Simulation Condition

To handle and analyze power line channel based on point cloud data and simulated data and then generate analysis report. Specific functions are as below:



- Add Data
- Settings
- Mark Tower
- Information
- Clip and Classify
- Classification Tools
- Profile Tools
- Vector Editing
- Danger Points Detection
- Scissors Crossing Analysis
- Batch Processing
- Comprehensive Working Conditions Simulation
- Tree Growth Analysis
- Tree Fall Analysis
- Current Carrying Capacity Analysis
- Allowable Stress Analysis
- Scissors Crossing Double Line Simulation Analysis
- Wind Deflection Collision Analysis
- Clear
- Generate Image
- Generate Report
- Multiple Directory Report

> Note: Vector data used in this module must be vectorized by insulators.

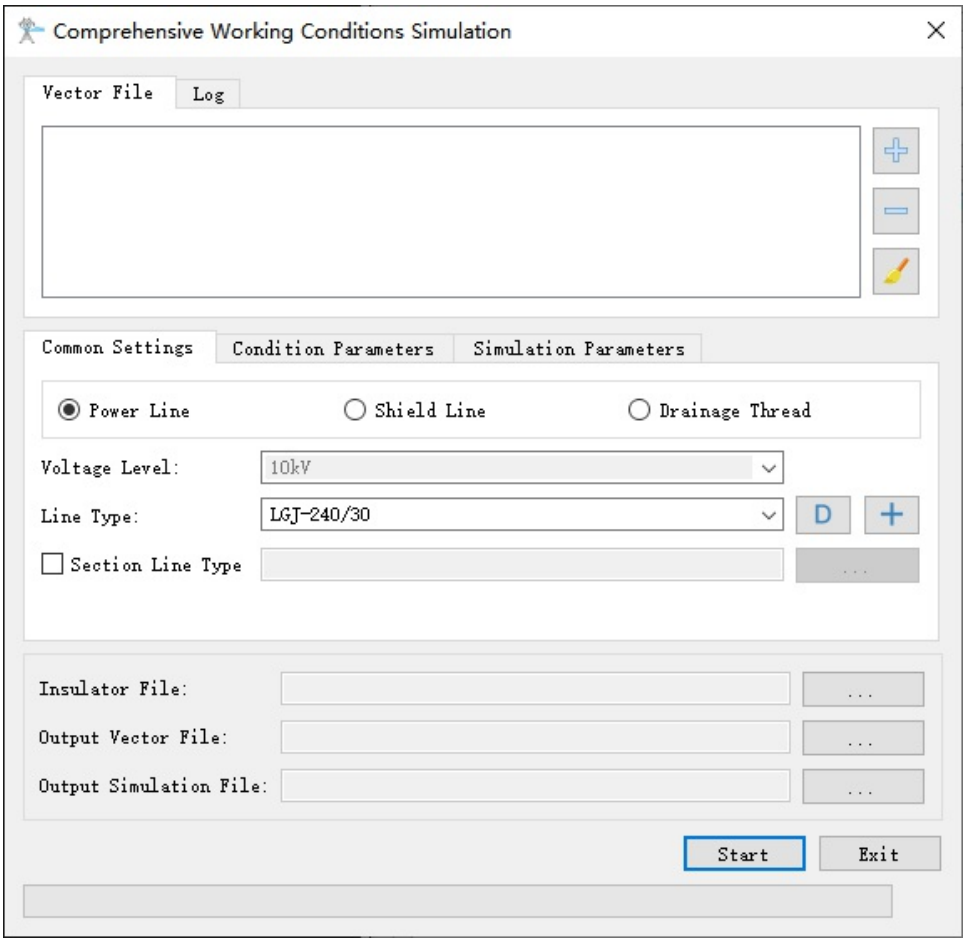
Comprehensive Working Conditions Simulation

Summary

Comprehensive working condition simulation analysis can simulate and analyze the power line status in different wind, high temperature and ice cover conditions. According to the type of tower, it can be divided into continuous segment and isolated segment. The continuous segment refers to the tension section composed of several straight line towers. The isolated segment is an independent segment with a tension tower at both ends, which is analyzed using the isolated gear method. The interface of comprehensive working condition simulation analysis is shown in the figure below. Click to add the vector data to be processed. Click to remove the selected vector data(remove the first record of the list if no data is selected). Click to clear the vector data list.

Usage

Click *Early Warning Analysis* > *Simulation*



Settings

- **Power Line(Shield Line, Drainage Thread)**: Select to process line classification.

- **Voltage Level**: Select the voltage level in the drop-down list. The default value is the voltage level in the settings step.
- **Line Type**: Select the line type from the drop-down list, or user can enter key words to search. If there is no desired record in the list, user can add a new type of line with "Add Line Type" function. The software can record the user's current settings and automatically restore the settings when opened again.
  - **Line Specifications**: View the corresponding specifications of the current power line type.
  - **Add New Line Type**: Add a new type of power line.
- **Line Type File**: Select piecewise line type file. Simulate the working conditions in different segments with different power lines.
- **Scanning Conditions**: Conditions when the data were collected. The software can record the user's current settings and automatically restore the settings when opened again.
  - **Wire Temperature (Celsius)**: Wire temperature during the scanning.
  - **Ice Thickness (mm)**: The thickness of ice on the wire during the scanning.
  - **Wind Speed (m/s)**: Wind speed during the scanning.
- **Simulation Conditions**: Simulated operating conditions. The software can record the user's current settings and automatically restore the settings when opened again.
  - **Wire Temperature (Celsius)**: The temperature of the wire under simulated conditions.
  - **Ice thickness (mm)**: The thickness of ice under simulated conditions.
  - **Wind speed (m/s)**: Wind speed under simulated conditions.
- **Section Condition Parameters**: Select piecewise condition file. Import parameters from the working condition file.
- **Start Tower Index**: Set the index of the starting tower.
- **End Tower Index**: Set the index of the ending tower.
- **Wind Deflection Process**:
  - **Wind Deflection Process**: This option is unchecked by default. If this option is checked, the software will interpolate the maximum wind deflection angle according to the interpolation angle to simulate the swing of the wire during the wind deflection. If this option is unchecked, the software will simulate the maximum wind deflection on both sides of the wire.
  - **Interpolation Angle (degrees) (default is "5")**: Angle used to interpolate the maximum wind deflection angle.
- **Insulator File**: Set the input vector file for the insulators.
- **Output Shp File**: Select the path of the simulated Shp file to be output after the analysis.
- **Output Simulation File**: Select the path of the simulation file to be output after the analysis.

> Note: To execute this function, user needs to set the type of the transmission tower in Mark Tower. If the power line in continuous segments are incomplete, the simulation analysis cannot be done, and the power line in the output file will be missing as well.

Current Carrying Capacity Analysis

Background

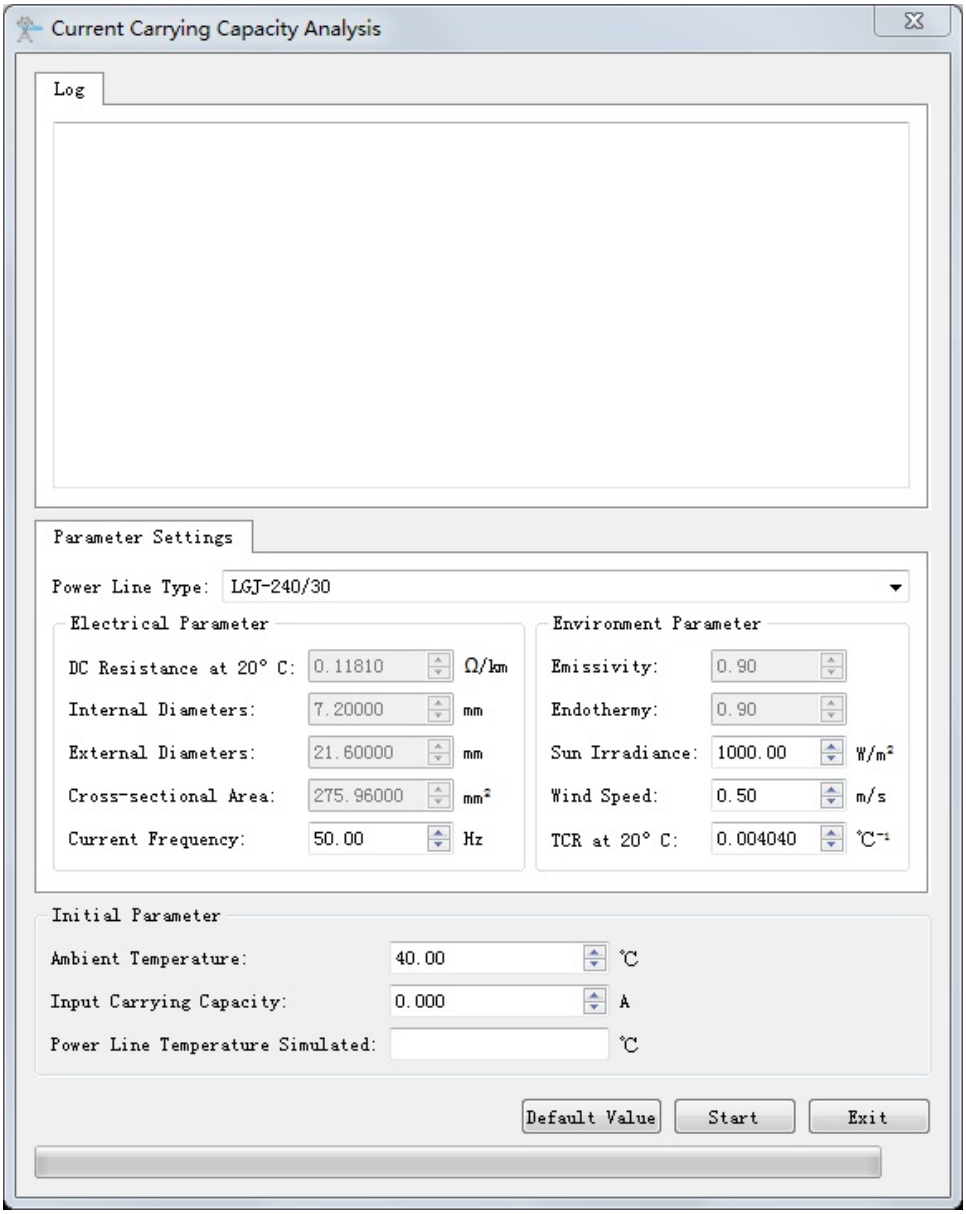
The current carrying capacity and temperature of the power line are important parameters for operation and design. At present, there are two main methods for increasing the current carrying capacity of high-voltage overhead transmission lines: static capacity increase and temperature calculation. Based on the thermal balance equation, the design code of China gives the formula for calculating the allowable current carrying capacity of overhead transmission line conductors. It is the most commonly used formula for calculating the current carrying capacity in China. In practical applications, the calculation direction opposite to the above is more applicable in the design steps of the power transmission project, that is, given the maximum allowable carrying capacity, the amount to be calculated is the temperature or temperature rise of the power line. Reference of the algorithm: (Lin et al., 2012)

Summary

The carrying capacity analysis function is mainly used to calculate the temperature rise of the power line under a certain ambient temperature and carrying capacity. The function interface is shown in the figure below.

Usage

Click *Early Warning Analysis* > *Current Carrying Capacity*



Settings

- **Parameter Settings**:
  - **Power Line Type("LGJ-240/30" by default)**: Select the power line type. After selecting any power line type, the electrical parameters below will change accordingly. Currently, only cored power line types are supported, such as "steel core aluminum stranded conductor" LGJ-300 / 40, where "300" represents the nominal cross-sectional area of the aluminum wire (square millimeter) and "40" represents the nominal cross-sectional area of the steel core (square millimeter).
  - **Electrical Parameter**: Parameters related to the power line. Among them, "DC resistance at 20℃", "inner diameter of the power line", "outer diameter of the power line", and "calculated cross-sectional area" will be automatically read from the file according to the selected power line type, without adjustment.
  - **Current Frequency (Hz) (default value is "50.0")**: Current frequency of AC resistance.
  - **Environment Parameter**: Environment-related parameters. Need to adjust according to the actual situation. The "radiation heat dissipation coefficient" and "strand surface heat absorption coefficient" are both 0.9, and no adjustment is required.

- **Sun Irradiance (W/m^2) (default value is "1000")**: Heat from the sun absorbed per square meter of the power line.
- **Wind Speed (m/s) (default value is "0.5")**: Wind speed of the environment where the power line is located.
- **Resistance at 20℃ (per degree Celsius) (default value is "0.004040")**: DC resistance of the power line at 20℃.

- **Initial Parameter**:
  - **Ambient Temperature (Celsius) (default is "40")**: The actual temperature of the environment where the wire is power line.
  - **Input Carrying Capacity(Ampere)**: The current passing through the power line.
  - **Power Line Temperature Simulated(Celsius)**: Output the actual power line temperature simulated under the above environmental conditions.

```
    Lin. The Calculation of Current Carrying Capacity and Temperature of High Voltage Overhead Lines[J]. Southern Pow
er System Technology, 2012, 6(4): 23-27.
```

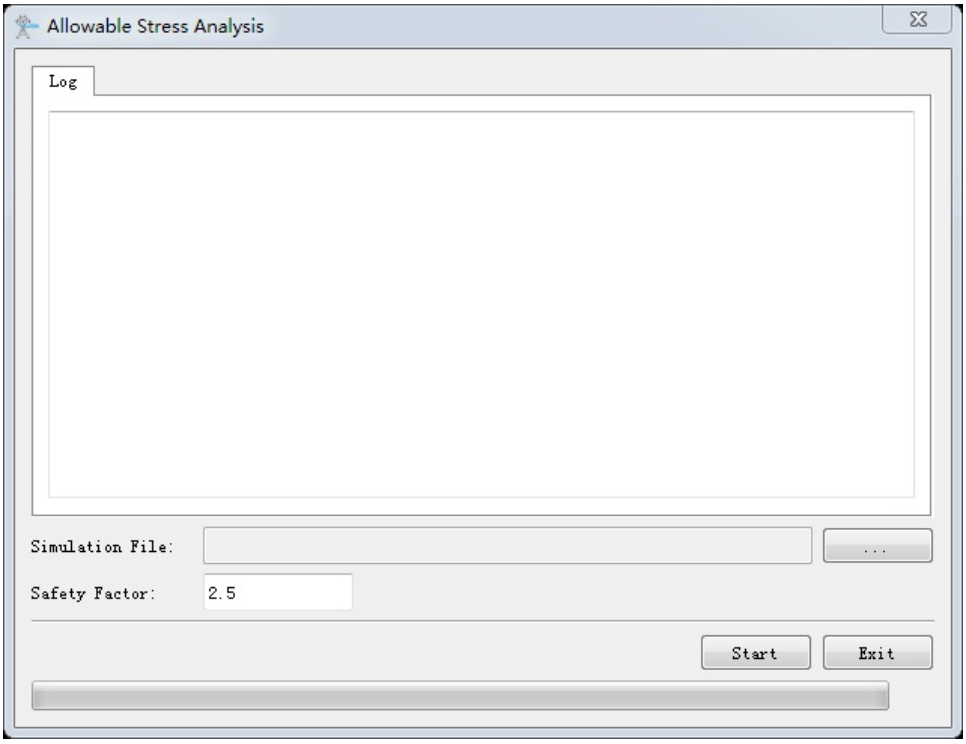
Allowable Stress Analysis

Summary

Based on the result of working conditions simulation, detect and analyze if the stress at the lowest point of the sag exceeds the allowable stress. The interface of allowable stress analysis is shown in the figure below.

Usage

Click *Early Warning Analysis* > *Allowable Stress*



Settings

- **Safety Factor (default value is "2.5")**: Power line safety factor.
- **Simulation File**: Set the input simulation file (*.LiSim file)

> Note: After the stress detection, user can view the result in the Allowable Stress Analysis List.

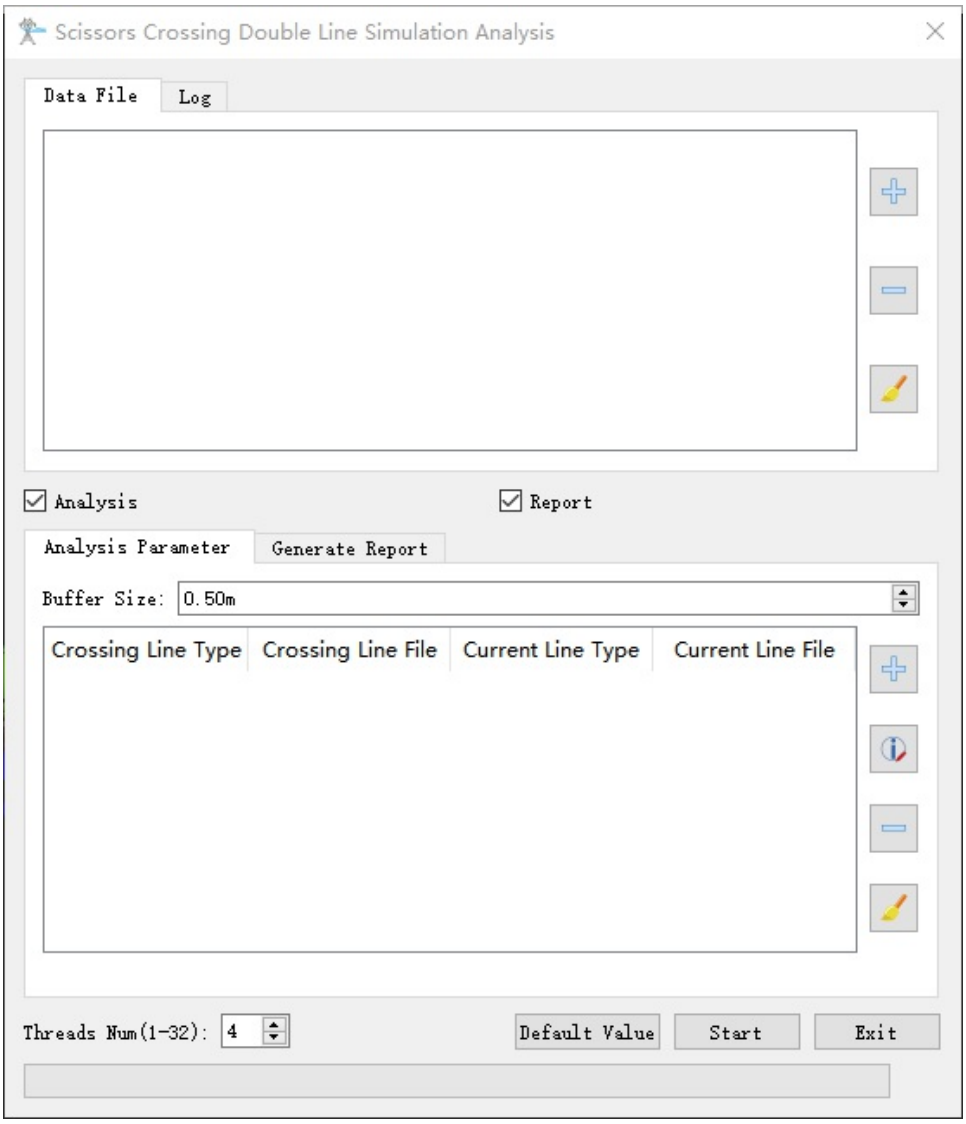
Scissors Crossing Double Line Simulation Analysis

Summary

Based on the result of working conditions simulation, analyze the distance between current line and crossing line. Click to add the vector data to be processed. Click to remove the selected vector data(remove the first record of the list if no data is selected). Click to clear the vector data list.

Usage

Click *Early Warning Analysis > Scissors Crossing Double Line Simulation Analysis*

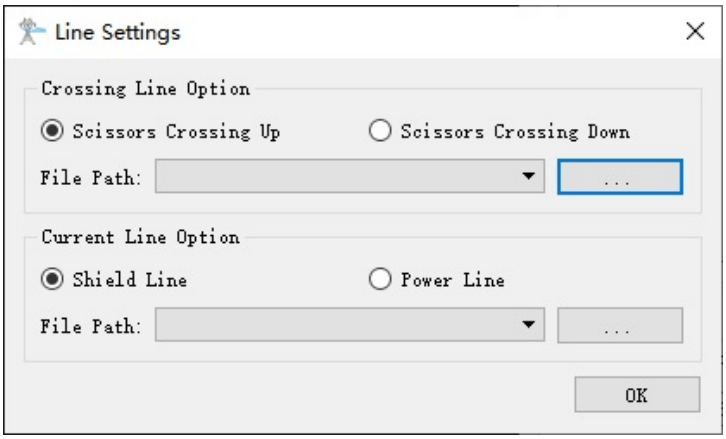


Settings

- **Analysis Parameter**:

Click to add the current line and crossing line. Click to modify selected line. Click to remove selected line. Click to clear line list.

- **Buffer Size**: Adjust channel width.



- **Line Settings**:
  - **Crossing Line Option**: Select the crossing type and the working conditions simulation file for crossing lines. Crossing types include scissors crossing up and scissors crossing down.
  - **Current Line Option**: Select the current line type and the current line working conditions simulation file. Line Type include shield wire and power line.
- **Report(check by default)**: Check to generate an analysis report based on the analysis result file. If not checked, no report will be generated.
  - **Assessor Company**: The company which generates the report.
  - **Electrical Transmission Bureau / Company**: The name of power supply bureau or company.
  - **Line Name**: Line name.
  - **Collection Date**: The date on which point cloud was collected.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: The output path of the report.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

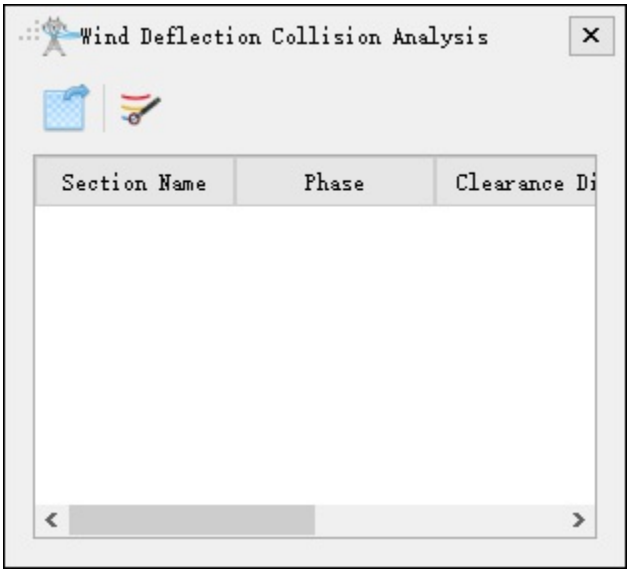
Wind Deflection Collision Analysis

Summary

Automatically analyze wind deflection collisions, save the analysis results to a specified directory, and support the export of result files.

Usage

Click *Early Warning Analysis* > *Wind Deflection Collision Analysis*



Export the wind deflection collision analysis result file.

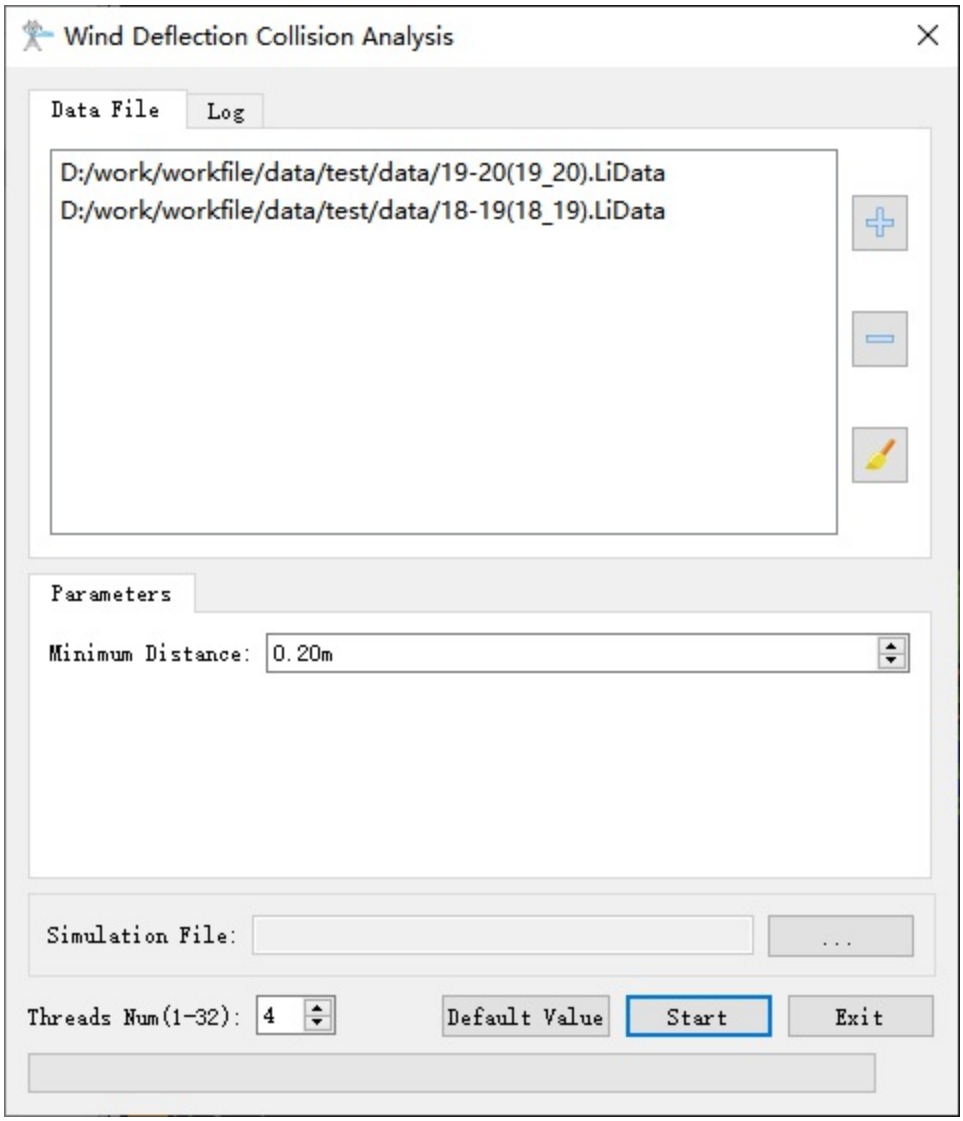
Automatic analysis of wind deflection collision.

Wind Deflection Collision Automatic Analysis

Summary

Analyze and calculate the selected point cloud data, automatically analyze wind deflection collisions and save them to the specified directory, and automatically update the result list upon completion. The functional interface is shown in the figure below. This function can process multiple datasets

simultaneously. Click to add the vector data to be processed. Click to remove the selected vector data(remove the first record of the list if no data is selected). Click to clear the vector data list.



Parameter Settings

- **Minimum Distance (default value: "0.2m")**: Sets the minimum distance.
- **Simulation File**: Selects the file for simulating the working condition process.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

Completion Acceptance

Completion Acceptance is suitable for completion analysis of power line and tower. Based on point cloud data, vector data and working condition simulation data, this module analyzes different components of the line and generates analysis report. The specific functions are as below:



- Add Data
- Settings
- Mark Tower
- Clip and Classify
- Classification Tools
- Profile Tools
- Vector Editing
- Sag Analysis
- Phase Spacing Analysis
- Drainage Thread Clearance Analysis
- Spacer Analysis
- Tension Tower Rotation Analysis
- Insulator Inclination Analysis
- Distance Between Conductor And Shield Wire
- Protect Angle Analysis
- Anchor Bolt
- Lighting Protector Inclination
- Earth Electrode Line
- Danger Point Sag
- Wind Turbine Tower Inclination
- Merge Report

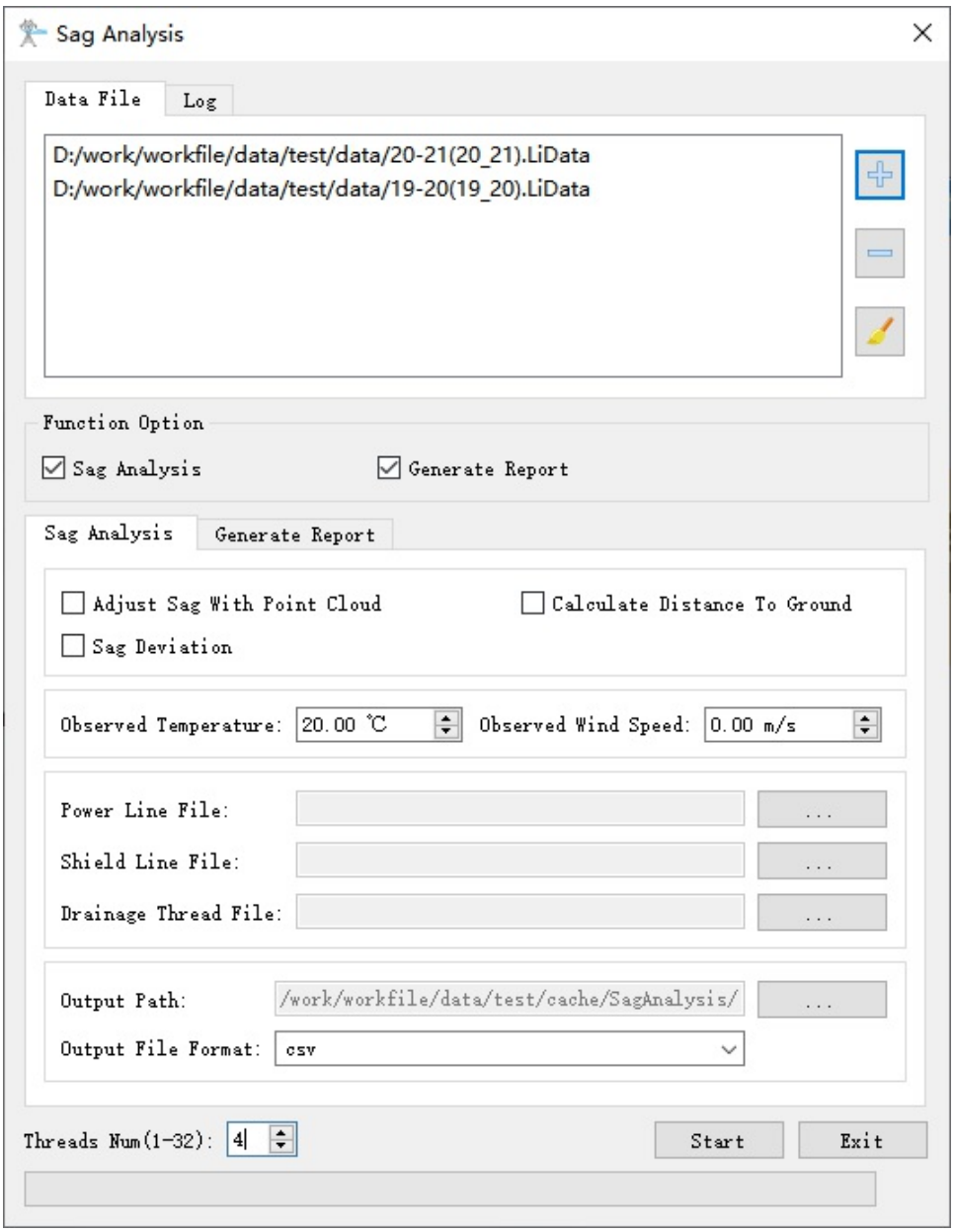
Sag Analysis

Summary

Analyze sag, line length, etc. based on vector file or simulation file input. The result data can be saved as (*.csv, *.xls) and generate report. Click to add data, click to remove data selected, click to clear data list.

Usage

Click *Completion Analysis* > *Sag*



Parameters

- **Sag Analysis(checked by default)**: Checked to calculate sag etc.
  - **Adjust Sag With Point Cloud(unchecked by default)**: Adjust sag based on point cloud.
  - **Distance to Ground(unchecked by default)**: Calculate distance to ground.
  - **Sag Deviation(unchecked by default)**: Calculate Sag Deviation.
  - **Observed Temperature**: Temperature when scanning.
  - **Observed Wind Speed(m/s)**: Wind speed when scanning.
  - **Powerline File**: Set input file for powerline sag analysis, file format:shp.
  - **Shield Line File**: Set input file for shield line sag analysis, file format:shp.
  - **Drainage Thread File**: Set input file for drainage thread sag analysis, file format:shp.
  - **Output Path**: cache/SagAnalysis/ by default.
  - **Output Format(csv by default)**: support csv and xls.
- **Generate Report(checked by default)**: Generate report.
  - **Assessor Company**: Assessor company.
  - **Electrical Transmission Bureau/Company**: Electrical transmission bureau/company.
  - **Line Name**: Line name.
  - **Target Coordinate**: Target Coordinate System.
  - **Report path**: Path to store result files.
- **Threads Num(4 by default)**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

> Note: Input data includes vector file and simulation file*.LiSim. And the vector file should be shapefile(.shp) created by vectorization, not simulation.

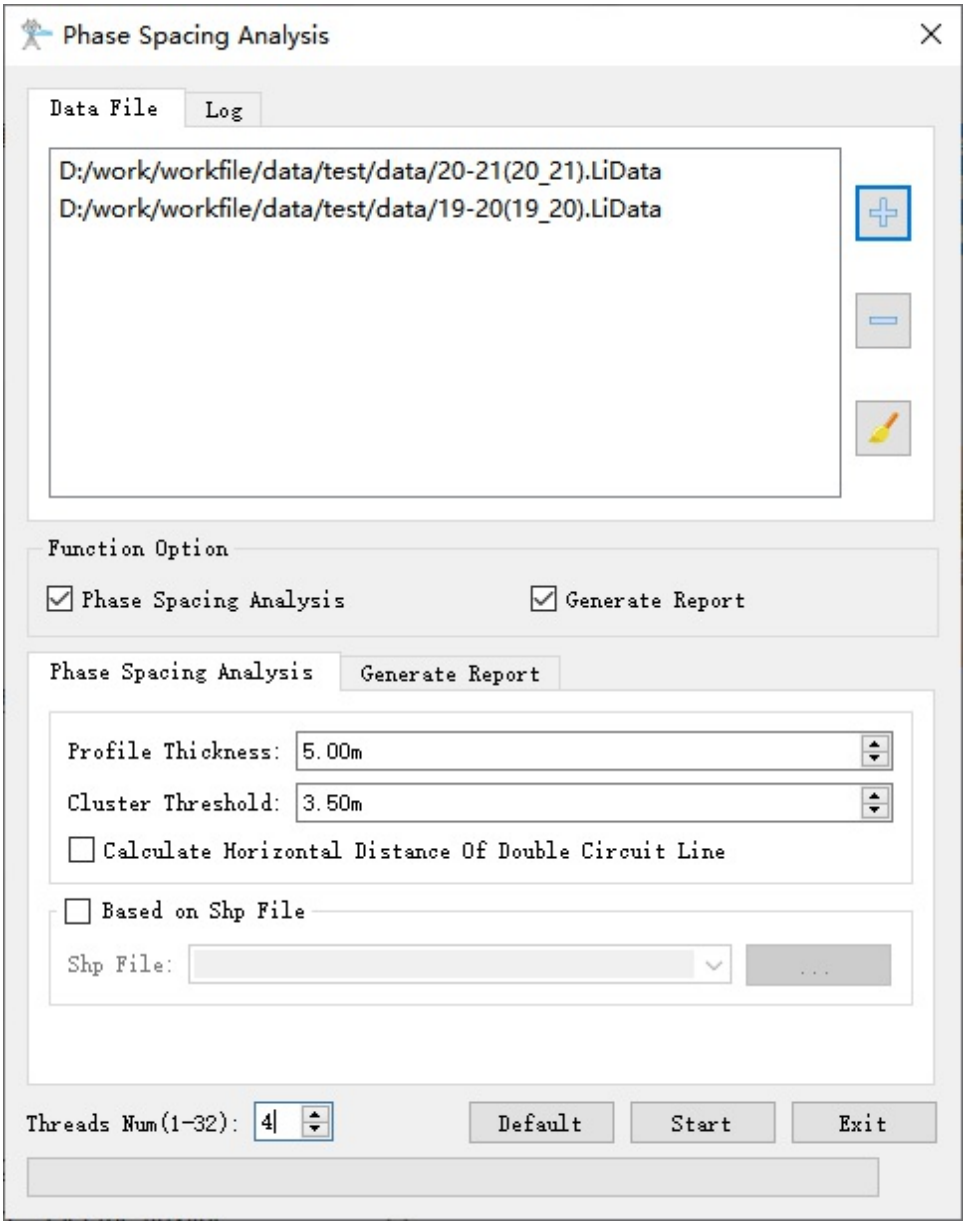
Phase Spacing Analysis

Summary

This function is used to calculate and analyze the distances between power lines, and then generate the analysis report. The phase spacing may change due to various factors such as excessive line length, high temperature, or line breakage. Click to add the data to be processed. Click to remove the selected data. Click to clear the data list.

Usage

Click *Completion Analysis* > *Phase Spacing*



Settings

- **Phase Spacing Analysis**: This option is checked by default. If it is checked, the software will perform phase spacing analysis; if not, the function will not be executed.
  - **Detection Type**: Set the detection type, including clearance distance, horizontal distance and vertical distance.
  - **Profile Thickness (m) (default value is "5.0")**: The thickness of the cross profile of the power line which is used to extract the point cloud for calculating. The software can record the current settings and when the user opens this function again, the setting will be kept.
  - **Cluster Threshold (m) (default value is "3.5")**: The maximum spatial separation distance when the point cloud data is clustered. Power line points smaller than the threshold will be clustered into a cluster. The software can record the current settings and when the user opens this function again, the setting will be kept.
  - **Calculate Horizontal Distance of Double Circuit Line**: Not selected by default. When selected, if the power line is a double loop, the horizontal distance between the left and right sides will be calculated.
  - **Based On Shp File**: Not selected by default. When selected, a power line vector file can be added, and the vector is used as the basis for calculating the distance between phases. Suitable for special sections of certain line situations.
- **Generate Report**: This option is checked by default. If this option is checked the analysis report will be generated; if the option is unchecked, the analysis report will not be generated.
  - **Assessor Company**: The company which generates the report.
  - **Electrical Transmission Bureau/Company**: The name of power supply bureau or company.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: The output path of the report.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

> Note: After the detection, the software will export the detection result file for each segment. User can check the accuracy of the analysis in phase spacing analysis list. Each row contains a phase spacing. And the name, coordinates of the target point, and the point cloud it belongs to will be recorded in different columns.

Drainage Thread Clearance Analysis

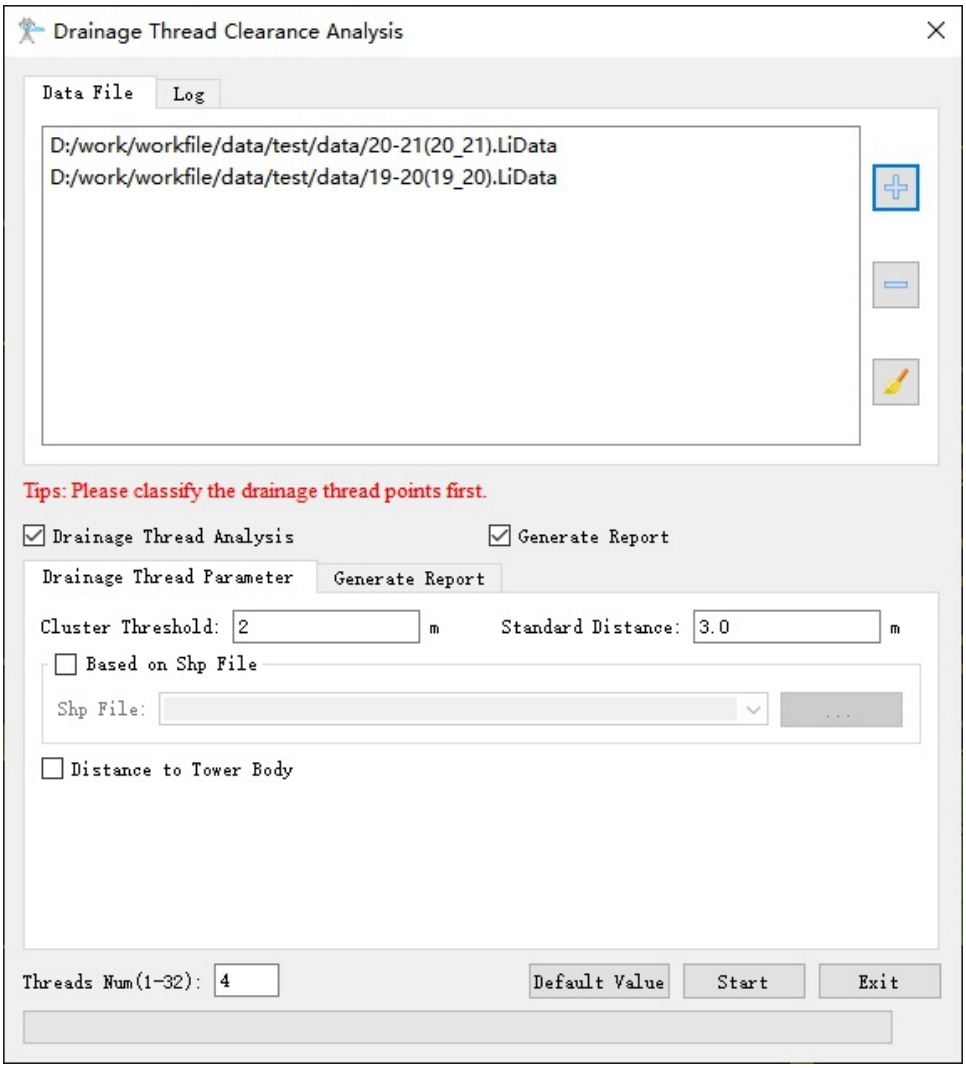
Summary



This function is used to calculate and analyze the clearance distances between the drainage threads and the transmission towers, and generate the analysis report. When the clearance distance between the drainage thread and the transmission tower is too small, it will become very dangerous. Before executing this function, user needs to classify the drainage thread and transmission tower in the point cloud. This function can process multiple data simultaneously. Click to add the data to be processed. Click to remove the selected file. Click to clear the data list.

Usage

Click *Completion Analysis* > *Drainage Thread*.



Settings

- **Drainage Thread Analysis**: This option is checked by default. If this option is checked, the software will perform drainage thread clearance analysis. If this option is unchecked, the analysis will not be done.
    - **Cluster Threshold(m)(default value is "2.0")**: The maximum distance for the point cloud data clustering. If the distance between two points is less than this value, they will be considered as on the same drainage thread. Thus, user should input a value that the distances between most of the points on the same drainage thread are less than. When the clustering splits the same drainage thread into several ones, user needs to increase this value. When more than one drainage threads are clustered as one, user needs to decrease this value.
    - **Standard Distance(m)(default value is "3.0")**: The standard distance from the drainage thread to the transmission tower. It is disqualified if the distance from the drainage thread to the transmission tower is less than this value. The software can record the current settings and when the user opens this function again, the setting will be kept.
    - **Shp File**: This option is unchecked by default. If this option is checked, the position information of the drainage threads will be extracted from the input shp file. If this option is unchecked, the position information of the drainage thread will be extracted from the point cloud. The software can record the current settings and when the user opens this function again, the setting will be kept.
    - **Distance to Tower Body**: This option is unchecked by default. If this option is checked, the clearance distance from the drainage thread to the tower body (without the cross arms) will be calculated. If this option is unchecked, the clearance distance from the drainage thread to the tower body (the cross arms included) will be calculated.
- **Generate Report**: This option is checked by default. If this option is checked the analysis report will be generated. If the option is unchecked, the analysis report will not be generated.
    - **Report Name**: The title of the report.
    - **Assessor Company**: The company which generates the report.
    - **Electrical Transmission Bureau/Company**: The name of power supply bureau or company.
    - **Line Name**: Line name.
    - **Target Coordinate**: The coordinate system used in the report.
    - **Report Path**: The output path of the report.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

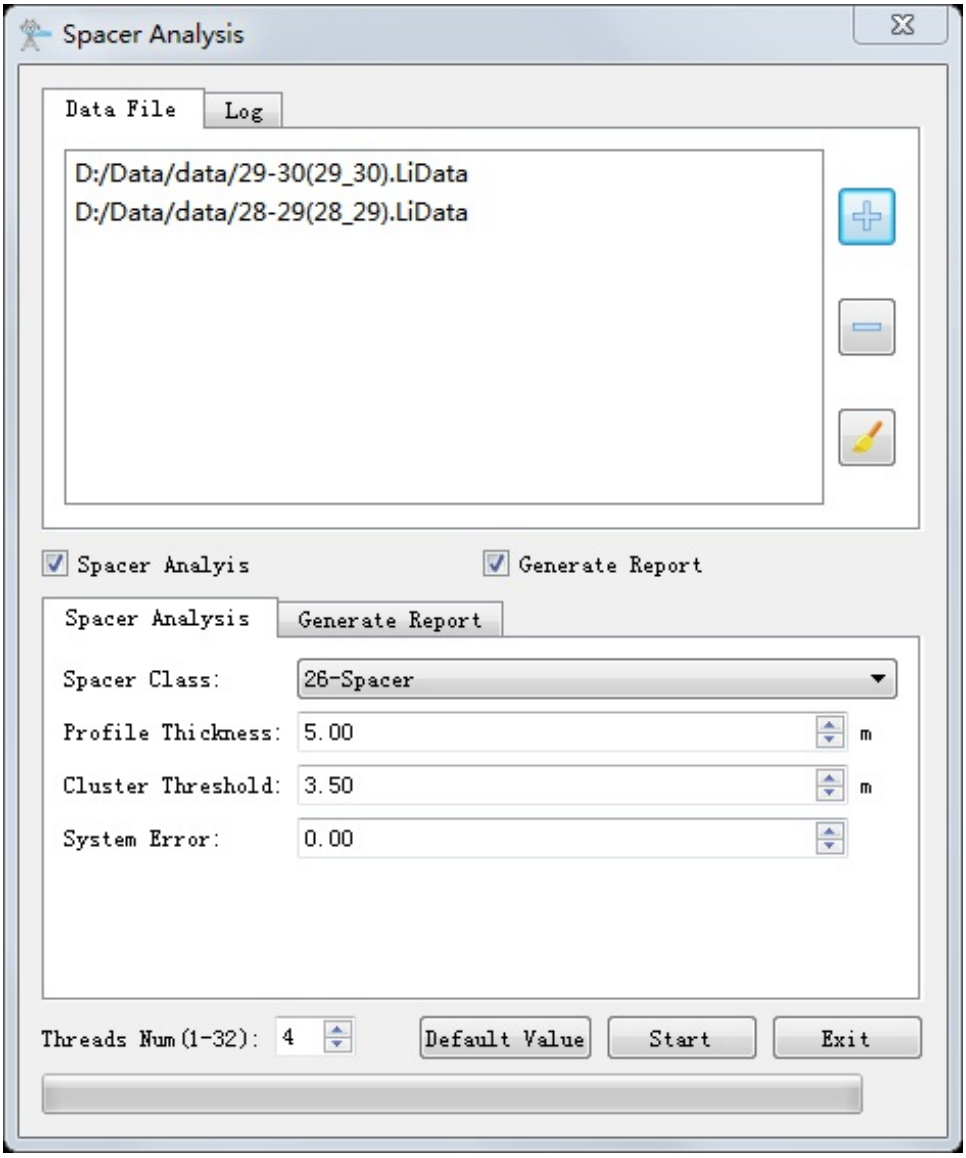
Spacer Analysis

Summary

This function is used to calculate and analyze the position and length information of the spacers in the point cloud of the power line, and then generate the analysis report. The interface of this function is shown as follows. This function can process multiple data simultaneously. Click to add the data to be processed, click to remove the selected file, click to clear the data list.

Usage

Click *Completion Analysis* > *Spacer*.



Settings

- **Spacer Analysis**: This option is checked by default. If it is checked, the software will perform spacers analysis; if not, the function will not be executed.
  - **Spacer Class(default value is "26")**: The class number of the spacers in the input point cloud.
  - **Profile Thickness(m)(default value is "5.0")**: The thickness of the cross profile which is used to extract the point cloud for calculating. The software can record the current settings and when the user opens this function again, the setting will be kept.
  - **Cluster Threshold(m)(default value is "3.5")**: The maximum spatial separation distance when point cloud data is clustered. Point cloud data points within this threshold distance will be grouped into the same cluster. The software can record the current settings and when the user opens this function again, the setting will be kept.
  - **System Error(m)(default value is "0")**: Affected by the accuracy of the point cloud and the classification, there will be errors in the result of the spacer length. This system error value will help to correct the result by being added to the result.
- **Generate Report**: This option is checked by default. If this option is checked the analysis report will be generated; if the option is unchecked, the analysis report will not be generated.
  - **Report Name**: The title of the report.
  - **Assessor Company**: The company which generates the report.
  - **Electrical Transmission Bureau/Company**: The name of power supply bureau or company.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: The output path of the report.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

Tension Tower Rotation Angle Analysis

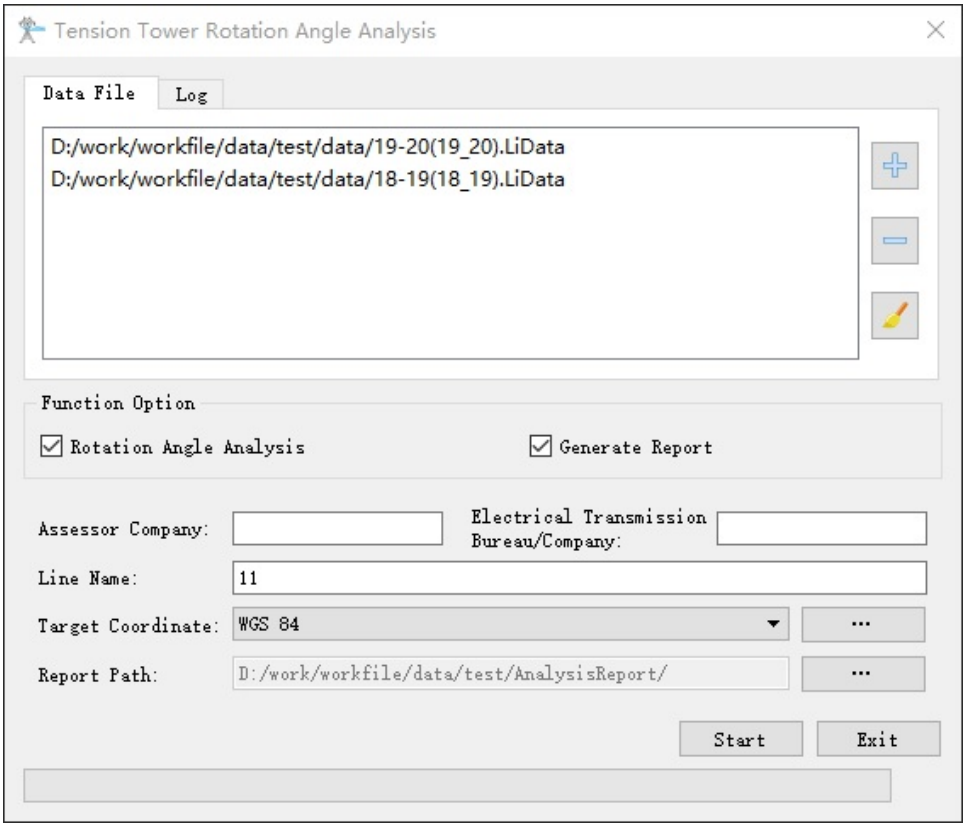
Summary



This function is used to calculate the tension tower rotation angle and generate the analysis report. The interface of this function is shown as follows. This function can process multiple data simultaneously. Click  to add the data to be processed, click to remove the selected file, click  to clear the data list.

Usage

Click *Completion Analysis* > *Rotation Angle*



Settings

- **Rotation Angle Analysis**: This option is checked by default. If it is checked, the software will perform tension tower rotation analysis. If not, the function will not be executed.
- **Generate Report**: This option is checked by default. If this option is checked the analysis report will be generated. If the option is unchecked, the analysis report will not be generated.
  - **Assessor Company**: The company which generates the report.
  - **Electrical Transmission Bureau/Company**: The name of power supply bureau or company.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.

- **Report Path**: The output path of the report.

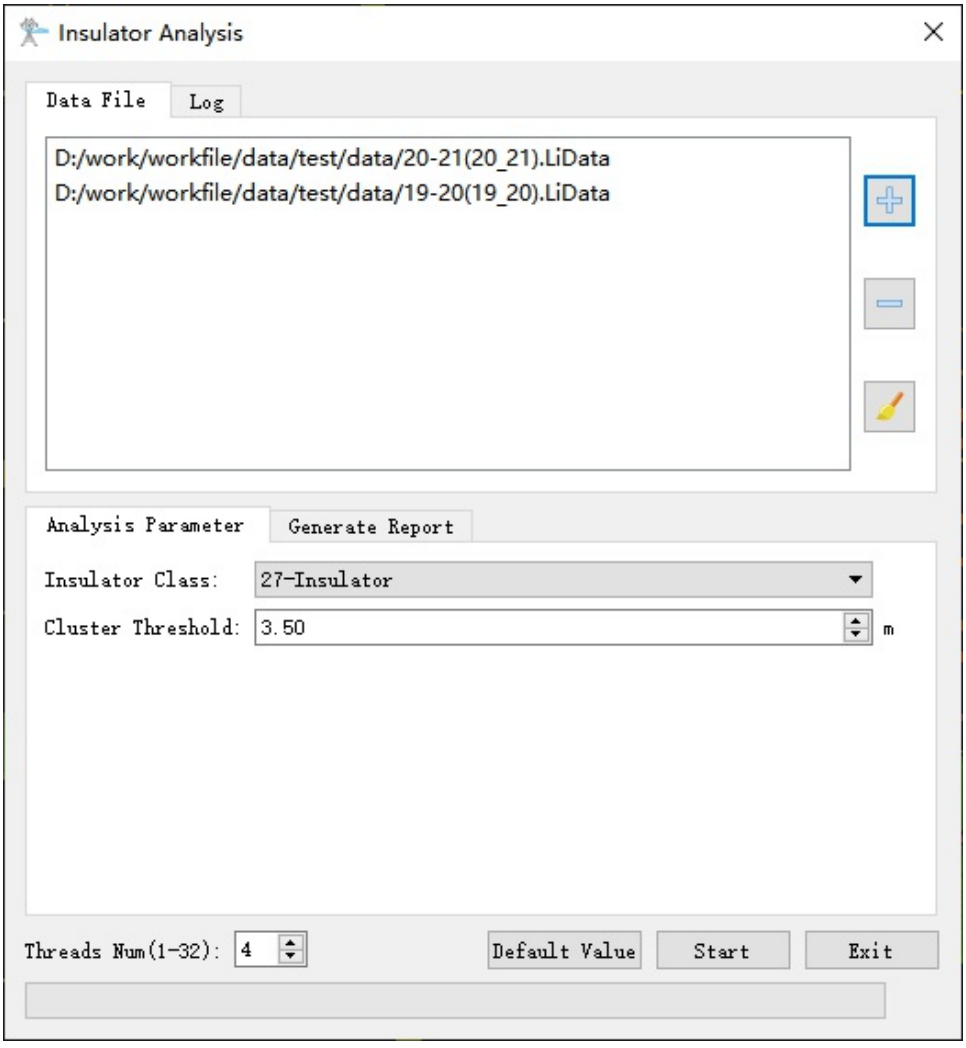
Insulator Analysis

Summary

This function is used to calculate the inclination information of insulators in power lines and generate analysis reports. This function requires classification of insulators in advance. The function interface is shown in the figure below. This function can process multiple data at the same time. Click to add pending data, click to remove the selected data, click to clear data list.

Usage

Click *Completion Analysis* > *Insulator*



Settings

- **Insulator Class(default value is "27")**: Class number of insulators in point cloud data.
- **Cluster Threshold(m)(default value is "3.5")**: The maximum spatial distance for clustering insulator point cloud data. Insulators with distances less than this threshold will be grouped into the same cluster.

- **Generate Report**: This option is checked by default. If this option is checked the analysis report will be generated; if the option is unchecked, the analysis report will not be generated.
  - **Assessor Company**: The company which generates the report.
  - **Electrical Transmission Bureau/Company**: The name of power supply bureau or company.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: The output path of the report.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

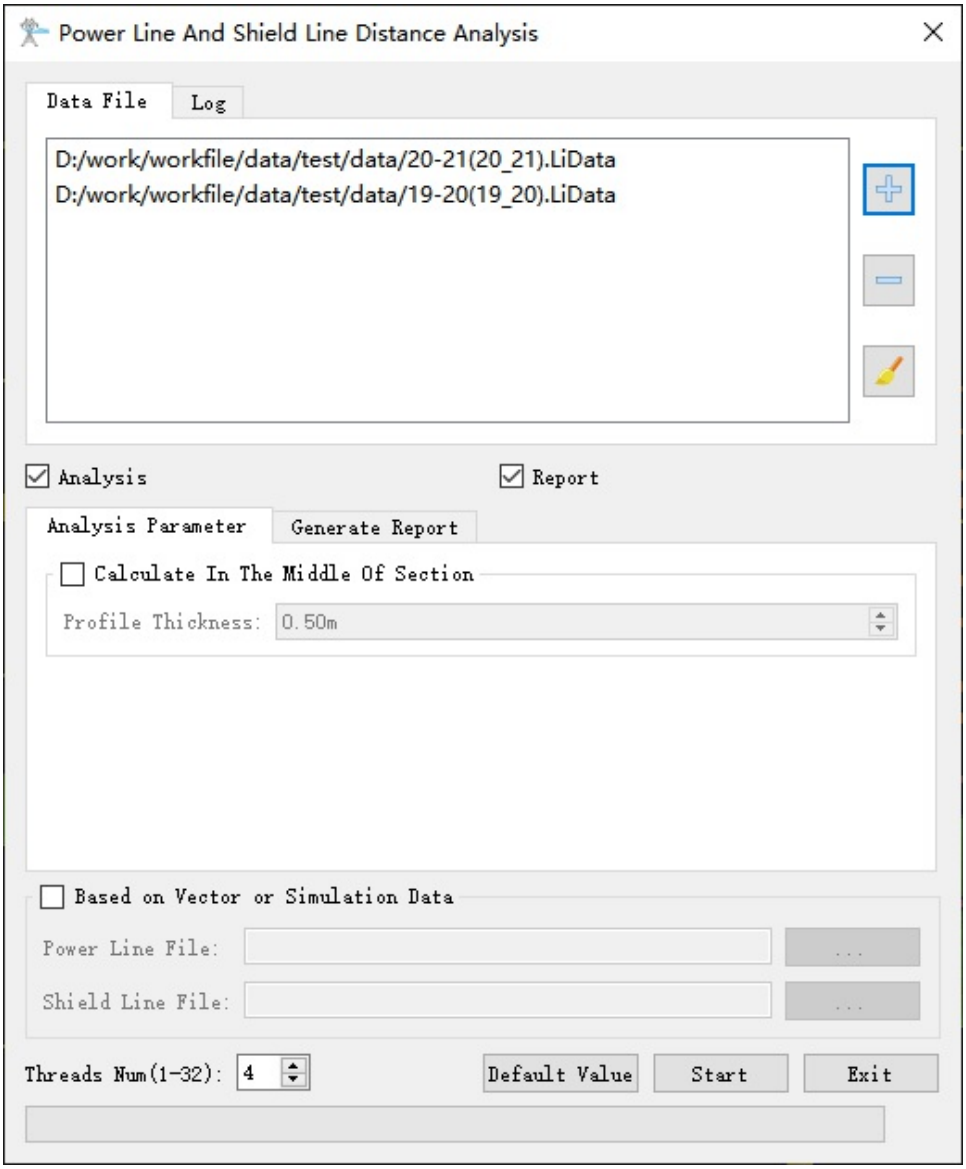
Power Line And Shield Line Distance Analysis

Summary

This function is used to automatically analyze and calculate the distance between power line and shield line and generate analysis report. The function interface is shown in the figure below. This function can process multiple data at the same time.Click to add the data to be processed, click to remove selected data, click to clear data list.

Usage

Click *Completion Analysis* > *Power line and shield line distance*



Settings

- **Calculate In The Middle Of Section**: Not selected by default. Check it to calculate the distance in the middle of the section, uncheck it to calculate the distance in the entire range.
- **Profile Thickness(default value is 0.5m)**: It is used to set the thickness of the spacing slice of the guide wire and to calculate the spacing slice.
- **Generate Report**: This option is checked by default. If this option is checked the analysis report will be generated; if the option is unchecked, the analysis report will not be generated.
  - **Assessor Company**: The company which generates the report.
  - **Electrical Transmission Bureau/Company**: The name of power supply bureau or company.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: The output path of the report.
- **Threads Num(default value is "4")**: Set the number of threads (1 to 32) to run this function. The software can record the current settings and when the user opens this function again, the setting will be kept.

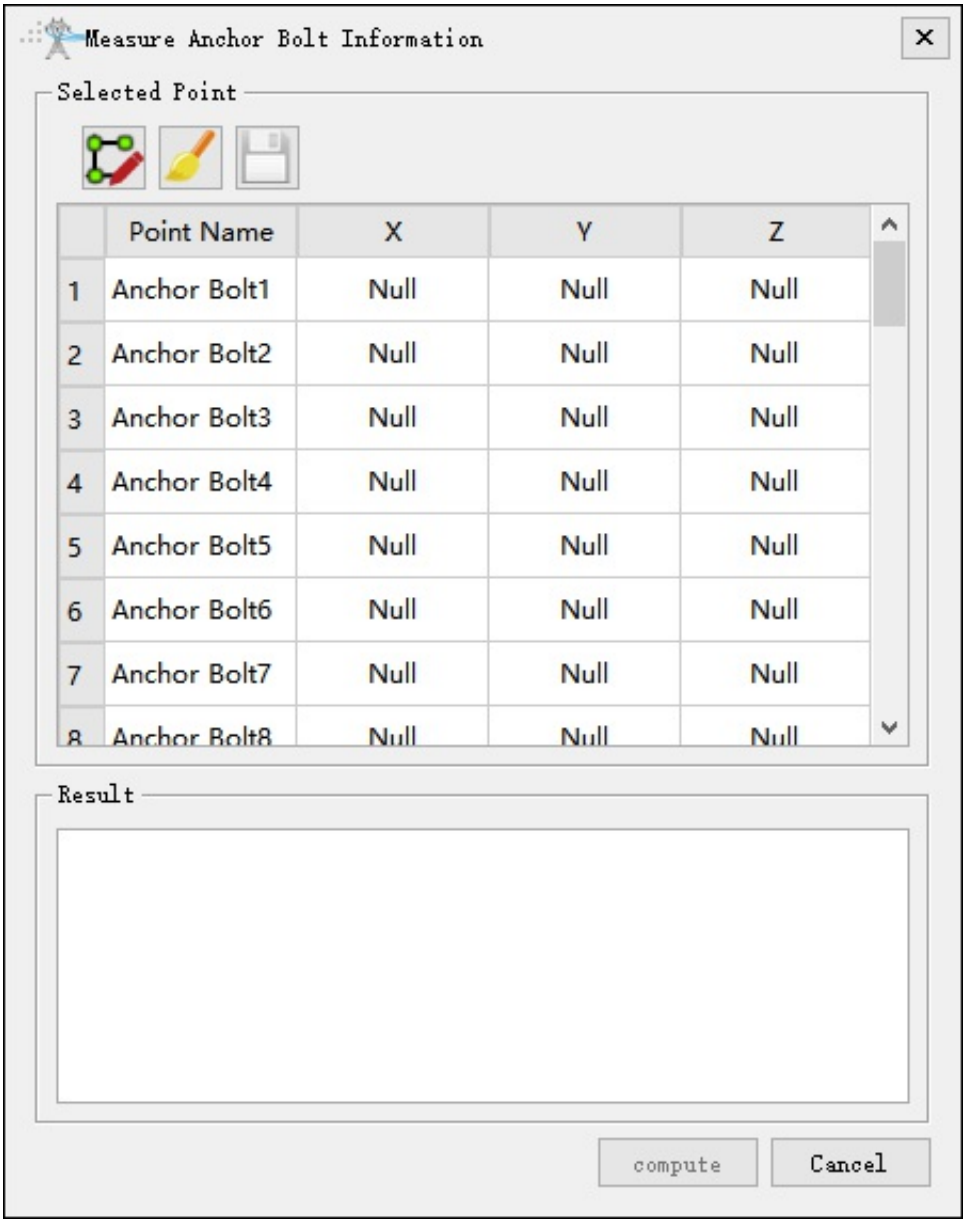
Measure Anchor Bolt Information

Summary

This function is used to measure anchor bolt information during infrastructure acceptance and generate analysis reports. The functional interface is shown in the following figure.

Usage

Click *Completion Analysis* > *Other* > *Anchor Bolt*



Select the position of the anchor bolt

 Select the position of the anchor bolt.

 Clear the result list record.

 Save the anchor bolt measurement results.

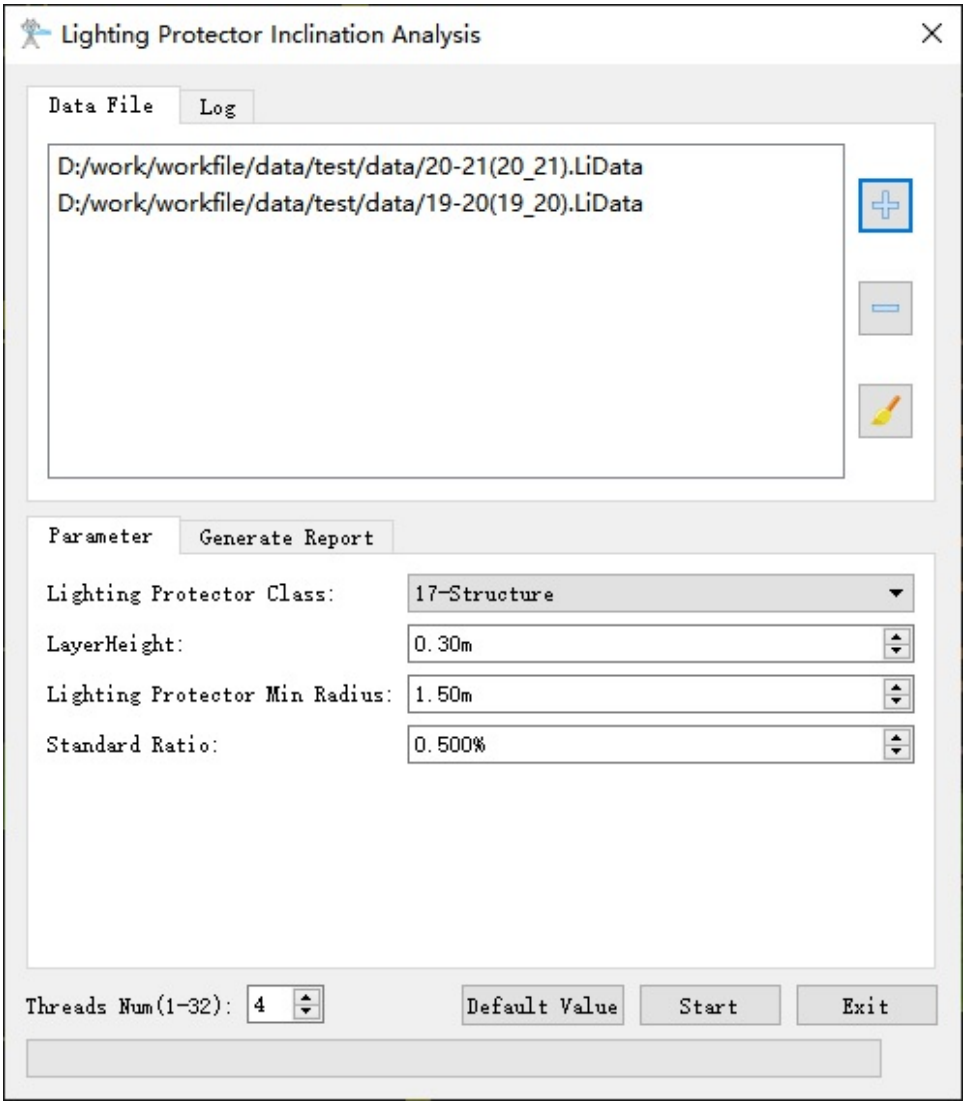
Lighting Protector Inclination Analysis

Summary

The function is used to analyze the tilt of the Lighting Protector and generate analysis report.Ensure the data has been classified.The function interface is shown in the following figure, this function can process multiple data at the same time, Click to add data to be processed, click to remove selected data, click to clear data list.

Usage

Click *Completion Analysis* > *Other* > *Lighting Protector Inclination*



Parameter Settings

- **Lighting Protector Class**: Category number of the arrester in the point cloud data.

- **Layer height(m)(The default value is "0.3")**: For the horizontal slice thickness of the arrester, the smaller the thickness is, the more precise the calculation is, and the higher the requirement for the density of the point cloud is. In the case of sparse point clouds, the value can be appropriately increased.
- **Lighting Protector Min Radius(m)(The default value is "1.50")**: The minimum radius of the arrester is used to obtain point cloud data.
- **Standard ratio(%)(The default value is "0.5")**: According to the standard ratio provided by the specification.
- **Generate report**: Selected by default.If this parameter is selected, an analysis report is generated based on the analysis result file. If unchecked, no report will be generated.
  - **Assessor Company**: The company that generated the report.
  - **Electrical Transmission Bureau/Company**: The name of the power supply bureau.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: Report output path.
- **Threads Num(The default value is "4")**: Set the number of threads. 1-32 threads can be supported. The software can record the user's current settings and automatically restore the Settings when it is turned on again.

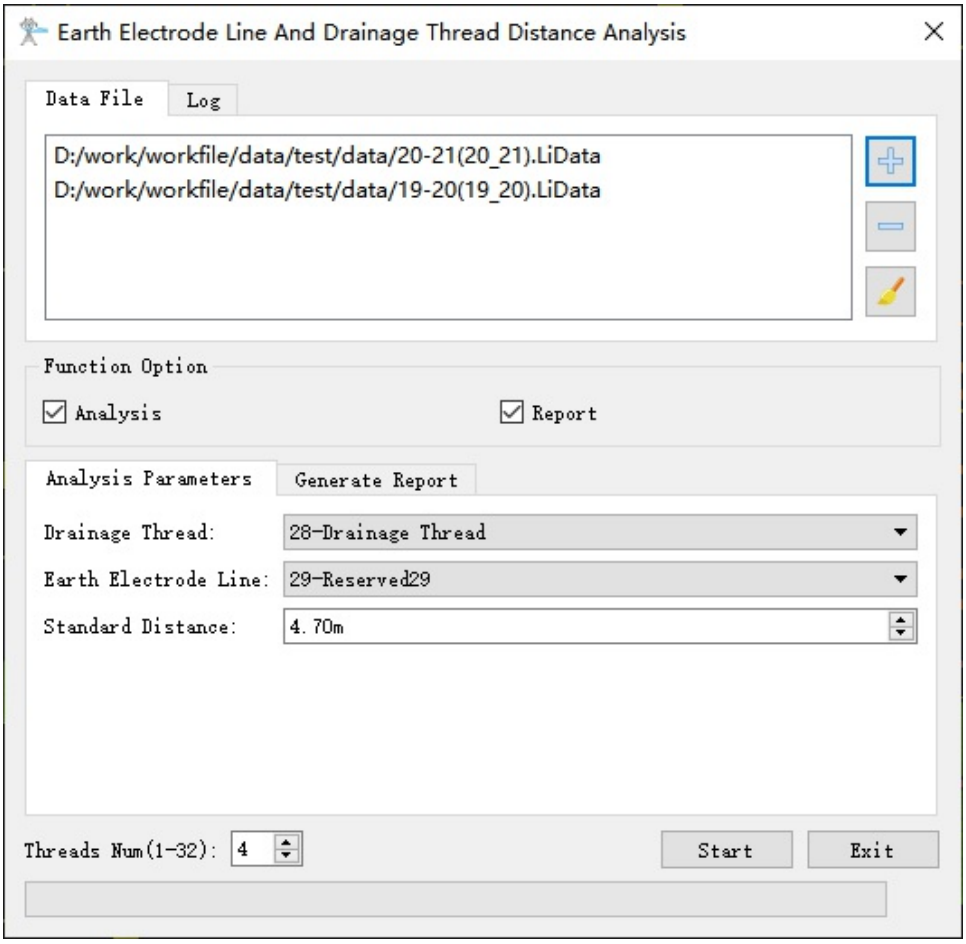
Earth Electrode Line And Drainage Thread Distance Analysis

Summary

This function is mainly used to automatically analyze and calculate the distance between the grounding electrode wire and the drainage threads, and generate an analysis report. The functional interface is shown in the following figure, which can process multiple data simultaneously. Click to add pending data, click to remove the selected data, click to clear the data list.

Usage

Click *Completion Analysis* > *Other* > *Earth Electrode Line*



Parameter settings

- **Analysis**: Selected by default. If selected, calculate the distance between the grounding electrode wire and the drainage threads; If not selected, it will not be calculated.
- **Drainage Thread(default value is "28")**: Set the category of drainage threads.
- **Earth Electrode Line(default value is "29")**: Set the category of grounding electrode wire.

- **Standard Distance(m)(default value is "4.7")**: Set the standard distance between the grounding electrode wire and the drainage threads.
- **Generate report**: Selected by default.If this parameter is selected, an analysis report is generated based on the analysis result file. If unchecked, no report will be generated.
  - **Assessor Company**: The company that generated the report.
  - **Electrical Transmission Bureau/Company**: The name of the power supply bureau.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: Report output path.
- **Threads Num(The default value is "4")**: Set the number of threads. 1-32 threads can be supported. The software can record the user's current settings and automatically restore the settings when it is turned on again.

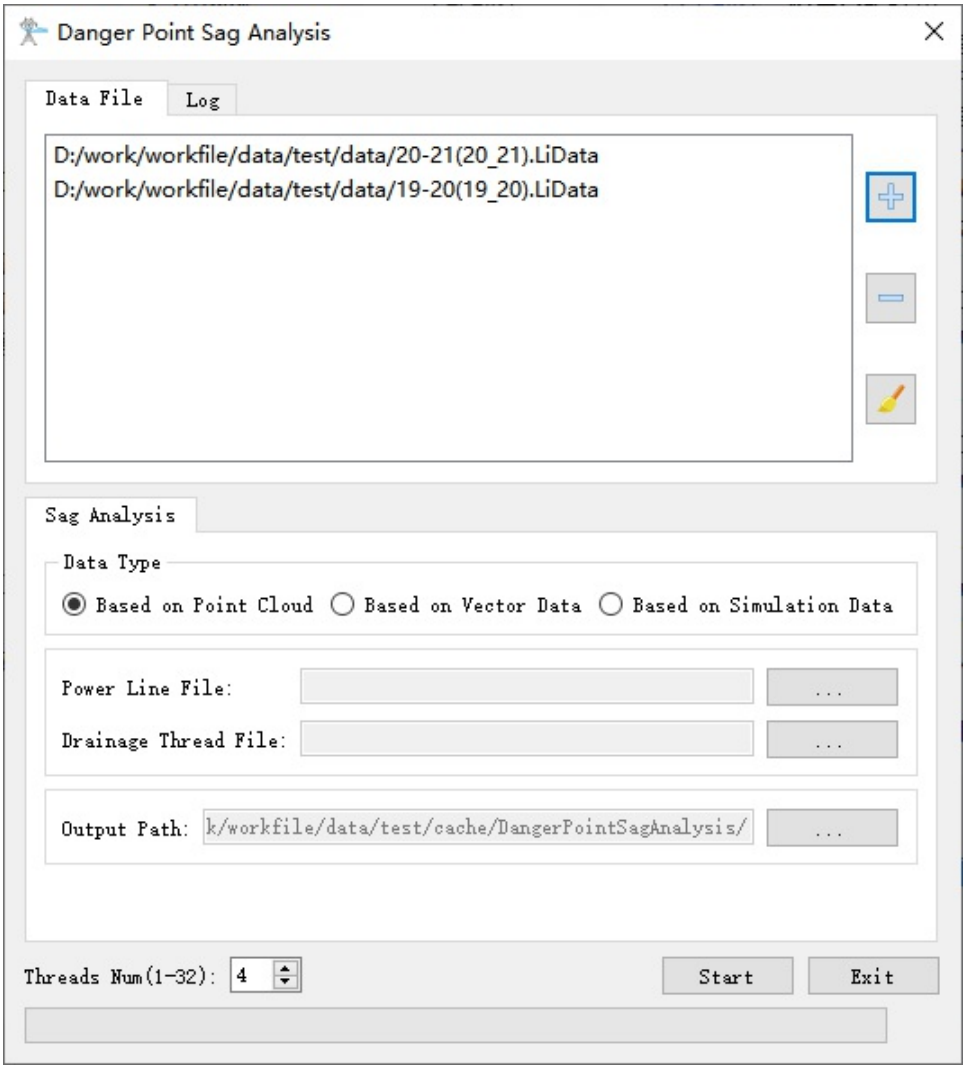
Danger Point Sag Analysis

Summary

This function is used to automatically analyze and calculate the sag of danger points. The functional interface is shown in the following figure, which can process multiple data simultaneously. Click to add pending data, click to remove the selected data, click to clear the data list.

Usage

Click *Completion Analysis* > *Other* > *Danger Point Sag*



Parameter settings

- **Data Type**: The default selection is based on point cloud data. If selected, obtain the dangerous point analysis results based on point cloud data to calculate the sag of danger points.
- **Based on Point Cloud**: Used to obtain dangerous point analysis results based on point cloud data.

- **Based on Vector Data**: Used to obtain the results of danger points analysis based on vector data.
- **Based on Simulation Data**: Used to obtain the analysis results of danger points based on working condition simulation data.
- **Power Line File**: Set the input file for power line sag analysis, supporting vectorized files and operating condition simulation files, with formats of *.shp and *.LiSim, respectively LiSim.
- **Drainage Line File**: Set the input file for drainage line sag analysis, supporting vectorized files and working condition simulation files, with formats of *.shp and *.LiSim, respectively LiSim.
- **Output Path**: Set the analysis result file output path, which defaults to "cache/DangerPointSagAnalysis/" in the working directory.
- **Thread Num(default value is "4")**: Set the number of running threads for the function, which can support 1-32 threads. The software can record the user's current settings.

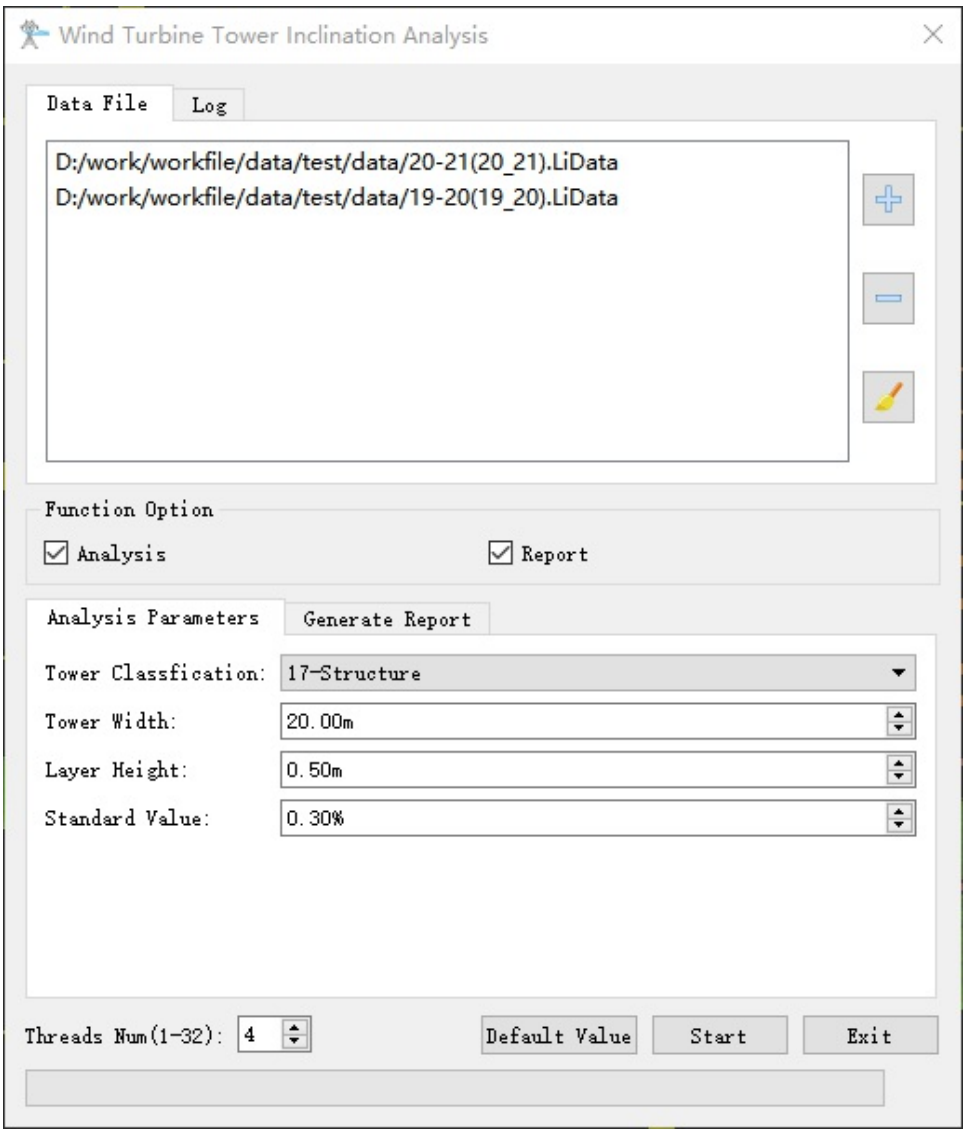
Wind Turbine Tower Inclination Analysis

Summary

This function is mainly used to automatically analyze and calculate the inclination of the wind turbine tower, and generate analysis reports. The functional interface is shown in the following figure, which can process multiple data simultaneously. Click to add pending data, click to remove the selected data, click to clear the data list.

Usage

Click *Completion Analysis* > *Other* > *Wind Turbine Tower Inclination*



Parameter Settings

- **Analysis**: Selected by default. Select to analyze the inclination of the wind turbine tower; If not selected, do not analyze.
- **Tower Classification(default value is "18")**: Set the category of the wind turbine tower.
- **Tower Width(m)(default value is "20")**: Set the tower width to set the range of sampling points. The software can record the user's current settings.
- **Layer Height(m) (default value is "0.5")**: Set the tower analysis layer height to extract the point cloud data to be calculated. The software can record the user's current settings.
- **Standard Value(default value is "0.3")**: Set the standard inclination ratio for wind turbine towers to determine if the tower's inclination exceeds the specified limits. The software can record the user's current settings.
- **Generate report**: Selected by default.If this parameter is selected, an analysis report is generated based on the analysis result file. If unchecked, no report will be generated.
  - **Assessor Company**: The company that generated the report.
  - **Electrical Transmission Bureau/Company**: The name of the power supply bureau.
  - **Line Name**: Line name.
  - **Target Coordinate**: The coordinate system used in the report.
  - **Report Path**: Report output path.
- **Threads Num(The default value is "4")**: Set the number of threads. 1-32 threads can be supported. The software can record the user's current settings and automatically restore the settings when it is turned on again.

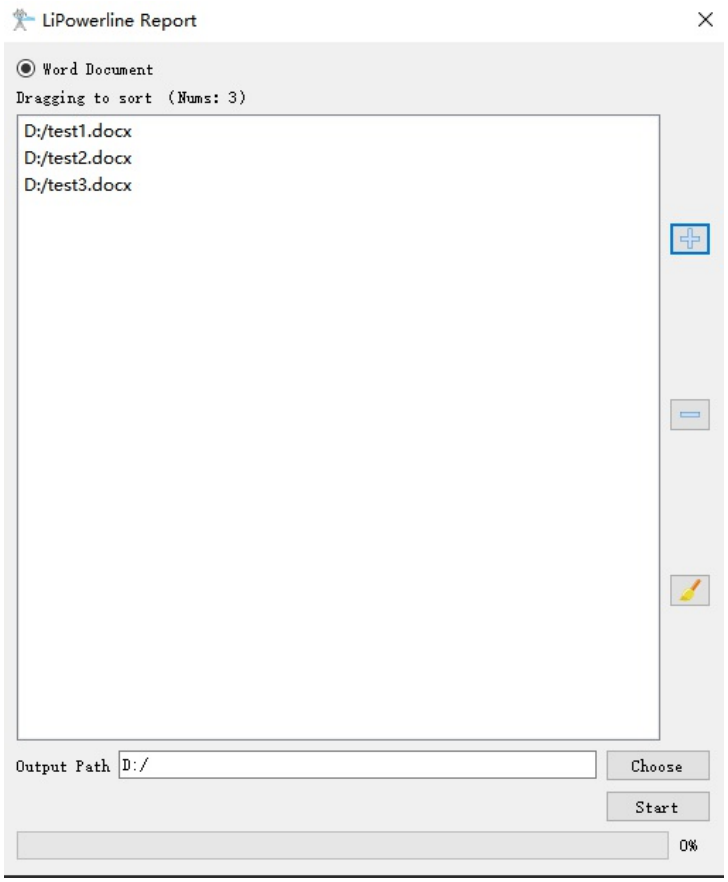
Merge Report

Summary

This feature is used to merge multiple analysis reports into a single document. The functional interface is shown in the following figure, which can process multiple data simultaneously. Click to add the data to be processed, click to remove the selected data, click to clear the data list.

Usage

Click *Completion Analysis* > *Other* > *Merge Report*



Parameter settings

- **Output Path**: Set the output directory path where the merged report file will be saved.

> Note: This feature is mainly used to concatenate multiple Word documents.

Fine Inspection

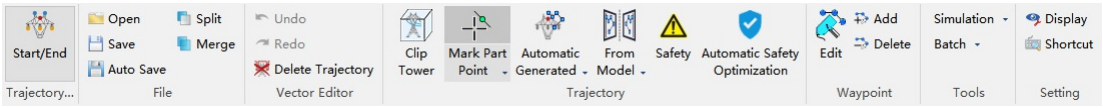
Summary

To generate fine trajectory based on tower marker points and point cloud data. This module includes Project Configuration, Mark Tower, Trajectory Planning, and Image.



Usage

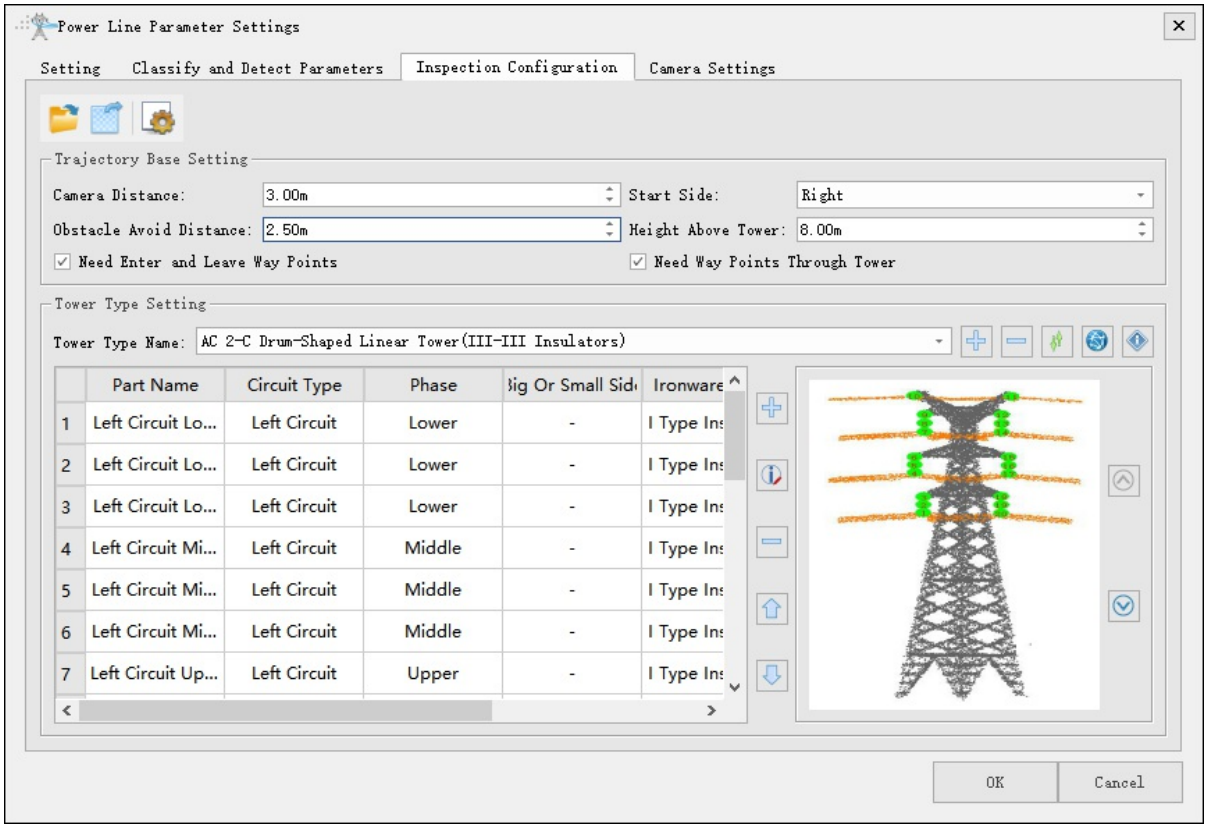
Click the "Fine Inspection" tab to open the menu, and click the "Start/End" button to expand the trajectory planning related function menu, as shown in the figure below.



- Project Configuration
- Mark Tower
- Trajectory Planning
- Defect Recognition
- Open Working Directory

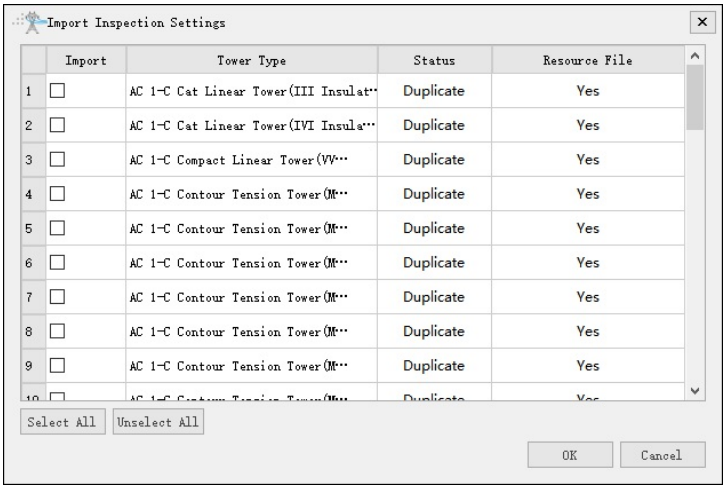
Project Configuration

Project configuration is the first step in trajectory planning. Trajectory planning can only be carried out after the configuration parameters and the various tower part points are determined. Click Project Configuration -> Inspection Configuration, as shown in the following figure.



Import Settings

Import the tower type configuration, supporting csv and icp formats. When importing icp, you can select the import range.



Export Settings


Export the tower type configuration, supporting csv and icp formats.

Reset


Reset the tower type configuration.

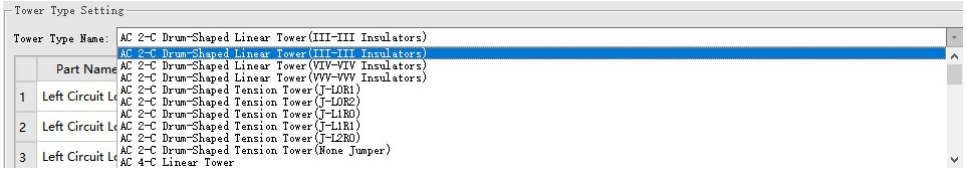
Trajectory Base Setting

- **Camera Distance**: The distance from the waypoint to the tower part point.
- **Obstacle Avoid Distance**: The minimum safe distance between the trajectory and obstacle point cloud.
- **Need Enter and Leave Way Points**: Check if you need the entry point and exit point. The entry point and exit point will be slightly higher than the top of the tower, located on the left and right of the tower.
- **Start Side**: It is mainly divided into the right side of the line and the left side of the line, which is the take-off side of the UAV.
- **Height Above Tower**: The height of the UAV from the top of the tower.
- **Need Way Points Through Tower**: Check if the tower point is needed.

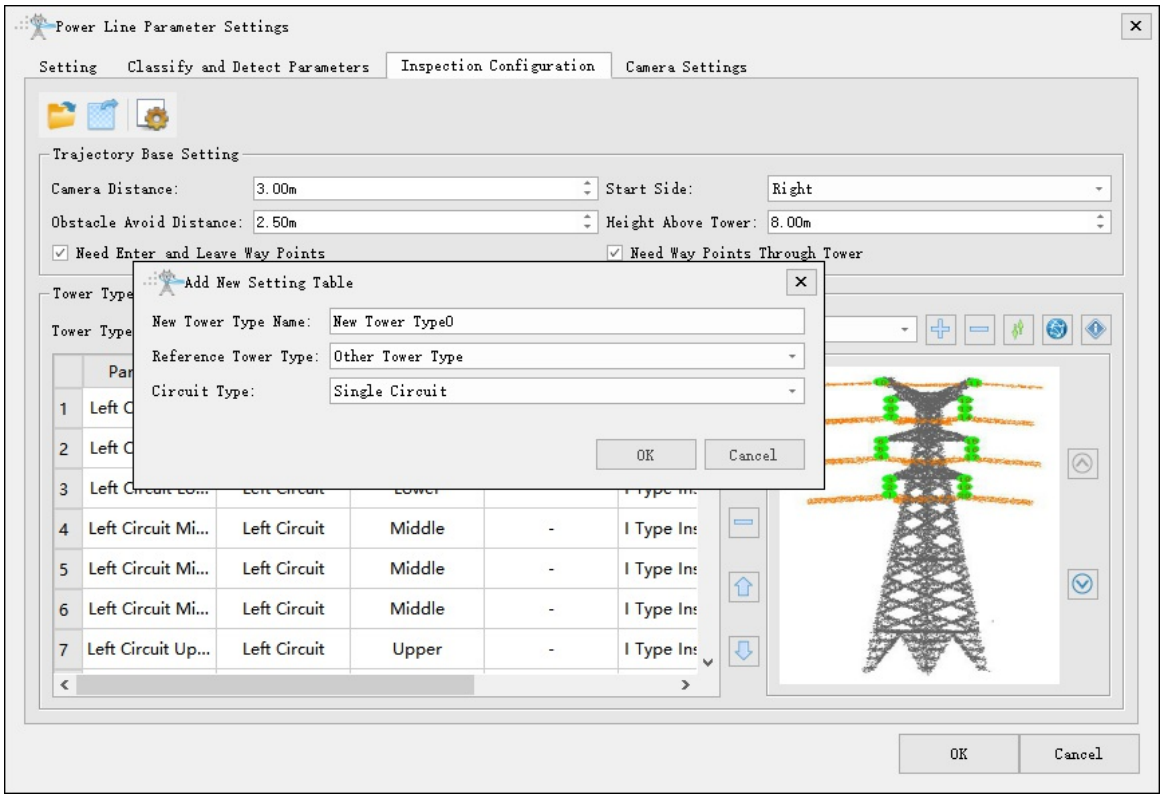
Tower Type Setting

The software has built-in 43 tower type trajectory configuration lists, each configuration has defined part point names and parameters, which can be selected according to the tower type. The 43 tower types are shown below.
1.AC 2-C Drum-Shaped Linear Tower(III-III Insulators)
2.AC 2-C Drum-Shaped Linear Tower(VIV-VIV Insulators)
3.AC 2-C Drum-Shaped Linear Tower(VVV-VVV Insulators)
4.AC 2-C Drum-Shaped Tension Tower(J-L0R1)
5.AC 2-C Drum-Shaped Tension Tower(J-L0R2)
6.AC 2-C Drum-Shaped Tension Tower(J-L1R0)
7.AC 2-C Drum-Shaped Tension Tower(J-L1R1)
8.AC 2-C Drum-Shaped Tension Tower(J-L2R0)
9.AC 2-C Drum-Shaped Tension Tower(None Jumper)
10.AC 4-C Linear Tower
11.AC 4-C Steel Tube Linear Tower
12.AC 4-C Tension Tower(J-L0R1)
13.AC 4-C Tension Tower(J-L0R2)
14.AC 4-C Tension Tower(J-L1R0)
15.AC 4-C Tension Tower(J-L1R1)
16.AC 4-C Tension Tower(J-L2R0)
17.AC 4-C Tension Tower(None Jumper)
18.AC 1-C Cat Linear Tower(III Insulators)
19.AC 1-C Cat Linear Tower(IVI Insulators)
20.AC 1-C Compact Linear Tower(VVV Insulators)
21.AC 1-C Contour Tension Tower(MPL-J-L0M1R0)
22.AC 1-C Contour Tension Tower(MPL-J-L0M2R0)
23.AC 1-C Contour Tension Tower(MPL-J-L0M2R1)

24.AC 1-C Contour Tension Tower(MPL-J-L0M2R2)
25.AC 1-C Contour Tension Tower(MPL-J-L1M2R1)
26.AC 1-C Contour Tension Tower(MPR-J-L0M1R0)
27.AC 1-C Contour Tension Tower(MPR-J-L0M2R0)
28.AC 1-C Contour Tension Tower(MPR-J-L1M2R0)
29.AC 1-C Contour Tension Tower(MPR-J-L1M2R1)
30.AC 1-C Contour Tension Tower(MPR-J-L2M2R0)
31.AC 1-C Gantry-Shaped Guyed Linear Tower(III Insulators)
32.AC 1-C Gantry-Shaped Guyed Linear Tower(IVI Insulators)
33.AC 1-C Shang-Shaped Linear Tower(MPL)
34.AC 1-C Shang-Shaped Linear Tower(MPR)
35.AC 1-C V-Shaped Guyed Linear Tower(III Insulators)
36.AC 1-C V-Shaped Guyed Linear Tower(IVI Insulators)
37.AC 1-C Wine Cup Linear Tower(III Insulators)
38.AC 1-C Wine Cup Linear Tower(IVI Insulators)
39.AC 1-C Wine Cup Linear Tower(VVV Insulators)
40.AC 1-C Wine Cup Tension Tower(J-L1M1R1)
41.DC 1-C T-Shaped Linear Tower(II Insulators)
42.DC 1-C T-Shaped Linear Tower(VV Insulators)
43.DC 1-C T-Shaped Tension Tower(J-L1R1)

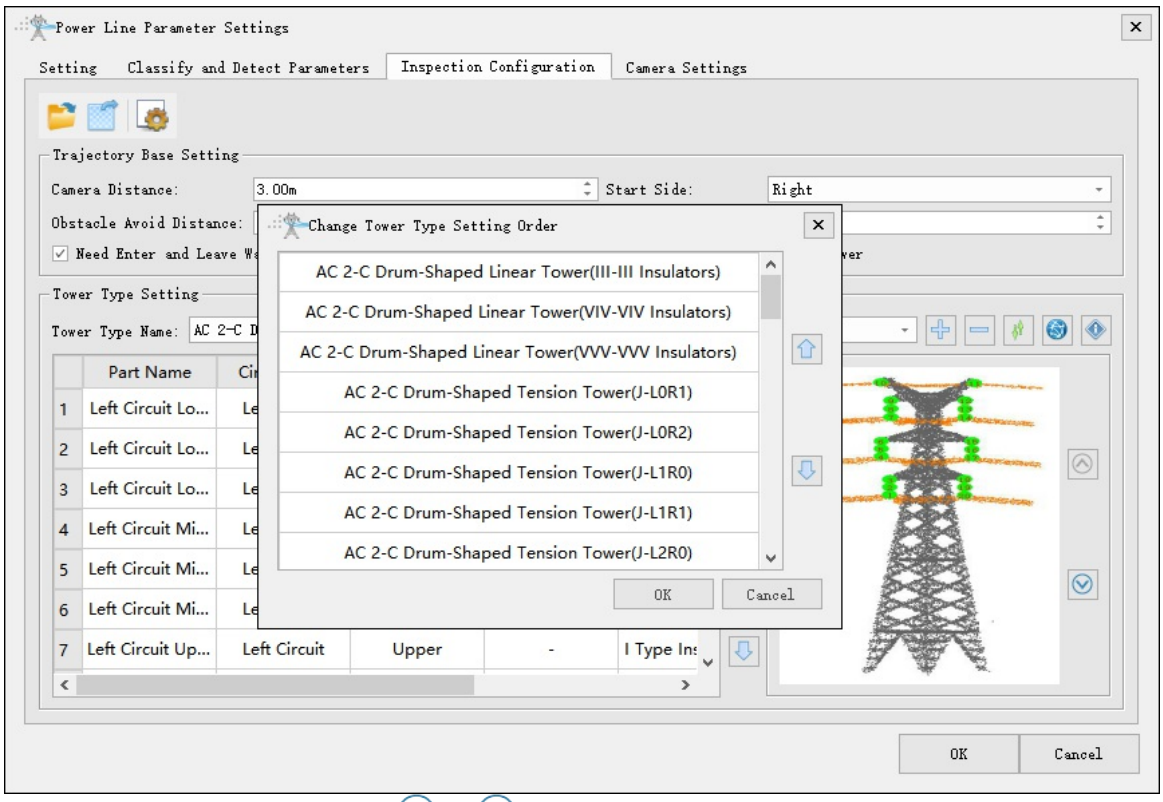


- **Add New Setting Table**: If you do not find the configuration table of the tower type you need, you can click the plus sign on the right to customize and add a new tower configuration table, as shown below.

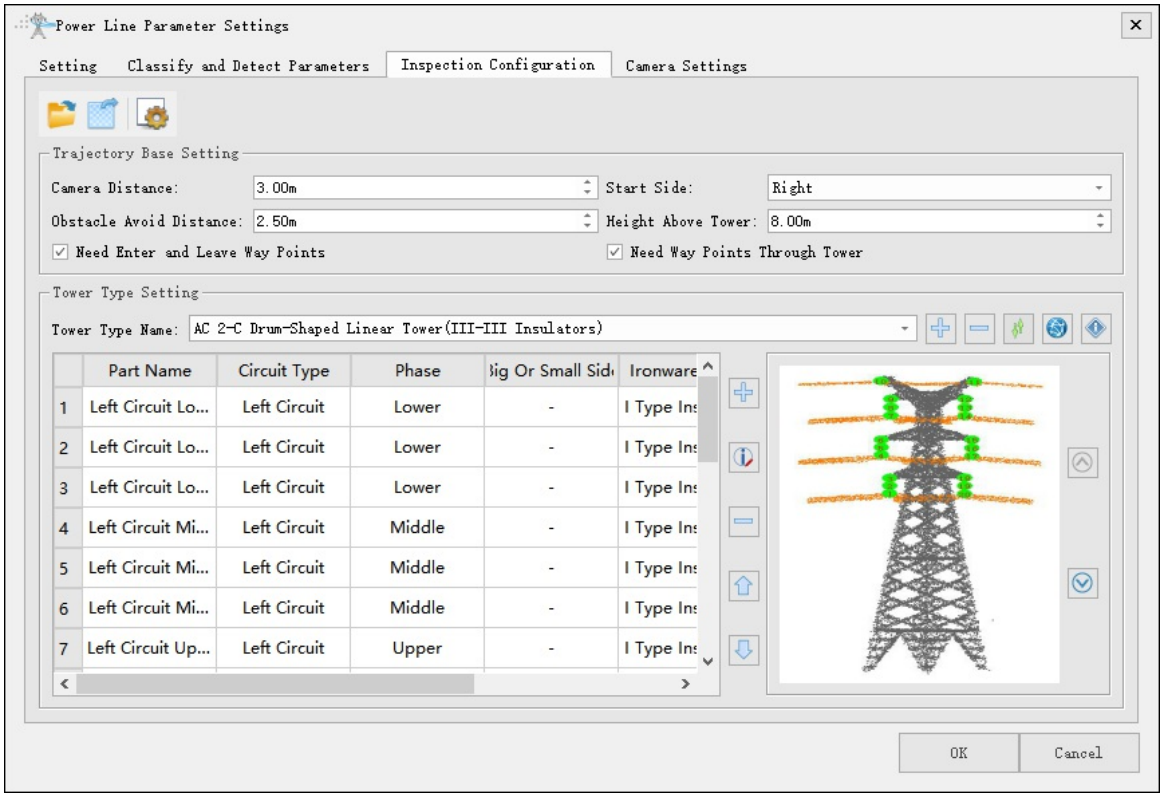


- **Delete Tower Type Setting**: Click the minus button to delete the tower type configuration.

- **Change Tower Type Setting Order**: Click the green arrow button to change the configuration order of the tower types.

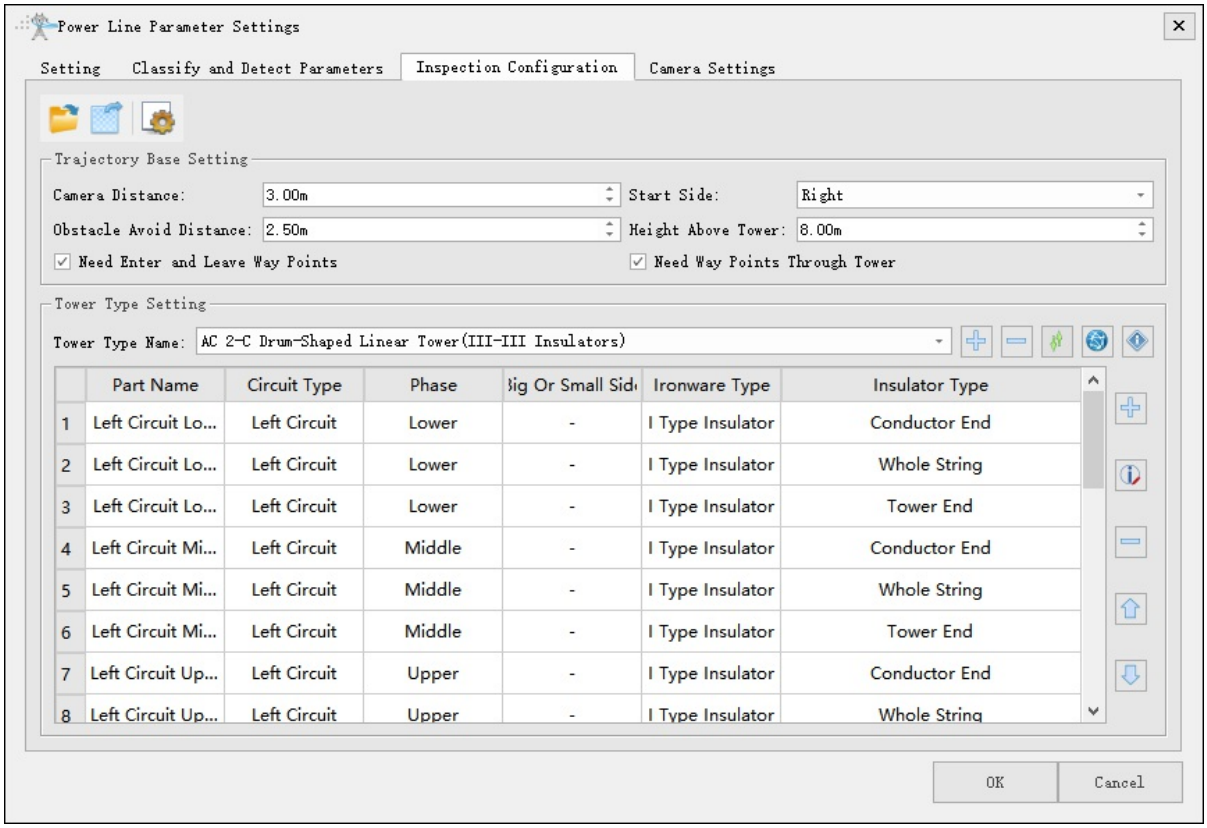


- **Preview**: Preview tower type image, and flip through images forward and backward.

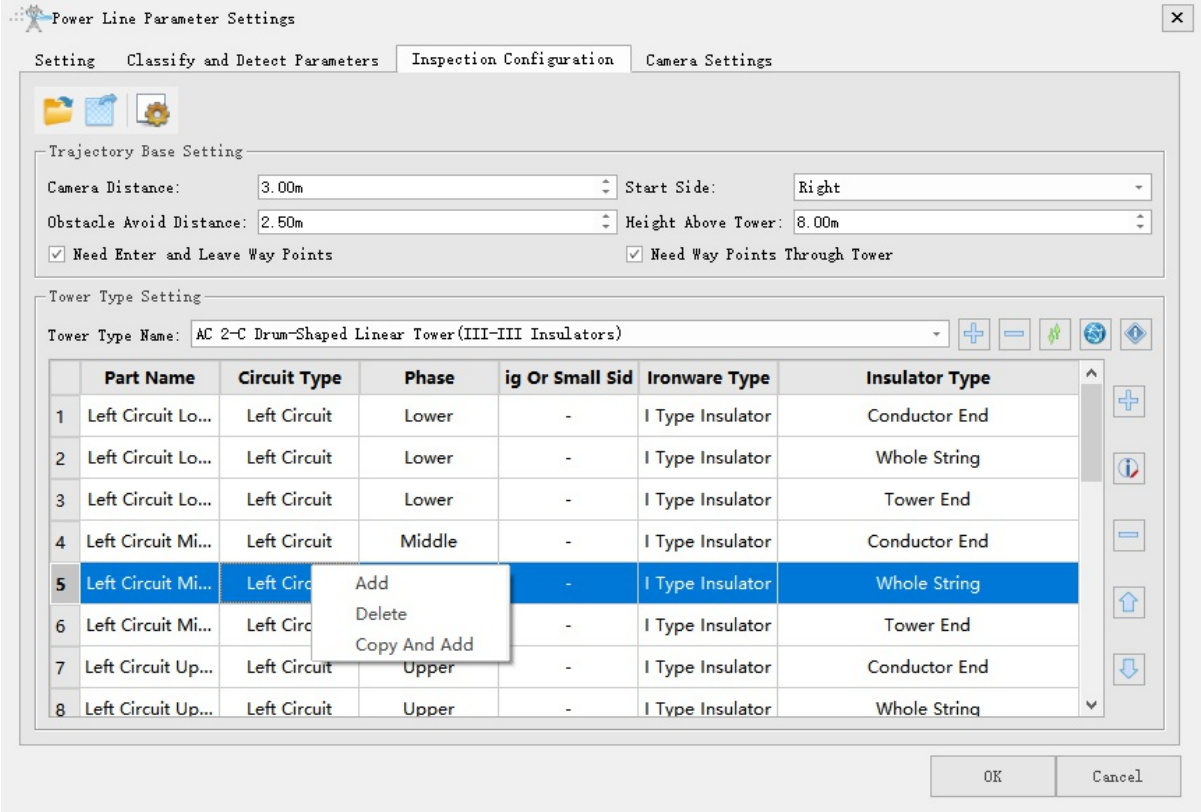


- **Part Name List Editing**: The control buttons on the right side provide comprehensive part point management capabilities: the plus sign enables adding new part points, the modify button allows editing existing points, and the minus sign facilitates point deletion. Additionally, the up and down arrows enable

users to adjust the sequential order of the part points as needed.

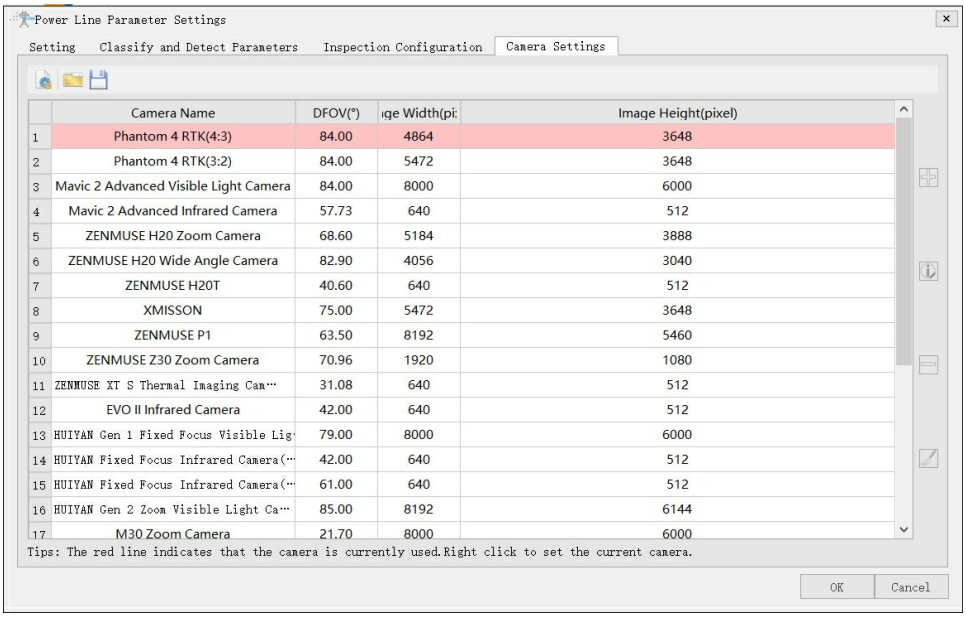


- **Add Part Point**: Add a new part point.
- **Delete Part Point**: Delete the selected part point.
- **Modify Part Point**: Can adjust the name, phase sequence, big/small side, hardware type, and insulator type of the part point.
- **Move Up**: Move the selected part point up (requires continuous selection) to adjust the order of part points.
- **Move Down**: Move the selected part point down (requires continuous selection) to adjust the order of part points.
- **Right Click**: Can add, delete, copy and add part points.



Camera Settings

Multiple types of UAV gimbal cameras are provided by default in the camera settings. The red row indicates the currently used camera, and the right-click button can be used to set the current camera.




Load default settings.

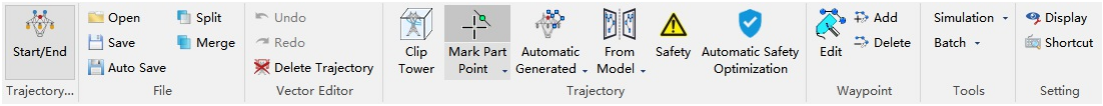

Open the camera configuration file.

 Save the camera configuration file.

Fine Inspection

Summary

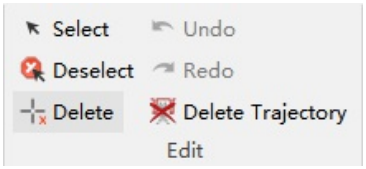
Click "Start/End" button, Expand the trajectory planning related function menu, including "File", "Vector Editing", "Trajectory", "Waypoint", "Tools and Setting", as shown below.



- File Menu
- Vector Editing
- Trajectory Menu
- Trajectory Point Operation
- Tools
- Setting

Edit Operation

The substation inspection edit menu is shown in the figure below, including Select, Unselect, Delete, Undo, Redo, and Delete Trajectory functions.



Select

After selecting the function button, trajectory and part point can be selected within the view window.

Deselect

Deselect selected trajectory and part point.

Delete

Delete selected trajectory and part point.

Undo

Undo the previous operation.

Redo

Restore the previous operation.

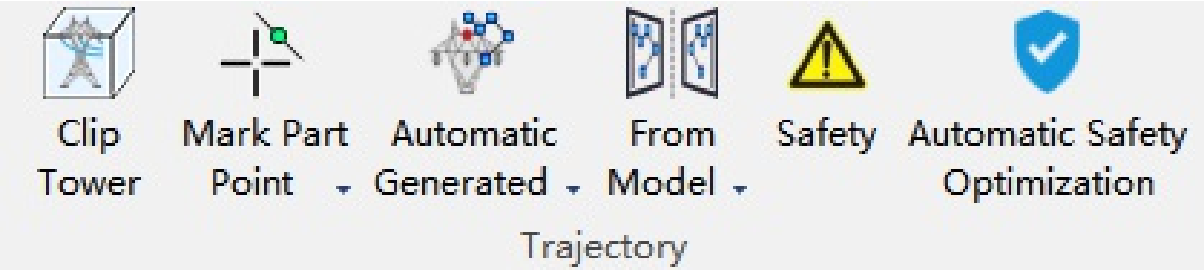
Delete Trajectory

Delete the trajectory in the current scene.

Fine Inspection

Summary

The fine inspection menu is as shown in the following figure, including Clip Tower, Mark Part Point, Automatic Generated, Generate Trajectory Model, Generate Trajectory On Model, Safety and Automatic Safety Optimization.

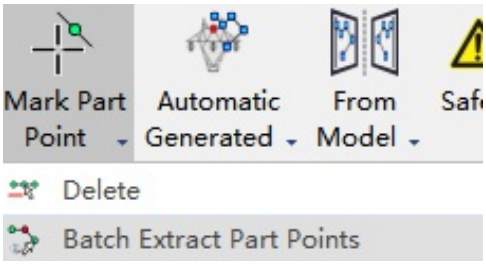


- Clip Tower
- Mark Part Point
- Generate Trajectory
- Generate Trajectory Model
- Generate Trajectory on Model
- Safety Analysis
- Automatic Safety Optimization

Mark Part Point

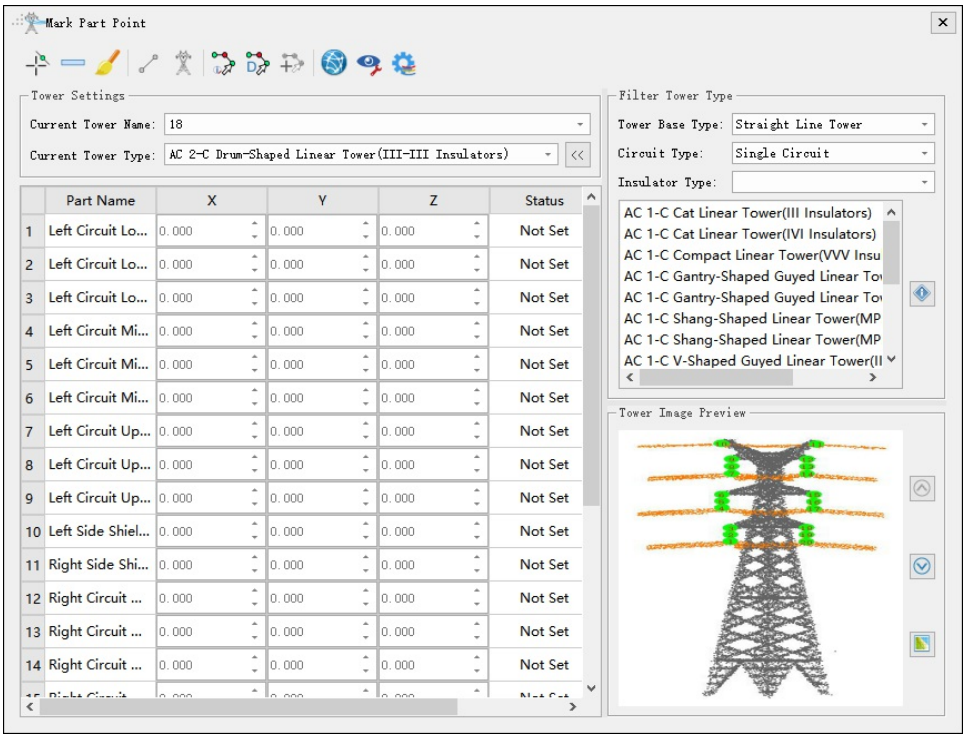
Summary

The generating trajectory menu is as shown in the following figure. This module includes Mark Part Point, Delete Part Point and Batch Extract Part Points.



Mark Part Point

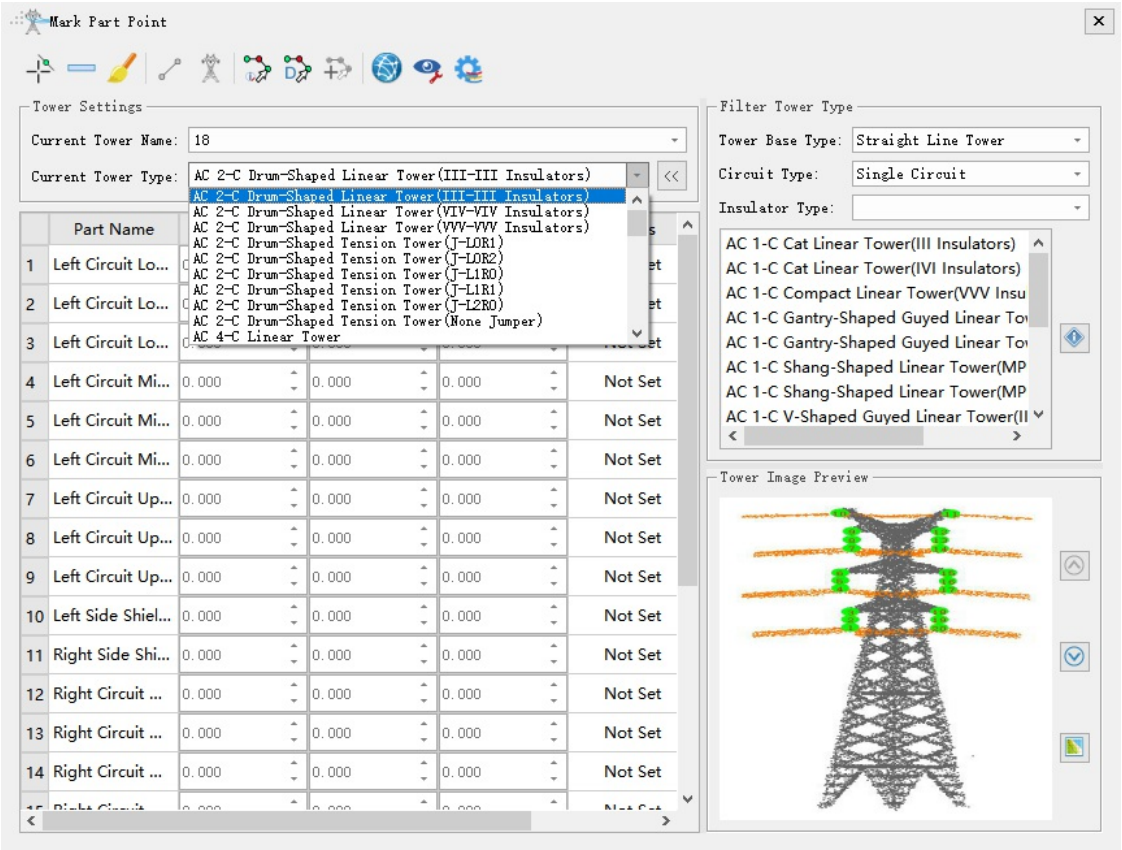
The part point menu of fine inspection is shown in the following figure,including marking part point, deleting part point, clearing part point, extracting part points by line, tower and channel point recognition, main network part point recognition(conditional), main network part point recognition(deep learning), channel perspective, automatic waypoint generation, hide XYZ columns and classification Setting.



> Note: Before marking part points, it is necessary to mark tower and set the tower type.

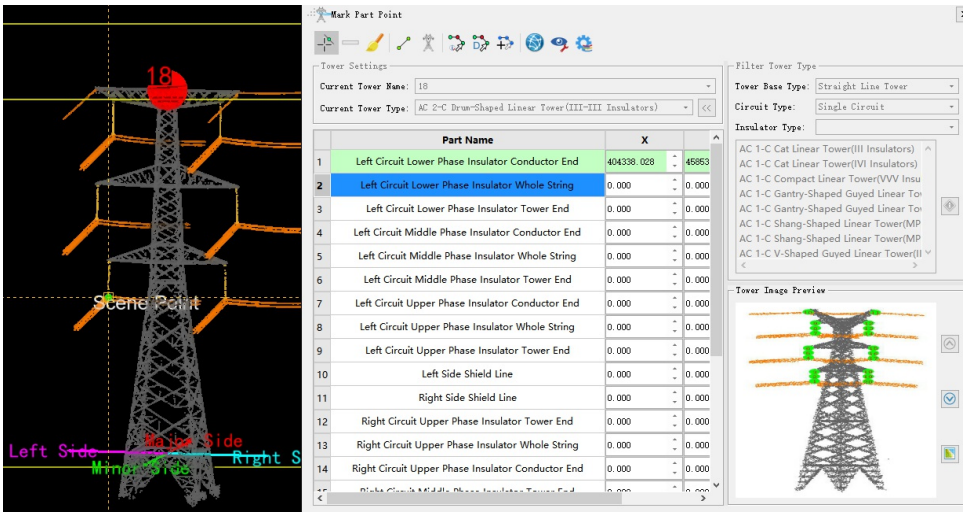
Tower Settings

The list of tower types is shown below. There are 43 kinds of conventional tower types built into the software. If you need to add other tower types, add them in Project Configuration->Inspection Configuration.



Mark Part Point

After selecting the tower type, there will be a corresponding list of part point. Select the corresponding part point on the point cloud according to the order of the list. The status of marked part point is "Has Been Set", and the status of unmarked part point is "Not Set". If there are part points that do not need to be marked, you can skip them directly and select the following part point for marking. After marking all part points, click the marking button again to finish the marking function. The list of part point and the results of part point marking are shown in the following figure.



Delete Part Point

Select the part points in the list and click the button to delete them.

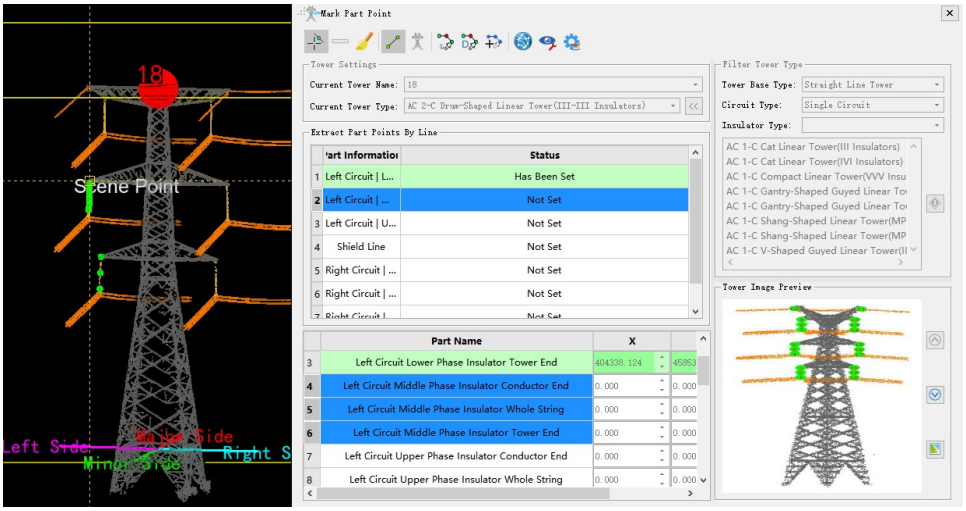
Select the part points in the list and click the button to delete them.

Clear

Click the button to clear all marked part points.

Extract Part Points by Line

For insulators and shield lines conforming to configuration specifications, support extracting part point positions by line and automatically matching the corresponding part names.



Tower and Channel Point Recognition

Automatically recognize the five tower points and channel points.

Main Network Part Point Recognition(Conditional)

For the main network tower, based on the classified point cloud and tower configuration information, a conditional method is used to automatically extract part points.

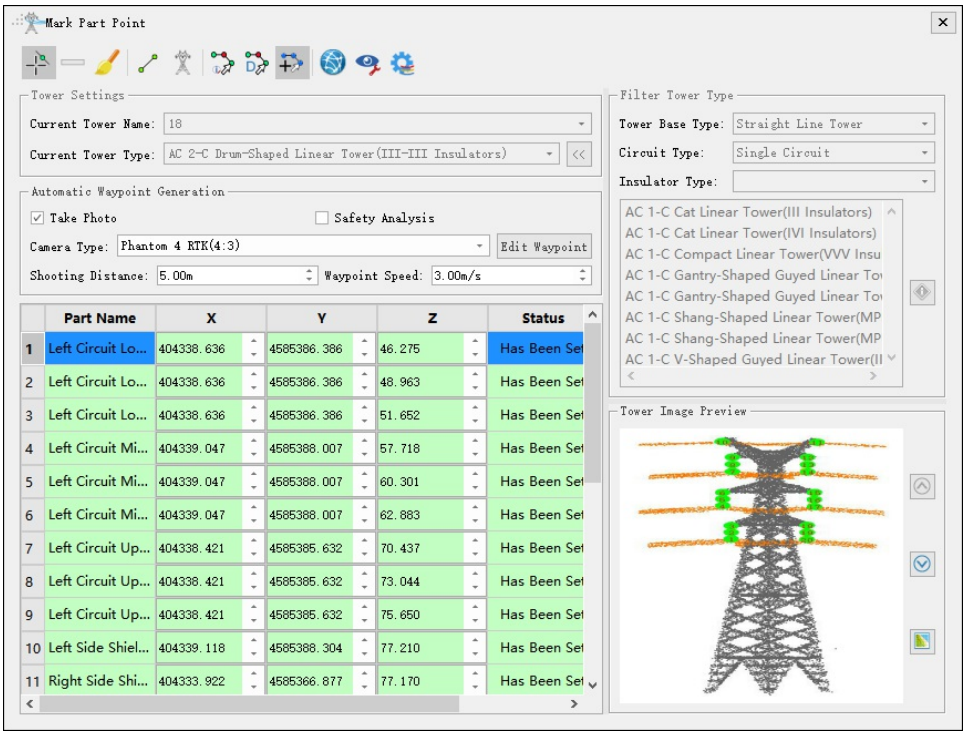
Main Network Part Point Recognition(Deep Learning)

For the main network tower, based on the classified point cloud and tower configuration information, deep learning method is used to automatically extract part points.

Automatic Waypoint Generation

After clicking the button, corresponding waypoints will be automatically generated when generating part

After clicking the button, corresponding waypoints will be automatically generated when generating part point.



- **Take Photo(Checked by default)**: If checked, the waypoint will include photo information.
- **Safety Analysis(Unchecked by default)**: If checked, the safety of the trajectory will be analyzed.
- **Camera Type**: Set current camera type. The current camera type is set by default through Project Configuration->Camera Settings.
- **Edit Waypoint**: Switch to edit waypoint function.
- **Shooting Distance(m)(default value is "5.0")**: Set the distance from the waypoint to the part point.
- **Waypoint Speed(m/s)(default value is "3.0")**: Set the waypoint speed.

Channel Perspective

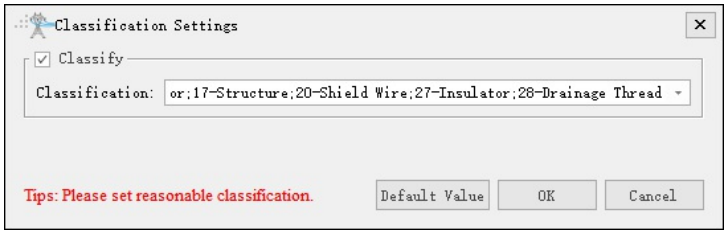
Click the button to display the tower from the perspective of the channel.

Hide XYZ Columns

If checked, hide the XYZ columns of the table; If unchecked, display the XYZ columns of the table.

Classification Setting

Set appropriate parameters for point cloud classification for the part point recognition of main network tower.



Filter Tower Type

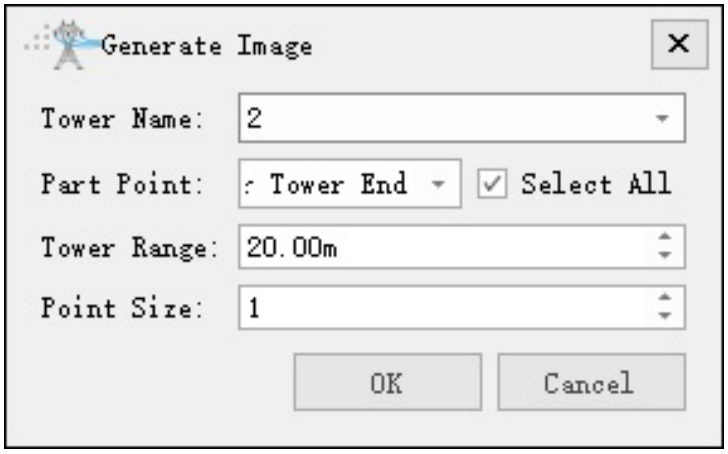
Filter tower types based on tower base type, circuit type, and insulator type. You can also use the auto-recommend tower type feature based on the selected tower. If you click ">>", the filter tower type window will be displayed; if you click "<<", the filter tower type window will be hidden.

Tower Image Preview

Display a preview image of the corresponding current tower type. If clicked ">>", the tower image preview dialog box will be displayed; If clicked "<<", hide the tower type image preview dialog box. and flip through images forward and backward.

Generate Image

Generate tower preview images based on tower point cloud and "Has Been Set" part point.



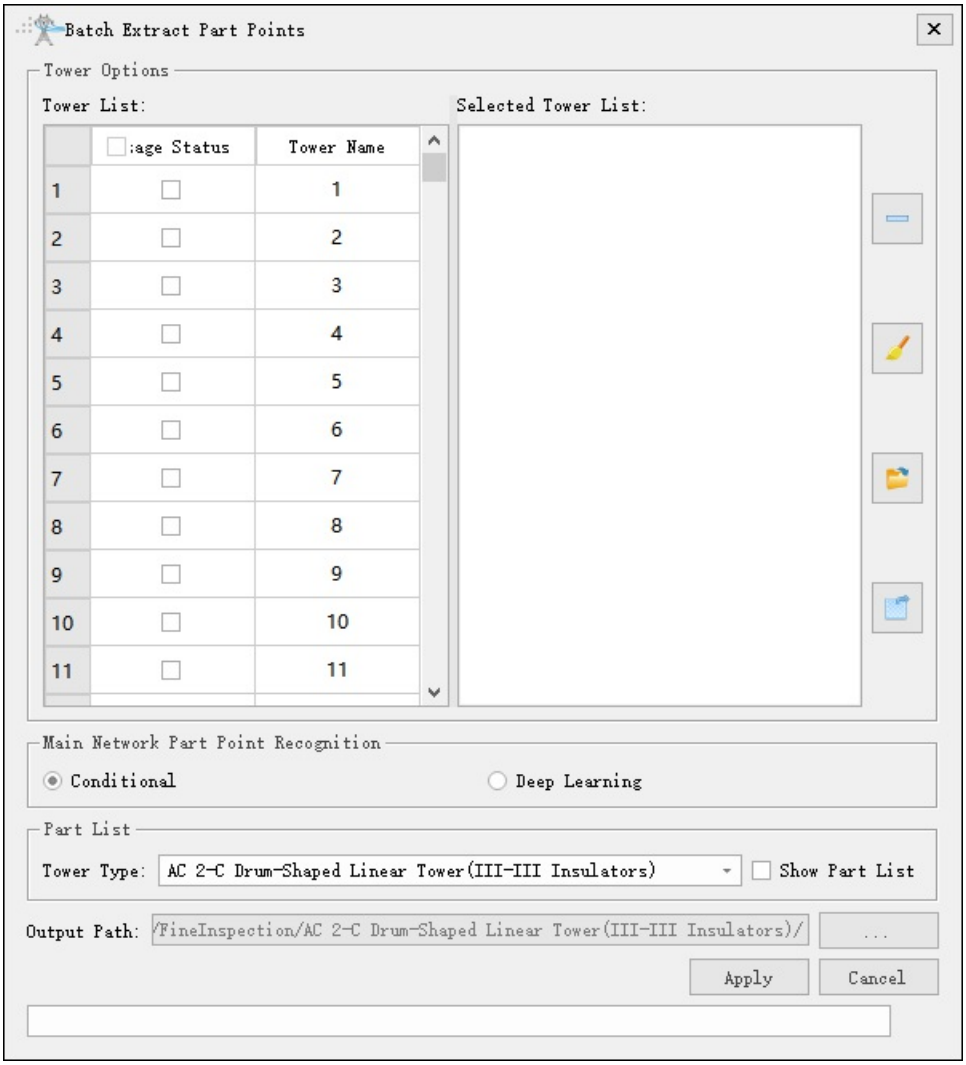
- **Tower Name**: Select the current tower name.
- **Part Point**: Check the part points that need to generate image information.
- **Select All**: Check or uncheck all part points.
- **Tower Range(m)(default value is "20.0")**: Set the extraction point cloud range for the current tower. By adjusting the range, fully display the tower and part points.
- **Point Size(default value is "1")**: Set the size of a single point in the point cloud in the image.

Delete Part Point

Delete part points in the scene.

Batch Extract Part Points

For selected towers, automatically extract part points in batches based on tower types and generate corresponding files.



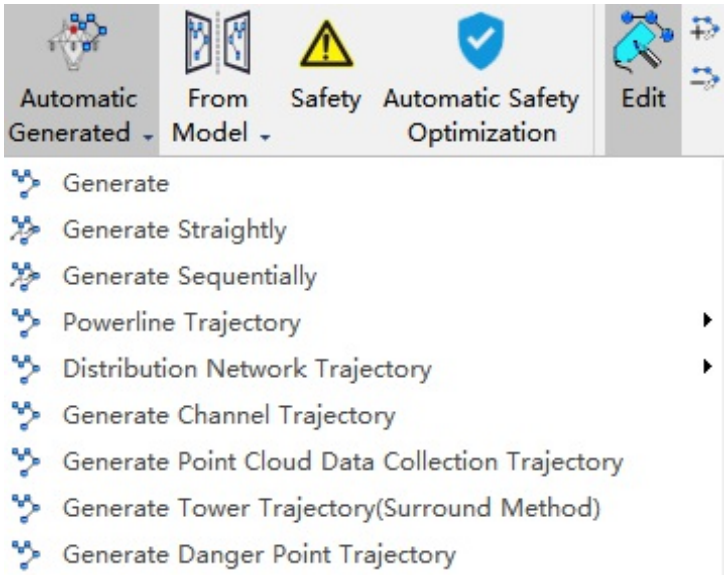
- **Tower Options**
  - **Tower List**: Supports checking, double-clicking, and right-clicking to check selected items. Checked towers will be added to the selected tower list, and double-clicking can locate the tower in the scene.
  - **Selected Tower List**: Displays the list of selected towers, supporting delete, clear, export tower files, and import tower files.
- **Main Network Part Point Recognition**
  - **Conditional**: Automatically extract part points using conditional method based on classified point cloud and tower configuration information.
  - **Deep Learning**: Automatically recognize part points using deep learning based on classified point cloud and tower configuration information.
- **Part List**
  - **Tower Type**: Specify tower type, the default output path automatically updates based on tower type.
  - **Show Part List**: Set whether to display the part list, unchecked by default. When checked, it displays the part list and supports selecting which parts to use.

- **Output Path**: Set the output path, defaults to creating a new tower type directory in fine inspection.

Generate Trajectory

Summary

The generating trajectory menu is as shown in the following figure:



Automatic Generation

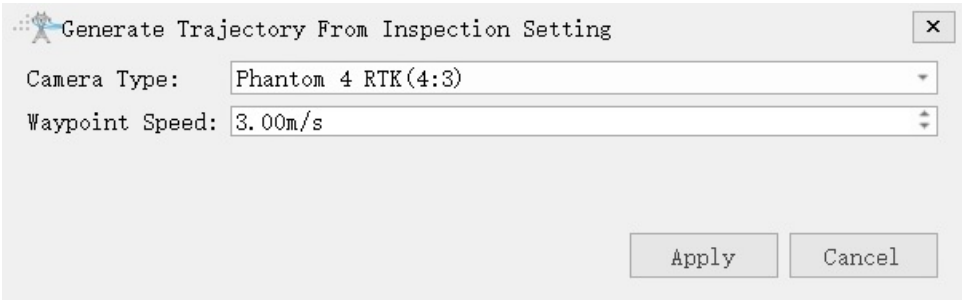


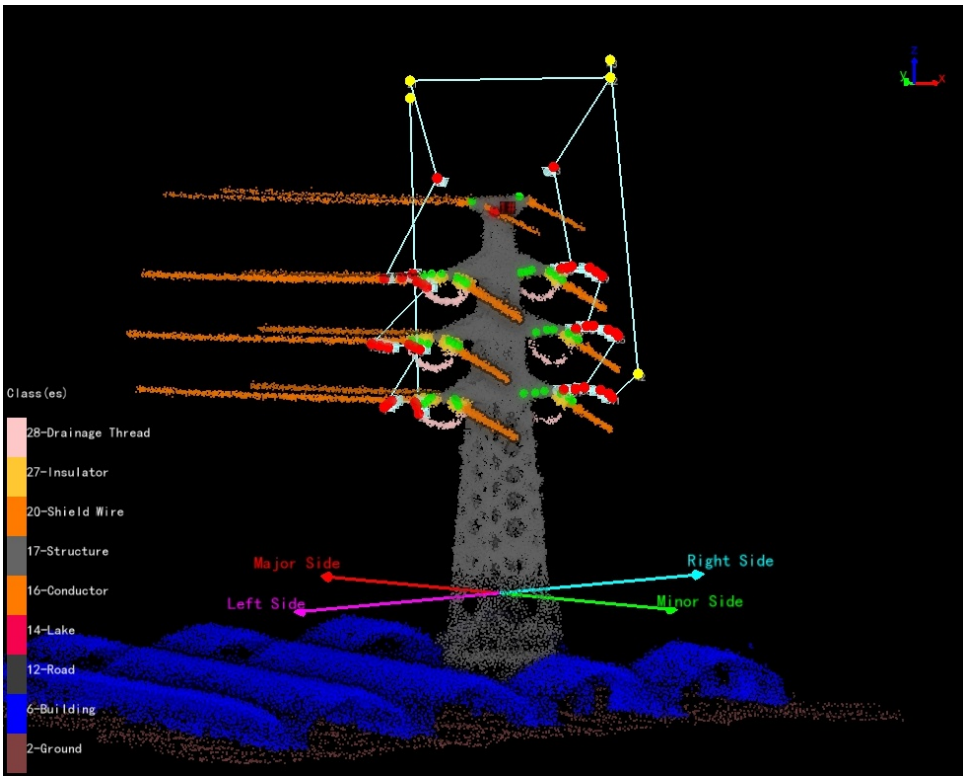
Automatic generation is to generate trajectory according to the inspection configuration. The drop-down menu also includes functions such as "Generate", "Generate Straightly", "Generate Sequentially", "Powerline Trajectory", "Distribution Network Trajectory", "Generate Channel Trajectory", "Generate Point Cloud Data Collection Trajectory", "Generate Tower Trajectory(Surround Method)", etc.

Automatic Generated



Automatically generate fine inspection trajectory for towers based on inspection configuration. After clicking the button, set the camera type and waypoint speed, and click "Apply" to automatically generate the trajectory.

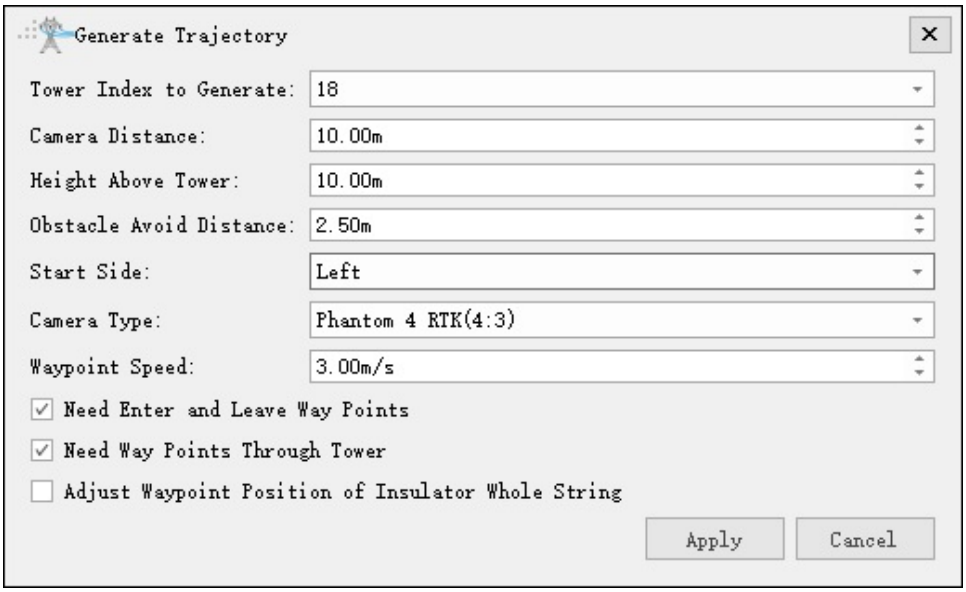




- **Camera Type**: Select camera type for taking photos. Add a new camera type in the camera configuration.
- **Waypoint Speed(m/s)(default value is "3.0")**: Set waypoint speed.

Generate

Automatically generated based on inspection configuration and shortest path principle.



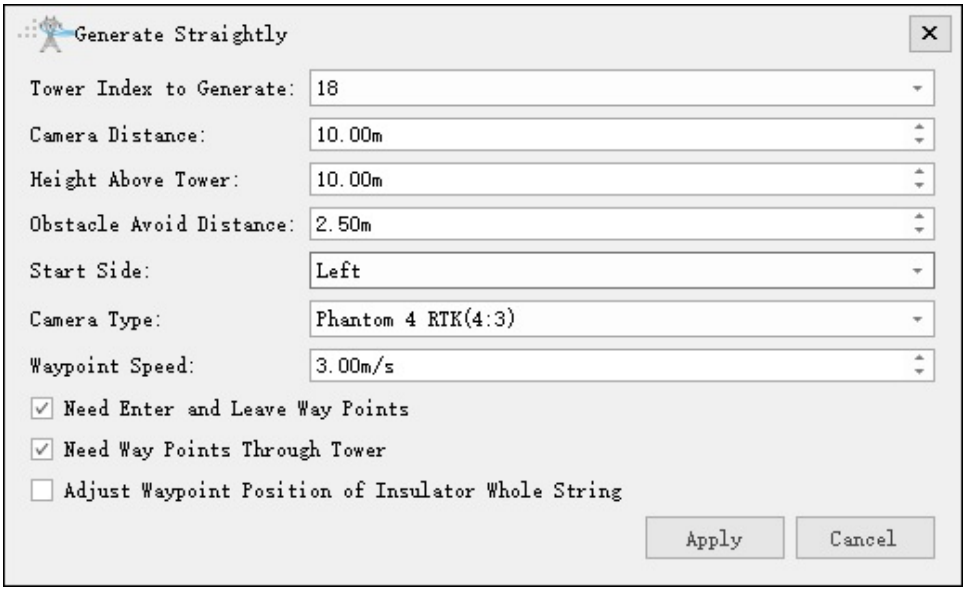
- **Tower Index to Generate**: The tower index needs to generate the trajectory.
- **Camera Distance(m)(default value is "10")**: The shooting distance from the waypoint to the part point.

- **Height Above Tower(m)(default value is "10")**: Height above tower.
- **Obstacle Avoid Distance(m)(default value is "2.5")**: Distance for obstacle avoidance detection.
- **Start Side(default value is "Left")**: Waypoint shooting starting side.
- **Camera Type**: Select camera type for taking photos. Add a new camera type in the camera configuration.
- **Waypoint Speed(m/s)(default value is "3.0")**: Set waypoint speed.
- **Need Enter and Leave Way Points(Checked by default)**: Add two auxiliary points for exiting the tower and entering the tower.
- **Need Way Points Through Tower(Checked by default)**: Add auxiliary points for passing the tower.
- **Adjust Waypoint Position of Insulator Whole String**: Not checked by default. If checked adjust the waypoint position of the whole insulator string according to the camera field of view.

Generate Straightly



Generate flight trajectories directly by connecting parts points in order. There may be a possibility of the trajectory passing through the tower, and auxiliary waypoints need to be manually added.

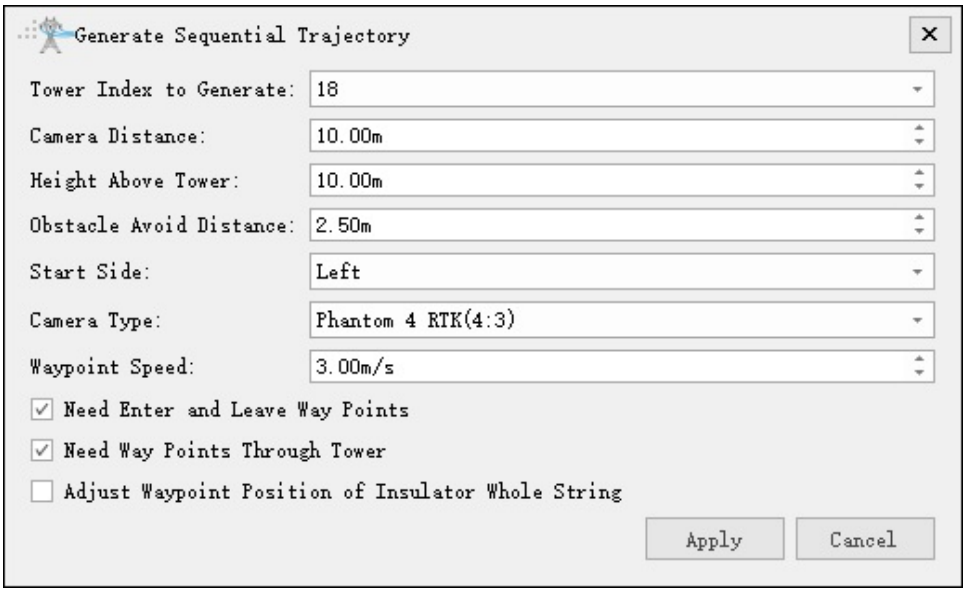


- **Tower Index to Generate**: The tower index needs to generate the trajectory.
- **Camera Distance(m)(default value is "10")**: The shooting distance from the waypoint to the part point.
- **Height Above Tower(m)(default value is "10")**: Height above tower.
- **Obstacle Avoid Distance(m)(default value is "2.5")**: Distance for obstacle avoidance detection.
- **Start Side(default is "Left")**: Waypoint shooting starting side.
- **Camera Type**: Select camera type for taking photos. Add a new camera type in the camera configuration.
- **Waypoint Speed(m/s)(default value is "3.0")**: Set waypoint speed.
- **Need Enter and Leave Way Points(Checked by default)**: Add two auxiliary points for exiting the tower and entering the tower.
- **Need Way Points Through Tower(Checked by default)**: Add auxiliary points for passing the tower.
- **Adjust Waypoint Position of Insulator Whole String**: Not checked by default. If checked adjust the waypoint position of the whole insulator string according to the camera field of view.

Generate Sequentially



Automatically generate trajectory based on inspection configuration and part point order.

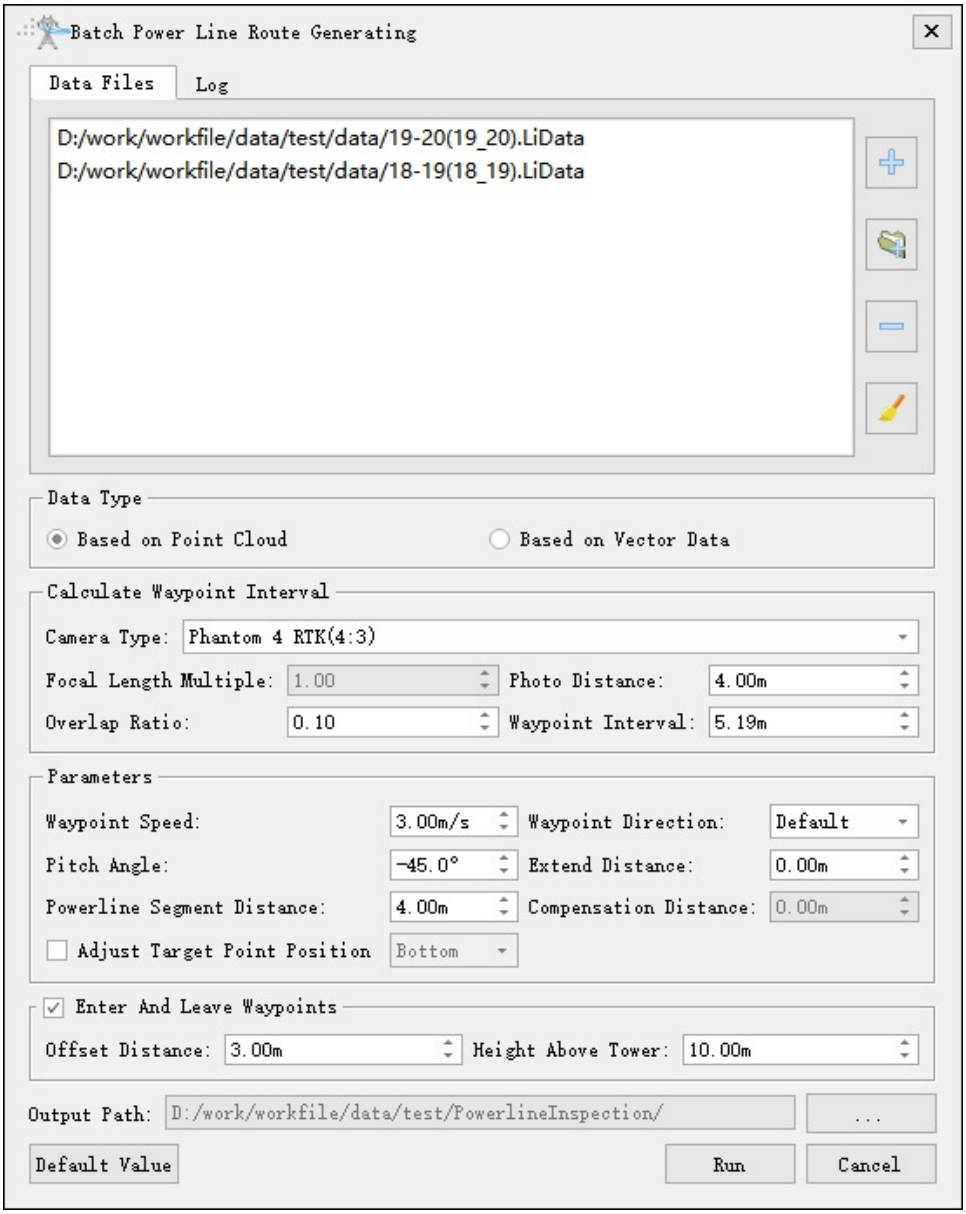


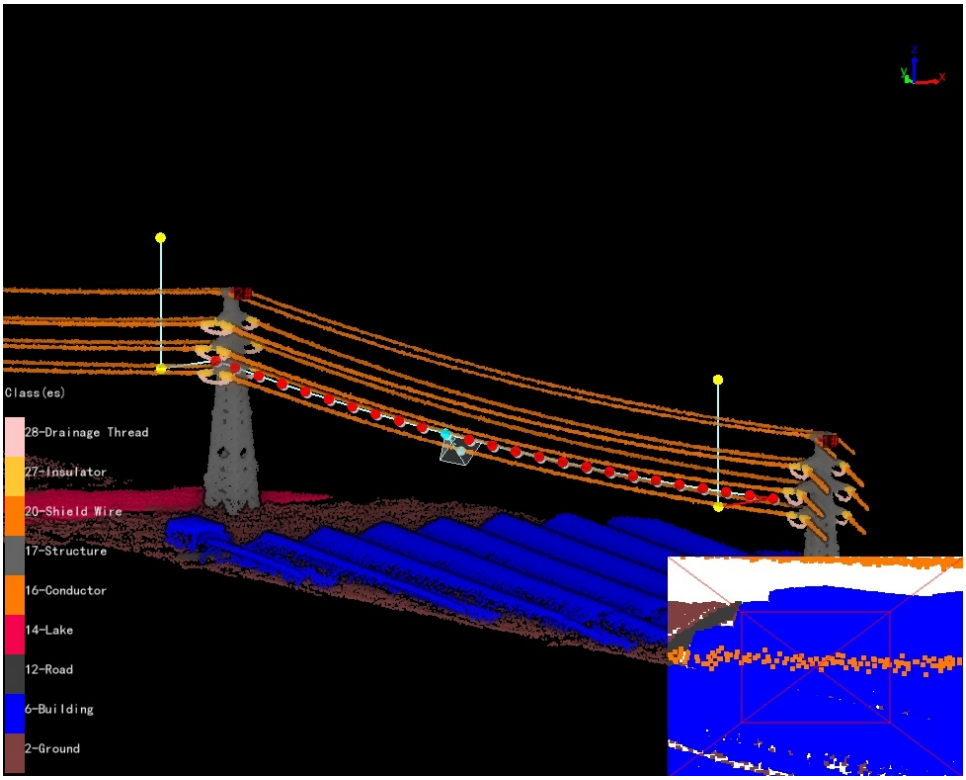
- **Tower Index to Generate**: The tower index needs to generate the trajectory.
- **Camera Distance(m)(default value is "10")**: The shooting distance from the waypoint to the part point.
- **Height Above Tower(m)(default value is "10")**: Height above tower.
- **Obstacle Avoid Distance(m)(default value is "2.5")**: Distance for obstacle avoidance detection.
- **Start Side(default is "Left")**: Waypoint shooting starting side.
- **Camera Type**: Select camera type for taking photos. Add a new camera type in the camera configuration.
- **Waypoint Speed(m/s)(default value is "3.0")**: Set waypoint speed.
- **Need Enter and Leave Way Points(Checked by default)**: Add two auxiliary points for exiting the tower and entering the tower.
- **Need Way Points Through Tower(Checked by default)**: Add auxiliary points for passing the tower.
- **Adjust Waypoint Position of Insulator Whole String**: Not checked by default. If checked adjust the waypoint position of the whole insulator string according to the camera field of view.

Batch Power Line Trajectory Generating



Batch generation of power line inspection trajectory(Add point cloud data or vector data to generate trajectory in batches).


Batch Power Line Route Generating
Data Files
Log
D:/work/workfile/data/test/data/19-20(19_20).LiData
D:/work/workfile/data/test/data/18-19(18_19).LiData
Data Type
Based on Point Cloud
Based on Vector Data
Calculate Waypoint Interval
Camera Type: Phantom 4 RTK(4:3)
Focal Length Multiple: 1.00
Photo Distance: 4.00m
Overlap Ratio: 0.10
Waypoint Interval: 5.19m
Parameters
Waypoint Speed: 3.00m/s
Waypoint Direction: Default
Pitch Angle: -45.0°
Extend Distance: 0.00m
Powerline Segment Distance: 4.00m
Compensation Distance: 0.00m
Adjust Target Point Position
Bottom
Enter And Leave Waypoints
Offset Distance: 3.00m
Height Above Tower: 10.00m
Output Path: D:/work/workfile/data/test/PowerlineInspection/
...
Default Value
Run
Cancel



- **Data Type**:
  - **Based on Point Cloud**: Generating trajectory based on point cloud.
  - **Based on Vector Data**: Generating trajectory based on vector data.
- **Calculate Waypoint Interval**:
  - **Camera Type**: Select camera type for taking photos. Add a new camera type in the camera configuration.
  - **Focal length multiple**: Set the focal length multiple.
  - **Photo Distance(m)(default value is "4.0")**: Set the photo distance.
  - **Overlap Ratio(default value is "0.1")**: Set the overlap ratio of adjacent photos.
  - **Waypoint Interval(m)(default value is "0.5")**: Set the distance between the waypoints and perform the safety inspection between the waypoints. Automatically calculate waypoint Interval when adjusting camera type, focal length multiple, photo distance, and overlap ratio.
- **Parameters**:
  - **Waypoint Speed(m/s)(default value is "3.0")**: Set waypoint speed.
  - **Waypoint Direction**: Set the position of the waypoint relative to the power line. When selecting "Default", the waypoint of the left phase is on the left side of power line, and the waypoint of the right phase is on the right side of power line. When selecting "Left Side", the waypoint is located on the left side of the power line; when selecting "Right Side", the waypoint is located on the right side of the power line.
  - **Pitch Angle(°)(default value is "-45.0")**: Set the pitch angle of the shooting waypoint.
  - **Extend Distance(m)(default value is "0.0")**: Set the extend distance. The starting and ending positions of the trajectory extend on both sides of the power line channel direction.
    - **Powerline Segment Distance(m)(default value is "4.0")**: Set the clustering threshold and cluster the point cloud points.Only used for point cloud data.
  - **Compensation Distance(m)(default value is "0.0")**: Set compensation distance. The vector line is located at the bottom of the power line point data. Used to compensate for the distance between vector lines and point clouds.Only used for vector data.
  - **Adjust Target Point Position**: Adjust the position of the target point. Based on the classified point cloud

data near the target point, fine-tune the target point's position on the power line. This function requires the point cloud to be classified first and is only applicable to position adjustments within a small range.

- **Enter And Leave Way Points**: Add two auxiliary points for entering the tower and leaving the tower.
  - **Offset Distance(m)(default value is "3.0")**: Set horizontal offset distance.
  - **Height Above Tower(m)(default value is "10.0")**: Set height above tower.
- **Output Path**: Set the output path of the trajectory.
- **Default Value**: Click "Default Value" to restore the initial parameters.
- **Run**: Click "Run" to start the calculation.

Batch Adjust Pitch Angle



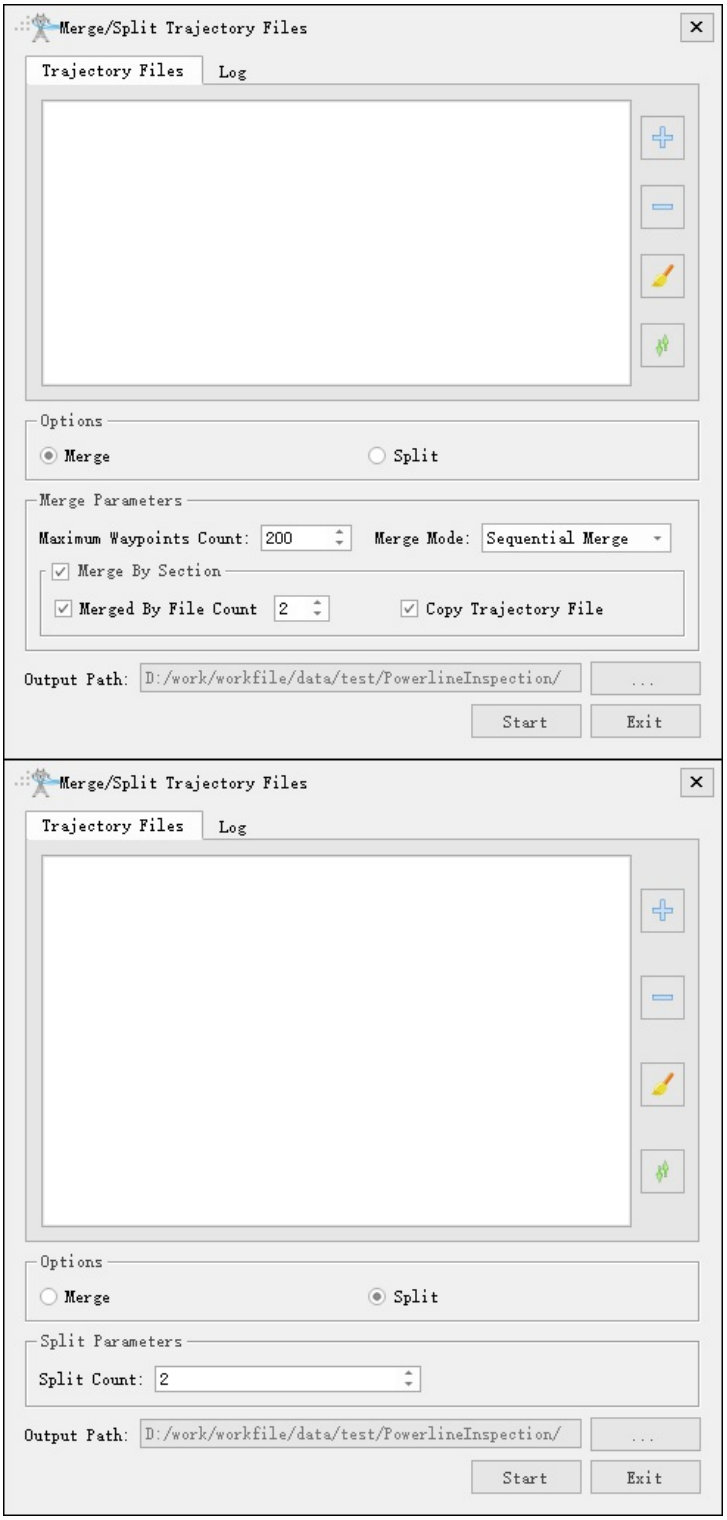
Batch adjust the pitch angles of other waypoints based on the selected waypoint and the first and last waypoints.



Merge/Split Trajectory Files



Merge and split shield wire and power line trajectory.



- **Option**: Check the "Merge" and "Split" options.
- **Merge Parameters**: Customize the maximum count of waypoints based on the maximum waypoints supported by the UAV. The merge mode supports two types: sequential merge and interval reverse merge. The merging function by section supports merging by the number of files. For example, if set to 2, two trajectories can be merged, and the waypoint count of merged trajectory cannot exceed the maximum count. If it exceeds, the merge will be abandoned. If "Copy Trajectory File" is checked, copy and output trajectory that do not meet the merging requirements.
- **Split Parameters**: Default 2, customizable.

- **Output Path**: Specify the path to save the file results.

Generate Distribution Network Trajectory

Generate Distribution Network Trajectory Model

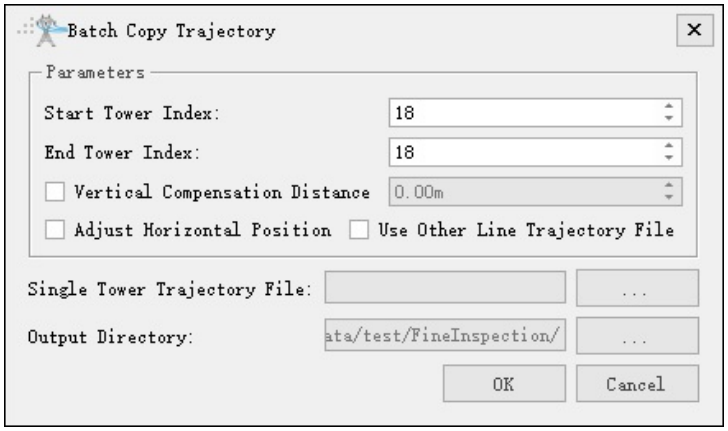
Generate Distribution Network Trajectory From Model

Generate Distribution Network Trajectory Model

Generate Distribution Network Tower Trajectory(Surround Method)

Batch Copy Trajectory

Based on the existing single tower trajectory file, batch copy to other towers and generate corresponding trajectory files.



- **Parameters**
  - **Start Tower Index**: Set the starting tower index.
  - **End Tower Index**: Set the ending tower index.
  - **Vertical Compensation Distance(m)**: Sets the vertical compensation distance; this option is unchecked by default. When checked, the vertical compensation distance can be configured.
  - **Adjust Horizontal Position**: Sets whether to adjust the horizontal position.
  - **Use Other Line Trajectory File**: Sets whether to use trajectory files for other lines. If the selected "Single Tower trajectory File" does not belong to the current line, check this option and specify the corresponding LiTower-format tower file. Otherwise, leave it unchecked.
- **Single Tower Trajectory File**: Select an existing single tower trajectory file.
- **Output Directory**: Select output directory.

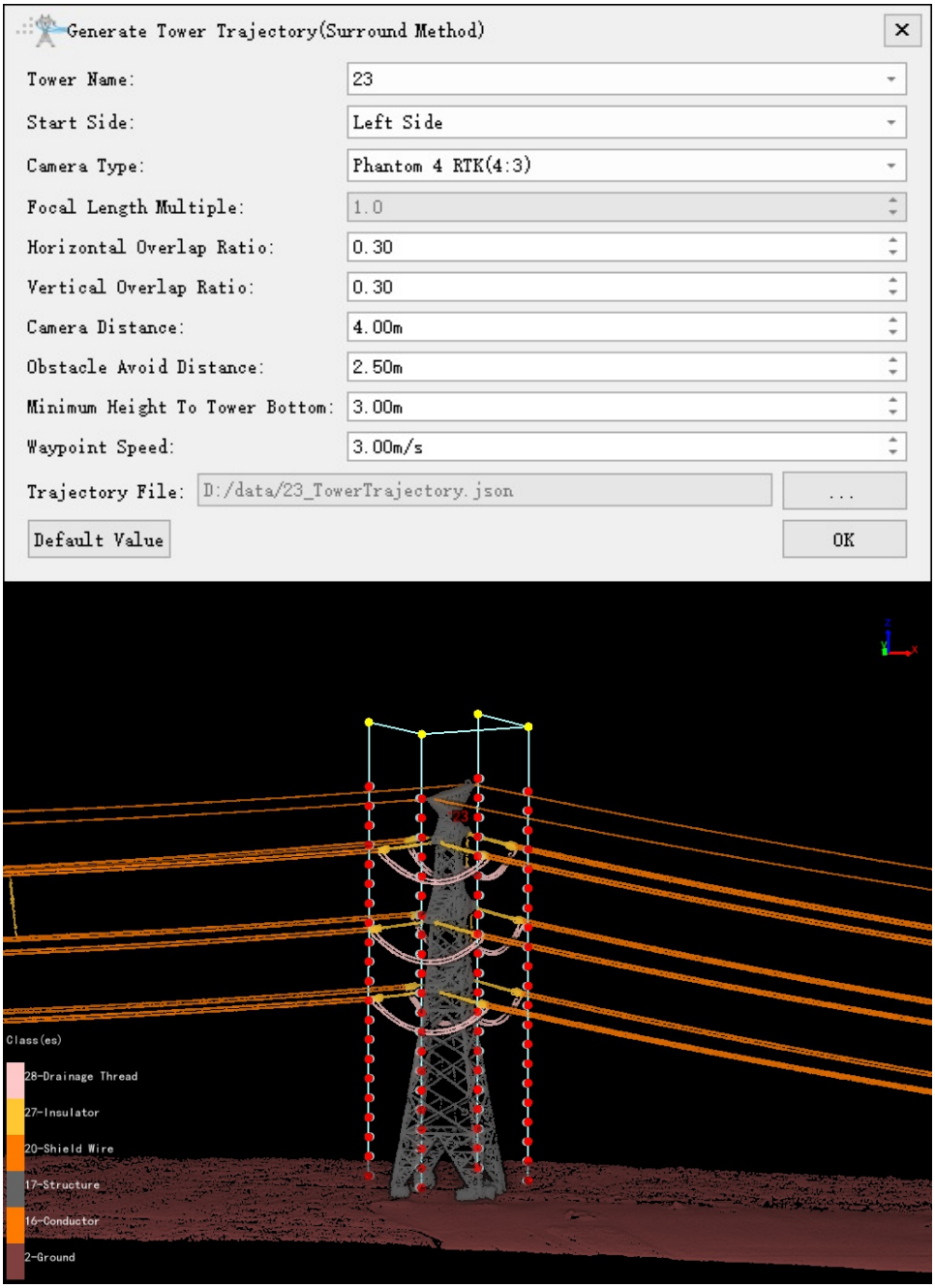
Generate Channel Trajectory

Generate Point Cloud Data Collection Trajectory

Generate Tower Trajectory(Surround Method)

Automatically generate a panoramic shooting trajectory for the tower. The waypoints are located on the

Automatically generate a panoramic shooting trajectory for the tower. The waypoints are located on the front, back, left, and right sides of the tower, and the number of waypoints on each side is determined by the vertical overlap rate. Each waypoint can take multiple photos, and the number of photos is determined by the horizontal overlap rate and camera type.



- **Tower Name**: Select the current tower name.
- **Start Side(default value is "Left Side")**: Waypoint shooting starting side.
- **Camera Type**: Select camera type for taking photos. Add a new camera type in the camera configuration.
- **Focal Length Multiple**: Set camera focal length.
- **Horizontal Overlap Ratio(default value is "0.3")**: The overlap rate of photos on the same side of the tower. It determines the number of photos on the current side.
- **Vertical Overlap Ratio(default value is "0.3")**: The overlap rate of waypoints on the same side of the

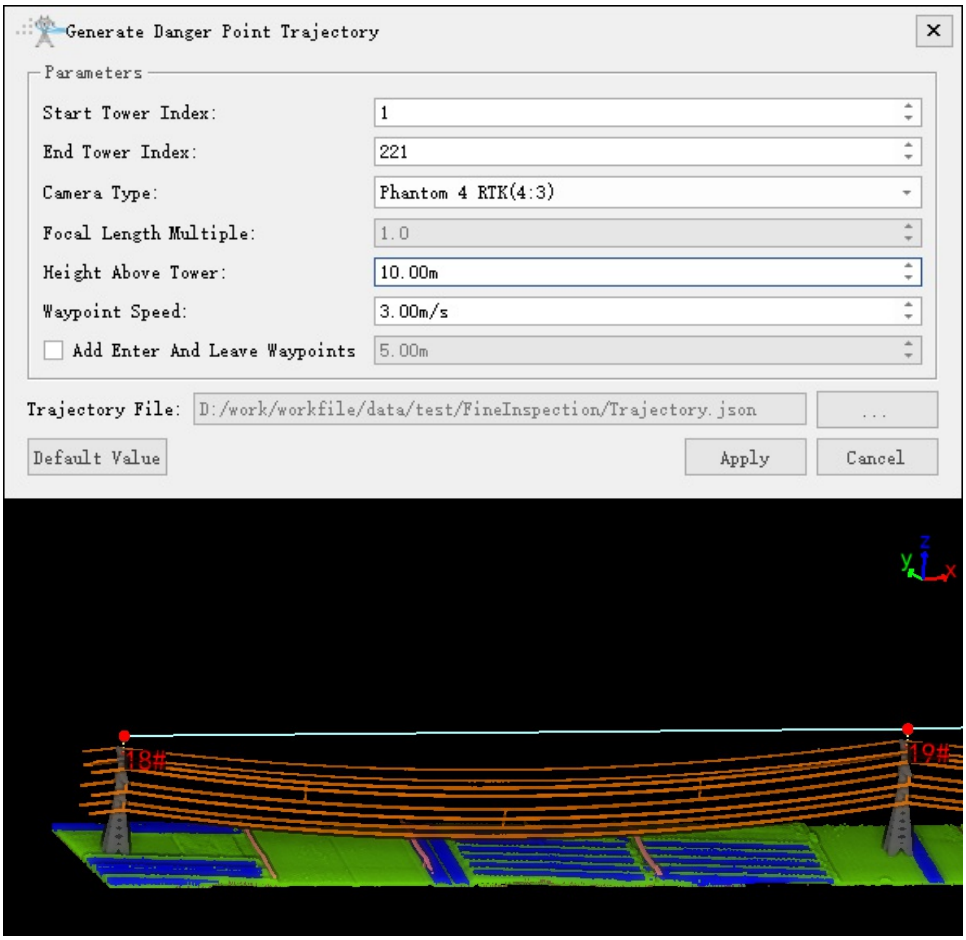
tower. It determines the number of waypoints on the current side.

- **Camera Distance(m)(default value is "4.0")**: The closest distance from the waypoint to the tower point cloud box.
- **Obstacle Avoid Distance(m)(default value is "2.5")**: Distance for obstacle avoidance detection.
- **Minimum Height To Tower Bottom(m)(default value is "3.0")**: Minimum height from waypoint to ground point.
- **Waypoint Speed(m/s)(default value is "3.0")**: Set waypoint speed.
- **Default Value**: Click "Default Value" to restore the initial parameters.

Generate Danger Point Trajectory



Generate an inspection trajectory above the danger points based on the danger point detection results.



- **Start Tower Index**: Set the starting tower index.
- **End Tower Index**: Set the ending tower index (including the current tower). Camera Type: Set the type of camera used for photography.
- **Camera Type**: Set the type of camera used for photography.
- **Focal Length Multiple**: Set the focal length multiple of the photography camera.
- **Height Above Tower(m)(default by "10.00")**: Set the waypoint height when passing the tower (relative to the tower marker point).
- **Waypoint Speed(m/s)(default by "3.00")**: Set the flight speed.
- **Add Tower Entry And Leave Points(m)(default by "5.00")**: When checked, add entry and leave points at the start and end of the tower.

Trajectory Model

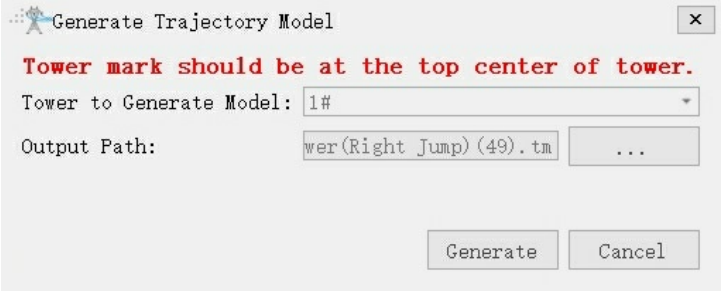
Summary



Select the planned trajectory, click "Generate Trajectory Model" from the drop-down menu, and click Generate. The file name will be named according to the tower types, the file format is .tm format. The default output path is the "FineInspection" folder. If there is no trajectory in the current scene, you can first use the "Generate Trajectory" or "Generate Special Trajectory" functions to create a trajectory before executing this function.

Usage

Click *Fine Inspection* > *Trajectory* > *Model*



Parameter Settings

- **Tower to Generate Model**: Select the tower to be used for generating the model. The dropdown list will only display tower names that already have generated trajectories. When there are no trajectories in the scene, the dropdown list will be empty, making it impossible to generate a trajectory model.

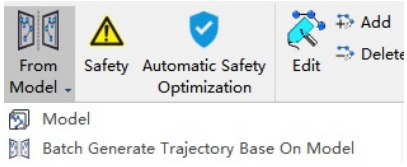
  > Note: For example, if user has selected part points and generated trajectories on towers 18 and 19 (using the "Generate Trajectory" or "Generate Special Trajectory" functions), then the dropdown list will contain 18 and 19. The user can choose either tower 18 or 19 as the trajectory model.

- **Output Path**: Select the path for generating the model. The default path is the "FineInspection" folder under the working directory, with the default name "TrajectoryModel.json".
- **Generate**: Click Generate, and the trajectory model will be saved to the output path in Json file format.

Generate Trajectory By Model

Summary

The generating trajectory on model menu is shown in the following figure, includes Generate Trajectory By Model, Batch Generate Trajectory Based On Model.



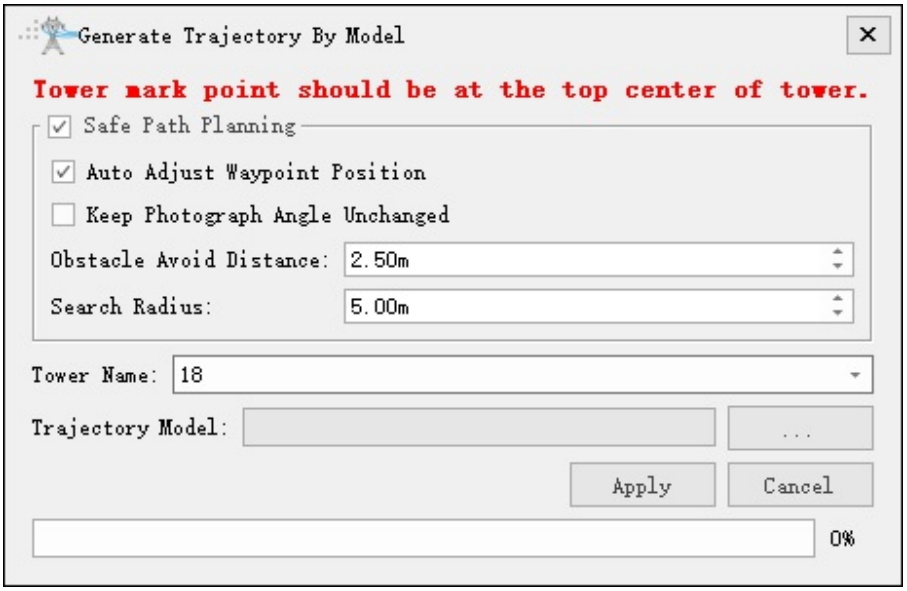
Generate Trajectory By Model



After generating the trajectory model, it is necessary to mark part points for towers that will use the model. All part points should be marked according to the inspection configuration of the same tower type, and the quantity and positions of these part points must remain consistent with the trajectory model.

Usage

Click *Fine Inspection* > *Trajectory* > *From Model*



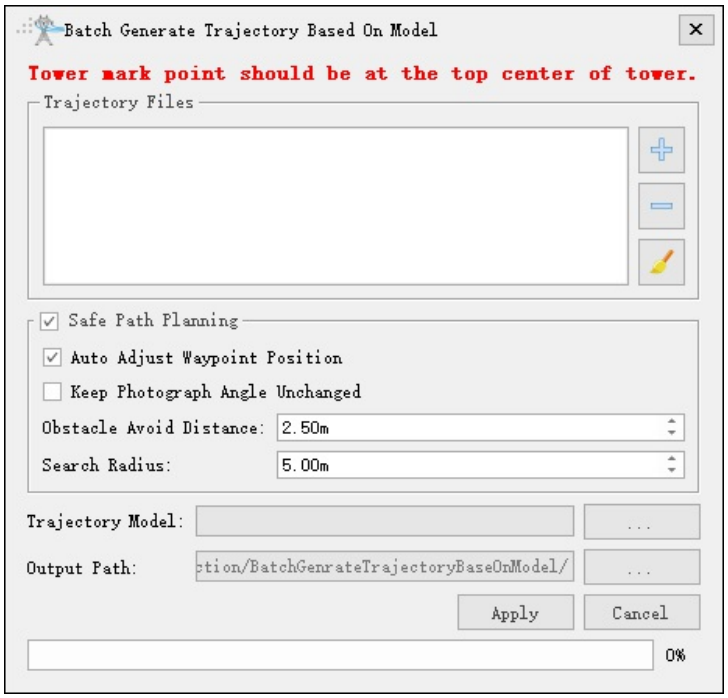
- **Safe Path Planning**: Set whether to perform safe path planning.
  - **Auto Adjust Waypoint Position**: Set whether to automatically adjust waypoint positions.
  - **Keep Photograph Angle Unchanged**: Set whether to keep the camera angle unchanged.
  - **Obstacle Avoid Distance(m)(default value "2.5")**: Set the obstacle avoidance distance.
  - **Search Radius(m)(default value "5")**: Set the search radius.
- **Tower Name**: Select the tower.
- **Trajectory Model**: Select the trajectory model file.

Batch Generate Trajectory Based On Model

After generating the trajectory model, you need to perform part point marking operations on the towers that apply the model. Mark all part points according to the inspection configuration of the same tower type, ensuring that the quantity and positions of part points remain consistent with the trajectory model.

Usage

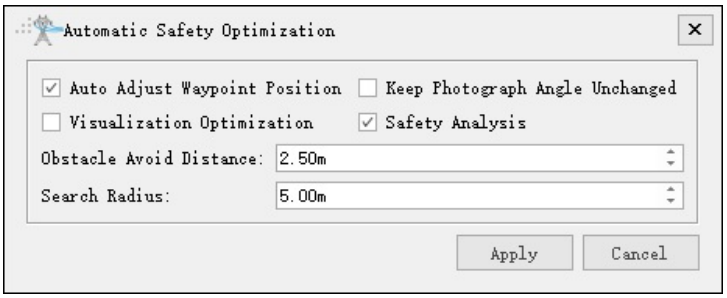
Click *Fine Inspection* > *Trajectory* > *Batch Generate Trajectory Base On Model*



- **Trajectory Files**: Maintain the trajectory file with part points that needs trajectory generation based on the model, and ensure the tower type is consistent with the model.
- **Safe Path Planning**: Set whether to perform safe path planning.
  - **Auto Adjust Waypoint Position**: Set whether to automatically adjust waypoint positions.
  - **Keep Photograph Angle Unchanged**: Set whether to keep the camera angle unchanged.
  - **Obstacle Avoid Distance(m)(default value "2.5")**: Set the obstacle avoidance distance.
  - **Search Radius(m)(default value "5")**: Set the search radius.
- **Tower Name**: Select the tower.
- **Trajectory Model**: Select the trajectory model file.

Automatic Safety Optimization

Automatically adjust waypoint positions and add auxiliary waypoints to ensure the safety of the trajectory.



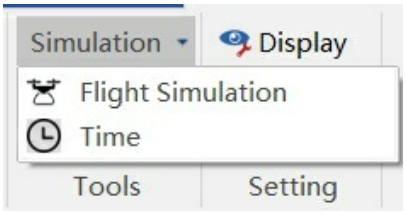
- **Parameters Setting**
  - **Auto Adjust Waypoint Position**: Set whether to automatically adjust waypoint positions.
  - **Keep Photograph Angle Unchanged**: Set whether to keep the camera angle unchanged.
  - **Visibility Optimization**: When checked, adjust waypoint positions according to visibility between waypoints and part points.
  - **Safety Analysis**: Set whether to perform safety analysis.
  - **Obstacle Avoid Distance(m)(default value "2.5")**: Set the obstacle avoidance distance.
  - **Search Radius(m)(default value "5")**: Set the search radius.

Tools

Usage

Tools mainly include Simulation and Batch. Simulation includes Flight Simulation and Time; Batch includes Statistics, Batch Safety Checking, Batch Attribute Modification, Batch Modify First And Last Auxiliary Waypoints, Batch Save As Trajectory, Batch Modify Part Name, Batch Modify Trajectory Tower Information, Batch Adjust Waypoint Height, Export to CSV Format, Export to DJI Pilot.

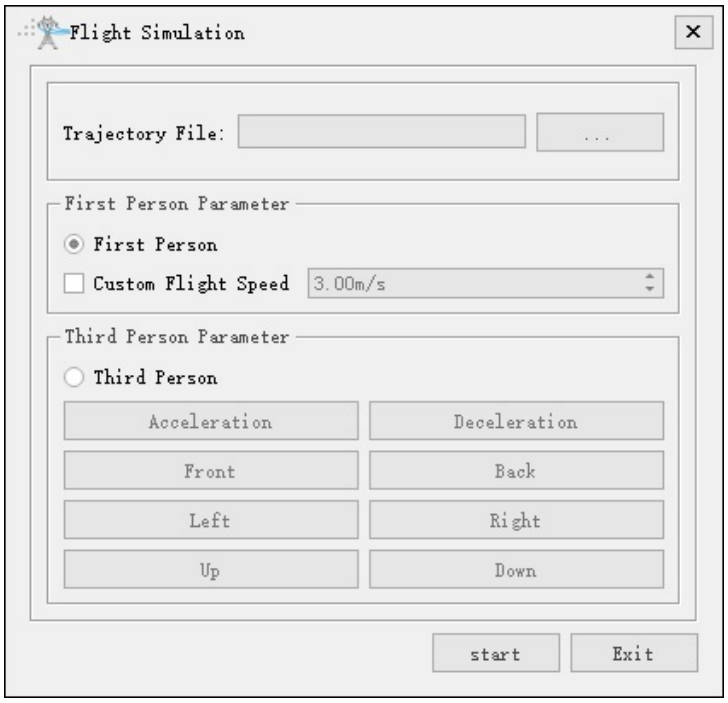






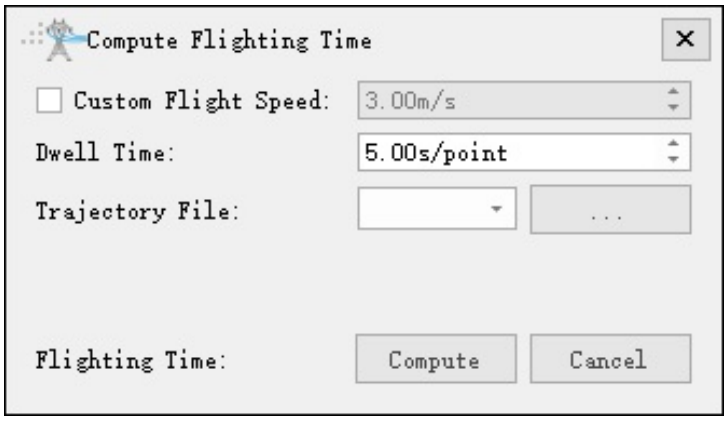
Flight Simulation

After loading the flight trajectory file, you can simulate the flight by selecting either the first-person or third-person perspective in the flight simulation.



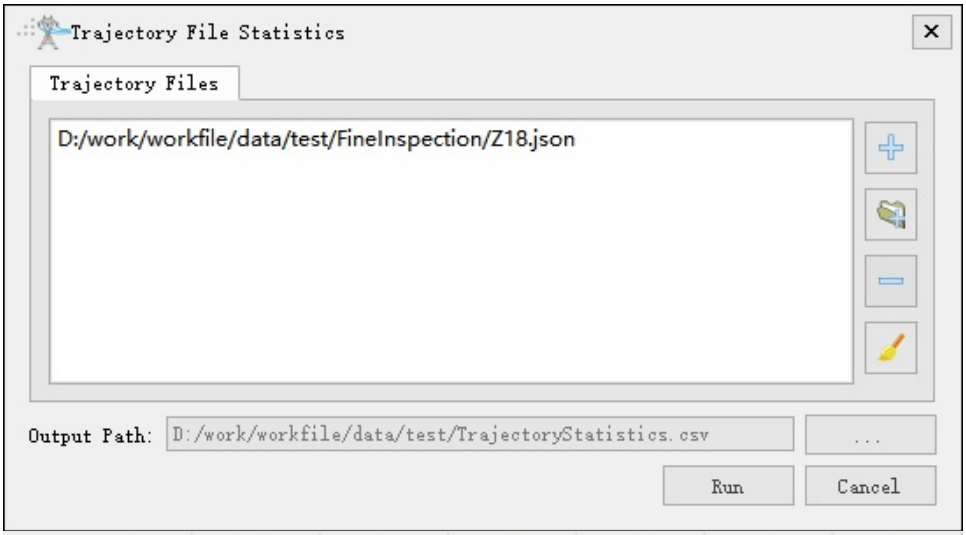
Time

Flight time calculation needs to load the trajectory file, set the flight speed and waypoint dwell time, and get the total flight time of the UAV after executing the trajectory.



Statistics

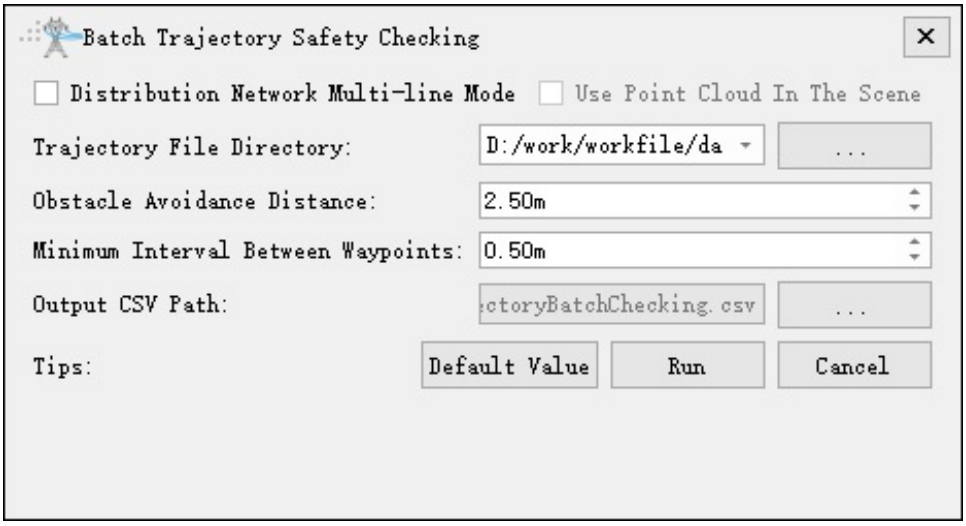
Statistics can export the parameter statistics table of the trajectory, click "Run" to generate a csv format file. The file is saved in the project folder. The statistical table mainly counts the number of photos of the trajectory, the number of auxiliary points, the number of manually added points and the number of waypoints, as shown in the figure below.



	A	B	C	D	E	F	G
1	Index	File Name	Photo Number	Auxiliary Way Points Number	Manually Added Points	Way Points Number	Trajectory Length(m)
2	1	N1#	38	5	0	43	159.85
3	2	N2#	38	5	0	43	232.18
4	Total:	2	76	10	0	86	392.03
5							

Batch Safety Checking

Batch safety checking mainly checks whether the trajectory files meet the safety requirements.



- **Distribution Network Multi-line Mode**: Not checked by default. When checked, set the root directory of distribution network lines. Automatically check the safety of trajectories in each branch directory.
- **Use Point Cloud In The Scene**: Not checked by default. When checked, use the point cloud in the scene for analysis. Otherwise, use the point cloud under the clipping data folder in each branch directory for analysis.
- **Trajectory File Directory**: Default fine inspection folder. In distribution network multi-line mode, select the line root directory.
- **Obstacle Avoidance Distance**: The default is the same as the inspection configuration.
- **Minimum Interval Between Waypoints**: The minimum safe distance between waypoints is 1.00m by

default.

- **Output CSV Path**: Default fine inspection folder.

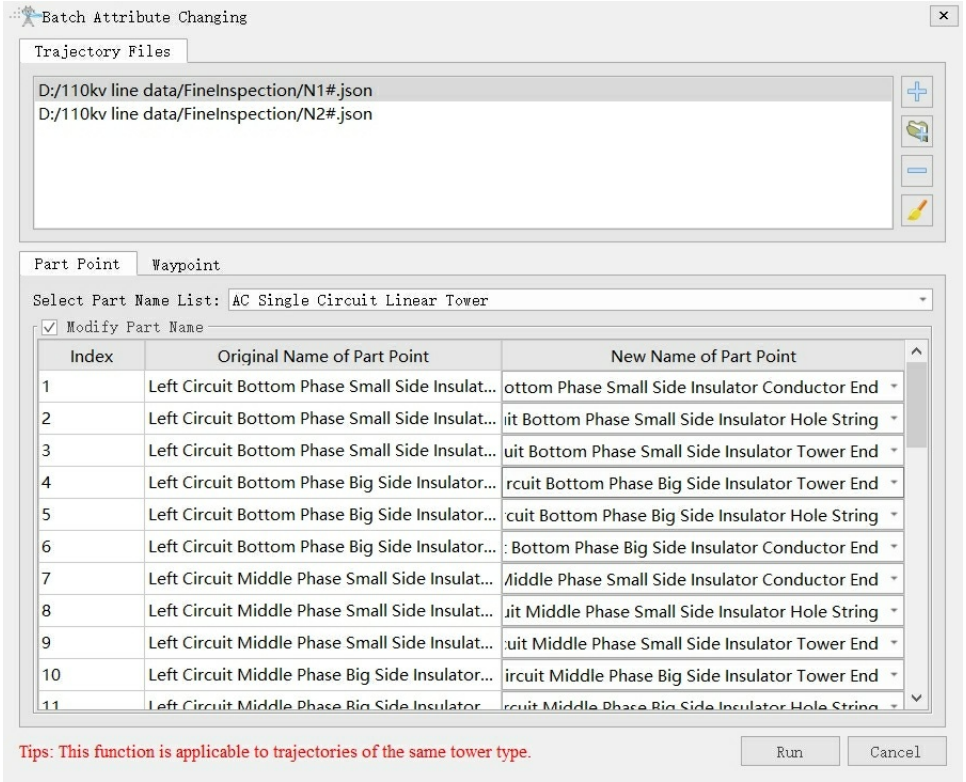
  After running, a TrajectoryBatchChecking.csv file will be generated, mainly checking for 5 common issues, where 1 indicates a problem and 0 indicates normal. When opened, it will appear as shown in the figure below.

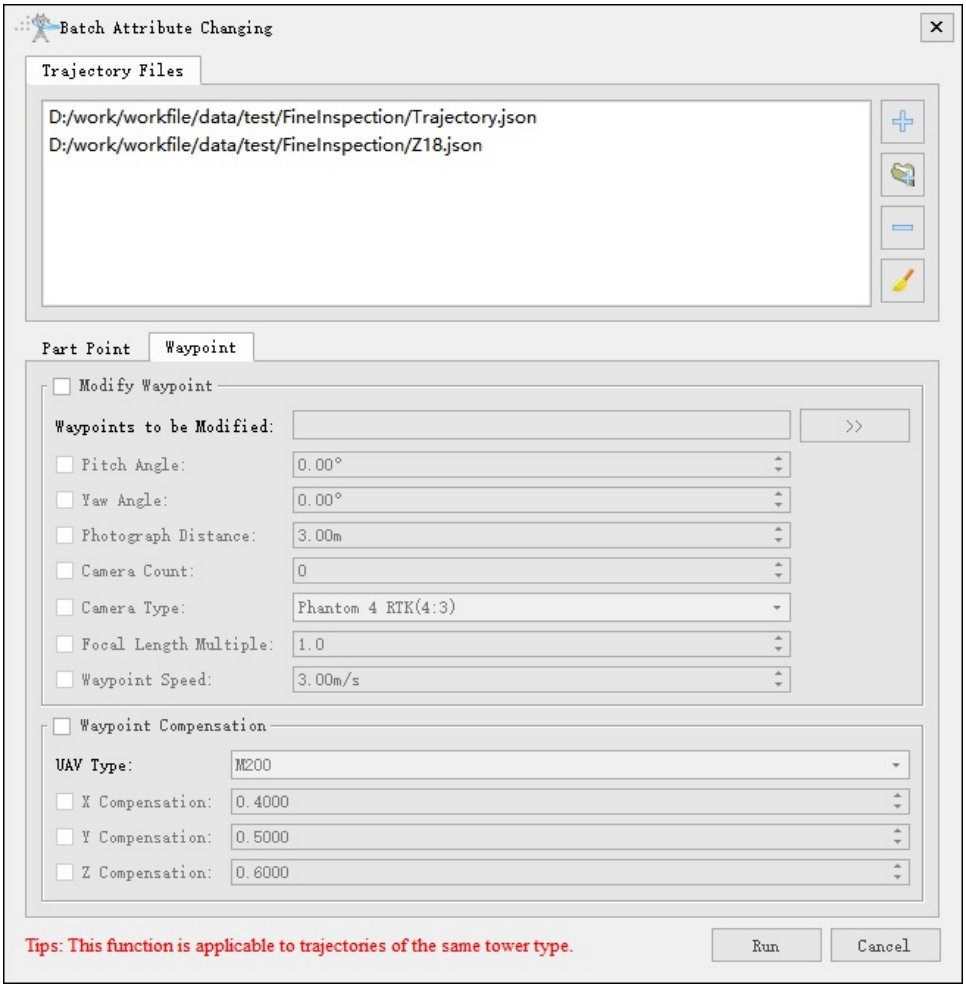
	A	B	C	D	E	F	G	H
1	Index	File Name	Trajectory Safe Distance is Danger	Distance Between Waypoints is Danger	Camera Angle is Danger	Do Not Have Waypoint	Have Unphotographed KeyPoints	Have Multiple Camera Types
2	0	N1#.json	1	1	0	0	0	0
3	1	N2#.json	1	1	0	0	0	0
4								
5								
6								
7								

- **Trajectory Safe Distance Is Danger**: Safety distance is dangerous, obstacle avoidance distance does not meet the requirements.
- **Distance Between Waypoints Is Danger**: The distance between two adjacent waypoints is dangerous and does not meet the requirements.
- **Camera Angle Is Danger**: Camera angle is dangerous. The pitch angle of the camera point is positive.
- **Do Not Have Waypoints**: There are no waypoints.
- **Have Unphotographed Key Points**: Some part points are not photographed.
- **Have Multiple Camera Types**: The cameras used for taking photos on the same flight trajectory are not consistent.

Batch Attribute Changing

Batch attribute changing mainly includes key point change and waypoint change. Only the same tower type trajectories can be modified in batches.



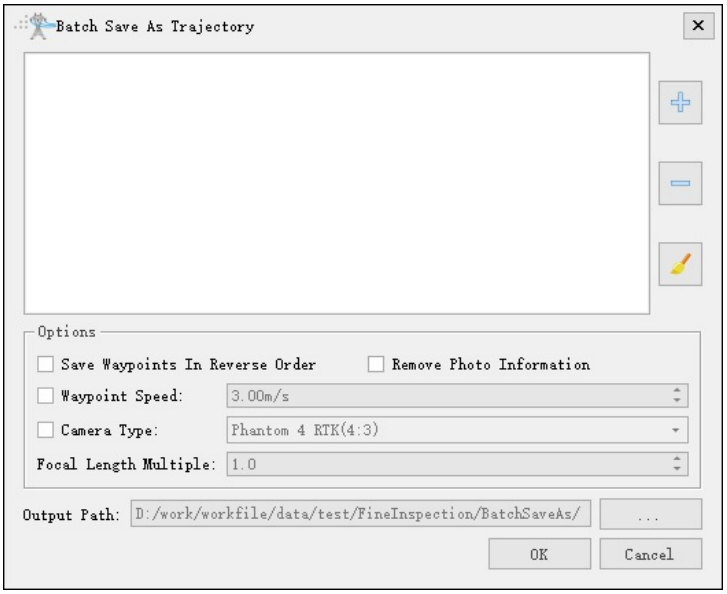


- **Modify Waypoint**:
  - **Waypoints to be Modified**: Click the button on the right to add and select the waypoints that need to be modified. Typically, you would select all of them.
  - **Pitch Angle**: The pitch angle of the waypoint, generally a negative value.
  - **Yaw Angle**: The yaw angle of the waypoint.
  - **Photograph Distance**: The distance at which photos are taken at the waypoint.
  - **Camera Count**: The number of photos taken at the waypoint.
  - **Camera Type**: Select the type of camera to be changed, a total of 14 types.
  - **Focal Length Multiple**: For selectable zoom camera types, you can set the zoom factor, with a setting range of 0.1 to 12.0, and one decimal place to be preserved. For a fixed-focus camera type, this value cannot be set.
  - **Waypoint Speed**: Flight speed at waypoints, with a setting range of 0.01 to 99.99, and two decimal places to be preserved.
- **Waypoint Compensation**: Check this option when converting drone trajectories for the M200 and M300 series.
  - **UAV Type**: Customize.
  - **X Compensation**: Default 0.4
  - **Y Compensation**: Default 0.5
  - **Z Compensation**: Default 0.6

> Tip: This function is suitable for trajectories with the same tower type.

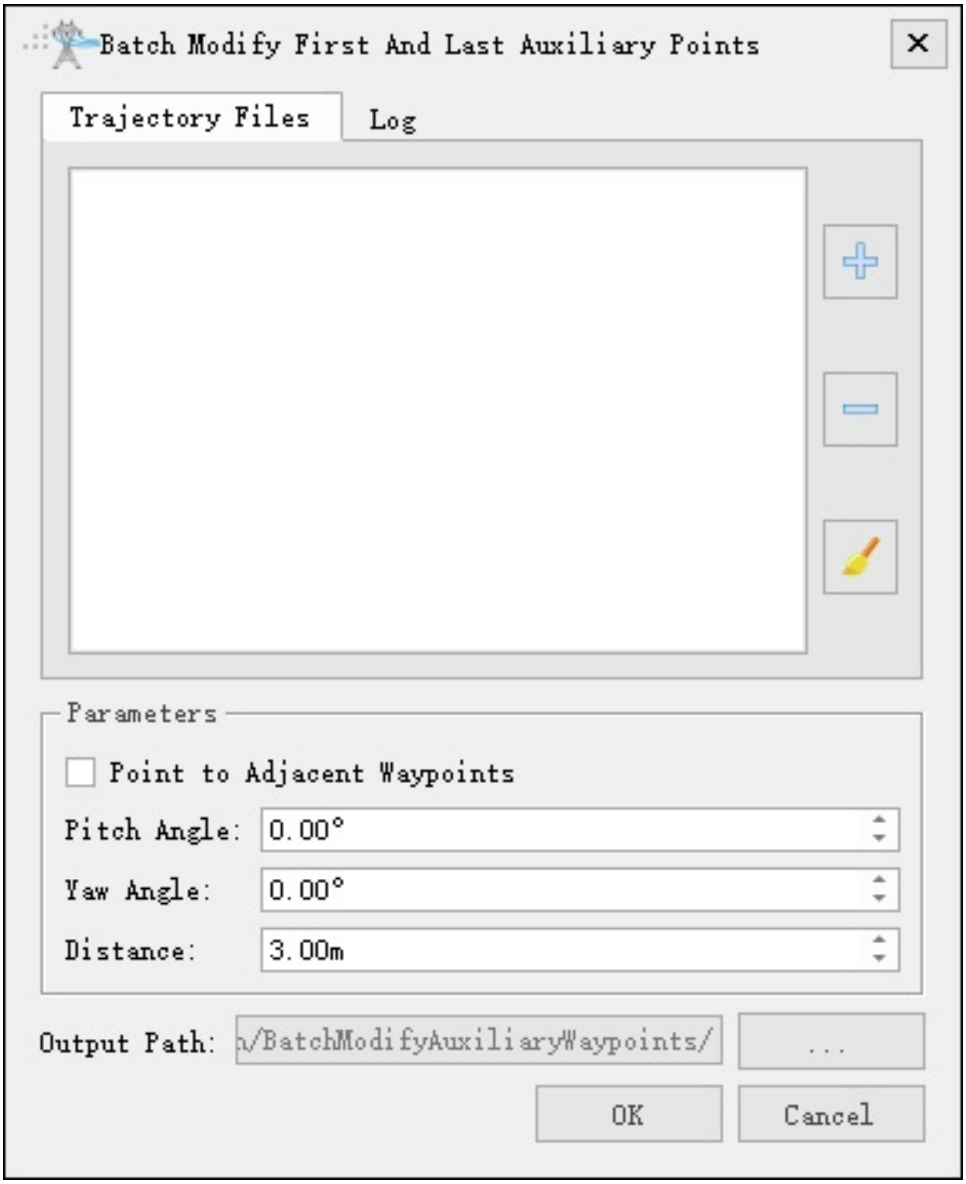
Batch Save As Trajectory

Batch save as trajectories allows for waypoints to be saved in reverse order, removing photo information, changing waypoint speed, camera type, and focal length multiple, as shown in the figure below.



Batch Modify First And Last Auxiliary Waypoints

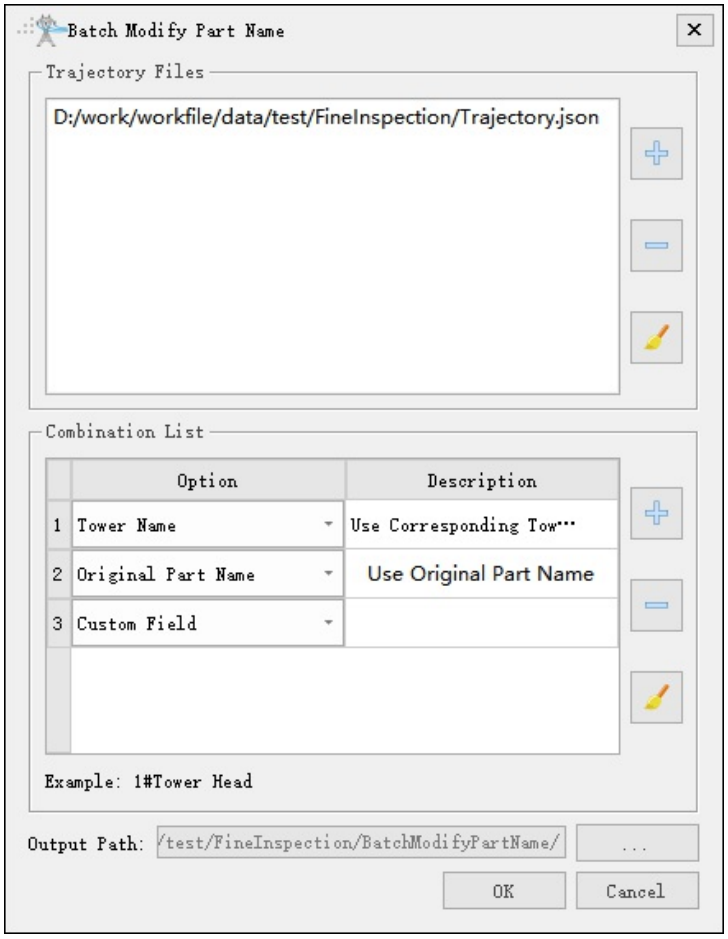
Batch modify the first and last auxiliary waypoints: the starting point points to the next waypoint, and the ending point points to the previous waypoint.



- **Parameters**
  - **Point to Adjacent Waypoints**: Not checked by default; if checked, it will point to the adjacent waypoint.
  - **Pitch Angle**: Set the pitch angle of the auxiliary waypoint.
  - **Yaw Angle**: Set the yaw angle of the auxiliary point.
  - **Distance**: Set the distance to the target point.

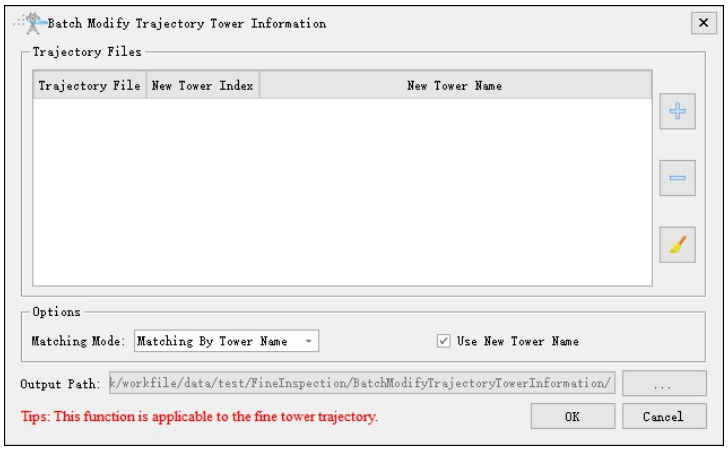
Batch Modify Part Name

Custom fields can be added, such as adding line names and voltage levels, and batch modifying part names, as shown in the following figure.



Batch Modify Trajectory Tower Information

If the tower information in the trajectory file is misaligned, this tool can be used to correct and redefine the tower number and name, as shown in the following figure.

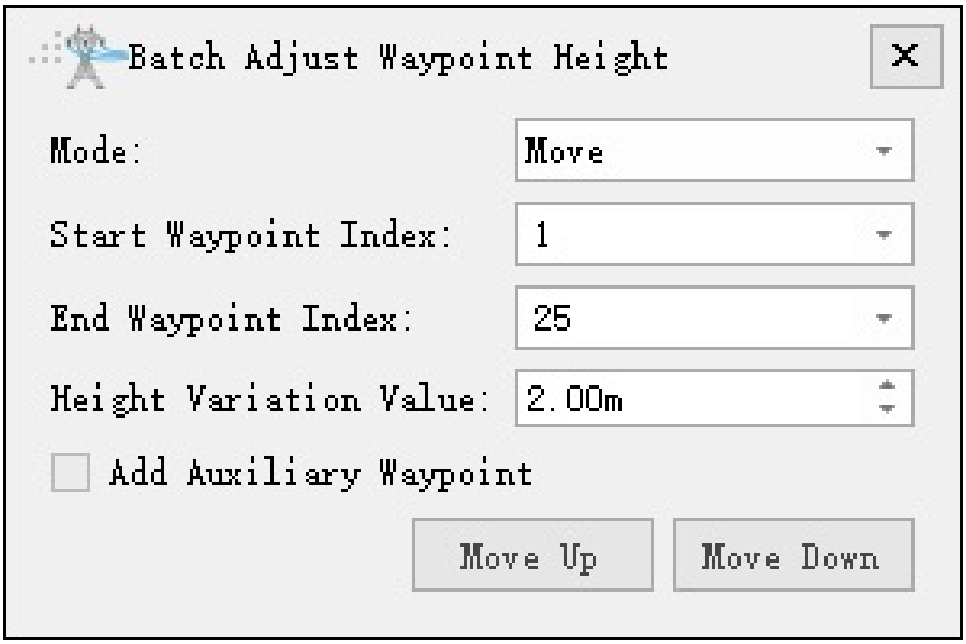


- **Options**:
  - **Matching Mode**: If this option is selected "Matching By Tower Index", the matching will be done using the tower index recorded in the flight trajectory file; If this option is selected "Matching By Tower Name", it will be done using the tower names recorded in the flight trajectory file; otherwise, the 'Trajectory File' column is arranged in ascending order to the tower index recorded in the file, and the 'New Tower Index' column is arranged in ascending order, and then matched according to the order after arrangement.
  - **Use New Tower Name**: Check this option to use the new tower name as the flight trajectory file name

when saving the file; otherwise, use the original flight trajectory file name.

Batch Adjust Waypoint Height

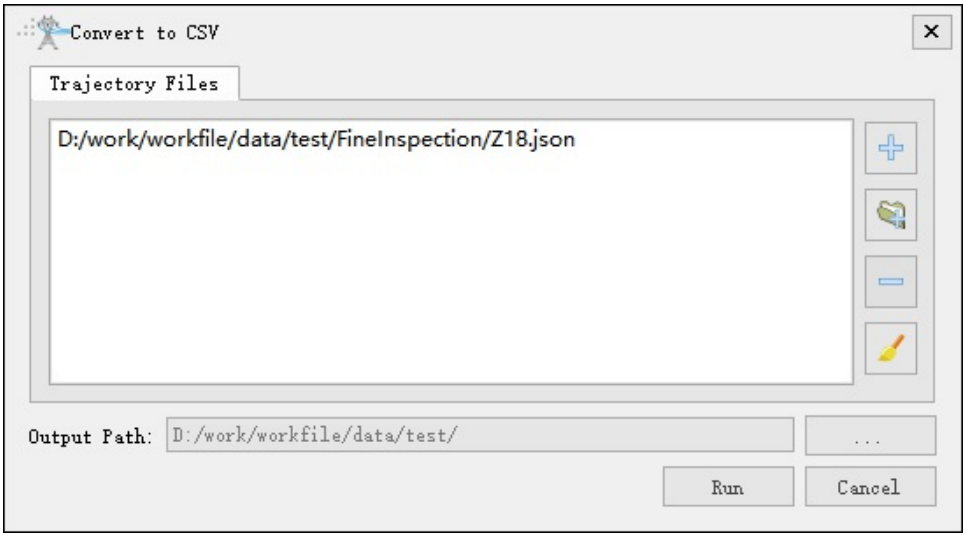
Batch adjust waypoint altitude, supporting two modes: Move and Set Elevation.

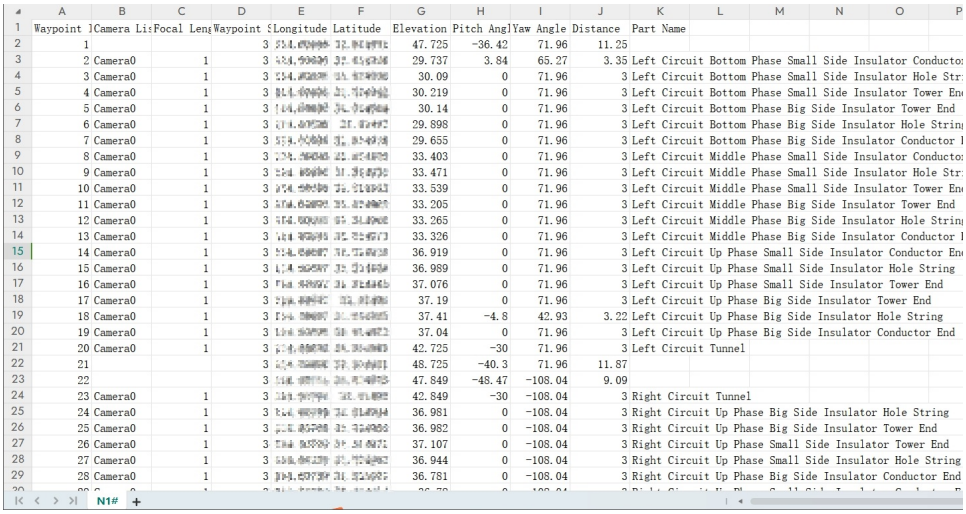


- **Mode**: Select the mode for settings, either Move or Set Elevation.
- **Start Waypoint Index**: Adjust the starting index of the waypoints.
- **End Waypoint Index**: Adjust the ending index of the waypoints.
- **Height Variation Value(default "2.00m")**: Set the height variation change value for moving waypoints.
- **Add Auxiliary Waypoints**: Not checked by default; if checked, auxiliary waypoints will be added automatically based on the adjustments.

Export to CSV Format

Exporting to CSV Format is to convert the trajectory file into a CSV format table file, which can compare and quickly view the parameters of each waypoint. The file is saved in the project folder by default.





	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Waypoint I	Camera Lis	Focal Leng	Waypoint S	Longitude	Latitude	Elevation	Pitch Angl	Yaw Angle	Distance	Part Name					
2	1			3	[illegible]	[illegible]	47.725	-36.42	71.96	11.25						
3	2	Camera0	1	3	[illegible]	[illegible]	29.737	3.84	65.27	3.35	Left Circuit Bottom Phase Small Side Insulator Conductor					
4	3	Camera0	1	3	[illegible]	[illegible]	30.09	0	71.96	3	Left Circuit Bottom Phase Small Side Insulator Hole Str					
5	4	Camera0	1	3	[illegible]	[illegible]	30.219	0	71.96	3	Left Circuit Bottom Phase Small Side Insulator Tower En					
6	5	Camera0	1	3	[illegible]	[illegible]	30.14	0	71.96	3	Left Circuit Bottom Phase Big Side Insulator Tower End					
7	6	Camera0	1	3	[illegible]	[illegible]	29.898	0	71.96	3	Left Circuit Bottom Phase Big Side Insulator Hole Strin					
8	7	Camera0	1	3	[illegible]	[illegible]	29.655	0	71.96	3	Left Circuit Bottom Phase Big Side Insulator Conductor I					
9	8	Camera0	1	3	[illegible]	[illegible]	33.403	0	71.96	3	Left Circuit Middle Phase Small Side Insulator Conductor					
10	9	Camera0	1	3	[illegible]	[illegible]	33.471	0	71.96	3	Left Circuit Middle Phase Small Side Insulator Hole Str					
11	10	Camera0	1	3	[illegible]	[illegible]	33.539	0	71.96	3	Left Circuit Middle Phase Small Side Insulator Tower En					
12	11	Camera0	1	3	[illegible]	[illegible]	33.205	0	71.96	3	Left Circuit Middle Phase Big Side Insulator Tower End					
13	12	Camera0	1	3	[illegible]	[illegible]	33.265	0	71.96	3	Left Circuit Middle Phase Big Side Insulator Hole Strin					
14	13	Camera0	1	3	[illegible]	[illegible]	33.326	0	71.96	3	Left Circuit Middle Phase Big Side Insulator Conductor I					
15	14	Camera0	1	3	[illegible]	[illegible]	36.919	0	71.96	3	Left Circuit Up Phase Small Side Insulator Conductor En					
16	15	Camera0	1	3	[illegible]	[illegible]	36.989	0	71.96	3	Left Circuit Up Phase Small Side Insulator Hole String					
17	16	Camera0	1	3	[illegible]	[illegible]	37.076	0	71.96	3	Left Circuit Up Phase Small Side Insulator Tower End					
18	17	Camera0	1	3	[illegible]	[illegible]	37.19	0	71.96	3	Left Circuit Up Phase Big Side Insulator Tower End					
19	18	Camera0	1	3	[illegible]	[illegible]	37.41	-4.8	42.93	3.22	Left Circuit Up Phase Big Side Insulator Hole String					
20	19	Camera0	1	3	[illegible]	[illegible]	37.04	0	71.96	3	Left Circuit Up Phase Big Side Insulator Conductor End					
21	20	Camera0	1	3	[illegible]	[illegible]	42.725	-30	71.96	3	Left Circuit Tunnel					
22	21			3	[illegible]	[illegible]	48.725	-40.3	71.96	11.87						
23	22			3	[illegible]	[illegible]	47.849	-48.47	-108.04	9.09						
24	23	Camera0	1	3	[illegible]	[illegible]	42.849	-30	-108.04	3	Right Circuit Tunnel					
25	24	Camera0	1	3	[illegible]	[illegible]	36.981	0	-108.04	3	Right Circuit Up Phase Big Side Insulator Hole String					
26	25	Camera0	1	3	[illegible]	[illegible]	36.982	0	-108.04	3	Right Circuit Up Phase Big Side Insulator Tower End					
27	26	Camera0	1	3	[illegible]	[illegible]	37.107	0	-108.04	3	Right Circuit Up Phase Small Side Insulator Tower End					
28	27	Camera0	1	3	[illegible]	[illegible]	36.944	0	-108.04	3	Right Circuit Up Phase Small Side Insulator Hole String					
29	28	Camera0	1	3	[illegible]	[illegible]	36.781	0	-108.04	3	Right Circuit Up Phase Big Side Insulator Conductor End					

N1#

Export to DJI Pilot

Convert to a drone trajectory compatible with DJI Pilot app in KML or KMZ format. In advanced settings, you can set initial speed(10m/s by default), yaw angle mode (1 Smooth transition; 2 along the trajectory direction) and waypoint turning mode (1 Fly in a straight line and stop at the waypoint; 2 Turn ahead and smooth through waypoints).

