Eagle User Manual

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FCC Statement

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation.

2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note:This equipment has been tested and found to comply with the limits for a class B digital device,pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates uses and can radiate radio frequency energy and,if not installed and used in accordance with the instructions,may cause harmful interference to radio communications.However,there is no guarantee that interference will not occur in a particular installation.if this equipment does cause harmful interference to radio or television reception,which can be determined by turning the equipment off and on,the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The device has been evaluated to meet general RF exposure requirement,This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

catalogue

1. INTRODUCTION 4

2. HARDWARE DESCRIPTION 5

2.1. EQUIPMENT APPEARANCE 5
2.2. BUTTON DESCRIPTION 5

3. COLLECTION SOFTWARE 8

3.1. START THE TIMING PAGE 8
3.2. ENGINEERING MANAGEMENT PAGE 9
3.3. ENGINEERING SETTINGS 13
3.4. SCANNING 17

4. DATA PROCESSING SOFTWARE 24

4.1. SOFTWARE INSTALLATION 24
4.2. CREATE PROJECT 25
4.3. OPEN PROJECT 27
4.4. CALIBRATION FILE SELECTION 28
4.5. DATA CALCULATION 30
4.6. FILTERING 35
4.7. SAMPLING 38
4.8. NORMAL VECTOR 40
4.9. COLORING 43
4.10. CLICK CLOUD BROWSE 47
4.11. POINT CLOUD DISPLAY SETTINGS 50

1. Introduction

The Eagle(JMK1,JMK2) handheld spatial 3D scanner integrates cutting-edge laser scanning technology and high-definition imaging capabilities, designed specifically to meet the precise measurement and 3D reconstruction needs of various complex spatial environments.

The scanner is equipped with a high-precision laser ranging module that can quickly emit and receive laser beams, capturing real-time three-dimensional coordinate information of the target surface in a non-contact manner. This feature ensures that detailed point cloud data can be easily obtained even in complex or difficult to access spaces, laying a solid foundation for subsequent modeling and analysis work.

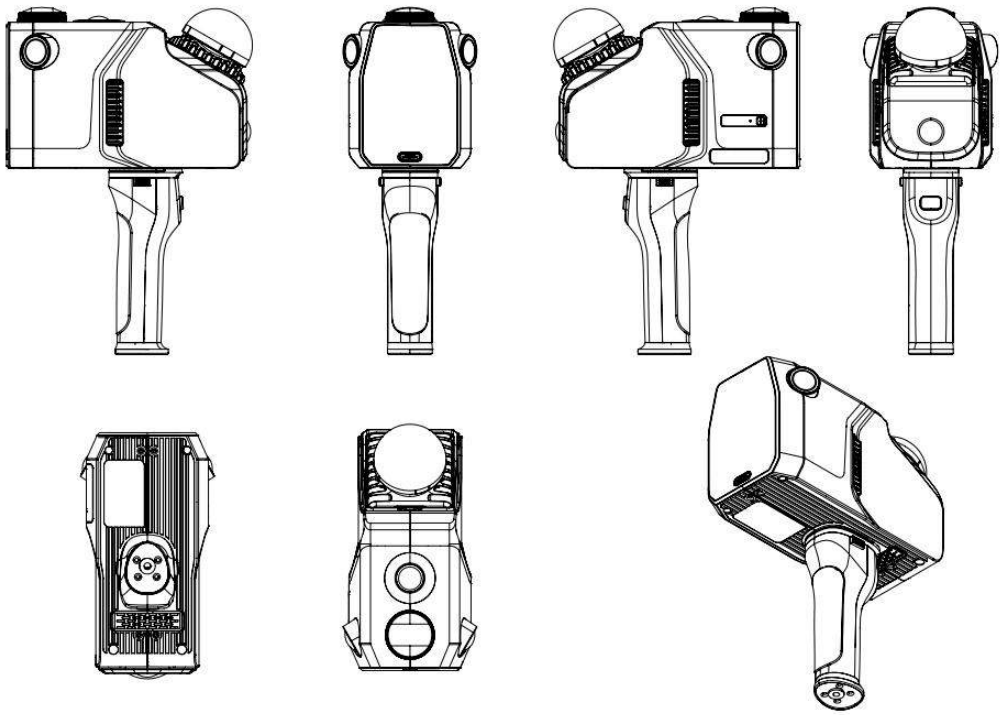
In order to provide more comprehensive scene recording, the scanner is equipped with high-definition fisheye cameras in four directions: front, up, left, and right. These cameras not only capture high-definition images with ultra wide viewing angles, but also effectively reduce blind spots, ensuring that every detail is accurately recorded. The design of fisheye lens further enhances the distortion correction ability of the image, making the final panoramic stitching more natural and smooth.

Users can easily import raw scanning data through the accompanying data post-processing software RayStudio, and automatically or semi automatically perform point cloud stitching, denoising, filtering, and other processing to generate high-quality raw

point cloud data. In addition, the software also supports point cloud coloring, which assigns real colors to point clouds based on IMU data and four-way camera photos, making it easier to intuitively understand spatial structures. At the same time, using high-definition photos taken by the camera, the software can generate seamless panoramic images and 3D Gaussian data based on point clouds, providing rich materials for multiple aspects such as design, analysis, and display.

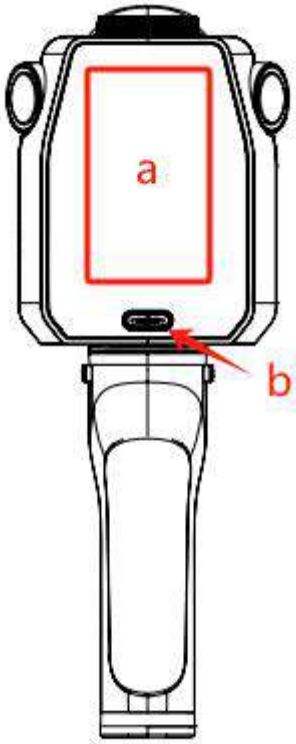
2. Hardware Description

2.1. Equipment appearance



2.2. Button Description

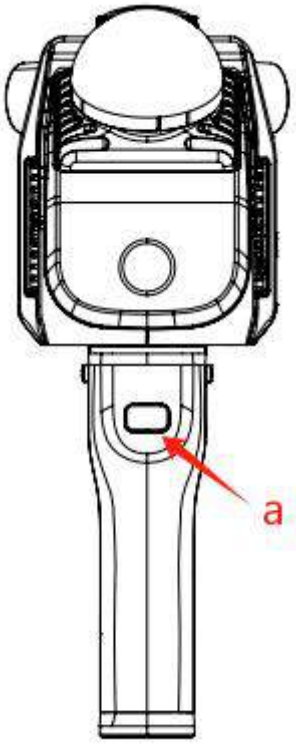
1）Display screen and power on/off buttons.



a. Display touch screen.

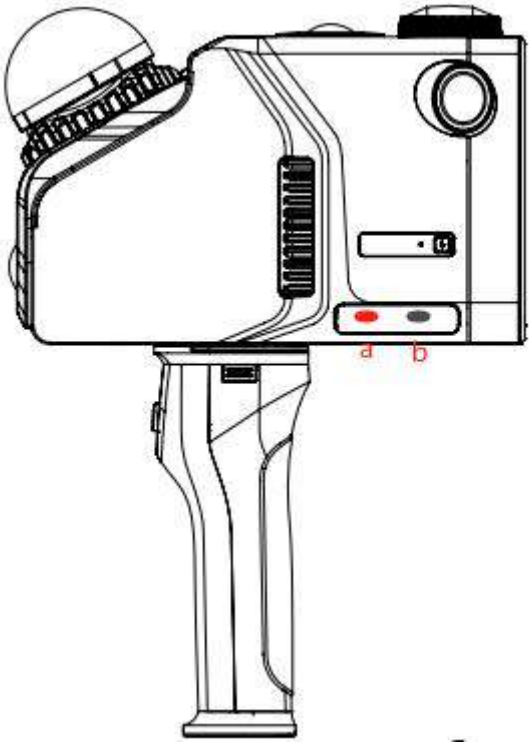
b. On/off button, when in the off state, click this button to turn on the device; Press and hold the button for 6 seconds while the device is turned on to shut it down.

2) Photo button.



a. In the "Fixed Point" fixed point acquisition mode, click this button to take photos.

3) Type-C interface.



a. Charging port.

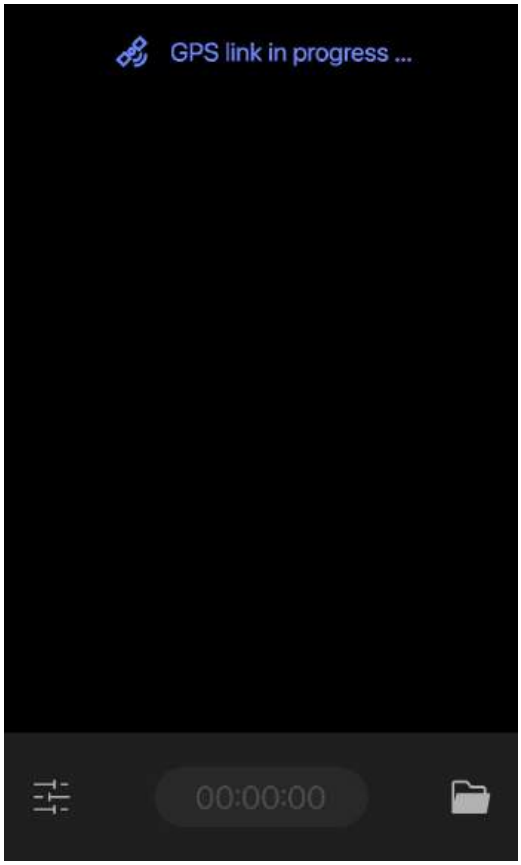
b. Data port, capable of connecting Type-C USB drives or portable hard drives, with a file system in NTFS format. Attention: The data jack cannot be connected to a power source!

3. Collection software

3.1. Start the timing page

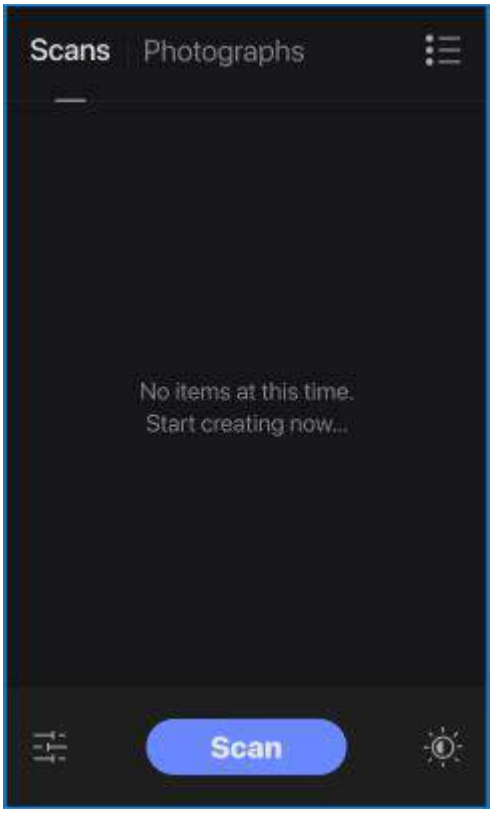
To start the Eagle(JMK1,JMK2) acquisition system, first enter the

initialization time synchronization page. If GPS signals can be obtained in the current environment, GPS time will be used for system time synchronization; If GPS signal cannot be obtained, the system time will be used directly. The entire initialization process will last for 20 to 100 seconds.



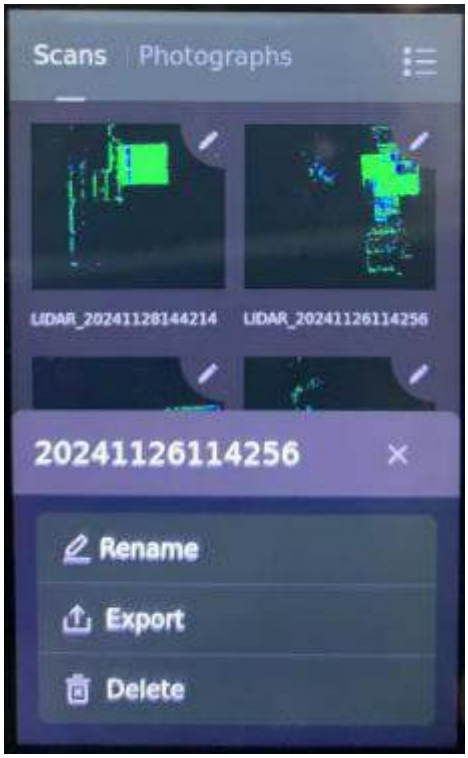
3.2. Engineering Management Page

1) Entering the Eagle(JMK1,JMK2) collection system for the first time, there are no collected projects.



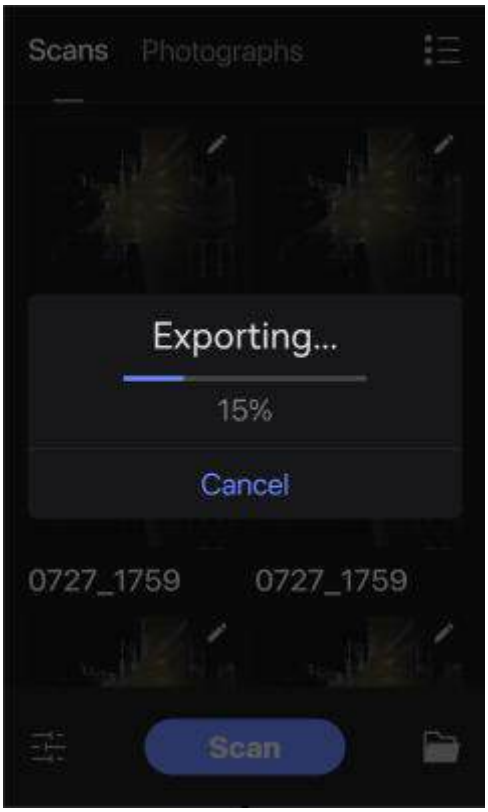
2) If you are not entering the Eagle collection system for the first time, you can view the list of collected projects on the main page.

3) Click on the icon in the upper right corner of the project icon to manage the selected project.

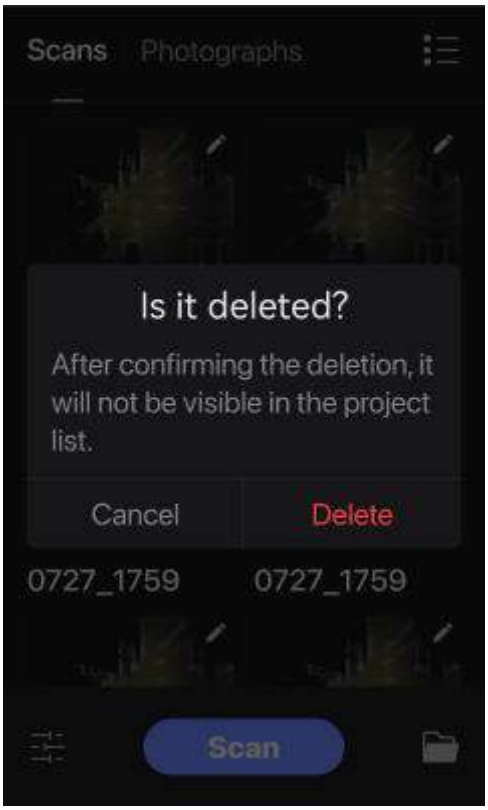


a. Rename: Rename the project, supporting both English and numerical input.

b. Export: Export project file data to a USB drive.

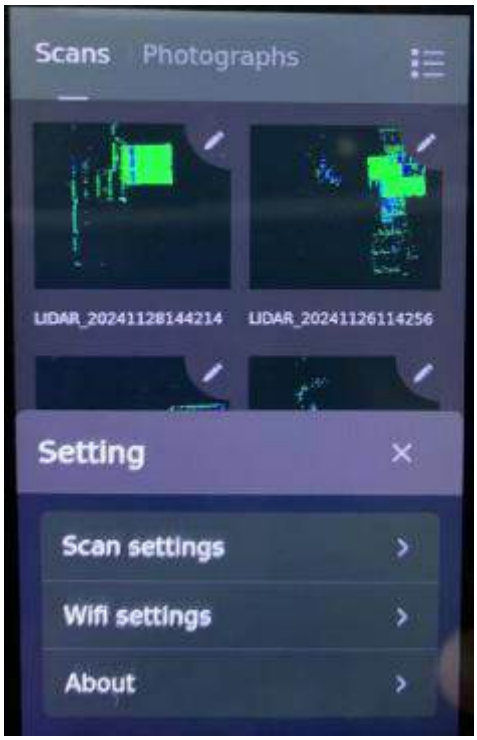


c. Delete: Delete project data.

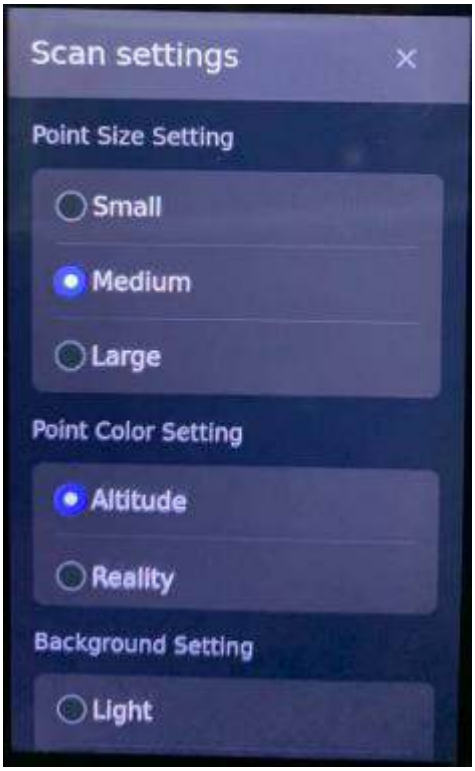


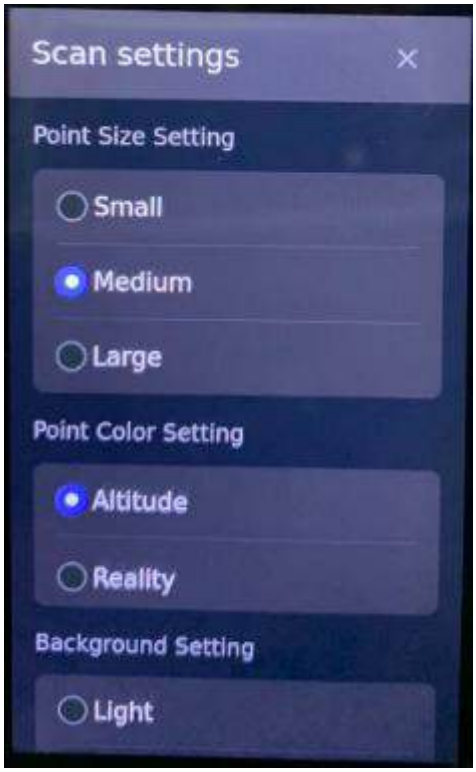
3.3. Engineering Settings

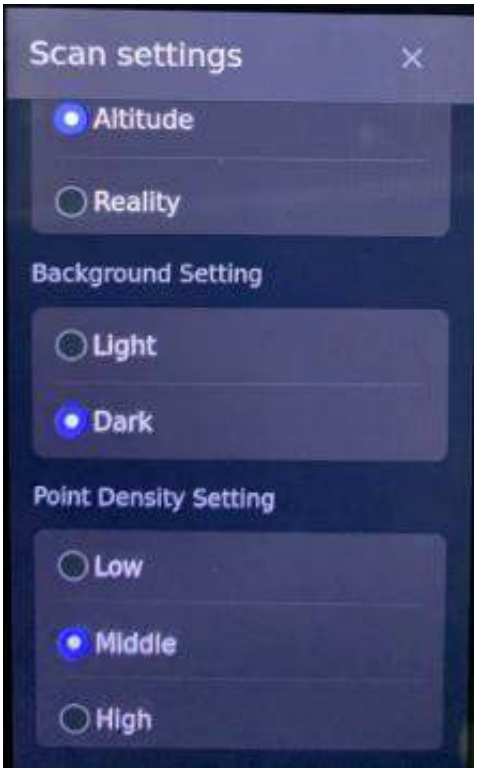
1) Click the button in the bottom left corner of the main page to enter the laser and system settings page



a. Scan settings:







Point Size Setting: Point cloud display size setting.

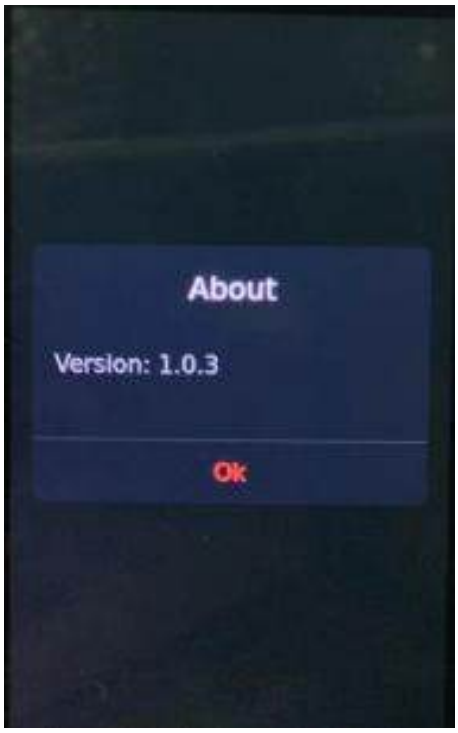
Point Color Setting: Point cloud shading settings.

Background Setting: Point cloud display background settings.

Point Density Setting: Point cloud display density settings.

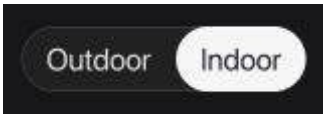
b. Wifi settings: Whether to turn on the device's wifi hotspot settings.

c. About: View the version information of the collection software.



2) Click the button in the bottom right corner of the main interface to enter the camera settings page

a. Indoor/Outdoor Options: Users can choose between "Outdoor" and "Indoor" options based on the capture environment, and the system will set the initial camera exposure parameters according to the user's options.



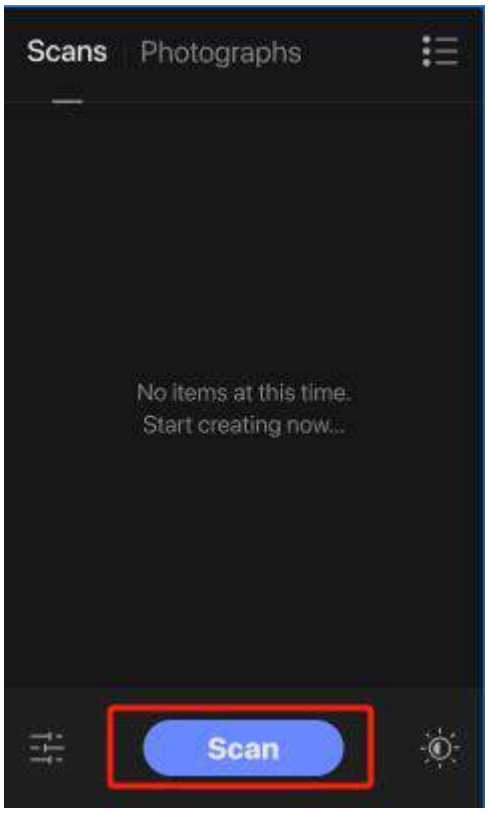
b. Brightness adjustment: Users can adjust the current environment brightness based on the indoor and outdoor environment options.

c. Exposure value adjustment: Users can adjust the exposure based on the indoor and outdoor environment and the current environment brightness to achieve the best shooting effect.

d. White balance adjustment: Users can enter the white balance parameter adjustment to make the colors in the photos closer to the real colors.

3.4. Scanning

1) Start scanning: Click the "Scan" button at the bottom of the main interface to start setting up space scanning.



2) Scan settings: Before starting the scan, it is necessary to set the basic scanning parameters. After setting, click the "Save" button in the upper right corner to save the setting information and start scanning; If you click "Cancel" in the upper left corner, you will exit the scan.

a. Project Name: The default collection time is the project name, and users can also modify the project name.

b. Connect GPS: Users can choose whether to connect to GPS or not. If selected, connect to GPS, and GPS information will be saved during the collection process. At the same time, GPS time will be used to update the system time; If you choose not to connect, GPS data will not be saved. Attention: Choosing to connect to GPS must be done outdoors and in a location with strong satellite signals, otherwise GPS signals will not be obtained.

c. “Acquisition Mode”： The acquisition mode is divided into

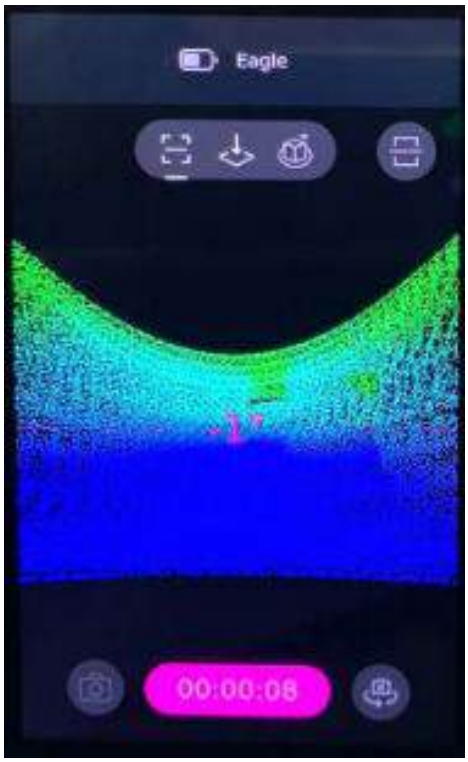
"Continuous" continuous acquisition and "Fixed Point" fixed point acquisition. During the continuous acquisition process, the four-way camera will automatically capture 4000 * 3000 photos continuously at a frame rate of 1 image per second; Fixed point collection: During the collection process, the four-way camera will not automatically take continuous photos. Users can choose a suitable shooting position and click the shooting button or the shooting button on the controller to take 8000 * 6000 photos with the four-way camera.

3) Time synchronization: When the device enters scanning for the first time, the system automatically synchronizes the camera and laser timing, which takes about 30 seconds to complete.

4) Start scanning: After time synchronization is completed, the "Scan" button below will turn blue. Click the "Scan" button to officially enter

the scanning process.

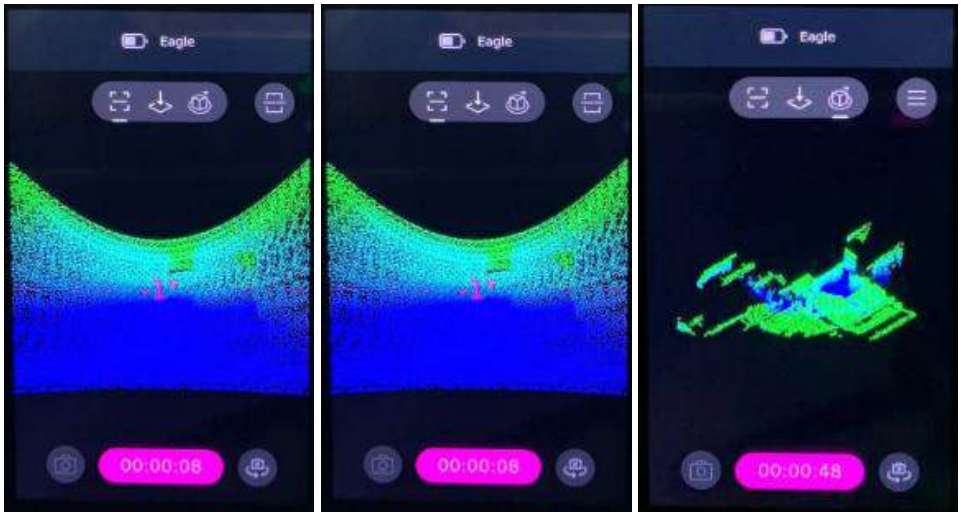
5) Scanning: During the scanning process, real-time display of the collected laser point cloud and camera video information.



a. Battery level display: The current battery level of the device is

displayed above the collection interface. If the battery level is below 20%, the system will automatically power off for protection. Please pay attention to the current battery level.

b. Point cloud display perspective: Users can click the button above the collection interface to switch point cloud display perspectives, which are "first person perspective", "bird's-eye view", and "45 degree bird's-eye view".



c. Split screen display: Click the button in the upper right corner of the capture interface to enter the front camera and laser point cloud split screen display mode.

d. Taking photos: Click the button in the bottom left corner of the capture interface to take photos with a four-way camera. Note: This button is only effective in the "Fixed Point" fixed point acquisition mode.

e. Camera video stream: Click the button in the bottom right corner of the capture interface to display the front camera video stream in real-time, without displaying point cloud data.

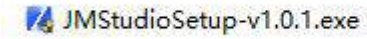
f. Collection time: At the bottom of the collection interface, the real-time collection time is displayed.

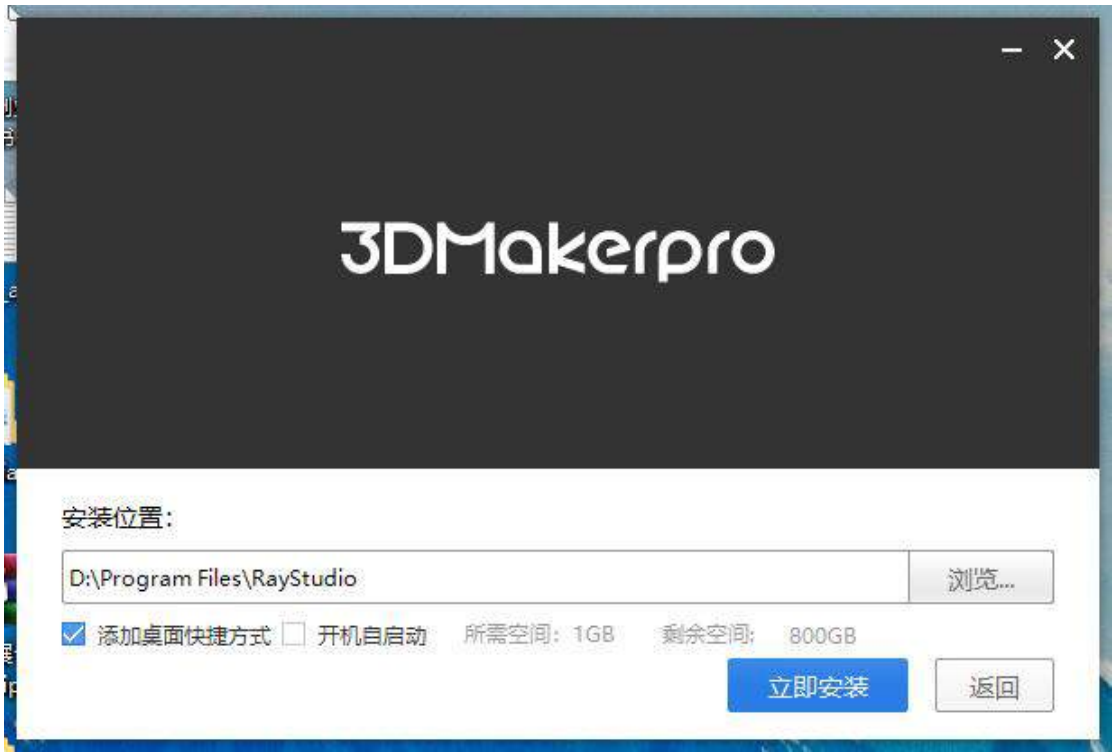
g. End data collection: Click the real-time collection time button to end the data collection of the current project. Click the "Save" button to save the project data and return to the initial project list page.

4. Data processing software

4.1. Software installation

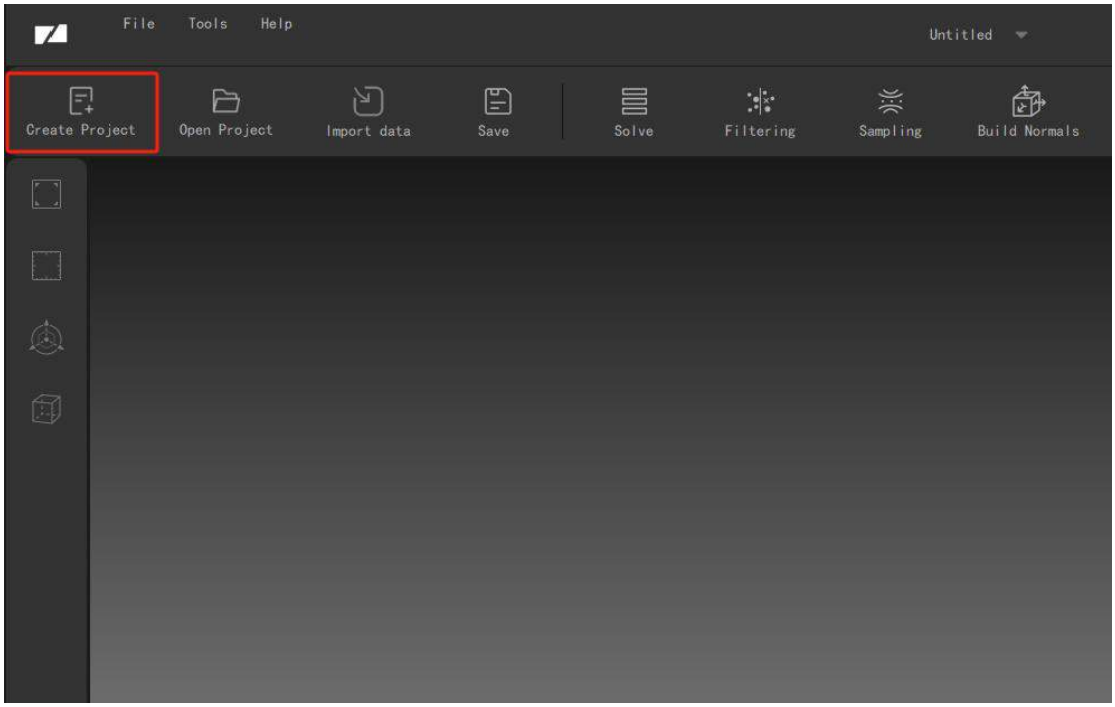
Double click JMStudioSetup. exe to install the software.



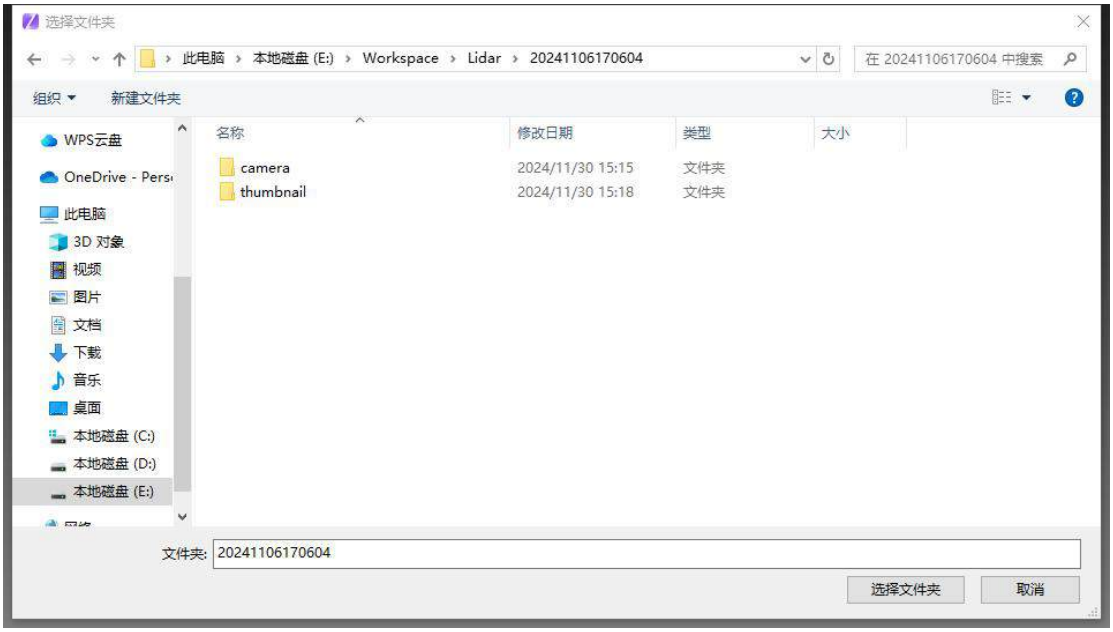


4.2. Create project

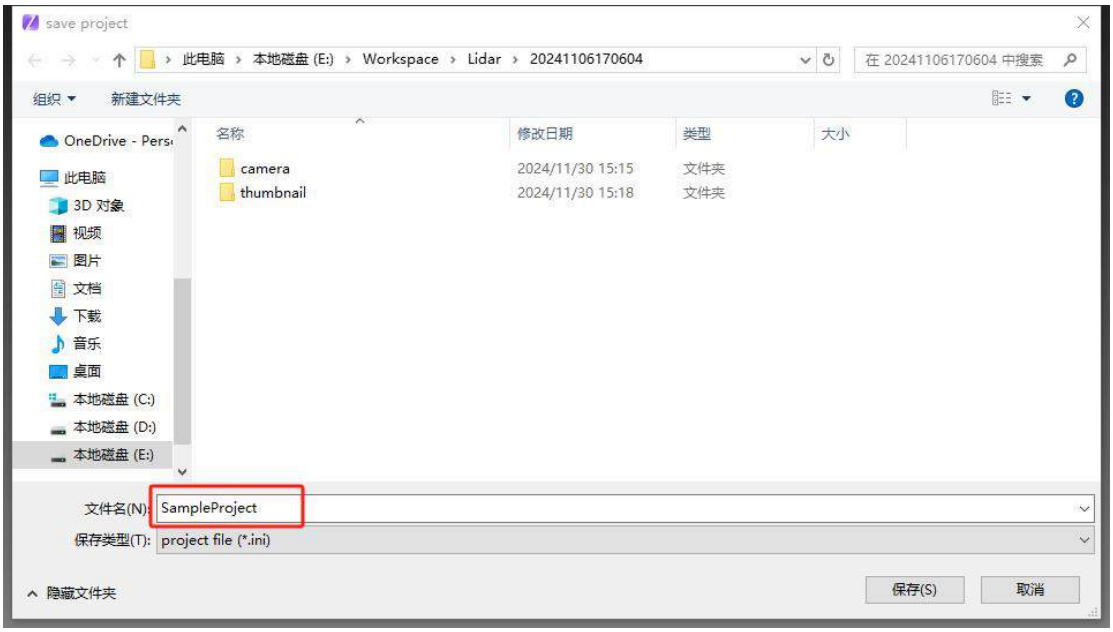
1) Click the "Create Project" button in the upper right corner of the RayStudio software to enter the new creation project.



2) Select the directory where the engineering data file is located. The engineering data directory contains two bag data sets, namely IMAGE ID&0. bag and LIDAR ID&0. bag, which are the photo dataset and laser point cloud dataset, respectively.

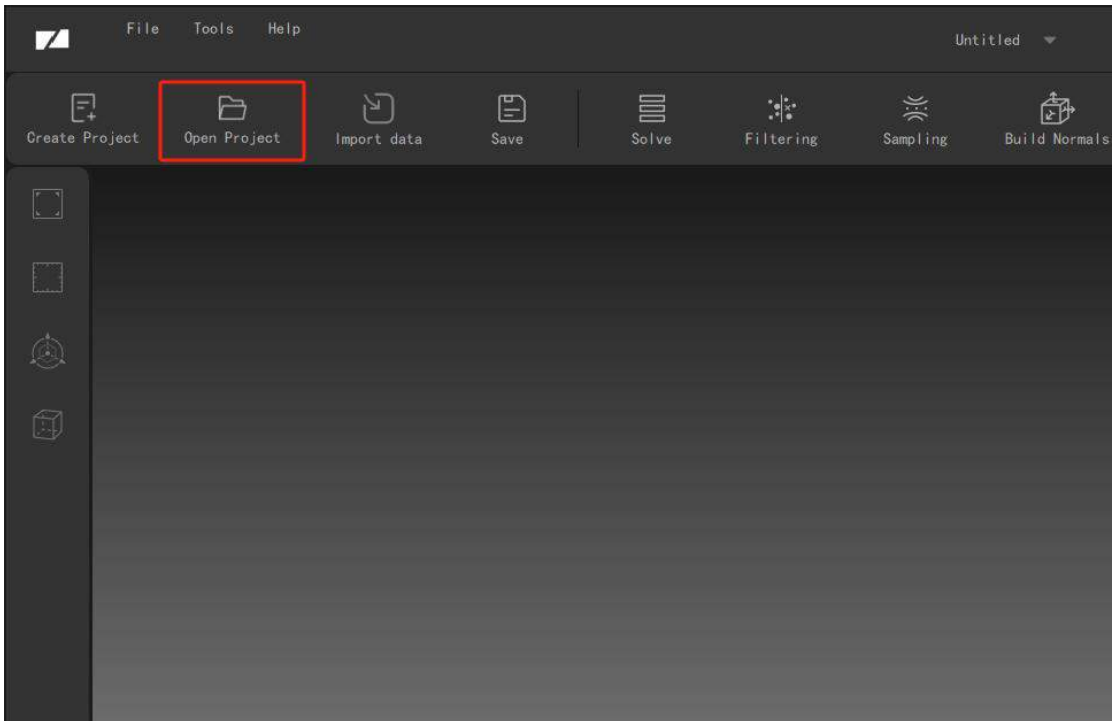


3) Enter the project name and save the project file.

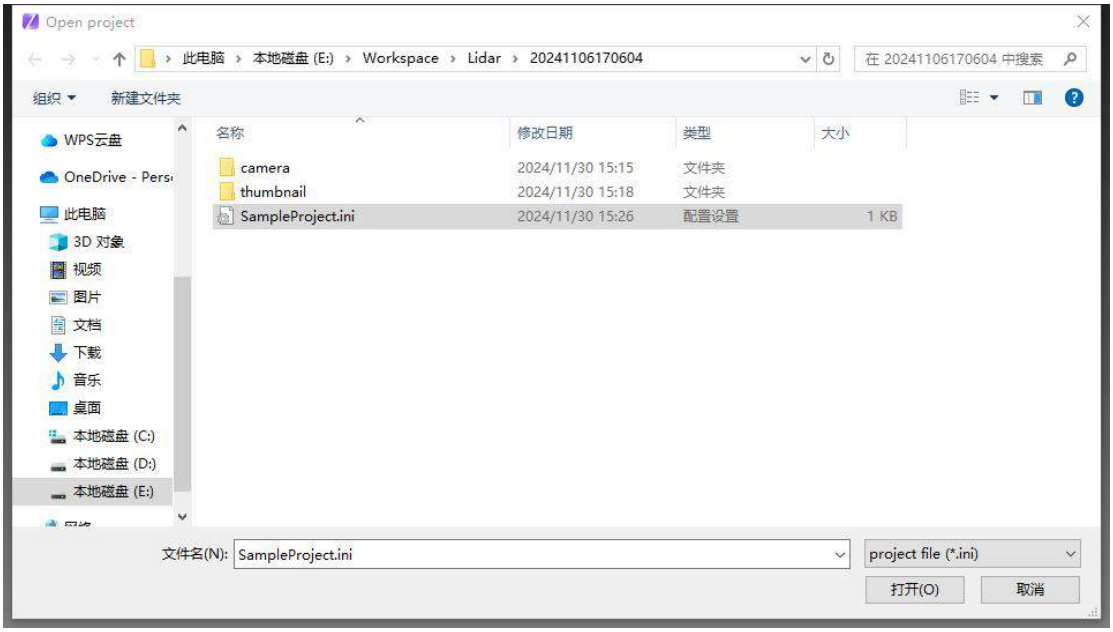


4.3. Open Project

1) Click the "Open Project" button in the upper right corner of RayStudio software to select an existing project file to open.



2) Go to the directory where the project file is located, select the project.ini file, and open this project.



4.4. Calibration file selection

In the field of 3D data acquisition and processing, each acquisition device plays a crucial role in capturing physical information from the real world and converting it into digital form. To ensure the accuracy and reliability of these digital information, each collection device will be equipped with a unique calibration file. This file not only records in detail the internal parameters of the device camera (referred to as internal parameters), but also includes the external parameter relationship between the camera and the laser (referred to as external parameters).

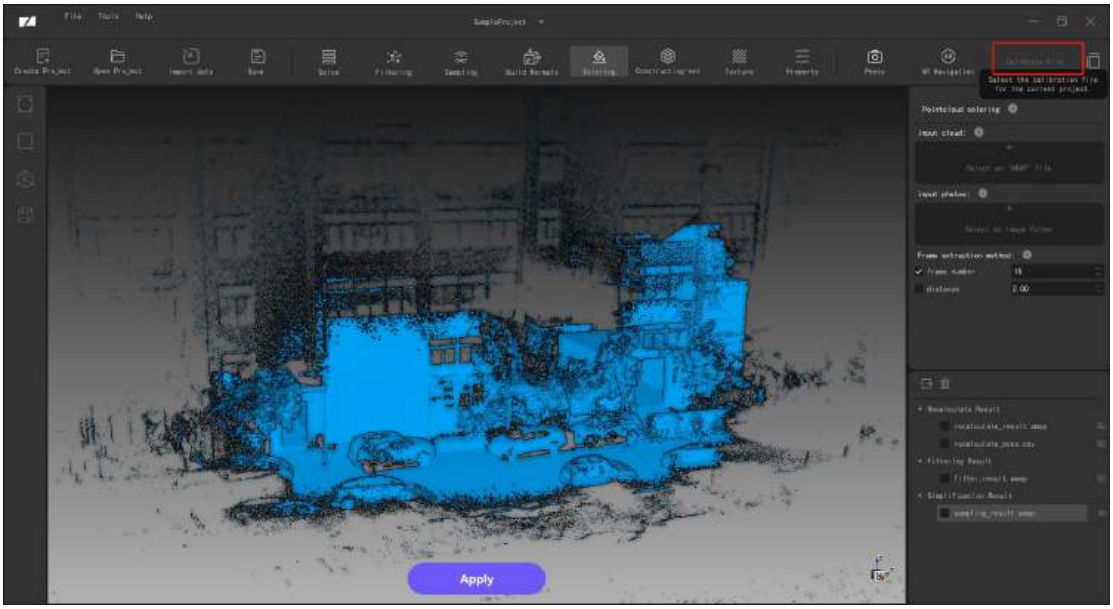
The camera's intrinsic parameters mainly include key information such as focal length, optical center position (also known as principal point coordinates), lens distortion coefficient, etc. These parameters are crucial for understanding how pixels in an image correspond to actual three-dimensional spatial points. For example, the focal length determines the magnification of the image, while the position of the optical center identifies the center point of the image. The distortion coefficient is used to correct image distortion caused by lens manufacturing or installation errors.

The extrinsic parameters of the camera and laser describe the transformation relationship between the camera coordinate system and the laser coordinate system. This includes the rotation matrix and

translation vector, which together define how to map the position of the laser emitted beam in three-dimensional space to the image plane of the camera. This mapping relationship is crucial for achieving accurate laser scanning and 3D reconstruction.

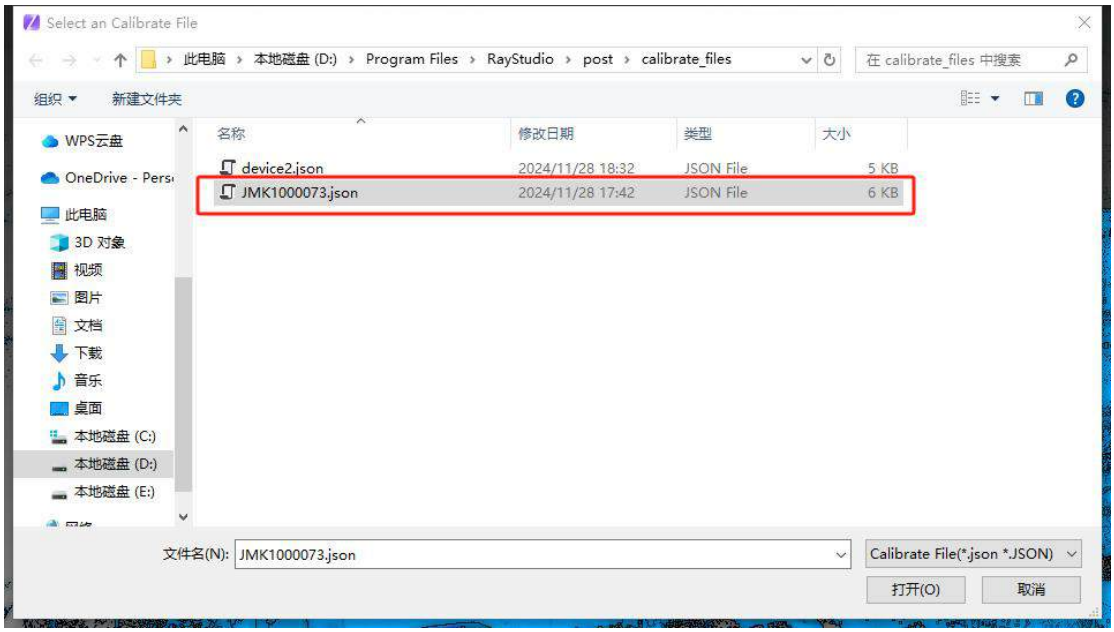
Therefore, selecting the correct calibration file is a crucial step when processing each engineering data. This means that it is necessary to select the one that matches the current project from multiple possible calibration files based on the acquisition device used. Only in this way can we ensure that subsequent tasks such as 3D reconstruction, object recognition, and size measurement can be carried out based on accurate spatial mapping relationships, thereby obtaining reliable results.

1) Click the "Calibrate File" button in the upper right corner of the RayStudio software to select the correct calibration file.



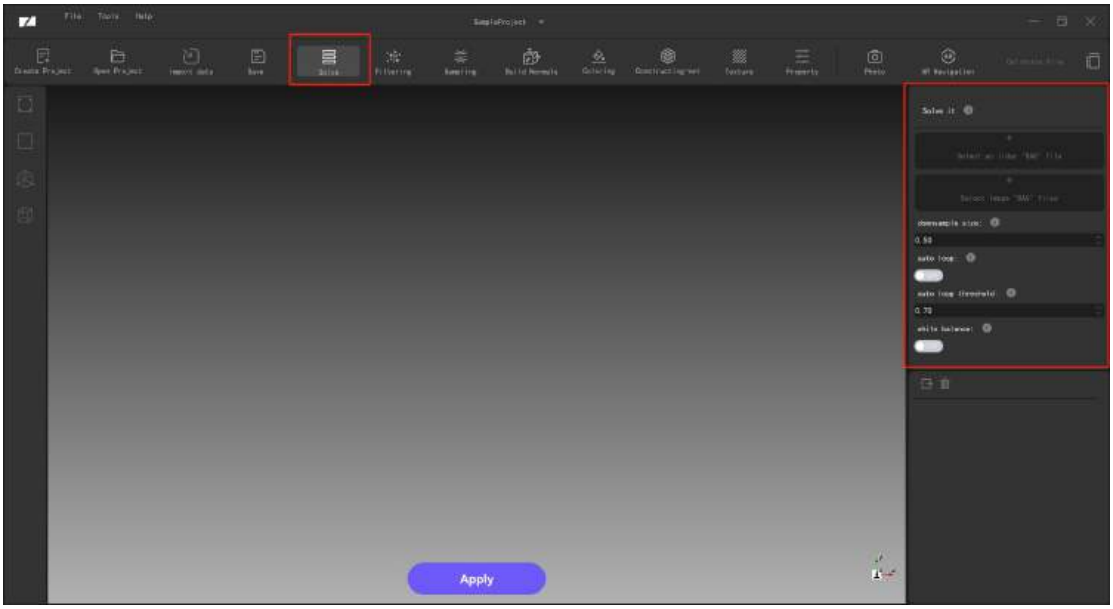
2) Select the calibration JSON file corresponding to the collection

device of this project, which has the same device ID number.



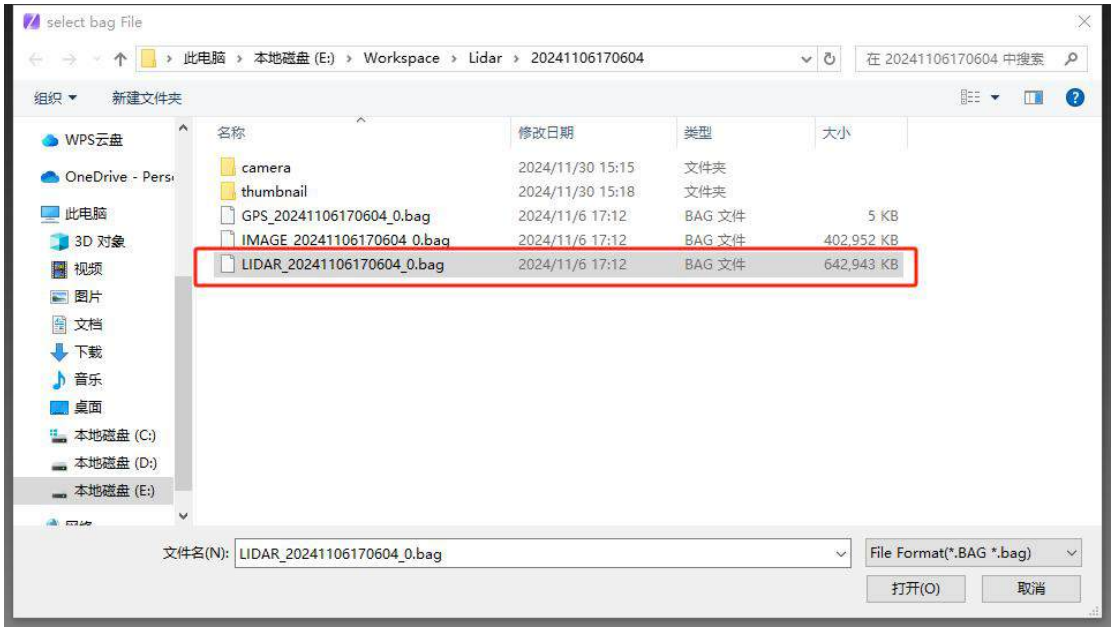
4.5. Data calculation

1) Click the "Solve" button on the top of the RayStudio software, and the operation bar on the right will enter the Solve sub item page.



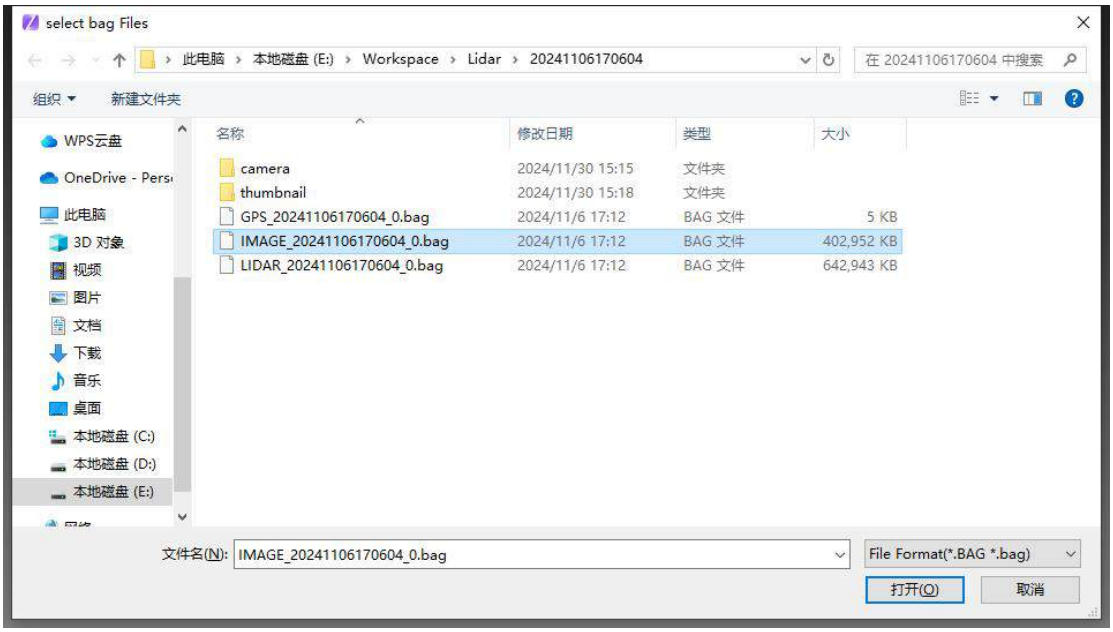
2) If you need to solve Lidar laser point cloud data, click the "Select Lidar" button on the Solve sub item page and select one or more

LIDAR.bag data in the project. If there is no need to solve Lidar data, this step can be skipped.

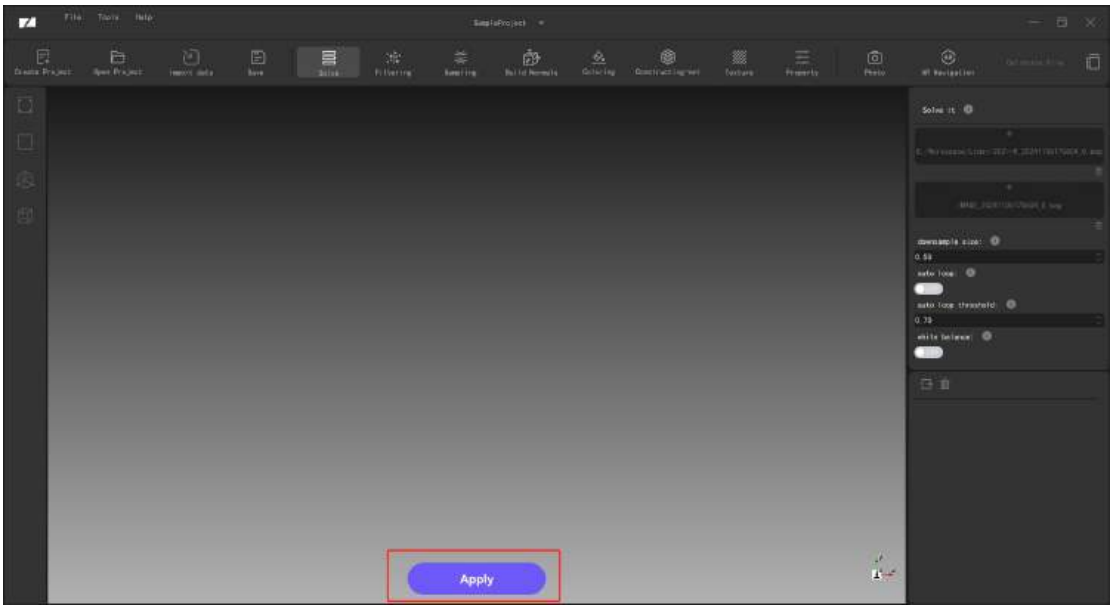


3) If you need to solve the photo data, click the "Select Image" button on

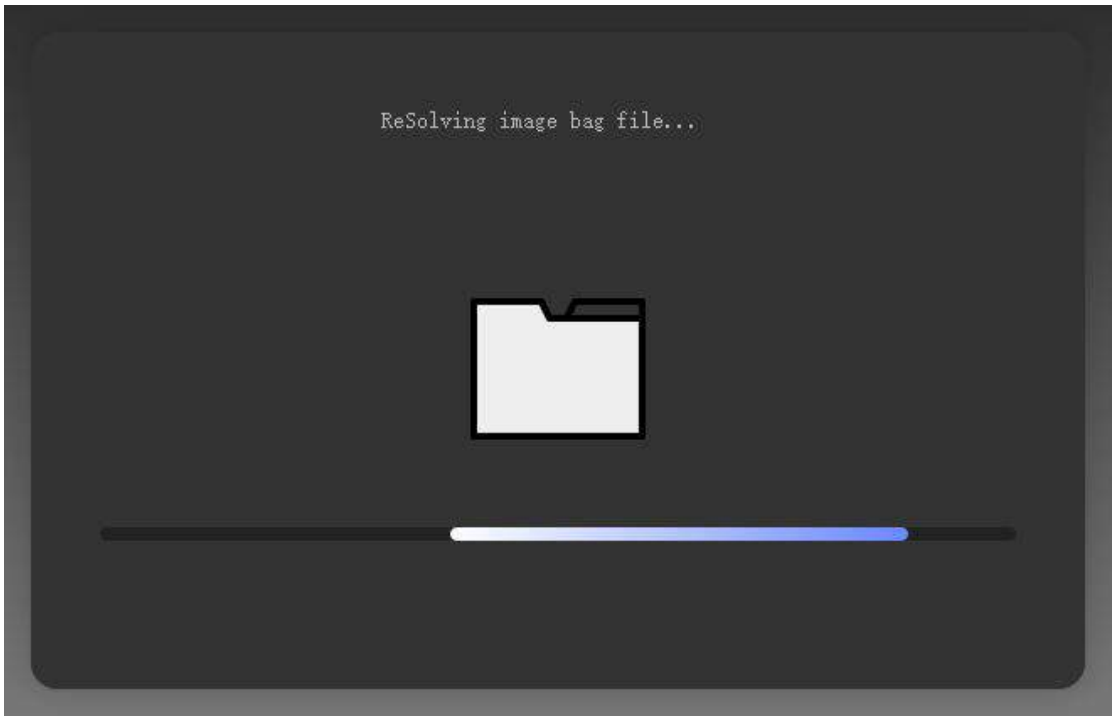
the Solve sub item page and select one or more IMAGE. bag data in the project. If there is no need to calculate the photo data, this step can be skipped.



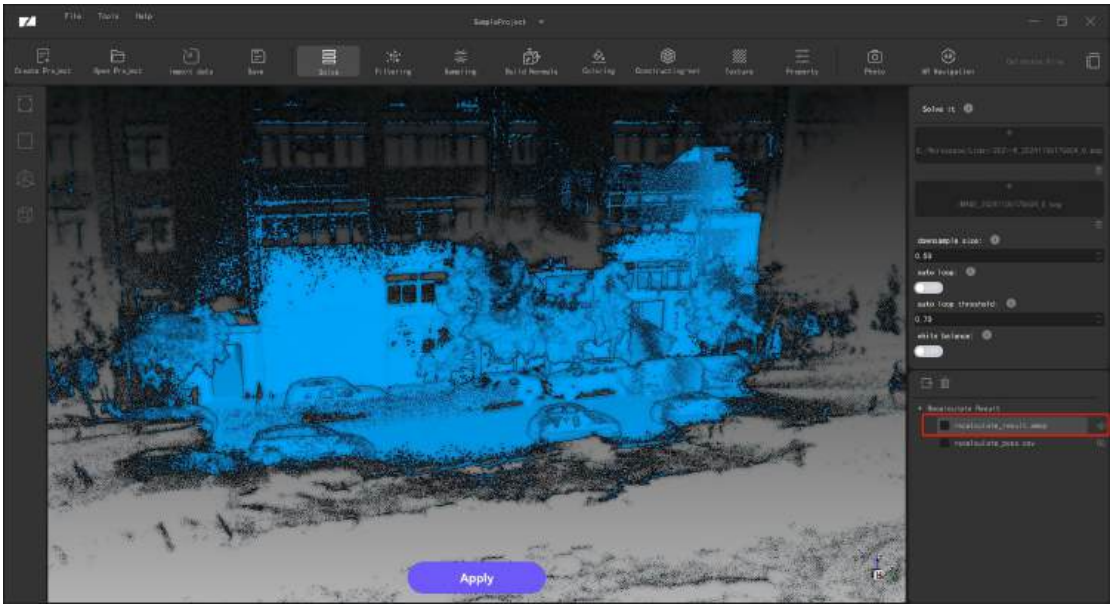
4) After selecting Lidar and Image data, click the "Apply" button to perform data analysis.



5) Waiting for the solution to be completed.



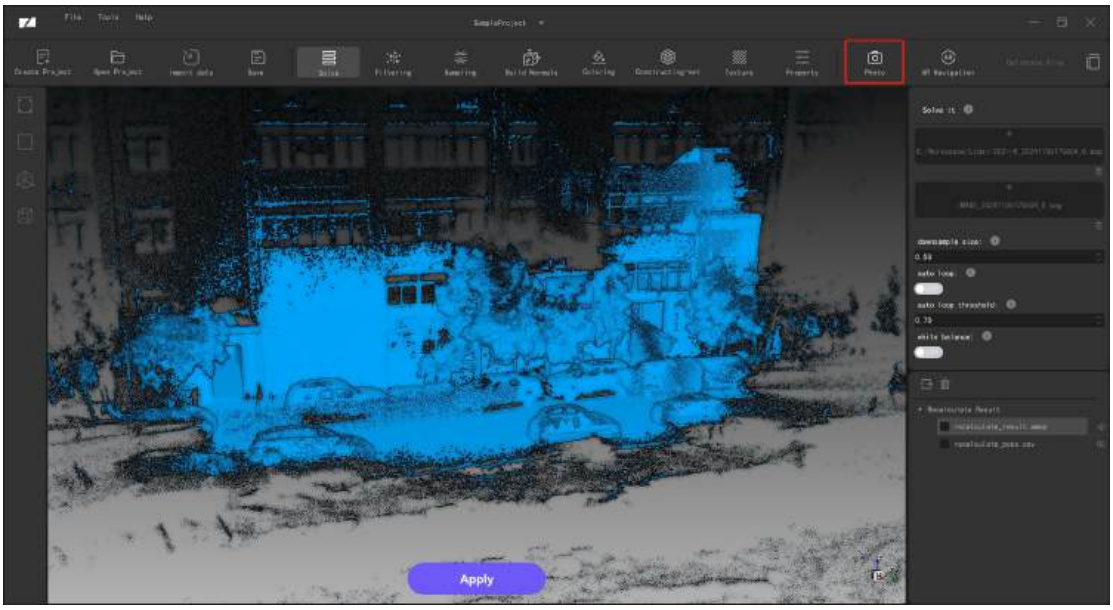
6) After the calculation is completed, use the engineering bar and buttons in the upper right corner of the software to view or hide the point cloud data.

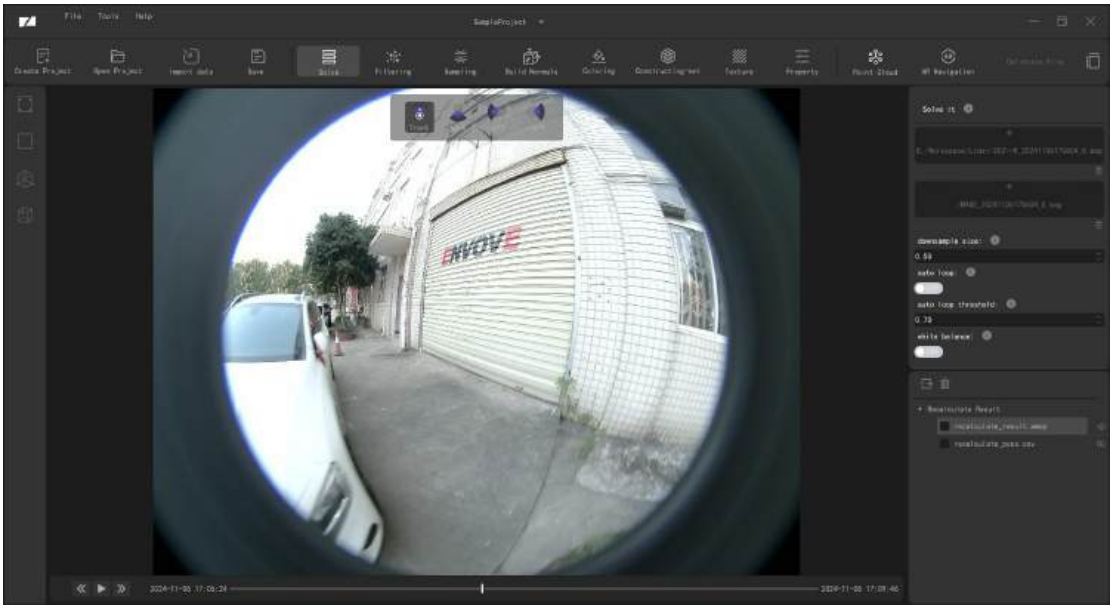


7) Click the

and

buttons above the software to switch between viewing point cloud or photo data on the main map.



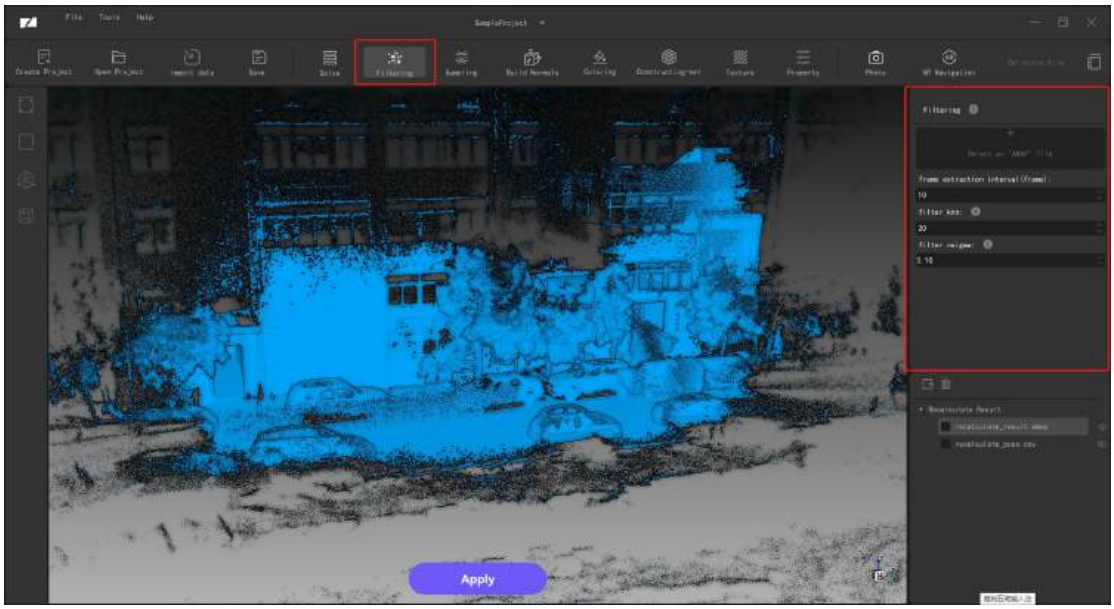


4.6. Filtering

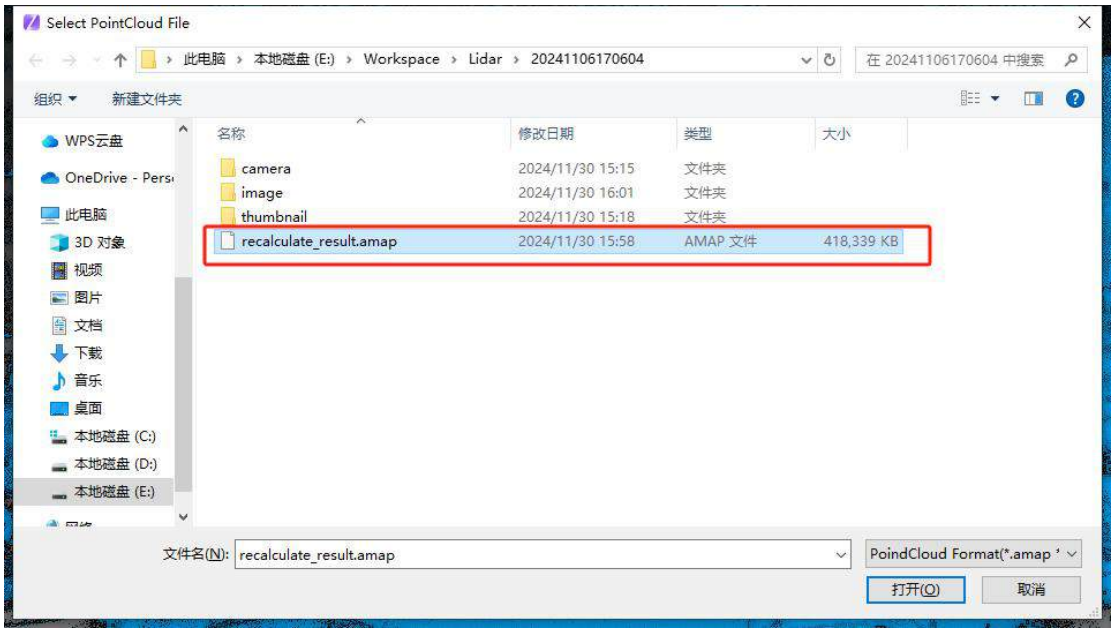
The main function of point cloud filtering is to remove noise and outliers from point cloud data, in order to improve the quality and accuracy of subsequent processing. When obtaining point cloud data, unexpected noise and outliers may be present due to factors such as device accuracy limitations, human factors, and environmental conditions.

These noise points and outliers will have adverse effects on subsequent processing steps such as registration, feature extraction, surface reconstruction, and visualization. Therefore, as the first step of preprocessing, point cloud filtering can significantly improve the effectiveness of subsequent processing by removing these noise points and outliers.

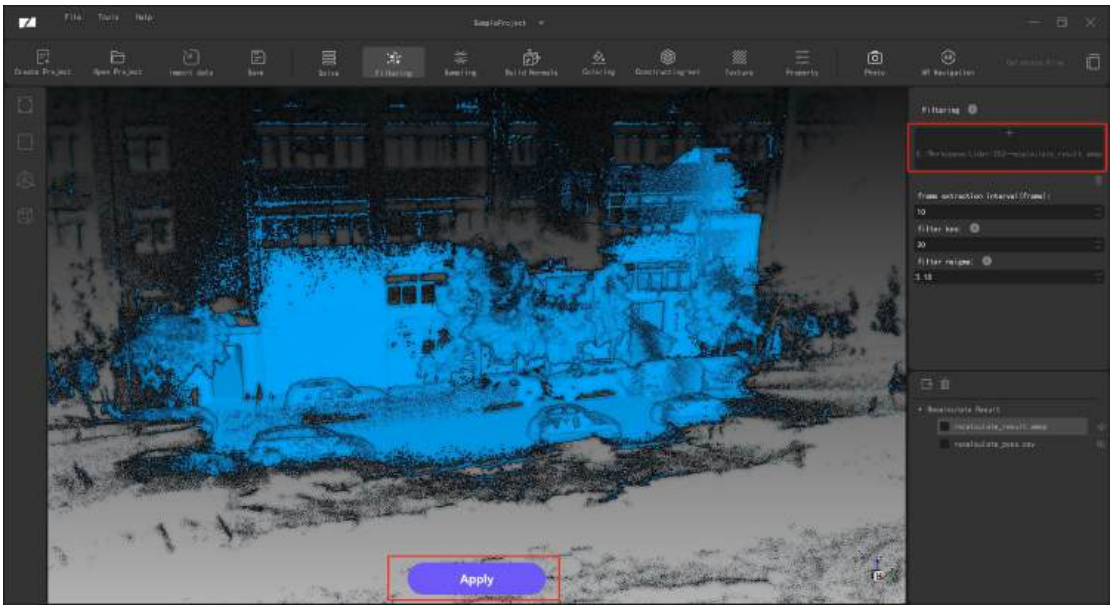
1) Click the "Filtering" button on the top of the RayStudio software, and the right operation bar will enter the Filtering sub item page.



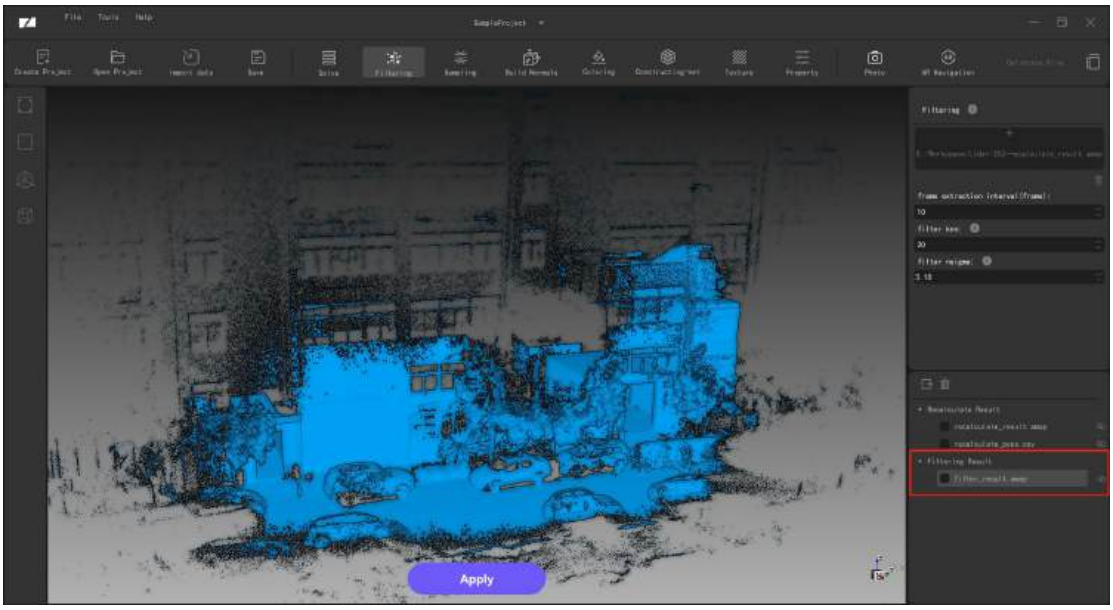
2) Click the "Select AMAP" button in the "Filtering" operation bar on the right, and select the AMAP point cloud file generated by "Solve" in the project directory.



3) Click the "Apply" button below the main map to perform filtering calculations and wait for the filtering calculations to complete.



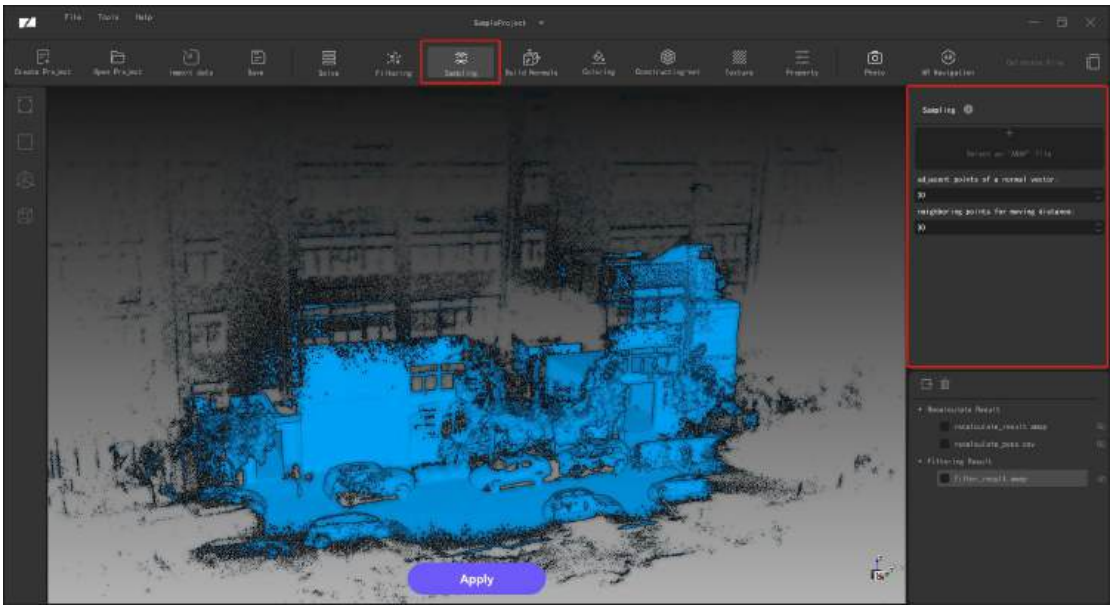
4) After completing the point cloud filtering calculation, you can select to view the filtered point cloud data in the engineering bar at the bottom right corner of the software.



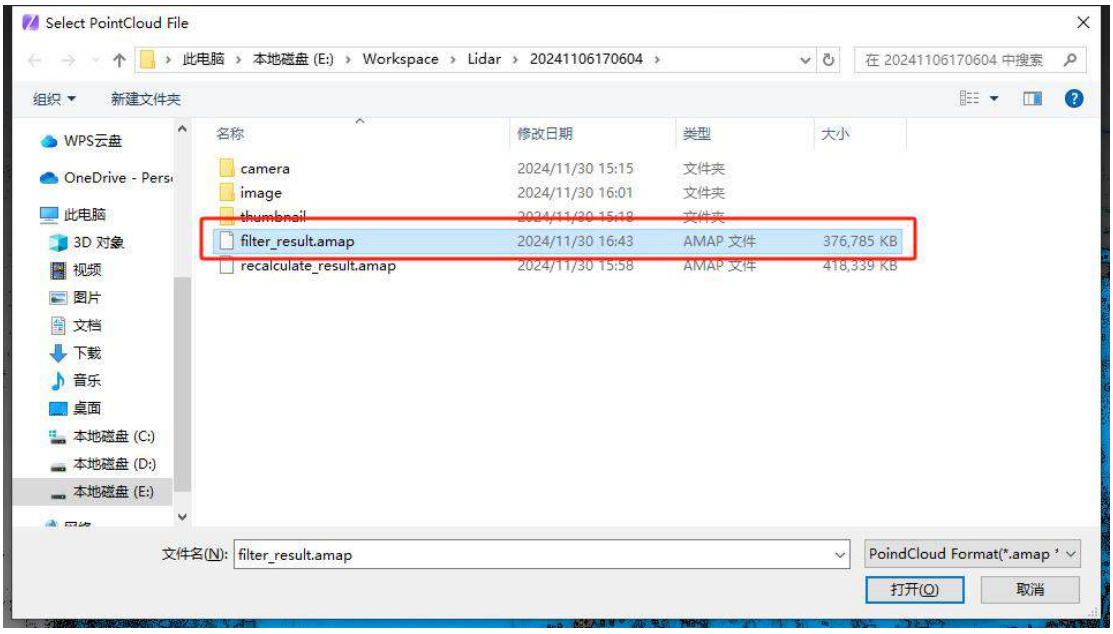
4.7. Sampling

Point cloud thinning provides strong support for the subsequent processing and analysis of point cloud data by reducing data volume, improving feature extraction accuracy, reducing fitting difficulty, optimizing visual effects, and saving storage space.

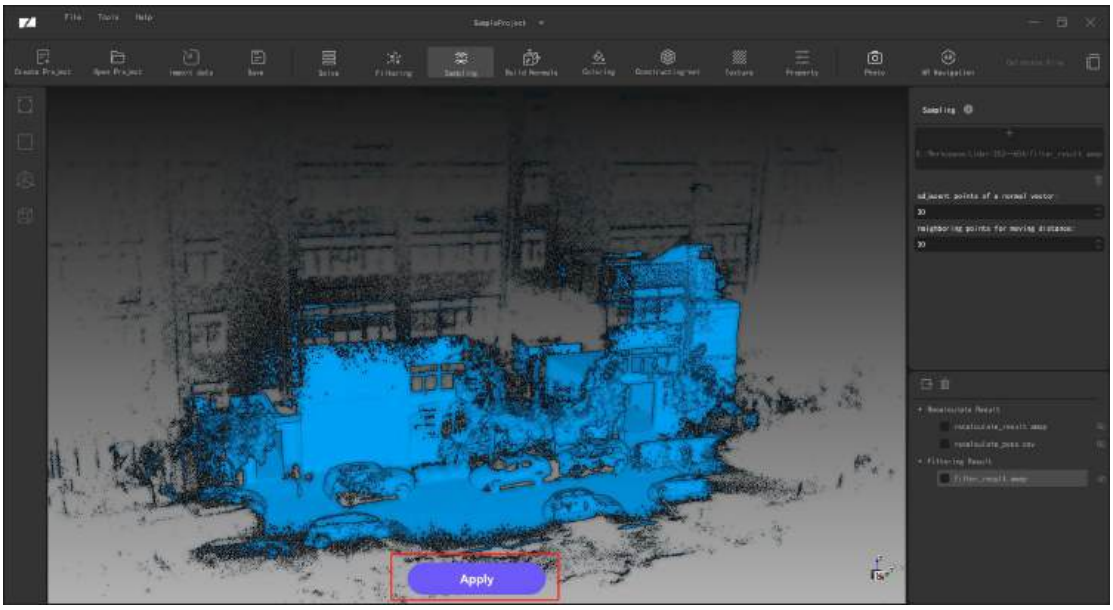
1) Click the "Sampling" button on the top of the RayStudio software, and the right-hand operation bar will enter the Sampling sub item page.



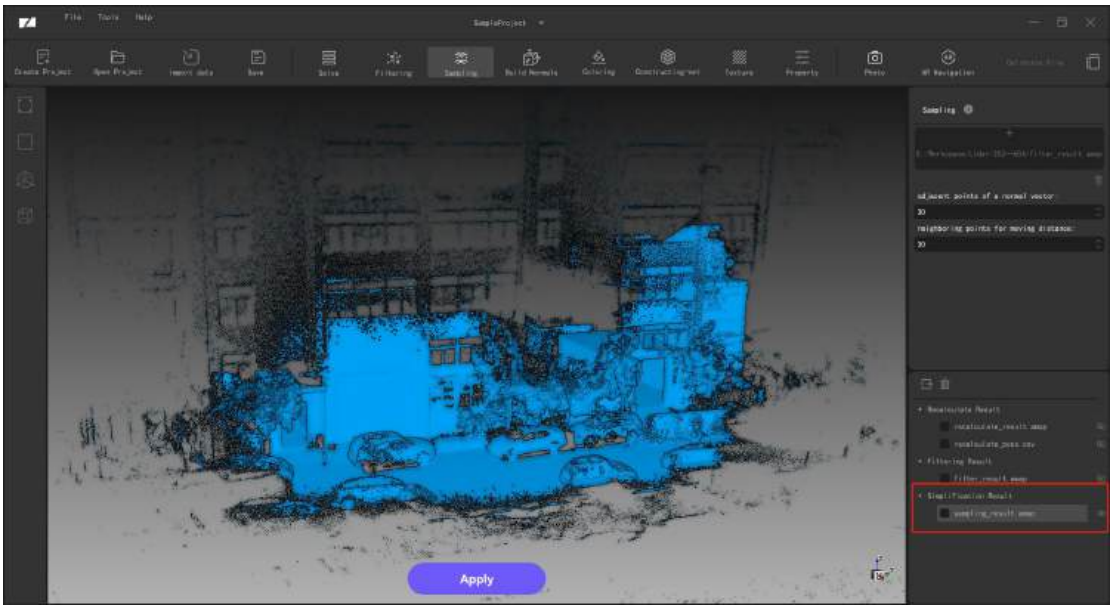
2) Click the "Select AMAP" button in the "Sampling" operation bar on the right, and select the AMAP point cloud file generated by "Filtering" or "Solve" in the project directory.



3) Click the "Apply" button below the main map to perform thinning calculation and wait for the thinning calculation to be completed.



4) After the point cloud thinning calculation is completed, you can select to view the thinned point cloud data in the engineering bar at the bottom right corner of the software.

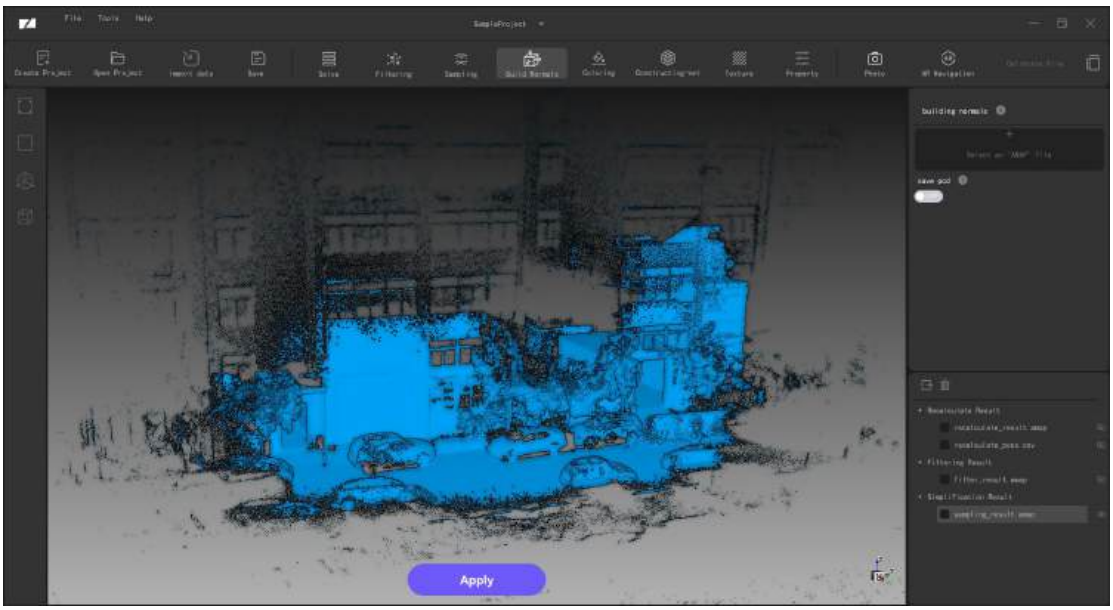


4.8. Normal vector

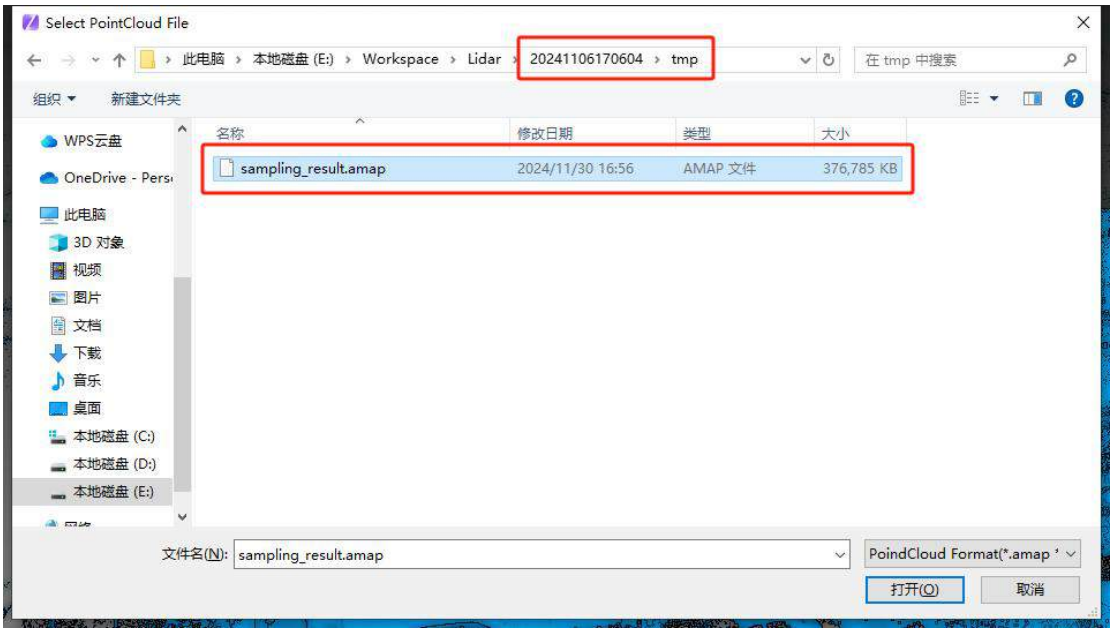
The normal vector is an important attribute of each point in a point cloud, which describes the directional properties of the surface on which

the point is located. By calculating the normal vector, geometric features such as orientation and curvature of the point cloud surface can be obtained, which is crucial for understanding the shape and structure of point cloud data.

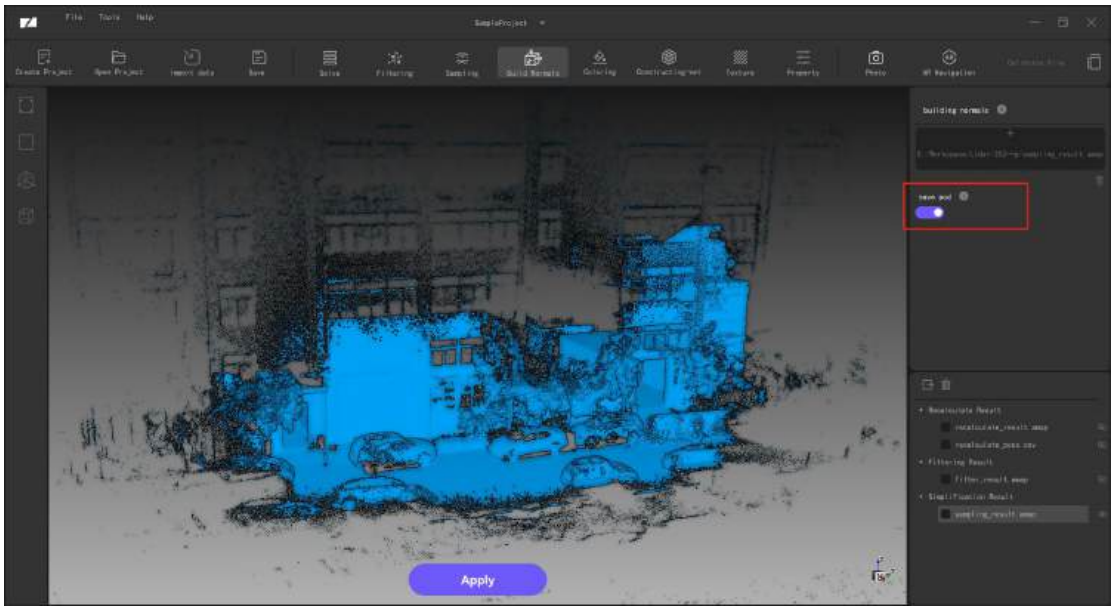
1) Click the "Build Normals" button on the top of the RayStudio software, and the right-hand operation bar will enter the Build Normals sub item page.



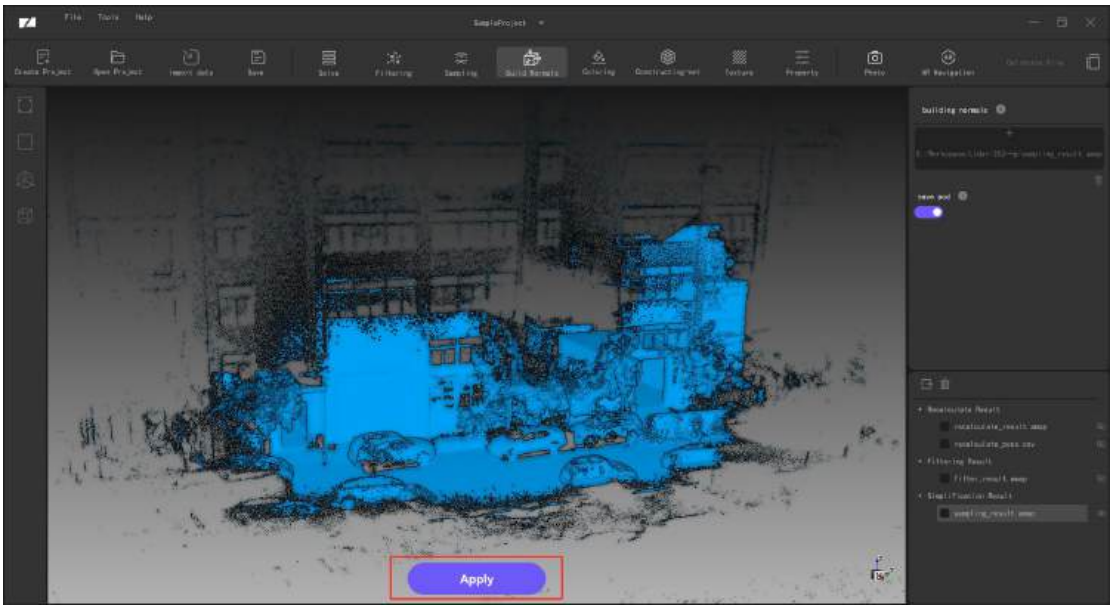
2) Click the "Select AMAP" button in the "Build Normals" operation bar on the right, and select the AMAP point cloud file generated by any step of "Sampling", "Filtering" or "Solve" in the project directory. Note: The amap data generated by the "Sampling" step is located in the "tmp" subdirectories of the project directory.



3) You can choose whether to turn on the 'save pcd' option. If this option is turned on, a point cloud file in pcd format will be generated.



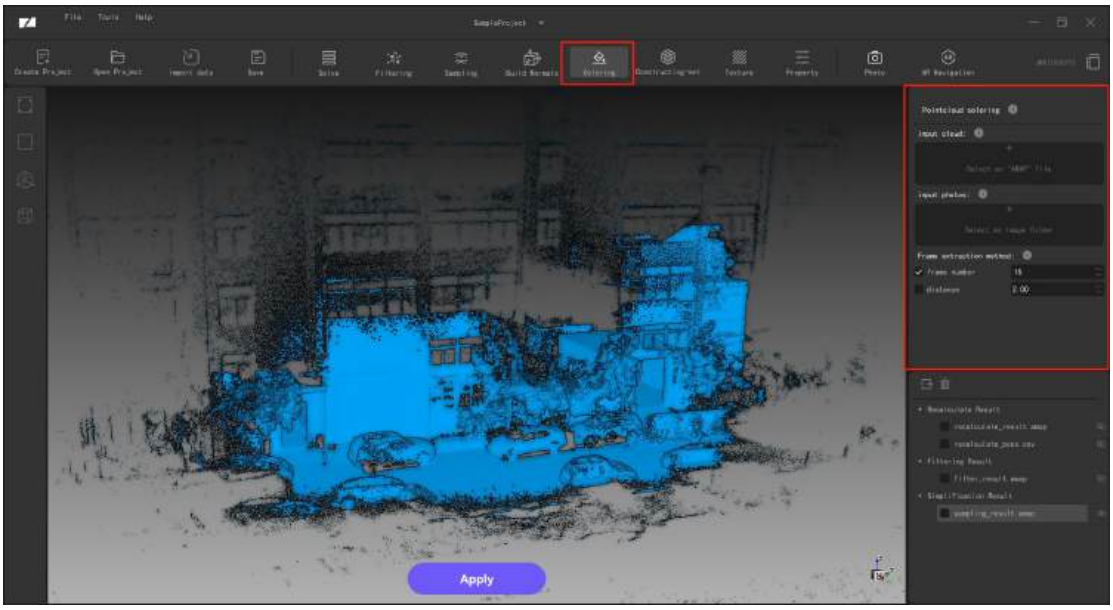
4) Click the "Apply" button below the main map to perform thinning calculation and wait for the normal calculation to be completed.



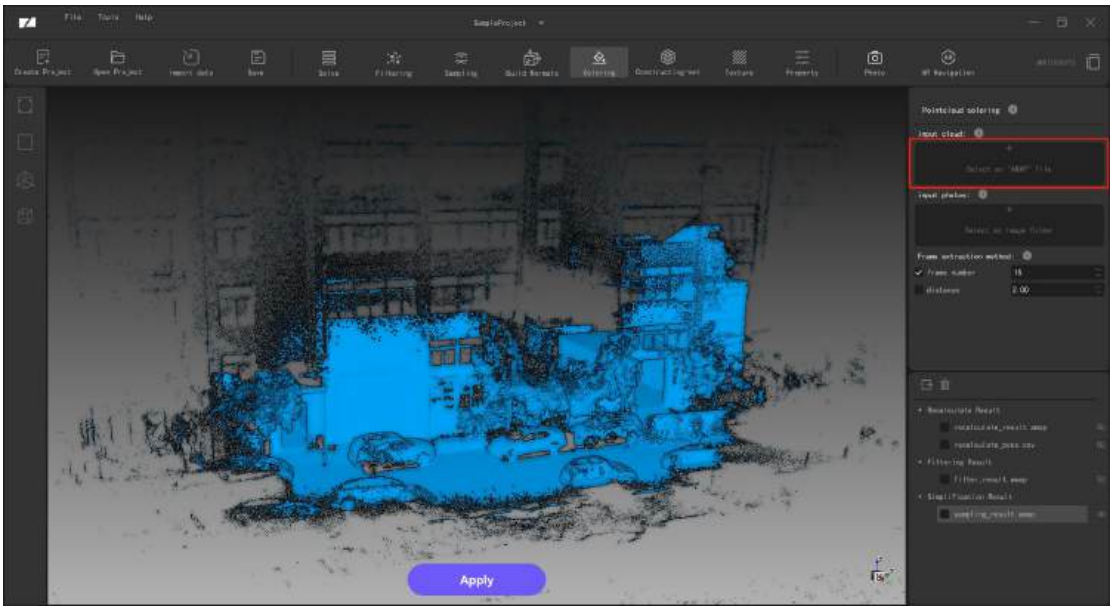
4.9. Coloring

Point cloud coloring can greatly enhance the visual effect of 3D datasets by assigning color values to each point in the point cloud. This coloring technique enables human observers to more easily identify and understand complex data structures. In point cloud data, color not only provides aesthetic pleasure, but more importantly, it helps distinguish different objects, surfaces, and features, thereby improving the readability of the data.

1) Click the "Coloring" button on the top of the RayStudio software, and the right-hand operation bar will enter the Pointcloud coloring sub item page.

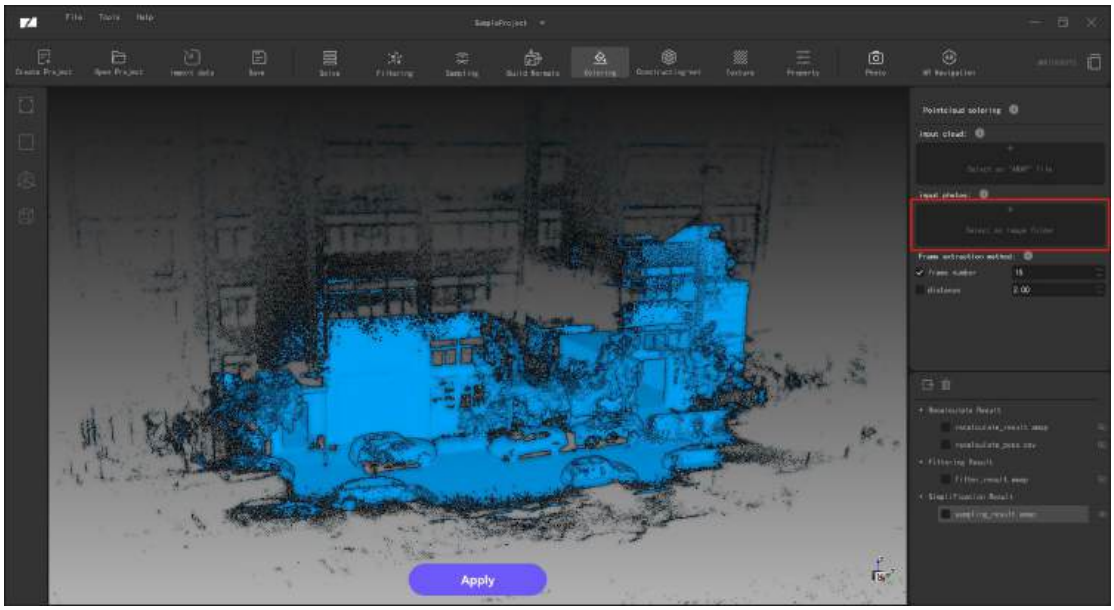


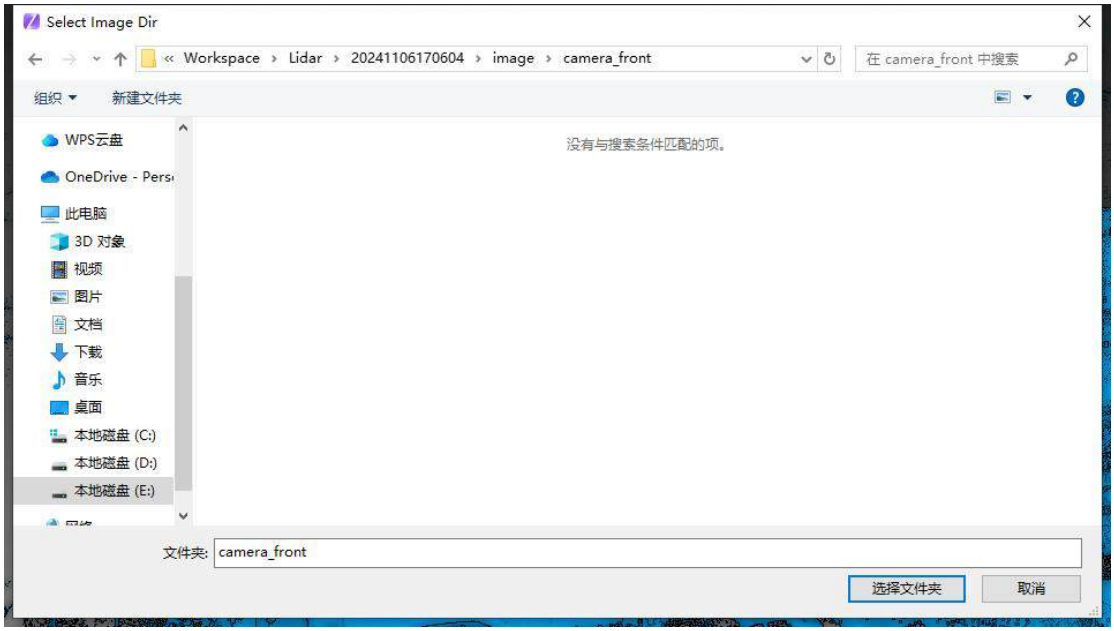
2) Click the "Select AMAP" button in the "Pointcloud coloring" operation bar on the right, and select the AMAP point cloud file generated by any step of "Sampling", "Filtering" or "Solve" in the project directory.



3) Click the "Select Image" button on the "Pointcloud coloring" operation bar on the right, and select the "image/camera_front" directory under the project directory. Note: Point cloud shading

currently only supports shading of front camera photos.





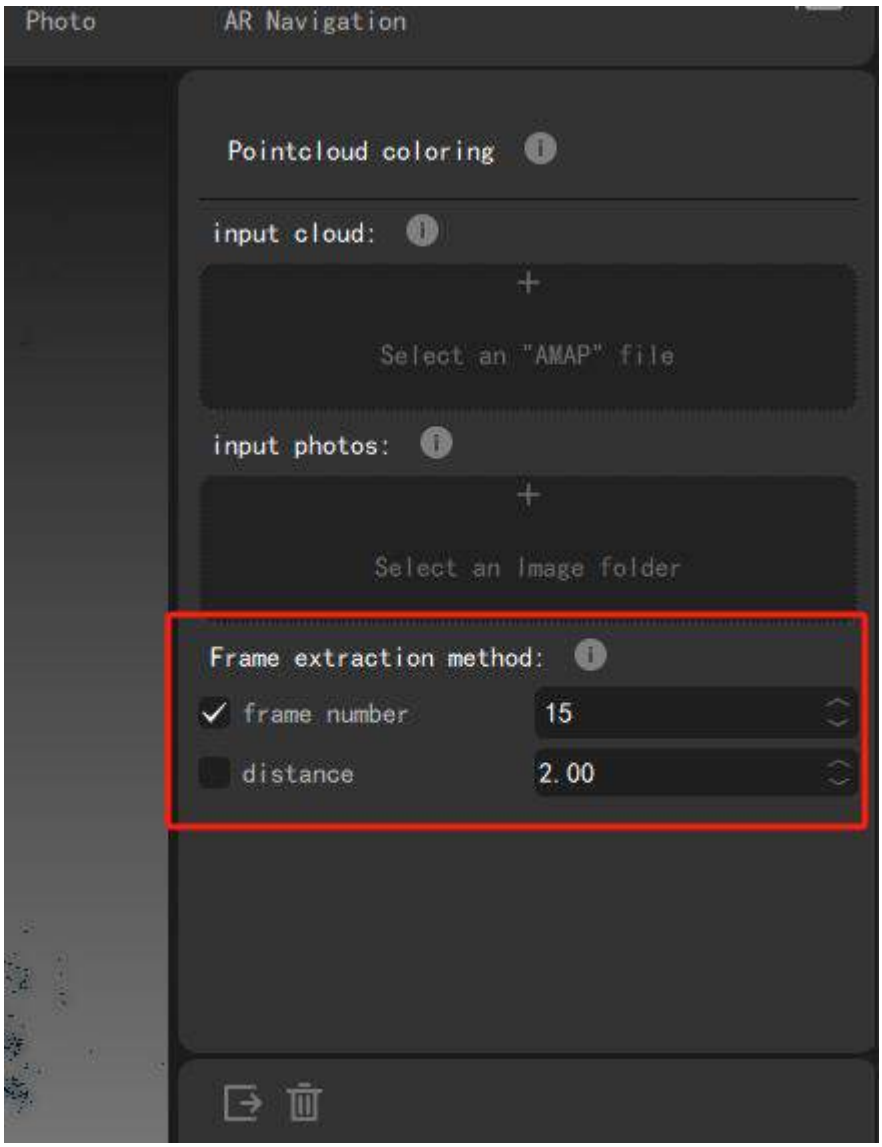
4) Modes:

The selection of shading mode can be flexibly chosen between the "frame number" and "distance" modes.

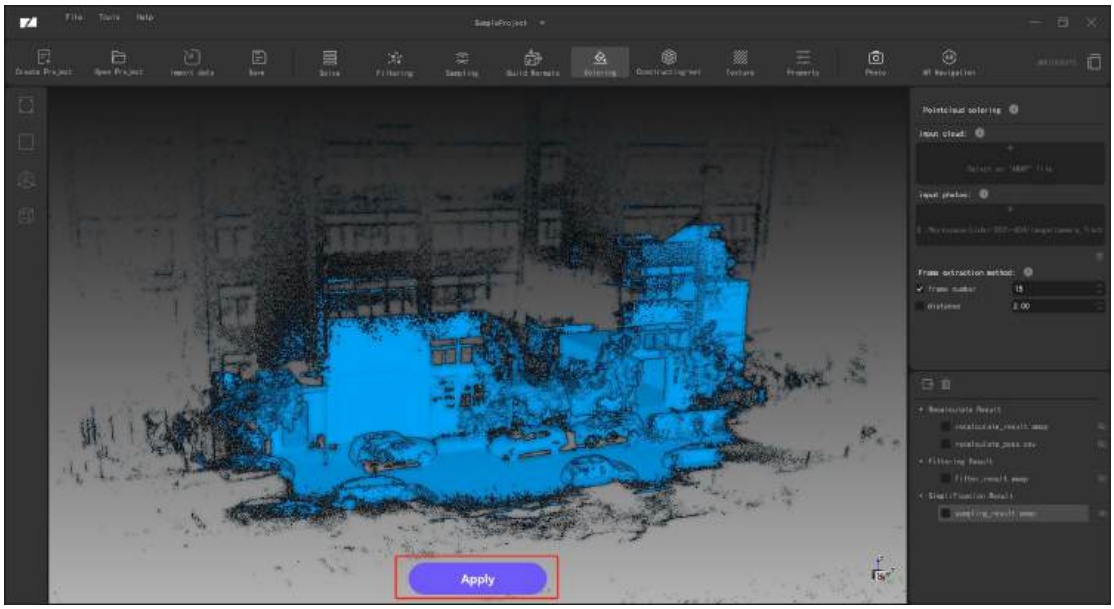
In the "frame number" mode, users need to specify a frame number range, and the system will extract one frame from the photo frames within this range for shading calculation. It is worth noting that the

smaller the frame number specified, the greater the total number of photos covered, for more detailed shading processing.

In the "distance" mode, coloring calculations are sampled based on the collected odometer data. Users need to set a distance threshold in meters, and the system will extract corresponding photo frames from the odometer data for coloring based on this threshold. In this mode, the smaller the distance value set, the more photos need to be used to ensure the accuracy and coherence of the coloring results.

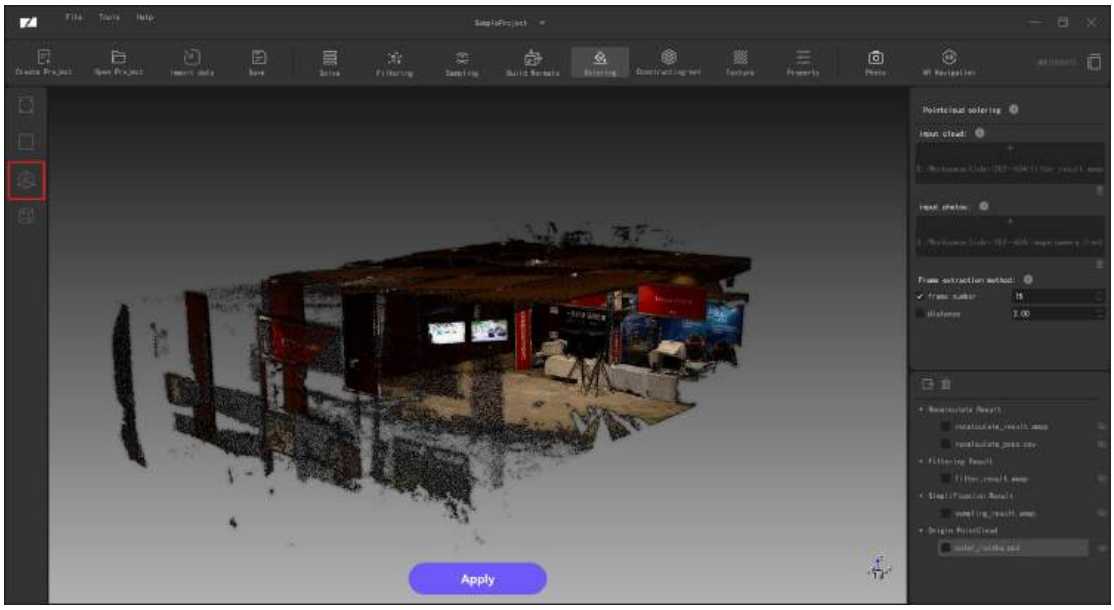


5) Click the "Apply" button below the main map to perform thinning calculation and wait for the point cloud shading calculation to complete.



4.10. Click Cloud Browse

The button on the left side of the main map can switch the point cloud browsing perspective, which defaults to a third person perspective; Click the select button to switch to the first person roaming perspective.



1) Third person perspective:

By pressing the left mouse button and moving the mouse accordingly, users can achieve rotation control of 3D point cloud data. This operation allows users to observe and analyze point cloud data from any angle.

Double click the left mouse button, and the system will capture this action and determine a new 3D rotation center point based on it. This feature provides users with more flexible means of adjusting their perspective, making it easier to focus on specific areas or objects in the point cloud.

By scrolling the middle wheel of the mouse, users can easily zoom in and out of the 3D point cloud. This feature allows users to adjust the display scale of point clouds as needed, in order to view details or overall structure more clearly.

Press and hold the middle mouse button, then move the mouse to

achieve the translation operation of the 3D point cloud. This operation allows users to pan point cloud data while maintaining the current perspective, making it easier for users to observe and analyze point clouds from different positions.

2) First person perspective:

The first person roaming perspective provides comprehensive spatial navigation and perspective adjustment functions, and the specific implementation method is as follows.

In terms of navigation, users can perform forward, backward, left, and right translation operations through the "W", "S", "A", and "D" keys on the keyboard, which form the standard WASD control system, allowing users to move freely in the virtual environment.

The direction control of the perspective relies on the coordination of the mouse and left button. When the user presses the left mouse button and moves the mouse, the system will adjust the heading angle in real-time based on the mouse's movement trajectory, thereby changing the user's observation direction.

The adjustment of roll angle is achieved through the "Z" and "C" keys on the keyboard, which are used to increase and decrease the roll angle, that is, the rotation angle around the vertical axis. This function helps simulate the visual effect of tilting or flipping.

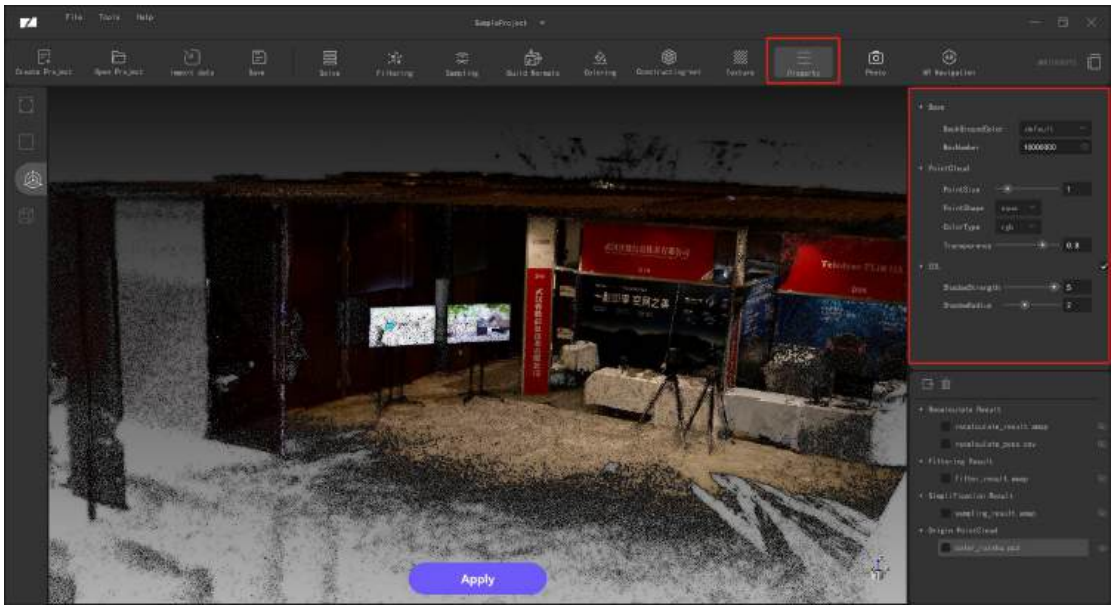
The "R" and "F" keys are used to adjust the pitch angle, allowing users to simulate the movement of looking up or down.

The adjustment of the viewing angle height is achieved through the "Q" and "E" keys on the keyboard, which are used to raise and lower the viewing angle height respectively, thereby changing the user's vertical viewing angle of the virtual environment.

The "↑" and "↓" keys on the keyboard are used to adjust the step values of the navigation and viewpoint adjustment operations mentioned above, that is, to control the displacement or angle change of each operation. This function enhances the user's ability to control the roaming speed and viewpoint adjustment amplitude.

4.11. Point cloud display settings

Click the "Property" button on the top of the RayStudio software, and the right operation bar will enter the Property sub item page.



BackGroundColor: Adjustable point cloud displays the background color of the main map.

MaxNumber: Adjustable maximum number of point cloud displays.

PointSize: The size of the point cloud display can be adjusted.