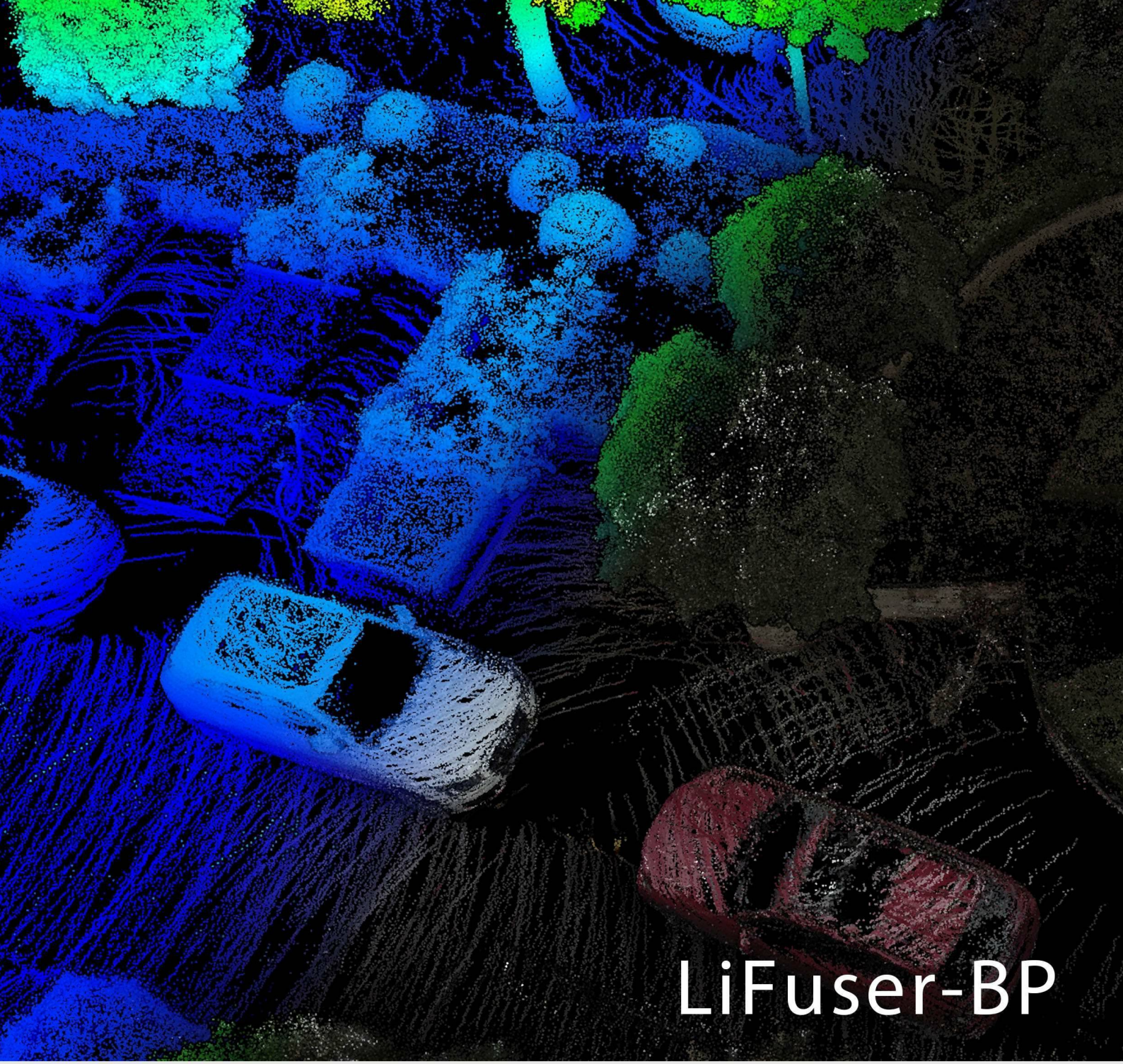


LiFuser-BP

LiBackpack Data Fusion Software

User Guide

GreenValley International

Copyright

GreenValley International

LiFuser-BP V1.1

User Guide

Imprint and Version

Document Version 1.1

Published by:

GreenValley International, Ltd.

Web: https://greenvalleyintl.com

Dear Users,

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

Legal Notes

Date printed: 13th April 2020

Introduction

LiFuser-BP is a data post-processing software designed for the GreenValley LiBackpack systems.

The main functions are listed below:

- High Accuracy Process
- GNSS Trajectory Process
- Visualization and Point Cloud Clip
- Point Cloud and Panoramic Roam
- Registration
- Cleaning Moving Objects

Other commonly used tools include:

- Project Management
- Measure Tools
- Profile Tools
- Batch Process Tools
- Viewing Tools
- Color Tools
- Select Tools
- Cut Tools
- Export Tools

Software Installation

Operation Environment

It is recommended to use a high-performance working equipment. The requirements are as follows

- **RAM**:16GB or above.
- **CPU**：Intel® Core ™ i5 / i7 is recommended; eight-core and sixteen-thread processors with single-core processing performance of 4GHz and above.
- **Hard Disk**：SSD is recommended with a transmission speed of 100M/s or above.
- **Display Adapter**: NVIDIA graphics card is recommended, video memory no less than 2GB.
- **System**：Microsoft Windows 7 (64-bit), Microsoft Windows 8 (64-bit), Microsoft Windows 10 (64-bit) or Windows Server 2012 and above.

> For Windows 8 and Windows 10 system, if the software is installed in the system disk, you need to run it in administrator mode. Note: Please enable high-performance graphics mode when running the software.

Installation

1. Launch LiFuser-BP installation wizard.
2. Click next step.
3. Click "I agree" to proceed if you agree with the license aggreement.
4. Choose installation path (or accept default path), and click "install".
5. Click "Finish".

License

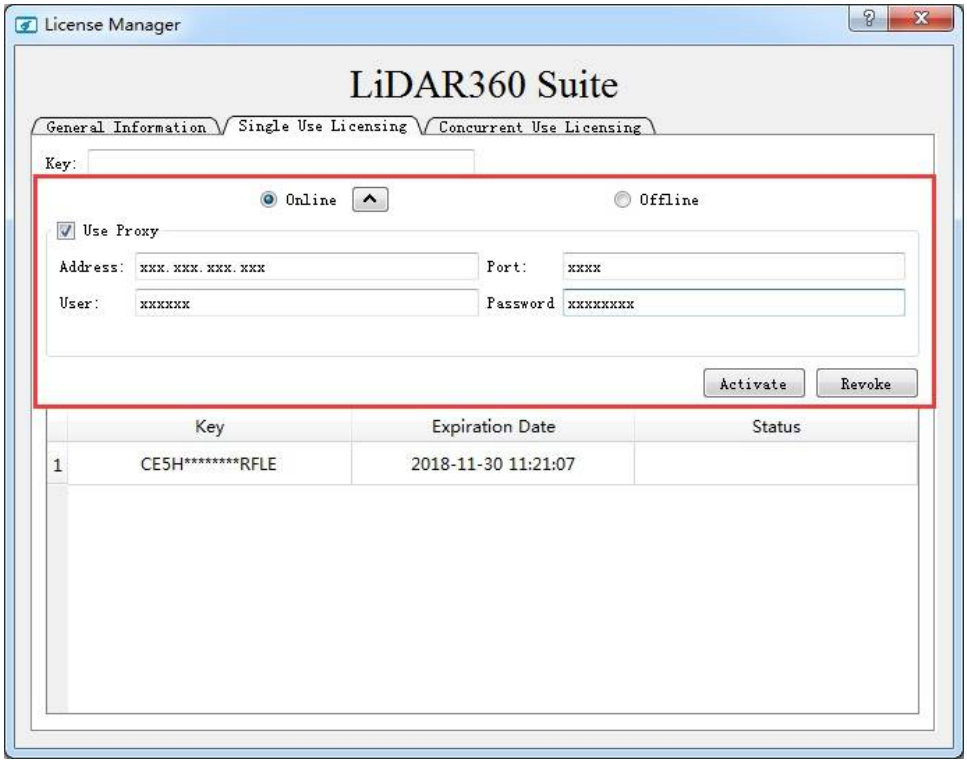
LiFuser-BP accepts two kinds of licenses: Hard lock and soft lock. Hard lock provides USB drive while soft lock provides license key. As for hard lock, users should keep it safe and are not allowed to performe some operations including format/delete/copy.

1. Hard lock license LiFuser-BP can detect hard lock license at real time. Users need to plug in the USB drive into the port.

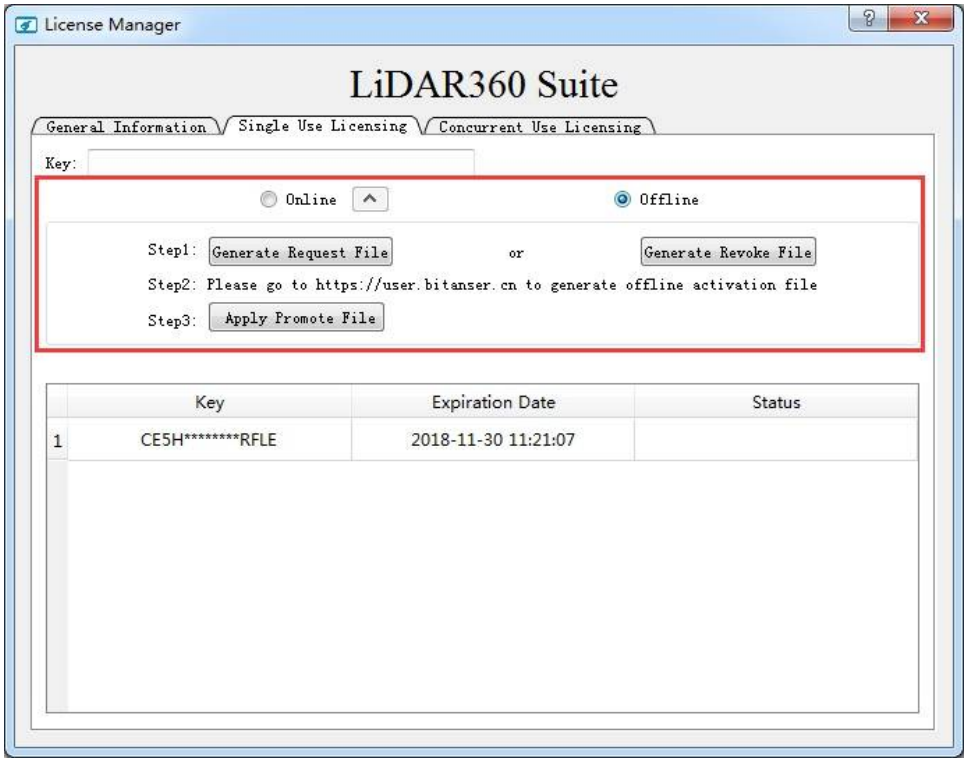
2. License key

In **License Manager**, under **General Information**, type in **Name**, **Company**, and check **LiFuser-BP**. Click **Copy**, and email the copied information to info@greenvalleyintl.com.

- Single Use License
    - Activation/Update
      Online Activate/Update: When having networking, enter the key under Single Use License tab, select "Online", and click "Activate". Users can check valid date in basic information module. If you need to use proxity, click  , and set address, port, user name and password of the proxy in the corresponding blanks.



Offline Activatin/Update: Enter the key under Single Use License tab, select "Offline", and click "Generate request file"(.req). Use a computern with internet access, type https://user.bitanswer.cn in an internet browser, enter the license key to log in and click "Offline update". Upload .req file, and then a file named as "download.upd" will be generated. Download the "download.upd" file and click "Apply license file" in License manager page to activate/update the license.



> Note: If software is already launched when license code is updating, please reopen it after updating is finished.

> Note: If the license key has already been used in a machine, users should unbound it before licensing another machine. If the license key has been deleted, users should activate it before unbounding.
>
> Note: Please contact info@greenvalleyintl.com for pricing and buying the license key.

Create/Open Project

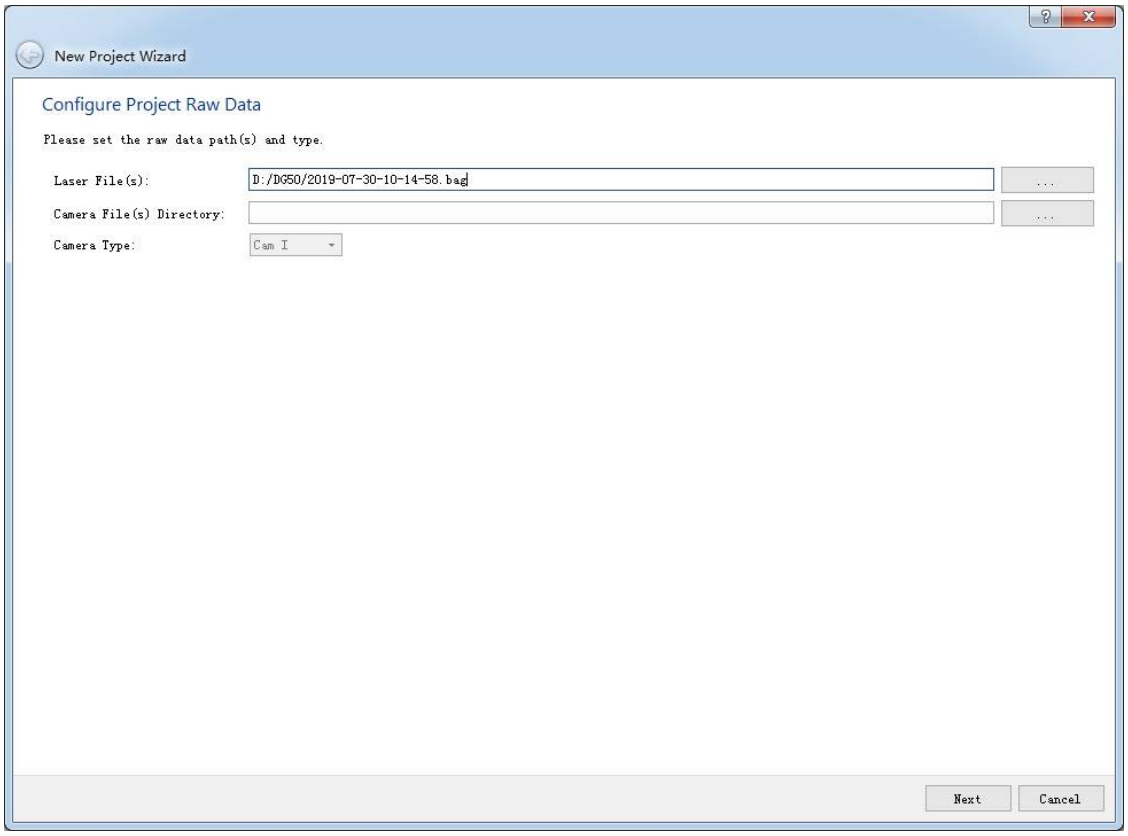
Before starting to process the data, it is strongly recommended that the data collected by LiBackpack are put in the computer's local disk, with a specific working directory. It's better to use letters and numeric characters as directory name, for example, "LiBackpackData00".

Create project

New Project Wizard includes 4 interfaces: Configure Project Raw Data, GNSS data, Coordinate System and Open Trajectory. Each one is used to configure corresponding data. Invalid data or configuration in any step will make the process be unable to processed. When project is finished, users can also set parameters in SLAM Process. Each step is explained as below:

Configure Project Raw Data

Launch the software, select **New**, click *Backpack* , and the Configure Project Raw Data interface will appear:



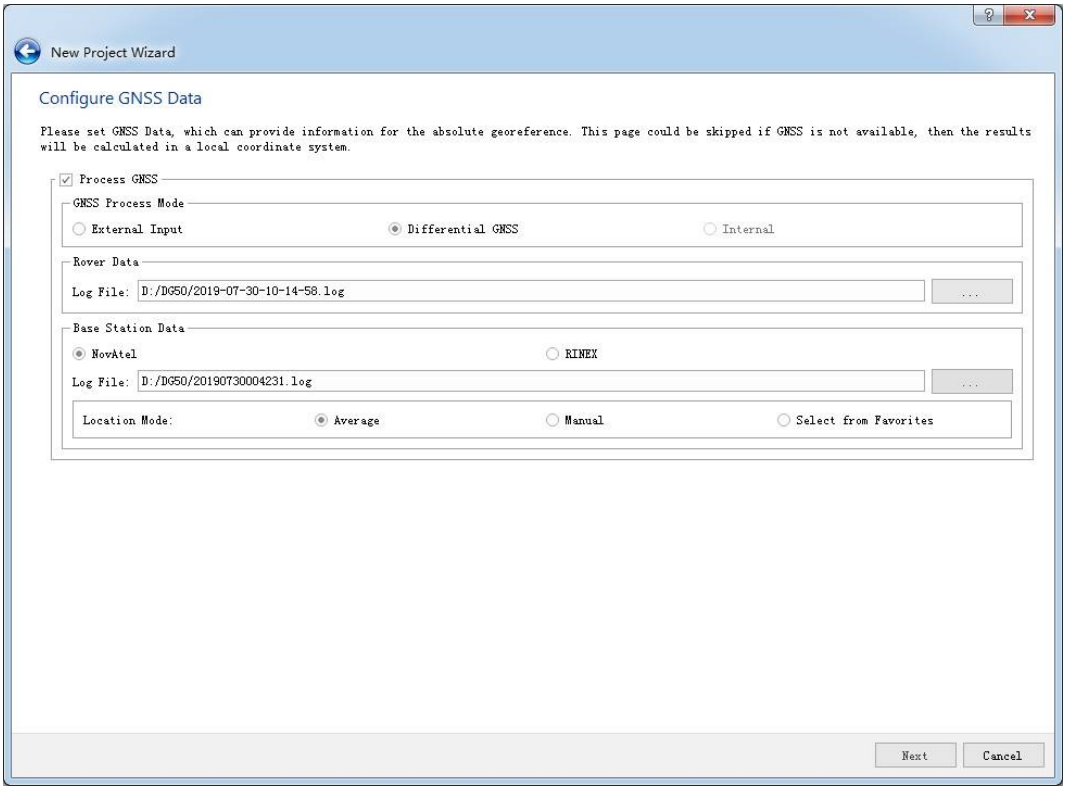
Configure Project Raw Data

- **Laser Files**：The raw data (.bag) collected by LiBackpack can be downloaded from the Collection Interface. Click the button on the right side and import the .bag file required.
- **Camera Files Directory**（**Optional**）：Directory of .mp4. It's an optional setting. Take LiBackpack C50 for example, if users want to solving point clouds data with RGB information，then select the directory where .mp4 is saved.
- **Camera Type**：Camera Type.

Configure GNSS Data

This step is only designed for a LiBackpack equipment with GNSS function, like LiBackpack DG50. Users can skip this step if there is no GNSS data. The configuration of GNSS data includes 3 ways: External Input, Differential GNSS and Internal.

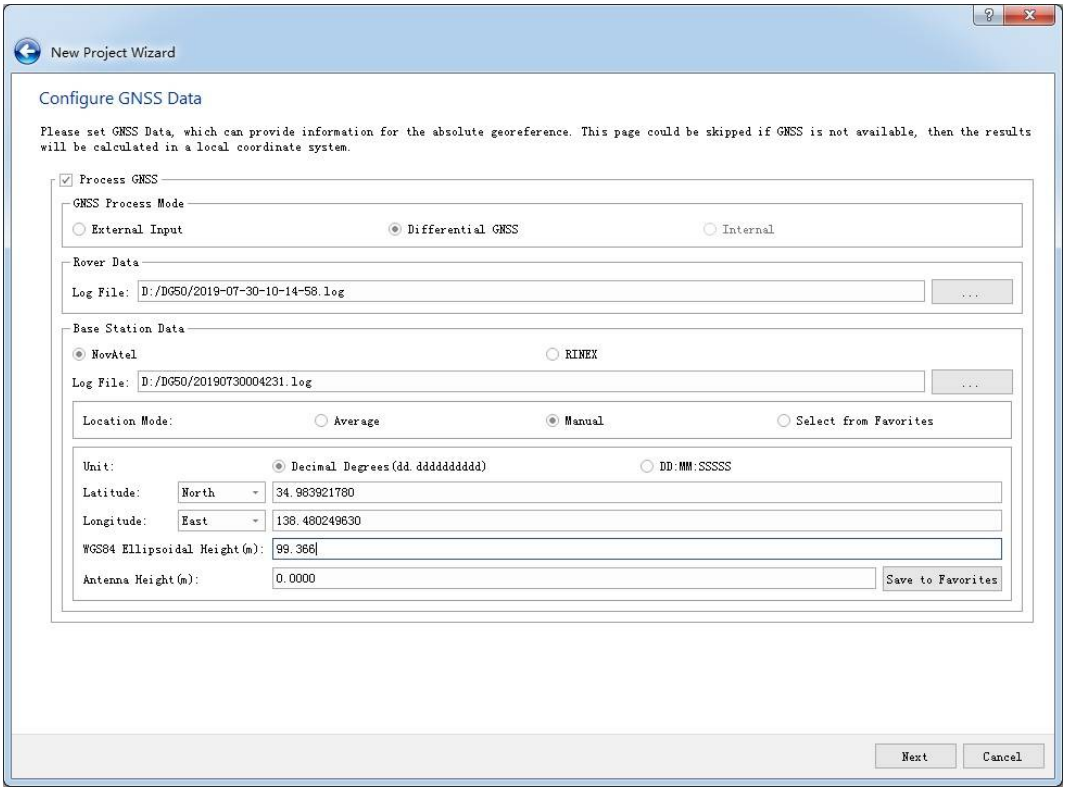
- **External Input**：Import trajectory file that already existed. For now, only .LiGNSS file is accepted. Check **Process GNSS**. Click **Extrnal Input** button after that page will go to external input mode. Choose responding tracjory file by click right button. When it is done, go to next step.
- **Differential GNSS**. Then the page will process Differential GNSS Model, in which users need to configure data of both base and mobile station. The solving result will be generate as .LiGnss.
    - **Rover Data**：Mobile station data (.log) acquired by LiBackpack. Click the button on the right to choose.
    - **Base Station Data**：Two formats, NovAtel and RINEX.
        - **NovAtel**：Suitable for NovAtel base station.
        - **RINEX**：Suitable for base station data that have been transformed into common format. Click the button on the right side and select the base station file (RINEX OBS). If the file is loaded normally, the software will automatically add in the rest files (NAV、GNAV、CNAV) according to its format. It should be noted that OBS and NAV are mandatory file while others are optional. Users need to check if files are added in correctly, if not, modify manually.



Configuration GNSS NovAtel

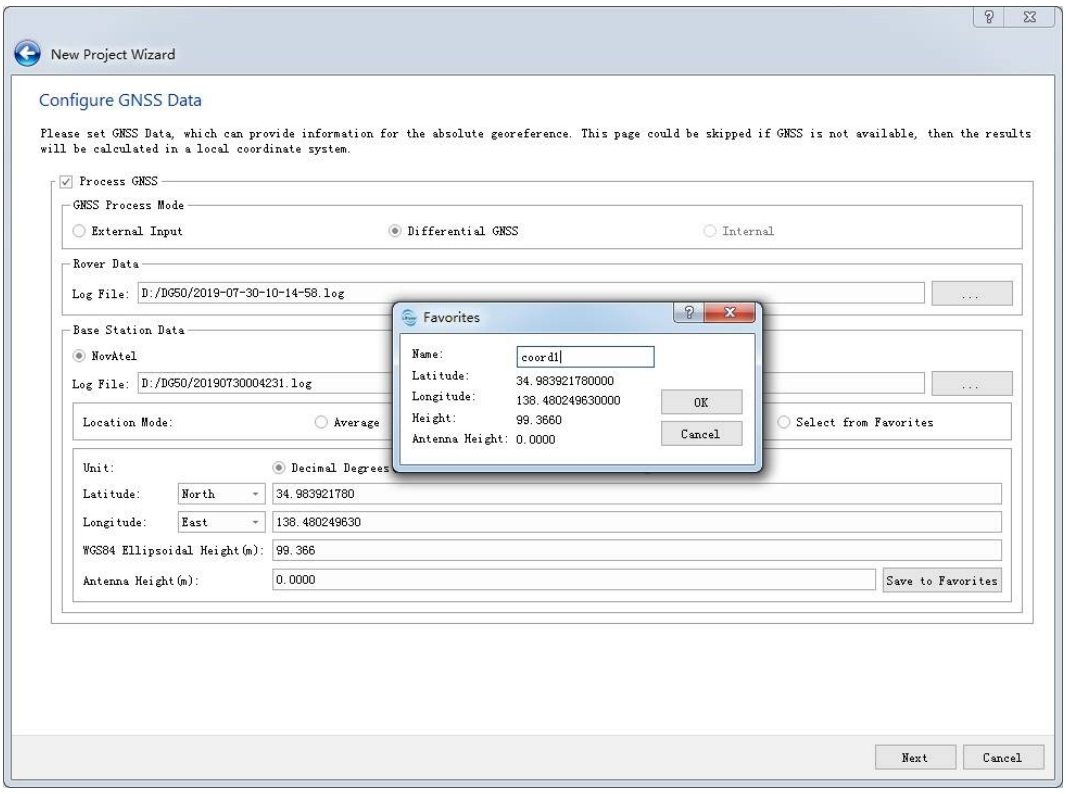
- **Location Mode**：Base station coordinates solving mode.
    - **Average**：Calculate averagely. Default mode when choose NovAtel.
    - **From Head**：Read from head file. Default mode when choose RINEX.
    - **Manual**：Add base station coordinates manually. Enter WGS84 coordinates, Ellipsoidal height and antenna height. Latitude and longitude values should be positive. If real latitude values is positive, select North(otherwise select South); if real longtitude values is positive, select East(otherwise

select West).Steps are shown below:



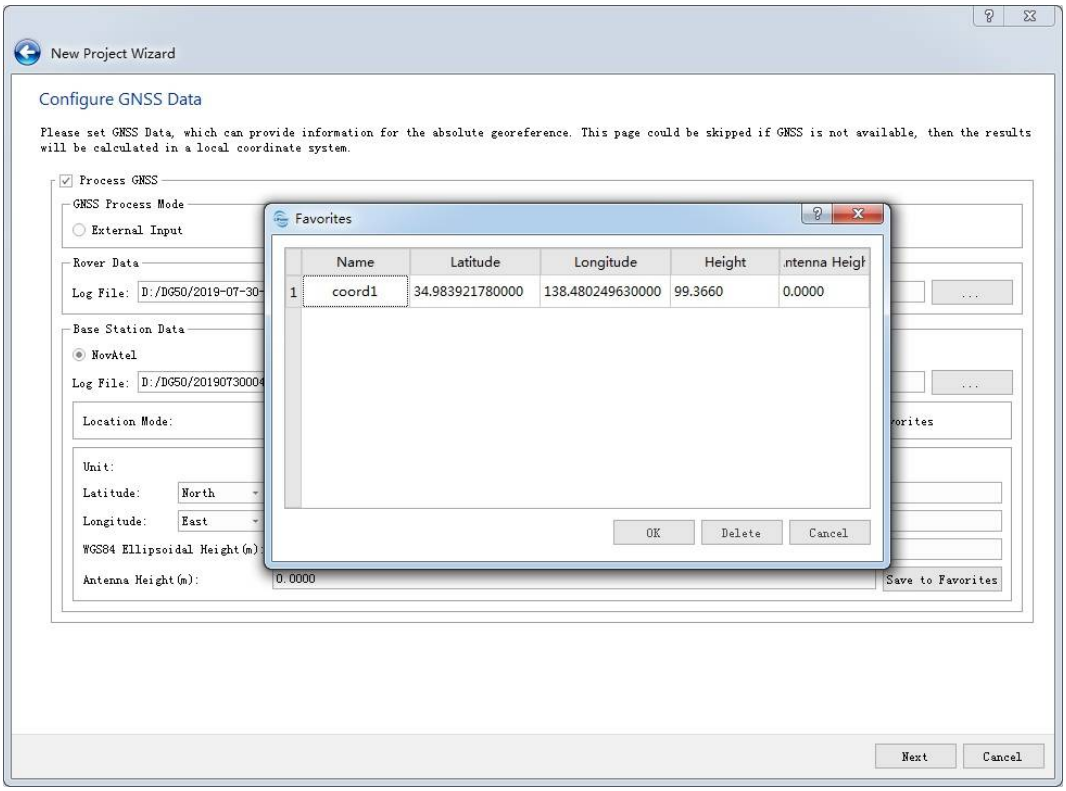
Add base station coordinates manually

Click **Save to Favorites** to save the current base station coordinate parameters:



save base station coordinate

- **Select from Favorites**：Select base station coordinates from favorite list. List is empty when first time using. And users need to manually enter and save their own base station coordinates under **Manual** mode.



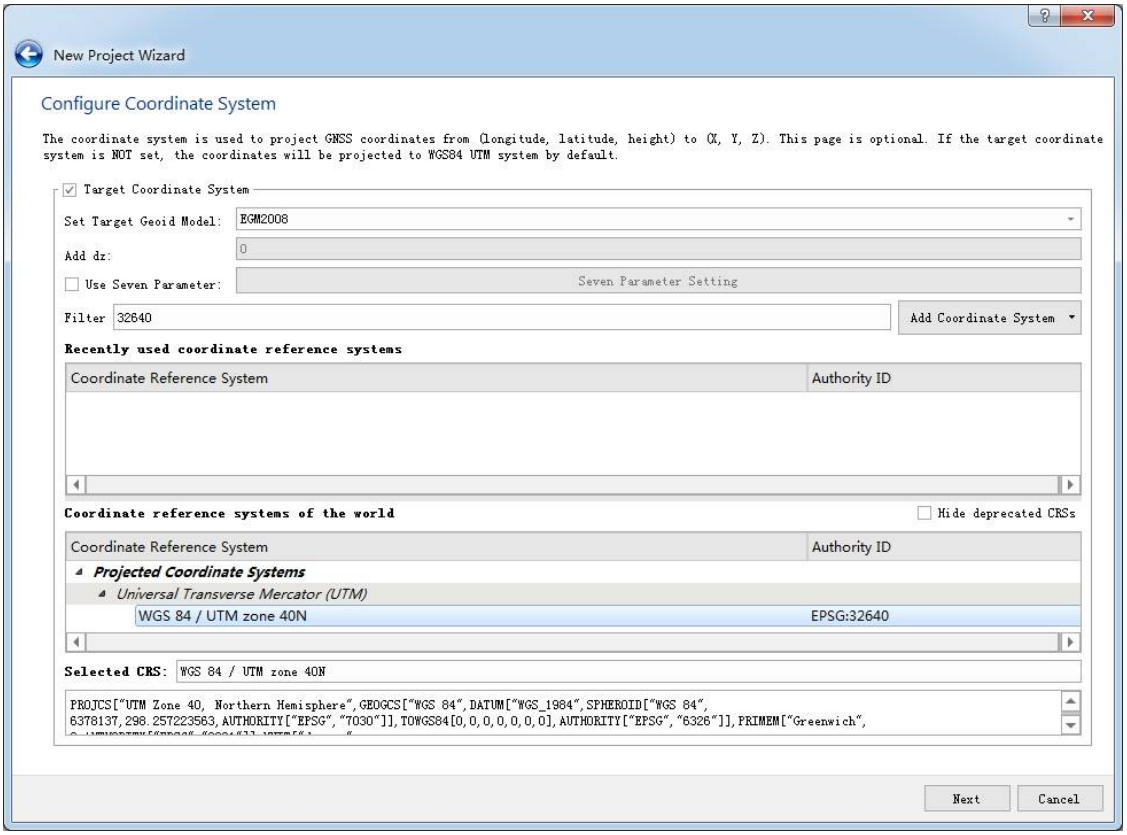
Select from favorite list

- **Internal**：Only show GNSS trajectory file directory used internally. When the wizard process is finished, if there does exist an internal trajectory file, the choice will be activated. Meanwhile, external trajectory file directory will be cleared.

Set Target Projection Coordinate System

Set coordinate system can reproject POS file imported or generated at the last step. If there is no GNSS data, users can skip this page. If **Target Coordinate System** is unchecked, the solving results will be transformed into UTM 6 degree zone with the WGS84 datum by default.

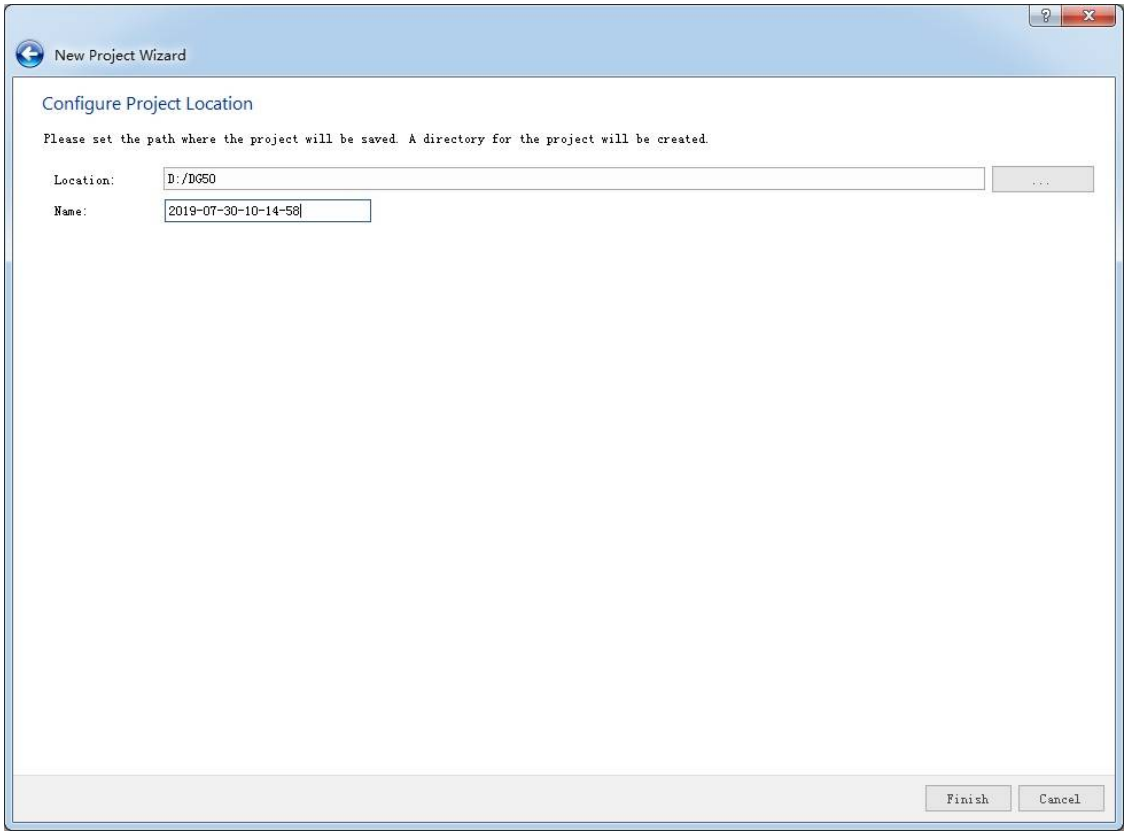
- **Set Target Geoid Model**：Users can select **EGM2008**、**EGM96**、**EGM84** and **Custom**，default setting is "None", i.e. no conversion.
- **Add dz**：z change value. Users can customize elevation change value when choose "custom".
- **Use Seven Parameter**：Click the button to set Seven Parameter.
- **Filter**：Select coordinate system to project data. Key words can help search quickly. Users can also import external coordinate system.
- **Hide deprecated CRSs**：Hide deprecated CRSs.
- **Selected CRS**：The CRS selected currently and its WKT text file.



Set Projection Coordinate System

Set Project Directory

Users can change project directory at the Configure Project Location page. The default diretory is where LiDAR files are saved, and the directory name is the same as the corresponding LiDAR file. Click **Finish** when finish project setting.

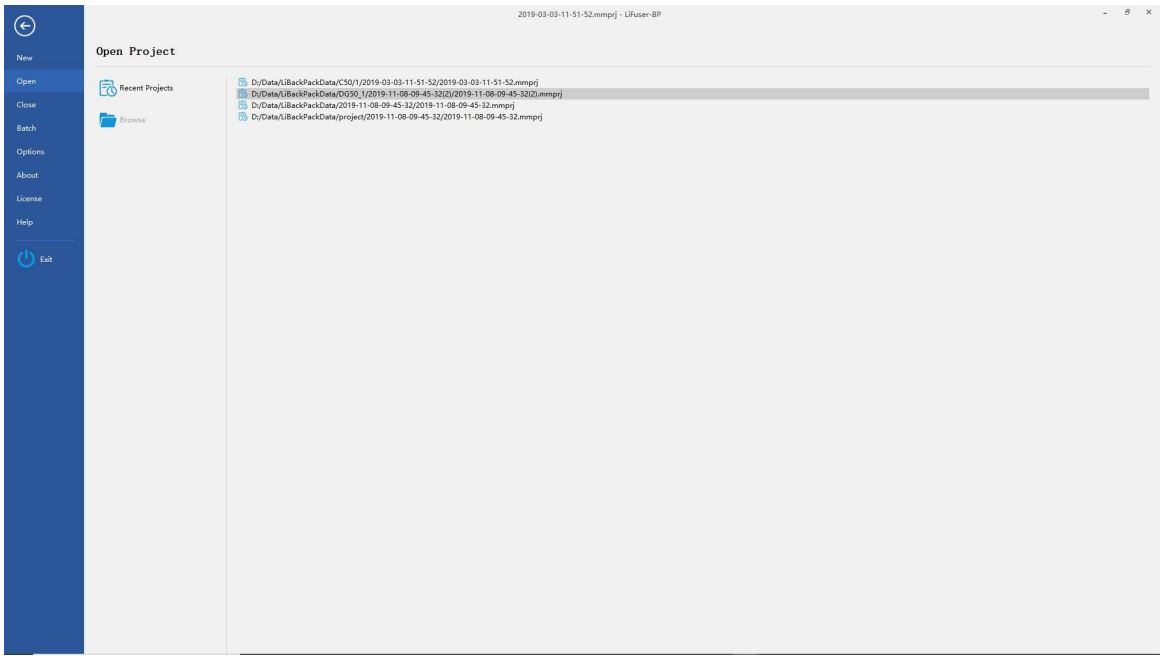


Set Project Directory

Open Project

Launch the software, click **Open**, select a recently saved project or open a project saved at a specific directory.

- **Recent Projects**：select a recently saved project.
- **Browse**：Browse a project at a specific directory.

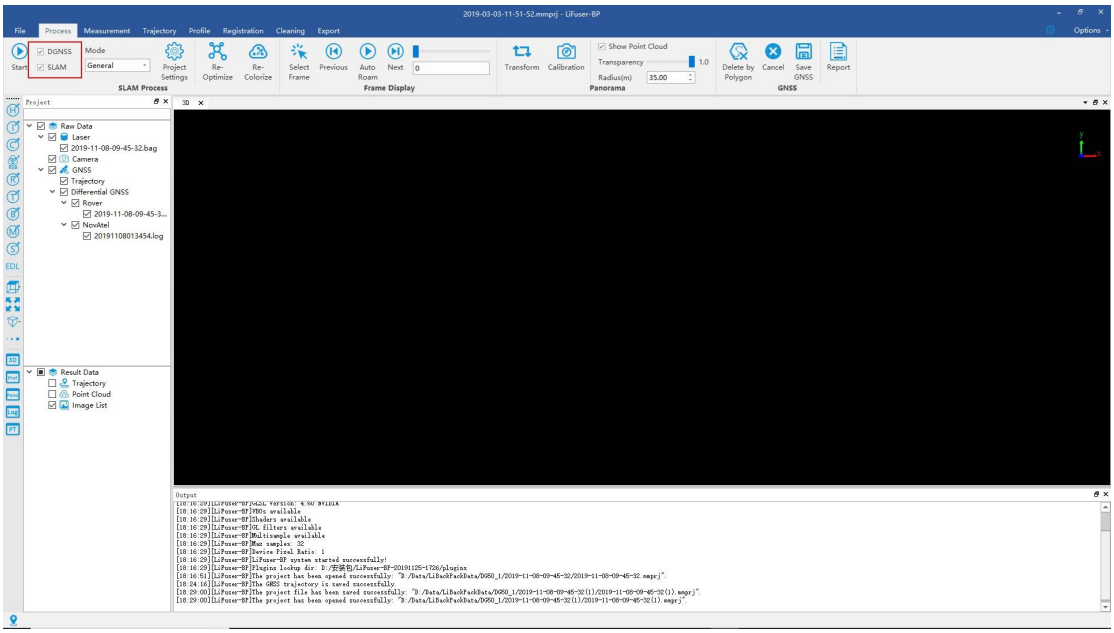


Open Project

High Accuracy Process

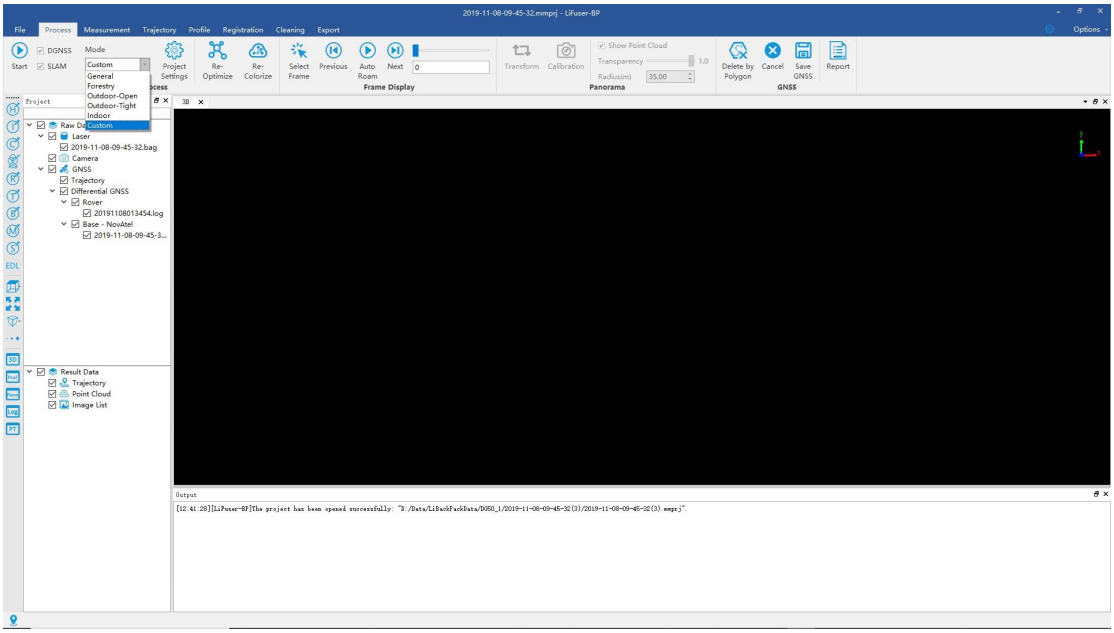
1. Switch to Process tab.
2. Select processing type by checking the corresponding button 

. There are 3 processing types:
   - **DGNSS+SLAM(default)**：Generate GNSS trajectory by differential processing, and then use SLAM to obtain point cloud data with real geographical coordinates. If GNSS is not set, point cloud data with relative coordinates will be calculated.
   - **DGNSS**: Generate GNSS trajectory only by differential processing.
   - **SLAM**: Only uses SLAM to obtain point cloud data with high accuracy.



Select processing type

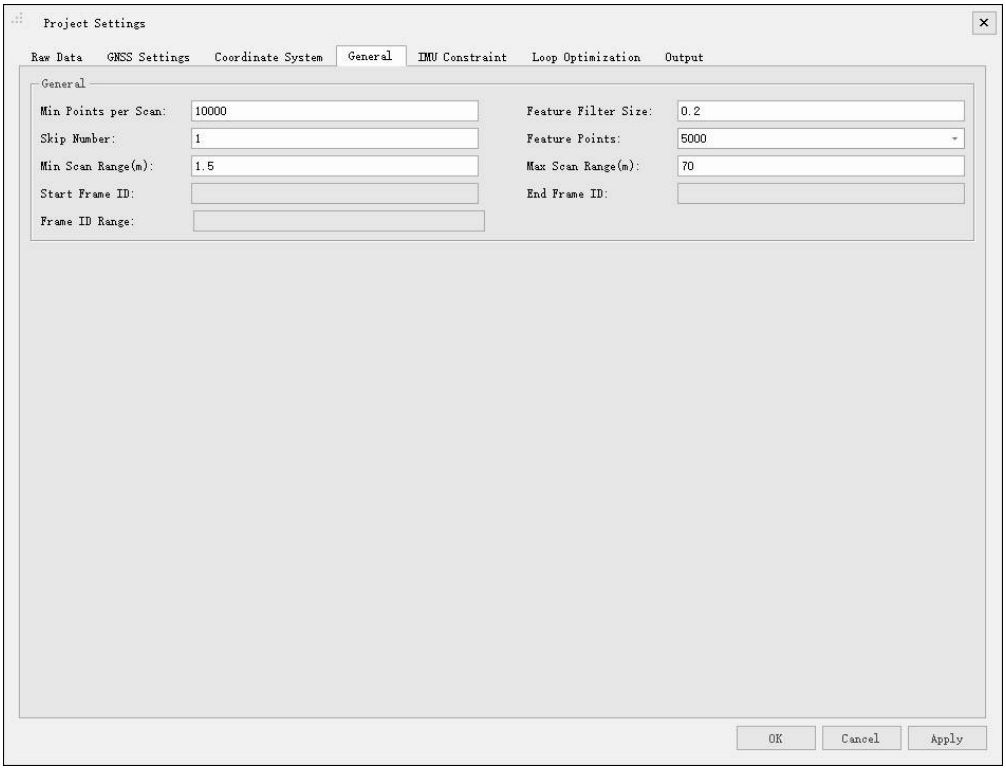
3. Select processing mode. There are 6 processing modes, click drop-down box to select:
   - **General**：General mode.
   - **Forestry**：Forestry mode.
   - **Outdoor-Open**：Outdoor-Open mode.
   - **Outdoor-Tight**：Outdoor-Tight mode.
   - **Indoor**:Indoor mode.
   - **Custom**：Custom mode.



Select processing mode

4. General setting Each processing mode has its default setting(Default setting is recommended). If users want to customize, click *Project Settings* to change the parameter values. Parameters explanations are shown below:

   - Raw Data：The .bag file, please see the process of importing laser scanner information for details.
   - GNSS Settings：Enter GNSS information, please see the process of importing GNSS information for details.
   - Coordinate System：Select target projection system, which only works after setting the GNSS. Please see detailed process at Set projection coordinate system.
   - General:



Genaral setting

Min Points per Scan：10000 by default.
Skip Number：Numbers of skipped frames. If wan set to 0, all data will be handled by frame; if was set to 1, data will be handled every other frame.

Feature Filter Size：Set the minimum size of feature point bounding box. Higher value can lead to quicker processing speed but with lower accuracy.

Feature Points：Set the maximum number of feature point extracted by frame. Higher value can lead to slower processing speed but with higher accuracy.

Min Scan Range(m)：Set the minimum scan range by frame .
Max Scan Range(m)：Set the maximum scan range by frame.

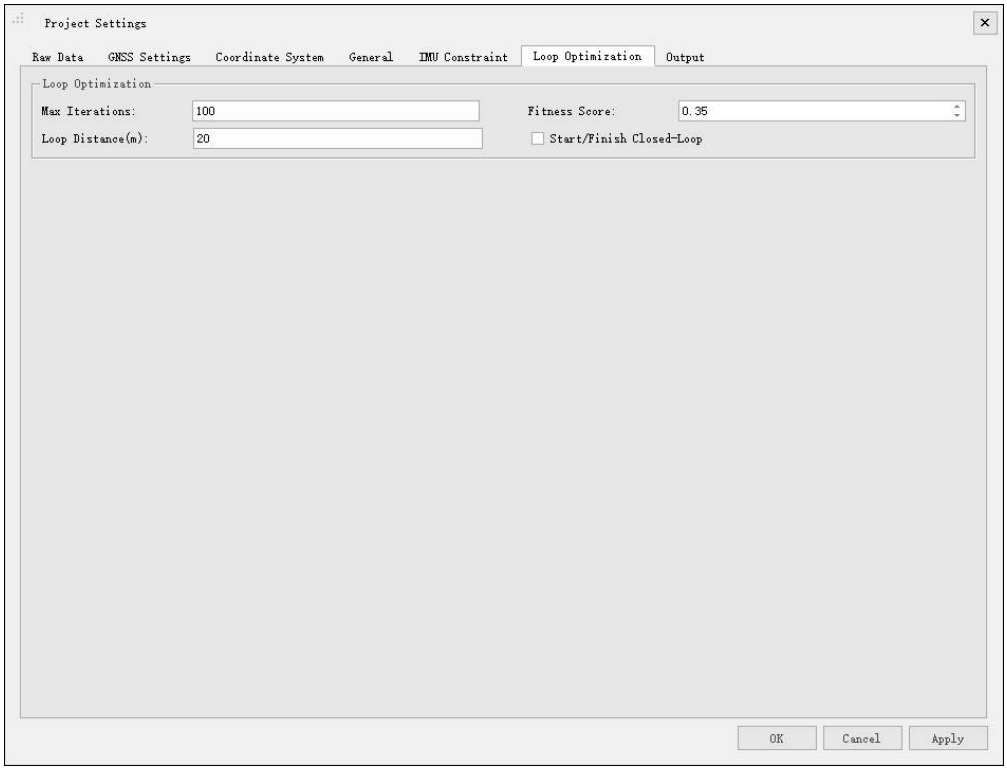
Start Frame ID： Set the start frame ID. Only works when opening a project which has already been handled.

End Frame ID：Set the end frame ID. Only works when opening a project which has already been handled.

Frame ID Range：Set the range of frames to be processed.

> Note: Users can check the corresponding frame ID of certain trajectory points from trajectory file.

- Loop Optimization:



Loop Optimization

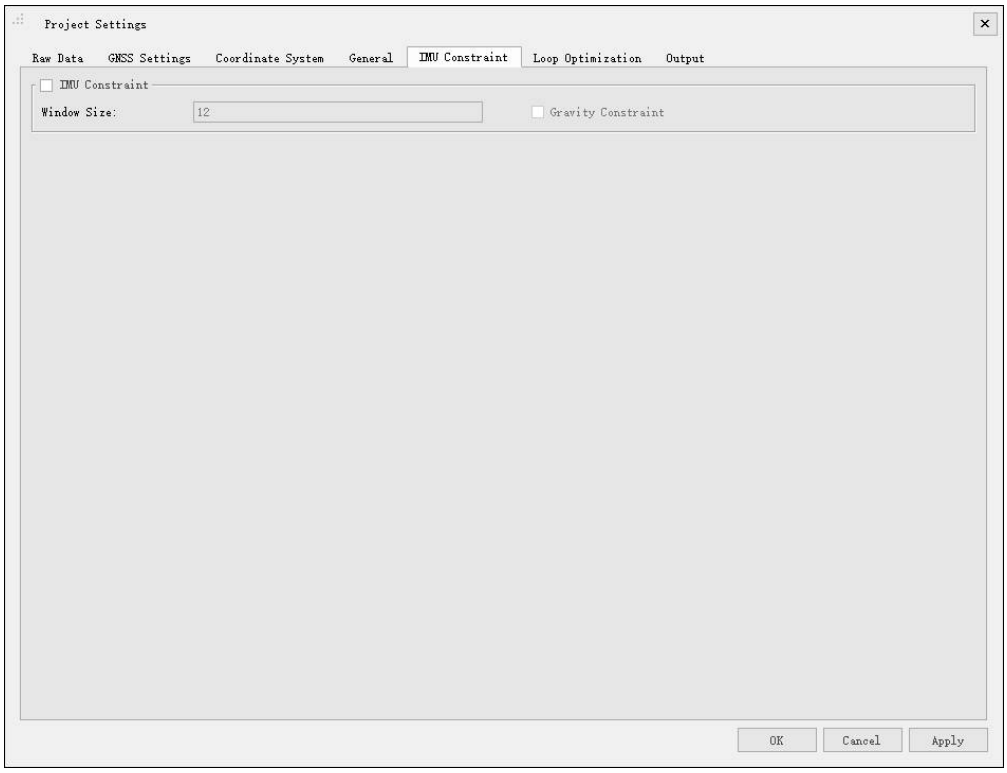
Max Iteration：Maximum iteration number of loop optimization. Higher value can lead to slower processing speed but with higher accuracy.

Fitness Score：Threshold of fitness inspection score. The lower the value, the higher the possibility of false inspection.

Loop Distance(m)：Neighbor distance value of loop inspection.

Start/Finish Closed-Loop：Set closed-loop or not.

- IMU Constraint:



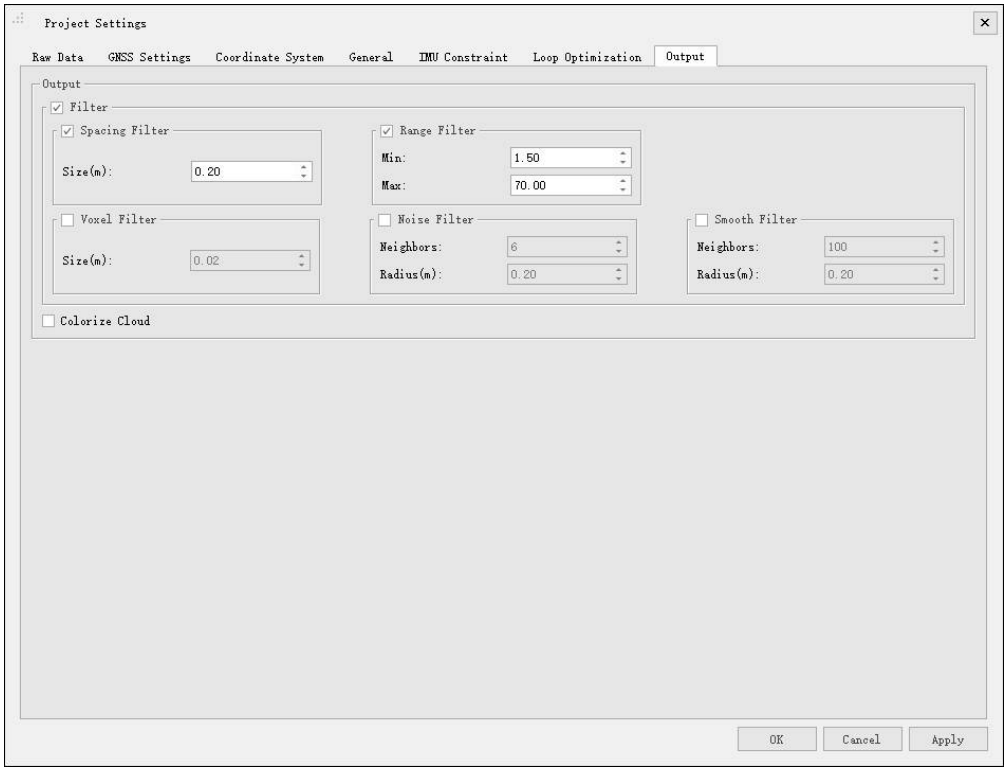
IMU Constraint

IMU Constraint：Whether to use IMU Constraint or not. Use IMU constraint can increase the accuracy but lower the processing speed.

Window Size：Set the window size of IMU processing.

Gravity Constraint：Whether to set Gravity Constraint or not.

- Output:



Output setting

Colorize Cloud：Choose to colorize point clouds or not.

Space Filter：Set space threshold when making data thinner.

Range Filter：Set threshold of data output.The data range kept by each frame must be within the threshold.

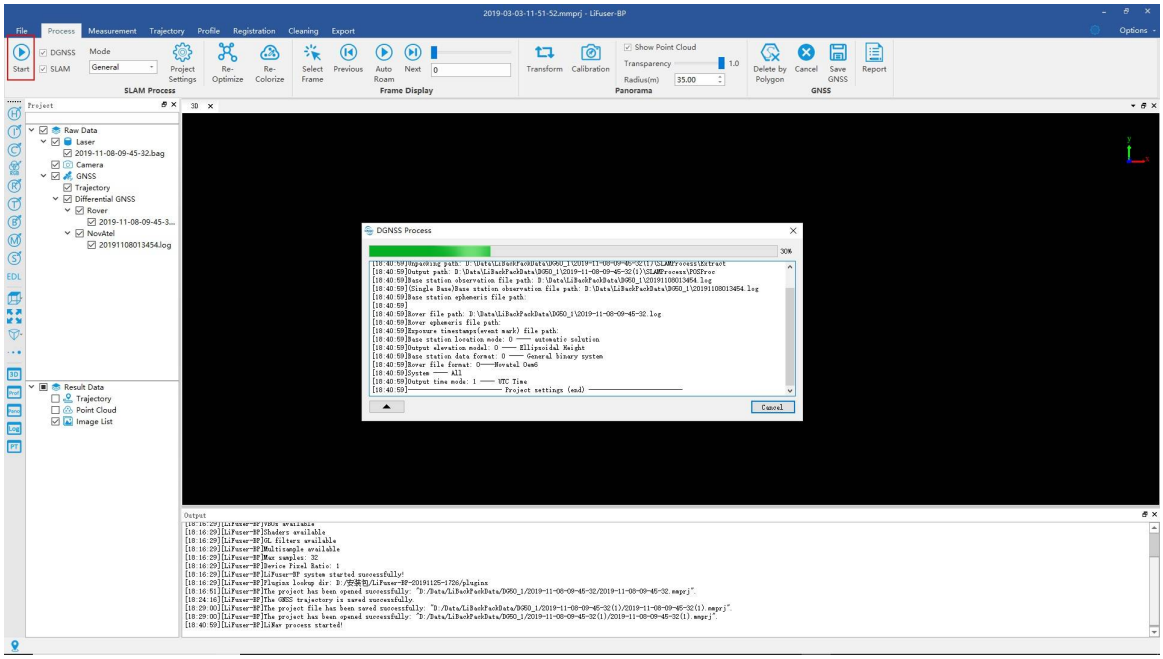
Voxel Filter：Voxel size is the minimum distance between two points, default value is 0.02m.

Noise Filter：Filter noise points according to the number of neighbor points(Neighbors) and searching semi-diameter(Radius).If the points within the radius is less than the threshold, the point will be removed as noise.

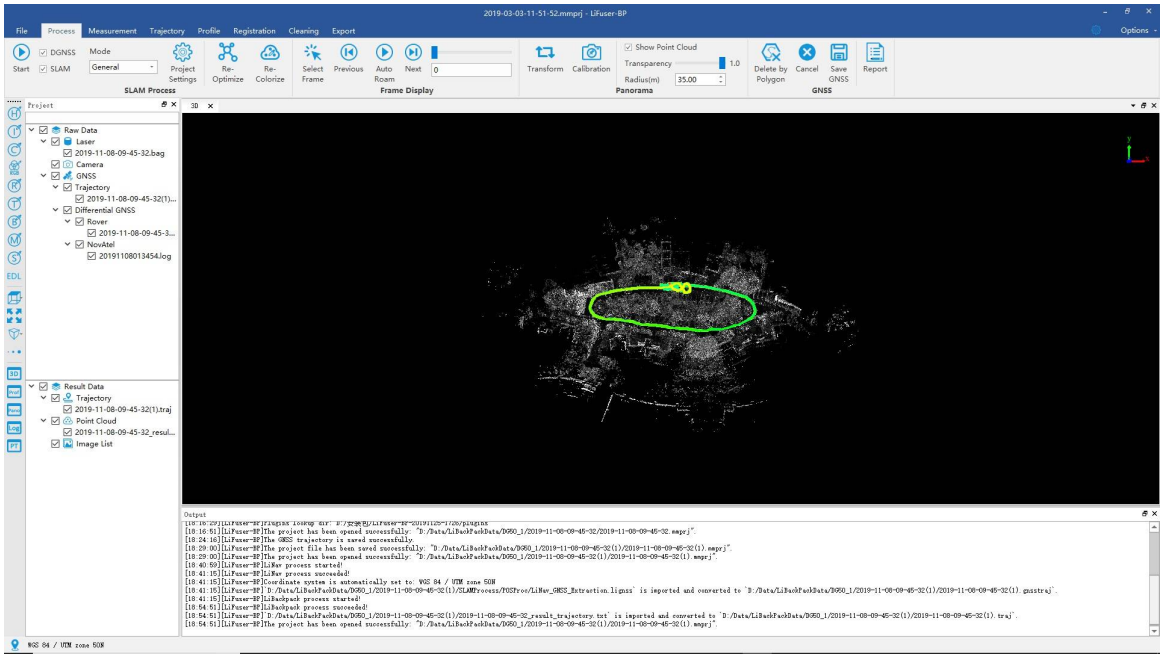
Smooth Filter：Number of neighbor points(Neighbors) and searching semi-diameter(Radius).Use points within threshold and radius to smooth the data.

5. Start SLAM process

   After finishing setting up the above-mentioned parameters, click *Start* to start SLAM process.Please be patient as this may take some time.



Start SLAM process



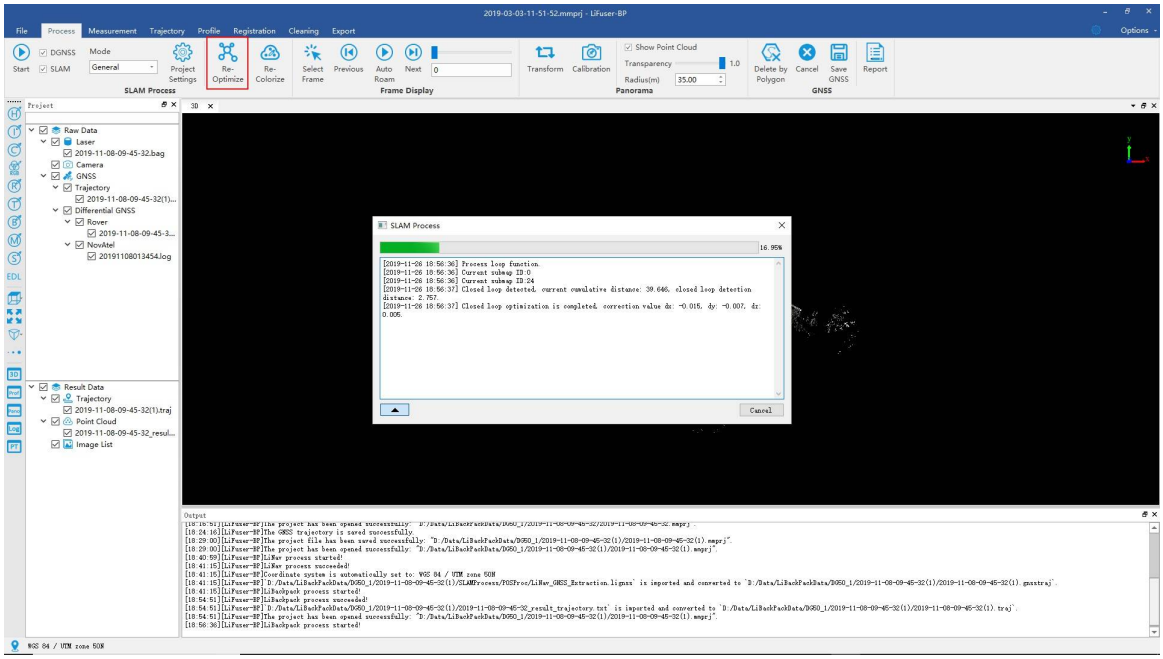
End SLAM process

6. Further Optimization

   Further optimization is targeted at two situations:

   (1) If current processing has a bad performance due to low accuracy of GNSS, users can improve it by editting GNSS manually. Click *Re-Optimize* and optimize again to improve the solving accuracy.

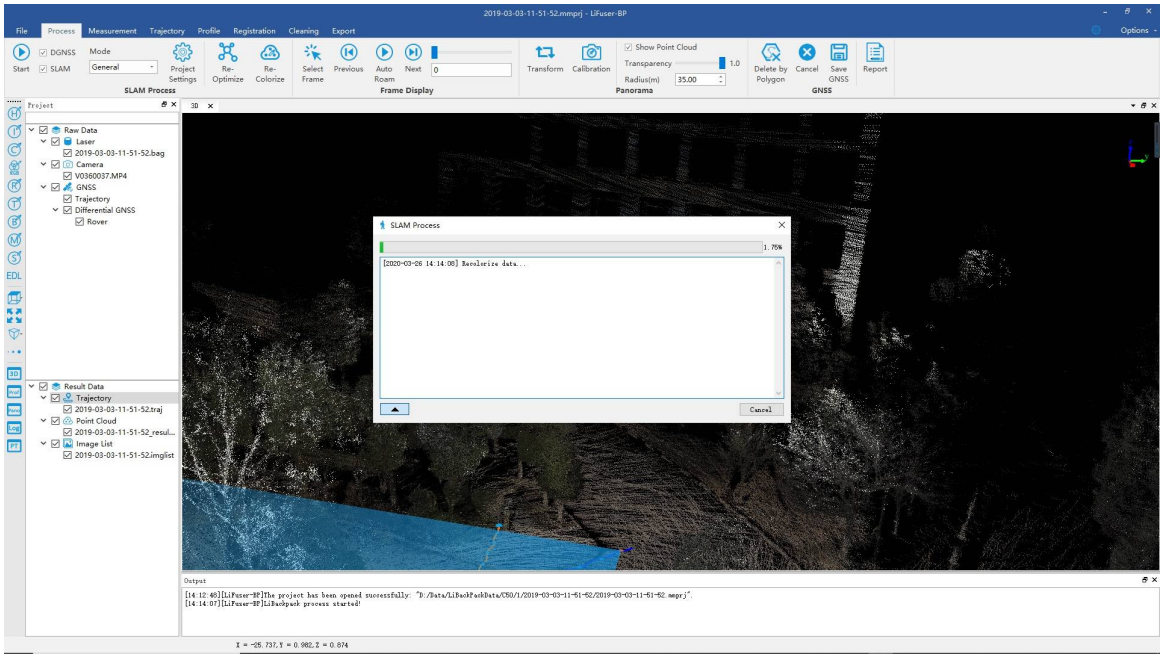
   (2) If the error comes from loop falses, users can correct it by changing parameters at step 4 **Loop Optimization**. Then click *Re-Optimize* and optimize again.



Futher Optimization

7. Recolorize(Optional)

   This function can be used after performing the modified image and laser calibration. Users can click *Re-Colorize*  to recolorize.

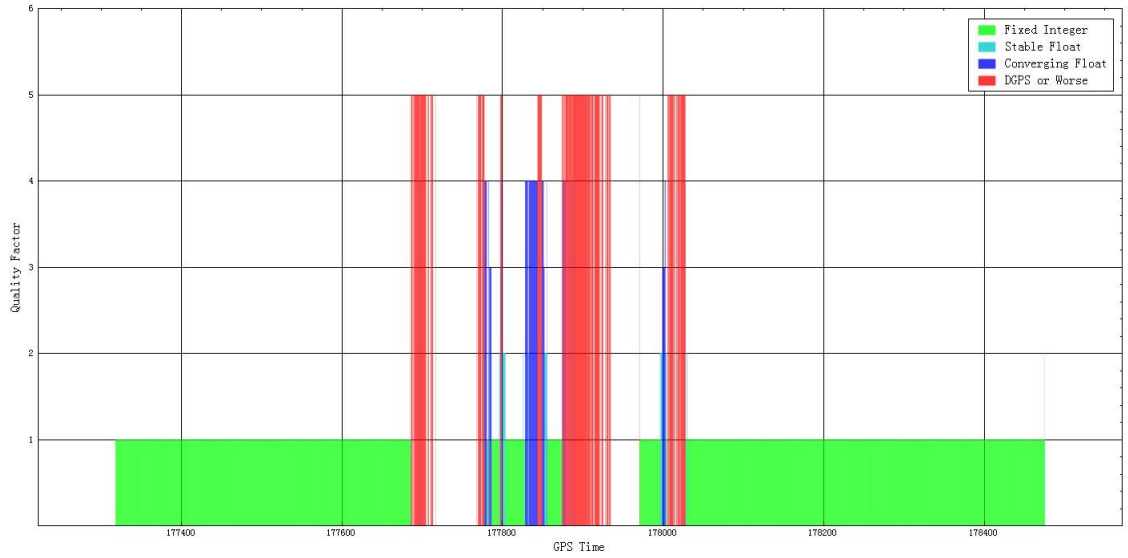


Recolorize

8. Check GNSS report

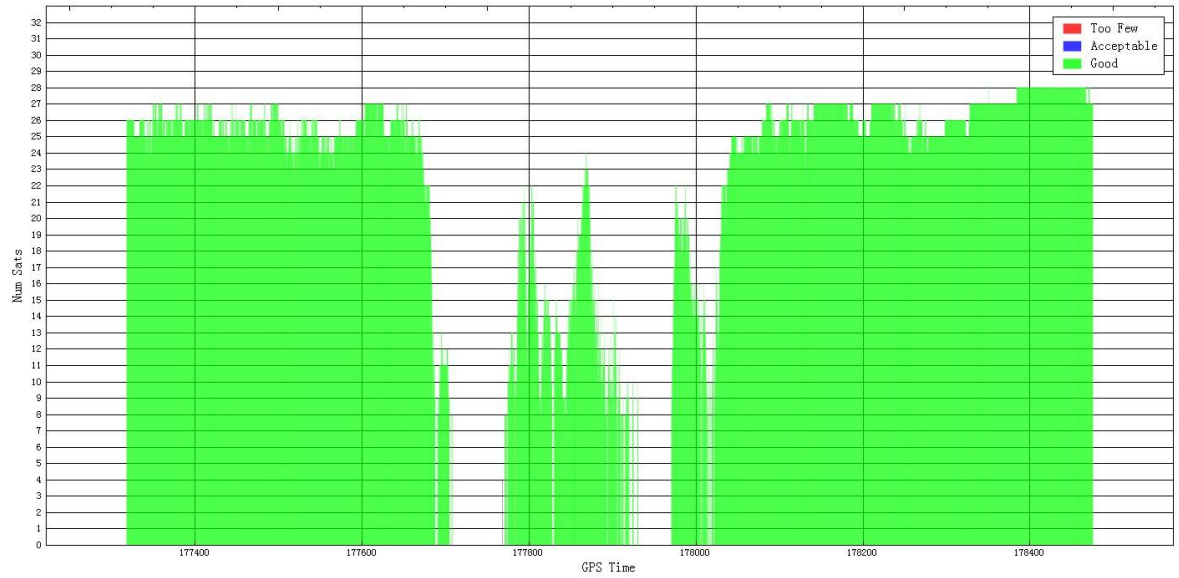
   If GNSS information has been imported, users can check GNSS report by click *Report*  after data processing. Report includes figures of satellites number and quality, float or fixed ambiguity plot, PDOP plot, height profile plot, velocity profile plot etc.

Figure 1. Quality Factor Plot



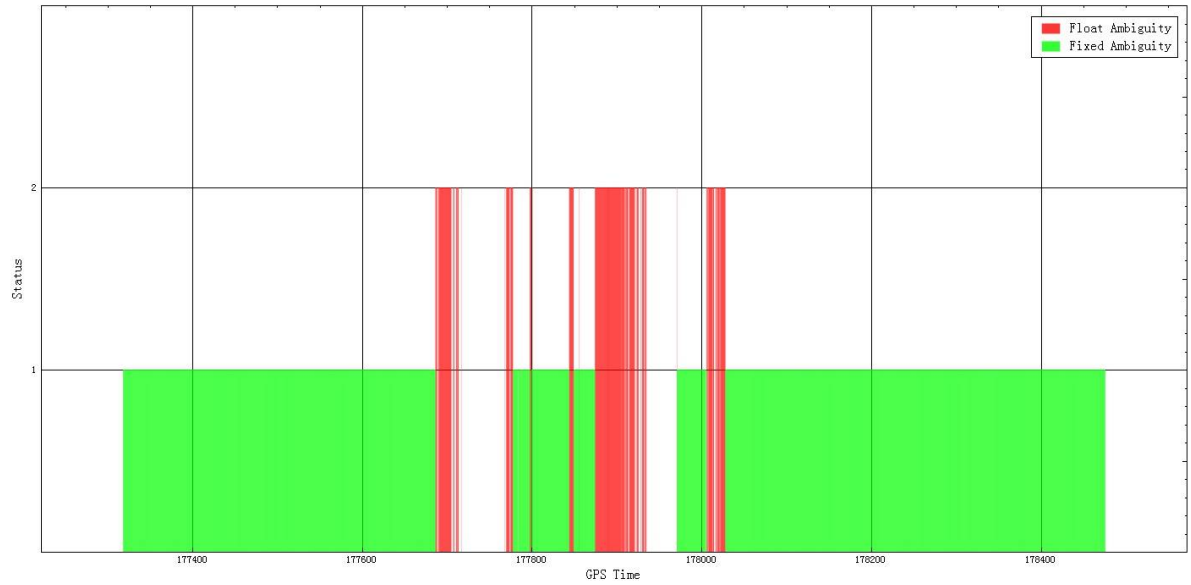
Quality factor plot

Figure 2. Number of Satellites Bar Plot



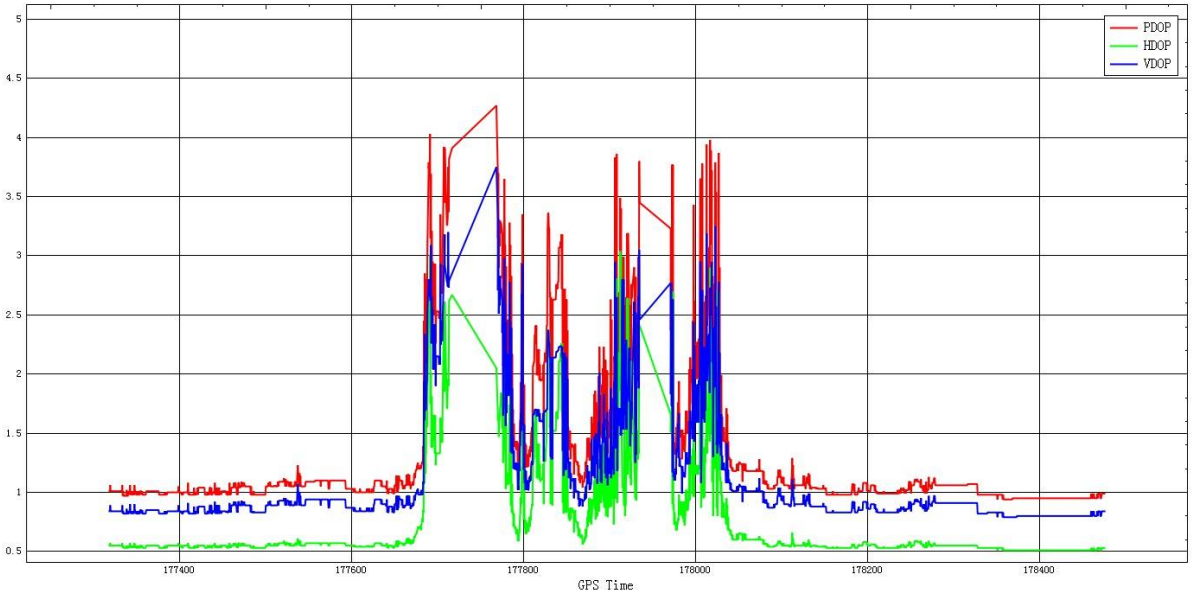
Number of satellites

Figure 3. Float or Fixed Ambiguity Plot



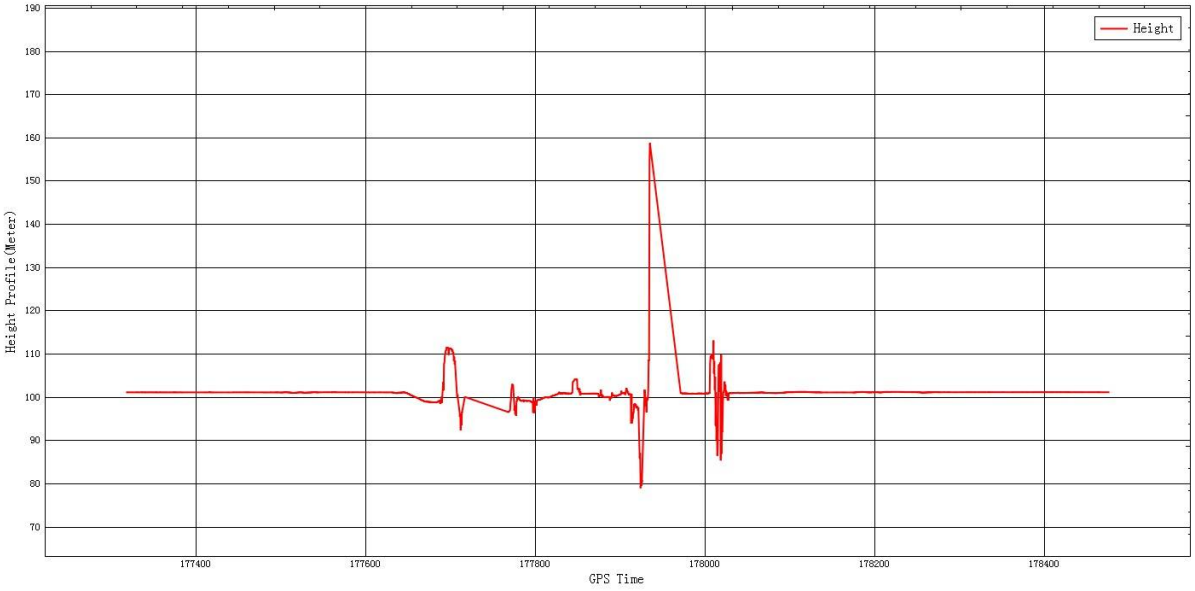
Float or fixed ambiguity plot

Figure 4. PDOP Plot



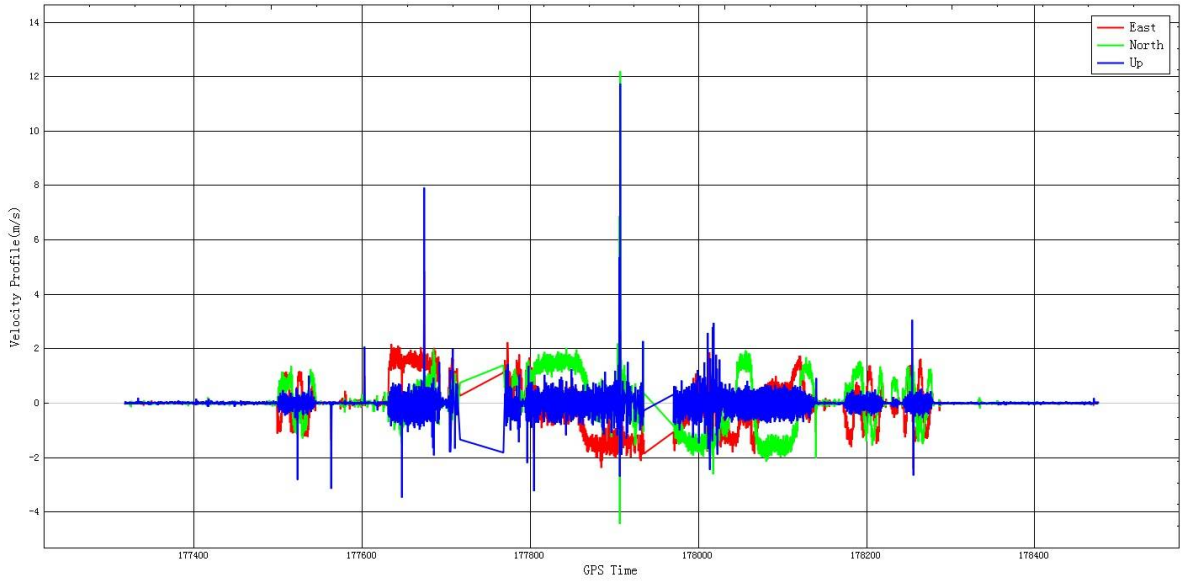
PDOP plot

Figure 5. Height Profile Plot



Height profile plot

Figure 6. Velocity Profile Plot



Velocity profile plot

Trajectory Process

There are two types of trajectory process supported by software, GNSS trajectory process and result trajectory process.

GNSS Trajectory Process

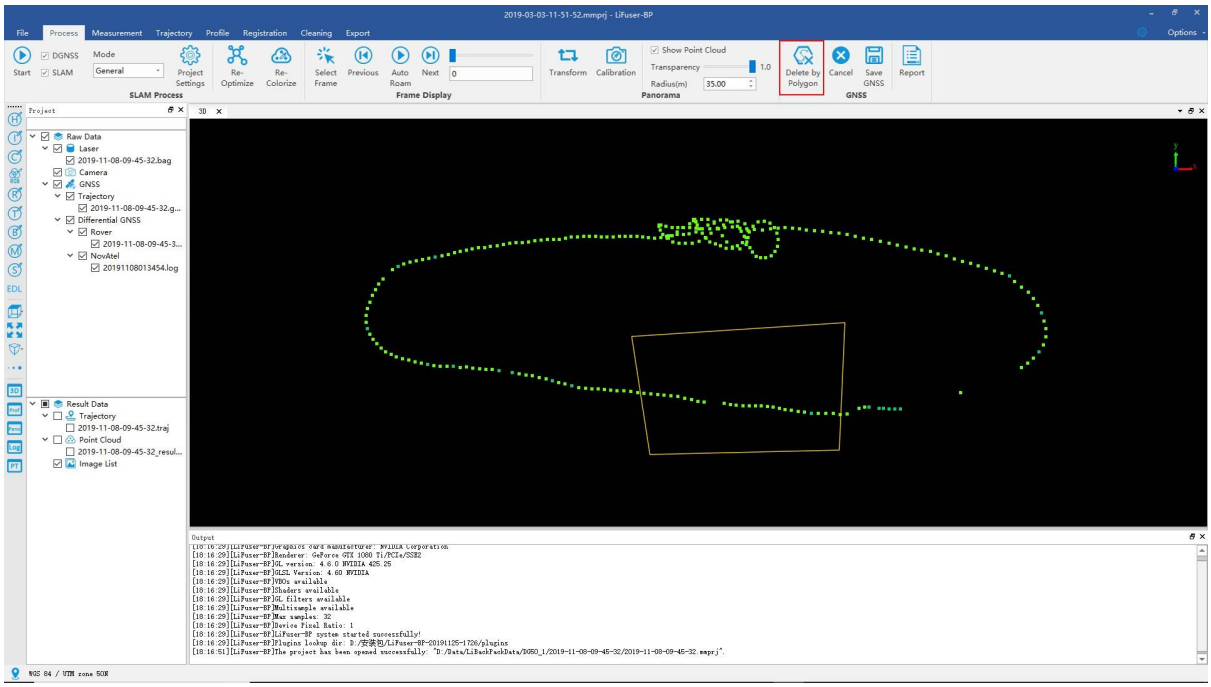
Result Trajectory Process

GNSS Trajectory Process

Due to blocking and multi-path effect in data acquisition, there are some inaccurate positioning points. After GNSS data processing, users can manually edit the data to remove the inaccurate points by following methods.

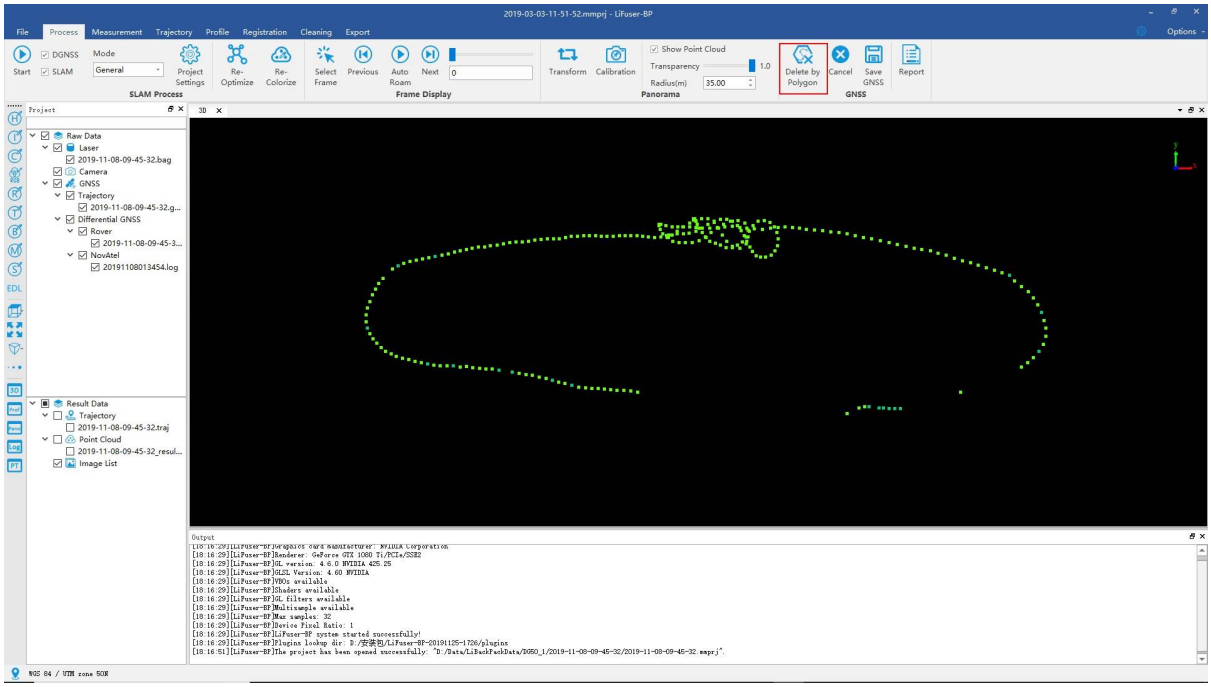
1.Delete by Polygon

Click the button of *Delete by Polygon*  to start clipping. In the 3D window, left click is used to make a user-defined polygon which will be removed (right click is to cancel the current selection).



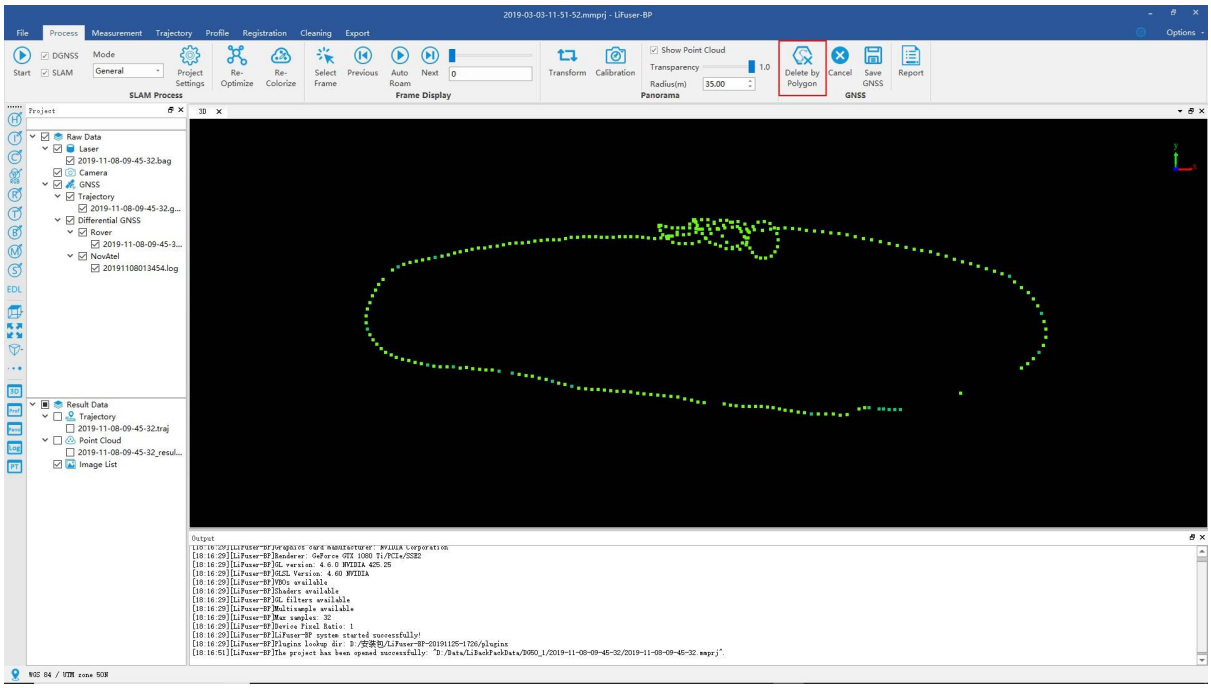
Start Clipping

Double click to finish clipping.



Finish Clipping

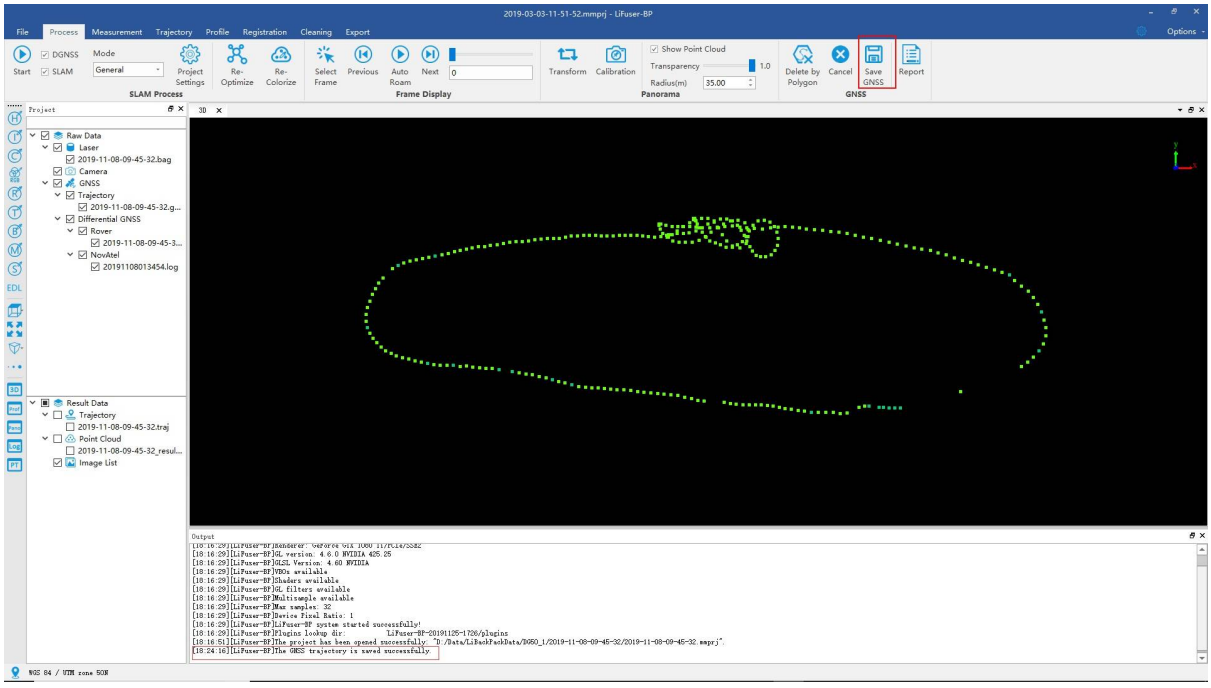
To cancel clipping, click the button of *Cancel*  or use the shortcut of "Ctrl + Z".



Cancel Clipping

2.Save GNSS

Click *Save GNSS*  button to save GNSS Trajectory.



Save GNSS Trajectory

3.Data Optimization

If users have already click the button of 

for SLAM Processing, then after finishing GNSS Trajectory Processing, users can click *Re-Optimize*  for a more accurate processing.

If users do not use SLAM Processing, then click *Start*  button of SLAM processing.

Result Trajectory Process

After finishing High Accuracy Process, users can edit the result trajectory through *Result Data* selection.

Switch to *Trajectory* interface.

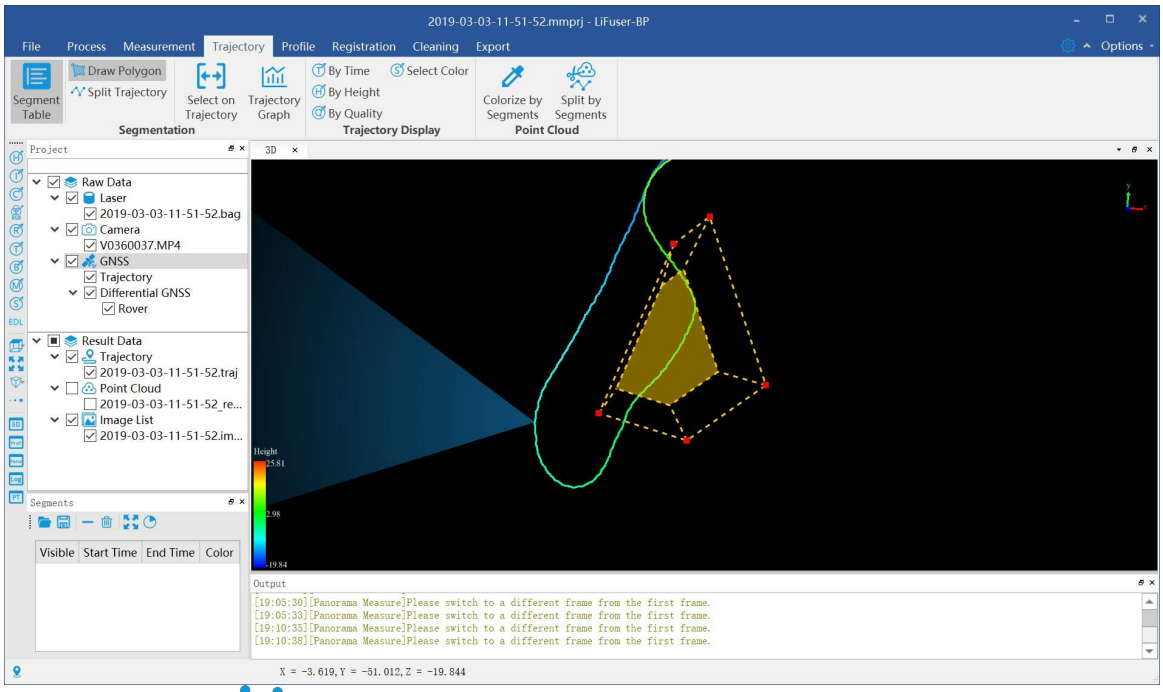
- Result Trajectory Segments
  - Segment Methods
  - Segment Result Table
  - Trajectory Graph
  - Colorize by Segments
  - Split by Segments
- Trajectory Display
  - Display by Time
  - Display by Height
  - Display by Quality
  - Display by Specific Color

Segment Methods

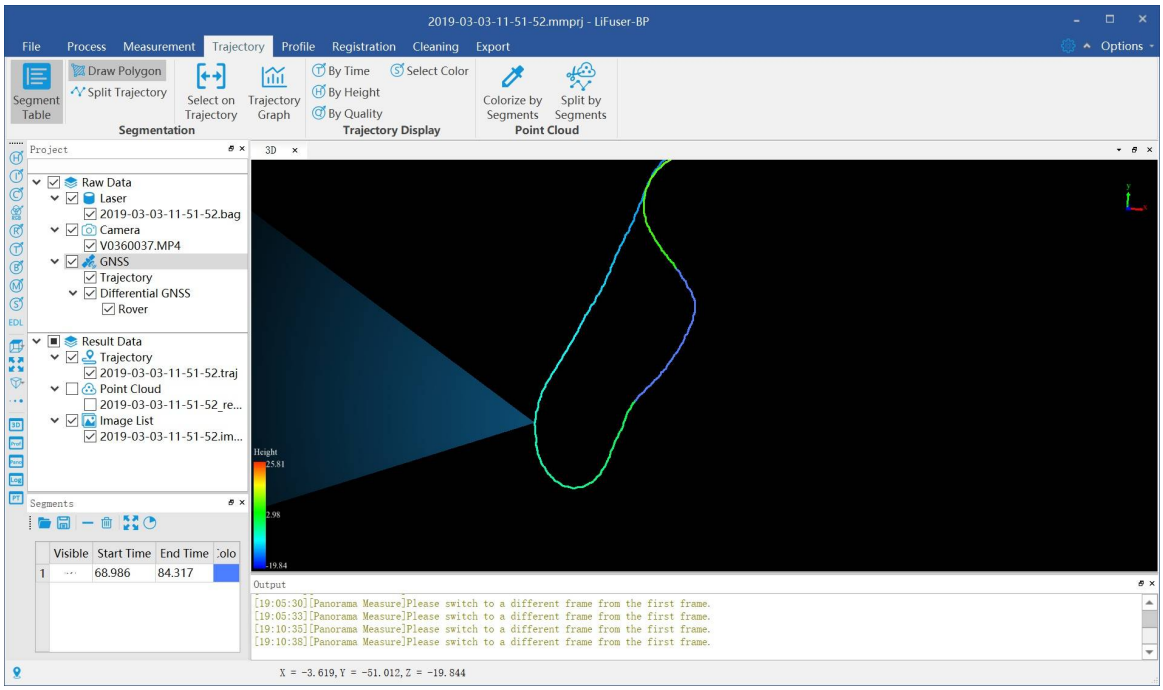
Split by Polygon

Step

- Click *Draw Polygon*  button in *Segmentation* mode.
- In 3D display window, users can select the interest area by left click to make a user-defined polygon.



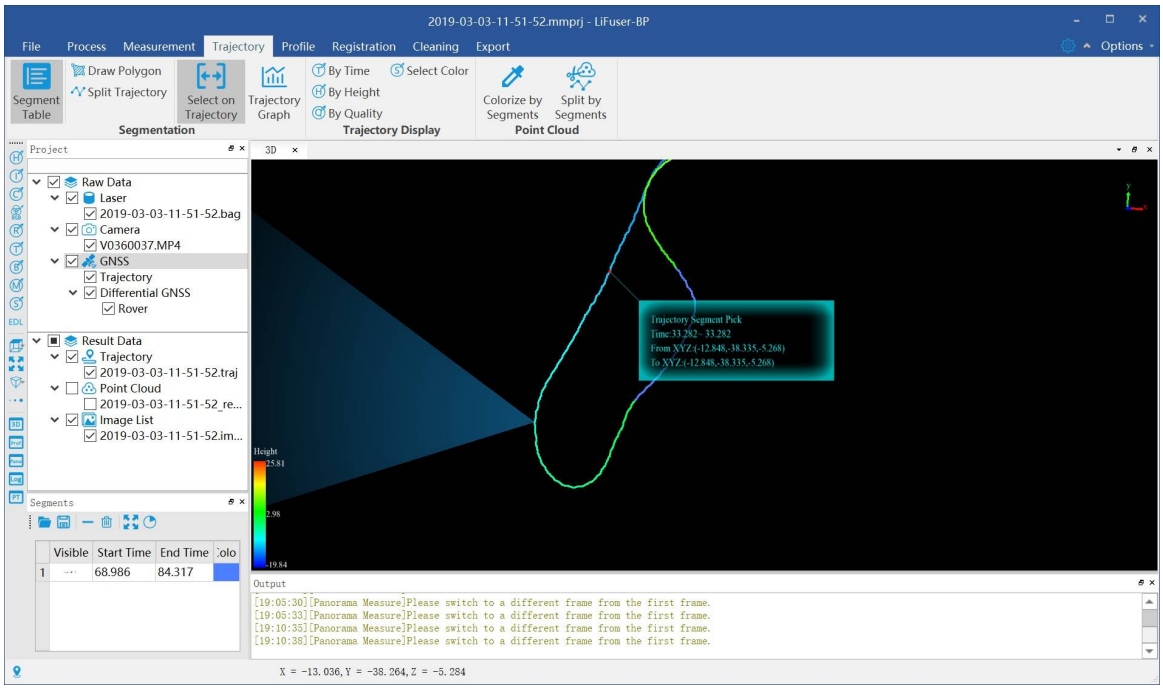
- Click *Split Trajectory*  button to split trajectory in the area of user-defined polygon.



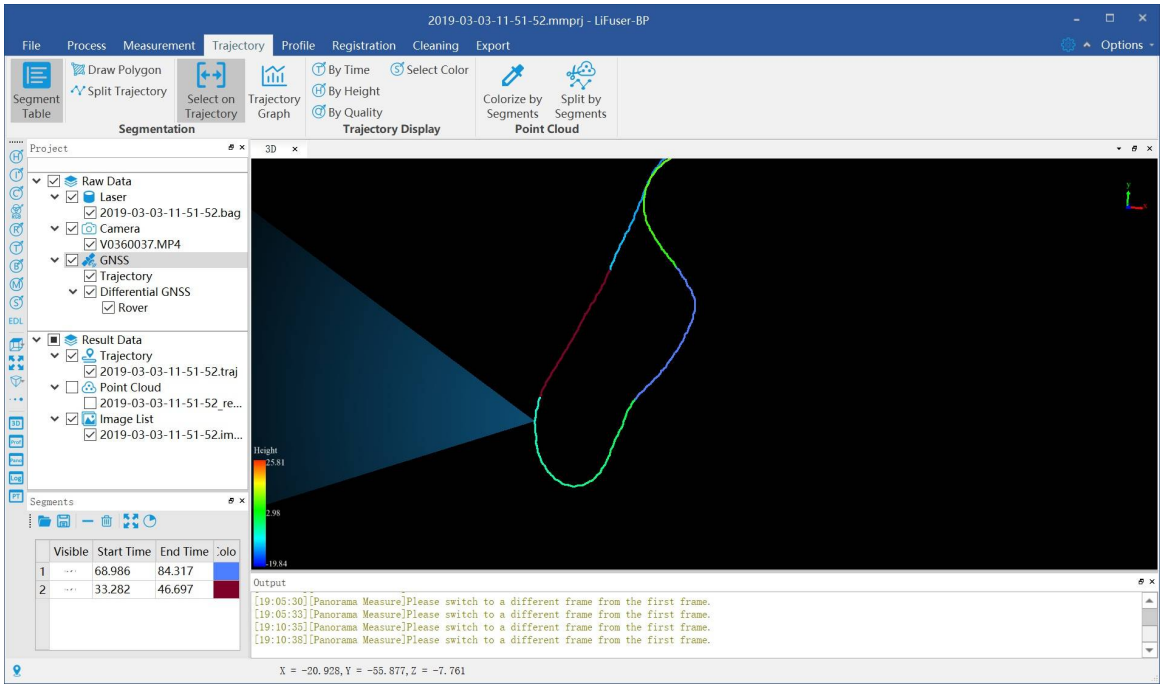
Split by Points

Step

- Click *Select On Trajectory* button in *Segmentation* mode.
- In the 3D display window, left click to select the starting point.

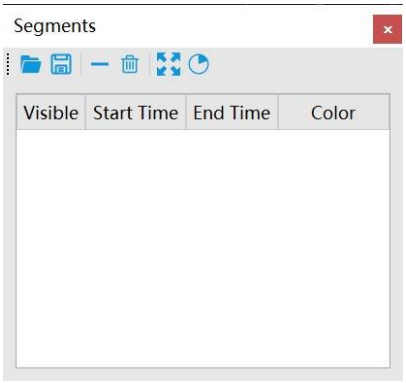


- Along the trajectory, select the ending point, the trajectory between the starting point and the ending point will be segmented.



Segment Result Table

Click *Segment Table* button in *Segmentation* mode, a segment table will pop up from the bottom right corner of user interface. The table records the details of segment information including segment visibility, start time, end time and the color information. Click on the menu bar above the segment table to enable the function of saving, opening, deleting, clearing, and hiding for unsegmented areas.



Save

Click *Save File* button , a window will pop up, save the trajectory to nominated position in hard disk. The *.xml format is supported to save.

Open

Click *Open File* button , a window will pop up, the trajectory information from nominated position in hard disk will be read, and the *.xml format is supported to read.

Delete

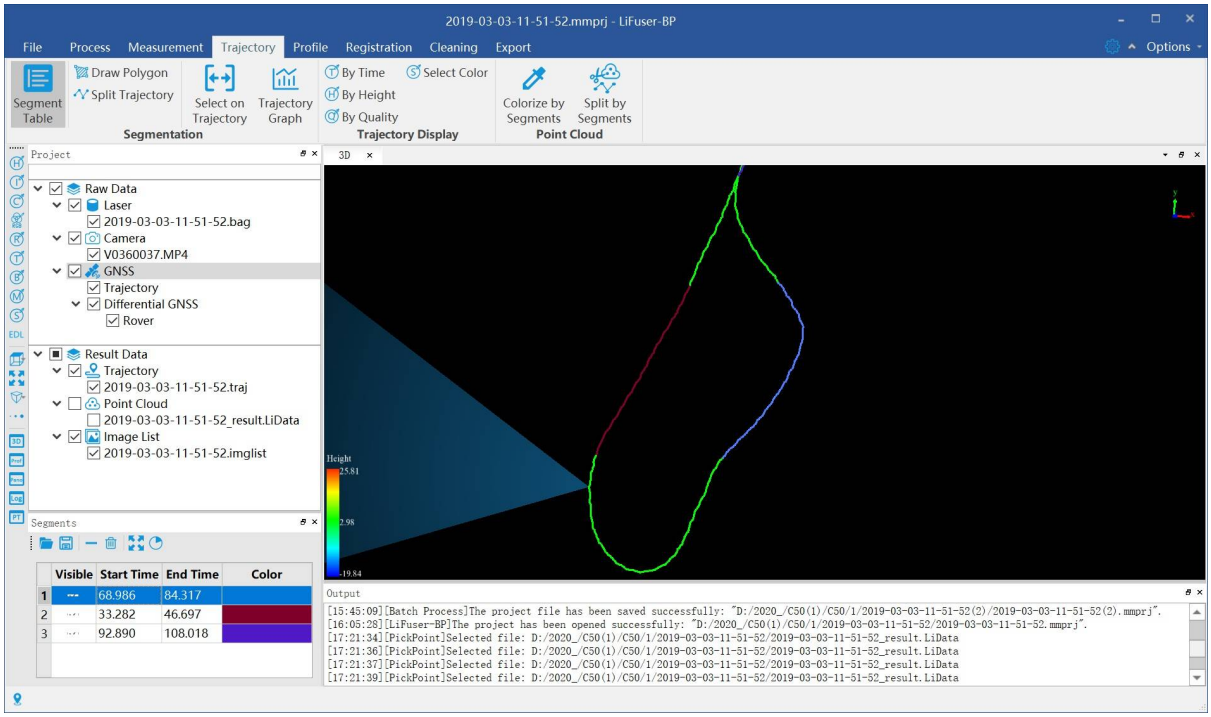
Click *Delete Segment* button , to delete the trajectory information of specified row in segment table.

Clear

Click *Delete All Segment* button , to delete all the trajectory information in segment table.

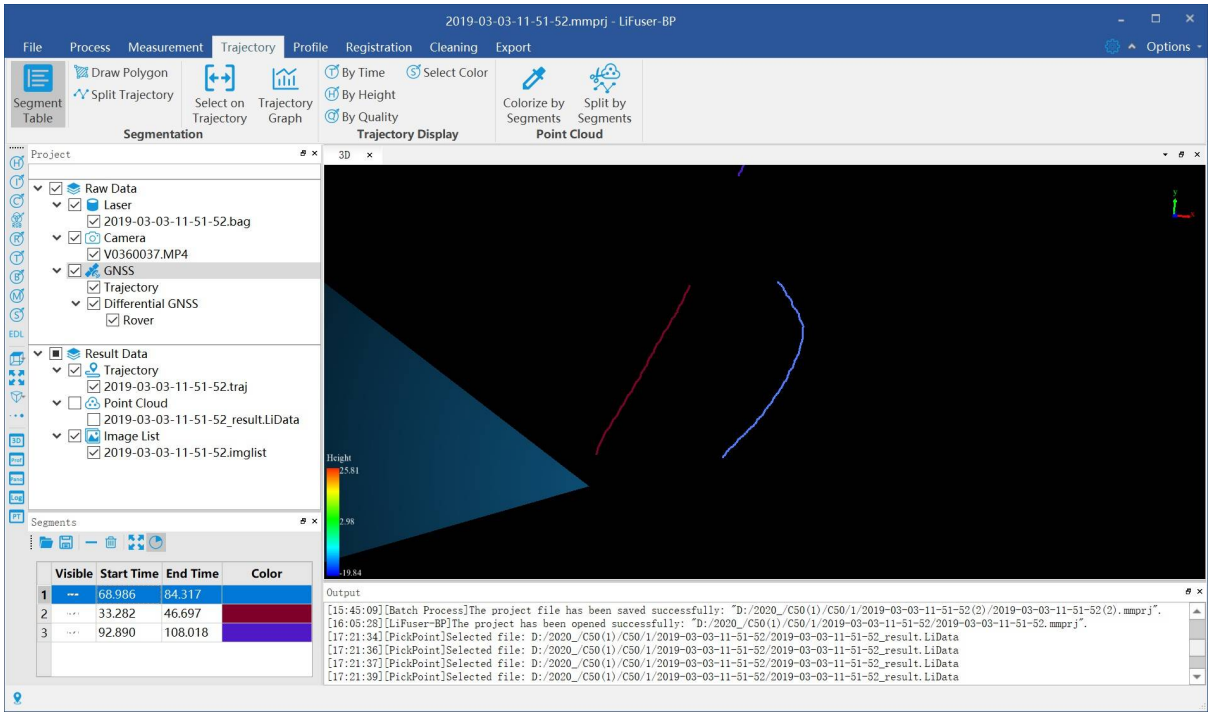
Extent

Firstly, click the specified row of sgment table. And click *Segment Full Extent* button , in 3D display window, the currently selected trajectory will be focused on.



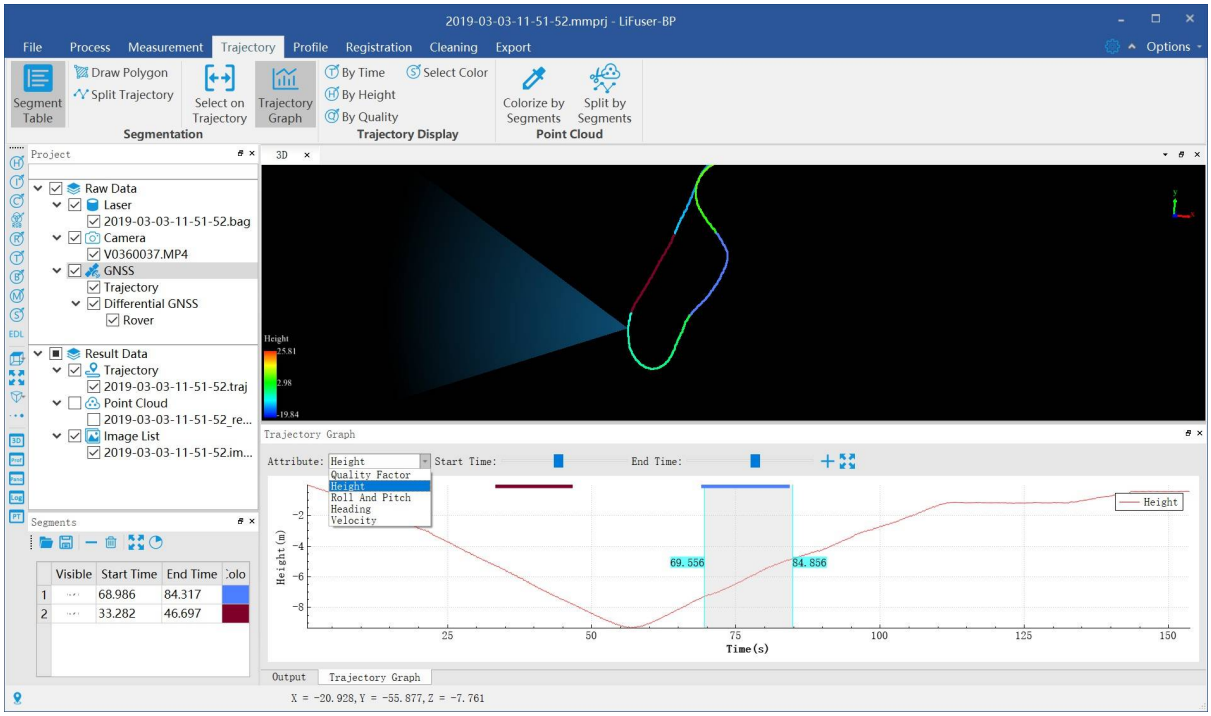
Hide

Click *Hide Remaining Part* button  , in 3D display window, the unsegmented area will hide, and only trajectory information from segment table will display.



Trajectory Graph

Click *Trajectory Graph* button in *Segmentation* mode, the trajectory graph will pop up. The trajectory segment information at any time can be read from trajectory graph. Users can change the display attribute, add new segment, and change the display range. The detailed information is listed below:



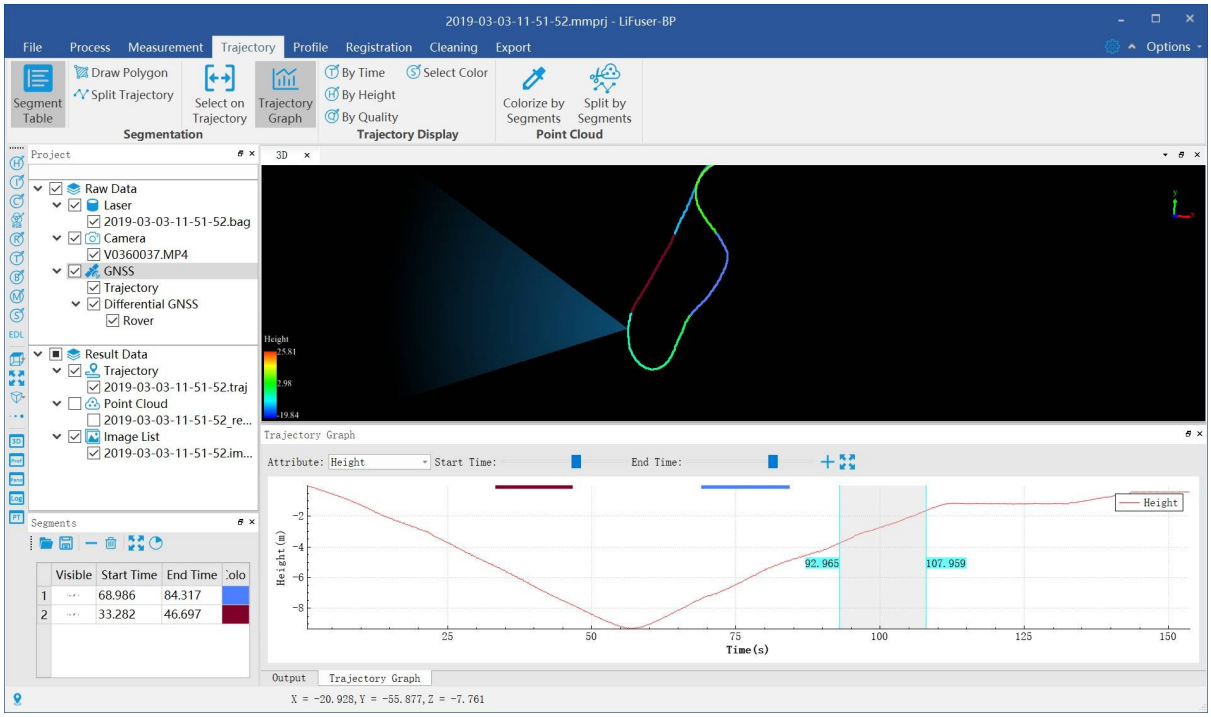
Attribute Display

Click *Atrribute* button, and users can select different display mode, including display by height, display by quality factor, display by roll and pitch angle, display by heading angle and display by velocity.

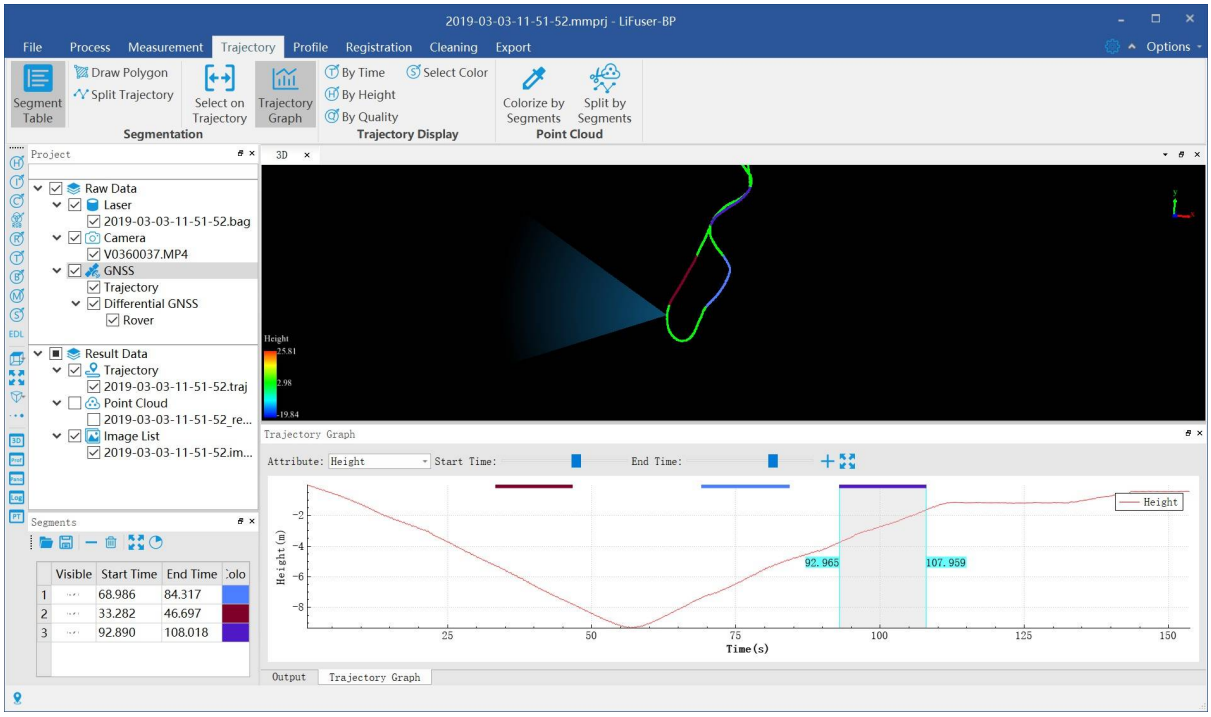
Add new Trajectory

Firstly, select both *Start Time* and *End Time* via scrollbars. And then click *Add Segment* button to add a new trajectory.

Select start and end time：



Add new trajectory：

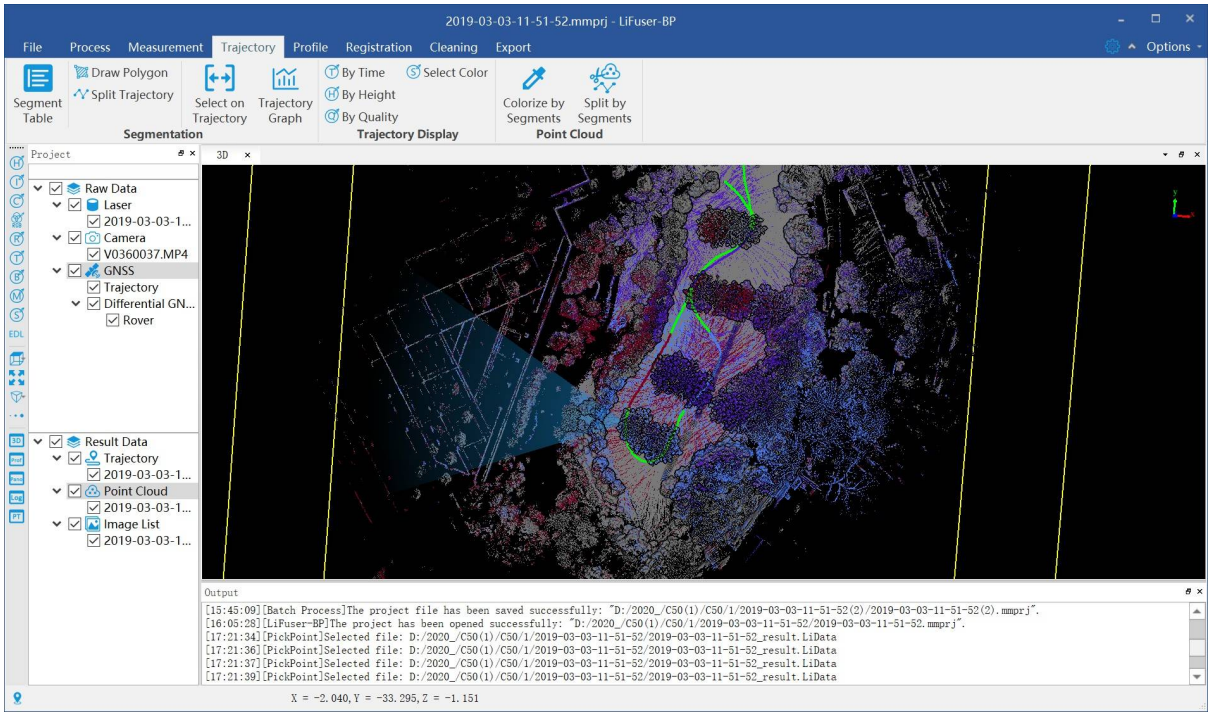


Change Display Range

All the trajectory information at any time will be displyed in trajectory graph as a default. Scroll up and down of mouse wheel to zoom in and out the display range. Click *Full Extent*  button to restore the default display.

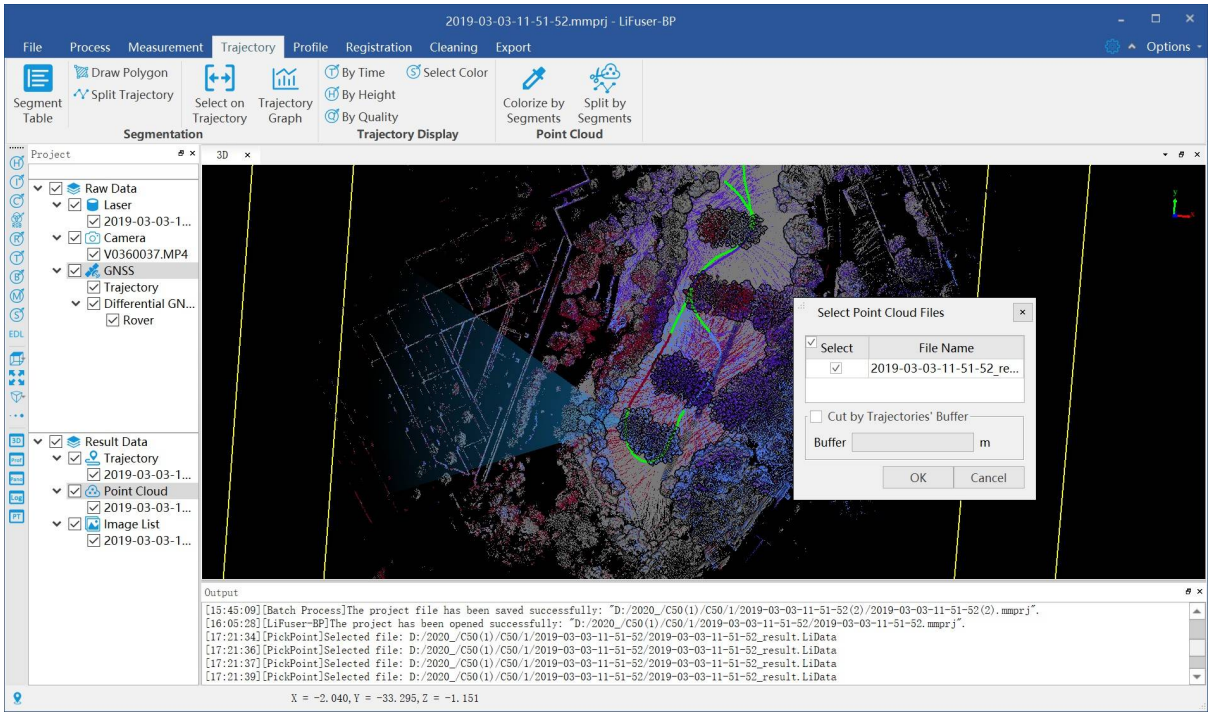
Colorize by Segments

Click the button of *Colorize by Segments* in *Point Cloud* Mode. In the display window, the point cloud will be colorized in specific color according to different trajectory segments. And if the point cloud is not segmented, the color will be gray.



Split by Segments

Click *Split by Segments* button in *Point Cloud* mode, click *OK* button in the pop-up window, the point cloud will be splitted into servel areas according to trajectory segment information. Click *Cut by Trajectorys' Buffer* button and edit the value of *Buffer*, the range of buffer value can be defined. And click *Cancel* button to stop segment operation.

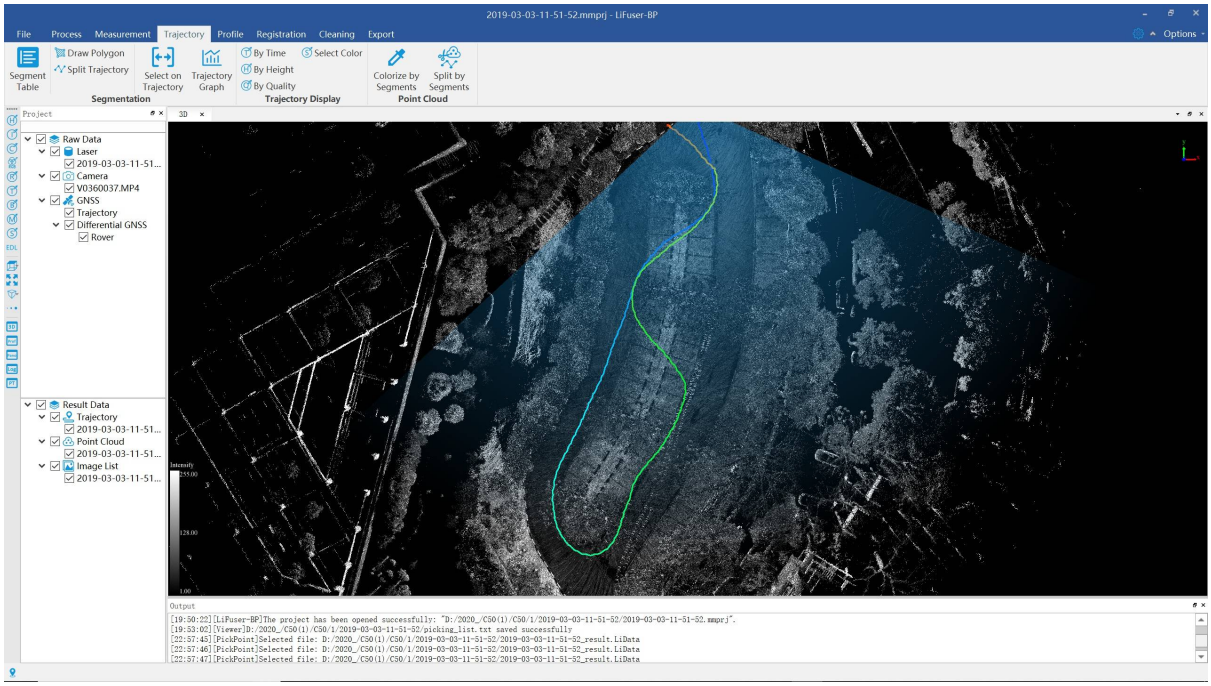


Trajectory Display

The software supports multi-displays:

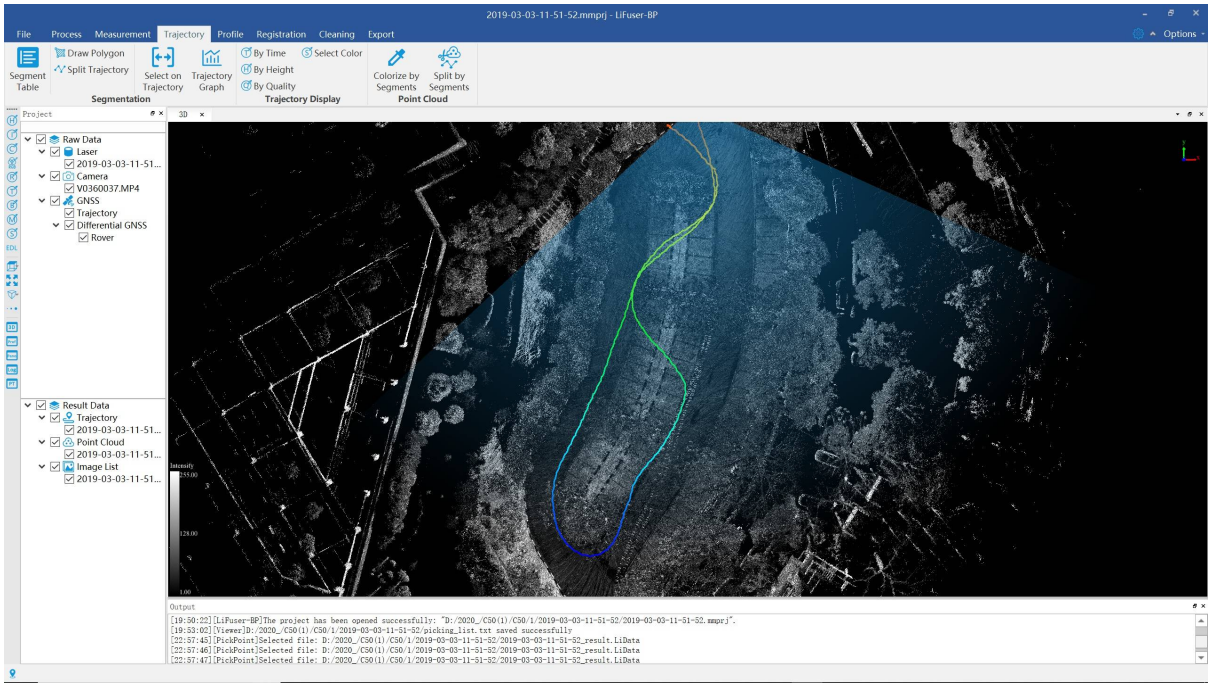
Display by Time (Default)

Click *By Time*  button in *Trajectory Display* mode, the trajectory will be displayed in different color according to acquisition time, users can select the color bar in a pop-up window.



Display by Height

Click *By Height*  button in *Trajectory Display* mode, the trajectory will be displayed in different color according to height information, users can select the color bar in a pop-up window.

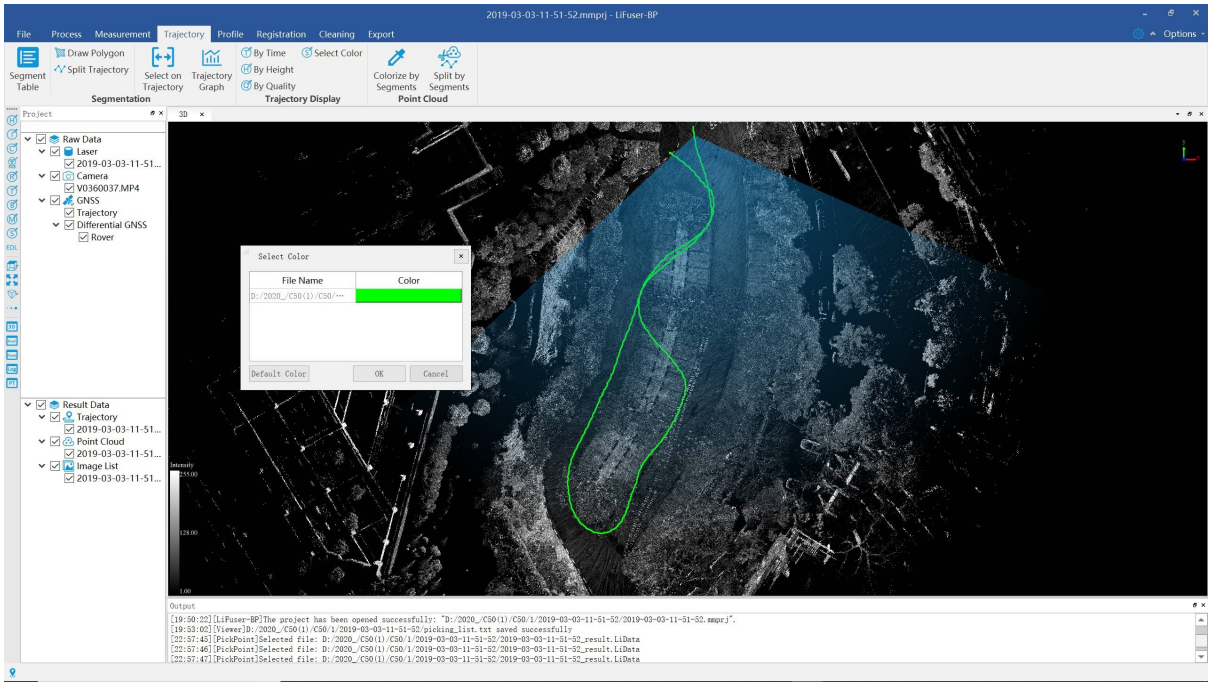


Display by Quality

Click *By Quality* button in *Trajectory Display* mode, the trajectory will be displayed in different color according to quality information, users can select the color bar in a pop-up window.

Display by Specific Color

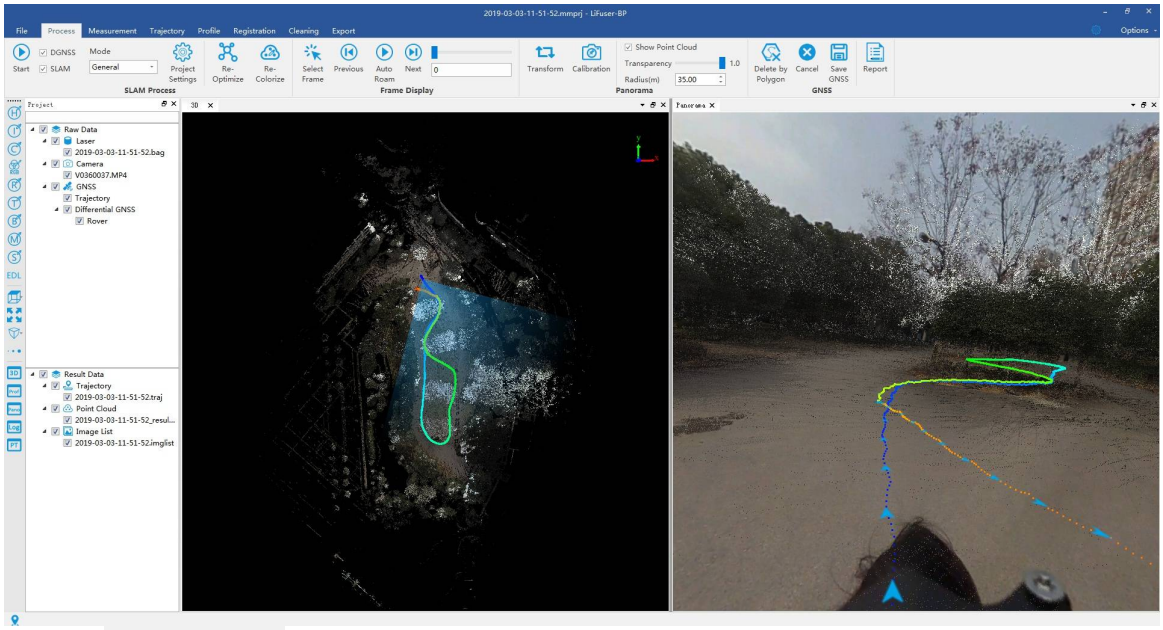
Click *Select Color* button in *Trajectory Display* mode, the trajectory will be displayed in specific color according to user-defined color, users can select the color bar in a pop-up window.



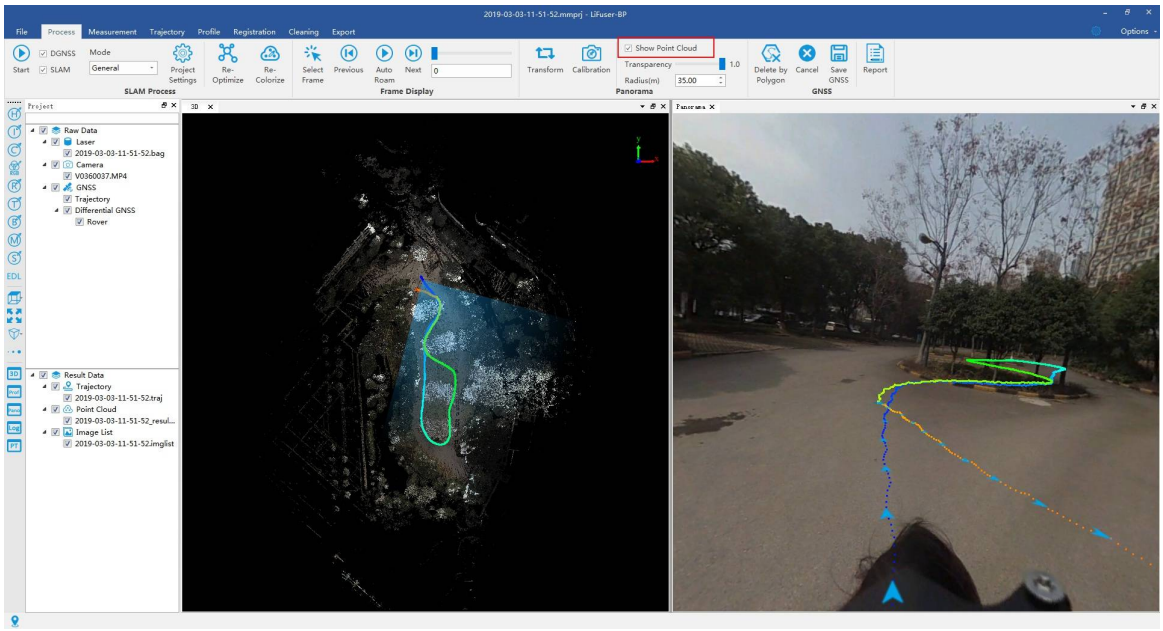
Point Cloud Roam

After finishing point clouds processing, the software supports Point Cloud and Panomatic Photo Roam. Note that there mush be video file for Panomatic Photo Roam. Open add video file reference wizard, and operate as below:

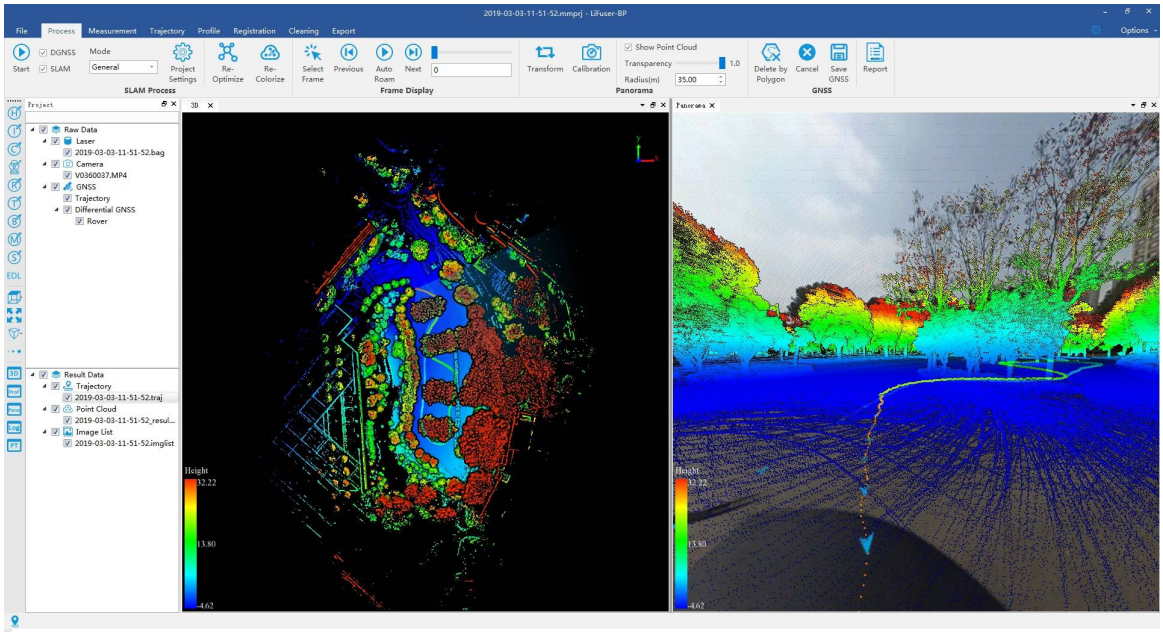
1. Create a new project and Process SLAM, or open a project which has been georeferenced.
2. There will be a 3D viewer and a panoramic viewer. Point cloud will be shown in both viewers while panoramic photo will only appear in panoramic viewer. By checking the data file to choose view it or not.



3. Uncheck  for only viewing panoramic photo.



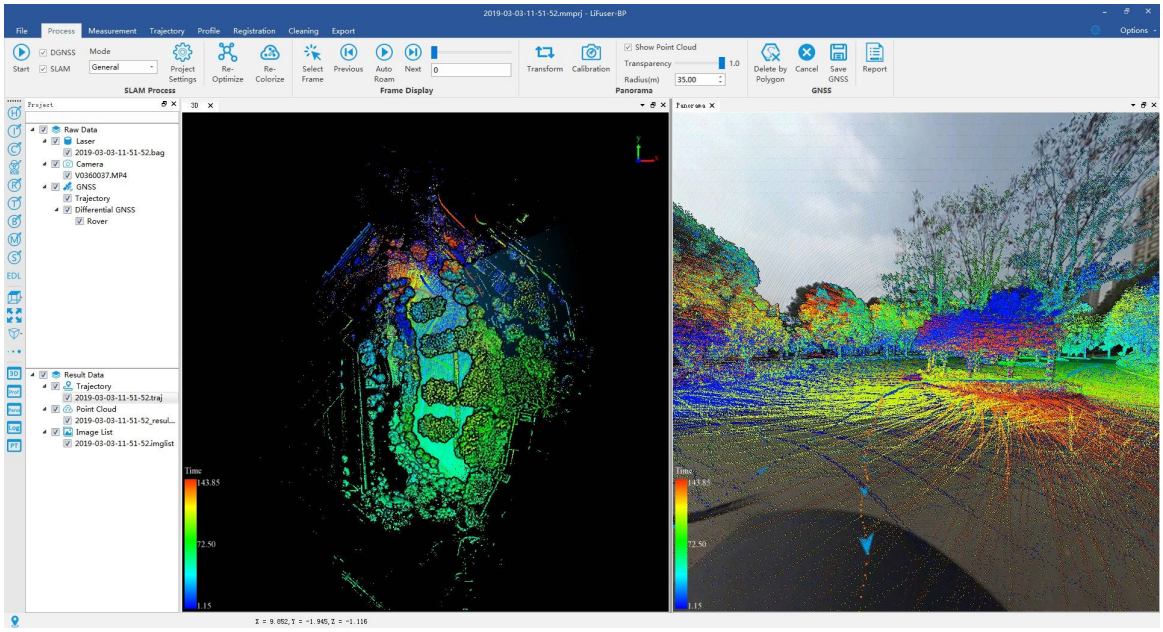
4. Click the colorize toolbar on the left window and change the display mode. EDL can be mixed with other mode to enhance the outline characteristic.



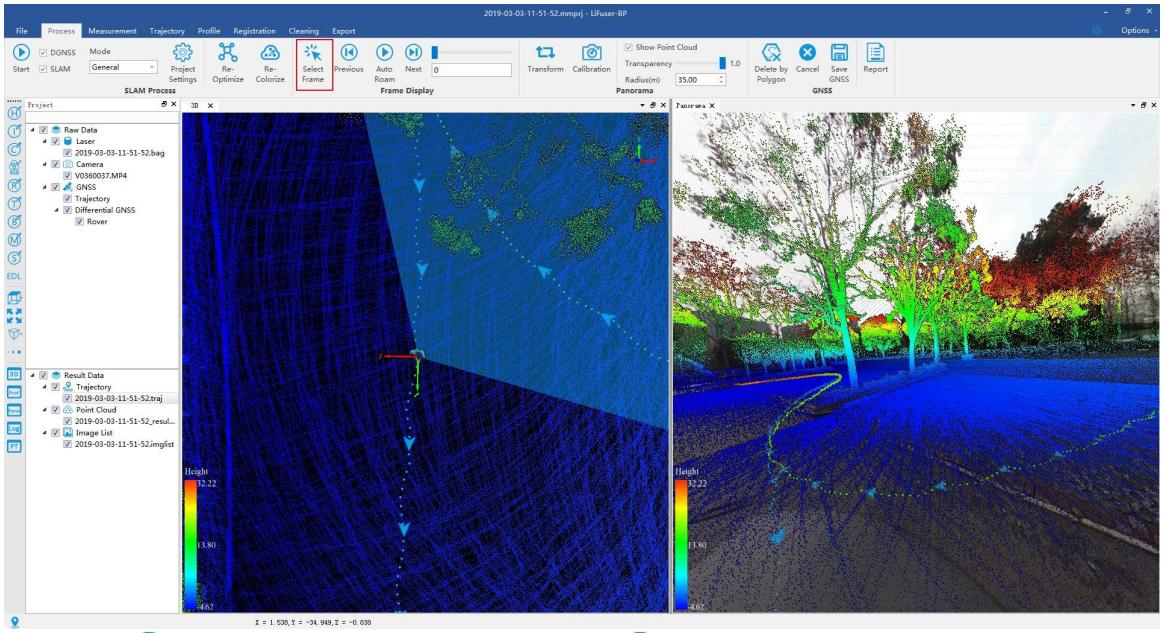
Note：Display mode in toolbar works for all point cloud, if users want to apply for a specific point cloud, right click on its name and choose View Mode > Display by Height / Intensity / Classification etc.

Note: Display by EDL is related to viewer. Please activate a viewer by click anywhere before choose display by EDL.

5. Users can right click point cloud file and tracjory file to change display mode including dispaly by tracjory quality,dispaly by time, dispaly by elevation or display by RGB. For example, display by time.



6. Click *Select Frame*  at Process page, users can choose exposure place in 3D or panoramic viewer (blue triangle by default, turn into orange after clicking), and redirect to the selected place.



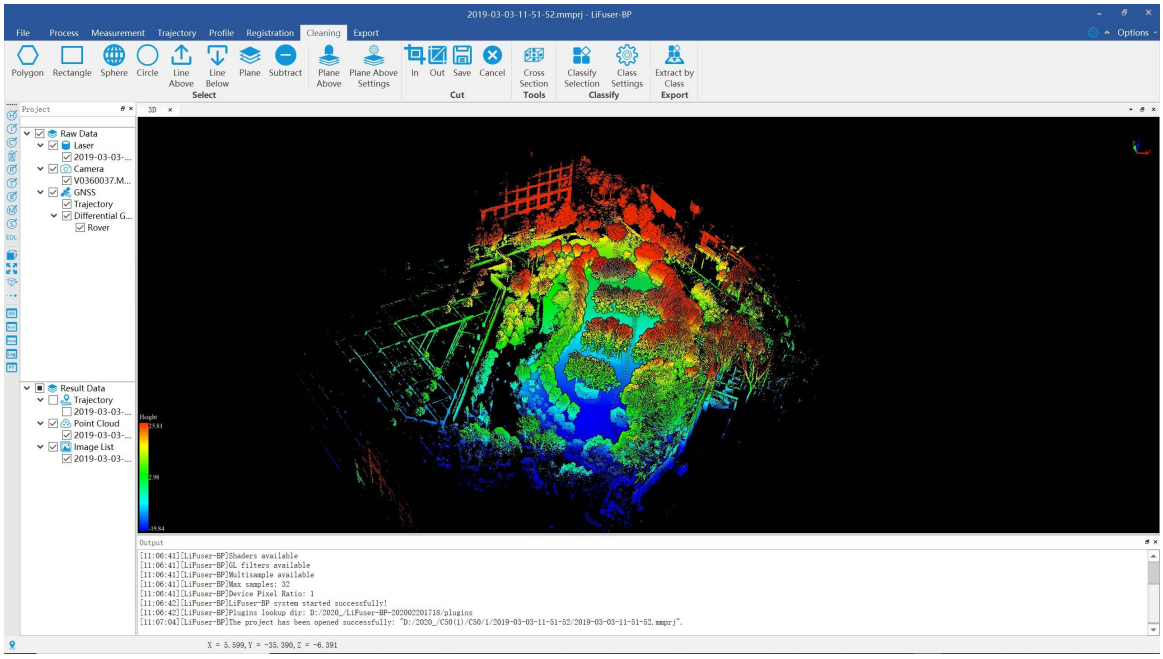
7. Click *Next*  to redirect to next frame. Click *Previous*  to the previous frame.

8. Drag the slider  to switch to different place or directly enter the frame number.

9. Click *Auto Roam*  to roam in panoramic viewer as user sight. Click again to stop roaming.

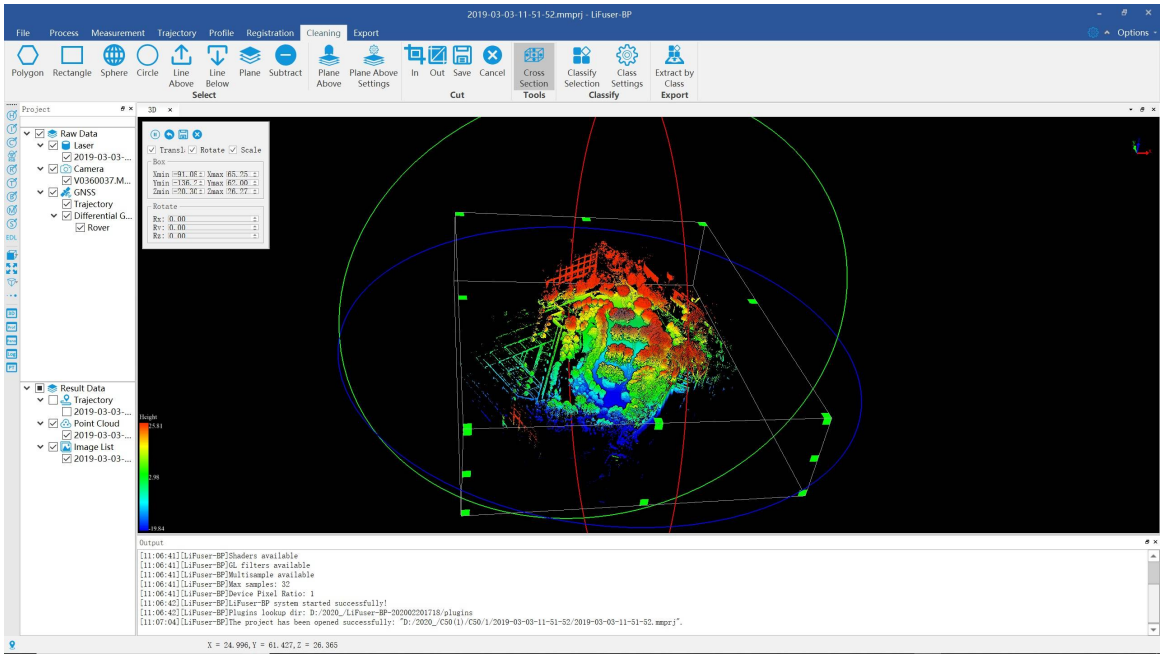
Clip by Cross Section

1. Launch LiFuser-BP software, and load the corresponding engineering files.
2. Set display mode as *Display by Height* + *Display by EDL*.



Set display mode as Display by Height + Display by EDL

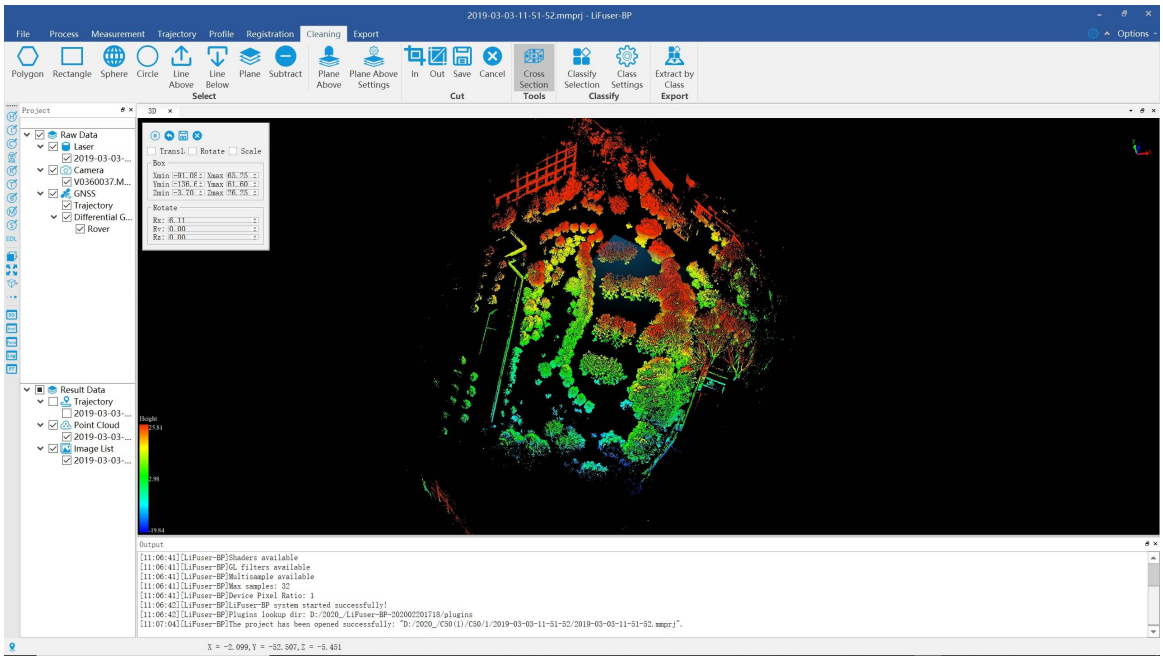
3. Switch to *Cleaning* mode, click *Cross Section*  button, a 3D window will pop up. Three selections on the left corner (*Translate*, *Rotate*, *Scale*) control the pan, rotate, and zoom operation of the bounding box, which works by ticking on the corresponding options.



Adjust the bounding box

4. (optional) Click  button, the bounding box will go back to initial status.

5. The following image is cropped according to the Z axis to remove the effect of the ground point.



Cutting along z-axis

6. Click  button to save the clipped point file.

7. Click  button button to pause intersection selection.

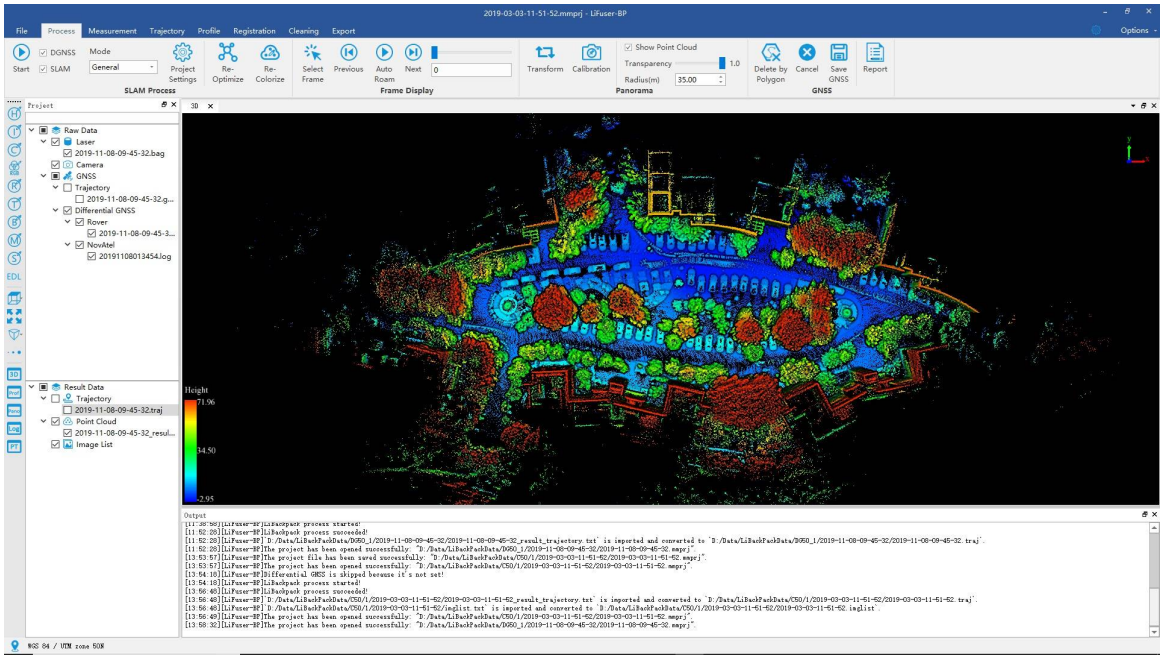
8. Click  buttom to quit intersection selection.

Parameters Setting

- **Translate**: Control the movement of the bounding box.
- **Rotate**: Control the rotation of the bounding box.
- **Scale**: Control the zooming of the bounding box.
- **Box**: It can be accurate to adjust the minimum and maximum value of x, y and z directions of the bounding box.
- **Rotate**: It can be accurate to adjust the angle value of x, y and z directions of the bounding box.

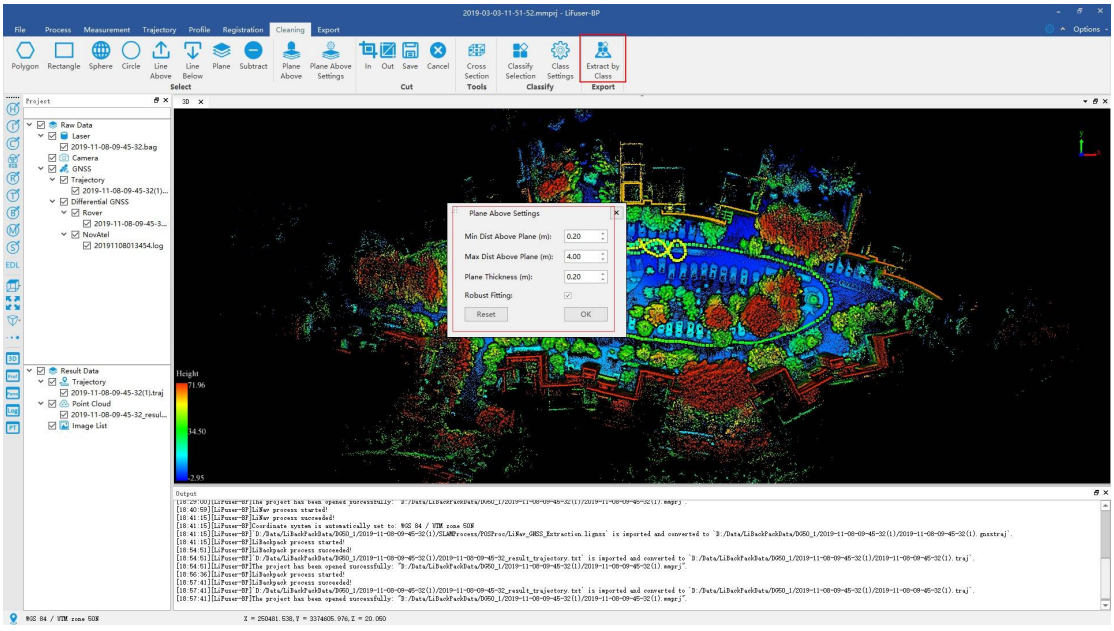
Clean Moving Targets

1. Launch LiFuser-BP, and load a project file.
2. Display the data by Height+EDL.



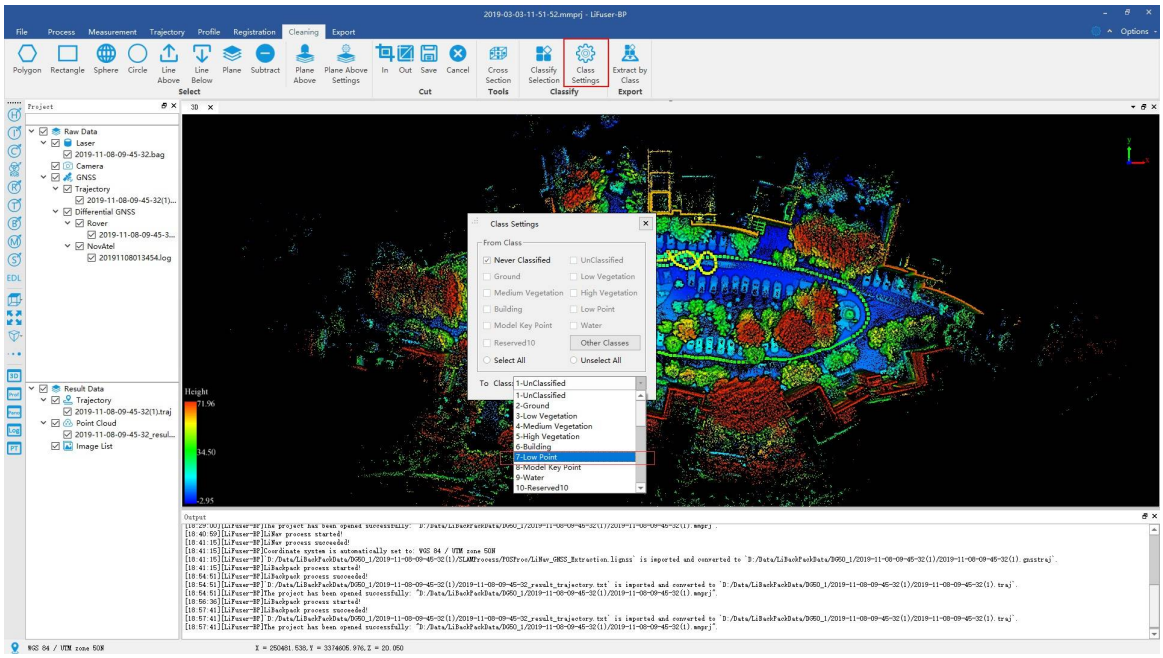
Display by Height+EDL

3. Click *Plane Above Settings*  at Cleaning toolbar, set parameters of designated point clouds above plane.
   - **Min Dist Above Plane(m)**：The minimum distance between the point cloud to the plane.
   - **Max Dist Above Plane(m)**：The maximum distance between the point cloud to the plane.
   - **Plane Thickness(m)**：The thickness of the fitted plane.
   - **Robust Fitting**：whether to use robust fitting or not.



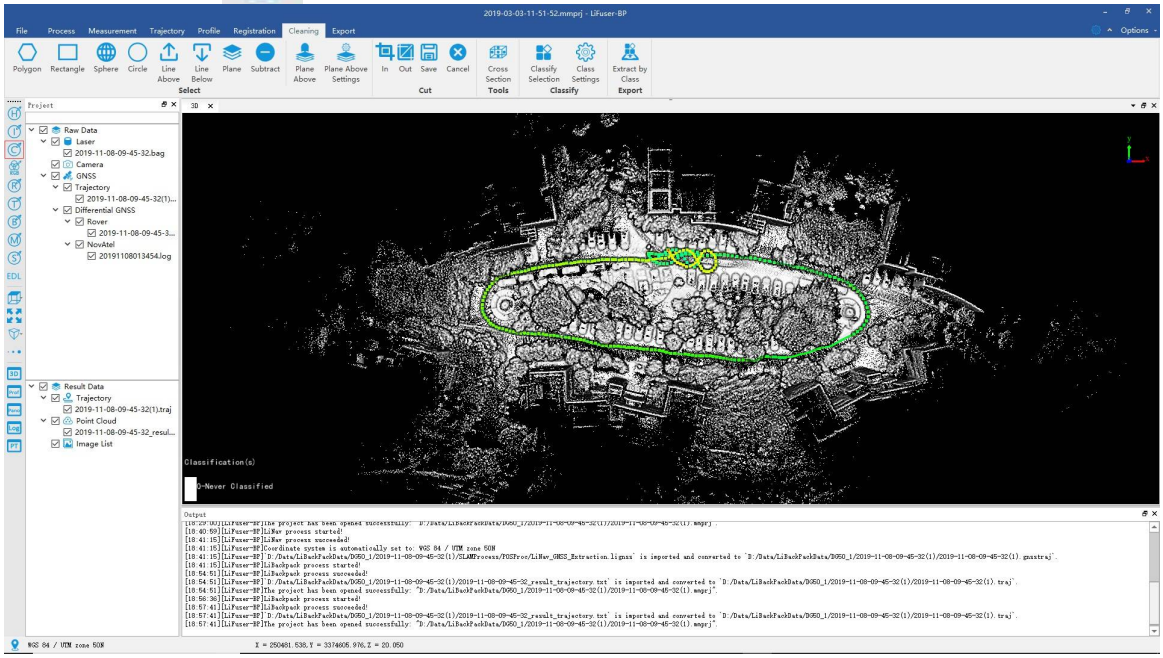
Plane above setting

4. Click *Class Settings button*  , set target classification in selected area and classify moving target to class as 7-Low Point.



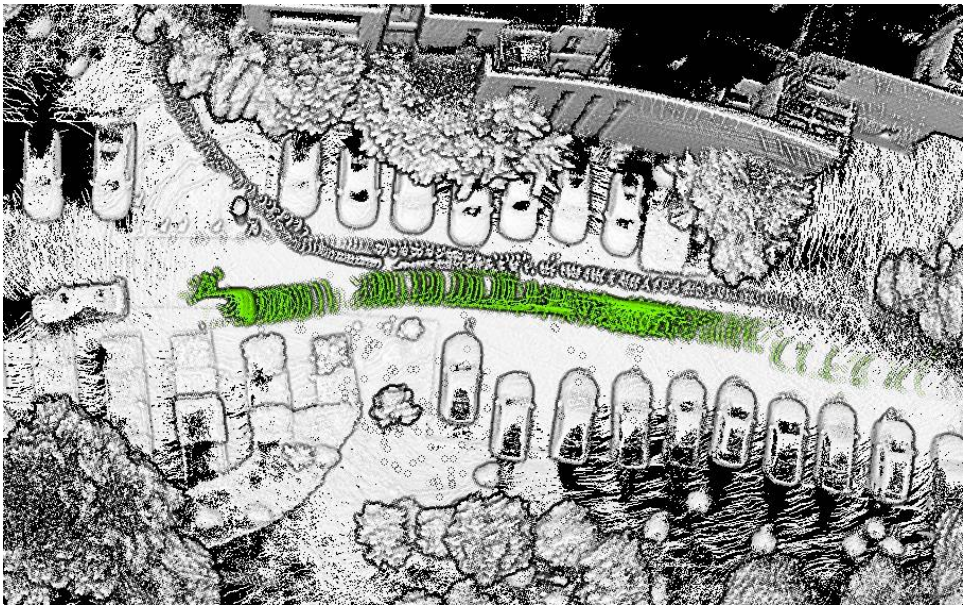
Class setting

5. Click *Display button*  , display the point cloud by classification.



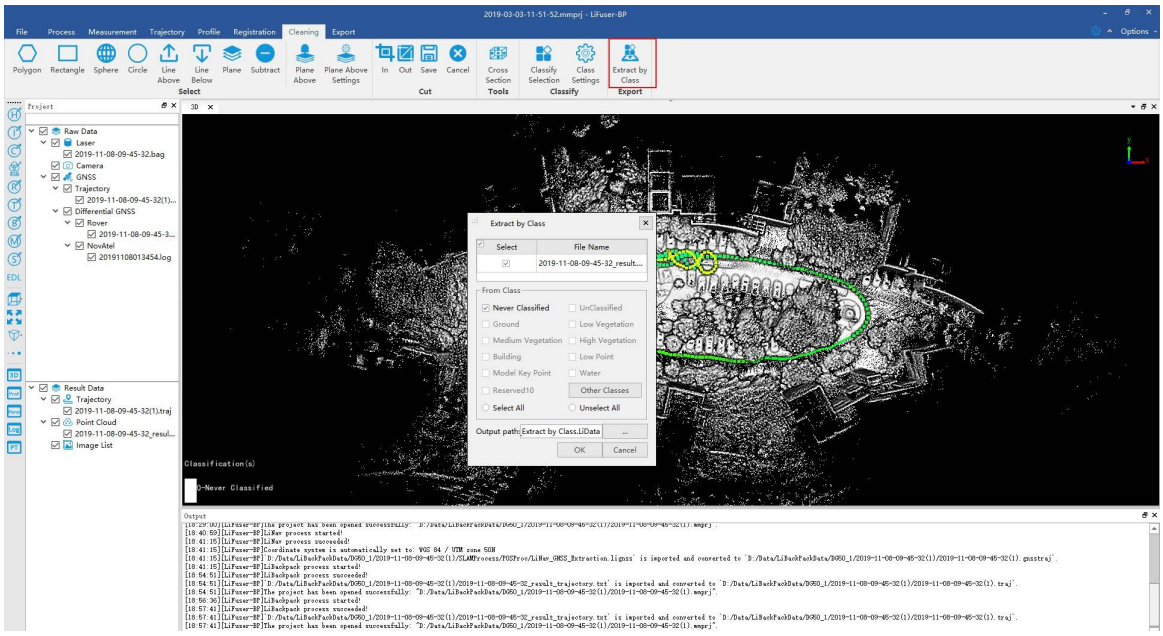
Display by classification

6. Click *Plane Above*  , choose moving objects area. Then click *Classify Selection*  , and the point cloud within selected area will be assigned to objective class.



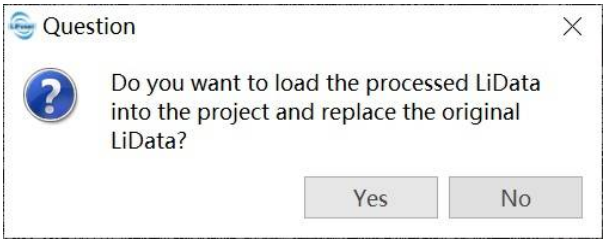
Extract and classify the moving objects

7. Click *Extract by Class*  , untick moving objects, then save the point cloud data to new LiData file.



Save new data by extracting by class

8. The pop-up dialog will ask if you want to load the previous saved point cloud and replace the project's existing point cloud file. If you confirm the replacement, click the *Yes* button, otherwise click the *No* button.



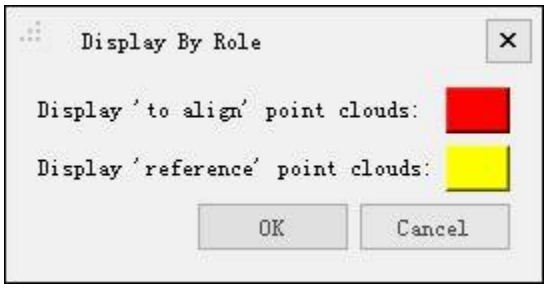
Question dialog

Registration

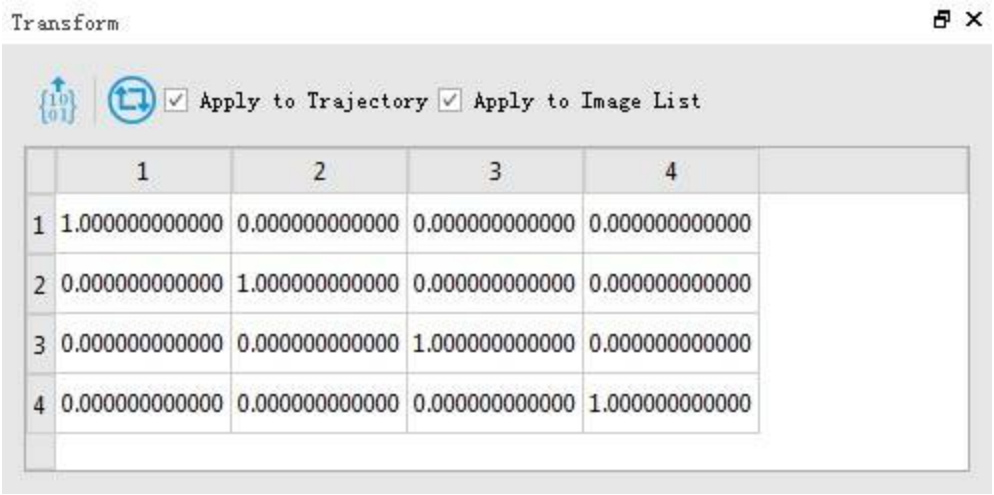
This part includes registering data from multiple stations within an area, and performing absolute geography coordinates calibration by ground control points. The former one can be handled by manual course alignment, ICP (Iterative Closest Point) registration, Point Pairs based registration or Georeference registration; the latter one can be handled by Point Pairs based registration, Georeference registration, TPS (Thin Plate Splines) Calibration.

Coarse Alignment

1. In Registration tab, click *Import Reference* , import reference point cloud, it will be added to the same view as the to-be-aligned point cloud.
2. Click *Display by Role* , this tool renders two point clouds in two different color.By default, point cloud to-be-aligned will be red, reference point cloud will be yellow. Users can click color bar to change it.

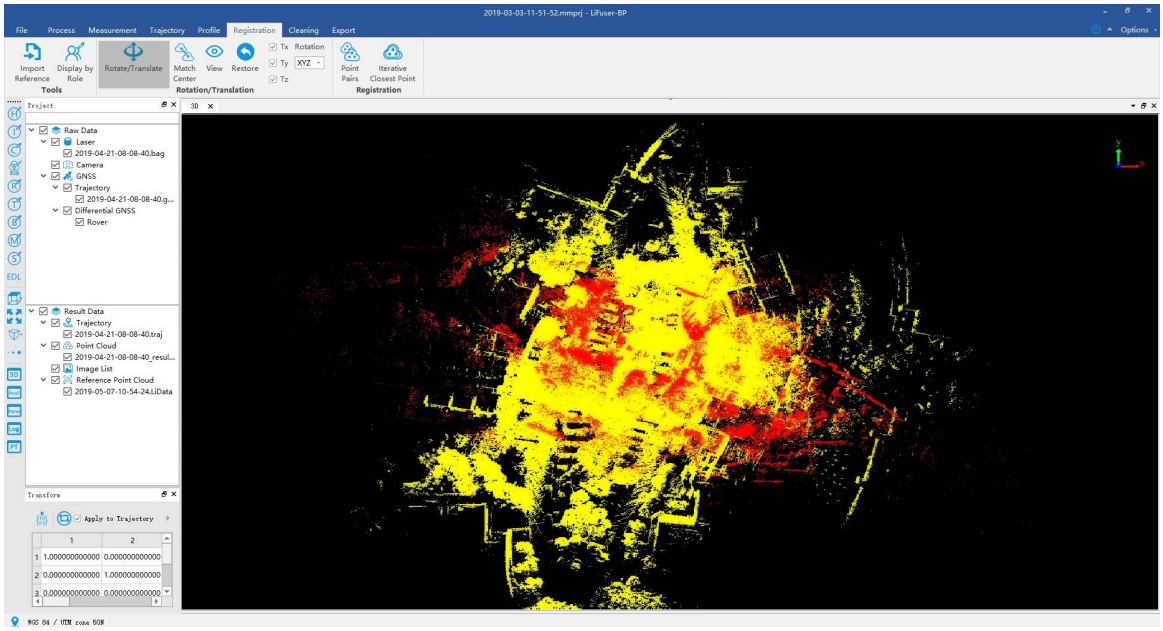


3. Click *Rotate/Translate* , Trasform window will pop up lower left.

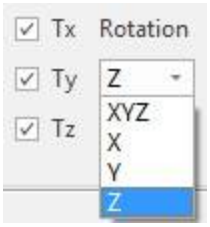


	1	2	3	4
1	1.000000000000	0.000000000000	0.000000000000	0.000000000000
2	0.000000000000	1.000000000000	0.000000000000	0.000000000000
3	0.000000000000	0.000000000000	1.000000000000	0.000000000000
4	0.000000000000	0.000000000000	0.000000000000	1.000000000000

4. (Optional)If two point clouds are far away with each other, users may click *Match Center* , which aligns the centers of the bounding boxes of these two point clouds. And the transformation parameters will appear in the Transform window.

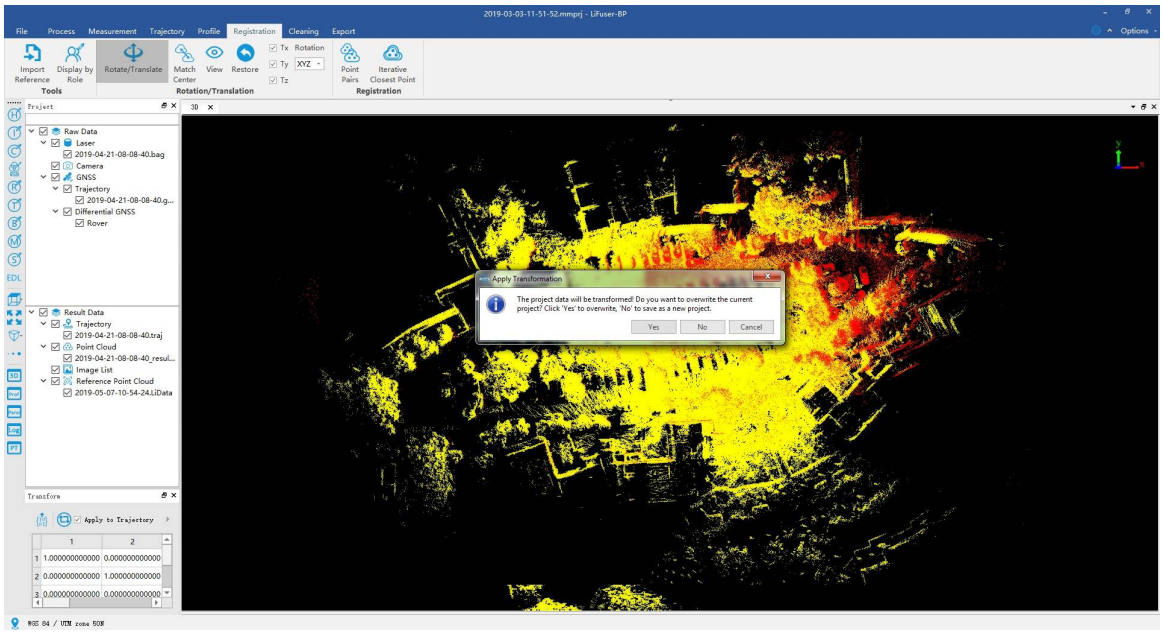


5. Adjust pan and rotate amount along X/Y/Z axises for manual registration. By tick/untick Tx, Ty and Tz to decide whether to pan by X//Y/Z direction or not. By Rotation drop-down box, users can control if rotate by single axis or all of the axises. Left click to rotate in the point cloud viewer, and right or middle click to pan.

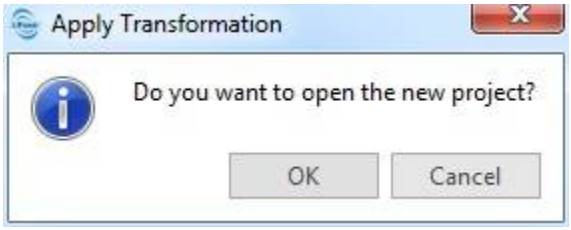


6. Users can check the registration performance by click *View*  during the process.

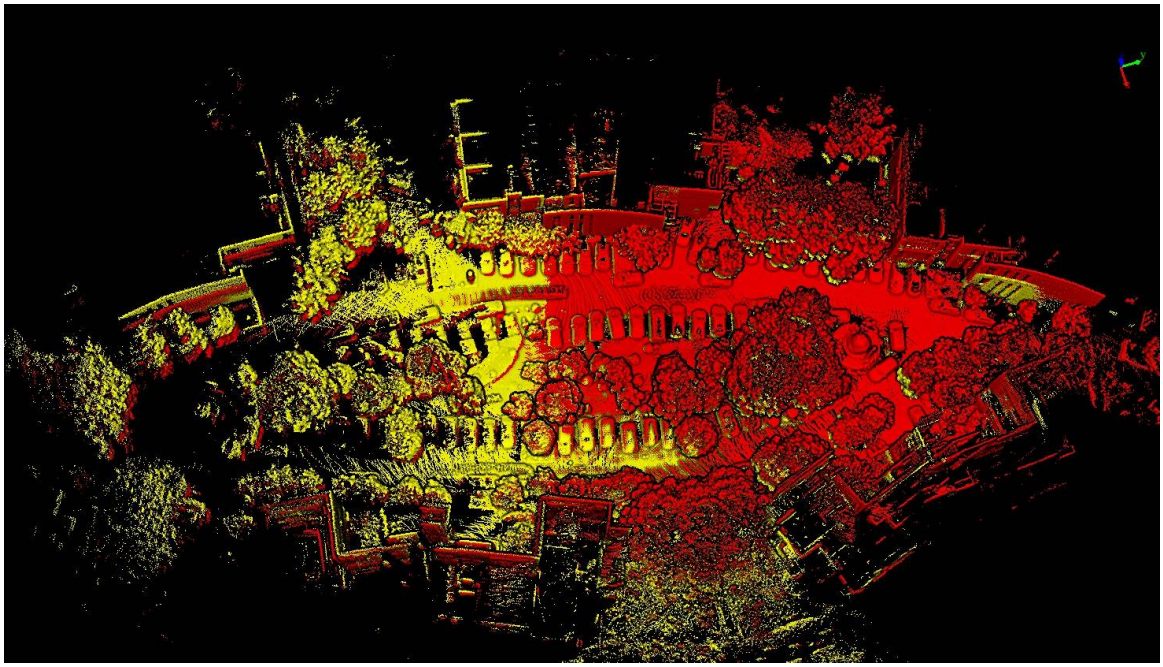
7. When registration is done, click  in Transform window to transform. In the pop-up window, click **Yes** to transform and overwrite the current point cloud, or click **No** to save a new transformed point cloud.



8. If click "No", after finishing transformation, the software will ask whether to open the new project or not, click OK.

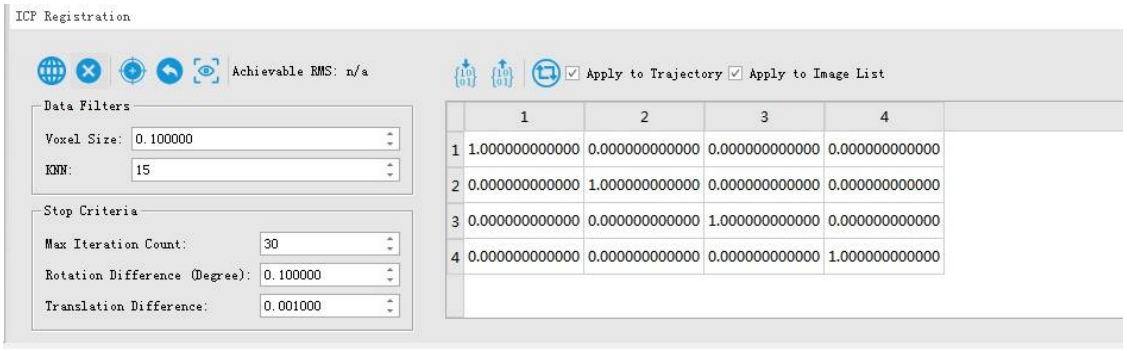


9. Repeat step one and two to add reference point cloud, the result of course registration are shown as below:

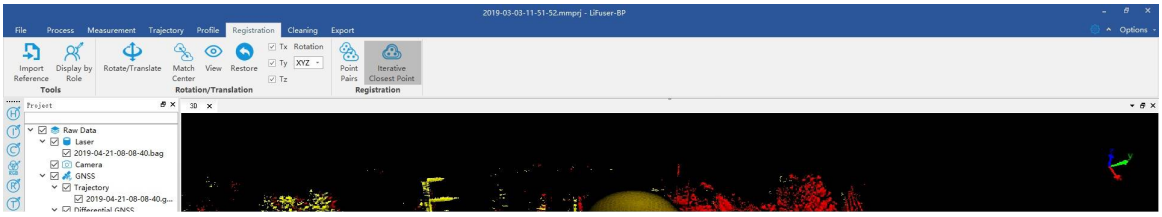


ICP Registration

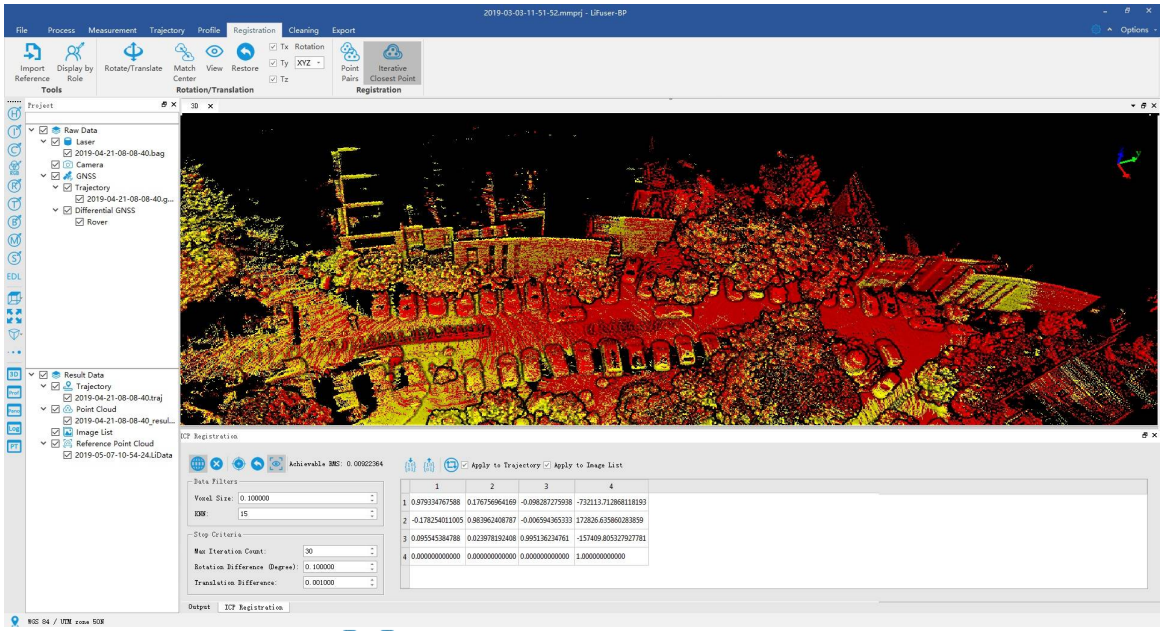
1. After completing coarse registration, click *Iterative Closest Point* to activate the ICP registration tool.



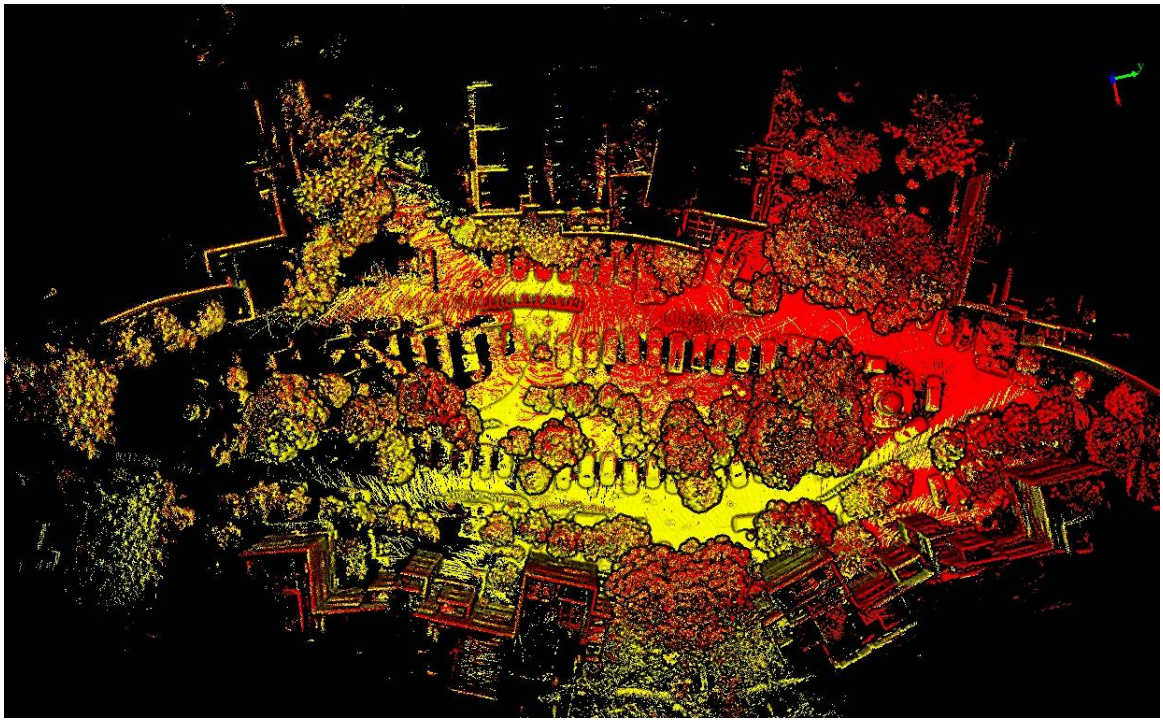
2. Click tool and click on an overlapping region of two point clouds. Drag and double-click to select. The selected overlapping region will be used for ICP. Multiple regions can be selected. Users can press ctrl+Z or click and re-select.



3. After selection, click to process ICP Registration.
4. Click to preview the registration results.

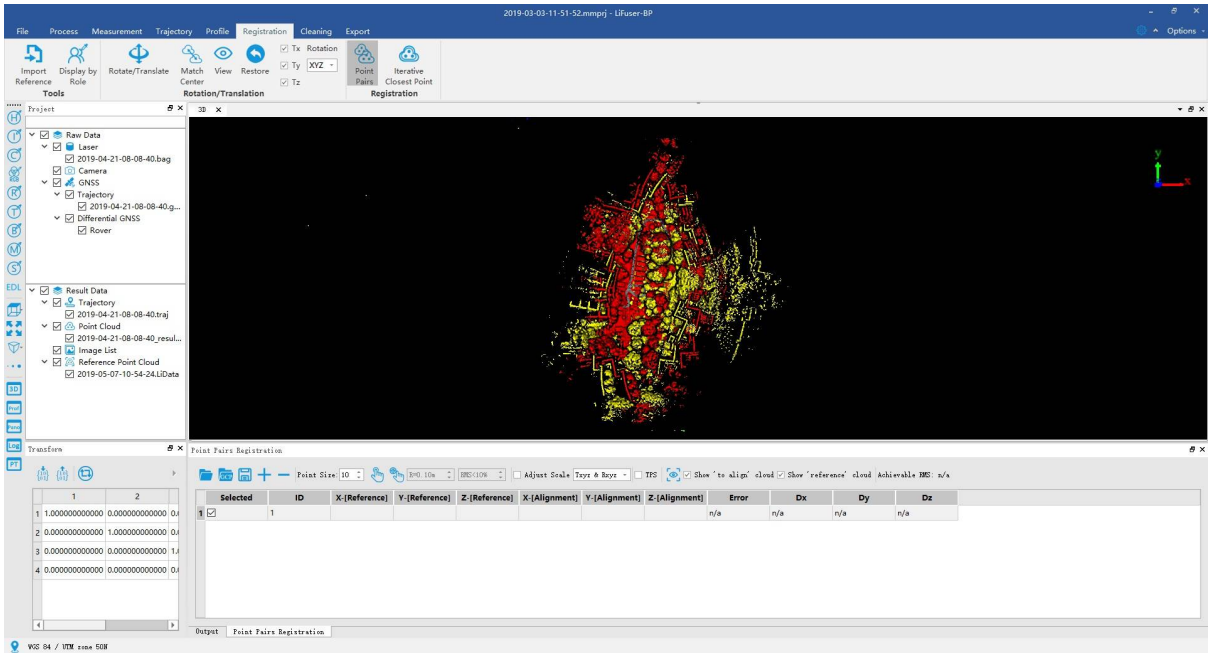


5. If unhappy with the result, click , close preview and repeat step 2 to 4 to re-register.
6. Once satisfied with the result, click **Apply Transform** to apply transformation. In the pop-up window, click **Yes** to transform and overwrite the current point cloud, or click **No** to save a new transformed point cloud.
7. If click "No", after finishing transformation, the software will suggest whether to open the new project or not, click OK.



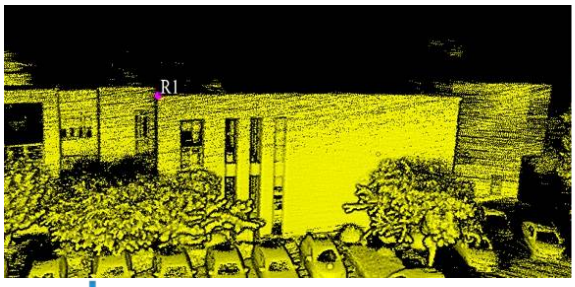
Point Pairs Registration

After completing coarse registration, click *Point Pairs* to activate the GCP registration tool. There are two ways of acquiring point pairs: pick manually or pick by registration sphere.

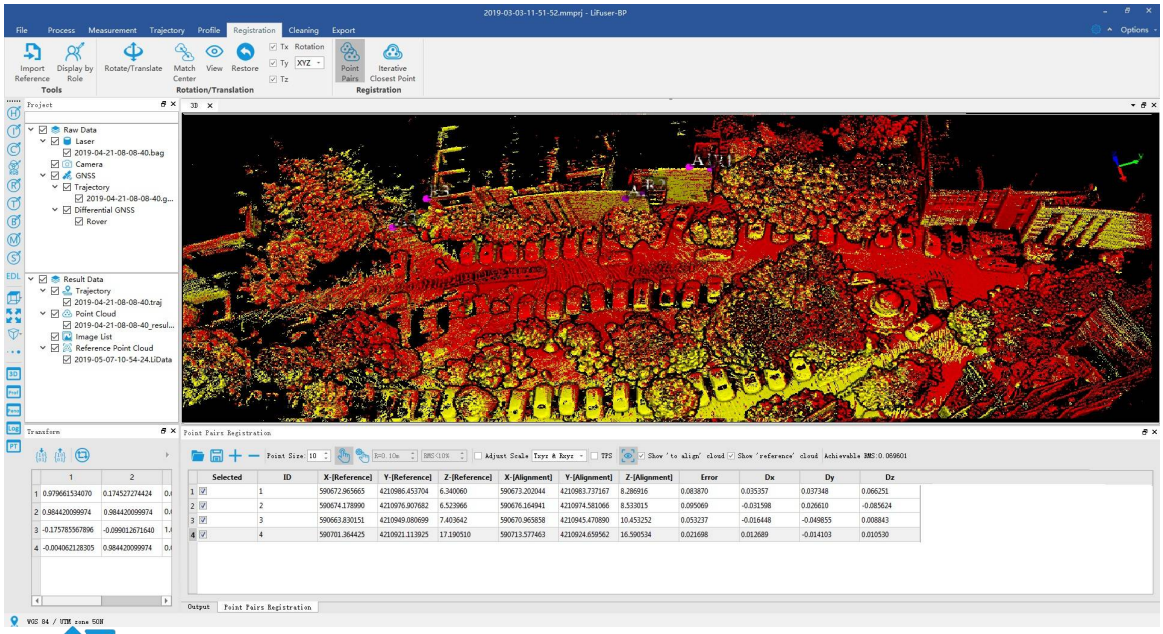


Pick manually

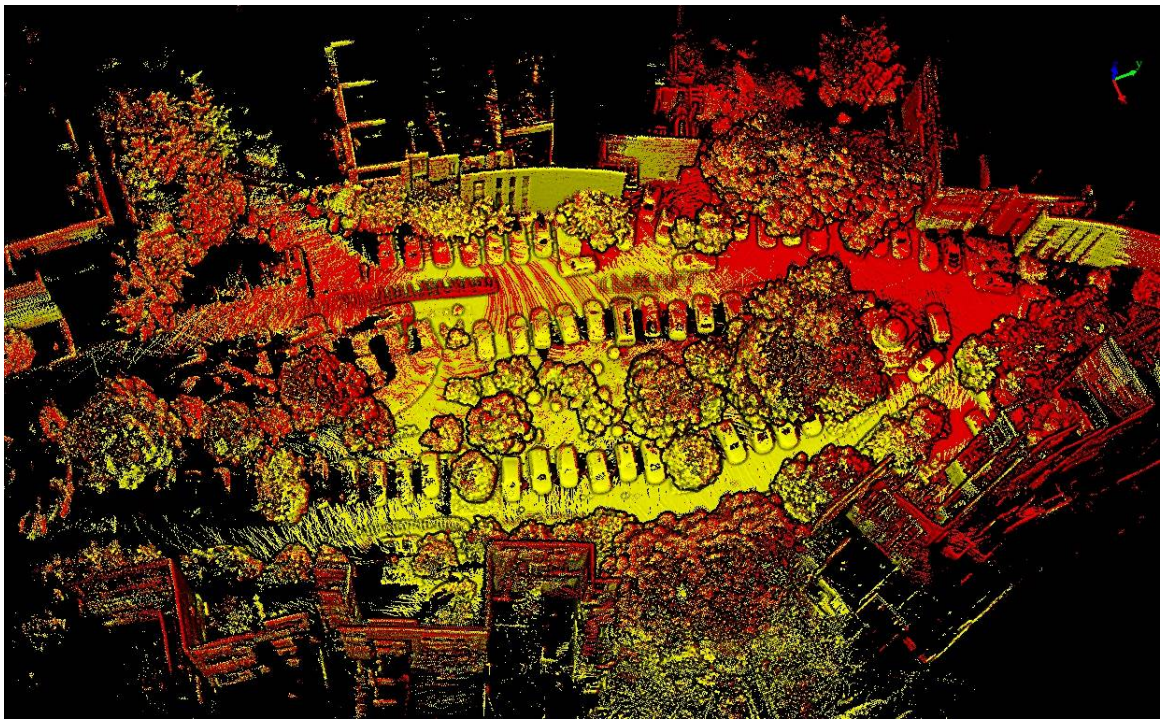
1. Click and pick point pair with obvious characteristic from both two point clouds.If point clouds due to block each other makes it hard to pick points, users can uncheck the box behind file name or check Show 'to align' cloud Show 'reference' cloud to view point cloud separately.



2. Click to add a row, and repeat the former step.
3. Repeat step 1 and 2, and pick at least three point pairs. When there are more than three point pairs picked, the registration error will appear in the table. Users can preview registration results by clicking .



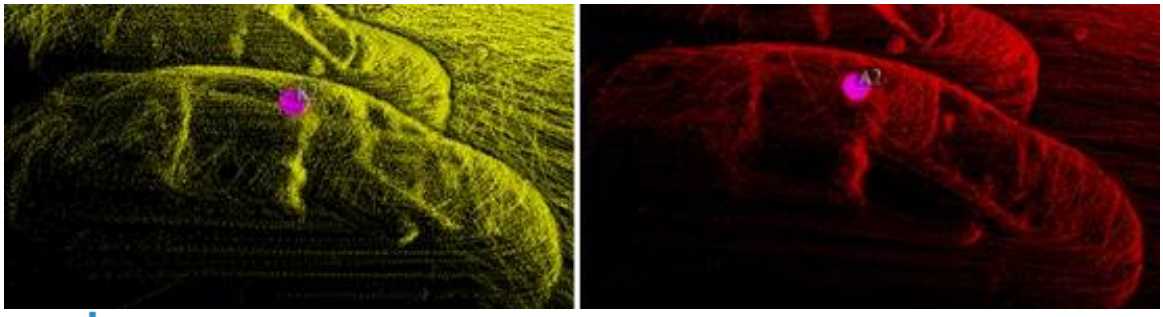
4. Click in Transform window to transform the data. In the pop-up window, click **Yes** to transform and overwrite the current point cloud, or click **No** to save a new transformed point cloud.
5. If click "No", after finishing transformation, the software will suggest whether to open the new project, and click OK.



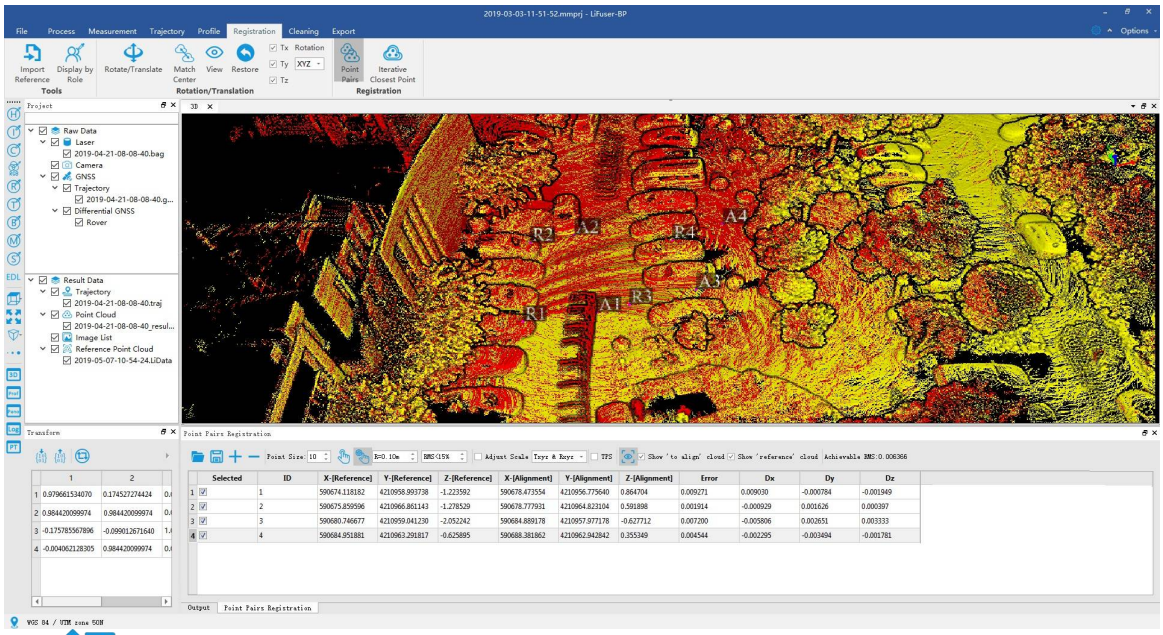
Pick by Registration Sphere

1. Click and set the radius and RMS (The higher the value, the easier the fitting, but with a higher fitting error; vice versa). Find where sphere located in both point cloud file, then left click to fit the sphere. Spherical center coordinates will appear in the pair window. If point clouds due to block each other makes it hard to pick points, users can uncheck the box behind file name or check

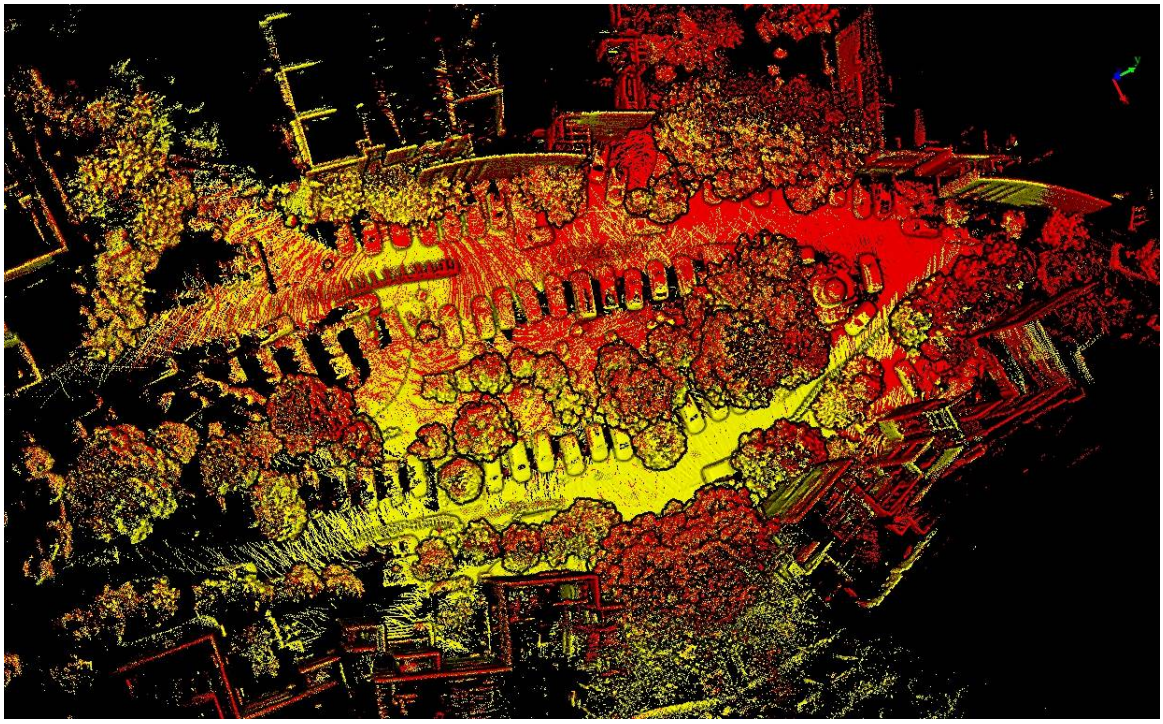
to view point cloud separately.



2. Click  to add a row, and repeat the former step.
3. Repeat step 1 and 2, and pick at least three point pairs. When there are more than three point pairs picked, the registration error will appear in the table. Users can preview registration results by clicking  .

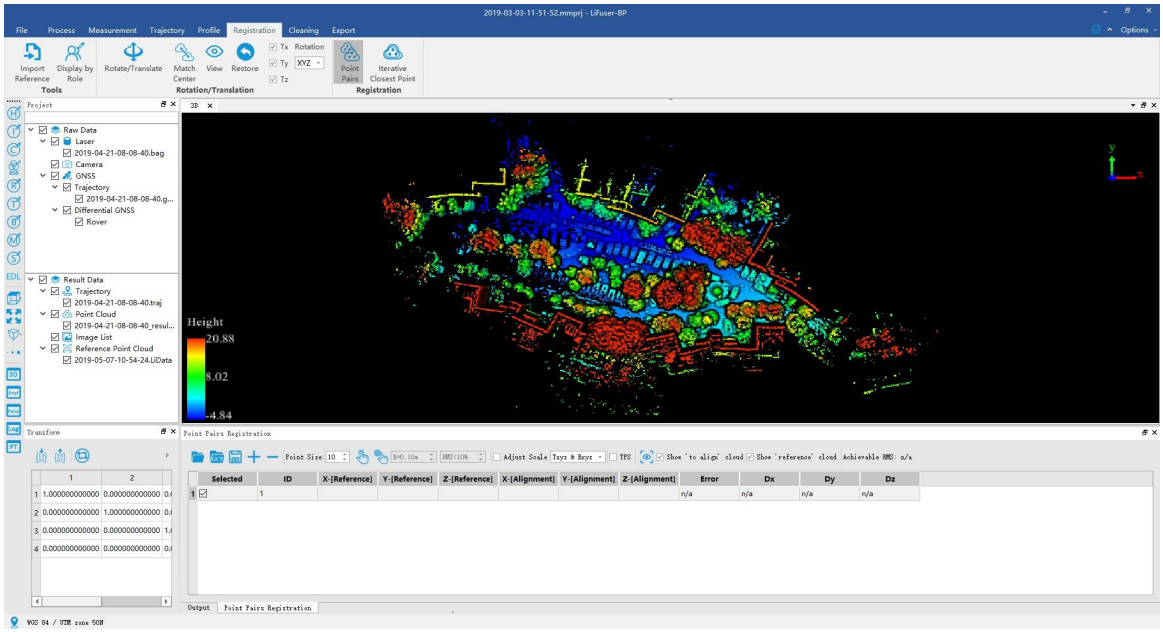


4. Click  in Transform window to transform the data. In the pop-up window, click **Yes** to transform and overwrite the current point cloud, or click **No** to save a new transformed point cloud.
5. If click "No", after finishing transformation, the software will suggest whether to open the new project, and click OK.

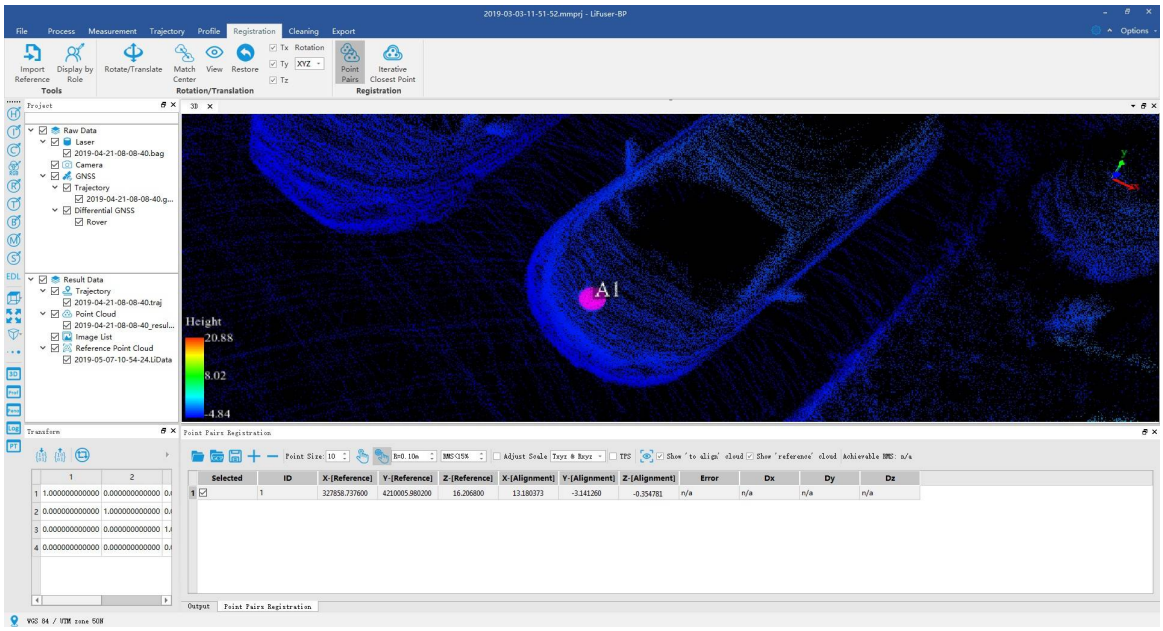


Georefernce Registration

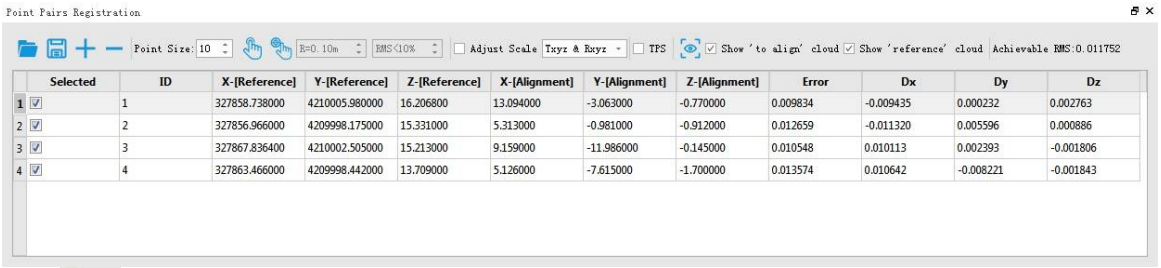
1. Click *Point Pairs*  under Registration tab, registration window and transform window will appear.



2. Enter the GCP coordinates into the reference window, and select the corresponding points as point pair. Points can be selected manually or by sphere registration.

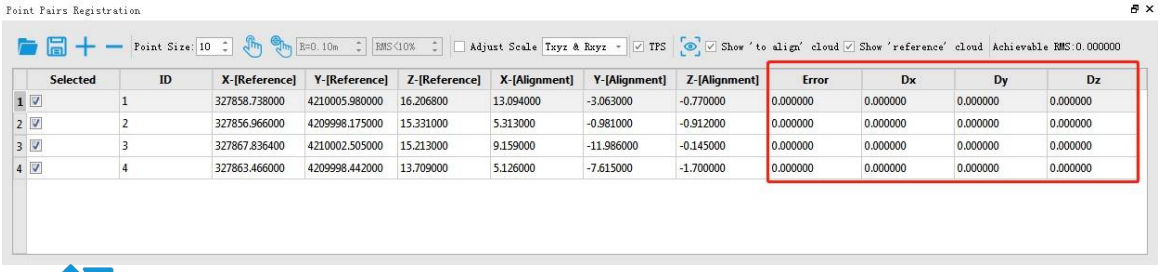


3. Pick at least three point pairs. When there are more than three point pairs picked, the registration error will appear in the table.



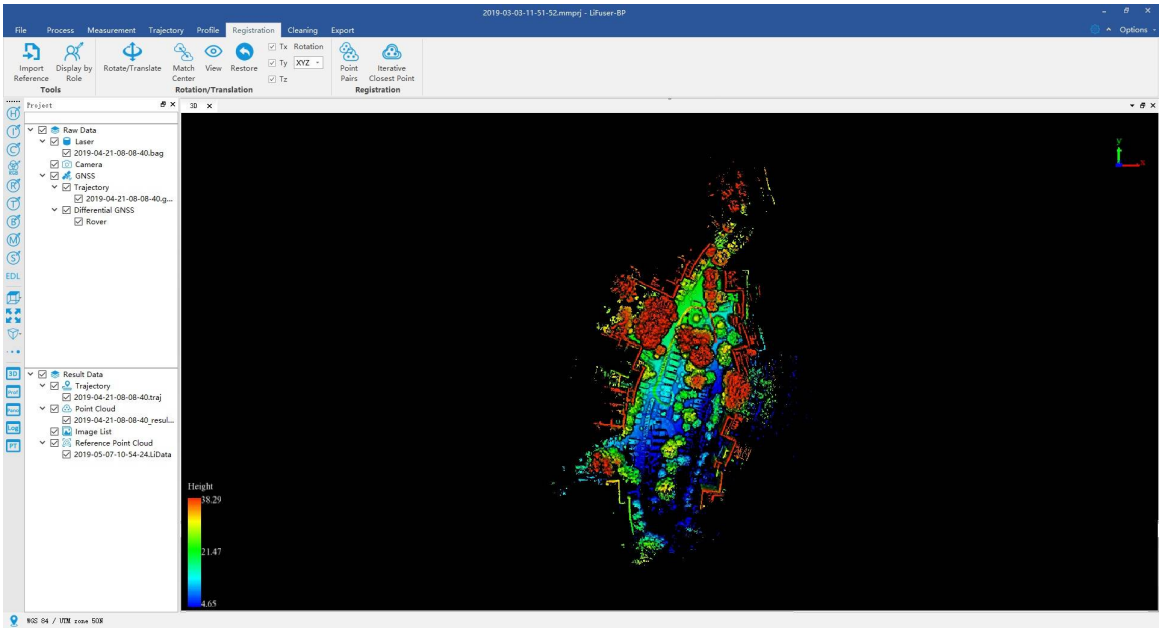
	Selected	ID	X-[Reference]	Y-[Reference]	Z-[Reference]	X-[Alignment]	Y-[Alignment]	Z-[Alignment]	Error	Dx	Dy	Dz
1	☑	1	327858.738000	4210005.980000	16.206800	13.094000	-3.063000	-0.770000	0.009834	-0.009435	0.000232	0.002763
2	☑	2	327856.966000	4209998.175000	15.331000	5.313000	-0.981000	-0.912000	0.012659	-0.011320	0.005596	0.000886
3	☑	3	327867.836400	4210002.505000	15.213000	9.159000	-11.986000	-0.145000	0.010548	0.010113	0.002393	-0.001806
4	☑	4	327863.466000	4209998.442000	13.709000	5.126000	-7.615000	-1.700000	0.013574	0.010642	-0.008221	-0.001843

4. Click ☑ TPS , turn residual of GCPs into zero by plane fitting.



	Selected	ID	X-[Reference]	Y-[Reference]	Z-[Reference]	X-[Alignment]	Y-[Alignment]	Z-[Alignment]	Error	Dx	Dy	Dz
1	☑	1	327858.738000	4210005.980000	16.206800	13.094000	-3.063000	-0.770000	0.000000	0.000000	0.000000	0.000000
2	☑	2	327856.966000	4209998.175000	15.331000	5.313000	-0.981000	-0.912000	0.000000	0.000000	0.000000	0.000000
3	☑	3	327867.836400	4210002.505000	15.213000	9.159000	-11.986000	-0.145000	0.000000	0.000000	0.000000	0.000000
4	☑	4	327863.466000	4209998.442000	13.709000	5.126000	-7.615000	-1.700000	0.000000	0.000000	0.000000	0.000000

5. Click  in Transform window to transform the data. In the pop-up window, click **Yes** to transform and overwrite the current point cloud, or click **No** to save a new transformed point cloud.
6. If click "No", after finishing transformation, the software will suggest whether to open the new project, and click OK.



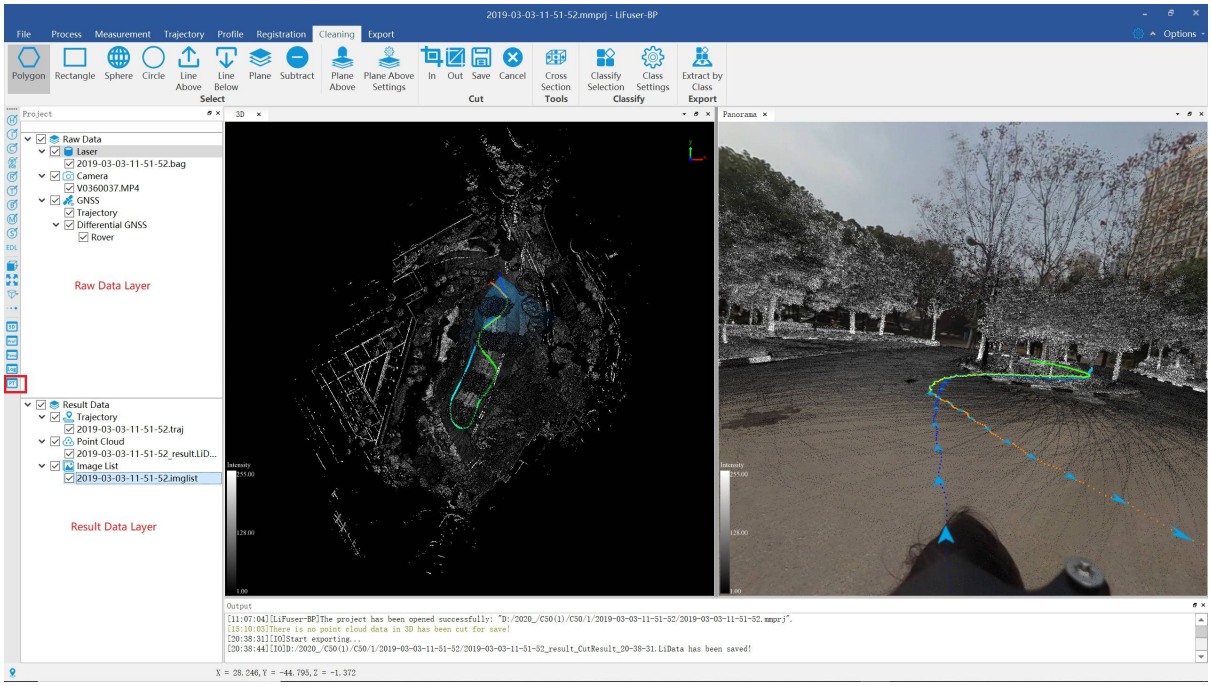
Project Management

Layer Management

Function Description

In the project layers the user can show/hide data in all windows by checking/unchecking the box before data node (or data type node). The data can be dragged from data node to different windows for display. The context menu (i.e. right-click menu) of data node, which differs depending on data types, is mainly used for data query, display, statistics, export, and removal, etc.

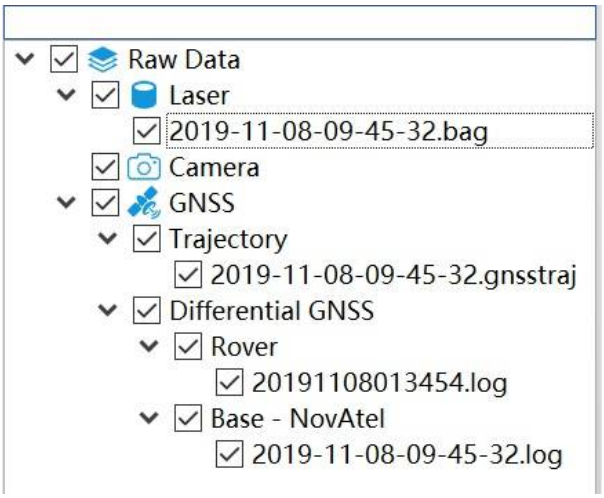
Click PT button to show project layers as follows:



There are two layers classified by source including:

- Raw Data Layer
- Result Data Layer

Raw Data Layer



Right-click Menu Introduction:

- GNSS Trajectory Right-click Menu

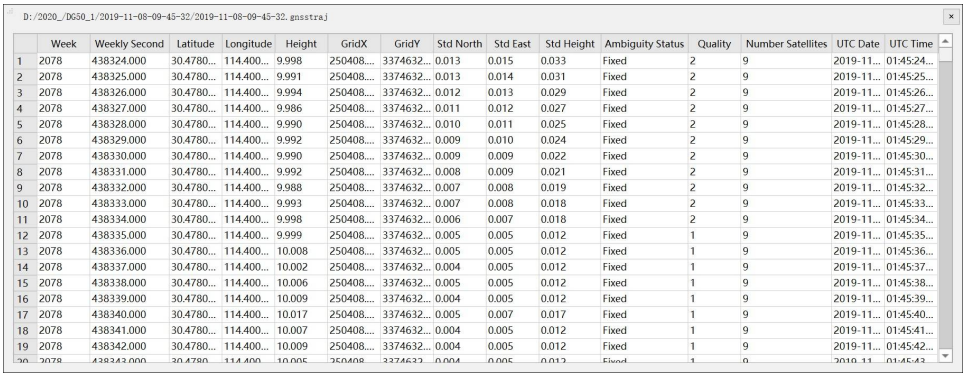
GNSS Trajectory Right-click Menu

Function Description

In raw data layer management, GNSS trajectory menu (i.e. right-click menu) of data node, is mainly used for data query, display, statistics, export, and removal, etc.

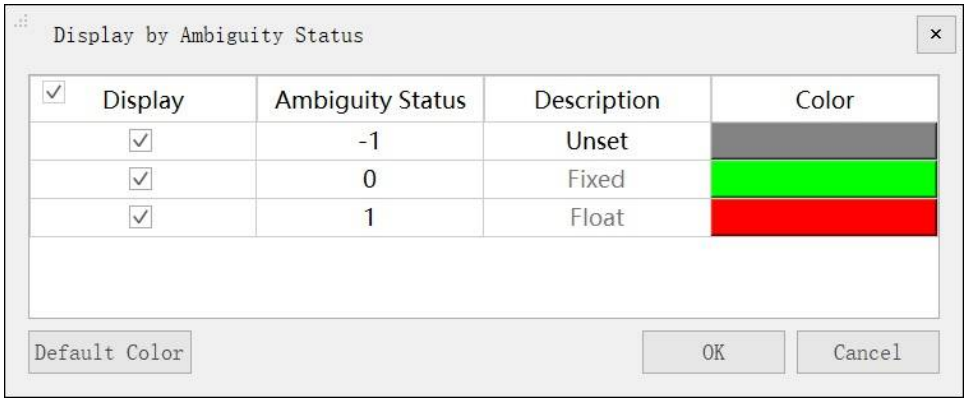
Data Right-click Menu

- **Info**: Check GNSS trajectory data information including cycle, cycle per second, longitude and latitude, ambiguity, altitude, quality and etc. as follows.

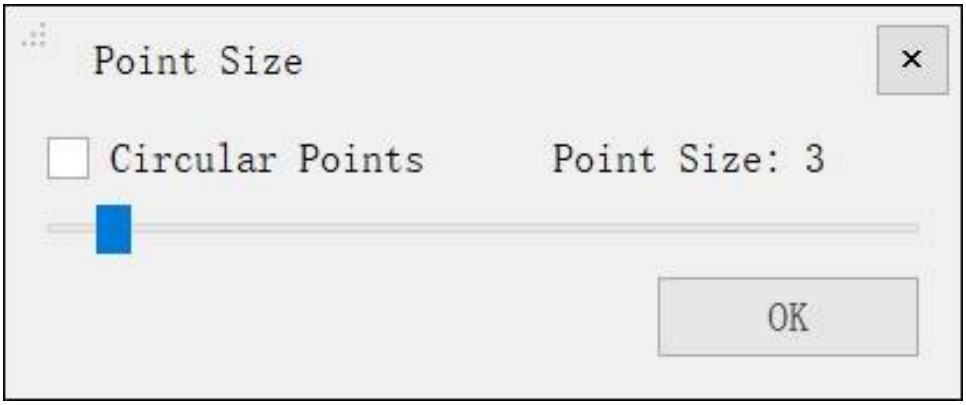

D:/2020_/DG50_1/2019-11-08-09-45-32/2019-11-08-09-45-32.gnsstraj

	Week	Weekly Second	Latitude	Longitude	Height	GridX	GridY	Std North	Std East	Std Height	Ambiguity Status	Quality	Number Satellites	UTC Date	UTC Time
1	2078	438324.000	30.4780...	114.400...	9.998	250408....	3374632...	0.013	0.015	0.033	Fixed	2	9	2019-11...	01:45:24...
2	2078	438325.000	30.4780...	114.400...	9.991	250408....	3374632...	0.013	0.014	0.031	Fixed	2	9	2019-11...	01:45:25...
3	2078	438326.000	30.4780...	114.400...	9.994	250408....	3374632...	0.012	0.013	0.029	Fixed	2	9	2019-11...	01:45:26...
4	2078	438327.000	30.4780...	114.400...	9.986	250408....	3374632...	0.011	0.012	0.027	Fixed	2	9	2019-11...	01:45:27...
5	2078	438328.000	30.4780...	114.400...	9.990	250408....	3374632...	0.010	0.011	0.025	Fixed	2	9	2019-11...	01:45:28...
6	2078	438329.000	30.4780...	114.400...	9.992	250408....	3374632...	0.009	0.010	0.024	Fixed	2	9	2019-11...	01:45:29...
7	2078	438330.000	30.4780...	114.400...	9.990	250408....	3374632...	0.009	0.009	0.022	Fixed	2	9	2019-11...	01:45:30...
8	2078	438331.000	30.4780...	114.400...	9.992	250408....	3374632...	0.008	0.009	0.021	Fixed	2	9	2019-11...	01:45:31...
9	2078	438332.000	30.4780...	114.400...	9.988	250408....	3374632...	0.007	0.008	0.019	Fixed	2	9	2019-11...	01:45:32...
10	2078	438333.000	30.4780...	114.400...	9.993	250408....	3374632...	0.007	0.008	0.018	Fixed	2	9	2019-11...	01:45:33...
11	2078	438334.000	30.4780...	114.400...	9.998	250408....	3374632...	0.006	0.007	0.018	Fixed	2	9	2019-11...	01:45:34...
12	2078	438335.000	30.4780...	114.400...	9.999	250408....	3374632...	0.005	0.005	0.012	Fixed	1	9	2019-11...	01:45:35...
13	2078	438336.000	30.4780...	114.400...	10.008	250408....	3374632...	0.005	0.005	0.012	Fixed	1	9	2019-11...	01:45:36...
14	2078	438337.000	30.4780...	114.400...	10.002	250408....	3374632...	0.004	0.005	0.012	Fixed	1	9	2019-11...	01:45:37...
15	2078	438338.000	30.4780...	114.400...	10.006	250408....	3374632...	0.005	0.005	0.012	Fixed	1	9	2019-11...	01:45:38...
16	2078	438339.000	30.4780...	114.400...	10.009	250408....	3374632...	0.004	0.005	0.012	Fixed	1	9	2019-11...	01:45:39...
17	2078	438340.000	30.4780...	114.400...	10.017	250408....	3374632...	0.005	0.007	0.017	Fixed	1	9	2019-11...	01:45:40...
18	2078	438341.000	30.4780...	114.400...	10.007	250408....	3374632...	0.004	0.005	0.012	Fixed	1	9	2019-11...	01:45:41...
19	2078	438342.000	30.4780...	114.400...	10.009	250408....	3374632...	0.004	0.005	0.012	Fixed	1	9	2019-11...	01:45:42...

- **View Mode**: Set display mode of GNSS trajectory data including:
  - **Display by Quality**: Please reference Display by Quality
  - **Display by Ambiguity Status**: Click to pop up the window, display by ambiguity status including unknown, fixed and unfixed status.



  - **Display by Height**: Please reference Display by Height
  - **Display by Time**: Please reference Display by Time
  - **Display by Specific Color**: Please reference Display by Specific Color
- **Zoom to Layer**: Calculate the bounding box of the current raster data. All the windows, in which the data object is loaded, will show full extent of the bounding box.
- **Point Appearance**: Users can select a circular or quadrate shape point and zoom in and out to change the point size.

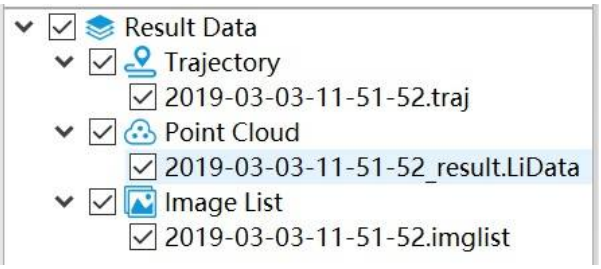


- **Open Report**: Open GNSS Report High Accuracy Process-GNSS Report

Parameters Setting

- **Point Attributes**
  - **Circular Points (optional)**: Set a circular or quadrate shape point for GNSS trajectory data.
  - **Point Size**

Result Data Layer



Right-click menu introduction:

- Point Cloud Right-click Menu
- Result Trajectory Right-click Menu
- Image List Right-click Menu

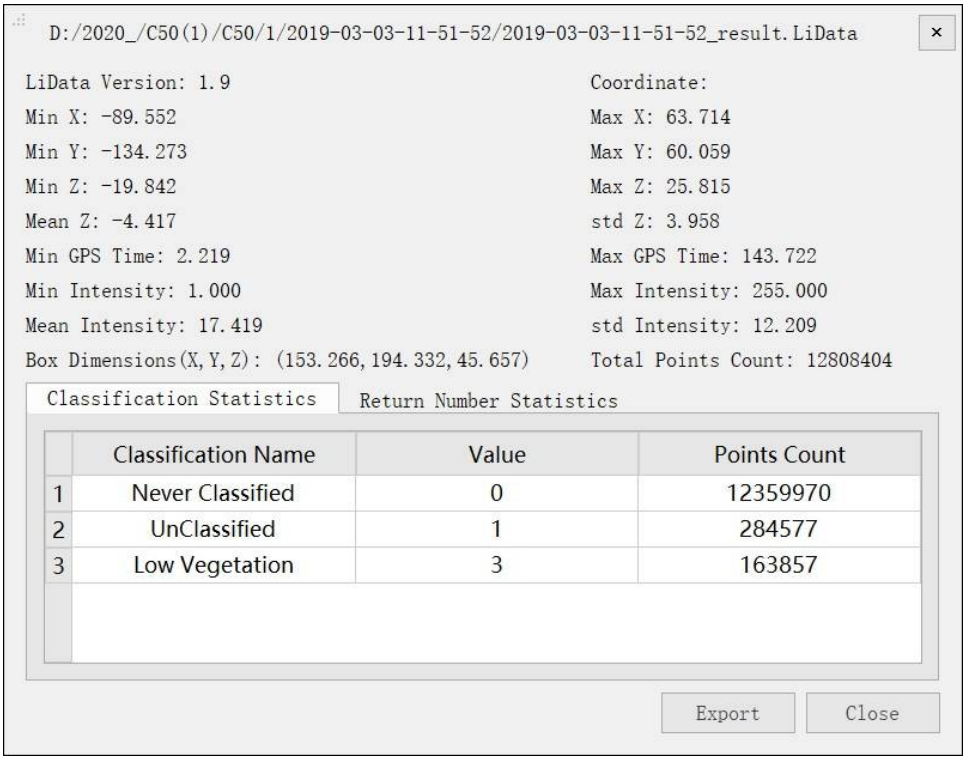
Point Cloud Data Right-click Menu

Function Description

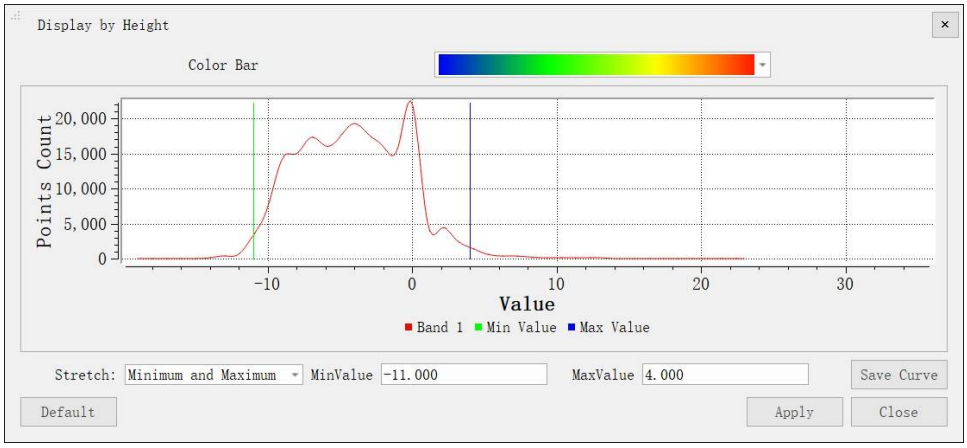
In result data layer management, point cloud menu (i.e. right-click menu) of data node, is mainly used for data query, display, statistics, export, and removal, etc.

Data Right-click Menu

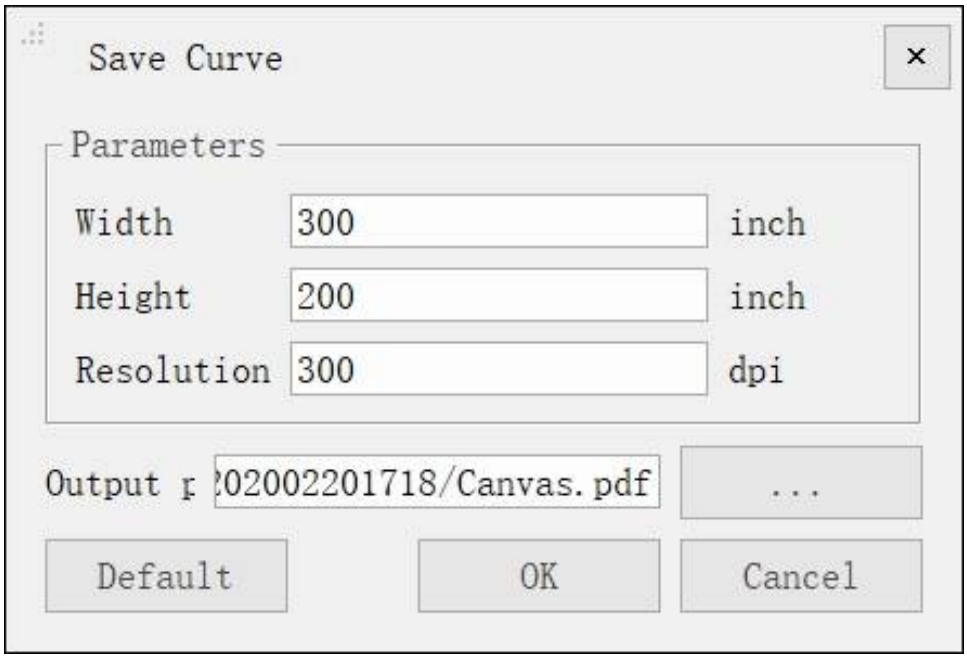
- **Info**: Check the point cloud information including data's path, coordinate information (minimum, maximum and mean value), GPS Time, intensity, the bounding box, total amounts of point cloud, classification and return of number information. Click "Export" buttton to save as *.txt formatted file.



- **View Mode**: Set display mode of point cloud including the following types.
  - **Display by Height**: Change the minimum, maximum or standard deviation value to enchance the display effect.

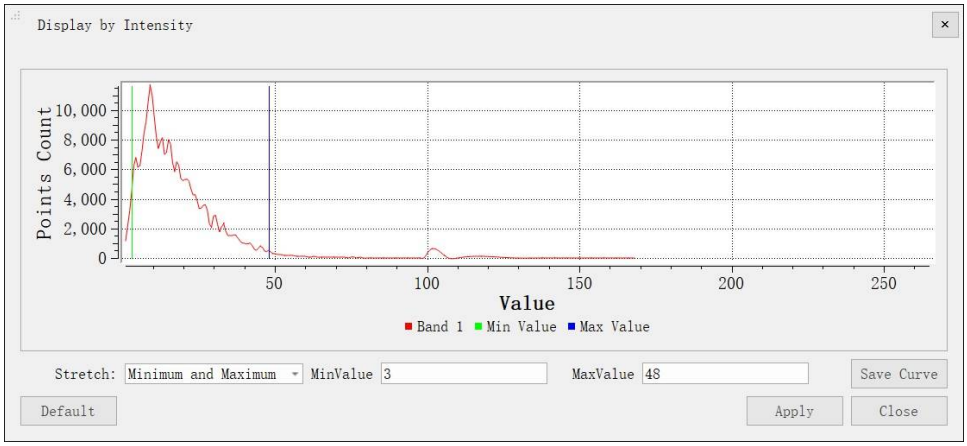


The histogram displayed on the interface can be exported in pdf format, and click on the "Save Curve" button to pop up the "Save Curve" dialog box, as shown. Select the width, height, and resolution of the export curve, select the output path, click the OK button, and save the curve.

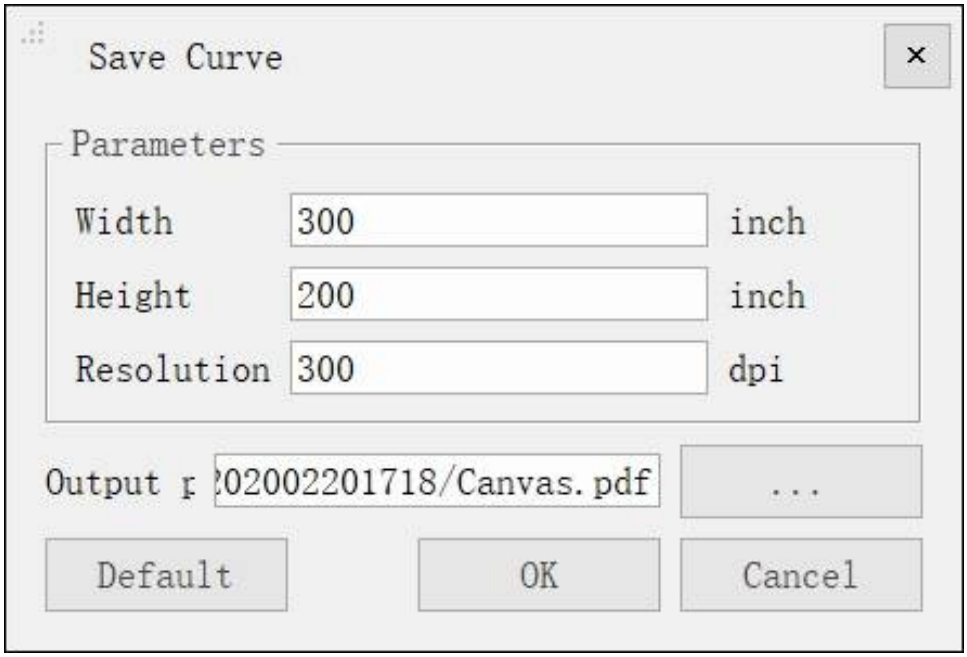


For more details please reference Display by Height。

- **Display by Intensity**: The interface pops up as shown and can be stretched by the minimum maximum or standard deviation value to improve the display.

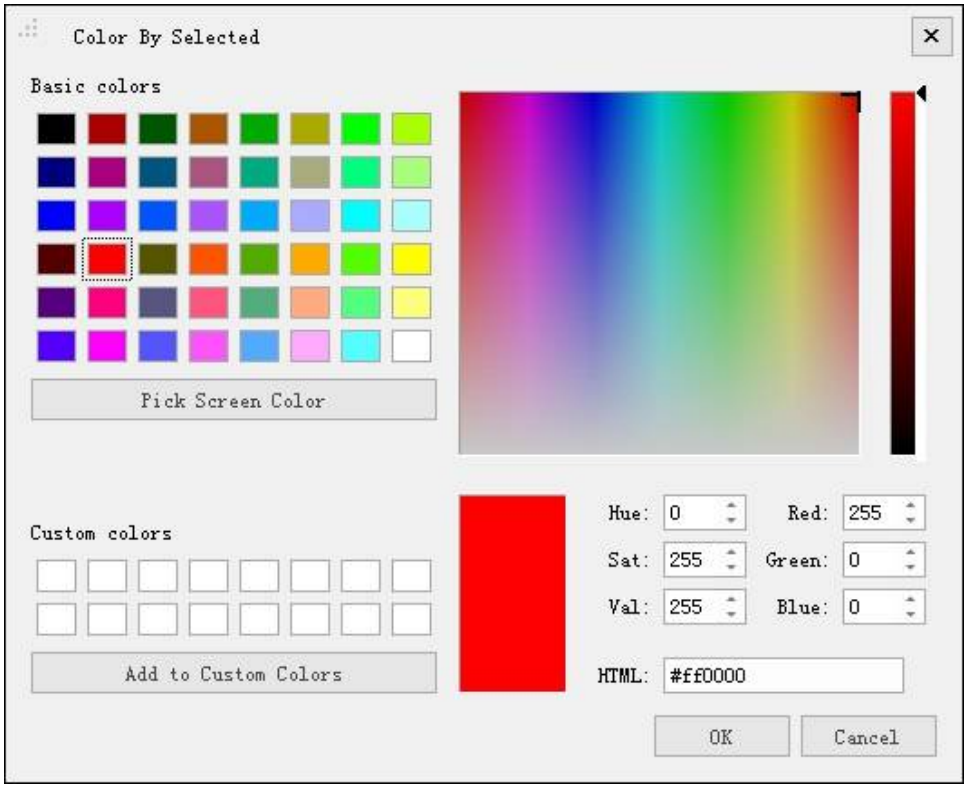


The histogram displayed on the interface can be exported in pdf format, and click on the "Save Curve" button to pop up the "Save Curve" dialog box, as shown. Select the width, height, and resolution of the export curve, select the output path, click the OK button, and save the curve.



For more details please reference Display by Intensity

- **Display by Classification**: Please reference Display by Classification
- **Display by RGB**: Please referenceDisplay by RGB.
- **Display by Return**: Please reference Display by Return.
- **Display by GPS Time**: Please reference Display by GPS Time.
- **Display by Specific Color**: Please reference Display by Specific Color



- **Display by Blend**: Please reference Display by Blend.
- **Display by Mix**: Please reference Display by Mix.

- **Zoom to Layer**: Calculate the bounding box of the current raster data. All the windows, in which the data object is loaded, will show full extent of the bounding box.
- **Export**: Export the data into LAS (.las, .laz) format.
- **Replace Data**: Replace the current point cloud data.

Parameters Setting

- **Display by Height**:
  - **Color Bar**: The color bar is used to reflect the elevation properties of the point cloud.
  - **Stretch**: Set the stretch of histogram.
    - **Min, Max (default)**: The method uses the minimum and maximum pixel values as the endpoints of the histogram. For example, set the minimum and maximum values of the image to 2488 and 2656 respectively, and set the linear stretch pixel value sits between 0-255. It improves the brightness and contrast of the image by distributing the pixel values across the entire histogram range, and makes the features in the image easy to distinguish.
    - **Standard Deviation**: This method is used between the values defined by the standard deviation n. For example, the minimum and maximum values of an image are 2488 and 2656 respectively. If n is 2, the value above the 2nd standard deviation will become 0 or 255, and the other values are stretched between 0-255.
- **Display by Intensity**
  - **Stretch**
    - **Min, Max (default)**: The method uses the minimum and maximum pixel values as the endpoints of the histogram. For example, the minimum and maximum values of an image are 2488 and 2656 respectively, and set the linear stretch pixel value sits between 0-255. By distributing pixel values across the entire histogram range, you can make the features in the image easily distinguish by increasing the brightness and contrast of the image.
    - **Standard Deviation**: This method is used between the values defined by the standard deviation n. For example, the minimum and maximum values of an image are 2488 and 2656 respectively. If n is 2, the value above the 2nd standard deviation will become 0 or 255, and the other values are stretched between 0-255.
- **Save Curve**:
  - **Width**: Save the pixel width of the curve.
  - **Height**: Save the pixel height of the curve.
  - **Resolution**：Save the resolution of the curve.
  - **Output Path**: Save the output path of the curve.

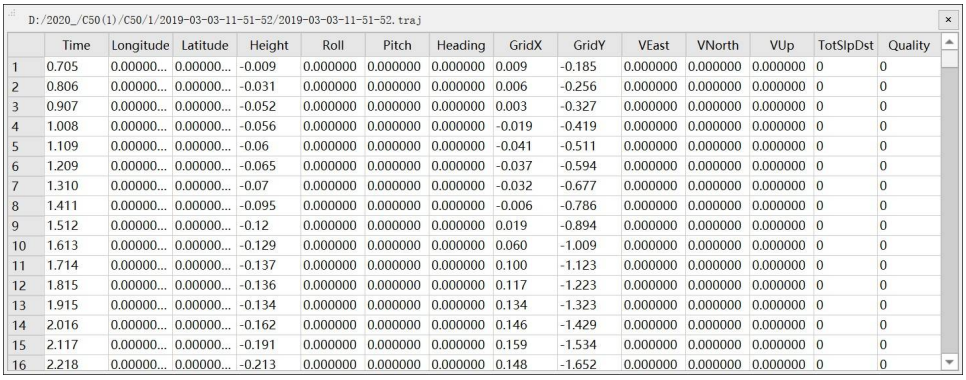
Result Trajectory Right-click Menu

Function Description

In result data layer management, point cloud menu (i.e. right-click menu) of data node, is mainly used for data query, display, statistics, export, and removal, etc.

Data Right-click Menu

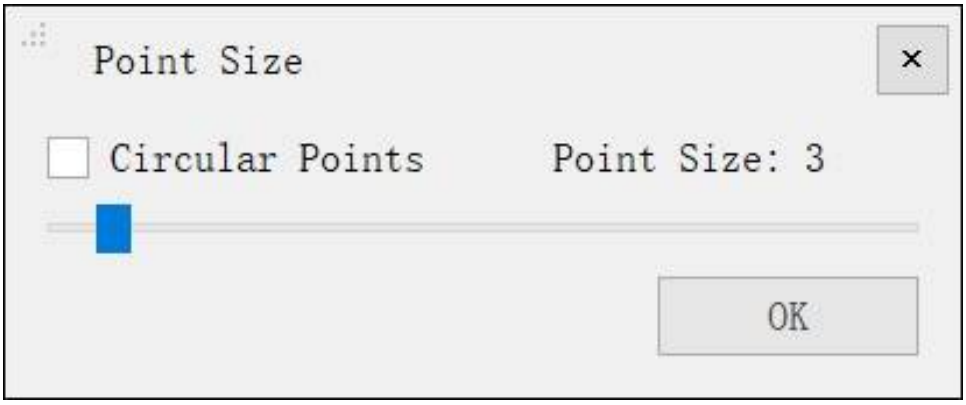
- **Info**: Check the result trajectory data information including GPS Time, Longitude and Latitude, altitude, angle (Roll, Pitch and Heading) information.



D:/2020_/C50(1)/C50/1/2019-03-03-11-51-52/2019-03-03-11-51-52.traj

	Time	Longitude	Latitude	Height	Roll	Pitch	Heading	GridX	GridY	VEast	VNorth	VUp	TotSlpDst	Quality
1	0.705	0.00000...	0.00000...	-0.009	0.000000	0.000000	0.000000	0.009	-0.185	0.000000	0.000000	0.000000	0	0
2	0.806	0.00000...	0.00000...	-0.031	0.000000	0.000000	0.000000	0.006	-0.256	0.000000	0.000000	0.000000	0	0
3	0.907	0.00000...	0.00000...	-0.052	0.000000	0.000000	0.000000	0.003	-0.327	0.000000	0.000000	0.000000	0	0
4	1.008	0.00000...	0.00000...	-0.056	0.000000	0.000000	0.000000	-0.019	-0.419	0.000000	0.000000	0.000000	0	0
5	1.109	0.00000...	0.00000...	-0.06	0.000000	0.000000	0.000000	-0.041	-0.511	0.000000	0.000000	0.000000	0	0
6	1.209	0.00000...	0.00000...	-0.065	0.000000	0.000000	0.000000	-0.037	-0.594	0.000000	0.000000	0.000000	0	0
7	1.310	0.00000...	0.00000...	-0.07	0.000000	0.000000	0.000000	-0.032	-0.677	0.000000	0.000000	0.000000	0	0
8	1.411	0.00000...	0.00000...	-0.095	0.000000	0.000000	0.000000	-0.006	-0.786	0.000000	0.000000	0.000000	0	0
9	1.512	0.00000...	0.00000...	-0.12	0.000000	0.000000	0.000000	0.019	-0.894	0.000000	0.000000	0.000000	0	0
10	1.613	0.00000...	0.00000...	-0.129	0.000000	0.000000	0.000000	0.060	-1.009	0.000000	0.000000	0.000000	0	0
11	1.714	0.00000...	0.00000...	-0.137	0.000000	0.000000	0.000000	0.100	-1.123	0.000000	0.000000	0.000000	0	0
12	1.815	0.00000...	0.00000...	-0.136	0.000000	0.000000	0.000000	0.117	-1.223	0.000000	0.000000	0.000000	0	0
13	1.915	0.00000...	0.00000...	-0.134	0.000000	0.000000	0.000000	0.134	-1.323	0.000000	0.000000	0.000000	0	0
14	2.016	0.00000...	0.00000...	-0.162	0.000000	0.000000	0.000000	0.146	-1.429	0.000000	0.000000	0.000000	0	0
15	2.117	0.00000...	0.00000...	-0.191	0.000000	0.000000	0.000000	0.159	-1.534	0.000000	0.000000	0.000000	0	0
16	2.218	0.00000...	0.00000...	-0.213	0.000000	0.000000	0.000000	0.148	-1.652	0.000000	0.000000	0.000000	0	0

- **View Mode**: Set the display mode of the result trajectory data, including the following types
  - **Display by Quality**: Please reference Display by Quality
  - **Display by Height**: Please reference Display by Height
  - **Display by Time**: Please reference Display by Time
  - **Display by Specific Color**: Please reference Display by Specific Color
- **Zoom to Layer**: Calculate the bounding box of the current raster data. All the windows, in which the data object is loaded, will show full extent of the bounding box.
- **Point Appearance**: Users can select a circular or quadrate shape point and zoom in and out to change the point size.



Parameters Setting

- **Point Appearance**:
  - **Circular Points (optional)**: Set a circular or quadrate shape point for result data trajectory.
  - **Point Size**

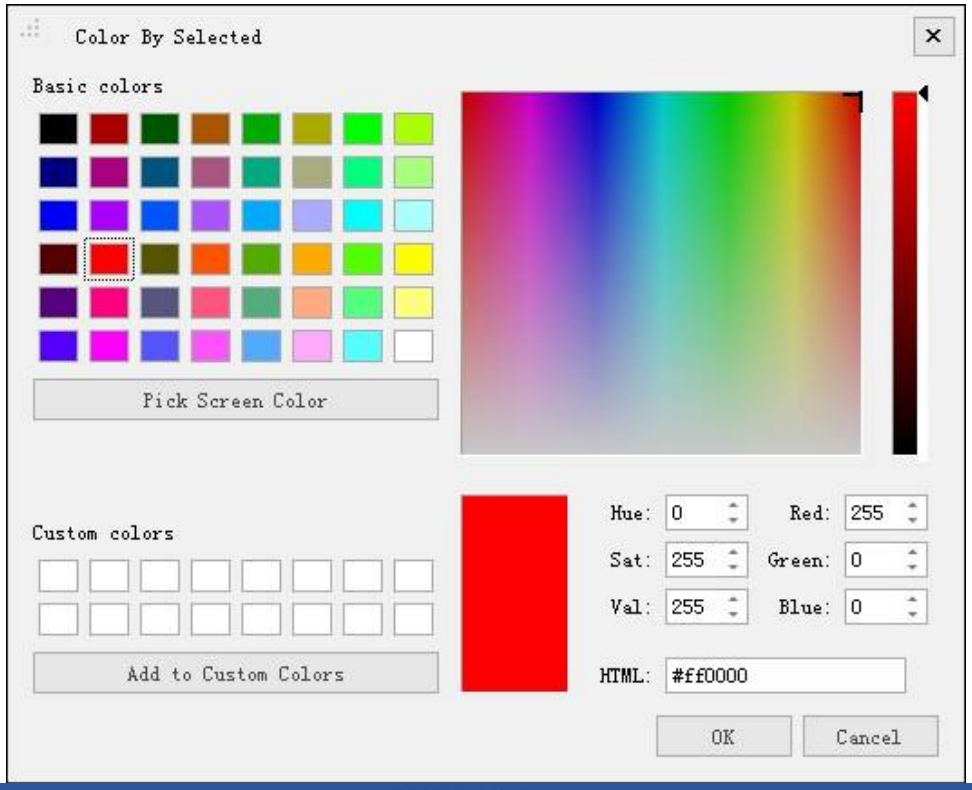
Image List Right-click Menu

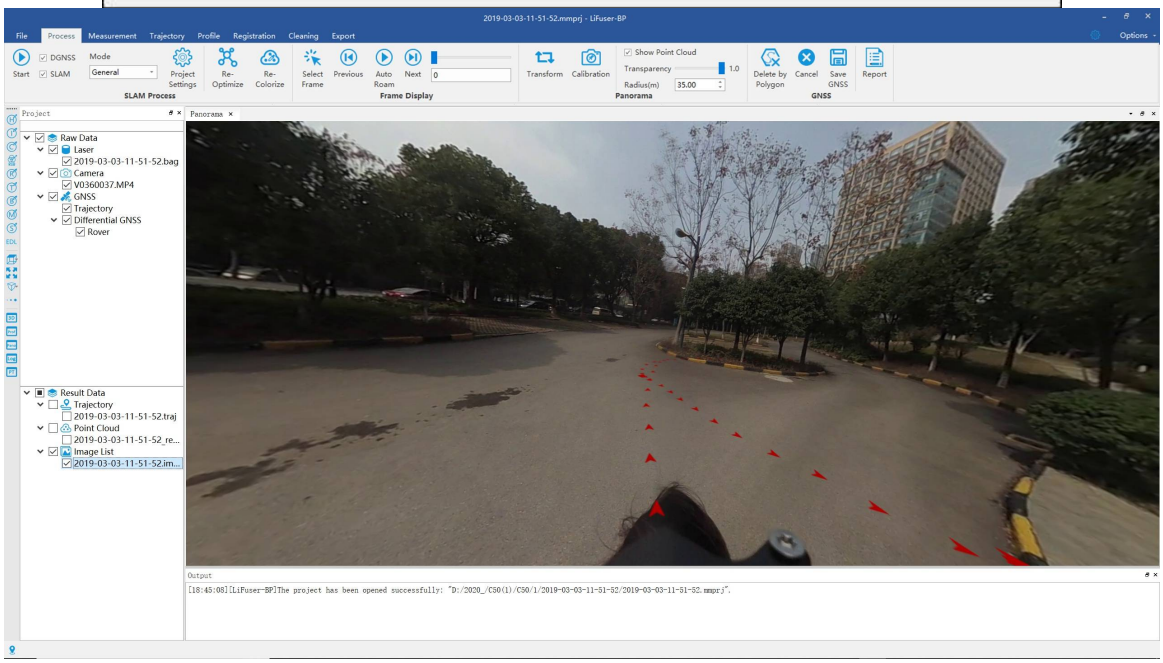
Function Description

Panorama data exposure display is managed by Right-click Menu in Result Data Layer Management Tree.

Data Right-click Menu

- **Select Color**: Click the window to select the specific exposure color as follows.





Window Management

Function Description

The display of project window is managed by window management tool.

Detailed Introduction

Display by 3D window.

Display by profile window.

Display by panorama window.

Display by log window.

Display by layer (Project Tree) window.

Measure Tools

The measure tools are used to measure geometric information about the data.The measurement tools in the software consist of two main types: 3D measure tools and panoramic measure tools. 3D measurements are for point cloud data in a 3D window, and panoramic measurements are for panoramic image data in a panoramic window.

3D Measure Tools

Panorama Measure Tools

3D Measure Tools

The measure tools are used to measure geometric information about the data.

- Pick point
- Multi Pick point
- Length Measurement
- Area Measurement
- Angle Measurement
- Height Measurement
- Volume Measurement
- Density Measurement

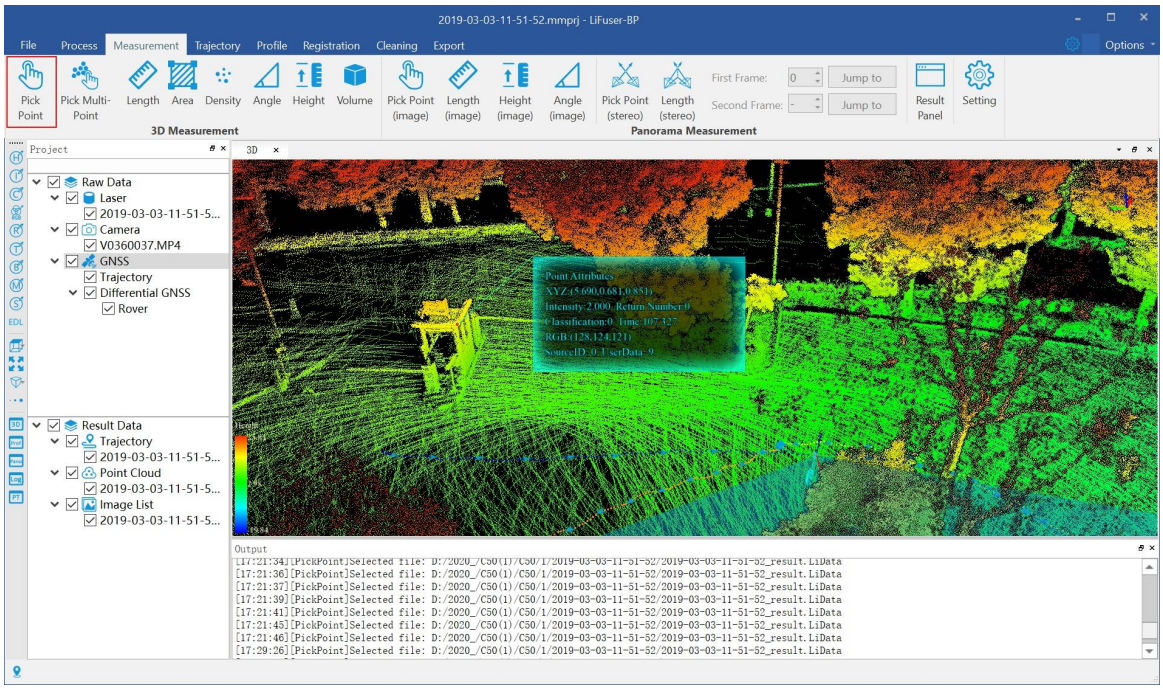
Pick Point

Function Description: This tool is applicable to point cloud data, the attributes that can be queried contain position, intensity, return number, classification and GPS time.

Step

1. Click *Pick Point*  button via *3D Measurement* mode.
2. Click a valid point in the scene and a label that displays the point attributes will pop up.

   The label will show the position, intensity, return number, classification and GPS time.



3. Right-click to go back to the previous point during the measurement.

> Note: The tool is only available in the 3D window.

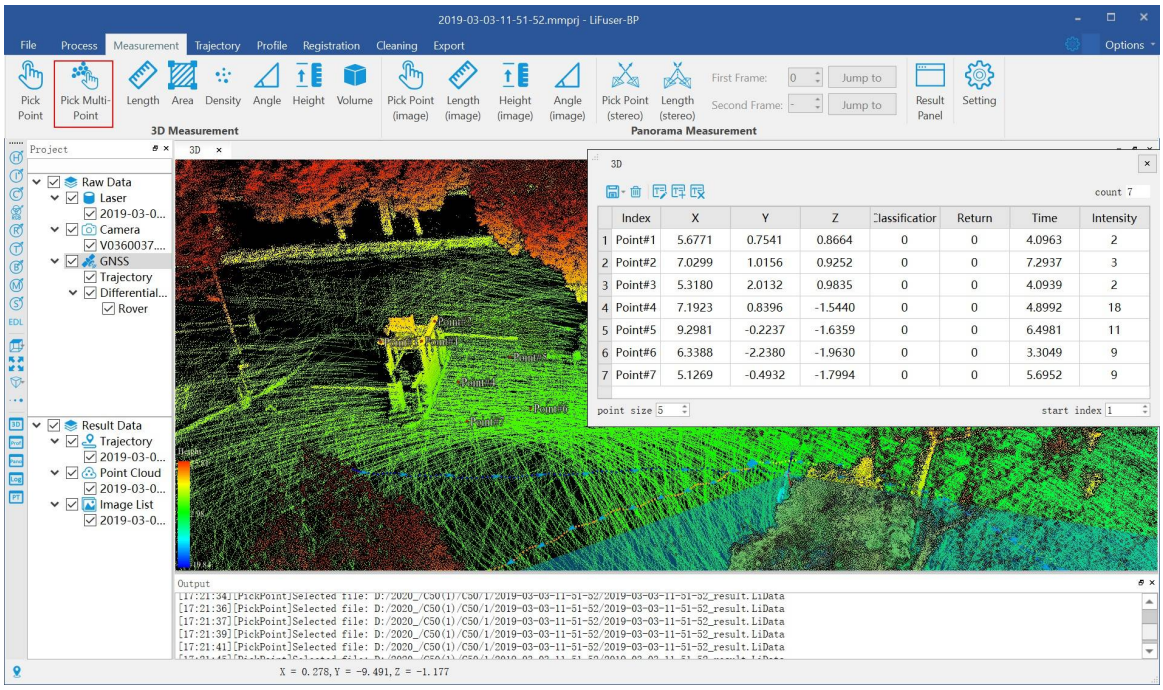
Multi Pick Point

Function Description: For point cloud data, the attributes that can be queried contain position, intensity, return number, classification and GPS time. Different from the pick point tool, this tool allows querying multiple points at the same time, and the selection set can be exported in txt, asc, neu, xyz, pts, or csv file.

Step

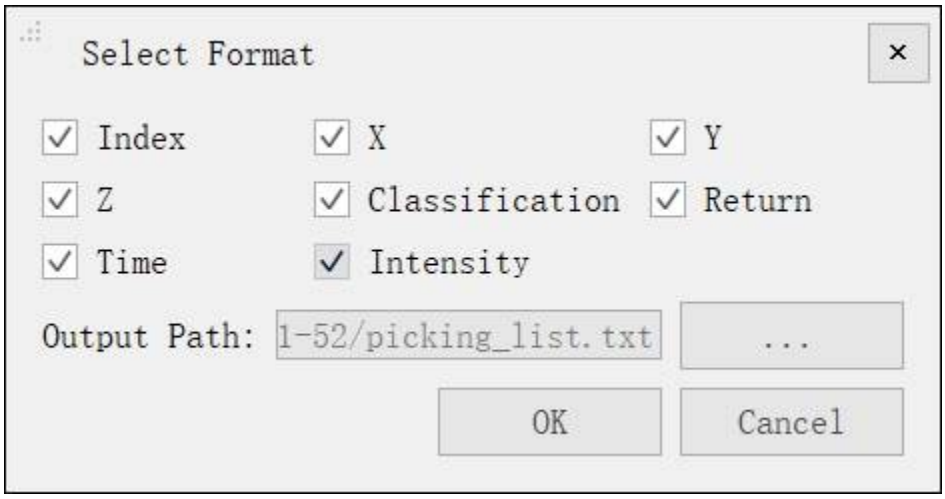
1. Click Pick Multi-Point  *button via* 3D Measurement* mode. Left-click the points in the scene and the selection results are marked by labels. At the same time, a table that contains the attributes of the selection points will pop up, shown as follows.

   The attributes of point cloud data shown in the table contain index, position (XYZ), classification, return number, GPS time and intensity. The total number of the points is updated real-time above the table.

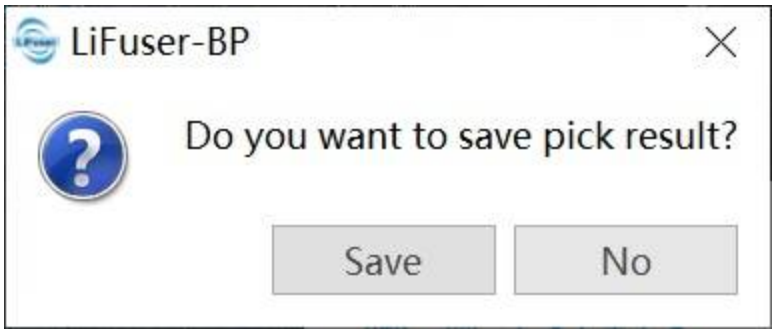


2. The "marker size" is used to set the point size of the marker in the scene. The "start index" is used to set the start index of the selected points.
3. Select a row of the table by left-clicking and click the button  to delete the point.
4. After clicking the "Start Editing" button  , the attribute values can be changed by double-clicking the cells in the added attribute columns, and typing in the new values.
5. After clicking the "Add Attribute" button  , the following dialog will pop-up. Currently, it is supported for the following types of custom attributes: integer, float, text, date, and enum. After click "ok" button, the added field will be displayed in the attributes table.
6. The "Remove Attribute" button  is not available when there is no custom attributes added. After adding custom attributes, the custom attributes can be removed by clicking "Remove Attribute" button (only the custom attributes can be removed).

7. The selection set can be exported as txt, asc, neu, xyz, pts, or csv file. Click the drop-down menu to pop up "Select Format" dialog, as shown below. The menu "Save 3D points" is available. The coordinates information and other attribute information can be saved as .txt format.



8. Click ... to pop up the export dialog. Input the output path, and check the attributes that need to be exported. Click "OK" to complete the export. Click "Cancel" to cancel the export.
9. If the selected points have not been saved before quiting this tool, a message box will pop up as follows. Click "Save" to save the points. Click "Discard" to cancel the selections.



Parameters Setting

- **X**：X component of the coordinate.
- **Y**：Y component of the coordinate.
- **Z**：Z component of the coordinate.
- **Classification**: The class attribute of point cloud data.
- **Return**: The return number attribute of point cloud data.
- **GPS Time**: The GPS time attribute of point cloud data.
- **Intensity**: The intensity attribute of point cloud data.
- **Index**: The index of select point
- **Output Path**: The path of the output file.

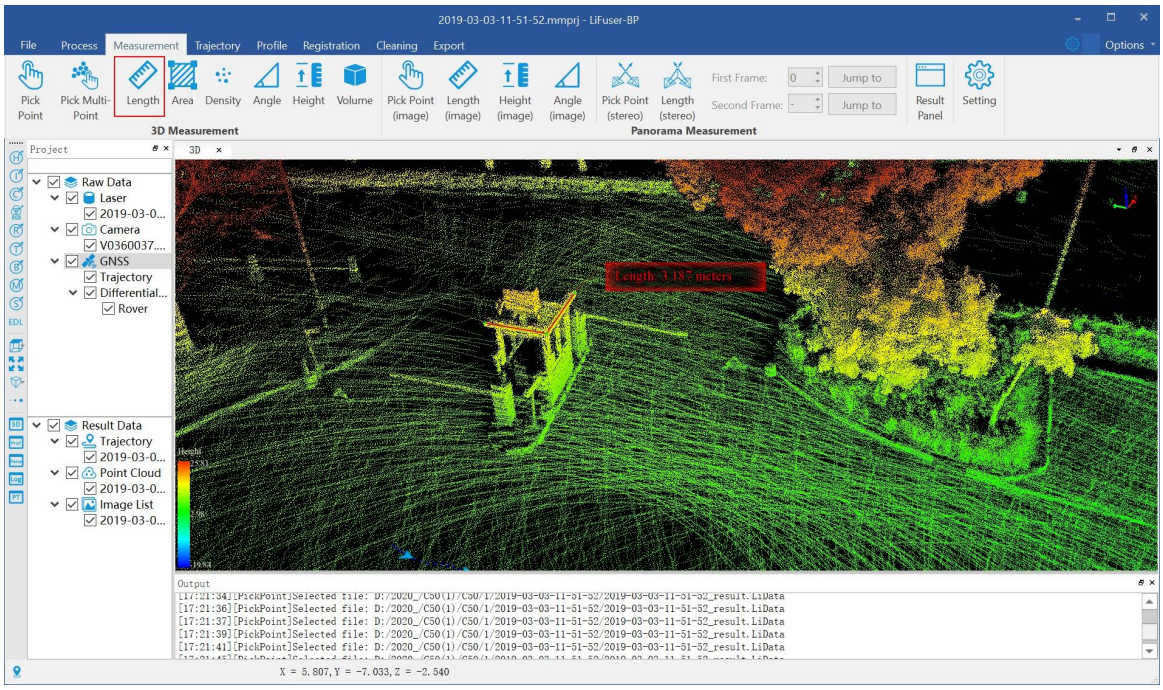
> Note: The tool is only available in the 3D window.

Length Measurement

Function Description: This tool is applicable to point cloud data, which calculates the distance between two consecutive points.

Step

1. Click *Length*  button via *3D Measurement* mode.
2. Left-click at least two points in the scene and the corresponding polyline will be rendered real-time.
3. The measurement result is displayed in a label as follows. Double-clicking the last point will stop the measurement process, and the distance value will continue to be displayed in the label.
4. Right-click to go back to the previous point during the measurement.



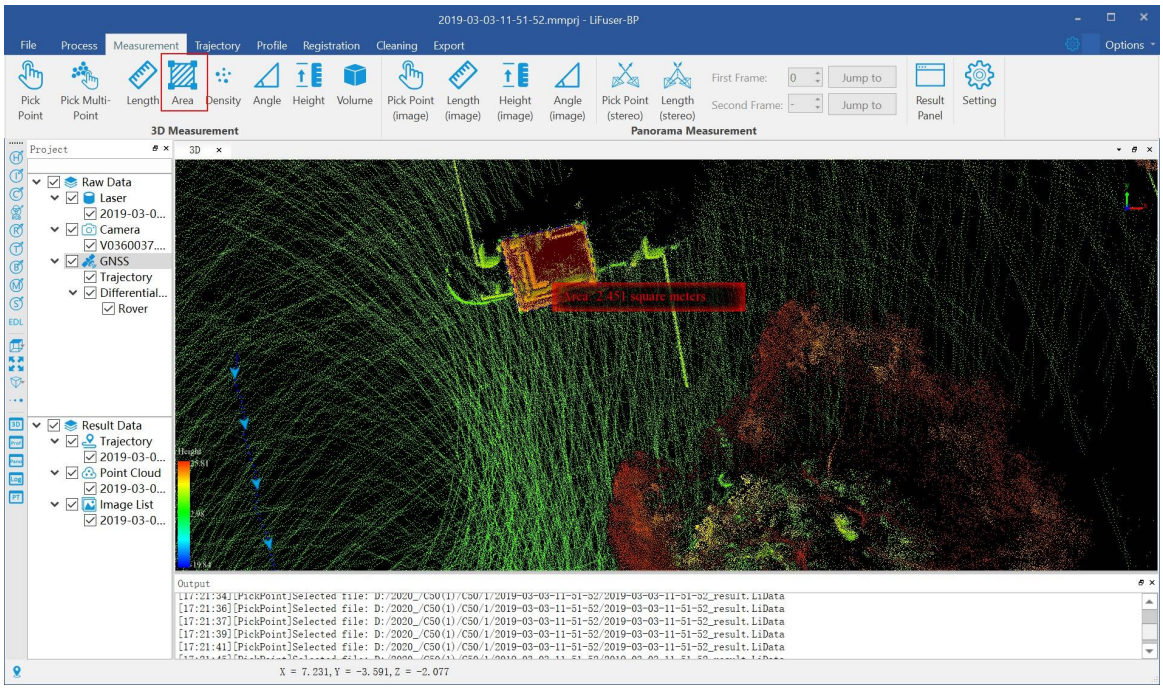
> Note: The tool is only available in the 3D window.

Area Measurement

Function Description: This tool is applicable to point cloud data which calculates the projected area within the polygon region. Current window will switch to Orthogonal Projection automatically for 3D data.

Step

1. Click *Area*  button via *3D Measurement* mode.
2. Left-click at least three points in the scene and the corresponding polygon area will be rendered real-time. The measurement result is displayed in a label as follows.
3. Double-clicking the last point will stop the measurement process, and the measurement result will continue to be displayed in the label.
4. Right-click to go back to the previous point during the measurement.



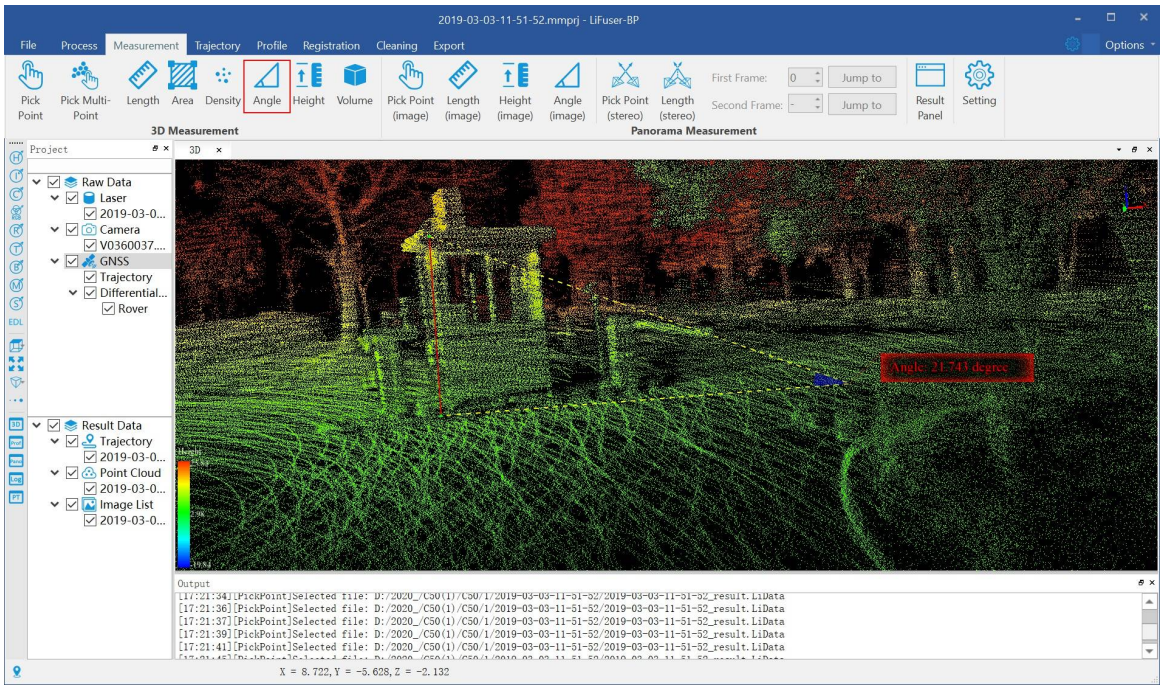
> Note: This tool only works under orthogonal projection. The tool is only available in the 3D window.

Angle Measurement

Function Description: This tool is applicable to point cloud data which calculates the angle of pitch between two points in 3D view and calculates the projection angle of three points on the horizontal plane in 2D view.

Step

1. Click *Angle*  button via *3D Measurement* mode.
2. Select the reference point of angle measurement by left-clicking.
3. Select the measurement point by double-clicking. The pitch angle between the reference point and the measurement point will be rendered in the scene and the measurement result is displayed in a label as follows.



4. Click the right mouse button, the menu "Back One Point" is used to go back to the previous step.

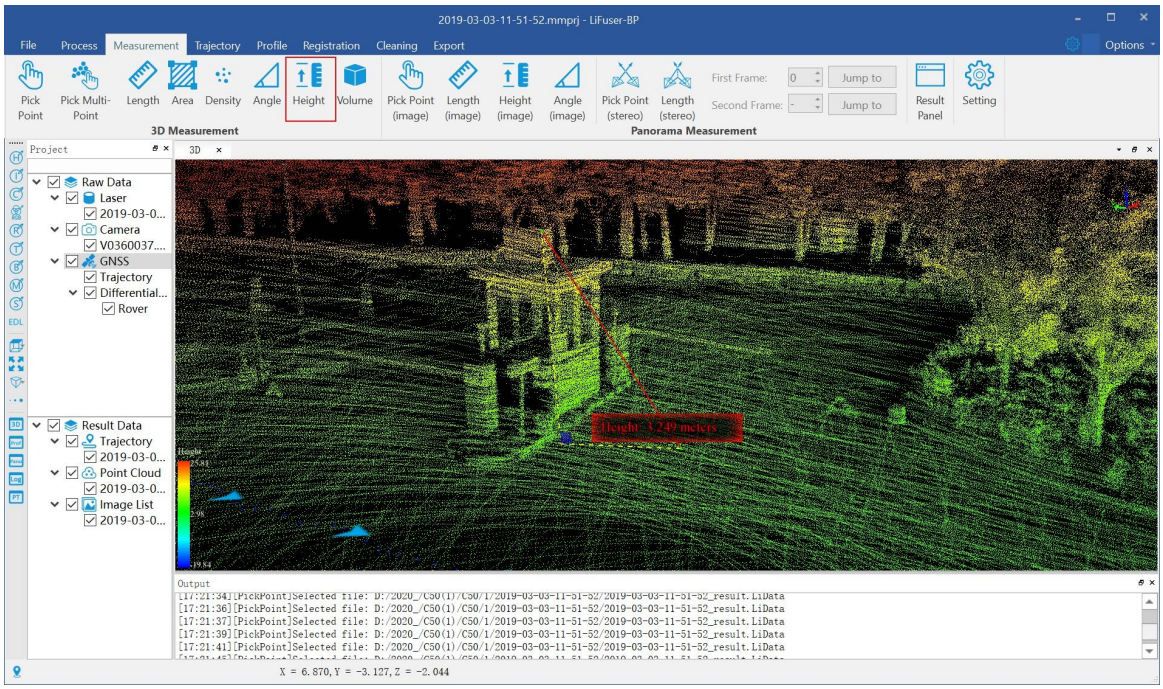
> Note: The tool is only available in the 3D window.

Height Measurement

Function Description: This tool is applicable to point cloud data which calculates the relative height difference between two points.

Step

1. Click *Height* button via *3D Measurement* mode.
2. Select the reference point of height measurement by left-clicking.
3. Select the measurement point by double-clicking. The relative height difference between the reference point and the measurement point will be rendered in the scene and the measurement result is displayed in a label as follows.



4. Right-click to go back to the previous point during the measurement.

> Note: The "Back One Point" is only available before the measurement is stopped and the tool is only available in the 3D window.

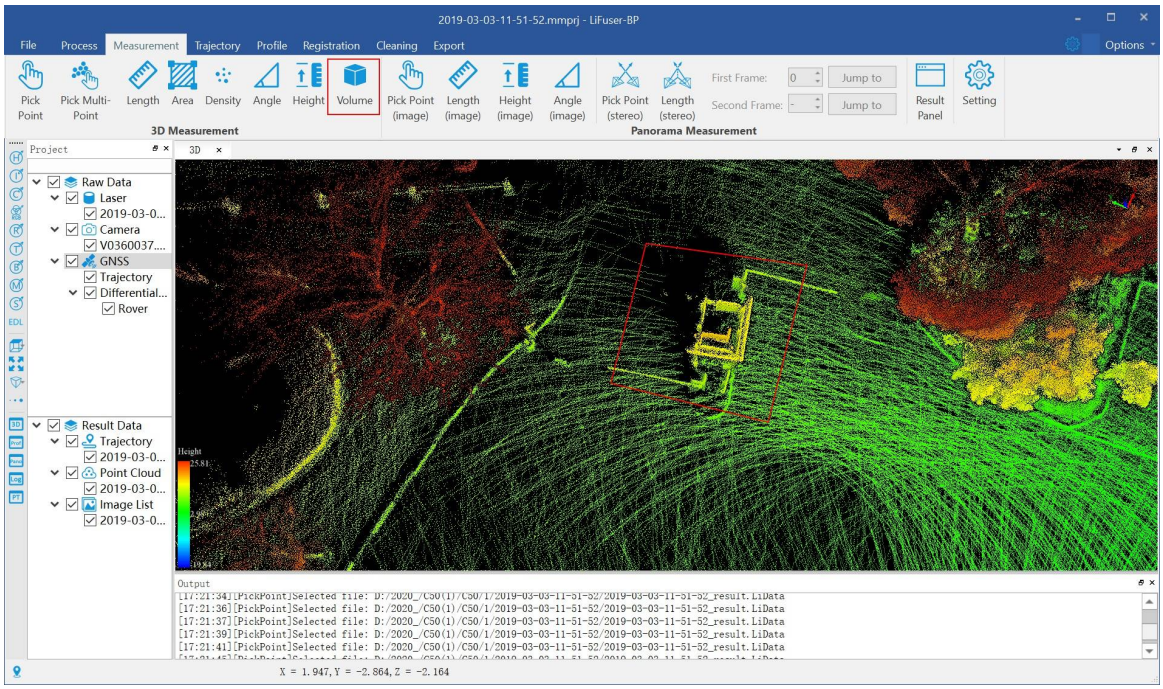
Volume Measurement

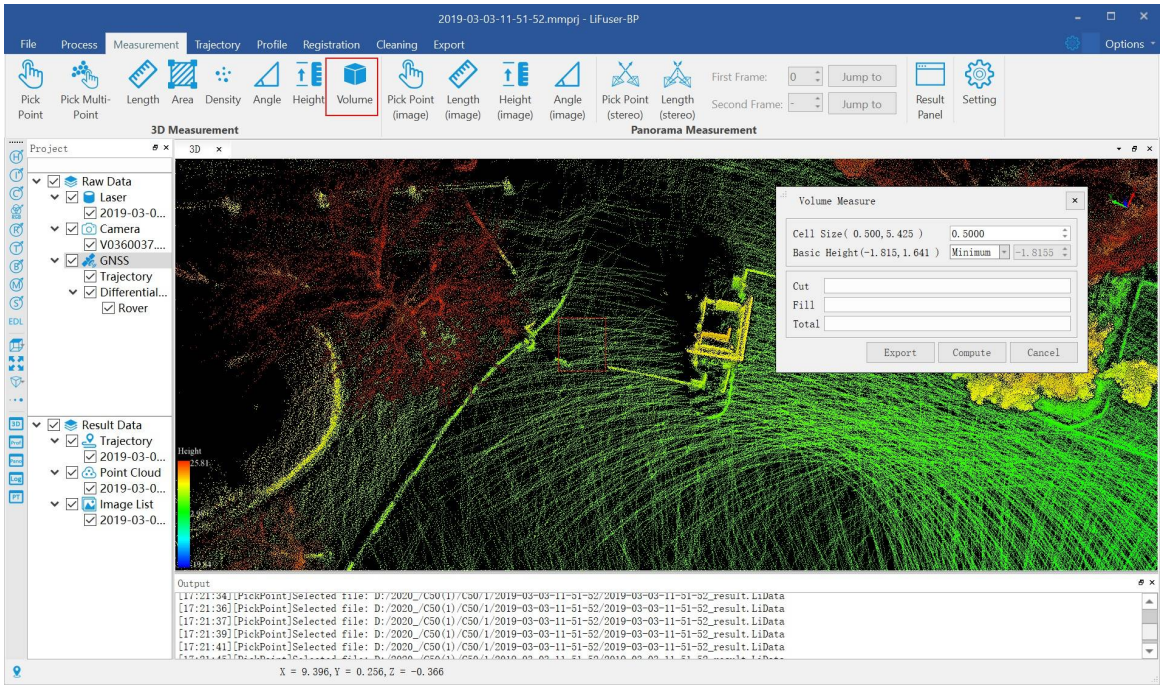
Function Description: This tool is applicable to point cloud data which calculates filling, cutting and total amount relative to a reference height. It's commonly used in volume measurement of coal pile and hull.

Step

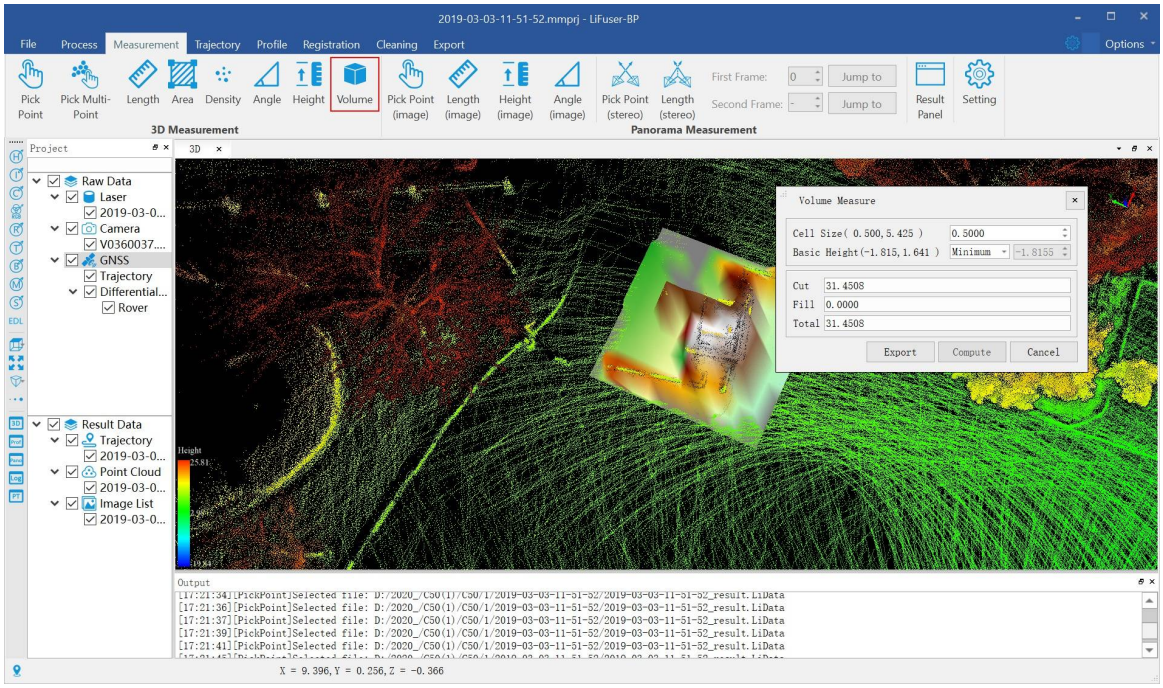
1. Click *Volume*  button via *3D Measurement* mode.

2. It is suggested to adjust the window to top view before the tool is used. Select at least three points to generate the reference plane for volume calculation by left-clicking. Select the last point by double-clicking. The border of the selected region will be rendered in red and the dialog "Volume Measure" will pop up.





3. Set the cell size.
4. Set the reference plane of volume measurement. The options include minimum value, fit plane, and customizing.
5. Click the "Compute" button to generate the measurement result, including Projected area, surface area, cut volume, and fill volume. The corresponding volume will be rendered in the scene, as shown below.



6. Click the "Export" button to export the result in *.pdf format.

Parameters Setting

- **Cell Size**： It defines the smallest unit size for calculation. The smaller the value is, the more accurate the calculation is.
- **Basic Height**： It defines the reference plane to calculate filling and cutting.

- **Minimum (Default)**: Use the minimum height of the selected points as the height of the reference plane.
- **Fitted Plane (Mean)**: Fit the best plane according to the selected points.
- **Customize**: This value is specified by the user.

> Note: This tool only works with point cloud data and model data in 3D view.

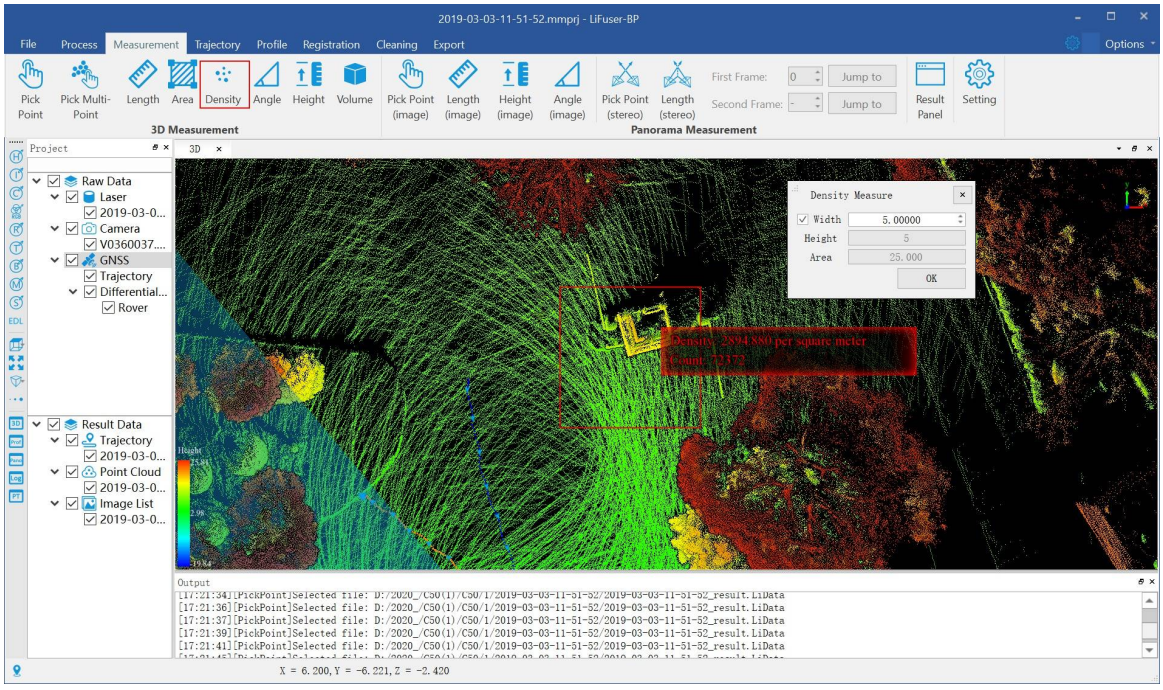
Density Measurement

Function Description: Point density is an important metric to measure the quality of point cloud data. The average number of points per square meter can be counted with this tool.

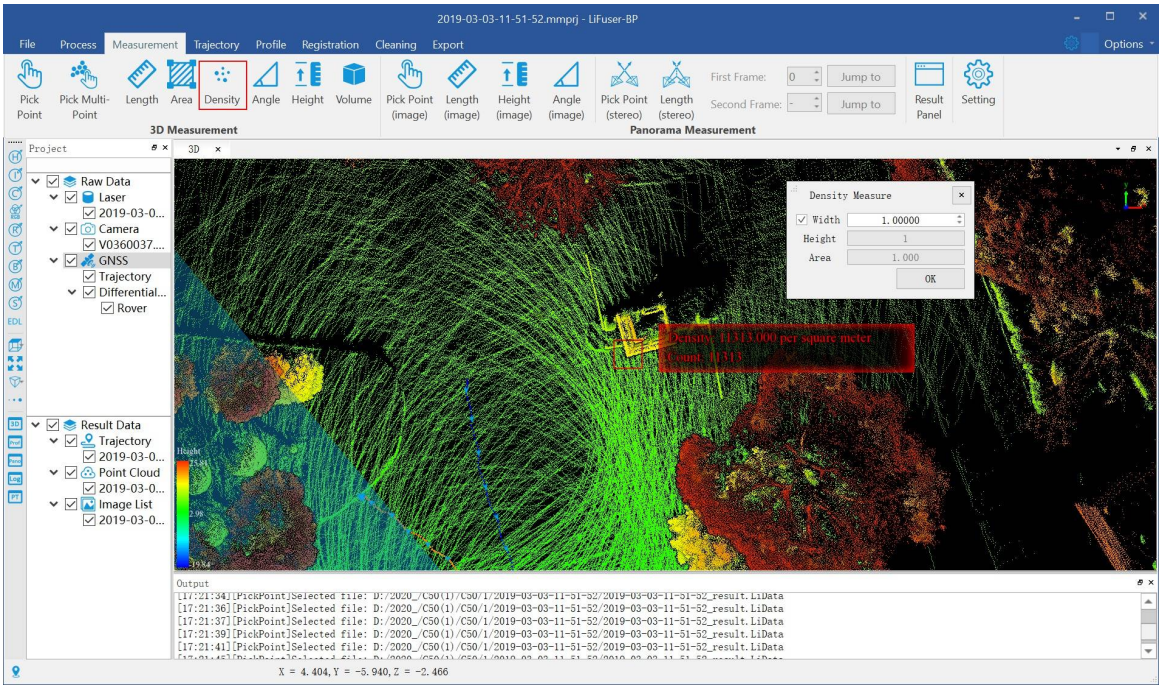
Step

1. Click *Density* button via *3D Measurement* mode.Active window is adjusted to orthogonal projection automatically when this tool is started.
2. Then the dialog "Density" pops up.
3. If the option "Width" is checked, the width value can be manually input, and the height value will be set to the same as the width value, then the area value will be decided by "Width" and "Height". The measurement region can be selected by left-clicking. If the option "Width" is unchecked, the width value and the height value will be decided by the size of the rectangle that is drawn interactively by left-clicking the upper left corner and the lower right corner. The area value will be decided by "Width" and "Height". The rectangle will be rendered in the scene and the measurement result (number of total points and point density) is displayed in a label as follows.

   Default Width (the Width value is five)



   Reset Wigth (the Width value is one)



Parameters Setting

- **Width**: It defines the width of the reference rectangle.
- **Height**: It defines the height of the reference rectangle.
- **Area**: It defines the area of the reference rectangle.

> Note: This tool only works with point cloud data and model data under orthogonal projection.

Panorama Measure Tools

Panorama measurements consist of two methods: one is based on Point Cloud Depth Interpolation and the other is based on Forward Intersection.

Switch the software top menu to the Measurement mode before the measurement begins.

Panorama Measurements based on Point Cloud Depth Interpolation

The principle of estimating the location information of measuring points is based on the point cloud data depth value and interpolation algorithm within a certain range around the measuring point.

The main functions are listed below:

Pick Point

Length Measurement

Height Measurement

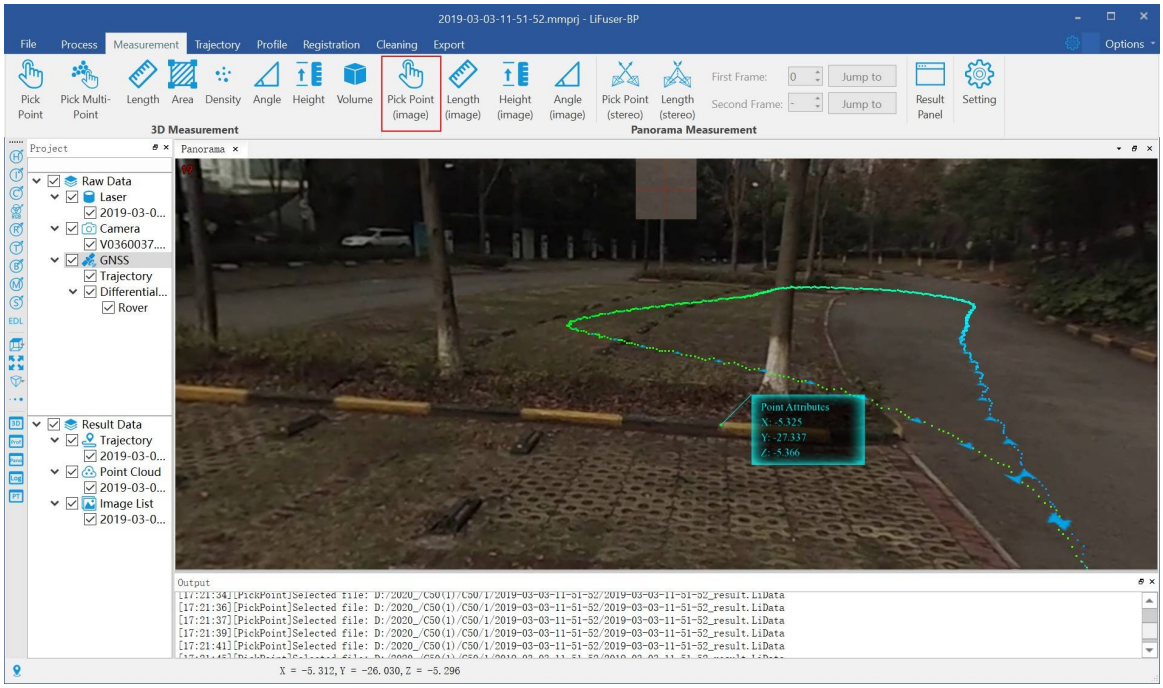
Angle Measurement

Pick Point (Depth Interpolation)

Function Description : This tool is applicable to panoramic data, the attributes that can be queried contain position information.

Step

1. Click *Pick Point(image)*  button via *Panorama Measurement* mode.
2. Select a point by left-clicking and the measurement result is displayed in a label as follows.



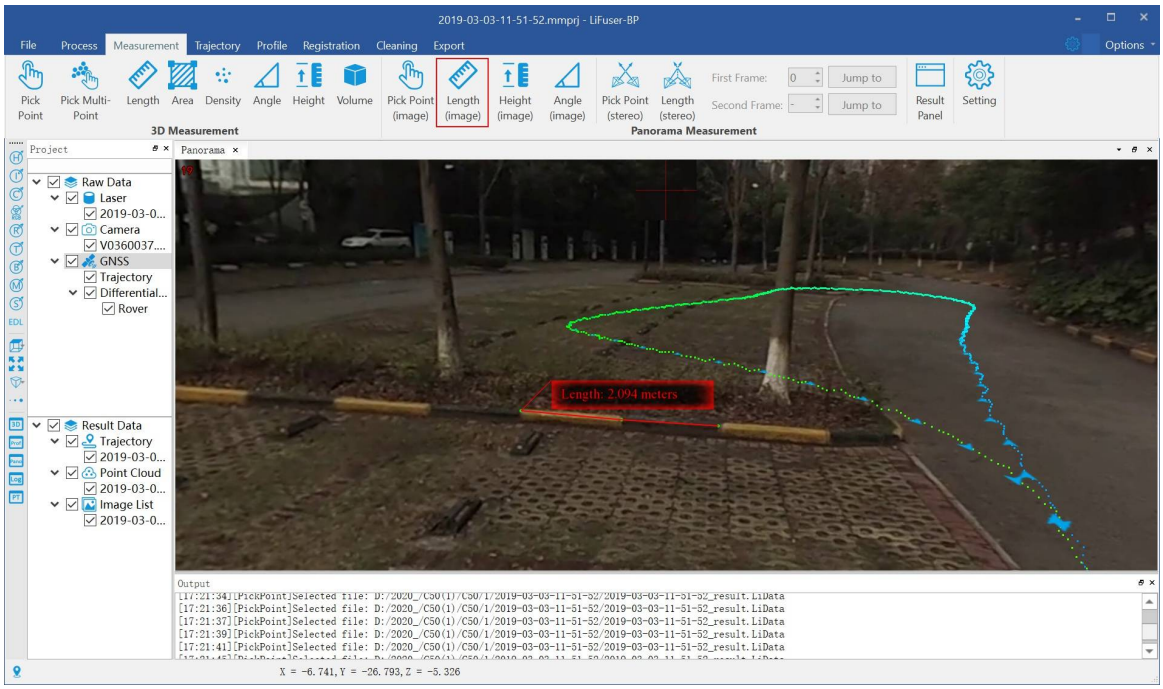
3. Right-click to go back to the previous point during the measurement.

Length Measurement (Depth Interpolation)

Function Description: This tool is applicable to point cloud data, which calculates the distance between two consecutive points.

Step

1. Click *Length(image)*  button via *Panorama Measurement* mode.
2. Left-click at least two points in the scene and the corresponding polyline will be rendered real-time.
3. The measurement result is displayed in a label.
4. Double-clicking the last point will stop the measurement process, and the distance value will continue to be displayed in the label.



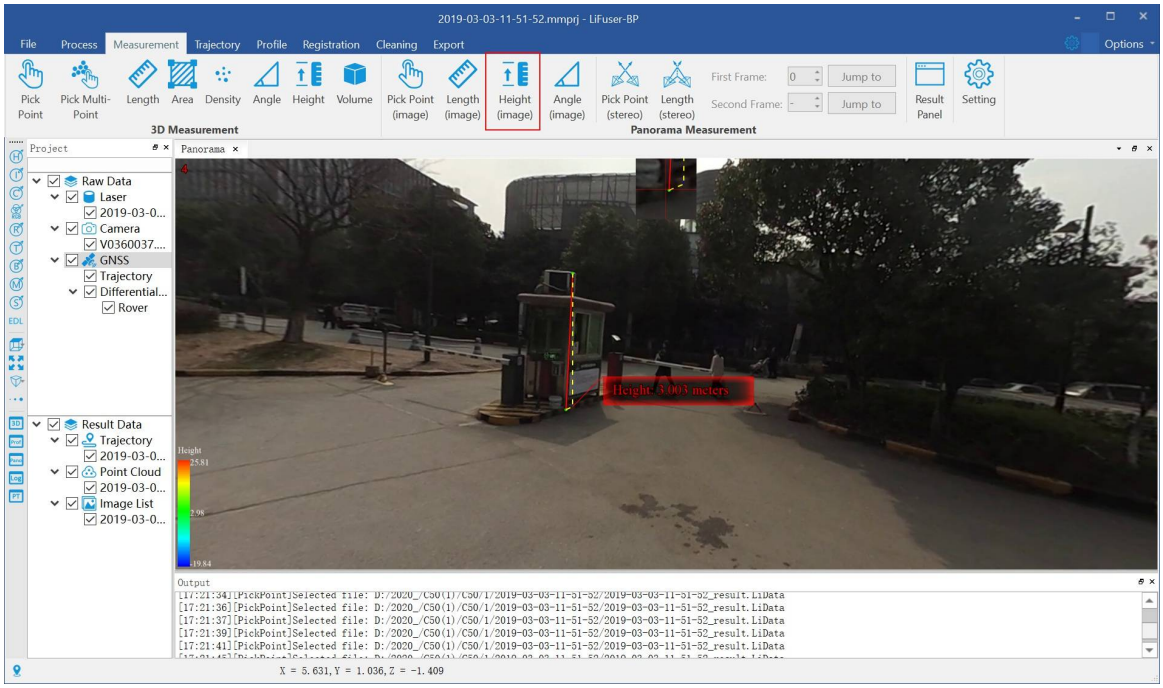
5. Right-click to go back to the previous point during the measurement.

Height Measurement (Depth Interpolation)

Function Description: This tool is applicable to point cloud data which calculates the relative height difference between two points in panorama window.

Step

1. Click *Height(image)*  button via *Panorama Measurement* mode.
2. Select the reference point of height measurement by left-clicking in panorama window.



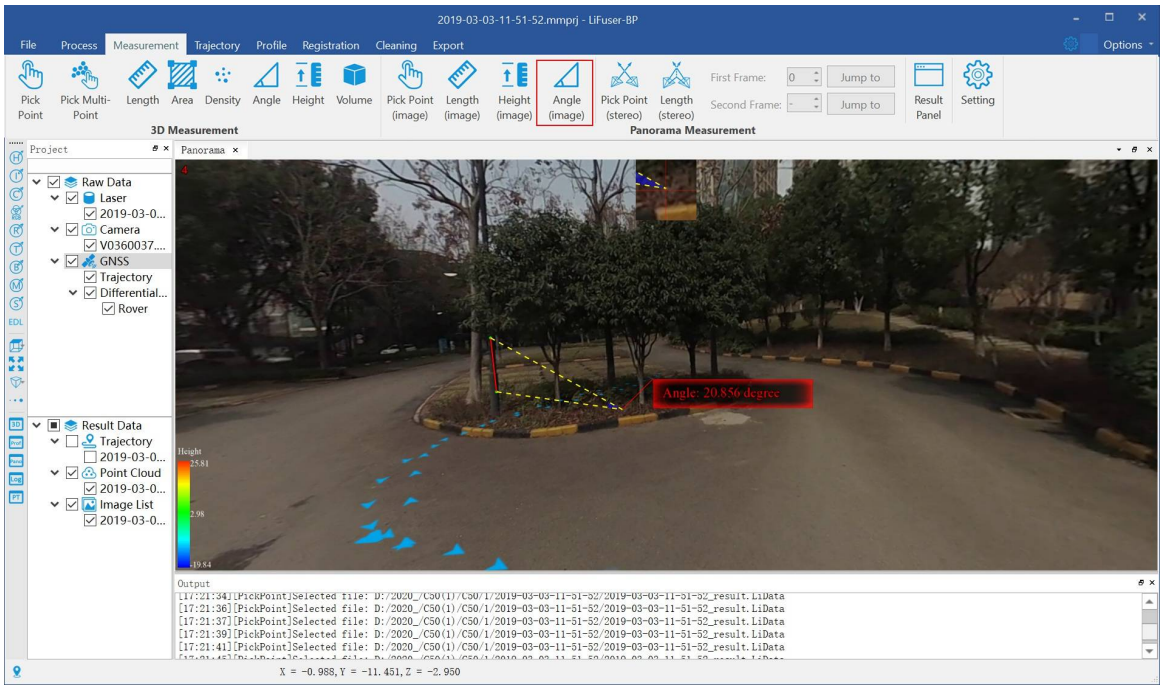
3. Right-click to go back to the previous point during the measurement.

Angle Measurement (Depth Interpolation)

Function Description: This tool is applicable to point cloud data which calculates the angle of pitch between two points in Panorama view.

Step

1. Click *Angle(image)*  button via *Panorama Measurement* mode.
2. Select the reference point of angle measurement by left-clicking in (*Panorama*) view.
3. Select the measurement point by double-clicking. The pitch angle between the reference point and the measurement point will be rendered in the scene and the measurement result is displayed in a label as follows.



Panorama Measurements based on Forward Intersection

Using the measuring point to select the tie-points on the two-frame image, and combined with the forward intersection algorithm, the measurement point position information is obtained.

The main functions are listed below:

Pick Point

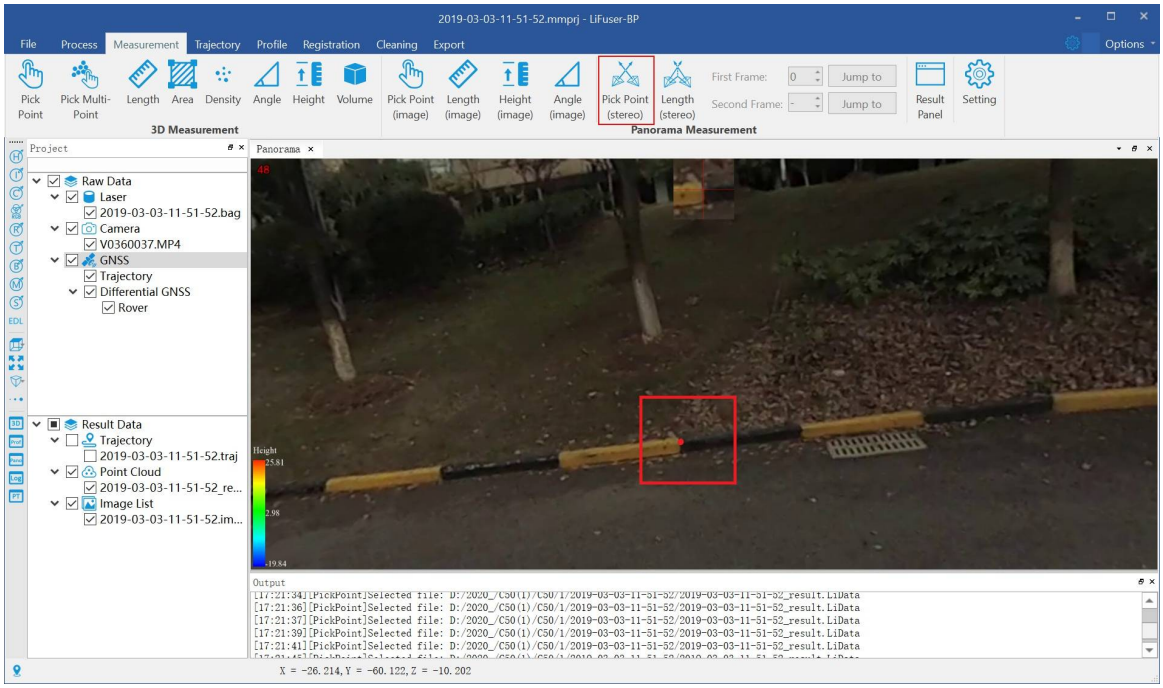
Length Measurement

Pick Point (Forward Intersection)

Function Description： This tool is applicable to panoramic data, the attributes that can be queried contain position information.

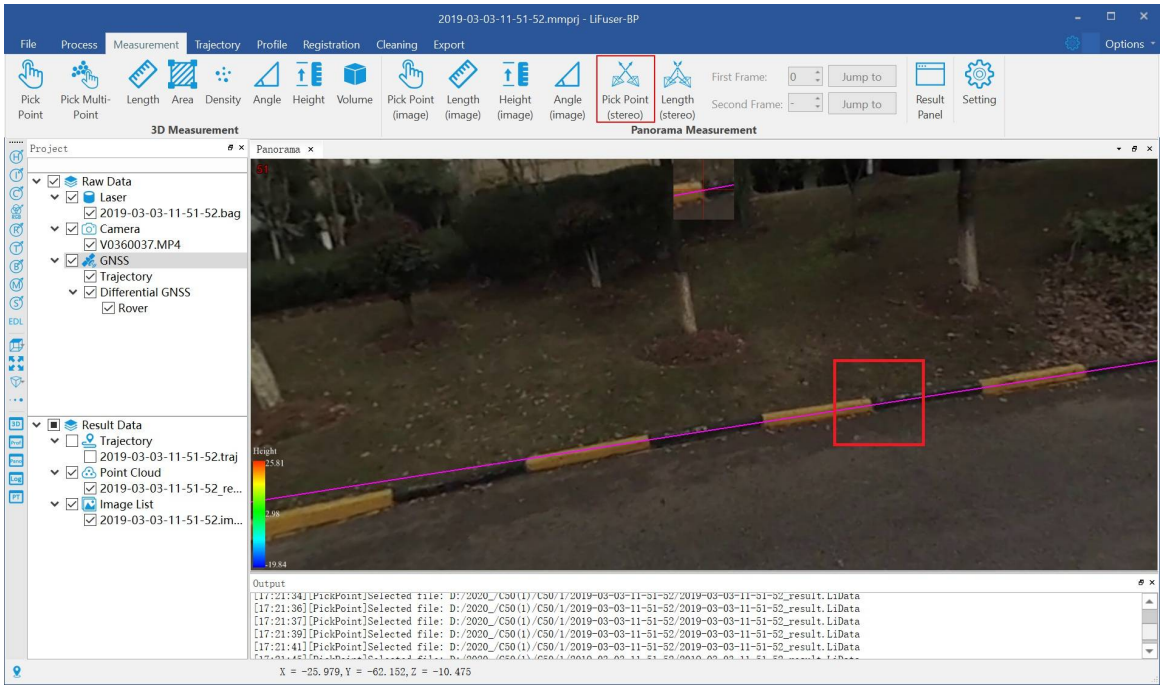
Step

1. Click *Pick Point(stereo)*  button via *Panorama Measurement* mode.
2. Select the first corresponding point by left-clicking in panorama window.

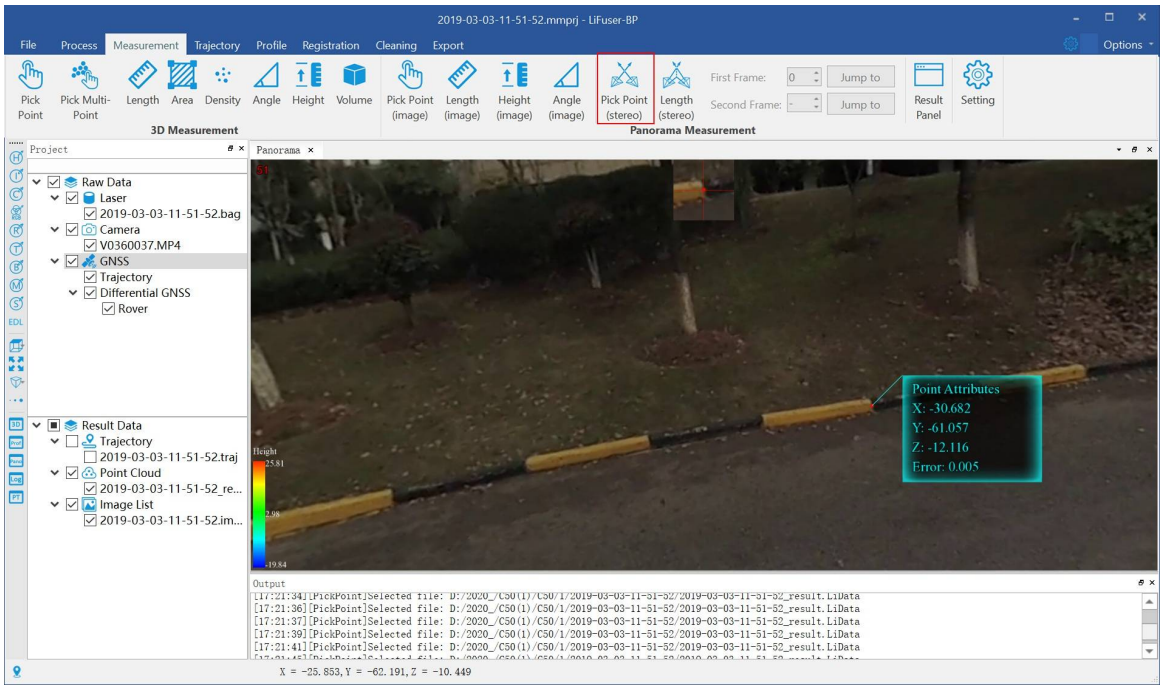


3. The image will update automatically in panorama window.Select the second corresponding point point by left-clicking, and the auxiliary line shown on the image helps to select the point.

   The panorama window will switch to the second frame image automatically and the auxiliary line will display：



Select the corresponding point on the second frame image:



> Note:
>
> 1. In step 3, the auxiliary line is actually the epipolar line generated by the intersection of the epipolar plane with the image plane. If the installation errors between the panorama camera and lidar have been calibrated (The attitude of image is accurate under this condition). In theory, the second corresponding point we select is close by the epipolar line. So the auxiliary line is useful to locate the corresponding point.

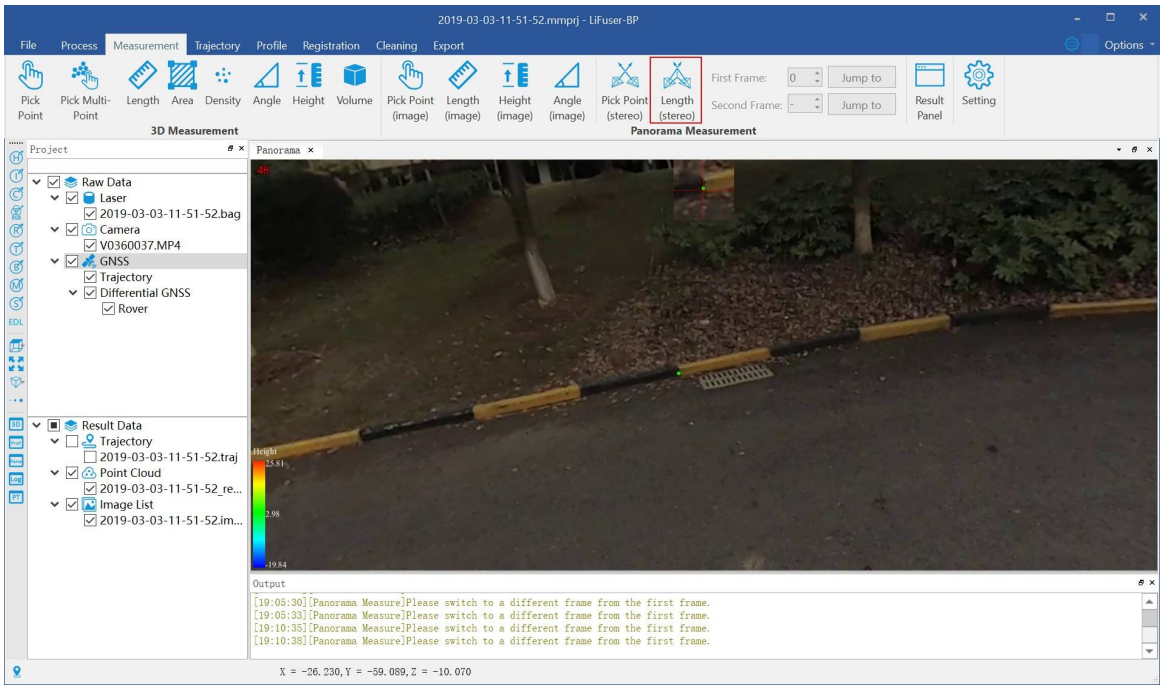
1. Switch to the first frame image which needs to be measured before selecting the first corresponding point. After selecting the first corresponding point, switch to the second frame image that needs to be measured. The specific switch method is to edit the frame number of *First Frame* and *Second Frame*. And click *Jump to* button or press the button of *Enter*.

Length Measurement (Forward Intersection)

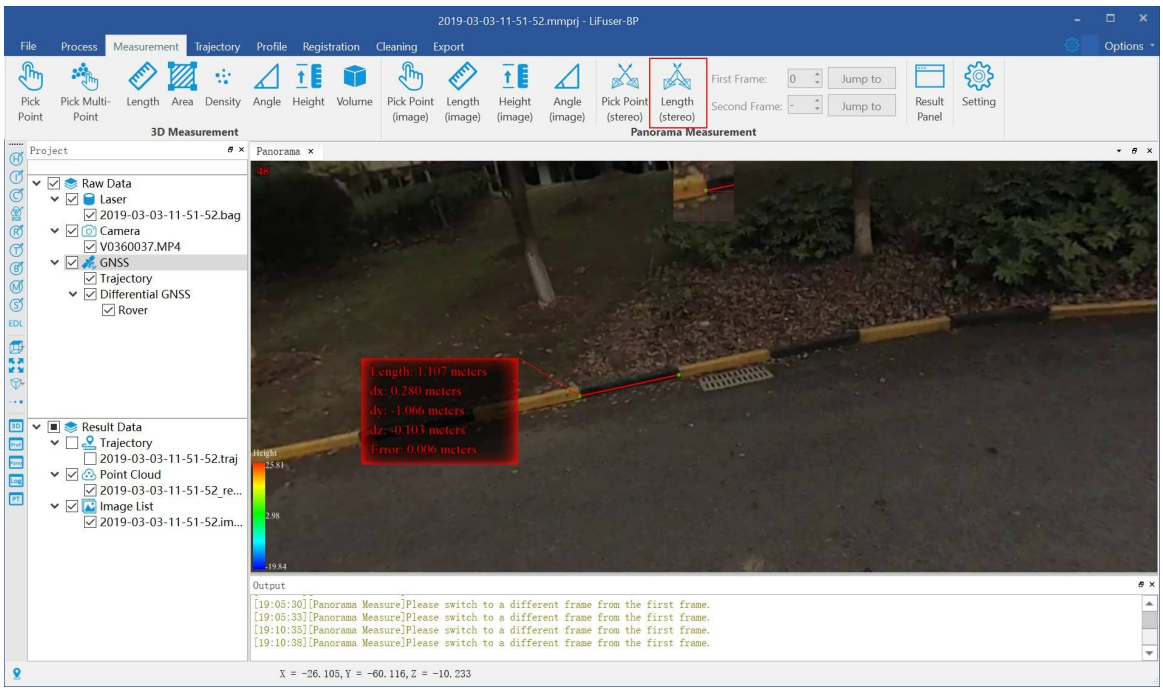
Function Description: This tool is applicable to point cloud data, which calculates the distance between two consecutive points.

Step

1. Click *Length(stereo)*  button via *Panorama Measurement* mode.
2. Left-click to select the starting point in the scene, the operation is the same as Pick Point step.



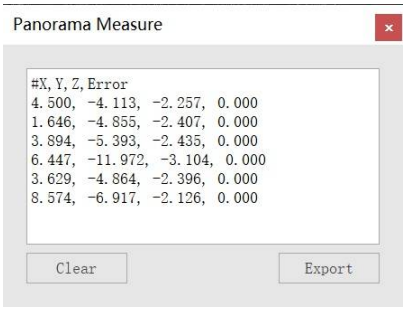
3. Select the end point, the operation is the same as Pick Point。



4. Right-click to go back to the previous point during the measurement.

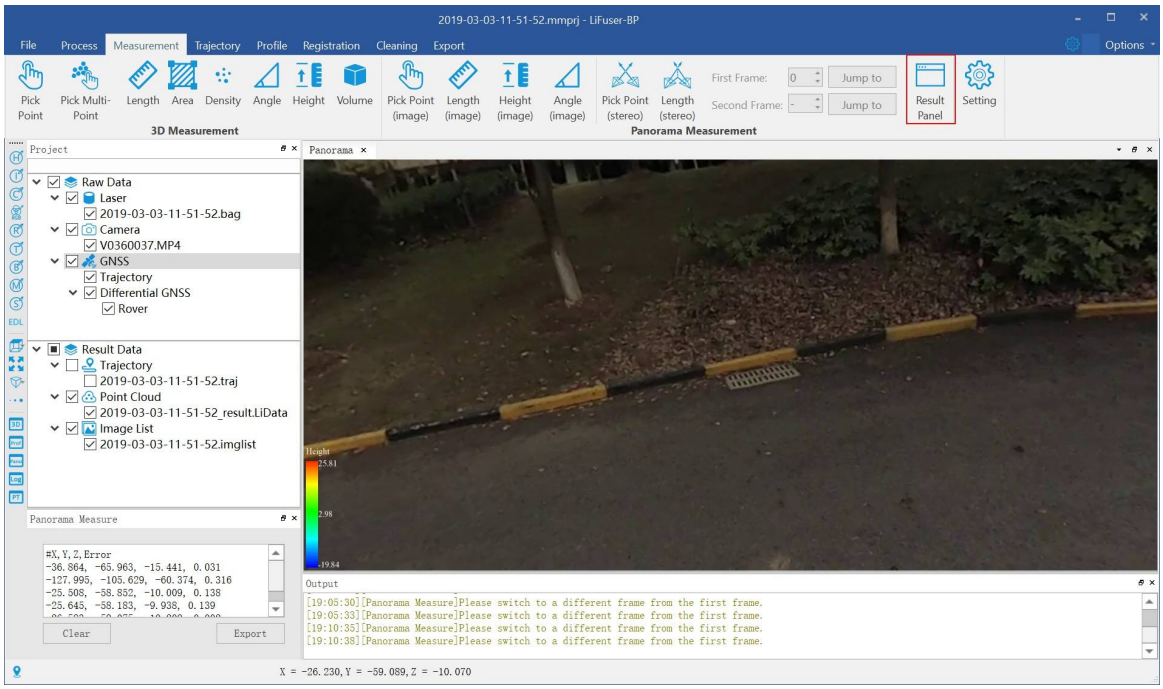
Result Panel

The result of panorama measurements can be recorded in Result Panel. And it is supported to export measured points list.



Step

1. Click *Result Panel* button via *Panorama Measurement mode. The Result Panel will pop up from the right corner.

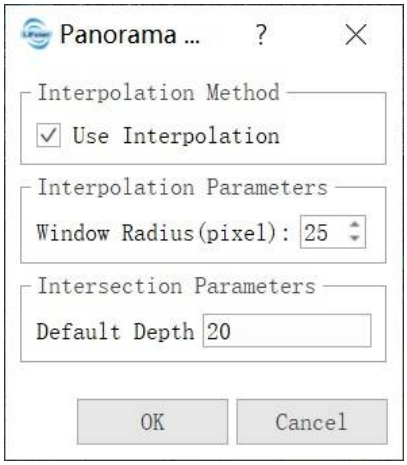


2. Click *Clear* button to clear Result Panel.

3. Click *Export* button to export measured points list.

Dialog Setting

Dialog Setting is used to set parameters for running the function of panorama measurements.



Parameters Introduction

- **Use Interpolation** : This function is set by default. It is available to choose whether select the complex interpolation algorithm or not when using the function of Panorama Measurements based on Depth Interpolation. If unselect this function, nearest neighbor algorithm is used to calculate the point location information.
- **Windows Radius**: It is the windows radius to be used when running interpolation algorithm. For example, when the windows radius is N, all the depth value around the measured points in the square area whose length value is 2N + 1 (the unit is pixel) will be read. If the point density is not high and measurements can not perform with default windows radius, users can increase the value of windows radius.
- **Default Depth**: It is the assumed depth of measured points. And it is recommended in the second frame image when using the function of Panorama Measurements based on Forward Intersection

Profile Tools

Profile editing tool allows users to view the profile of the point cloud data in the selected rectangle area. Users can view, meansure, and edit the data in the profile window.

- Switch View
- Select Profile Region
  - Fixed Buffer
  - Move
  - Rotate
  - Expand
- Measure Tools
- Manual Classify

Profile and Measuring Tool

It is supported to use all the 3D measurements tools in *Measurement* mode.

> Note: If users switch the profile window to measurement tools interface, the measurement tools will activate. And to reuse the profile tools, it is necessary to reclick the profile tools.
>
> ---
>
> ### Profile and Select Tool
>
> All the select tools (Cut tools included) are supported to use in the main profile window.
>
> Note: If users switch the profile window to select tools interface, the measurement tools will activate. To reuse the profile tools, it is necessary to reclick the profile tools. The sub-interface of profile tools only support selected tool in the profile interface,

Switch View

Function Description: By default, profile view shows the front view, rear view, left view and right view of selected rectangle area. However, under default condition, rotate operation is not supported.

Step

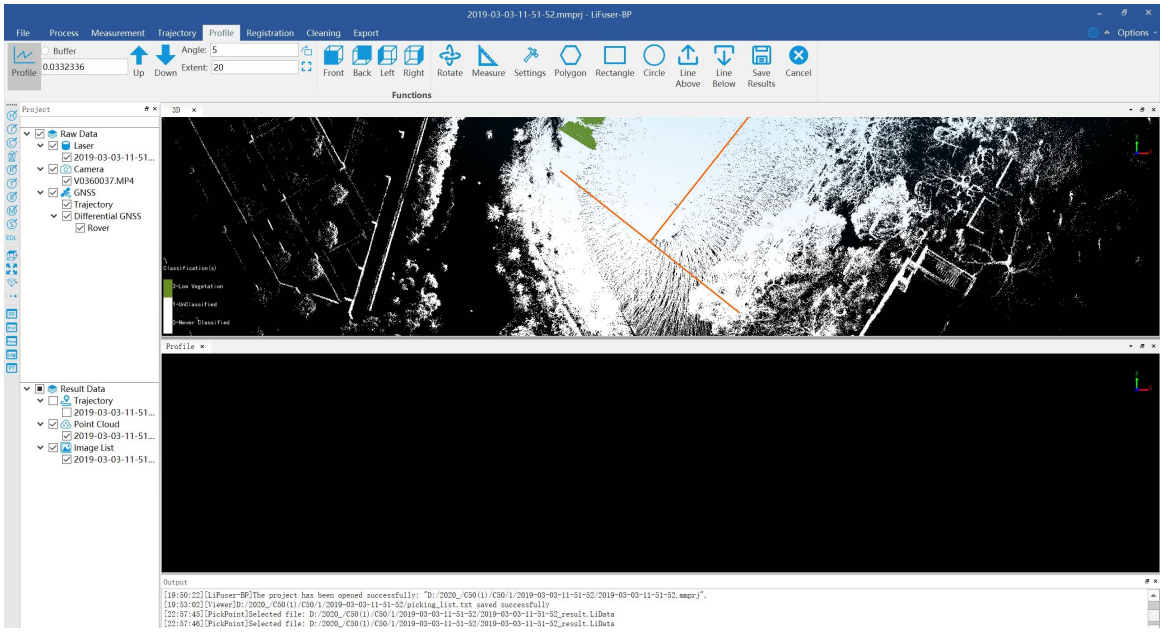
1. By default, profile view shows the front view.
2. **optional** Click  button to switch to front view.
3. **optional** Click  button to switch to rear view.
4. **optional** Click  button to switch to left view.
5. **optional** Click  button to switch to right view.

> Note: It is also supported to start  rotate mode under non-default settings.

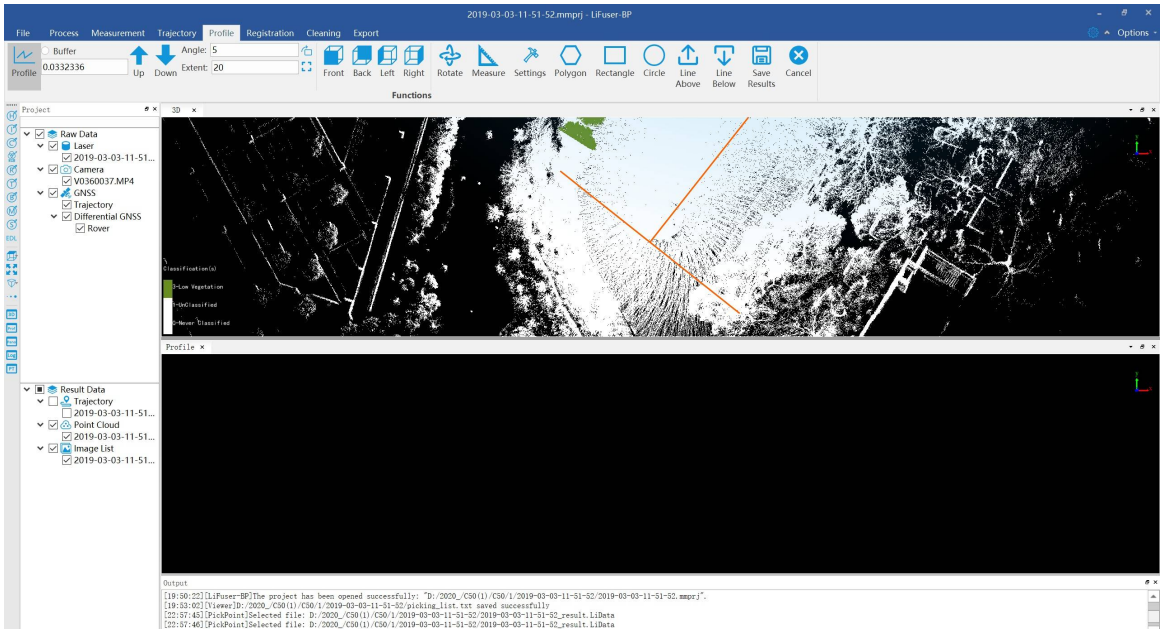
Select Profile Region

Step

1. Move the mouse to 3D window to zoom to interested area.
2. Select the first point by left-clicking, move the mouse to select the second point. The profile direction is done.



3. Move the mouse to select the profile width, double left-clicking to finish profile area. In profile window, the selected profile area will display.。



LiFuser-BP supports multi selection tools.

Fixed Buffer

Move

Rotate

Expand

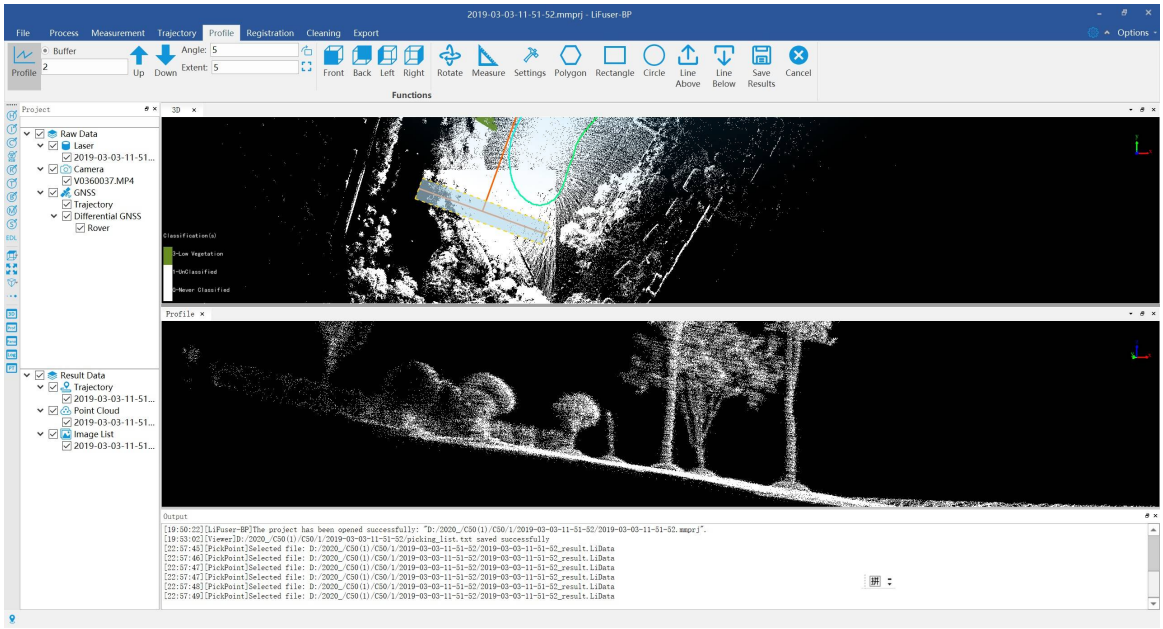
> Note: It is supported to mixed use of tools mentioned above.

Fixed Buffer

Fixed rectangular width is supported to use.This function can help users to fix the size of the buffer area.

Step

1. Set the buffer value, for example, set 2 meters as fixed buffer.



2. Click the buffer setting button.

3. Select the first point by left-clicking, move the mouse to select the second point. The profile direction is done.

Move

Used to move up (move down) the current profile to create a new profile with the same size and right above (below) the current profile.

Step

1. Select the first point by left-clicking, move the mouse to select the second point. The profile direction is done.
2. Move the mouse to select the profile width, double left-clicking to finish profile area.
3. **optional** Click  to move up the profile.
4. **optional** Click  to move down the profile.

Rotate

Function Description: Support to rotate the profile area based on the angle that users enter in the rotate settings window.

Step

1. Select the first point by left-clicking, move the mouse to select the second point. The profile direction is done.
2. Move the mouse to select the profile width, double left-clicking to finish profile area.
3. Set rotate angle (-360~360)
4. Click  button to rotate.

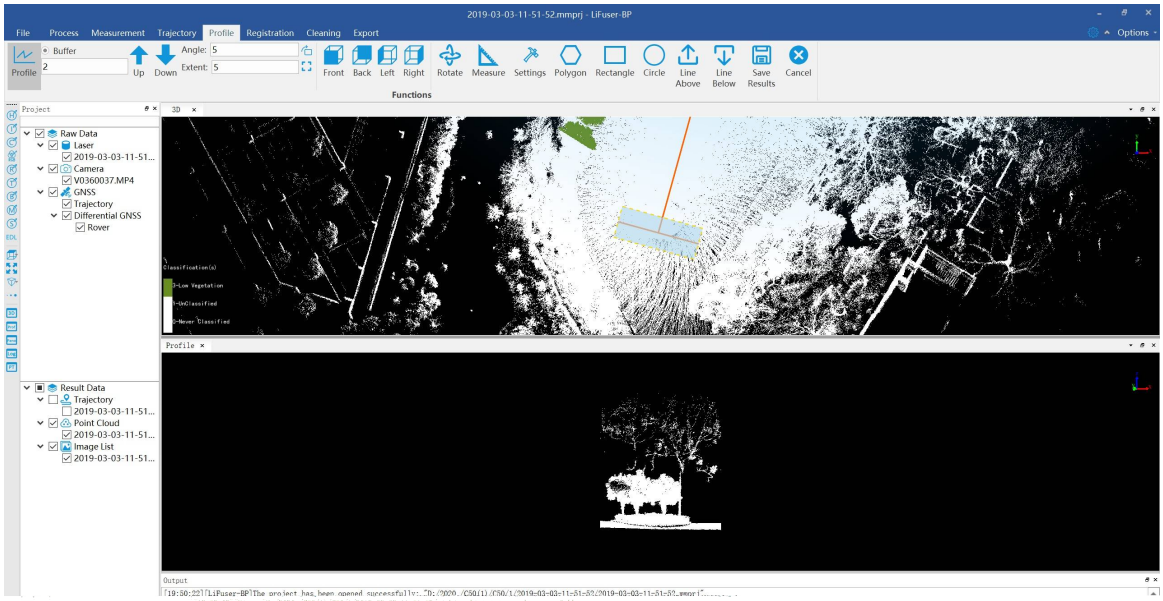
Expand

Function Description: Used to expand the width of profile area by the entered number.

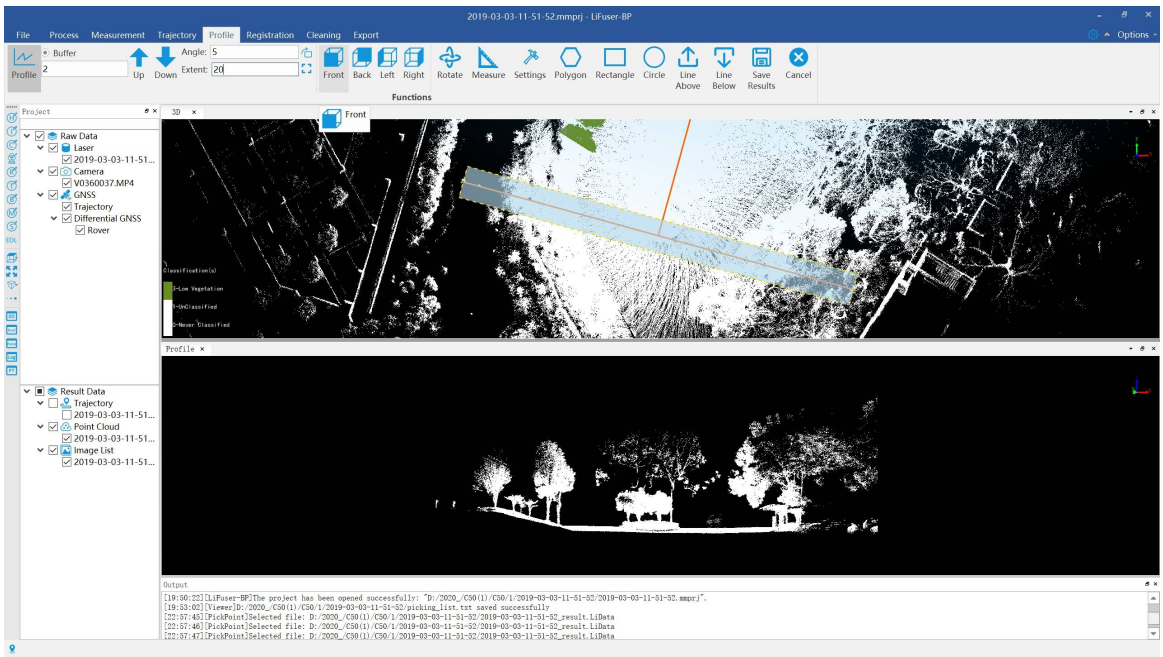
Step

1. Click *Expand* button to expand current selected area.

   Before expand：

   After expand:

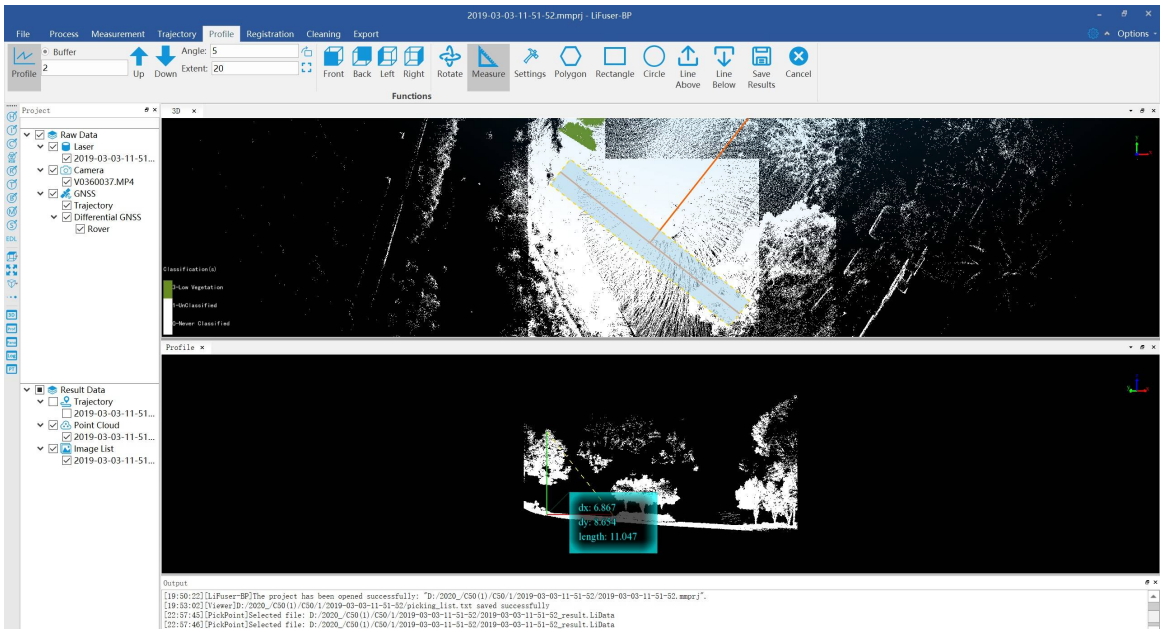
2. Click *Expand* button to change the expand length.

Measure Tools

Function Description: Orthogonal projection is as default for profile window, and it is convenient to calculate the horizontal and vertical distance.

Step

1. Click *Measure* button via *Profile* mode to start profile measurements.
2. Left-click to select the first point.
3. Select the second point by double-clicking to finish calculating the distance between two points.

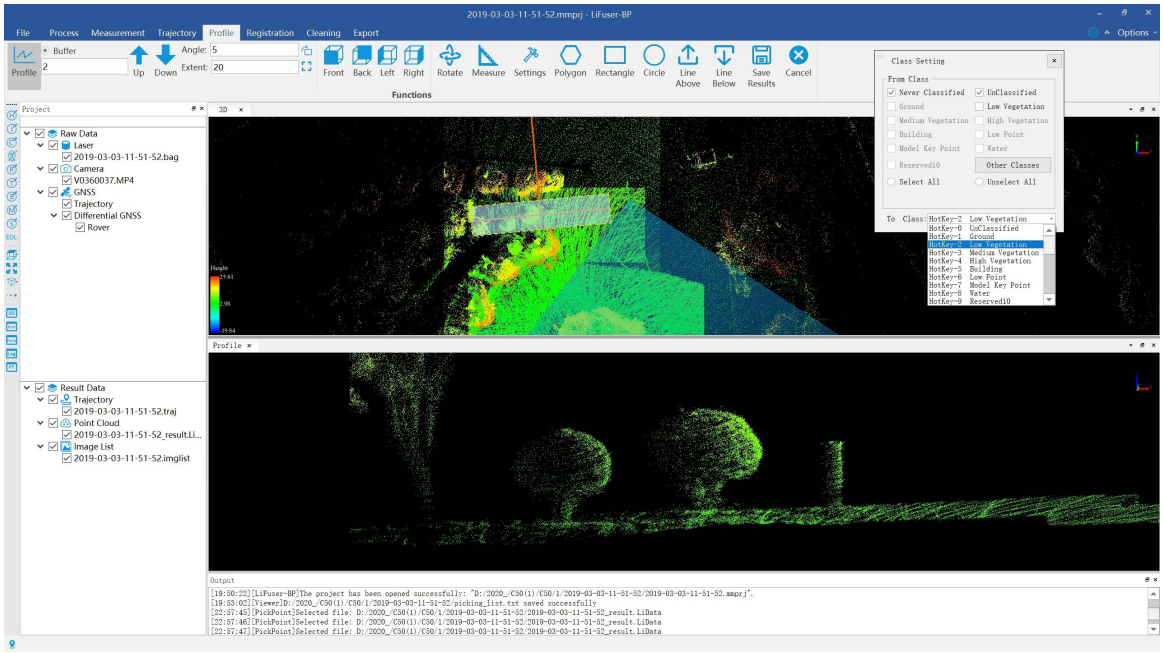


Manual Classify

Function Description: Use tools supported by profile window for manual classification.

Step

1. Click button to set modified classification and targeted classification.
2. Select "From Class" to "To Class" in Class Setting window. For example, users can classify unclassified points to low vegetation points as shown below.



3. Change attributes by selection tools.

   Polygon Selection:It is suggested for complexed polygons using Even-odd Rules. For example, a tree or a building.

   Rectangle Selection: It is suggested for simple shape object.

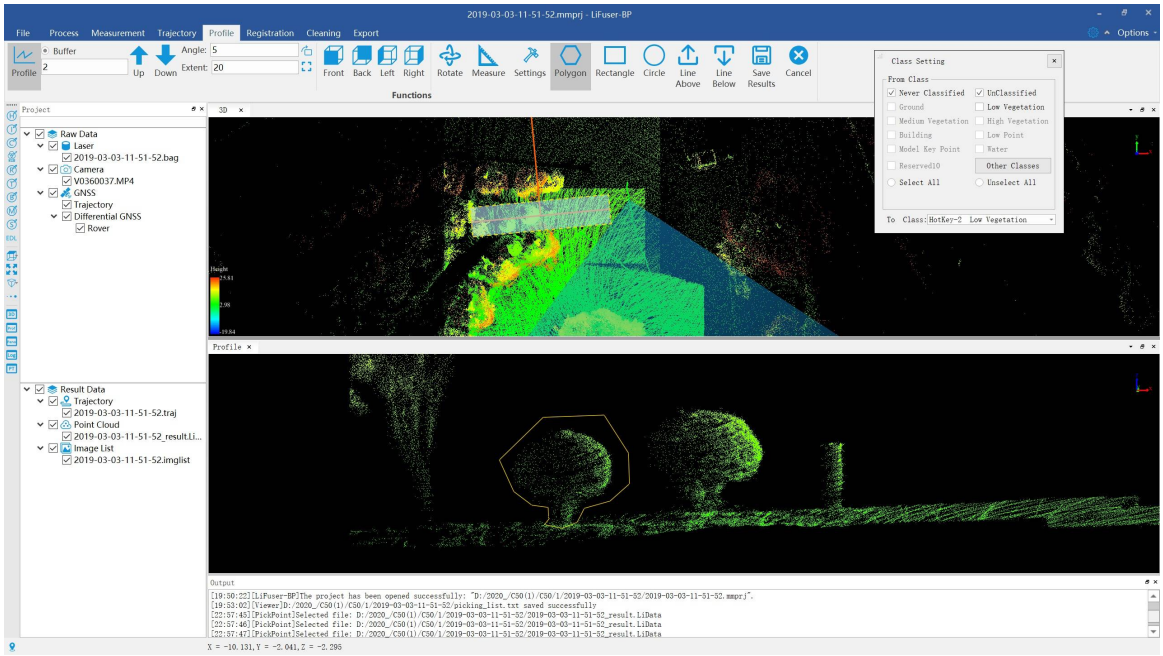
   Circle Selection.

   Select above the line.

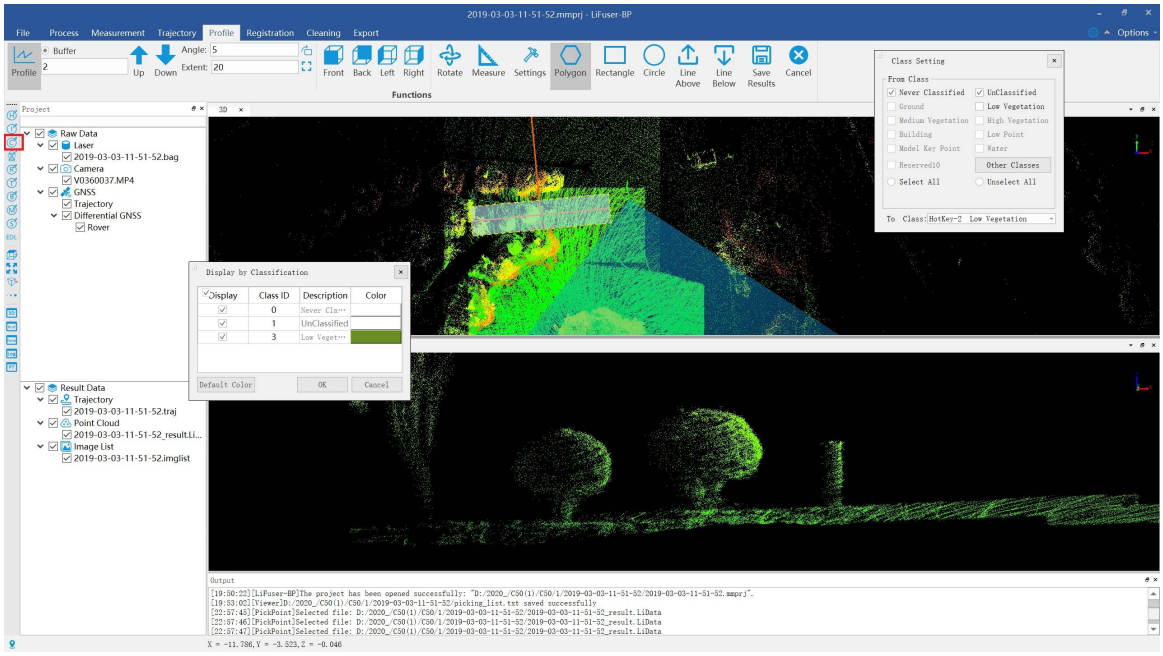
   Select below the line.

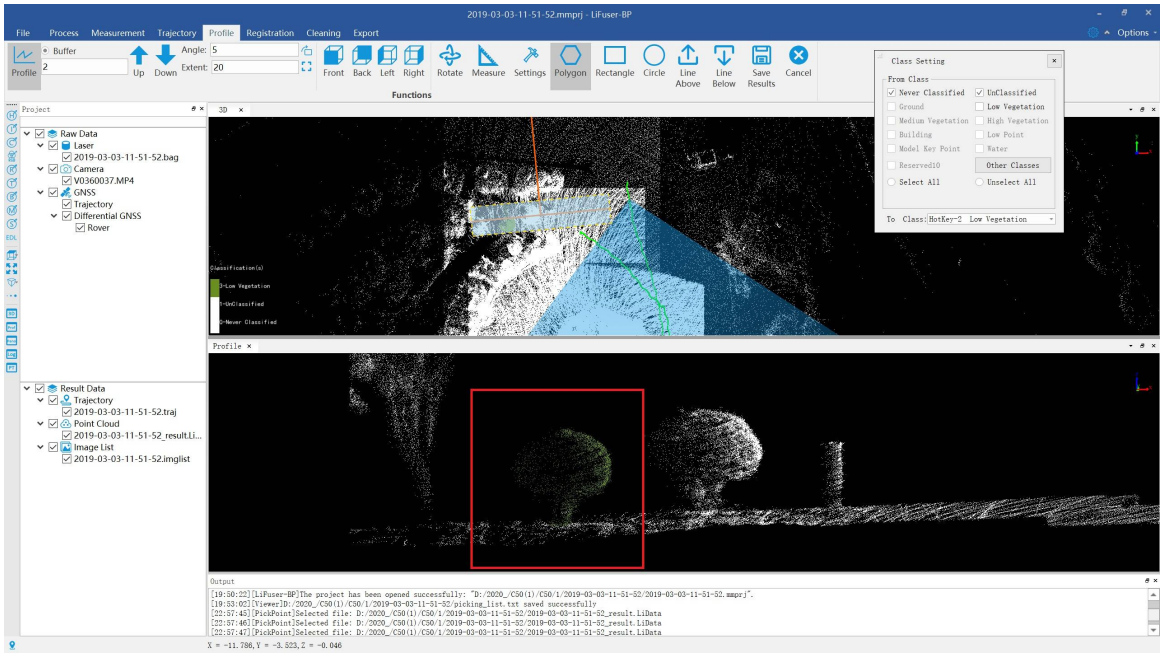
   For example:

   Draw polygon (double left-clicking to finish the selection)



4. Display by class to see previous selected points.

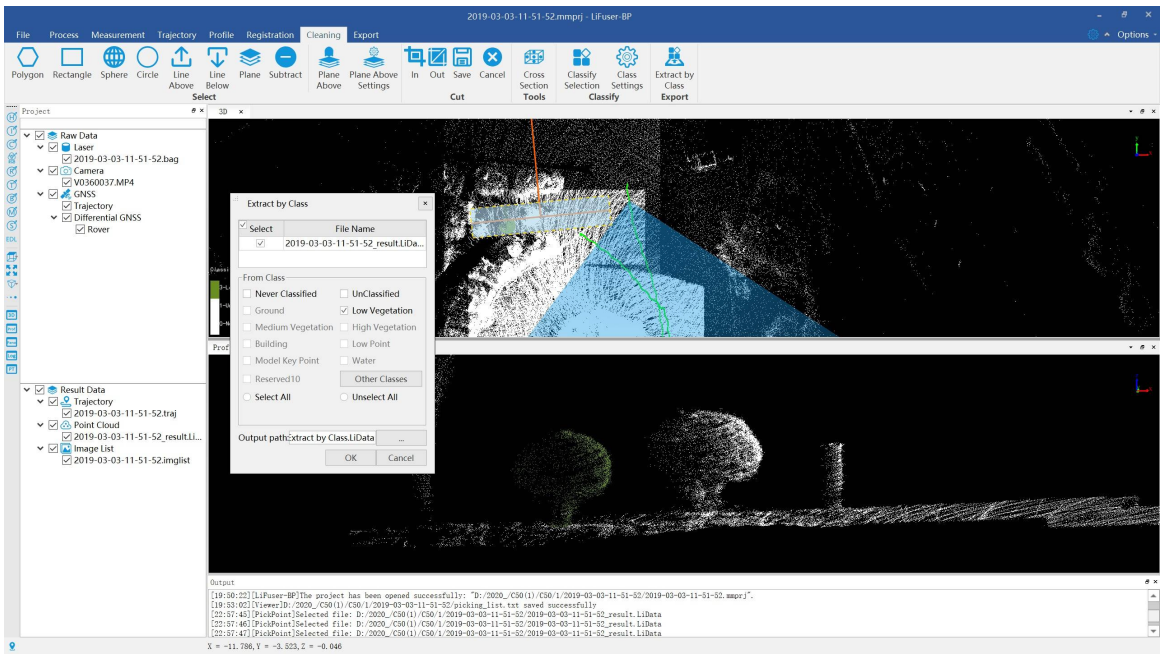


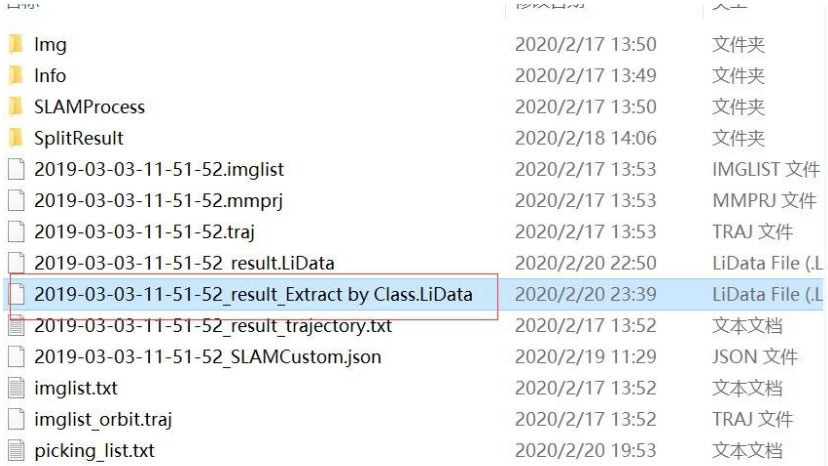


5. (**optional**) Use **Ctrl+Z** to undo the previous steps.Or by clicking button to clear all the unsaved steps.

6. Click to save the profile.

7. Click *Extract By Class* button via *Cleaning* mode, save the classified file in hard disk.

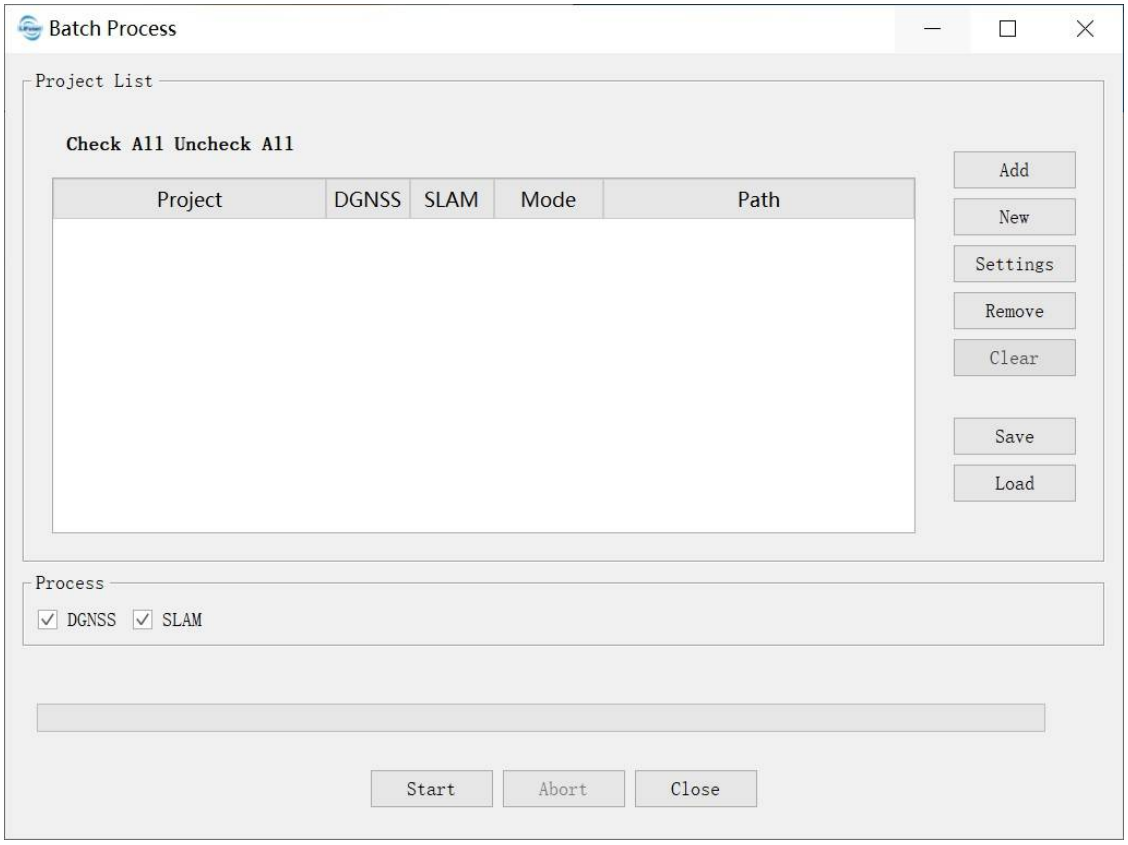




> Note: It is valid only after saving the classified files.

Batch Processing Tools

Launch the software, select *Batch* mode and click *Batch Process* button to display the interface below.



Batch processing interface

Add Project to Batch Processing List

There are two ways to add the project to batch processing list, one for adding existing project and the other for creating new projects.

- Add existing projects.

  Click *Add* button to import the project file.

- Create new projects.

  Click *New* button to create New Project, the created new project will be imported into batch processing list automatically.

Modify the Project Configuration in the List

There are two ways to modify the configuration:

- Double click on the list row which needs to be modified.
- After selecting the specified row and click *Setting* button. For more details please reference High Accuracy Process -Parameters Configuration

Modify the Project Processing Mode in the List

Modify by setting *Mode* and for more details please reference High Accuracy Process-Select Process Mode

Modify Process Procedure

Users can control processing workflow by deciding whether ticking conrespondnig buttons. For more details please reference High Accuracy Process-Select Process Procedure

Start Batch Processing

Click *Start* button to start batch processing.

Abort Batch Processing

Click *Abort* button to abort batch processing.

Close Batch Processing

Click *Close* button to close batch processing. Note: The batch processing cannot be closed while the batch is running thus it needs to be aborted first.

Save Batch Processing

Click *Save* button to save batch processing.

Load Batch Processing

Click *Load* button to load batch processing.

Remove Batch Processing

Click *Remove* button to remove batch processing.

Clear Batch Processing

Click *Clear* button to clear batch processing.

Viewing Tools

Set current active window to some views.

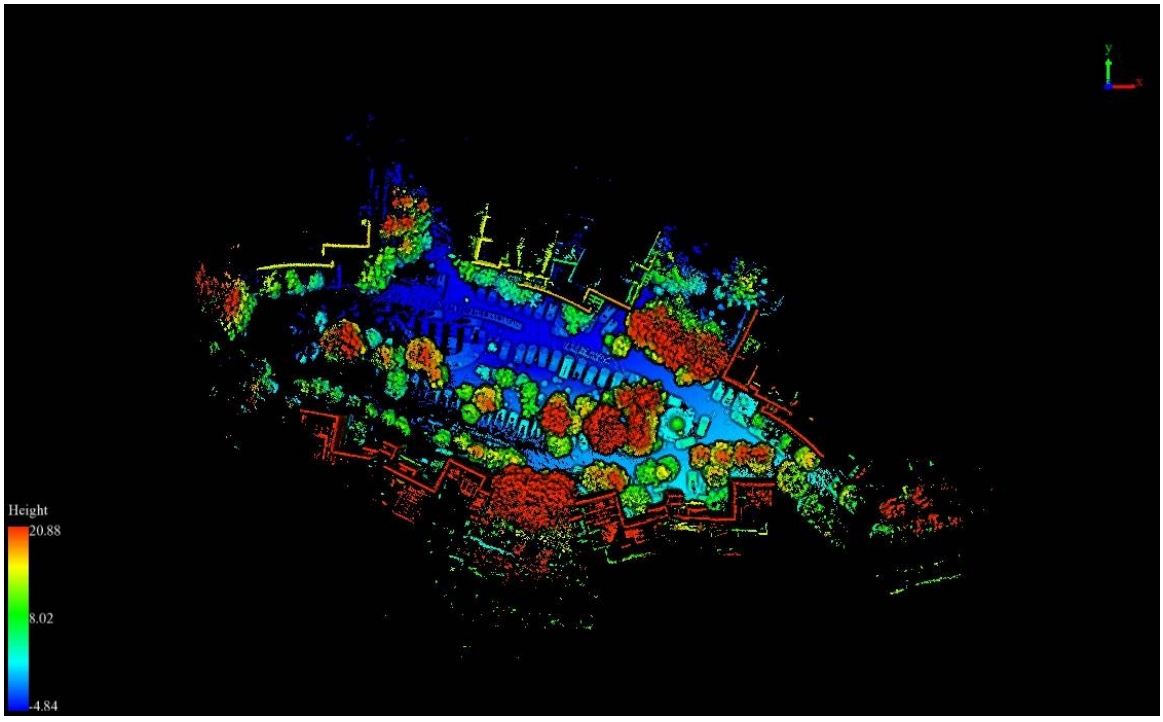
- Top View
- Bottom View
- Left View
- Right View
- Front View
- Back View
- Front Isometric View
- Back Isometric View
- Set View Mode
- Full Extent
- Configure Point Size and Type

Top View

Function Description: Set camera to top view. View data from +z to -z direction. View plane: x-y plan

Step

1. After clicking this button, current active window will be shown:



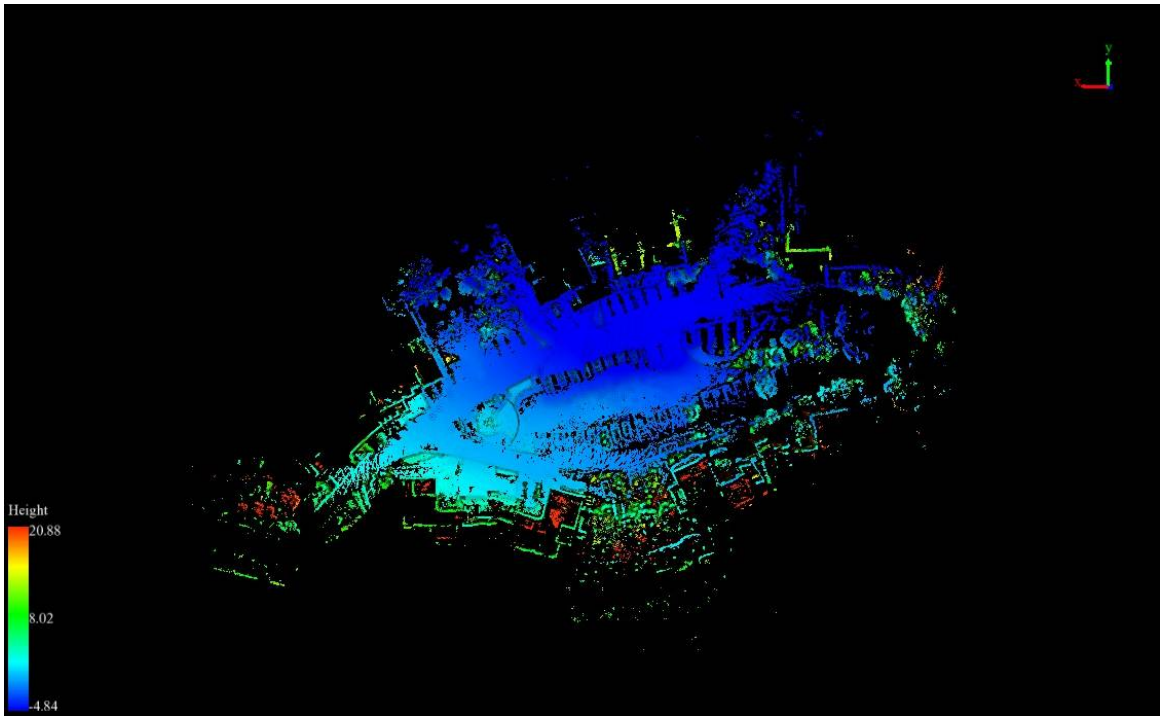
> Note: This tool is only for viewer in 3D mode, and it does not reset the center position of the viewer. If you need to reset to the default view, please click Full Extent。

Bottom View

Function Description：Set camera to bottom view. View data from -z to +z direction. View plane: x-y plane.

Step

1. After clicking this button, current active window will be shown:

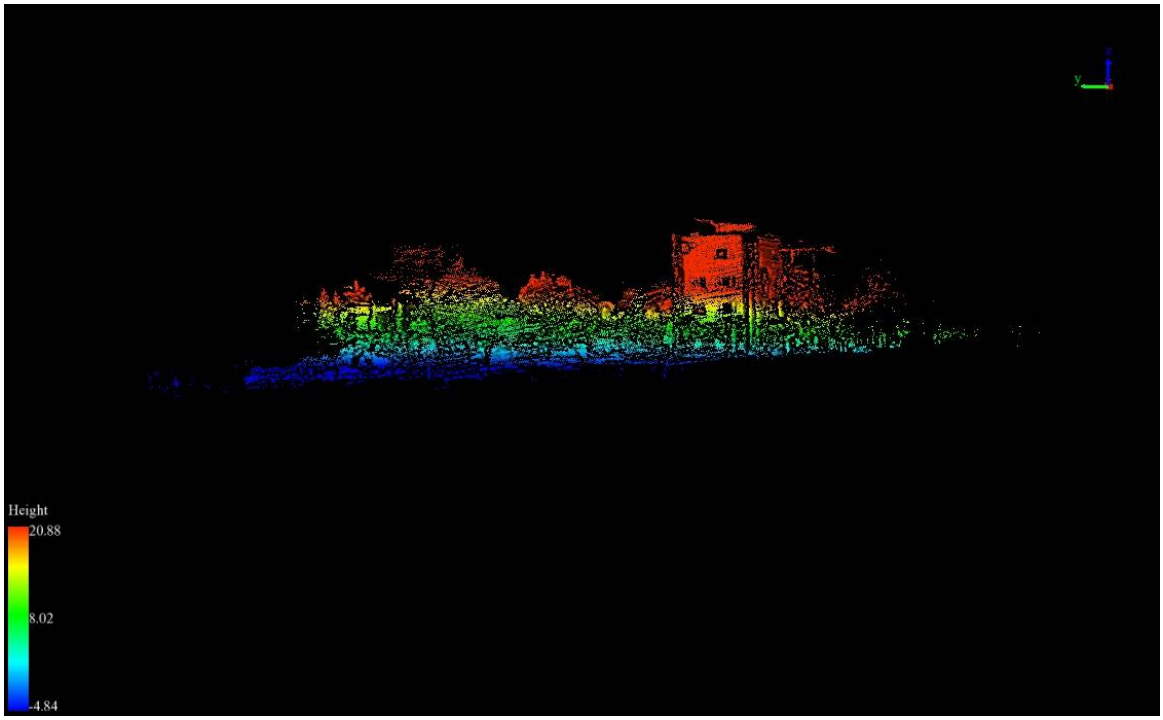


Left View

Function Description: Set camera to left view. View data from -x to +x direction. View plane: y-z plane

Step

1. After clicking this button, current active window will be shown:

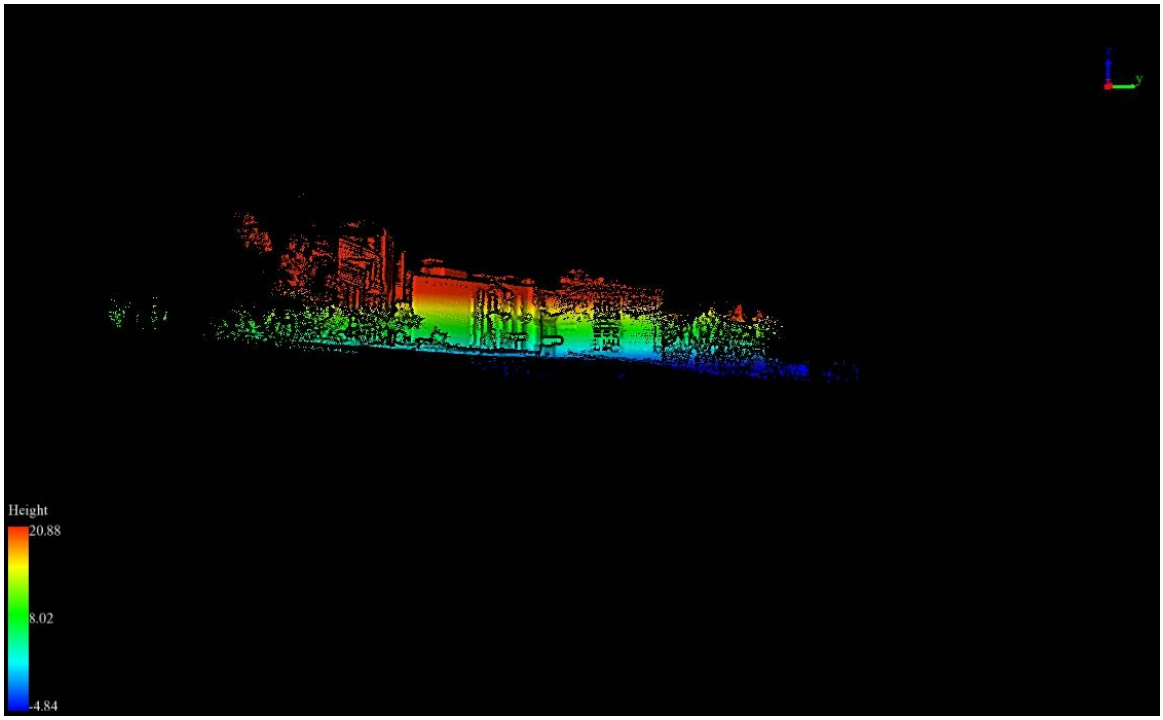


Right View

Function Description: Set camera to right view. View data from +x to -x direction. View plane: y-z plane.

Step

1. After clicking this button, current active window will be shown:

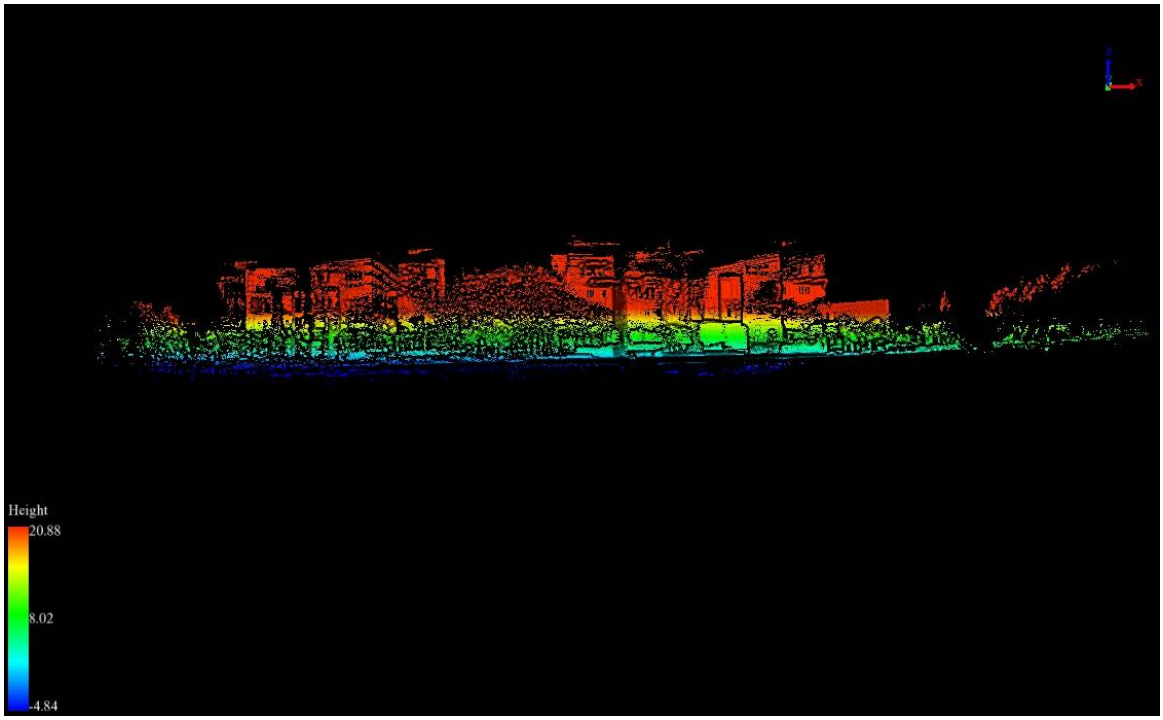


Front View

Function Description: Set camera to front view. View data from -y to +y direction. View plane: x-z plane.

Step

1. After clicking this button, current active window will be shown:

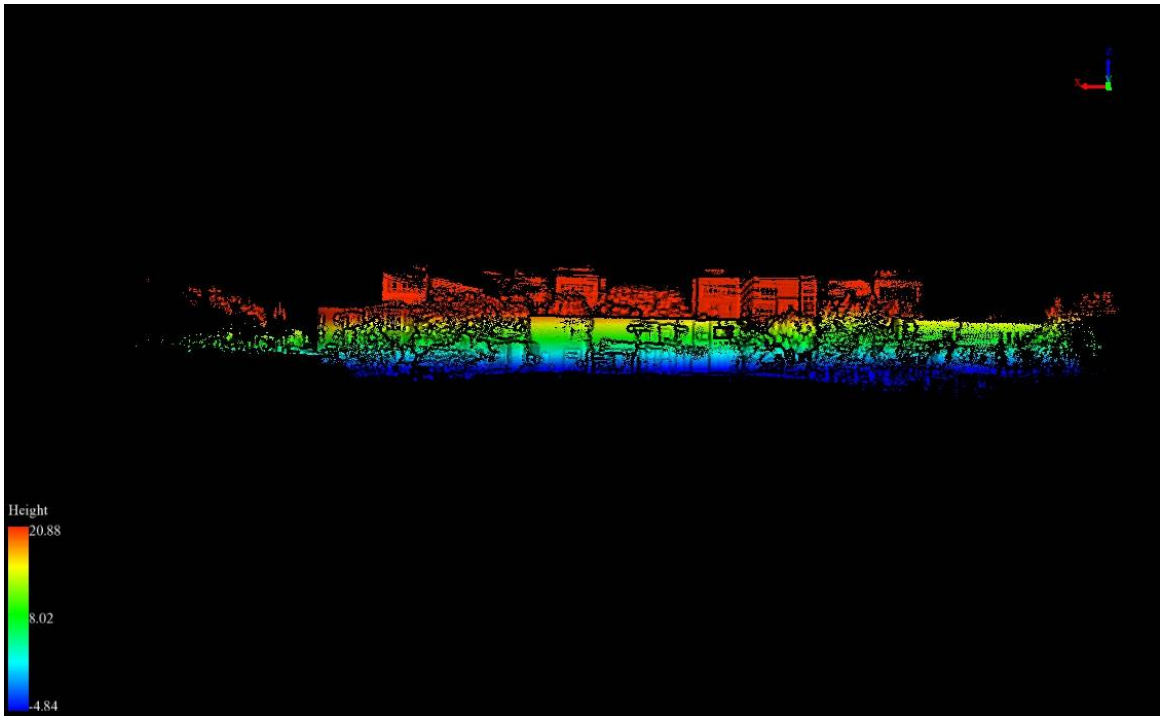


Back View

Function Description: Set camera to back view. View data from +y to -y direction. View plane is x-z plane.

Step

1. After clicking this button, current active window will be shown:

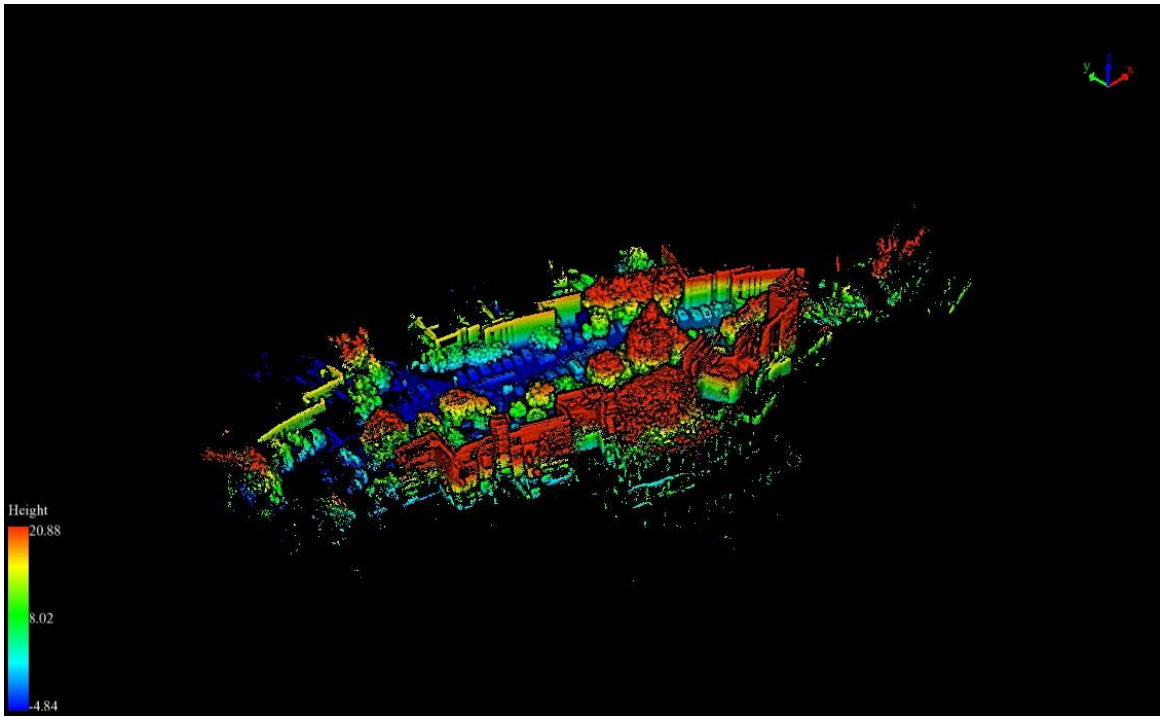


Front Isometric View

Function Description：Set camera position to front 45 degrees of X-Y plane.

Step

1. After clicking this button, current active window will be shown:

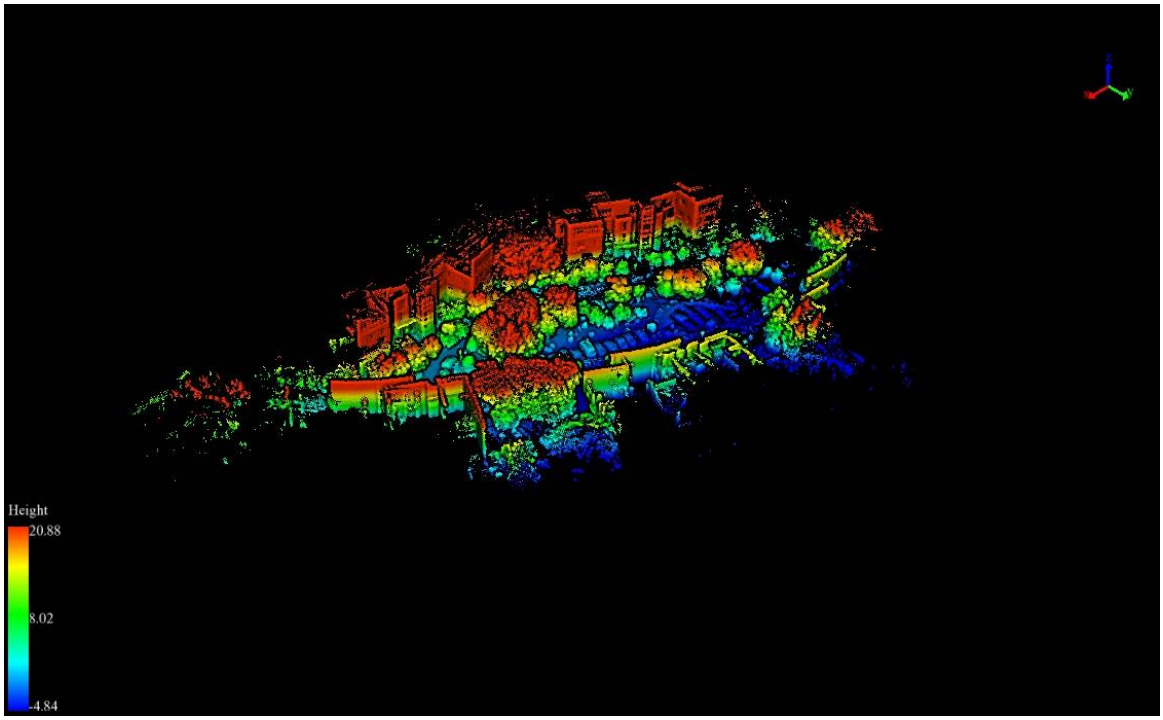


Back Isometric View

Function Description: Set camera position to back 45 degrees of X-Y plane.

Step

1. After clicking this button, current active window will be shown:

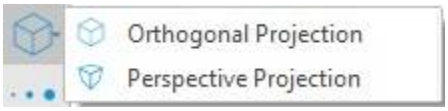


Set View Mode

Function Description: Select projection mode(orthographic/perspective).

Step

1. After clicking this button, the option of projection mode is popped up. If Orthogonal Projection is selected, current active window will be set in orthogonal projection. If Perspective Projection is selected, current active window will be set in perspective projection.



Parameters Setting

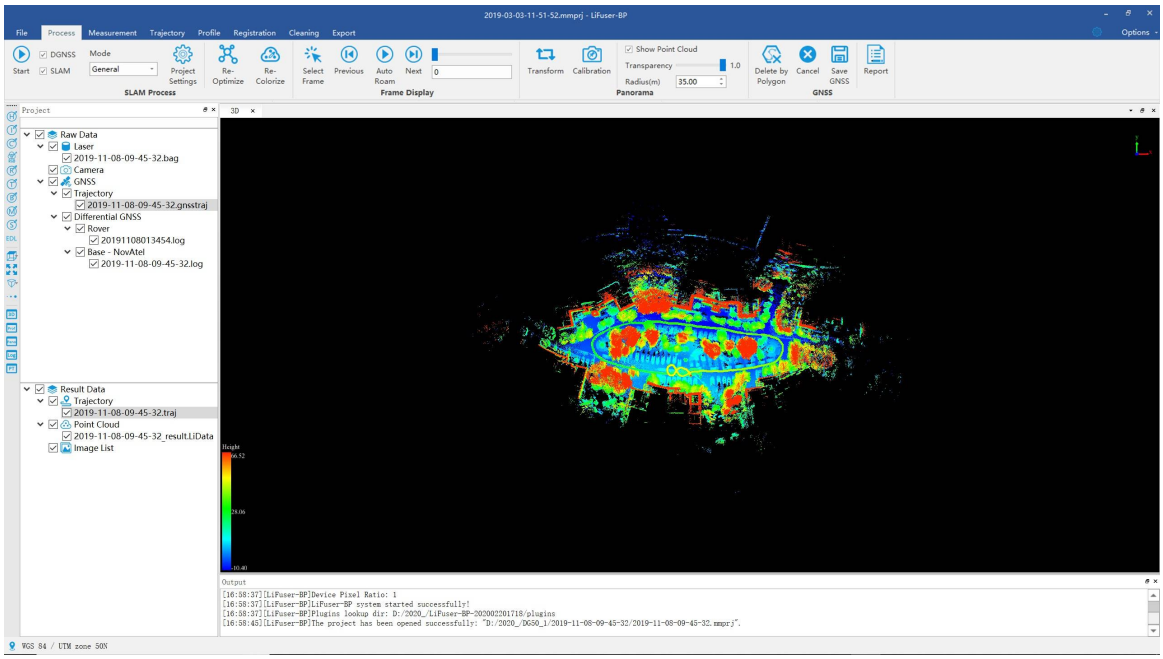
- **Shortcut Key**：F3

Full Extent

Function Description: The function of full extent is applicabale to 3D window in LiFuser-BP software t display all data in 3D window in the way of top view. Its aims to achieve global browing of data.

Step

1. Click  button in toolbar, the data in 3D windows will spread over the window automatically. The picture is shown below:

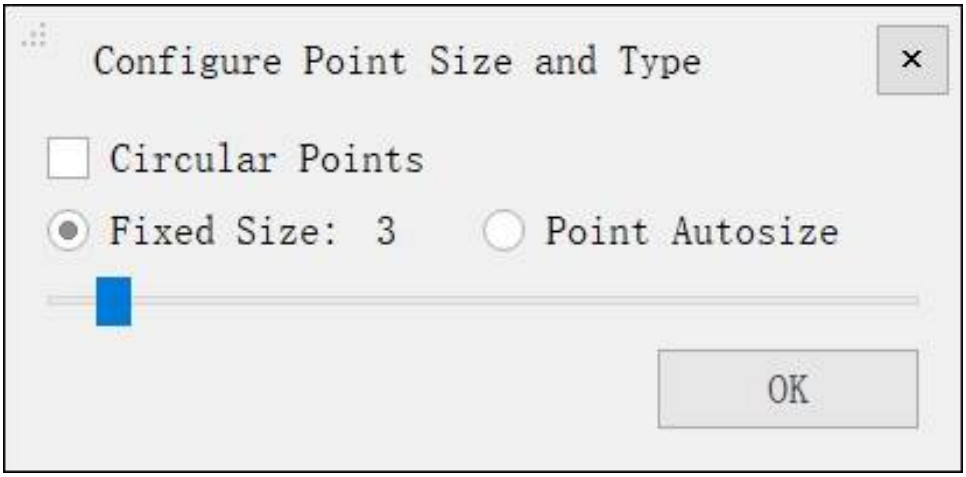


Configure Point Size and Type

- **Function Description**: Configure point size and type.

Step

1. Click this button to open the dialog shown as below:



2. Configure point size and type.

Parameters Setting

- **Circular Points**: Determine point type. If checked, point will be rendered as circle, otherwise, point will be rendered as square.
- **Fixed Size**: If checked, point size would be fixed. User can adjust point size using the slider below (range 0-50 pixels).
- **Point Autosize**: If checked, point size is auto changing based on the depth of the viewer.

Color Tools

With tools in this section, LiFuser-BP allows you to visualize vast amounts of point cloud using the best data representations for your analysis. You can change the coloration of the point cloud displaying by classification (or intensity, GPS time, return of number etc.). You can also enhance the render effect using visualization tools such as EDL which is intuitive and helpful for quality check.

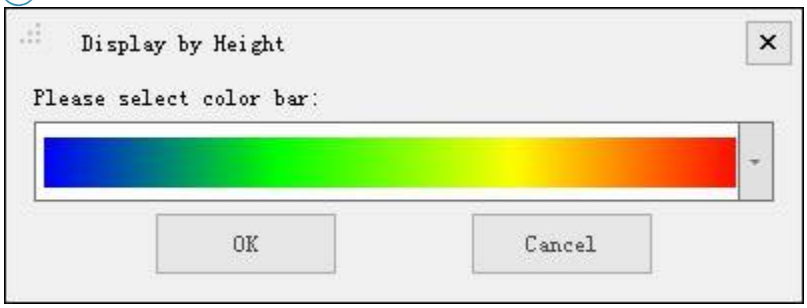
- Display by Height
- Display by Intensity
- Display by Classification
- Display by RGB
- Display by Return Number
- Display by GPS Time
- Display by Blend
- Display by Mix
- Display by Specific Color
- Display by EDL

Display by Height

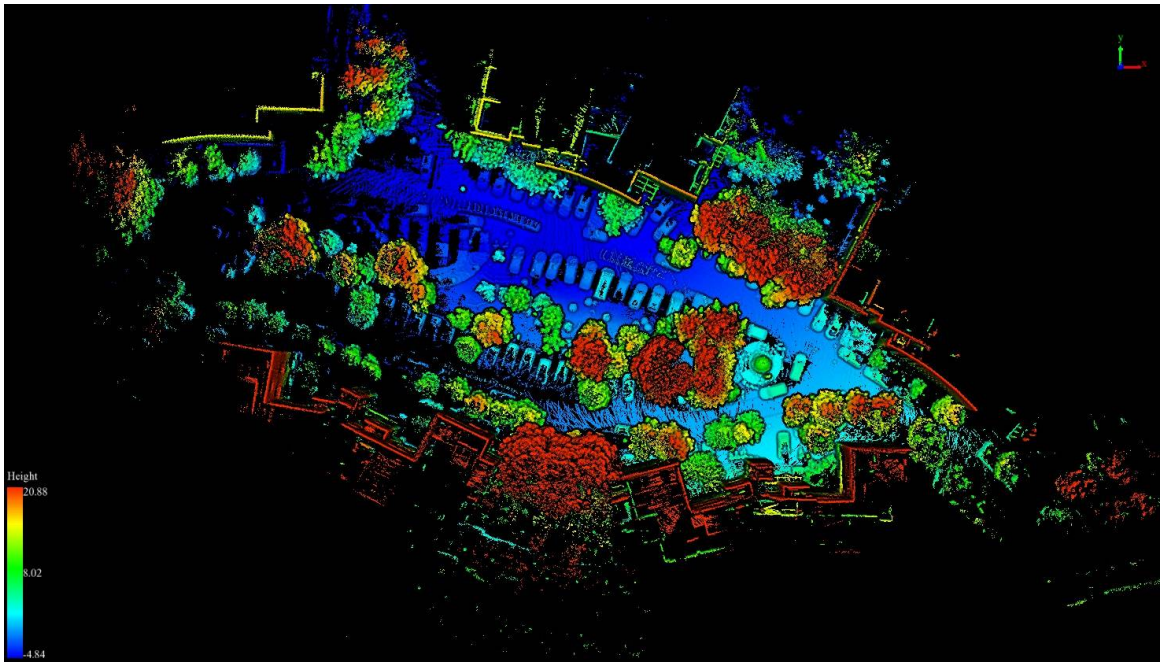
Function Description：this tool is used for displaying point cloud data. The elevation values of point cloud data are mapped to several uniformly varying color intervals, so as to display the variation of elevation values more intuitively.

Step

1. Click the button on the toolbar to pop up the dialog "Display by Elevation", as shown below.



2. Select the appropriate color bar in the combo box and click the "OK" button. The color indicator of the window will generate the corresponding color bar according to the elevation range of the point cloud data. At the same time, the data is displayed by elevation in the scene. The visual effects are better with EDL mode.



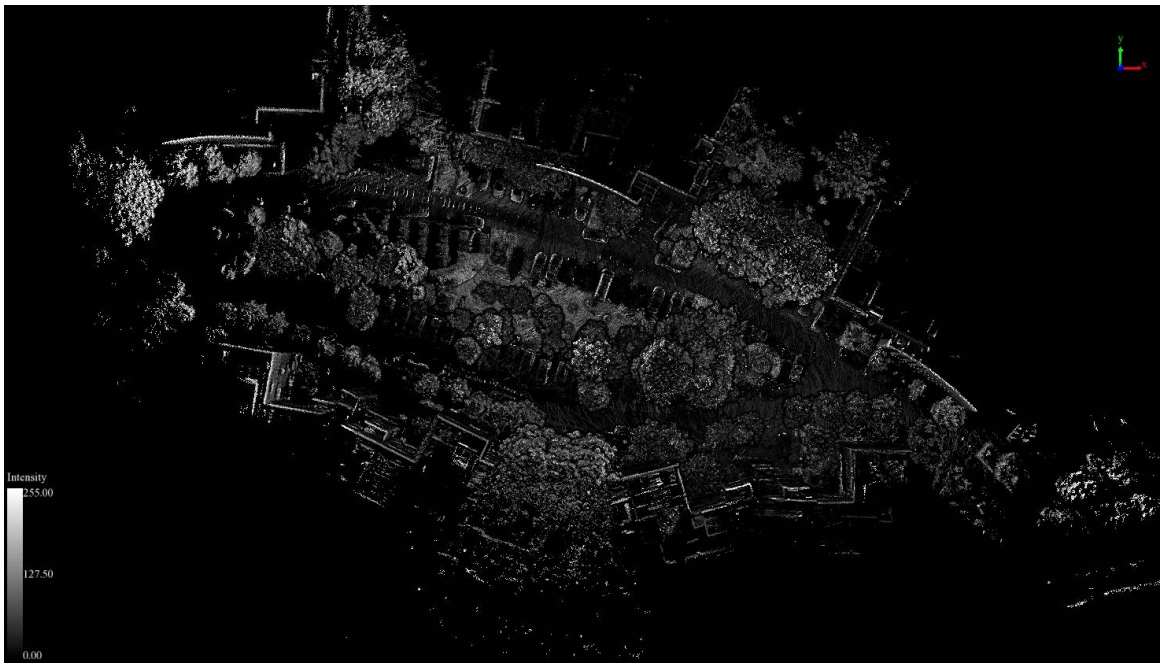
> Please note: this function only works for point cloud data.

Display by intensity

Function Description: this tool is used for displaying point cloud data. The intensity values of point cloud data are mapped to several uniformly varying color intervals, so as to display the variation of intensity values more intuitively.

Step

1. Click the button on the toolbar. The color indicator of the window will generate the corresponding gray color bar according to the intensity range of the point cloud data. At the same time, the data is displayed by intensity in the scene.



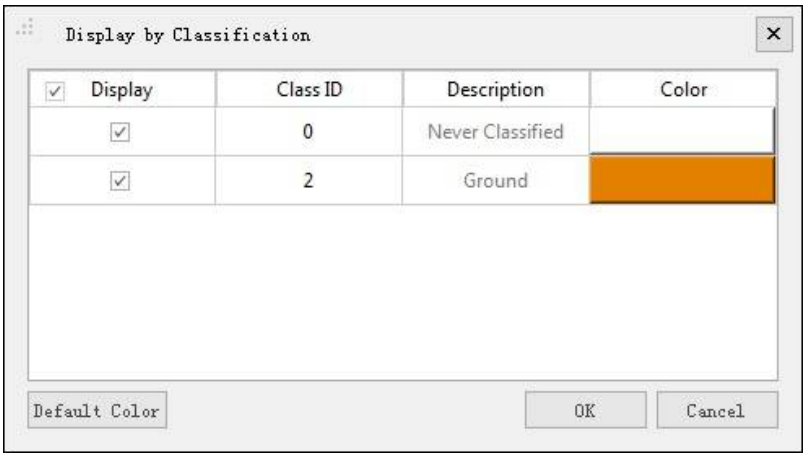
> Please note: this function only works for point cloud data.

Display by Classification

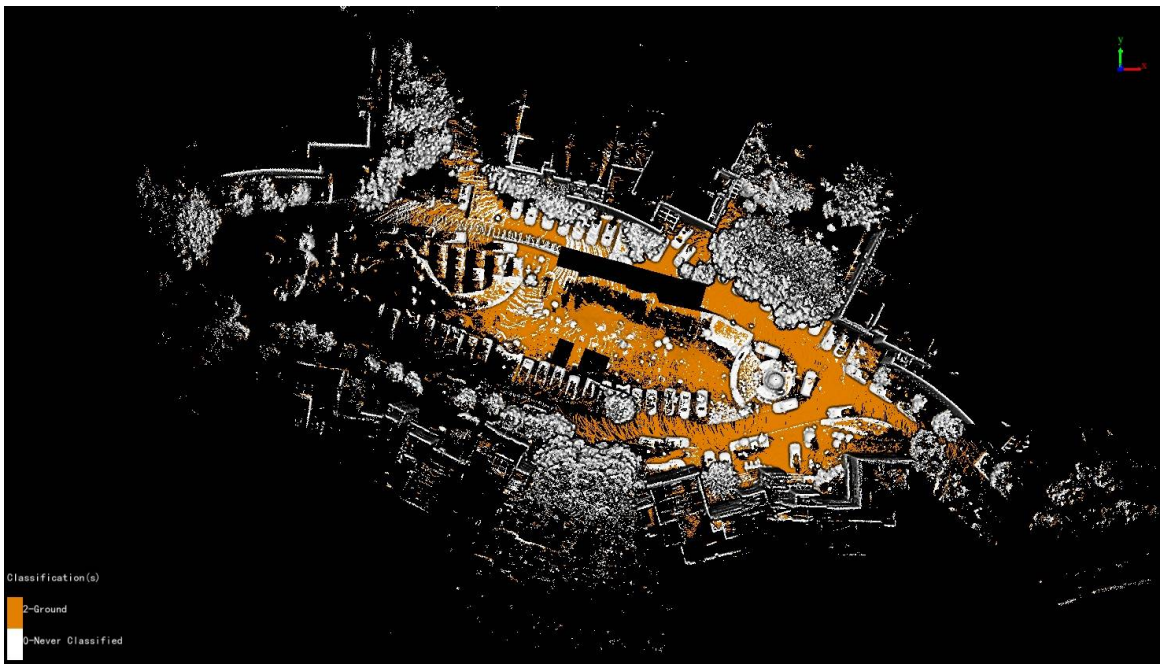
Function Description: this tool is used for displaying point cloud data. The classes of point cloud data are mapped to discrete color values, so as to distinguish different classes of point cloud data more intuitively.

Step

1. Click button on the toolbar, Display by Classification dialog will pop up.



2. Select the appropriate color for each class and click the "OK" button. The color indicator of the window will generate the corresponding color bar according to the class attribute of the point cloud data. At the same time, the data is displayed by classification in the scene. The visual effects are better with EDL mode, as shown below.



> Please note: this function only works for point cloud data.

Display by RGB

Function Description：this tool is used for displaying point cloud data. The point cloud data is displayed according to its own color value.

Step

1. Click the button on the toolbar, the data is displayed according to its own RGB values in the scene, as shown below.

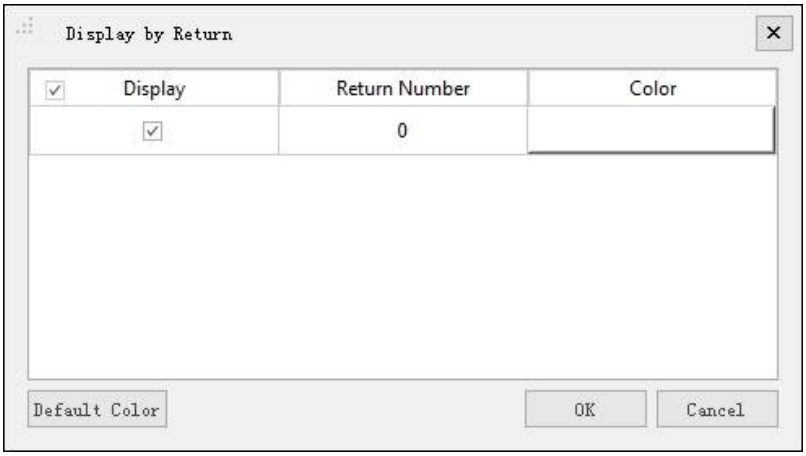
> Please note: this function only works for point cloud data.

Display by Return Number

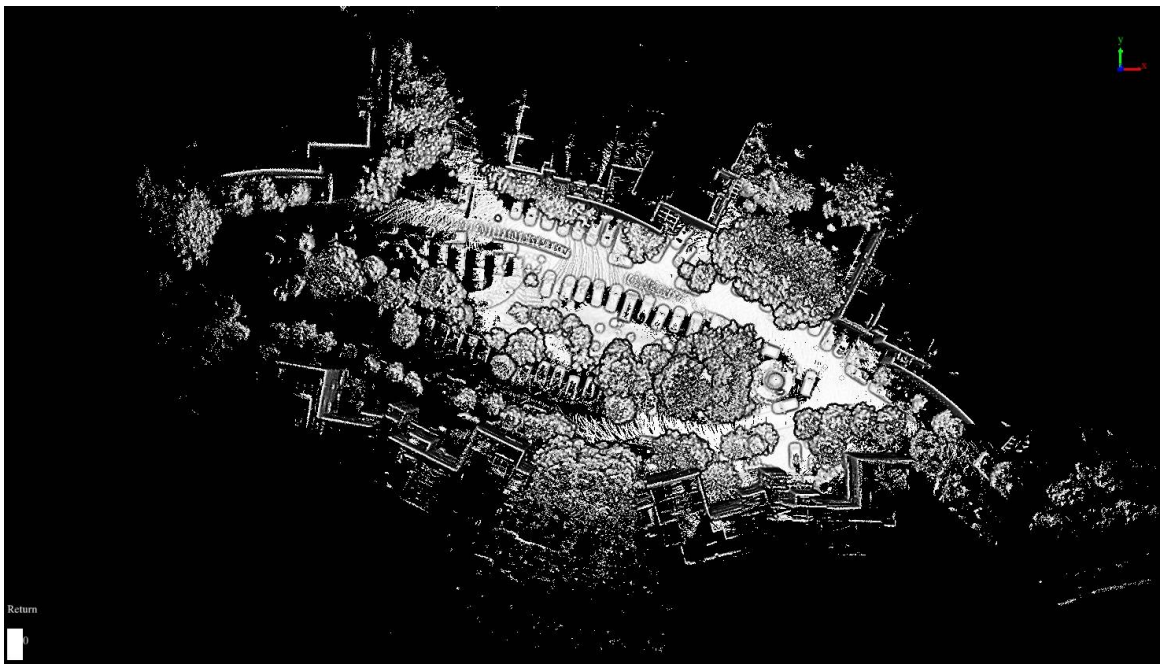
Function Description: this tool is used for displaying point cloud data. The return numbers of point cloud data are mapped to discrete color values, so as to distinguish different return numbers of point cloud data more intuitively.

Step

1. Click the button on the toolbar to pop up the dialog "Display by Return Number", as shown below.



2. Select the appropriate color bar for each return number and click the "OK" button. The color indicator of the window will generate the corresponding color bar according to the return number attribute of the point cloud data. At the same time, the data is displayed by return number in the scene. The visual effects are better with EDL mode, as shown below.



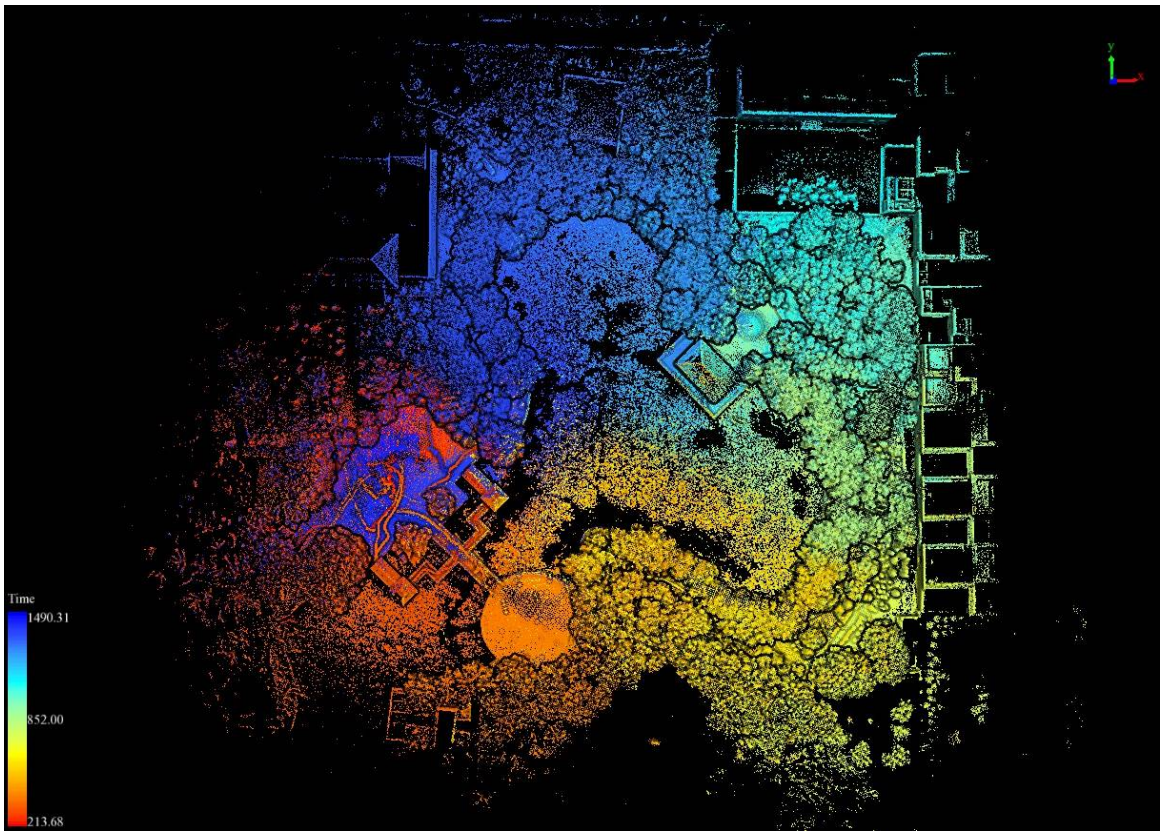
> Please note: this function only works for point cloud data.

Display by GPS Time

Function Description: this tool is used for displaying point cloud data. The GPS time values of point cloud data are mapped to several uniformly varying color intervals, so as to display the variation of GP time values more intuitively.

Step

1. Click the button on the toolbar,
2. Select the appropriate color bar in the combo box and click the "OK" button. The color indicator of the window will generate the corresponding color bar according to the GPS time range of the point cloud data. At the same time, the data is displayed by time in the scene.



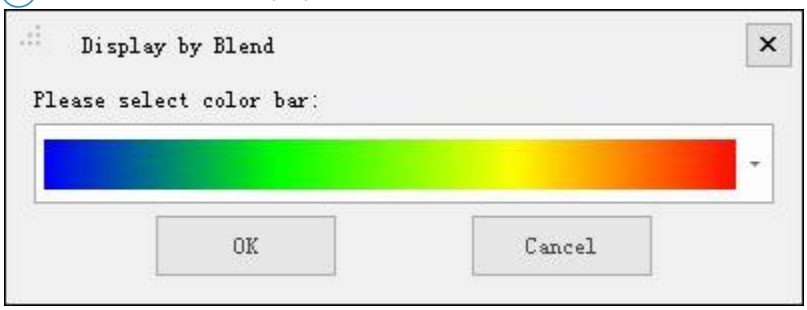
> Please note: this function only works for point cloud data.

Display by Blend

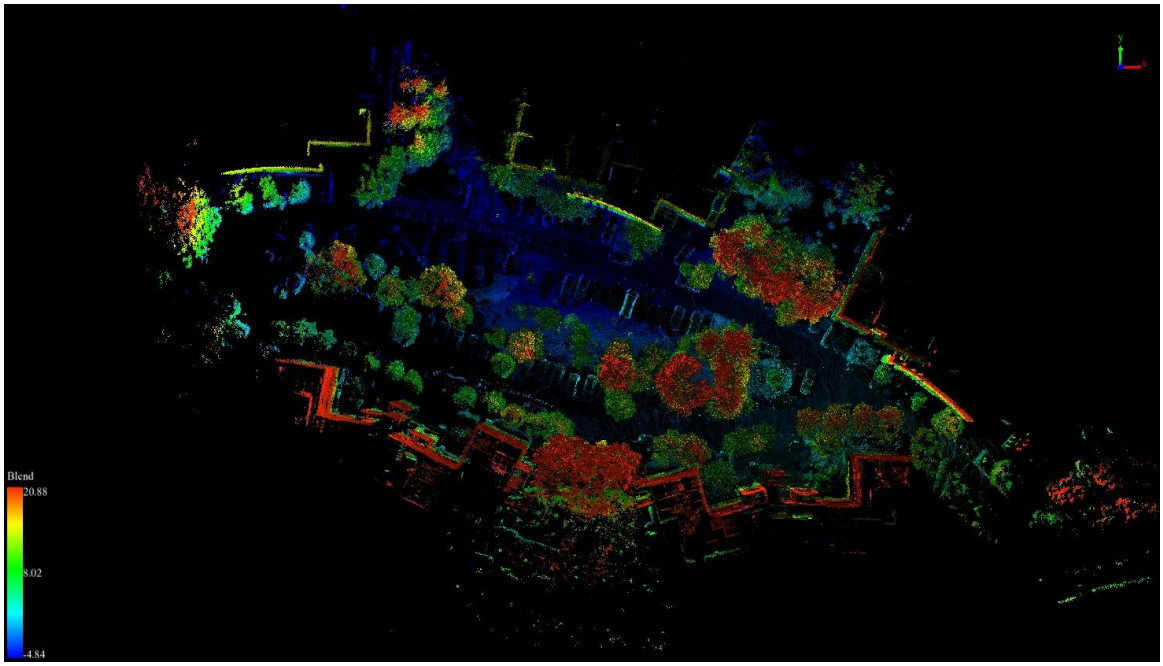
Function Description: it can be used for the display of point cloud data. Through displaying by blend, is more visual to demonstrate changes according to both point cloud elevation and intensity informatio and it is more clear to show the surface features and object boundaries as well.

Step

1. Click the button on the toolbar. Display by blend window will pop up:



2. Select the appropriate color bar in the drop-down box, click the OK button. The color indicator in the lower left corner of the window automatically maps the point cloud data elevation value to the selected color bar, and the display of point cloud data is mixed by elevation and intensity information. At the same time, the data is displayed by blend in the scene. The visual effects are better with EDL mode, as shown below.



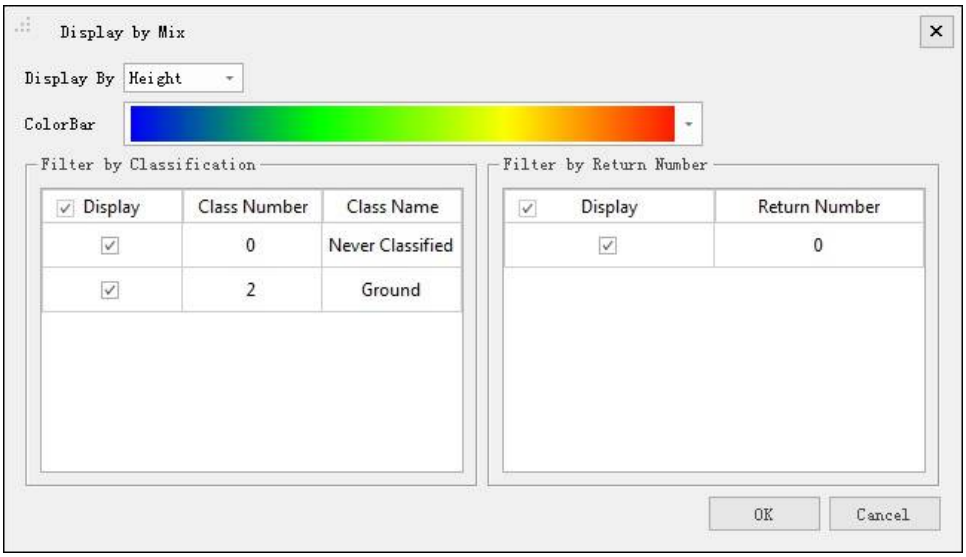
> Please note: this function only works for point cloud data, and it's better to have a PCV processing of point cloud data before displaying by blend.

Display by Mix

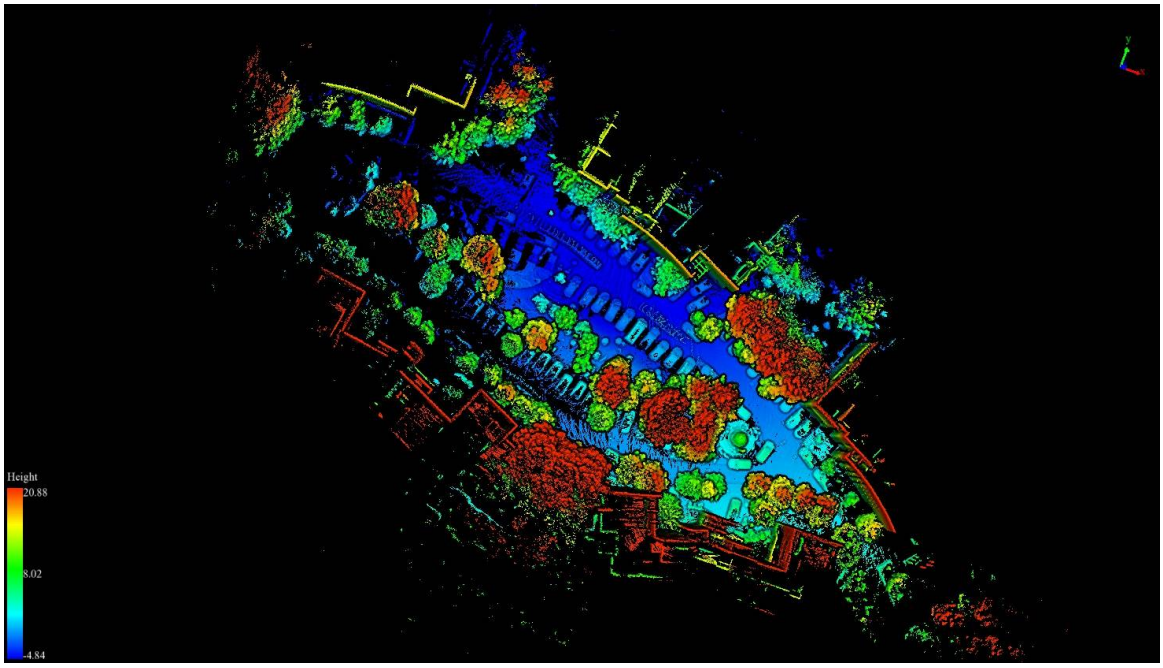
Function Description: this tool is used for displaying point cloud data. Different attributes of point clou data are mapped to several uniformly varying color intervals, at the same time different ways of attribut filtering are supported, so as to display the variation of a certain attribute of the filtered point cloud data more intuitively.

Step

1. Click the button on the toolbar to pop up the dialog "Display by Mix", as shown below.



2. Select the attribute to display.
3. Select the appropriate color bar in the combo box.
4. Check the classes and return numbers for filtering.
5. Click the "OK" button after that the color indicator of the window will generate the corresponding color bar according to the selected attribute range of the point cloud data. The data will be filtered by the specified attributes first and then be displayed by the specified attributes in the scene. The visual effects are better with EDL mode, as shown below.



Setting Parameters

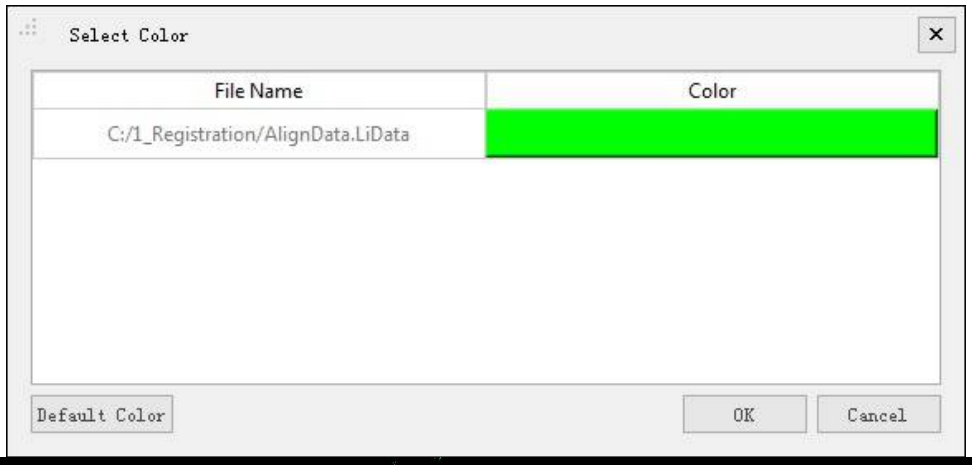
- **Display By**： The selected attribute will be mapped to specified color range.
  - **Height (Default)**：The elevation attribute of the point cloud data.
  - **Intensity**：The intensity attribute of the point cloud data.
  - **GPS Time**：The GPS Time attribute of the point cloud data.
- **ColorBar**：The color bar supports several uniformly varying color intervals for color mapping.
- **Filter by Classification**：List all the classes, users can choose them to filter the point cloud data.
- **Filter by Return Number**：List all the return numbers, users can choose them to filter the point cloud data.

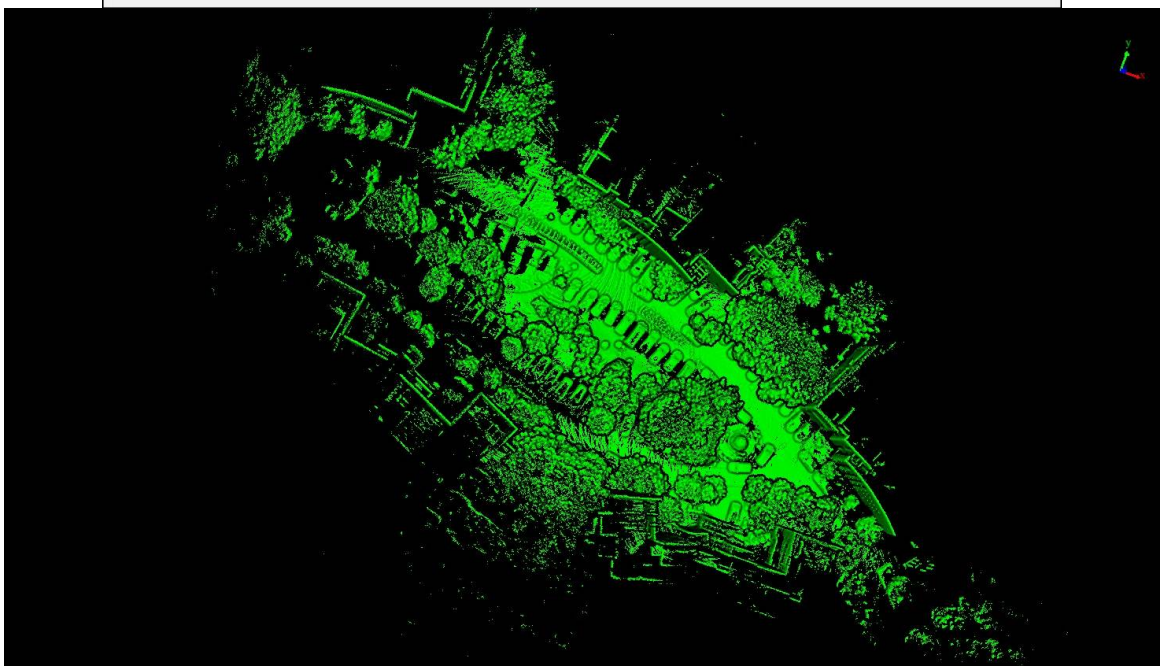
  > Please note: this function only works for point cloud data.

Display by Specific Color

Function Description：This tool is used for displaying point cloud data. The point cloud data is displayed according to specified color.

1. Click the button on the toolbar, users can customize the color for point cloud display.



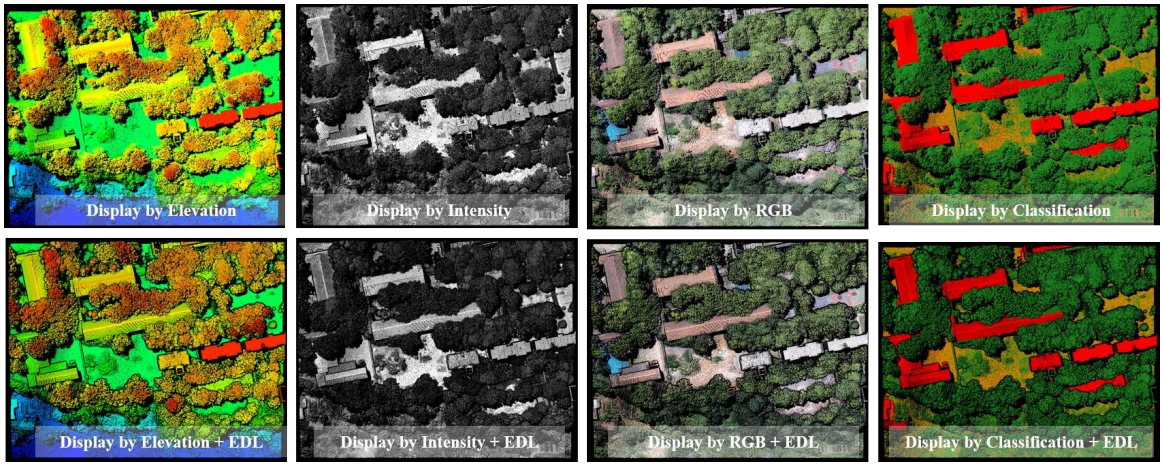


Display by EDL

EDL **Function Description：** this tool is used to display the point cloud data and enhance the visual effects of the contour features by using the Eye Dome Lighting (EDL) mode. EDL is a shading technique that works with other display mode (e.g. display by height, display by intensity) to improve the depth perception in 3D point cloud visualization.

Step

1. Click the button EDL on the toolbar, the visual effects of the point cloud data in the scene will be improved with EDL mode. The following picture shows the comparison before and after using EDL display mode.



> Please note: this function only works for point cloud data.

Select Tools

The main functions are listed as follows:

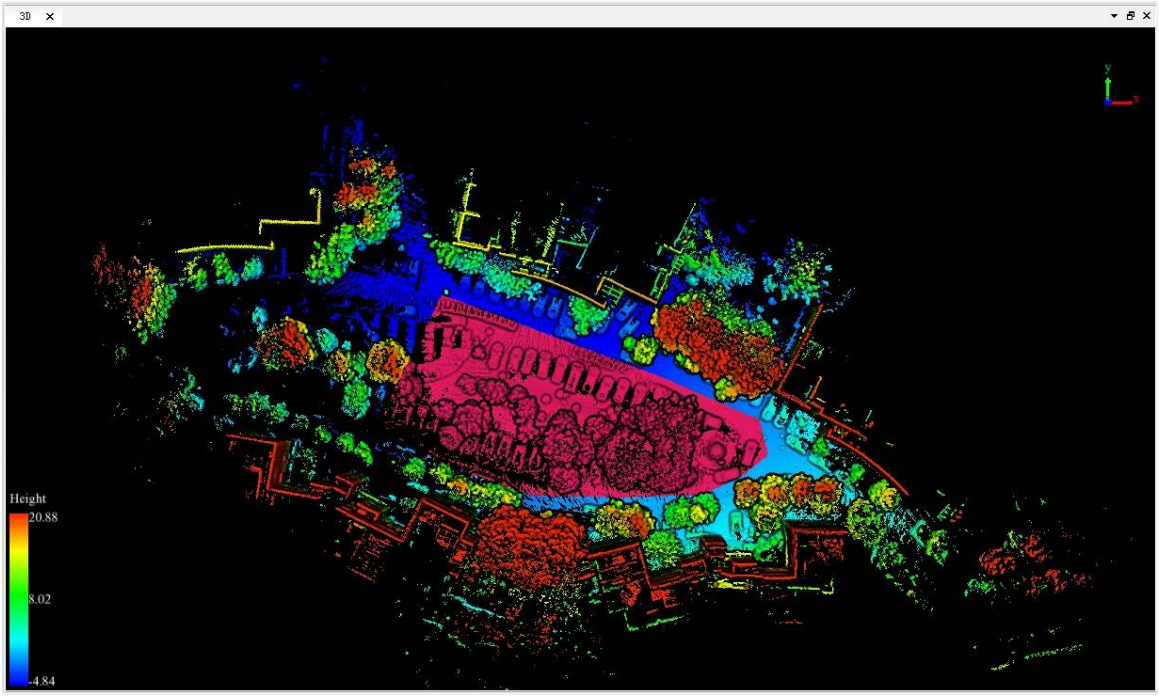
- Polygon Selection
- Rectangle Selection
- Sphere Selection
- Circle Selection
- Line above Selection
- Line below Selection
- Plane Selection
- Subtract Selection
- Cancel Selection

Polygon Selection

Function Description: Select point cloud data in polygon area.

Step

1. Click the button  to activate this function.
2. Add polygonal vertices by left click. At least 3 vertices are needed to form a closed loop.
3. (Optional) Delete added vertices in reverse order by right click, if some of them are unwanted.
4. Left double click to add the last vertex. The selected points in the polygon area are highlighted.



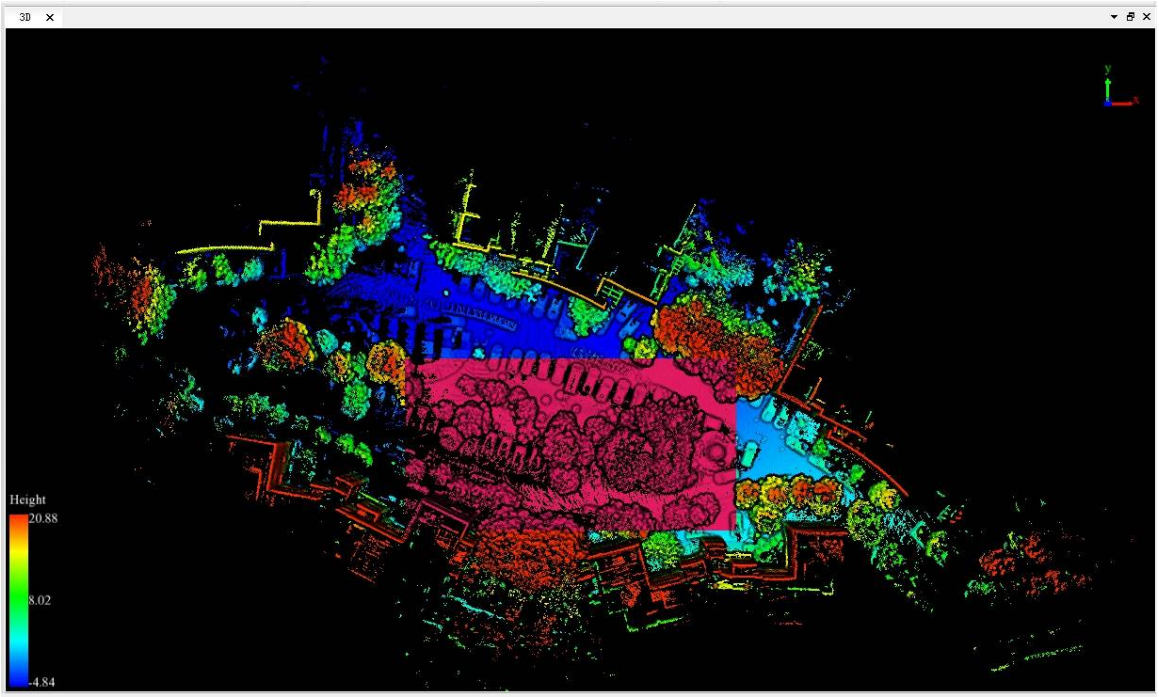
5. (Optional) Combine multiple selections.

Rectangle Selection

Function Description: Select point cloud data in rectangle area.

Step

1. Click the button to activate this function.
2. Add the first vertex by left click. Then move cursor to adjust rectangle size.
3. (Optional) Delete the first vertex by right click, if it's unwanted.
4. Left double click to add the second diagonal vertex. The selected points in the rectangle area are highlighted.



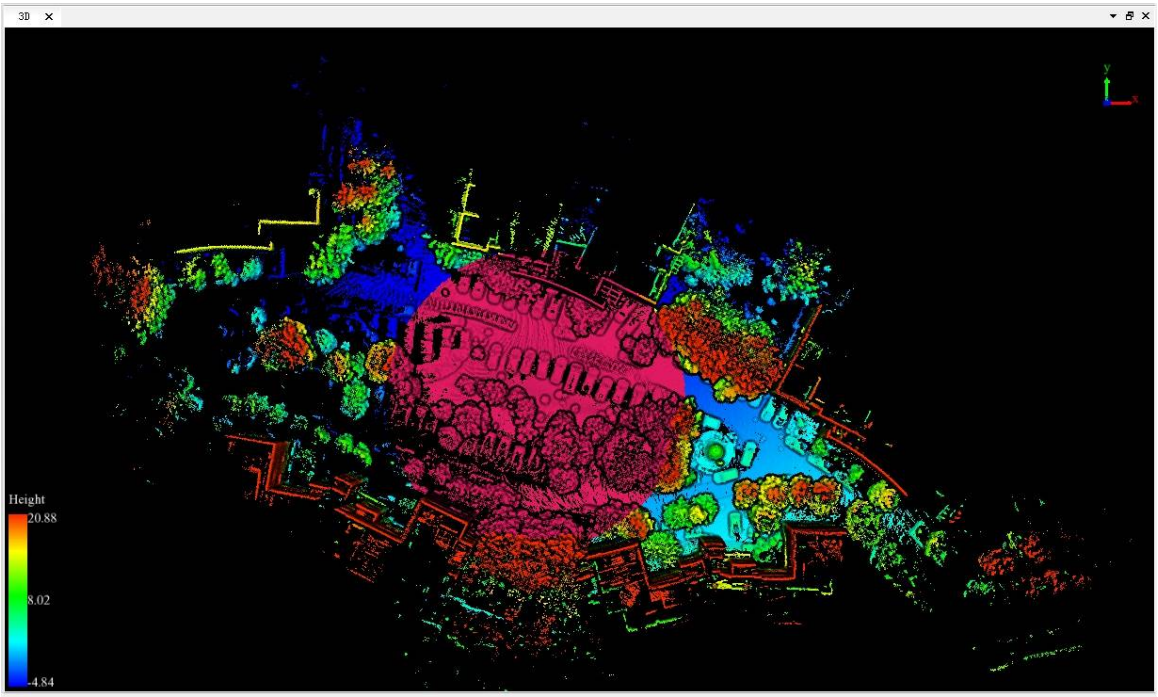
5. (Optional) Combine multiple selections.

Sphere Selection

Function Description: select point cloud data in sphere.

Step

1. Click the button to activate this function.
2. Add the center point of sphere by left click. Then move cursor to adjust radius.
3. (Optional) Delete the center point by right click, if it's unwanted.
4. Left double click to confirm the radius. The selected points in the sphere are highlighted.



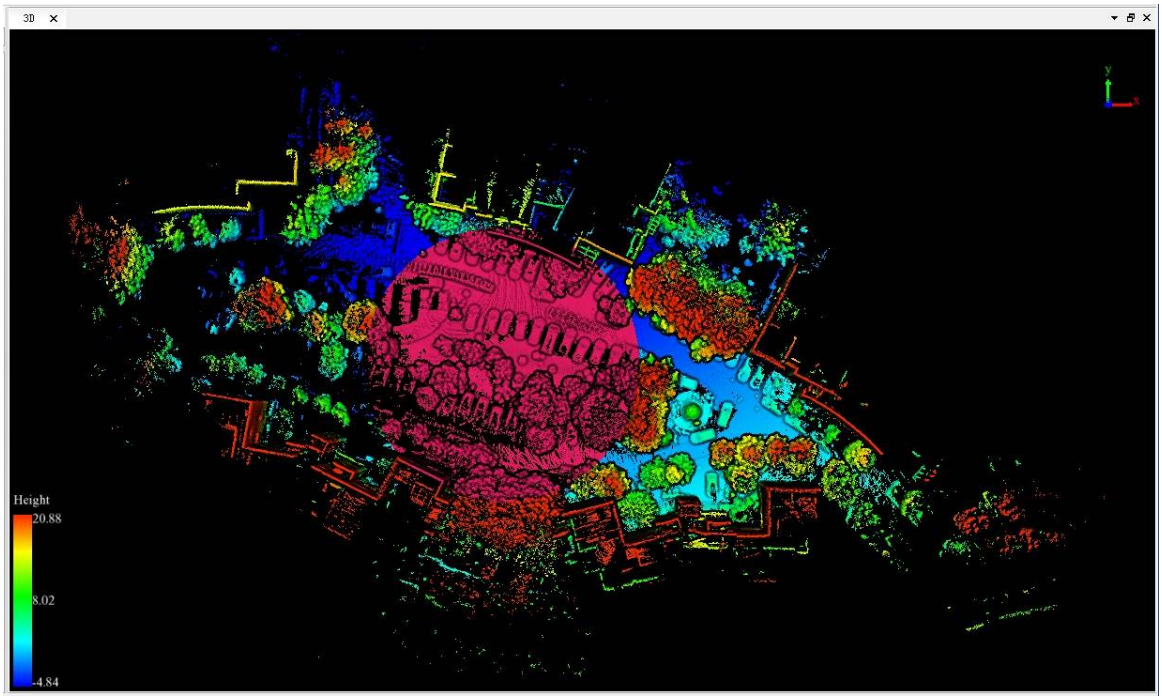
5. (Optional) Combine multiple selections.

Circle Selection

Function Descriptionf: Select point cloud data in circle area.

Step

1. Click the button to activate this function.
2. Click to select the center of the circle. Move the mouse, and the position of mouse will be recognized as the boundary of the circle.
3. Right-click to cancel the circle center selection. Go back to the second step and choose the circle center again.
4. Double-click to define the boundary of the circle. The selected points in the circle area are highlighted.



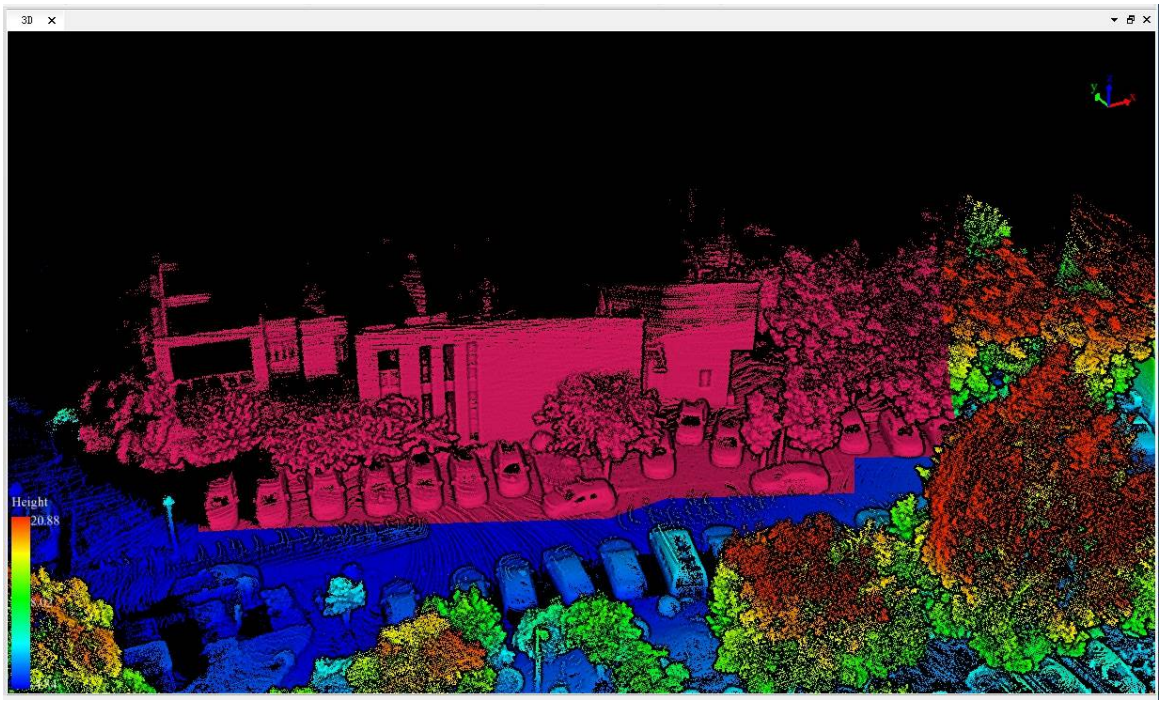
5. (Optional) Combine multiple selections.

Line above Selection

Function Description: Select point cloud data above line.

Step

1. Click the button to activate this function.
2. Add the first vertex by left click. Move the mouse, the mouse position is determined to be the boundary point of the area above the line.
3. Right-click to cancel the first vertex selection. Go back to the second step and choose the vertex again.
4. Left double click to finish selection. The selected area above the polylines are highlighted.



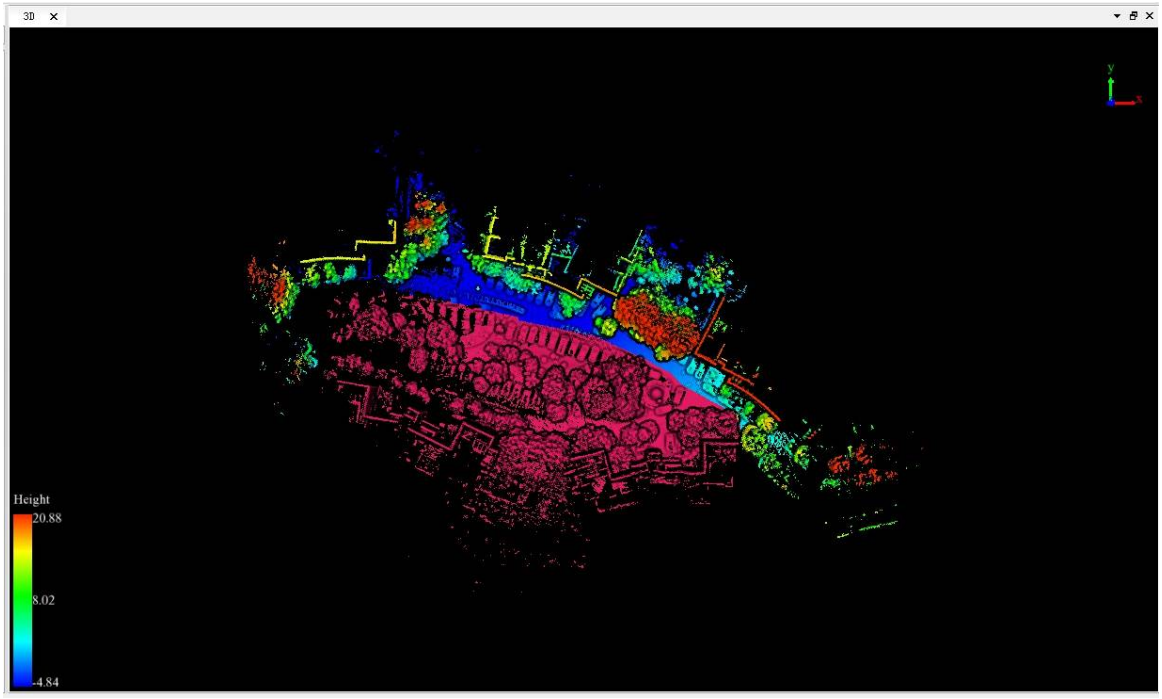
5. (Optional) Combine multiple selections.

Line below Selection

Function Description: Select point cloud data below line.

Step

1. Click the button  to activate this function.
2. Add the first vertex by left click. Move the mouse, the mouse position is determined to be the boundary point of the area below the line.
3. Right-click to cancel the first vertex selection. Go back to the second step and choose the vertex again.
4. Left double click to finish selection. The selected area below the polylines are highlighted.



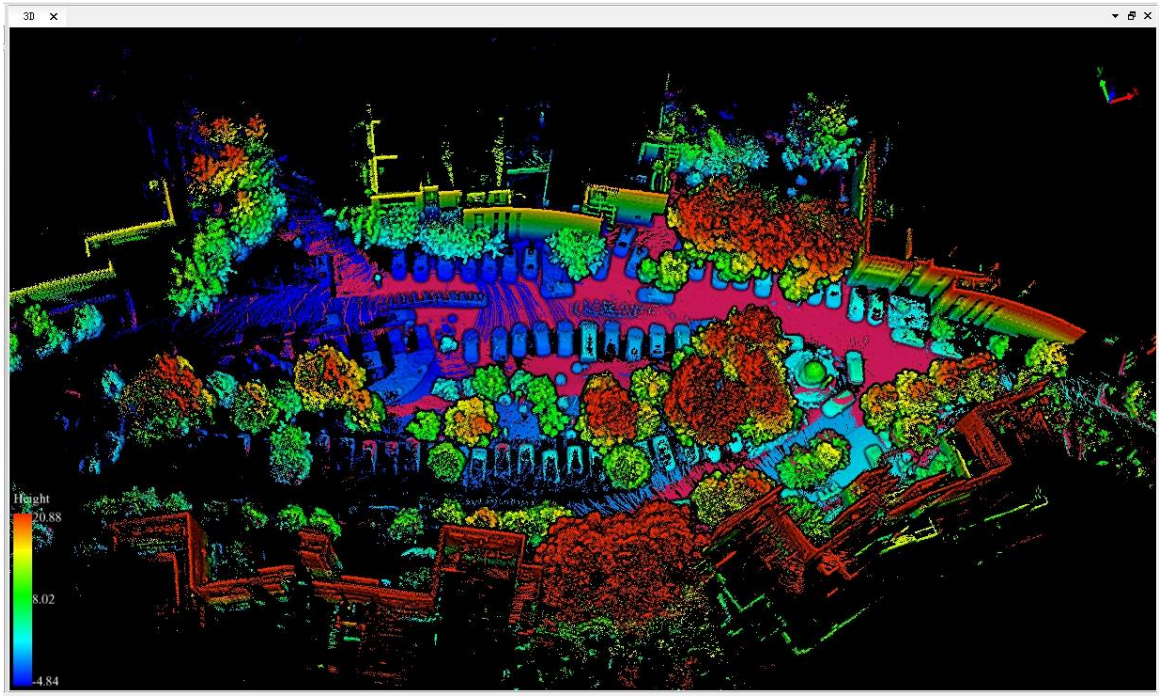
5. (Optional) Combine multiple selections.

Plane Selection

Function Description: Select point cloud data automatically in specific area.

Step

1. Click the button  to activate this function.
2. In the window, select a polygon area and the point in this selected area will generate automatically.
3. Right-click to cancel the selection. Go back to the previous step and choose the selection again.
4. Left double click to finish selection. The selected plane are highlighted.



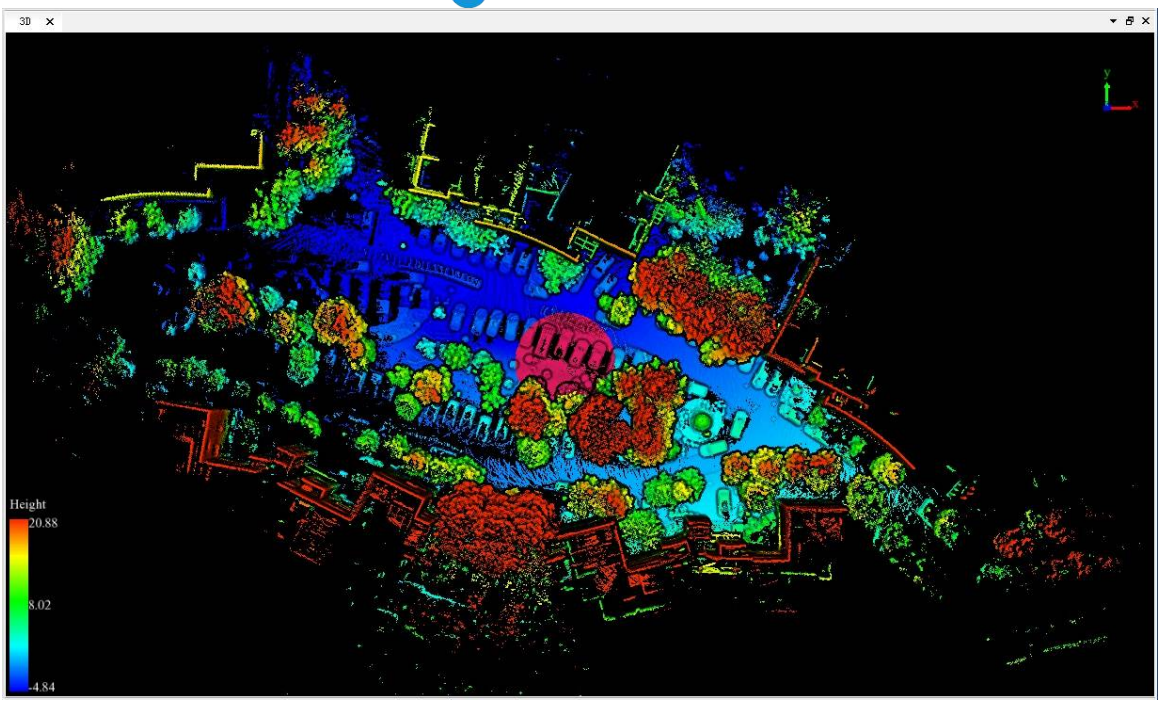
5. (Optional) Combine multiple selections.

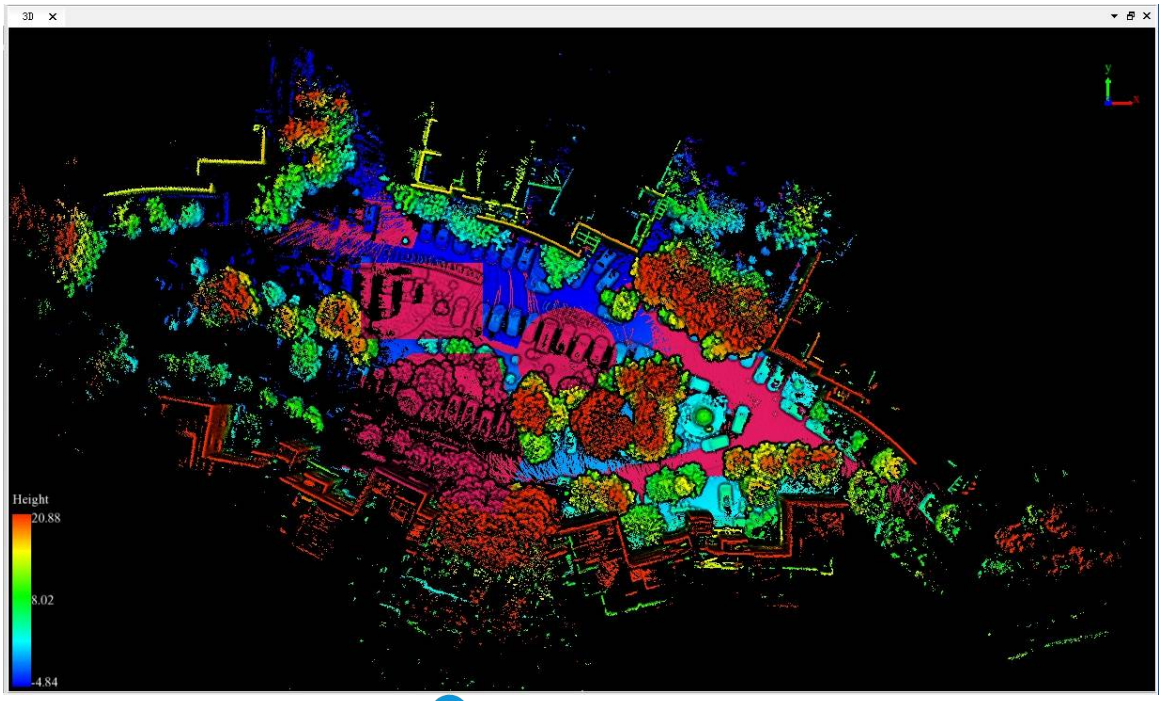
Subtract Selection

Function Description: If Subtract Selection is inactive, more points can be added to the currently selected. If active, unwanted points can be removed from the currently selected. This function is effective on one of the geometric selection tools including Polygon Selection, Rectangle Selection, Sphere Selection, Circle Selection, Line above Selection, Line below Selection, Panel Selection

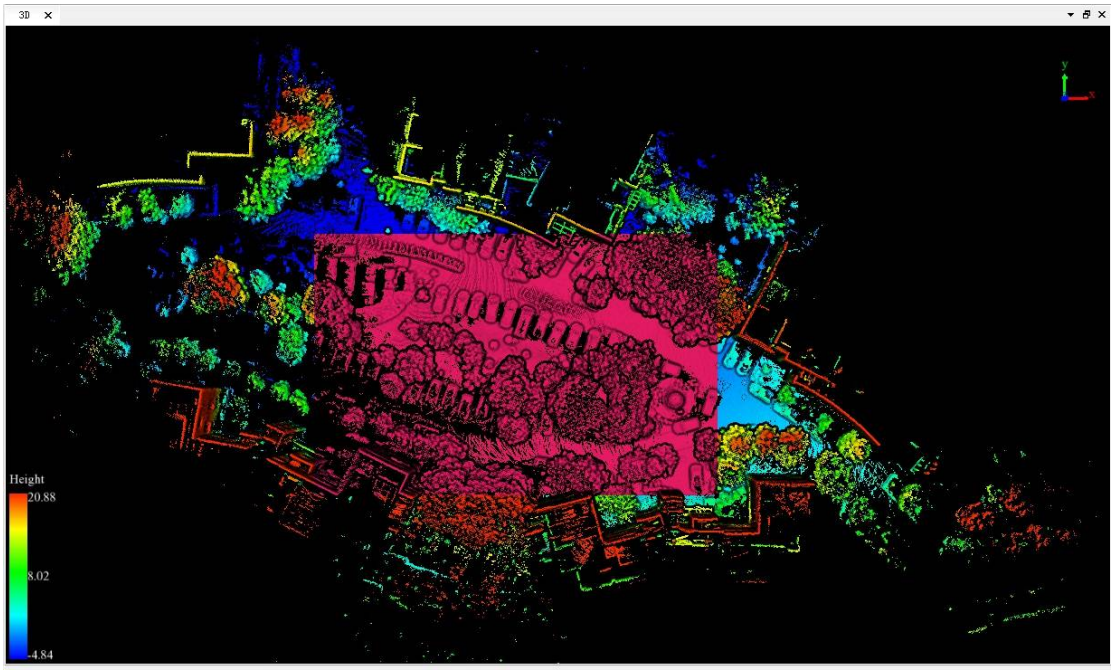
Step

1. Activate one of the geometric selection tools (Polygon Selection, Rectangle Selection, Sphere Selection, Circle Selection, Line above Selection, Line below Selection, Panel Selection) before using Subtract Selection. Then please activate/deactivate Subtract Selection by left click.
2. (Optional) If Subtract Selection is inactive , multiple selections can be combined.

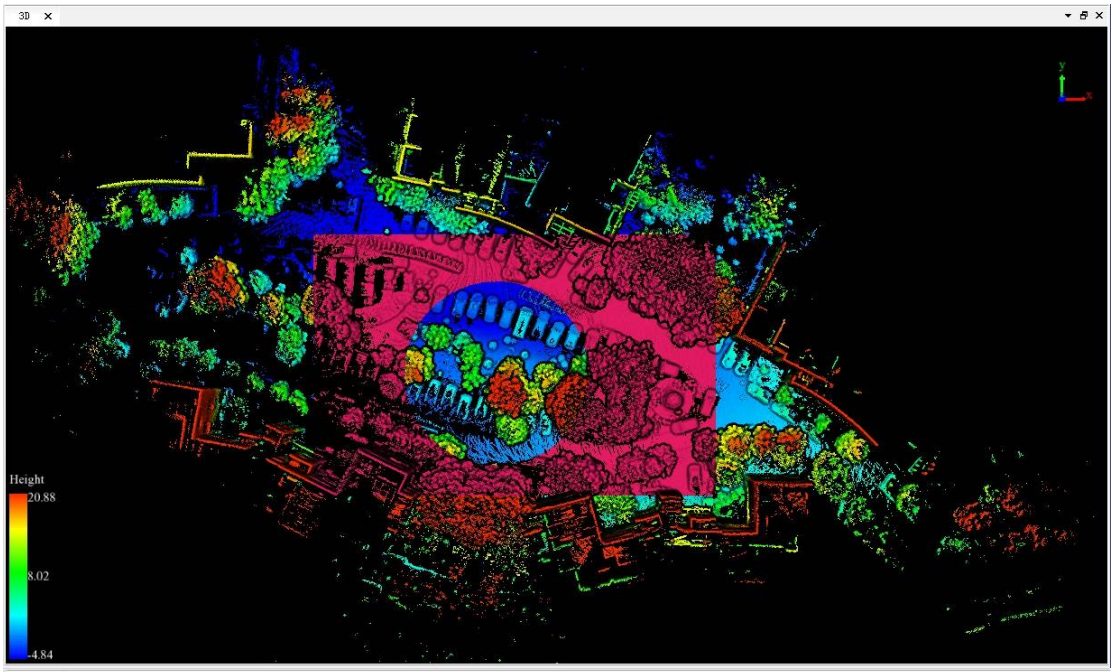


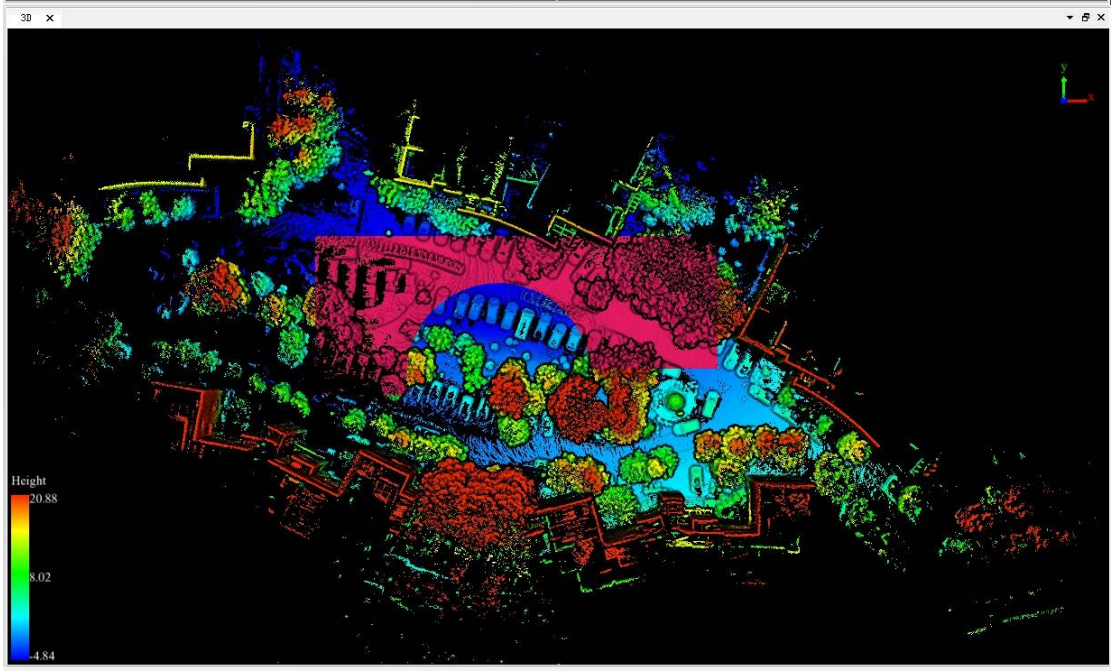


3. (Optional) If Subtract Selection is active , unwanted points can be removed from the currently selected.
    - 3.1 Select an initial selection area.



    - 3.2 Activate Subtract Selection, choose polygon selection and circle selection to delete the area.


3D
Height
20.88
8.02
-4.84


3D
Height
20.88
8.02
-4.84

Cancel Selection

Function Description: Cancel all the selections and cut operations.

Step

1. Click this button after selections (Polygon Selection, Rectangle Selection, Sphere Selection, etc.) or cut operations (In Cut, Out Cut).
2. Click the button  . All the selections and cut operations will be cancelled.

> Note: This function is only applicable to point cloud data.

Cut Tools

Cut point clouds after selection. Users can use Selection Tools to make an interest area first, and use cut tools to perform the job including Incut Tools, OutCut Tools, Save Cut Results and Cancel Selection.

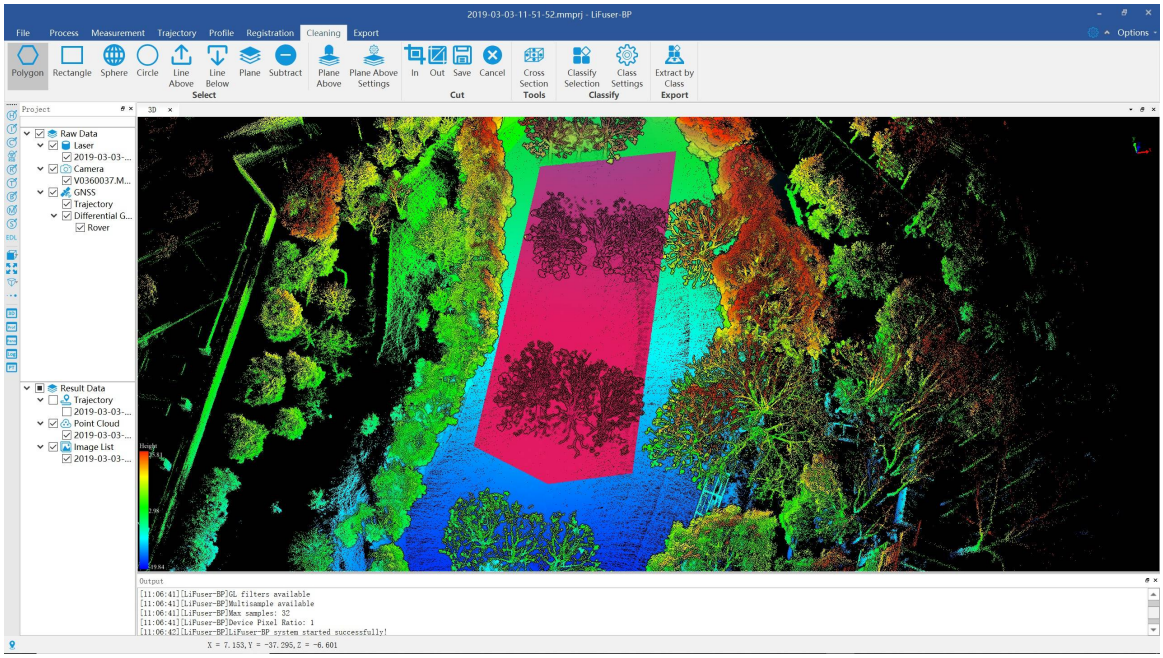
- InCut
- OutCut
- Save Cut Result
- Cancel Selection

InCut Tools

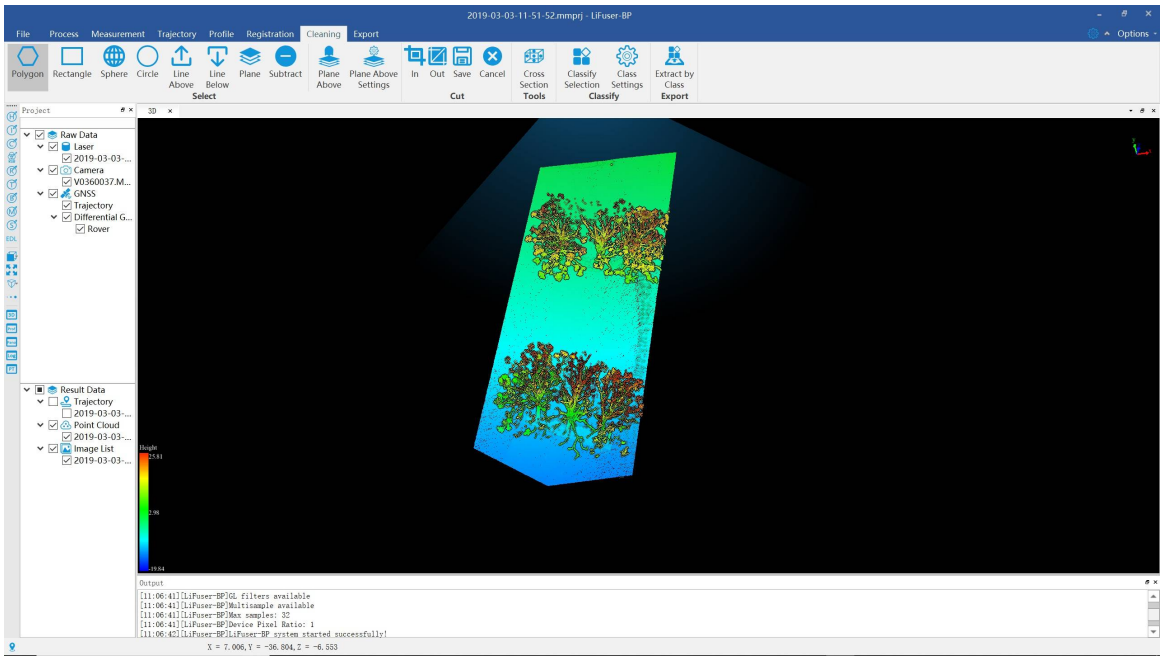
Function Description: users can select an interest area firstly and cut point clouds after selection. The selected points are kept while the unselected are hidden.

Step

1. First, users could select an interest area using select tools including Polygon Selection, Rectangle Selection, Sphere Selection, Circle Selection, Line above Selection, Line below Selection, Plane Selection.



2. Use InCut Tools to perform your job.



3. (Optional) You can repeat this function several times to get the result you need with Polygon Selection , Rectangle Selection , Sphere Selection , Circle Selection , Line above Selection , Line below Selection , Plane Selection and Cut (OutCut) tools.

Parameters Setting

- **Shortcut Key**：Press **Ctrl + Z** to undo the cut operation. The corresponding selection is also cancelled.

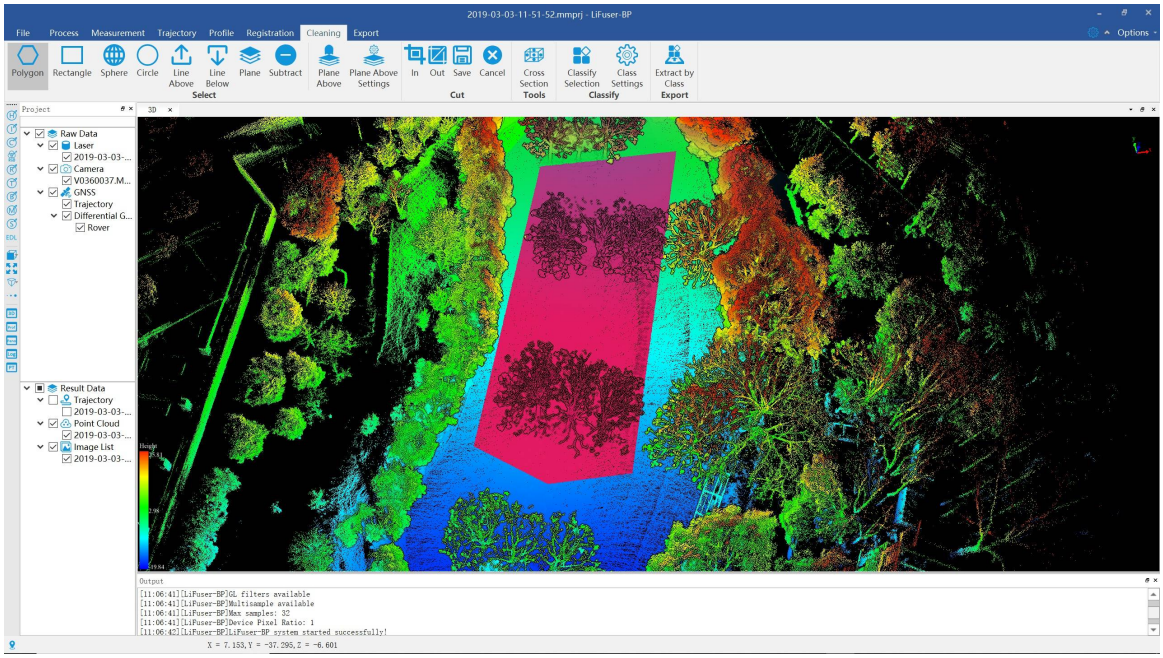
> Note: This function is only applicable to point cloud data.

OutCut

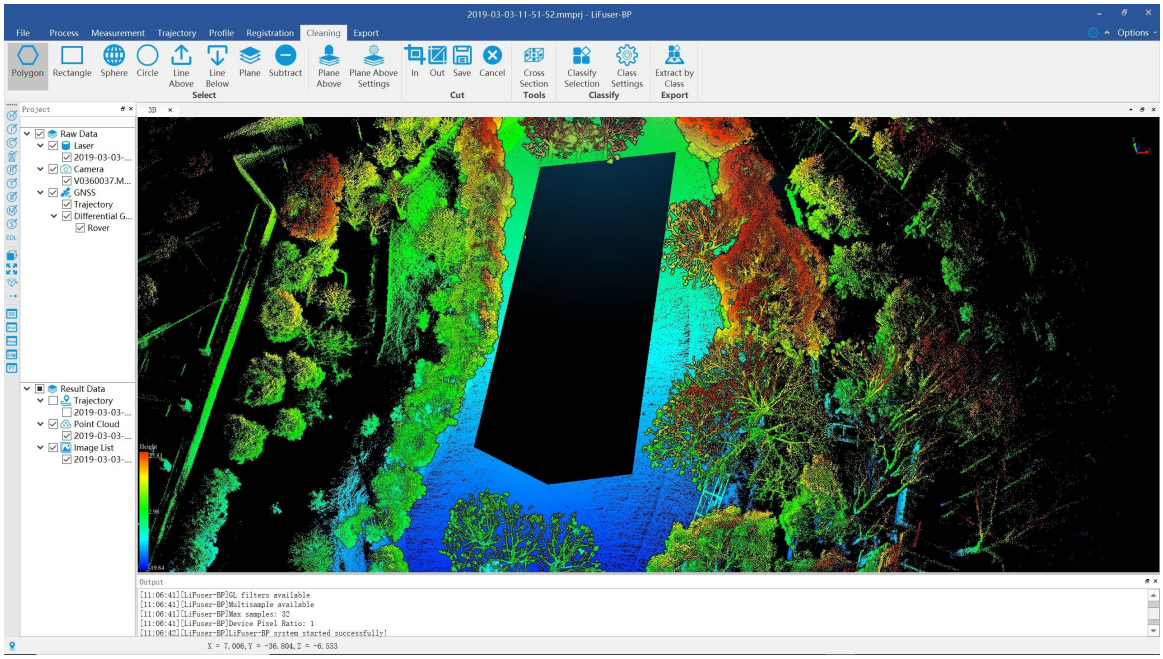
Function Description: Cut point clouds after selection. The selected points are hidden while the unselected are kept.

Step

1. Select points using (Polygon Selection, Rectangle Selection, Sphere Selection, Circle Selection, Line above Selection, Line below Selection, Plane Selection). The selected points are highlighted.



2. Click the Out Cut Button. The result is shown in the following figure.



3. (Optional) You can repeat this function several times to get the result you need with Polygon Selection, Rectangle Selection, Sphere Selection, Circle Selection, Line above Selection, Line below Selection, Plane Selection and Cut (InCut Tools also included)Tools.

Parameters Setting

- **Shortcut Key**：Press **Ctrl + Z** to undo the cut operation. The corresponding selection is also cancelled.

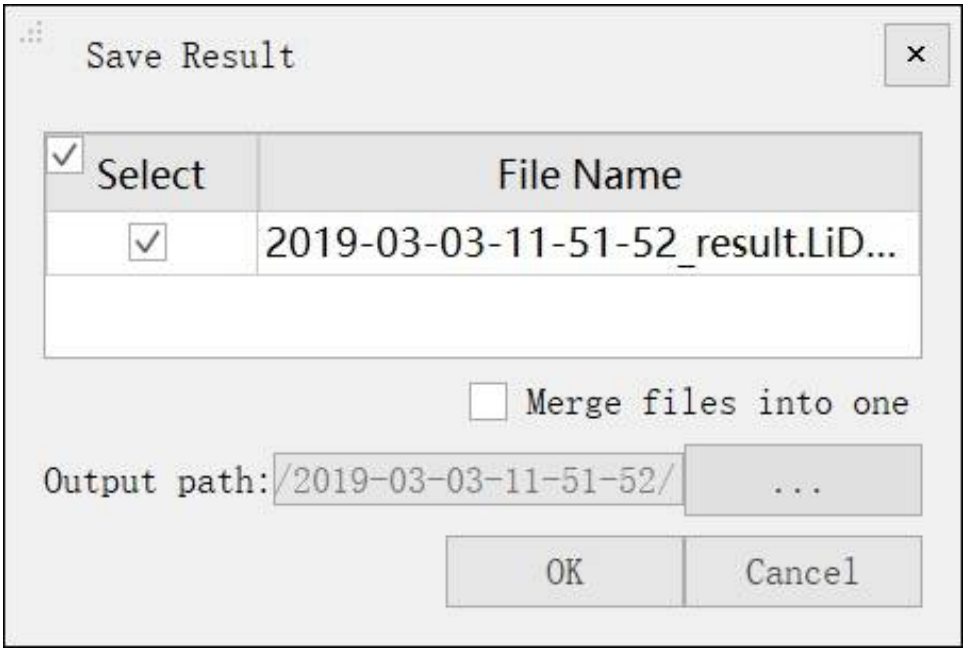
> Note: This function is only applicable to point cloud data.

Save Cut Result

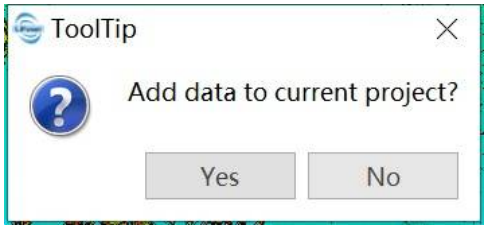
Function Description: Save results after cutting operation as new point cloud files. (OutCut) tools

Step

1. Use InCut or OutCut tools to perform your job.
2. Click this button after successful cutting operations (InCut, OutCut). An interface is shown as follows.



3. Select source point cloud files, from which new files are generated.
4. (Optional) Check/Uncheck the option "Merge files into one" according to demand.
5. Specify the output path. New file names are created based on the source file names and system time. An example of new file name is "SourceFileName_CutResult_SystemTime.LiData".
6. After data saving, a dialog will ask if you want to add the new files to current project.



7. Click Yes or No according to demand.

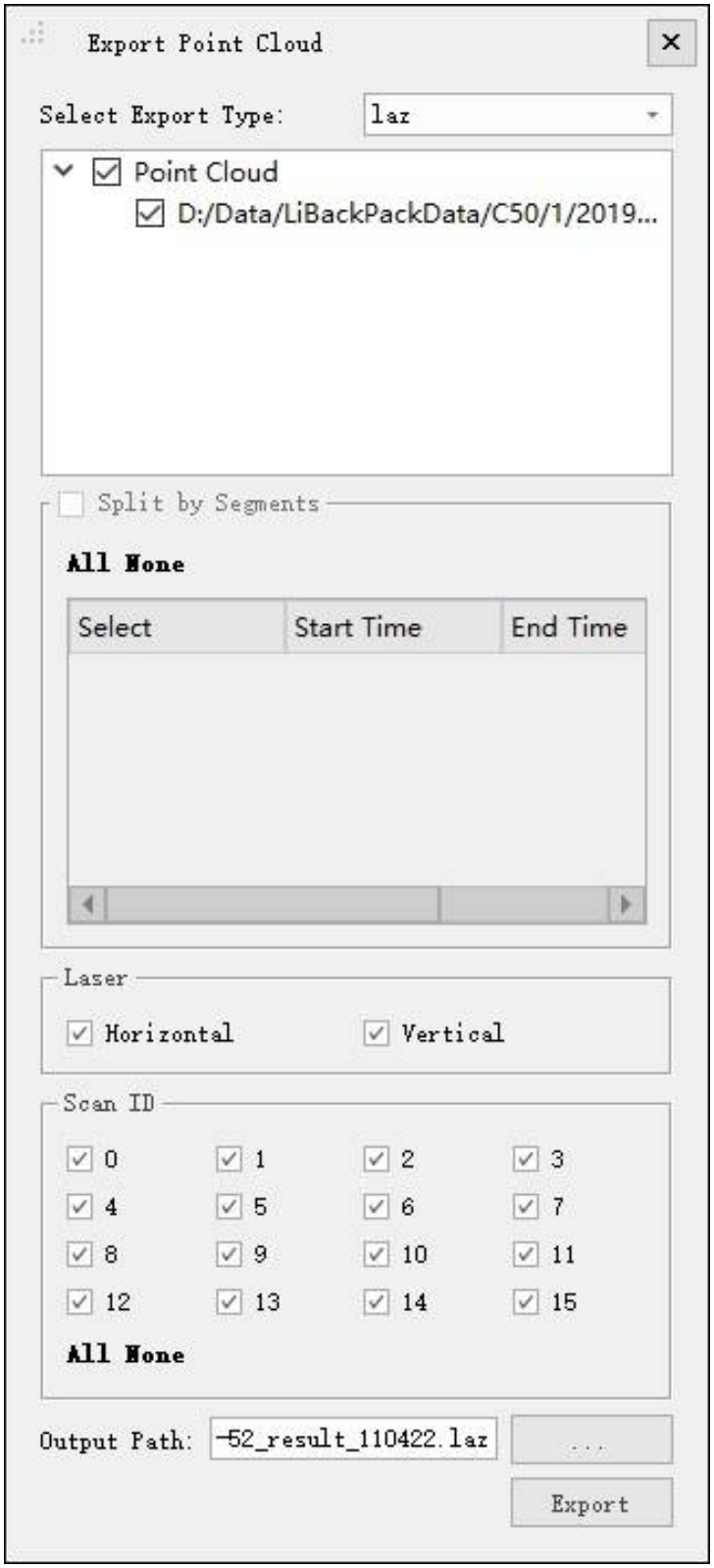
Export

You can export data to multiple data types for futher application or analysis.

Switch to *Export* tab.

Export Las/Laz

Click  and export las/laz file.



Export Orbit GT

Click and export data type compatible with OribitGT. The exported files include image list and high accuracy point cloud data.

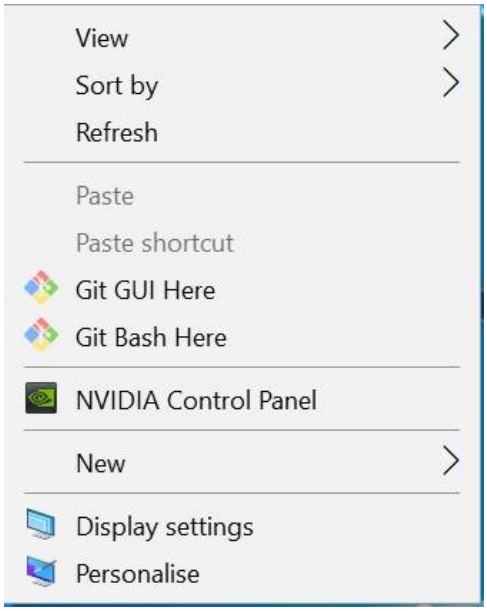
Export GeoPlus

Click  and export data type compatible with Geo-Plus. The exported files include image list and high accuracy point cloud data.

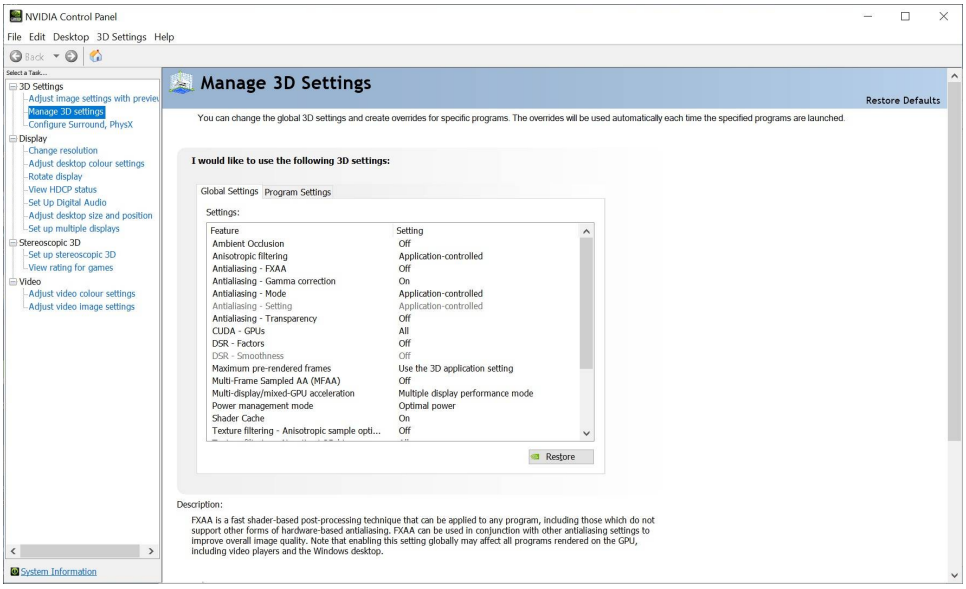
High-Performance Graphics Mode Adjustment

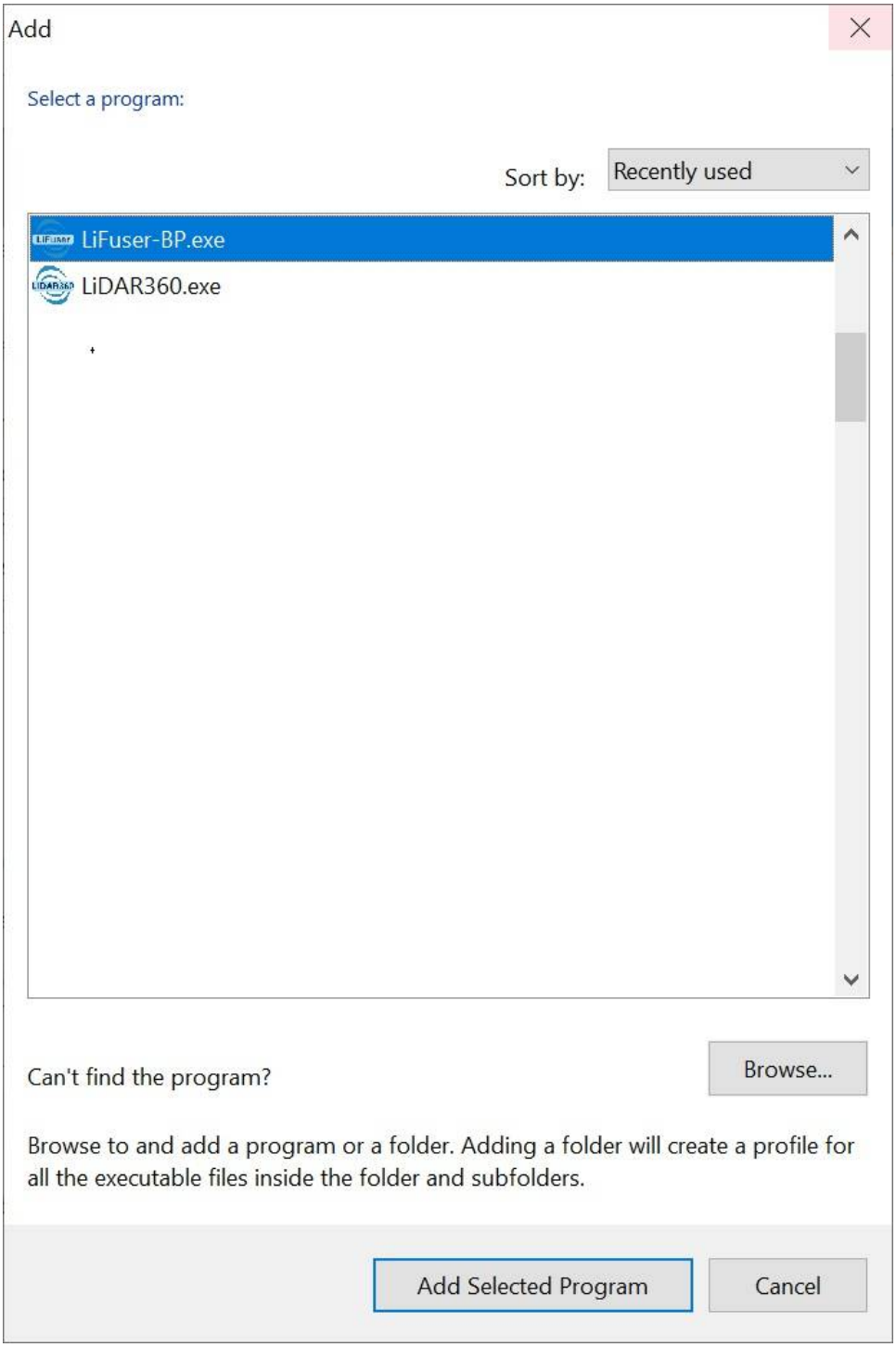
Follow the procedure below to optimize graphics for LiFuser-BP (for NVIDIA graphic cards).

1. Right click on desktop and select NVIDIA Control Panel.



2. Select **Manage 3D settings** > **Program Settings** > **Add** to add LiFuser-BP.exe to high-performance graphics mode list.




Add
Select a program:
Sort by:
Recently used
LiFuser-BP.exe
LiDAR360.exe
Can't find the program?
Browse...
Browse to and add a program or a folder. Adding a folder will create a profile for all the executable files inside the folder and subfolders.
Add Selected Program
Cancel