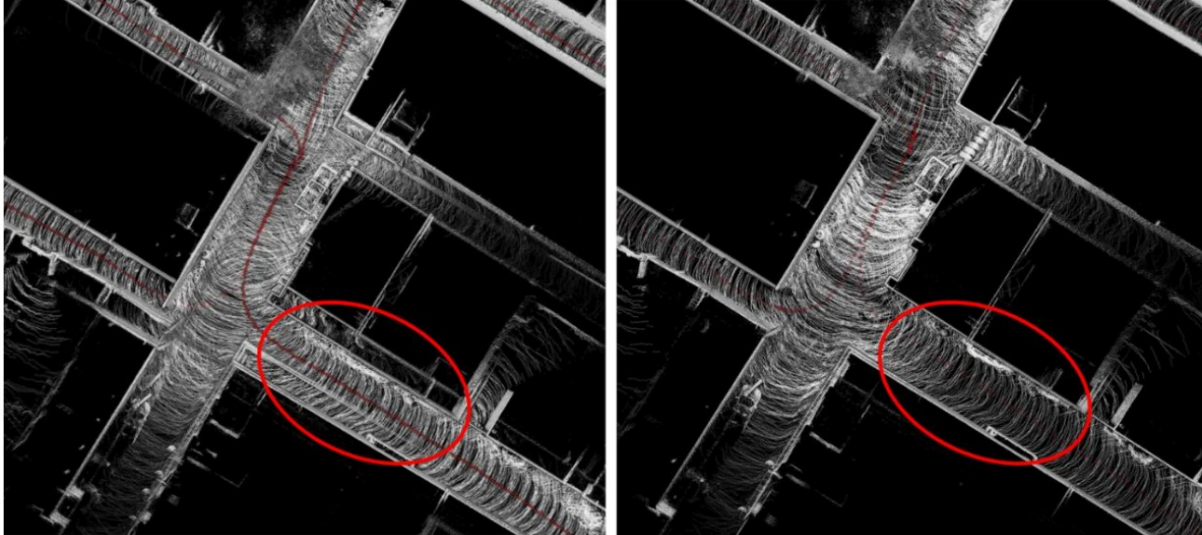

In what situations will the accuracy of the output point cloud be reduced?

- In cylindrical/spherical tunnels or buildings without rich 3D structures. When using the device in cylindrical tunnels or buildings, it is hard for the device to find enough 3D features, which might affect the key points matching process, and therefore influence the accuracy of the mapping accuracy.
- In areas with reflective surfaces, such as glass. Highly-reflective surfaces may result in matching errors and more noise points in the collected data.
- In narrow scanning environments such as small rooms, narrow hallways, and stairways, which may also cause matching errors. The limited vertical field-of-view (FOV) of single XT-16 results in a lack of data for the top and bottom of the scanned environment, which thus affects matching accuracy.

Can I align multiple point cloud datasets or georeference them?

It is recommended that specialized referencing targets are used as control points to align multiple point cloud datasets or to georeference a single point cloud during post processing. Referencing targets should be placed over datum monuments when the goal is to use them to georeference LiBackpack point clouds. LiDAR360 has a Manual Registration (Rectify) Tool which allows users to complete scan-to-scan alignments and/or georeferencing processes. When target spheres are not available, you can align multiple point clouds with LiDAR360's Manual Registration (Rectify) Tool by using pairs of co-located points found in overlapping regions of the to-be-aligned point clouds.
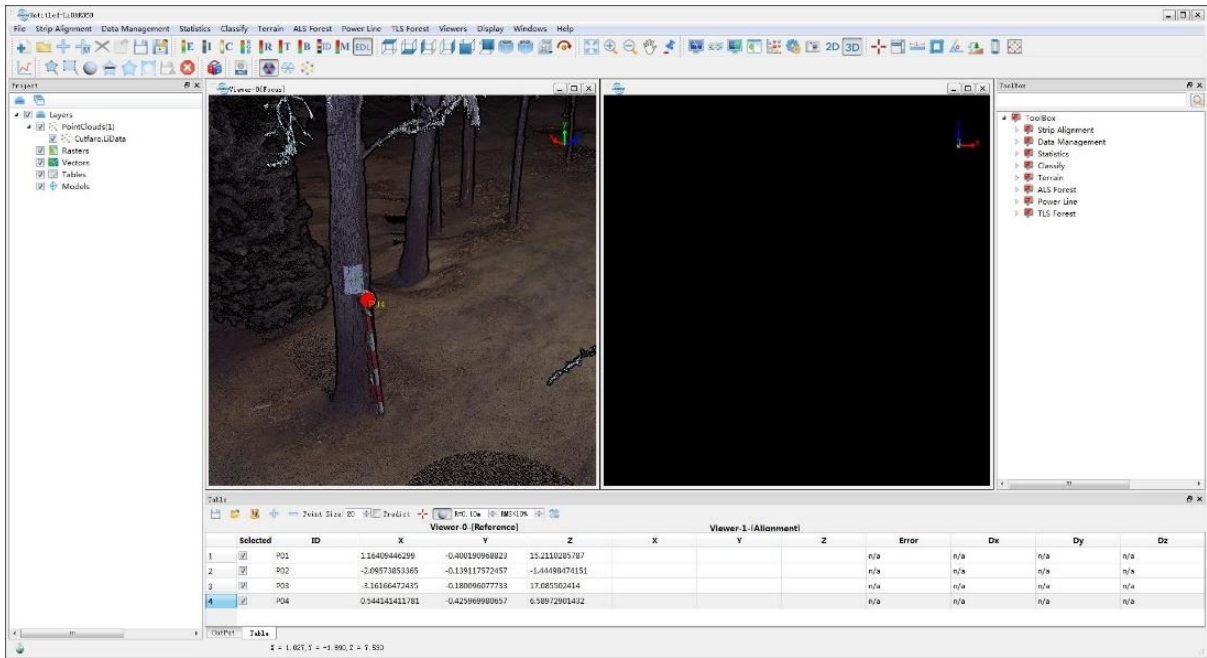
How long can I scan with LiBackpack on one battery charge?

Continuous use and operation of the system can be sustained for up to one hour on a fully charged battery. We recommend stopping the data collection process when the battery is still sufficient in order to save your data.

What are the recommended operation environment and conditions?

Operation of the system should be carried out when ambient temperatures are within the −10° to 60°C range. You should avoid operating the LiBackpack outdoors on wet-weather conditions.

What is the ANSI Laser Safety Standard rating of LiBackpack's LiDAR sensor?

ANSI Laser Safety Standard rating of LiBackpack is Class-1 (eye-safe).

Is my data collected with LiBackpack secure?

All data collected with the LiBackpack system is securely stored local on the system drive and not uploaded to any network. The data can later be transferred out to USB devices or deleted from the UI. If you encounter any difficulties with real-time data processing, please contact us at support@greenvalleyintl.com and send us the data with its documentations. We will post-process your data to produce high accuracy point cloud.

How long does LiBackpack's on-board data processing take to complete?

Data processing is performed by LiBackpack firmware in nearly real-time. However, data processing may take longer to complete in situations where there the scanning environment is spatially complex (contains many geometrically unique features), or there are large numbers of survey loops to close. Data processing should not take longer than 3 to 5 minutes to complete after pressing the Stop button for a scanning session no longer than 30 minutes.

What should I do if the flash drive is not detected after powering on the system?

Power off the system. Unplug the USB drive from the system, and plug it in again after powering on the system.

When can I unplug the flash drive?

It is possible to hot swap the drive if data copying is not in progress. DO NOT unplug the drive if data copying is in progress. Wait until the process is completed and a notice to unplug the drive is displayed.

Why can I not copy a file larger than 4 GB to my USB drive from LiBackpack?

Please ensure that the USB flash drive is in the NTFS or exFAT format. The FAT32 format does not support files larger than 4 GB.

Why can't I open the .ply file I transferred from the LiBackpack's internal storage?

This indicates that the file is incomplete or corrupted, which is most likely to be caused by the disconnection of the flash drive before the data copying process is completed. Please copy the complete data again.
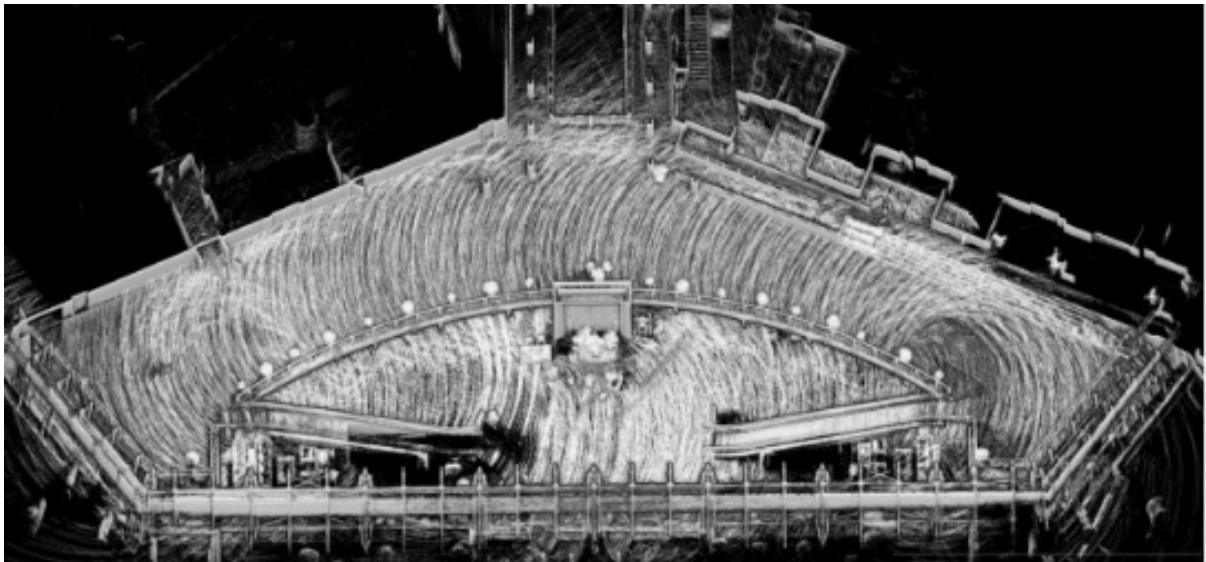
8. Appendix

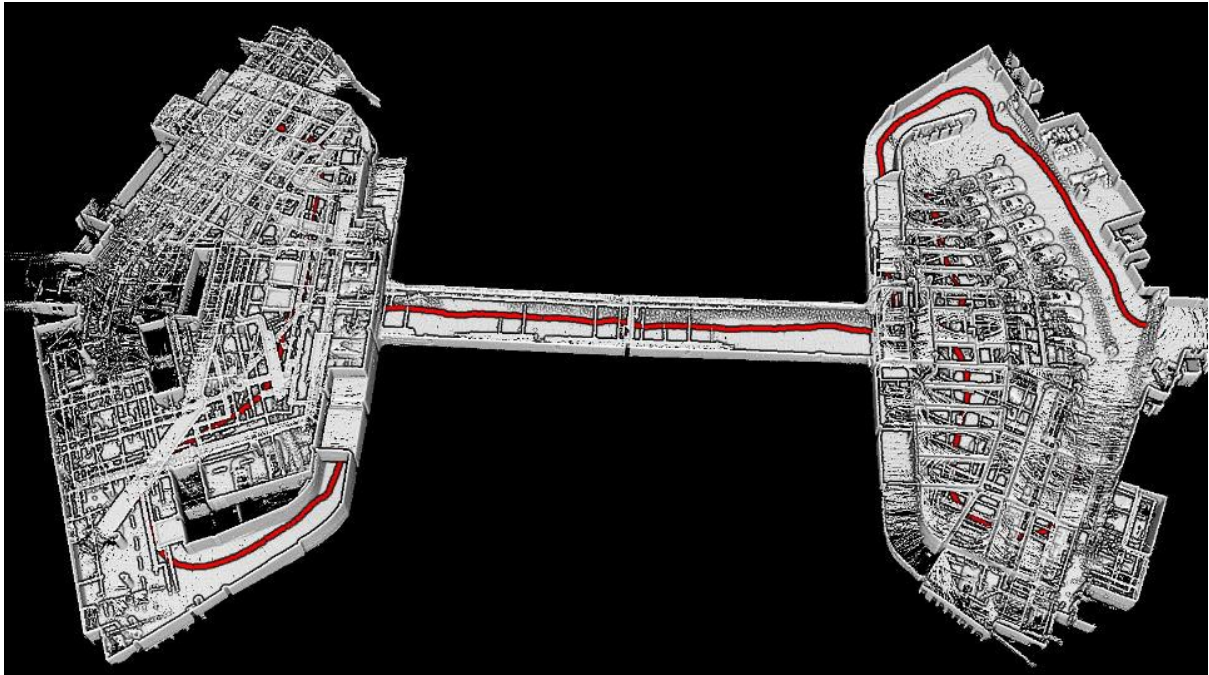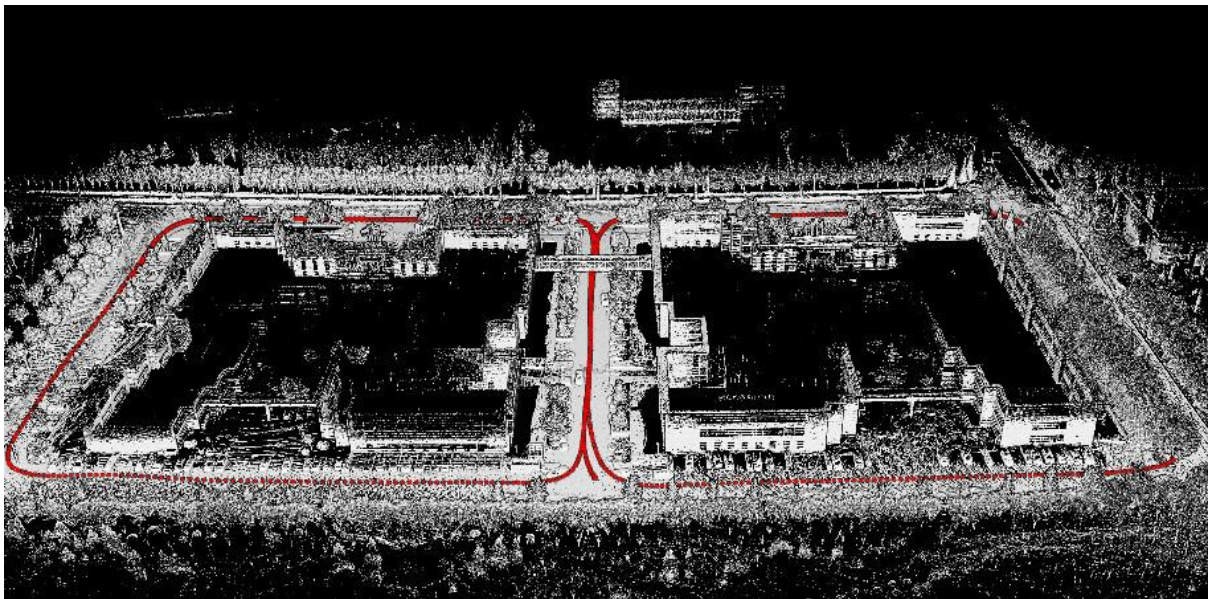## LiBackpack Data Product Examples:

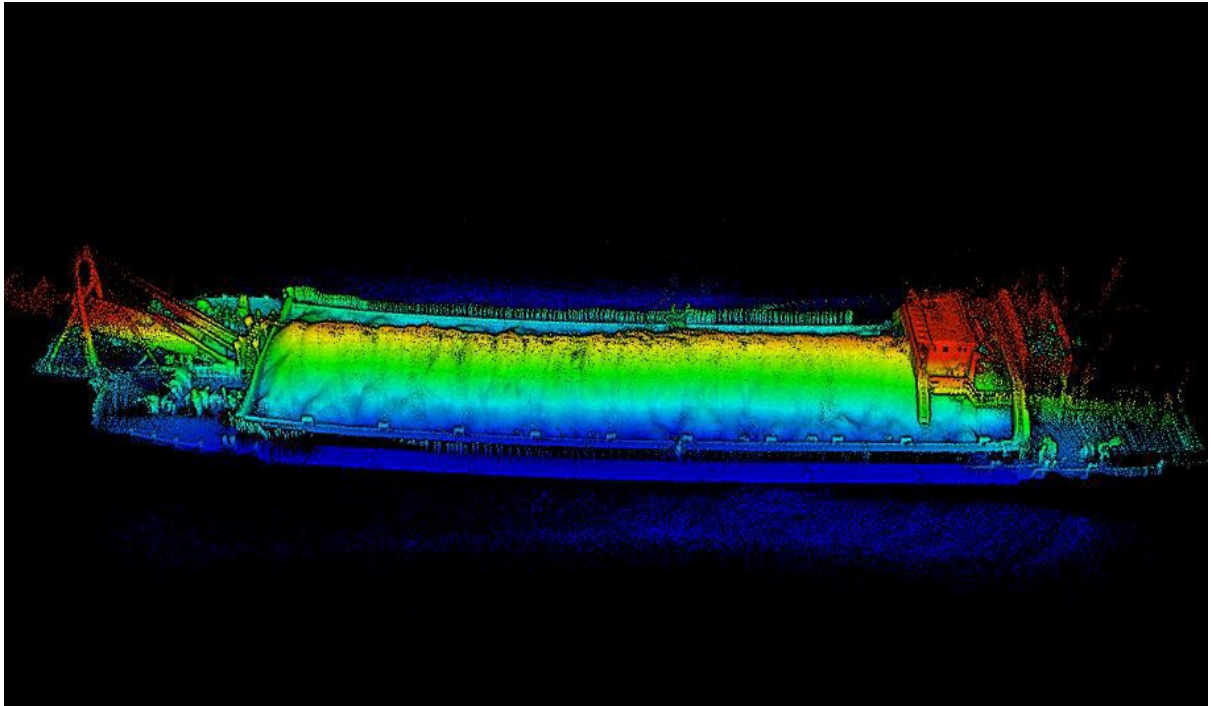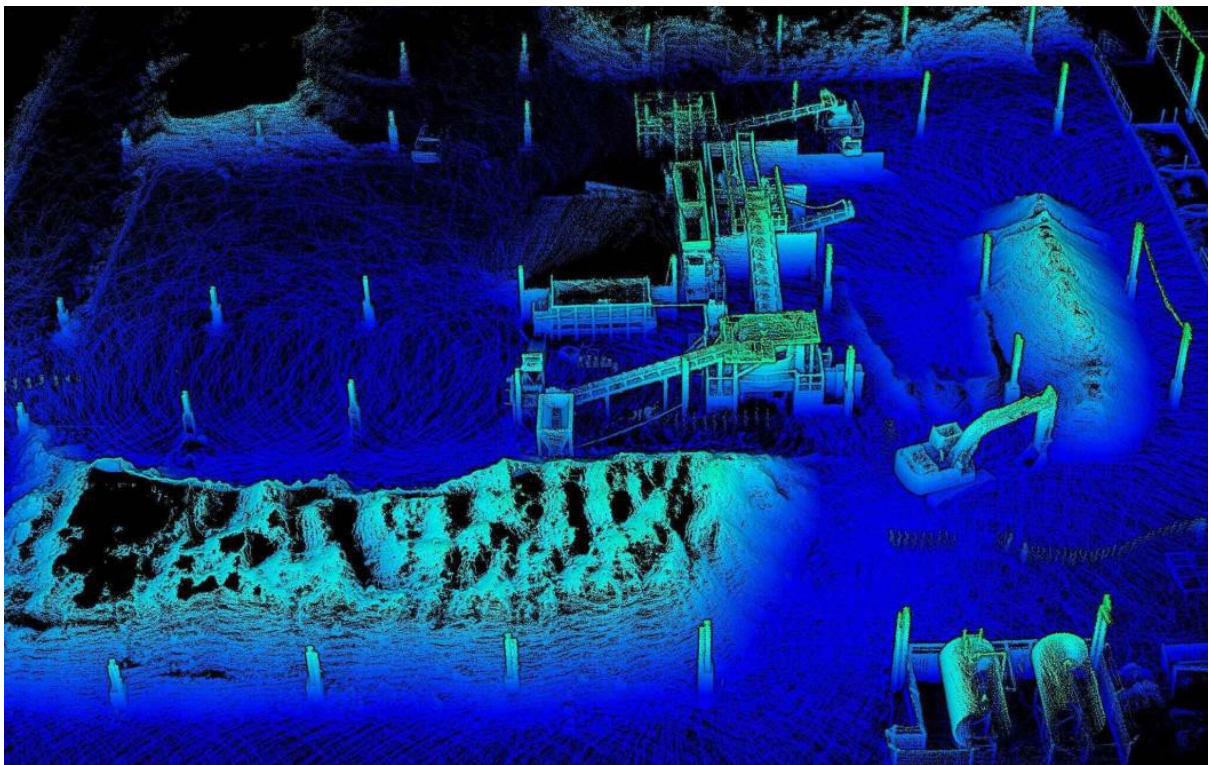Indoor scenes (hotel, conference room, office, and auditorium), parking lot, underground parking garage, office buildings, forestland, sand barge, construction site, pipelines, and powerlines. All data are displayed in LiDAR360, GVI's all-in-one software that provides comprehensive LiDAR solutions. LiDAR360 supports regular point cloud display modes by height, intensity, classification, return, etc., along with EDL and GLASS special filters for the best data display effects.
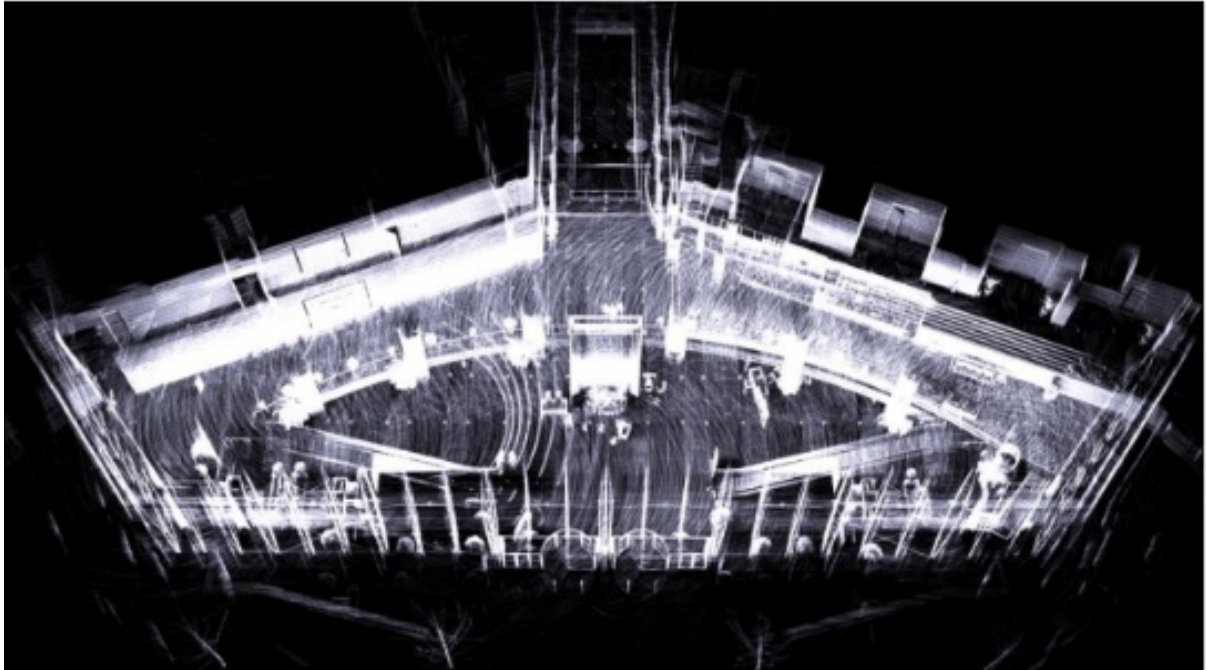
Hotel

Hotel

Conference room
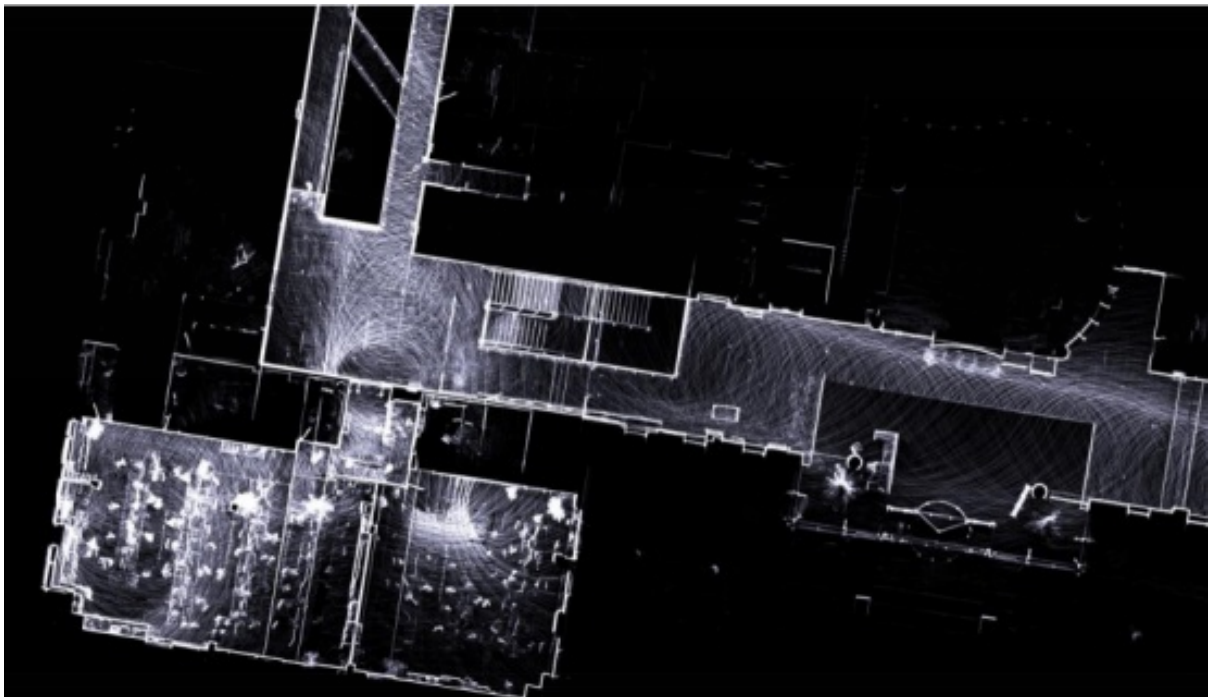
Office

Auditorium

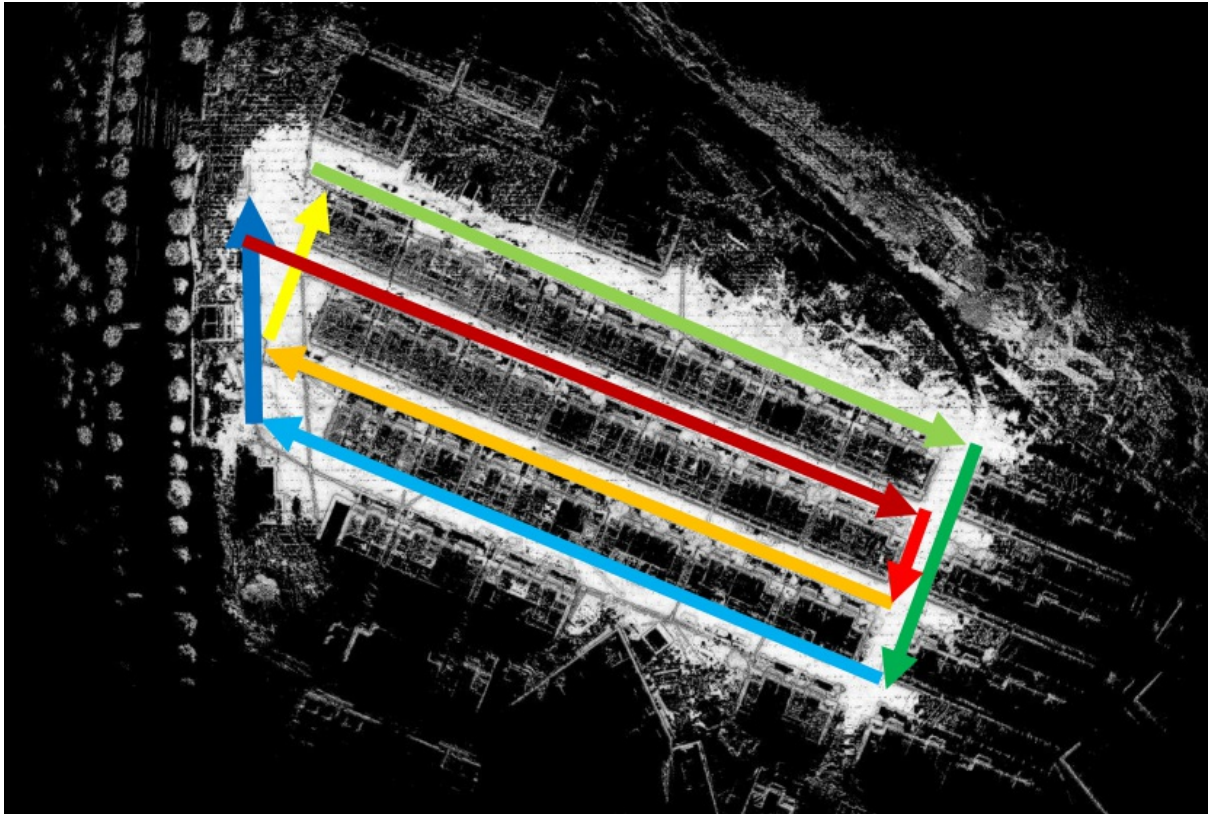
Parking lot

Underground parking garage
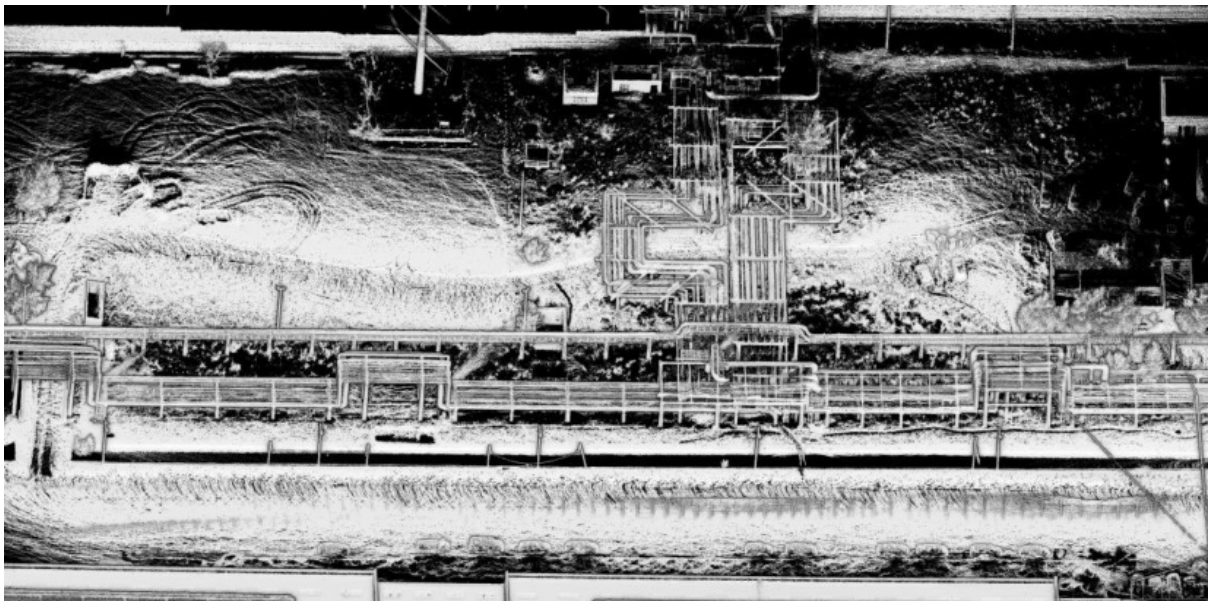

Office buildings
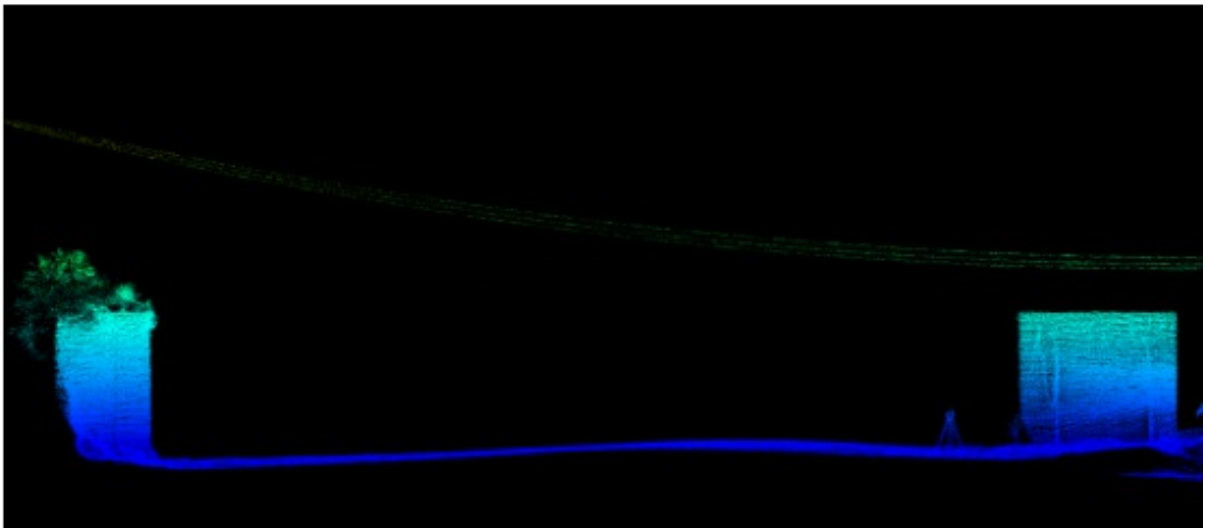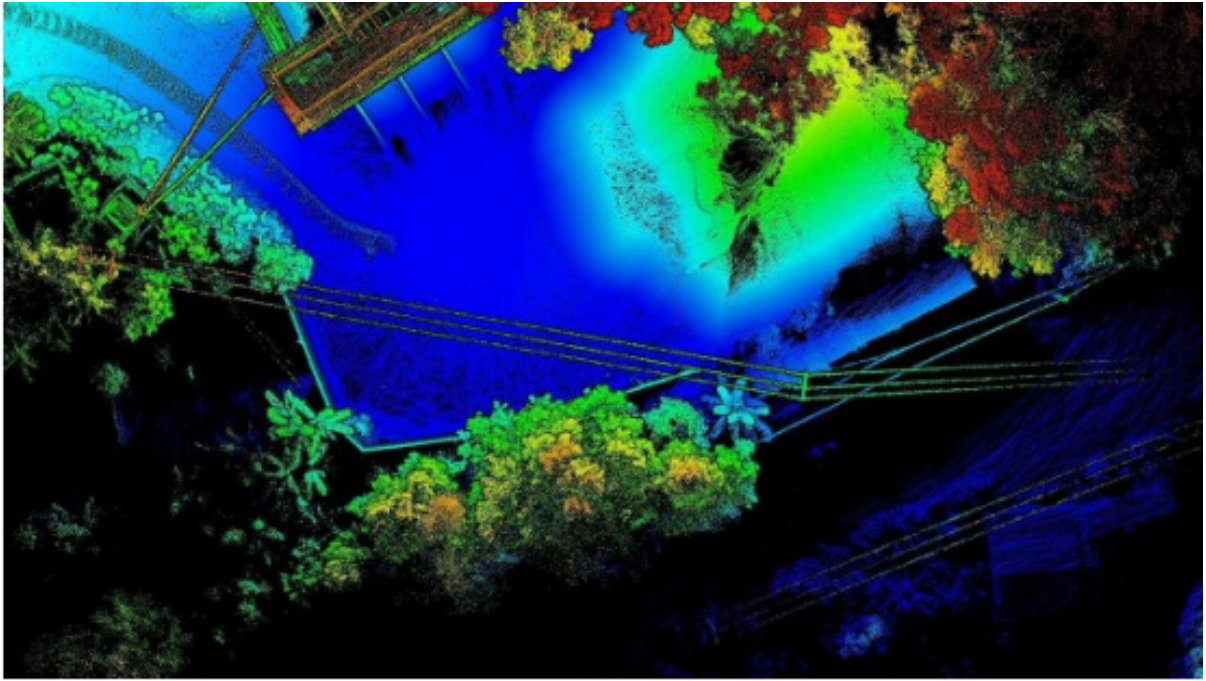
Forestland

Sand barge

Construction site

Building Foundation. Recommended acquisition route: start with red arrow and follow through blue.

Pipelines

Powerlines