

CNPilot Ground Station Operating Techniques

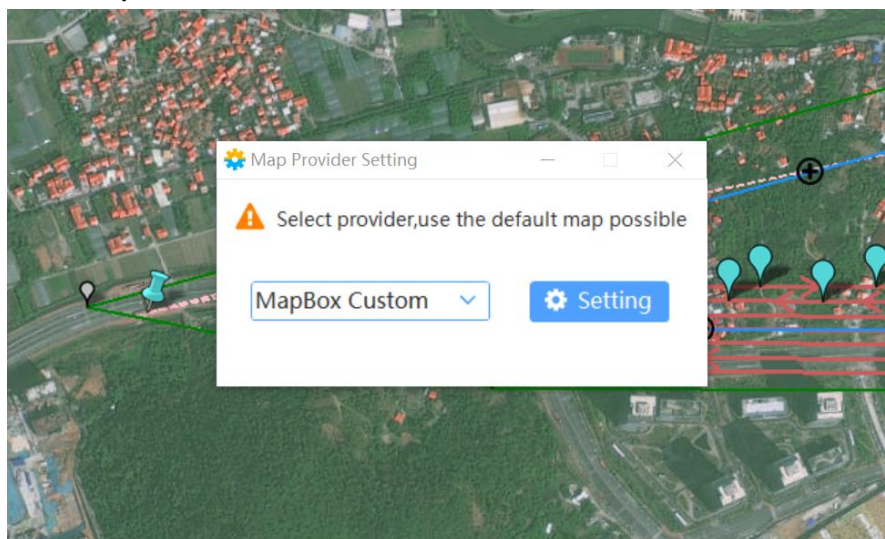
Latest earth station version currently in use: 2.1.6

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1. Setting routes and configuring basic parameters	2
1.1 Adjust Basemap	2
1.2 Camera Configuration	2
1.3 Parameter setting	2
1.4 Check Flight Altitude and Duration	3
1.5 Calibration in Relation to Ground Elevation	3
1.6 Auto Expand	5
1.7 Linear regional route planning	6
1.8 Follow Terrain	7
1.9 Check Elevation above ground	10
1.10 Task saving and recall	11
1.11 Manual import of DEM base map function	12
1.12 UAV endurance	12
2. Flight interface	13
2.1 Exposure time	13
2.2 Format Function	16
2.3 Firmware Upgrade	16
2.4 Point Break Flying Function	17
2.5 Manual operation of the E300	17
3. VH2 Radar with E300	19
3.1 Parameter Configuration	19
3.2 Flight path setup	19
4. Common Errors and Solutions	21
4.1 GPS problem prompt:	21
4.2 Proximity sensor error	22
4.3 Mission Mode Switching Failed	22
4.4 Low Voltage Fault Protection	22
4.5 Geomagnetic anomalies	22
5. Guidelines for checking flight data fields	22
5.1 Battery Level	22
5.2 Voltage	22
5.3 Flight Mode	23
5.4 Current and Wind Speed	24
5.5 Number of Satellites	24
6. Sensor Calibration	24
6.1 Gyro Calibration	24
6.2 Magnetic Compass Calibration	25
6.3 Flight Pointing Line and Yaw Angle Calibration	25

1. Setting routes and configuring basic parameters

1.1 Adjust Basemap



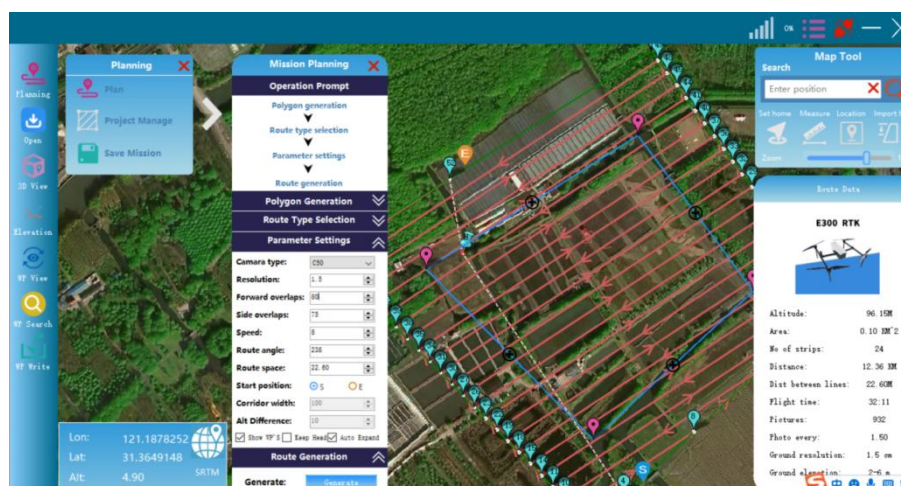
Use Ctrl+M to adjust the basemap. Set it to the usual local map.

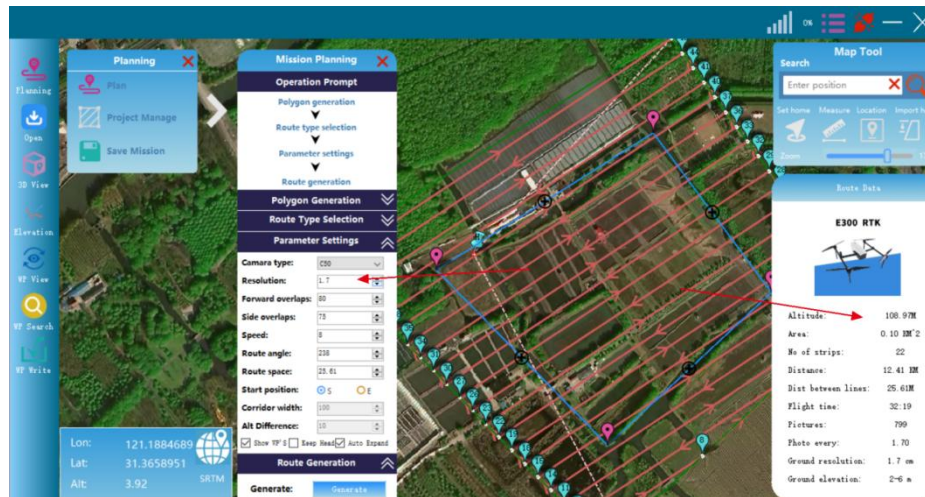
1.2 Camera Configuration

Before starting the task, first determine the type of camera to be used. Depending on the needs of the project, either an orthographic single camera or a five-lens camera configuration may be selected. Each type of camera has specific applications and advantages when mapping.

C20: single lens. C50: 5 lens. VH2: LiDAR

1.3 Parameter setting





Relevant parameter settings are as follows:

Camera Type: Ensure the desired camera model is correctly selected.

Resolution: Set the resolution to 1.5cm to guarantee the acquired image quality meets surveying and mapping requirements. During the mapping process, the required scale will determine the corresponding resolution. A 1:500 scale demands a 1.5cm resolution, whereas a 1:1000 scale requires a 3cm resolution.

Forward Overlaps : Set to 80%, ensuring sufficient overlap of aerial images in the forward and backward directions for subsequent stitching and mapping processing.

Side Overlaps : Set to 75%, ensuring sufficient overlap of aerial images in the left and right directions.

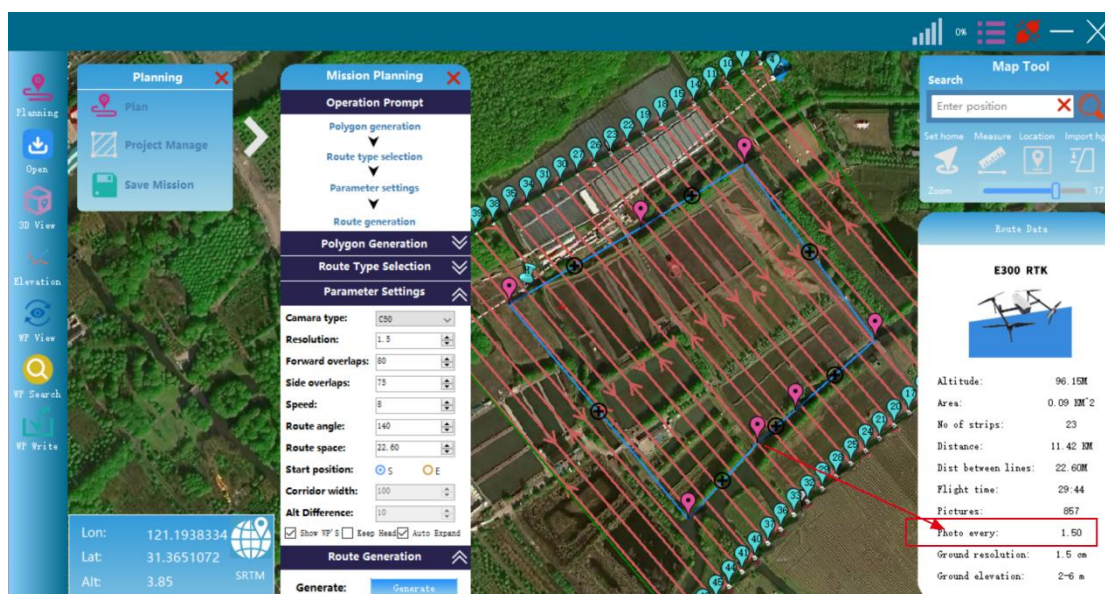
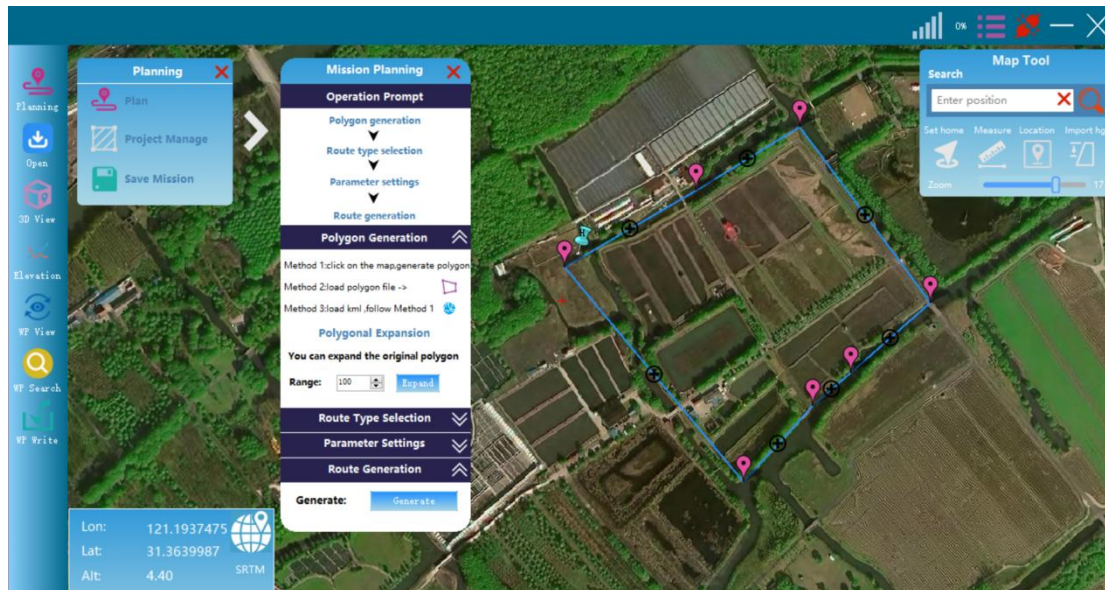
Flight Speed: A recommended speed of 8-10m/s, but minor adjustments might be necessary depending on actual wind speed and weather conditions.

1.4 Check Flight Altitude and Duration

After setting the flight path and parameters, it's crucial to meticulously verify the flight altitude to ensure the drone remains at a safe height throughout its flight. Additionally, evaluate the projected flight duration to ascertain if the battery has sufficient charge to complete the entire mission.

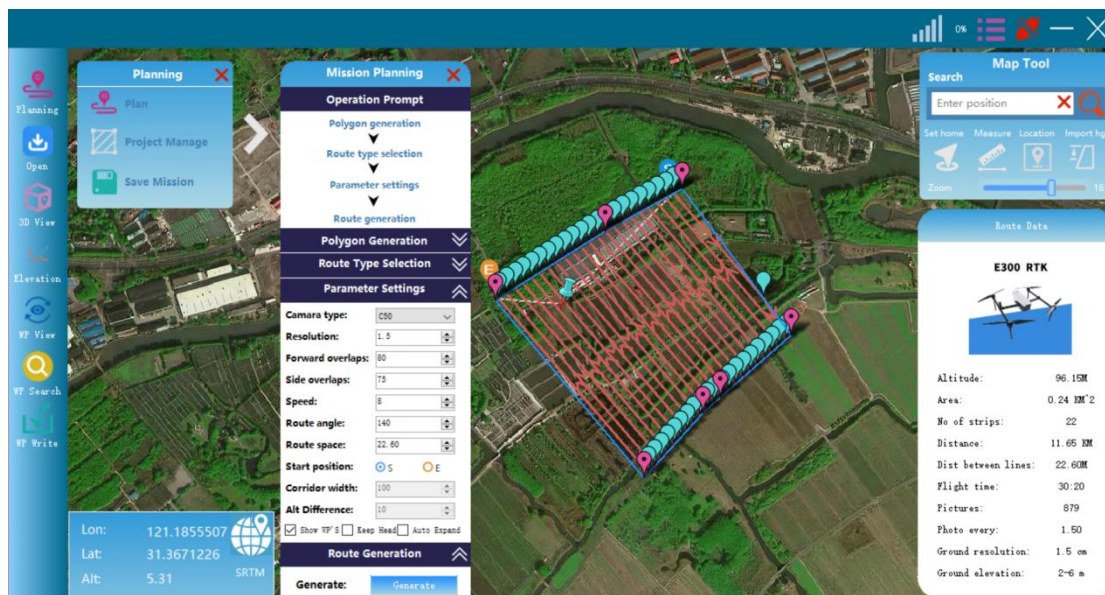
1.5 Calibration in Relation to Ground Elevation

To guarantee the safety of the drone's flight and the accuracy of the mapping, it's necessary to inspect the correlation between the designed flight path and ground elevation. Ensure that in areas with complex terrains, the drone's flying altitude is always above ground-based obstructions, such as buildings, trees, etc.

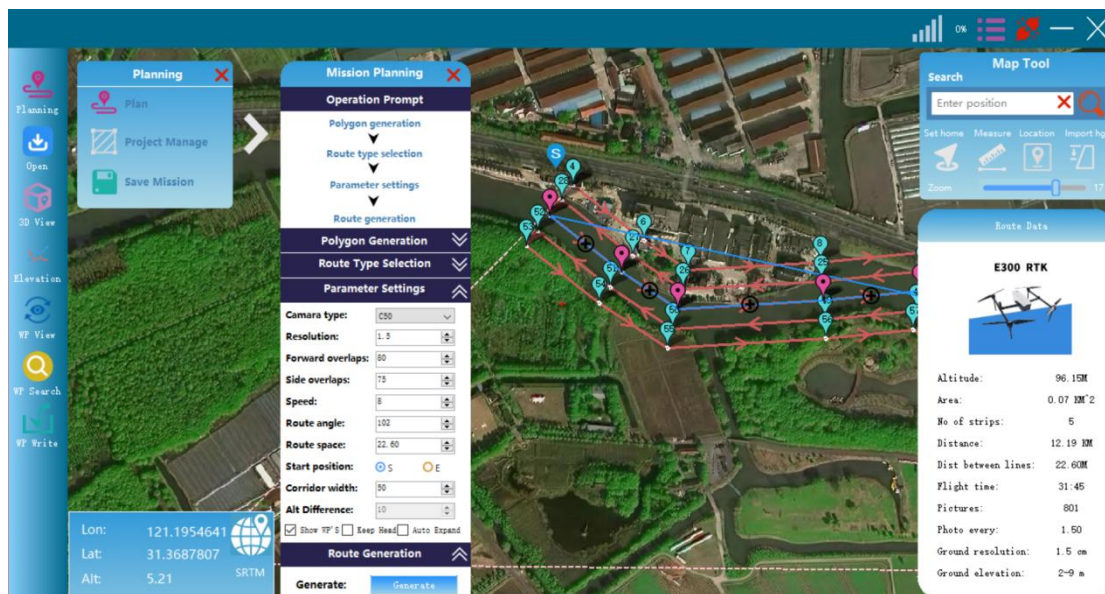


Note: When setting the photo capture parameters, make sure the interval between shots is no less than 0.8 seconds to prevent missed shots due to inadequate response time.

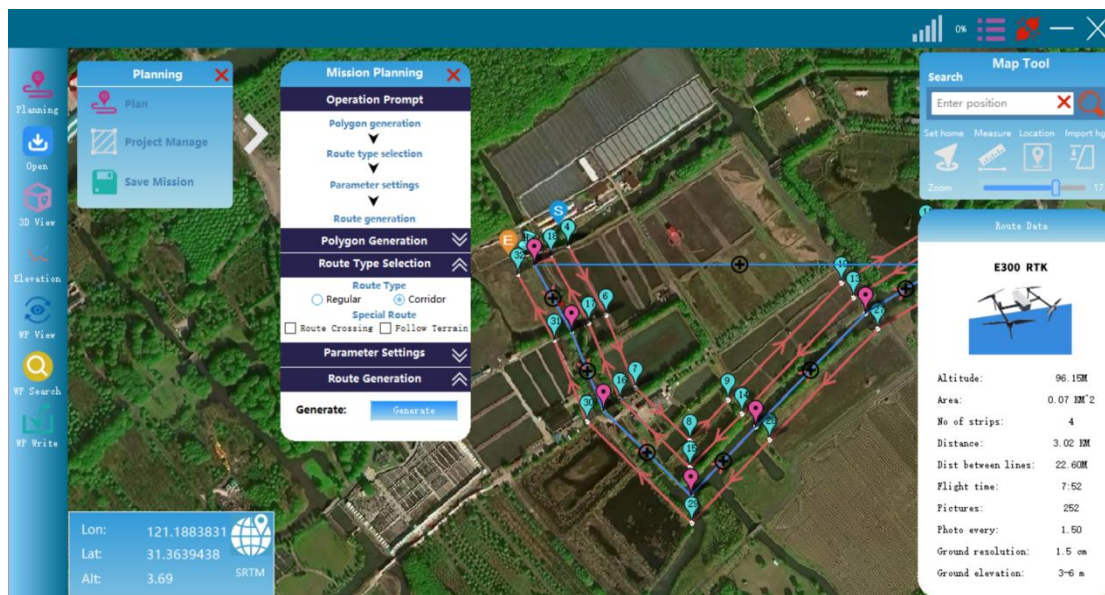
1.6 Auto Expand



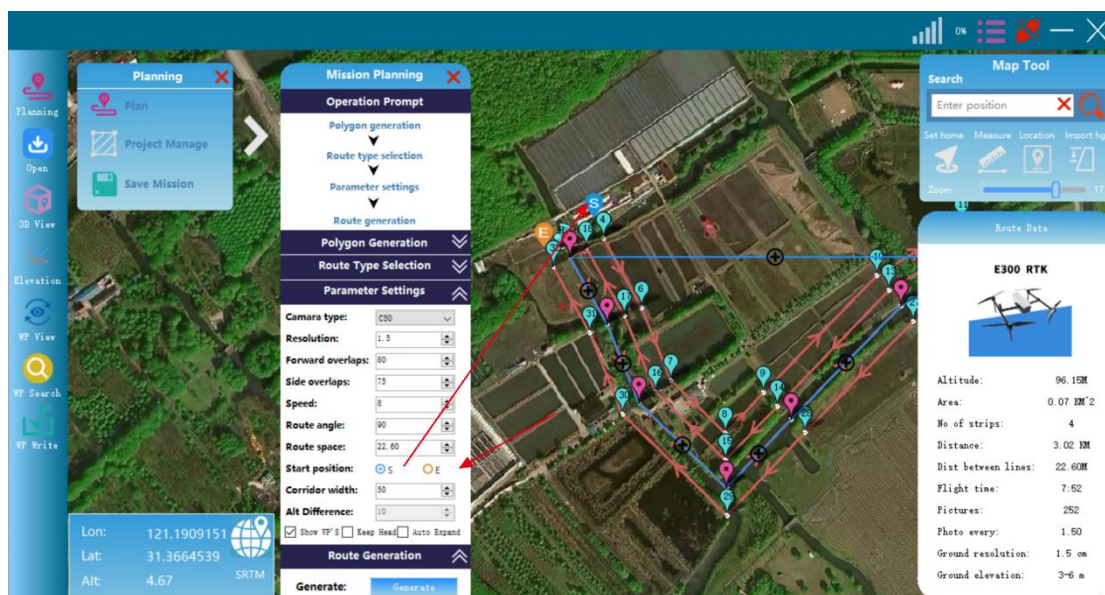
When the "Auto Expand" option is unchecked, the drone will not automatically expand its route, ensuring that the aircraft does not exceed the predefined flight area. However, this setting may result in insufficient data collection in the fringe area, leading to poor data quality in that part of the field.



1.7 Linear regional route planning

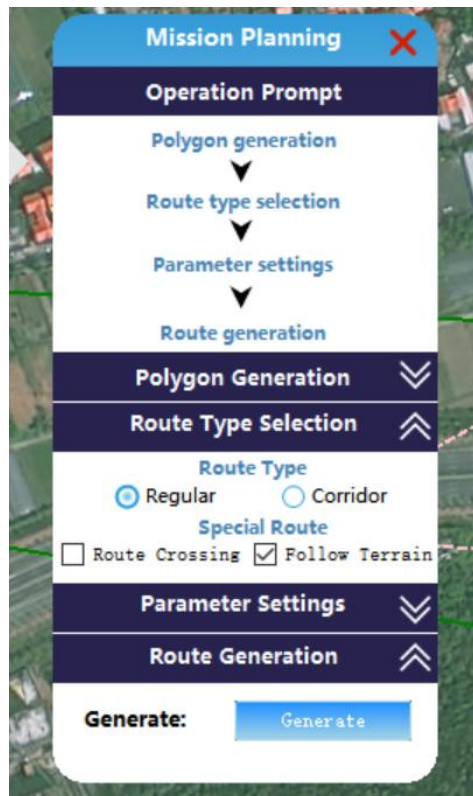


When mapping line areas, the user should select the "route type" as "corridor". In this way, you only need to plan a route along the target mapping line, and the system will automatically generate the corresponding measurement route for you. If you need to adjust the width range of the survey, you can modify the "corridor width" parameter to realize the adjustment of the route width.

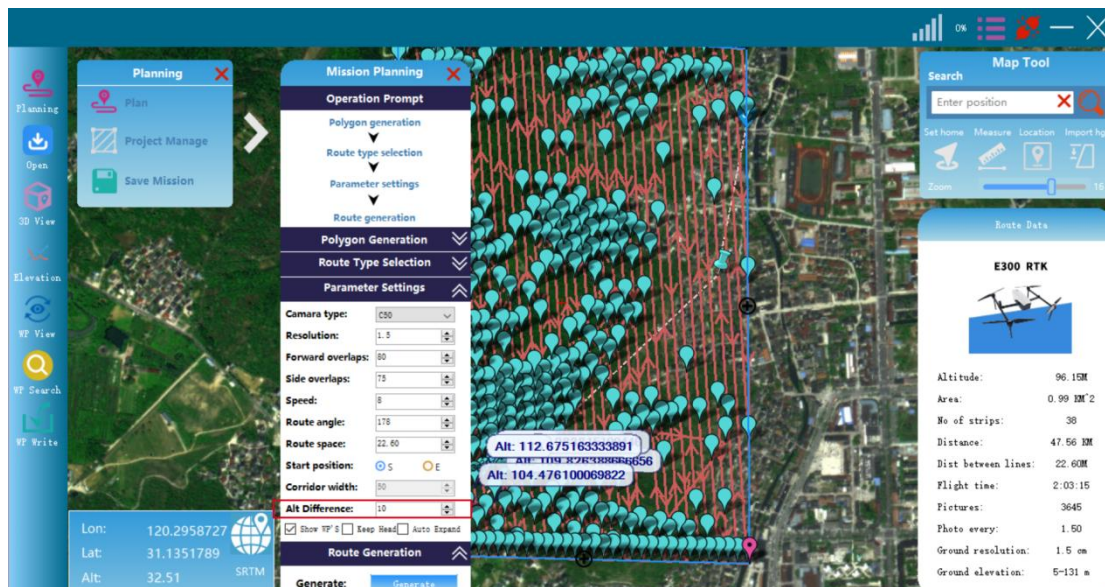


To optimize mapping efficiency and safe return of the UAV, the user can adjust the flight start point. This can be achieved by modifying the "Start position" parameter. It is recommended that the flight path be designed to start away from the take-off point and gradually proceed towards the take-off point, ensuring that the end point is close to the take-off point, thus facilitating the timely and safe return of the UAV.

1.8 Follow Terrain



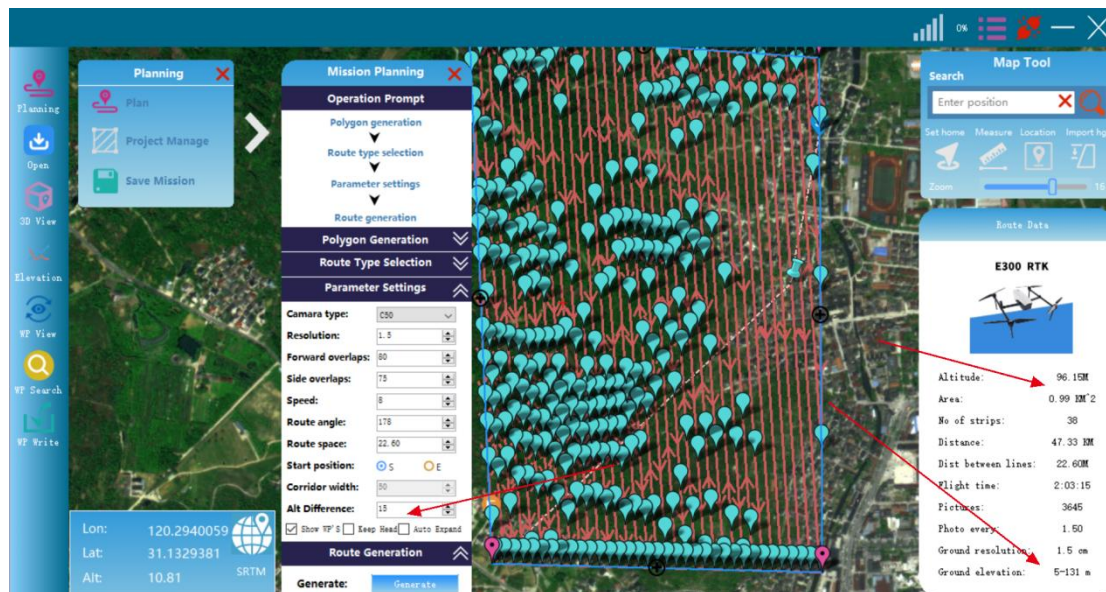
When mapping in mountainous areas or areas with complex terrain, setting up Follow Terrain allows the UAV to automatically adjust its flight altitude according to the terrain to maintain a constant relative altitude to the ground, thus obtaining more stable and accurate mapping data. When planning a route, simply check the "Follow Terrain" box to enable this function.



"Alt Difference" is a key parameter that controls how often the UAV responds to altitude changes in terrain in geomimetic flight mode. In short, it defines at what altitude change the UAV should reset a waypoint to accommodate this terrain altitude change.

For example, when "Alt Difference" is set to 10, this means that only when the UAV detects a 10

meter change in terrain altitude from its current flight altitude will it create a new waypoint and adjust its flight altitude accordingly to accommodate this change. Smaller values of "Alt Difference" mean that the drone will respond more frequently to small changes in terrain, while larger values may blind the drone to small terrain changes.



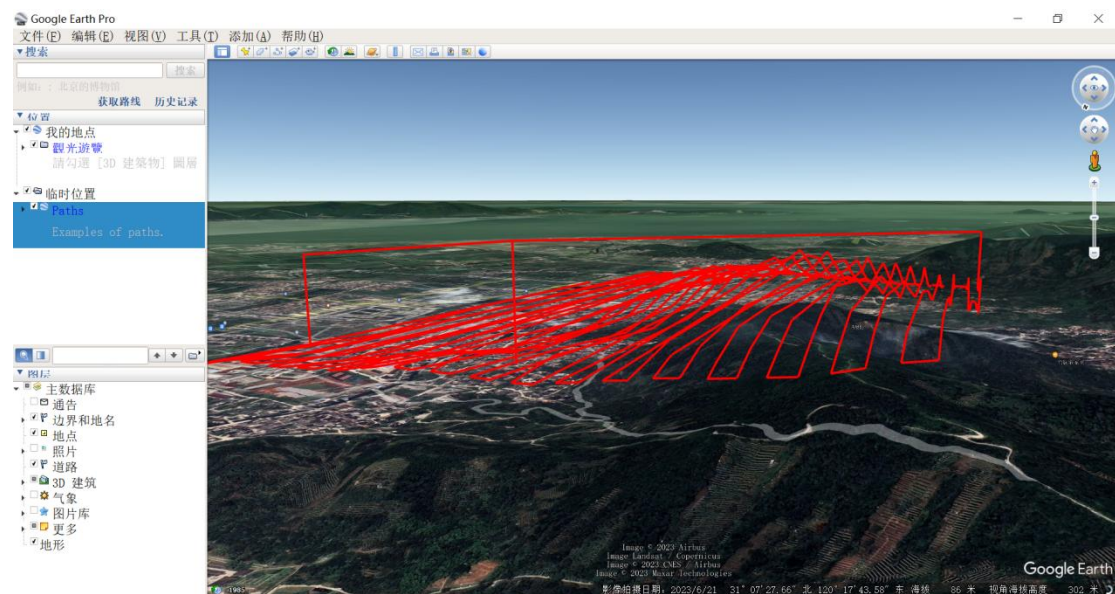
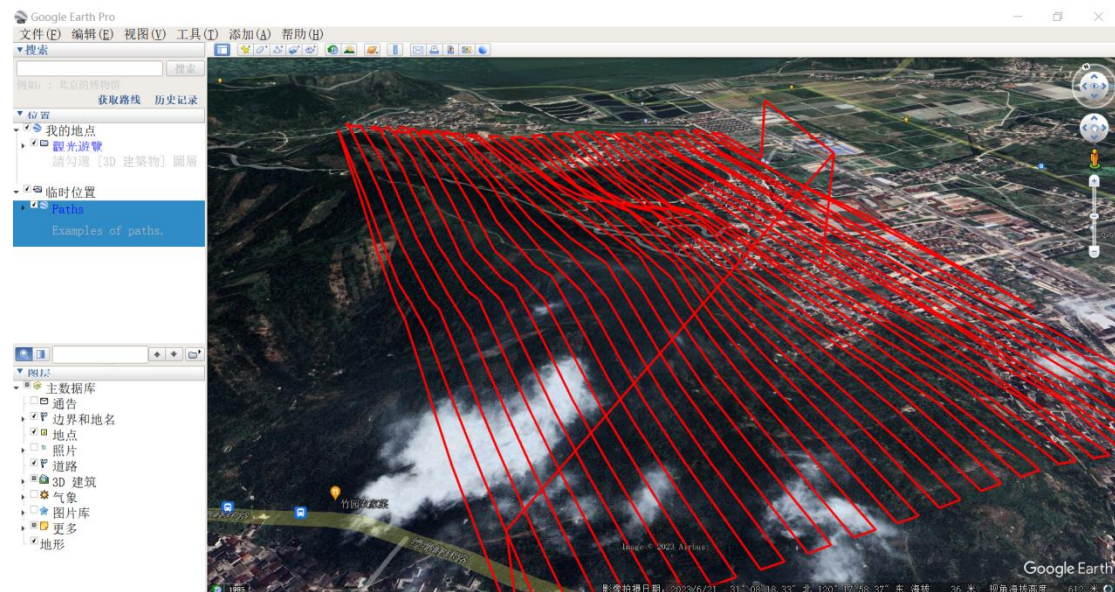
The recommended setting for "Alt Difference" is 15-20% of the course altitude.

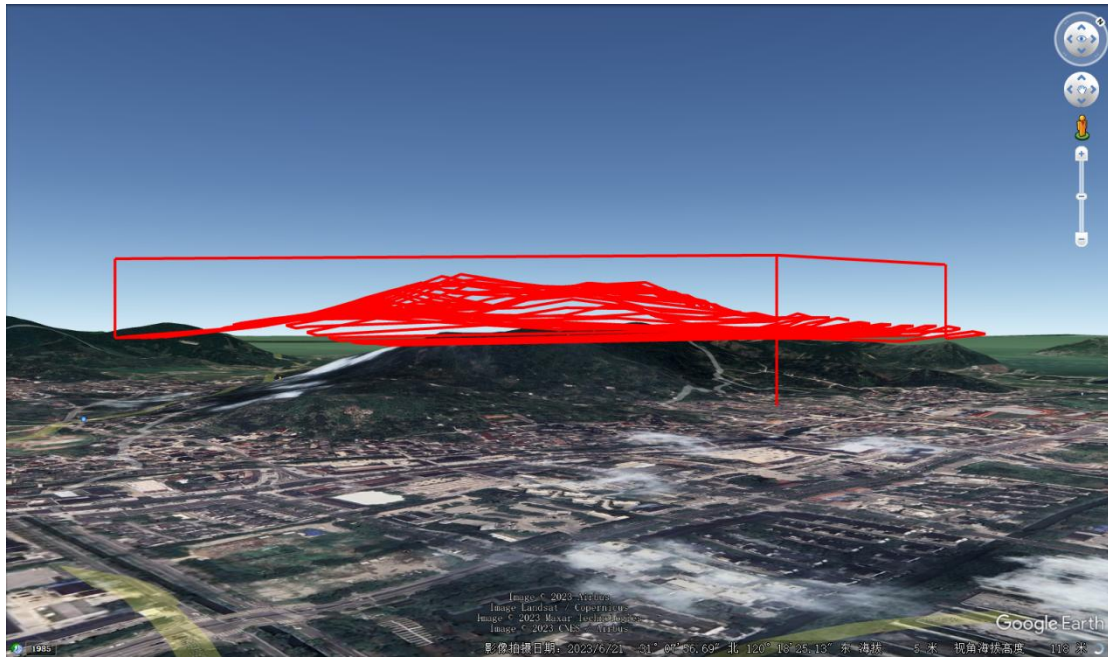
In this example, the altitude of the route ranges from 5m to 131m, so according to the recommended setting, the parameter "Alt Difference" can be set between 18.9m and 25.2m. The choice of a specific value can be determined by the actual complexity of the terrain and the need for mapping accuracy.



Viewing the 3D position of a route in Google Earth using the "3D View" feature provides you with

a three-dimensional view, allowing you to better understand and check the position of the route in the actual terrain.





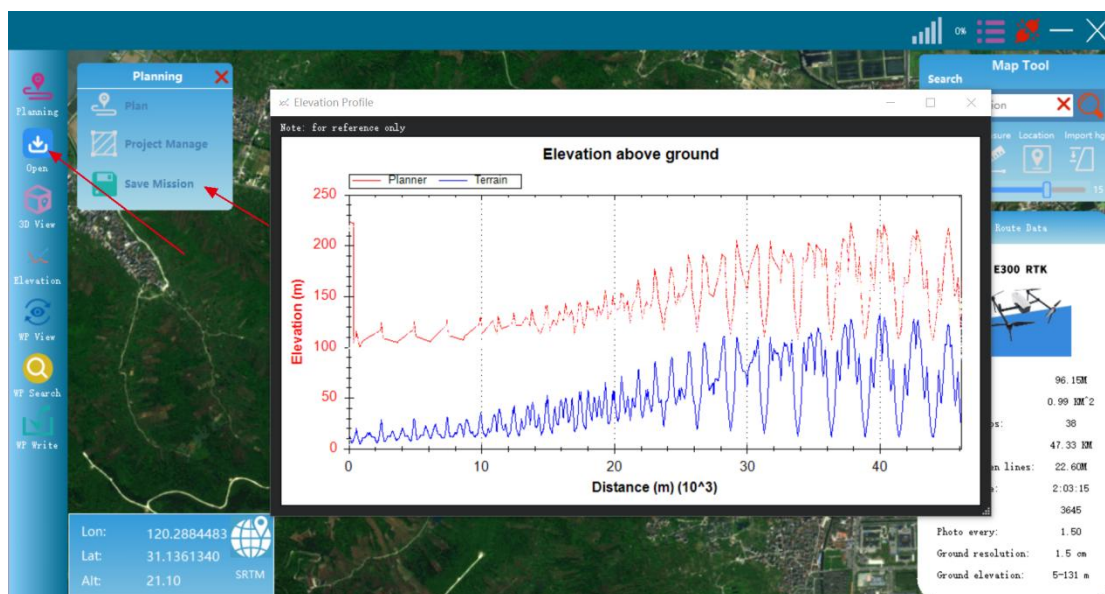
During flight, the UAV's obstacle avoidance function plays a crucial role, especially when the altitude reaches 50m and above. The following is a description of the workflow of this function:

When the UAV is in flight, the obstacle avoidance function is activated once its flight altitude exceeds 50m.

If the distance between the UAV and an obstacle is reduced to 25m, it will immediately activate the braking mechanism and trigger the return program.

To ensure safety, the UAV will first climb to 30m, and then fly back according to the predetermined return route. After returning to the take-off point, the UAV will perform a landing operation to ensure its safe landing.

1.9 Check Elevation above ground



Check that the course altitude is always above the terrain altitude before flying, and check the flight path for tall buildings. The system may not record the terrain of buildings.

1.10 Task saving and recall



After completing the route planning, in order to ensure the continuity of subsequent flights and to facilitate reuse, you can utilize the functions provided by the software for task saving and recall.

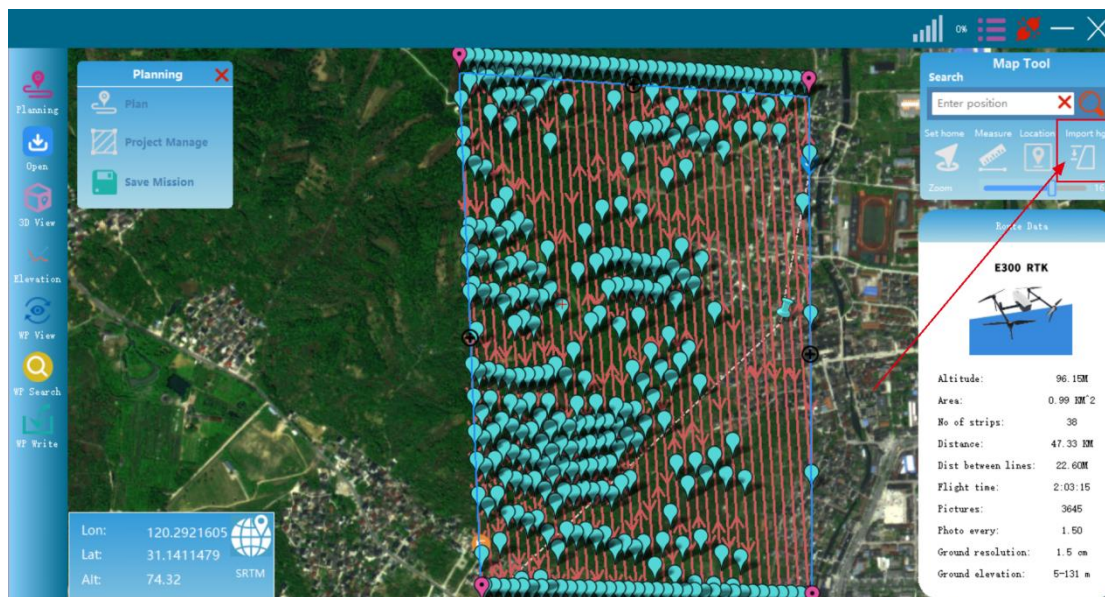
1. Save mission: After completing the route planning, click the "save mission" button directly to save the current mission data into the system. This not only provides a convenient way for future flight resumption, but also serves as a backup in case of unknown errors or unexpected events. **2. call saved mission:** If you need to call a previously saved mission, you can do so by clicking "save mission" button.

2. Recall a saved mission: If you need to recall a previously saved mission, simply click the "open" button and select the previously saved mission from the list to load. This will quickly return to the previous flight state, saving you time and labor in re-planning.

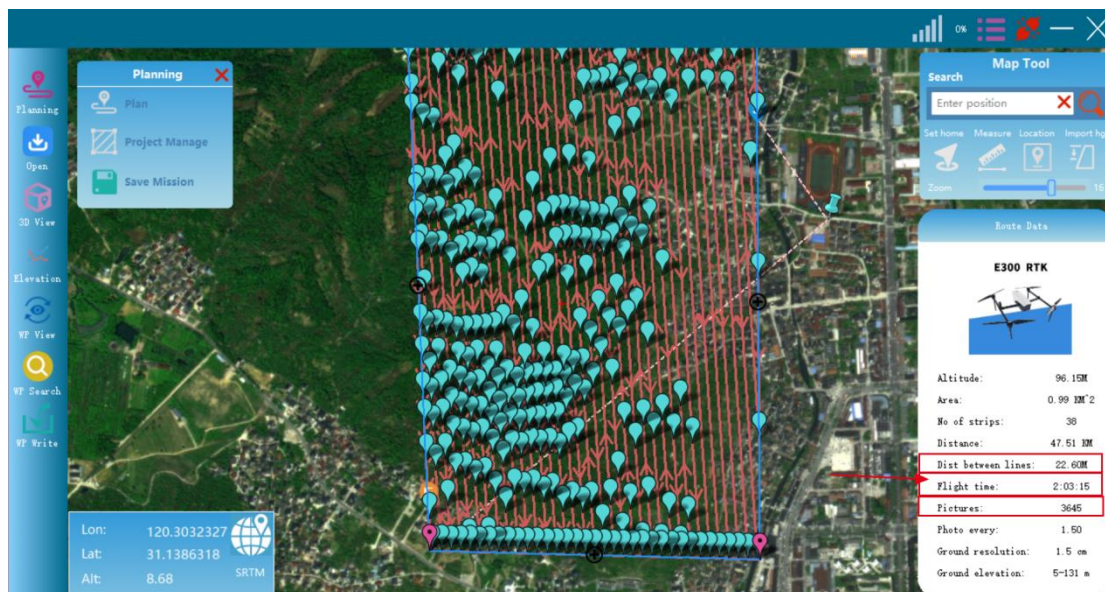
3. Write Task to Aircraft: After the task is planned and confirmed, you need to pass this information to the UAV. Click the "WP Write" button to write the planned mission data to the aircraft's control system. This step ensures that the aircraft follows your predetermined route and parameters during flight.

Ensure that mission writing is done before each flight to ensure that the drone is operating according to the latest instructions, thus increasing the safety and accuracy of the flight.

1.11 Manual import of DEM base map function



If the elevation information that comes with the software does not meet the mapping needs, you can manually import the DEM as a base map.



1.12 UAV endurance

Understanding the endurance of a UAV is key to route planning and flight missions. To do this, actual flight tests can be done to get the actual battery life. Below is a compilation of the data provided and suggested steps:

1. Actual flight test:

- Start the mission and monitor the battery level at all times.
- Allow the aircraft to trigger the default return function when the battery level falls below a certain threshold to ensure that the UAV can return safely.
- Record the total time from the start of the flight to the return trigger, that is, the actual

range time.

2. Endurance time data:

- Five-lens camera: During flight, when using a five-lens camera, the battery life is approximately 40-45 minutes. Once the flight time approaches this range, the UAV will automatically trigger the return program.
- Ortho-lens: When using an ortho-lens, the UAV has a range of 1 hour.

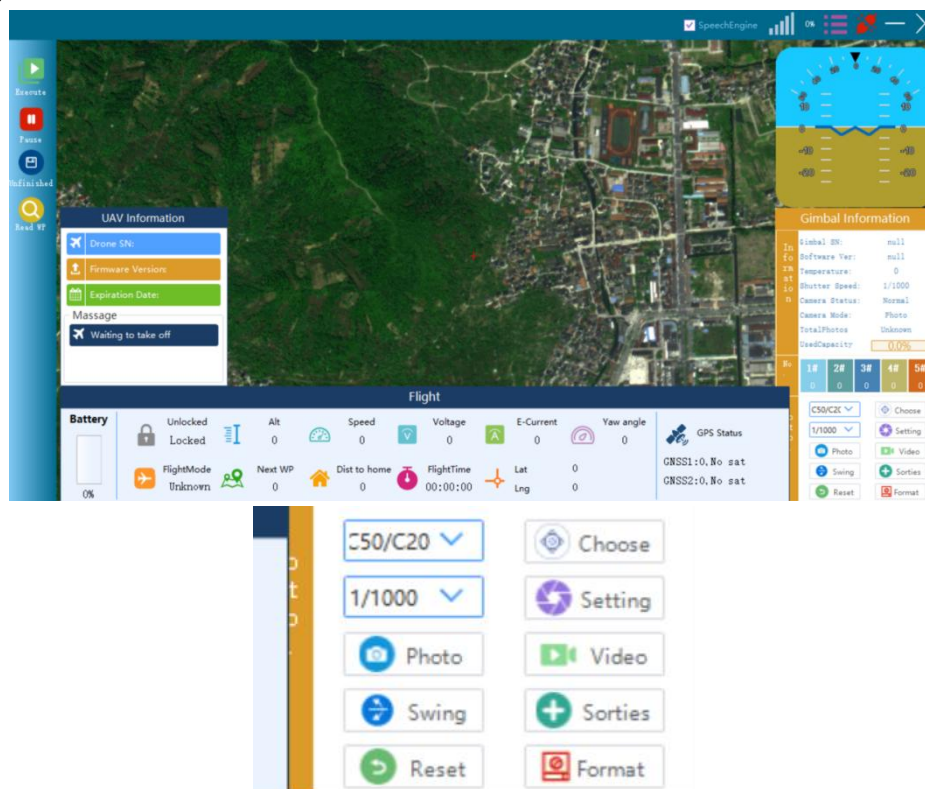
3. Follow Terrain flight considerations:

When performing Follow Terrain, this will consume additional power due to the need for frequent altitude adjustments to adapt to terrain changes. Therefore, it is recommended that an additional one-third of the range time be added to account for this. For example, if the original endurance is 40 minutes, the recommended flight time should be adjusted to 60 minutes after considering the effects of terrain-mimicking flight.

To ensure the safe flight of the UAV, it is recommended to always reserve a certain amount of power as a buffer and to conduct regular real-world flight tests on the UAV to obtain the most accurate data on endurance time.

2. Flight interface

2.1 Exposure time



Changing the exposure time is one of the key ways to affect the parameters of a photograph. Exposure time, also known as shutter speed, determines how long the image sensor is exposed to light. The length of the exposure time directly affects the light and darkness of the photo and how well it captures motion.

Suggestions for adjusting exposure time for different weather conditions are as follows:

1. Cloudy:

- Recommended exposure time: 1/1000 second

- Reason: In cloudy conditions, the light is weak and a proper extension of the exposure time can help capture more light and make the photo brighter.

2. Normal weather:

- Recommended exposure time: 1/1250 second (default setting)

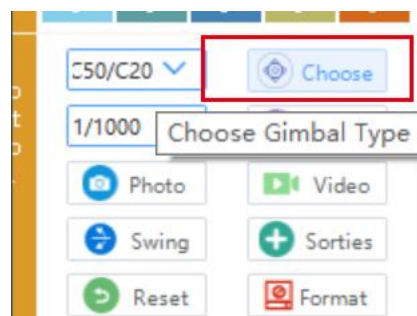
- Reason: In normal weather conditions, an exposure time of 1/1250 second is sufficient to capture the right amount of light and ensure that the photo is properly exposed.

3. Strong sunny weather:

- Recommended exposure time: 1/2000 second

- Reason: In very strong sunlight, the exposure time should be shortened to prevent overexposure of the photo. 1/2000 sec. can effectively reduce the time the sensor is exposed to light and ensure that the photo is not overly bright.

Flexibility in adjusting the exposure time to the actual light conditions is the key to ensuring the quality of your photos. For best results, it is recommended to conduct field tests in different weather conditions to find the most suitable exposure time setting.



After modification, you must tap Choose button to save. And take two photos manually by tapping Photo before taking off to test if the photos can be taken properly.

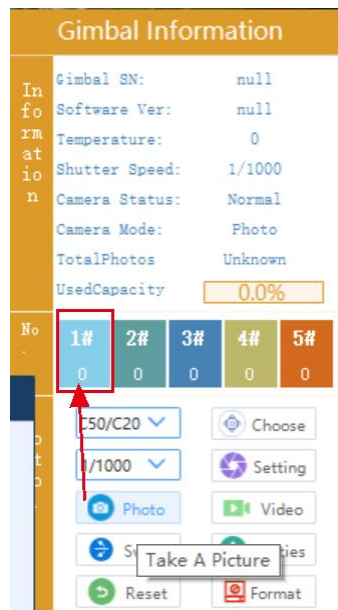
Ensuring the correct exposure time setting and testing the shooting function are both necessary steps for conducting drone aerial survey before flight.

1. Set the exposure time:

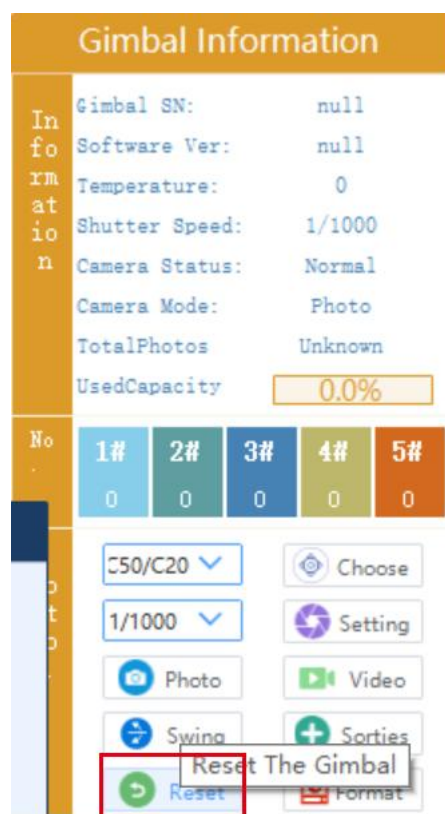
After changing the exposure time, in order to ensure that the new settings will take effect, the user must click the "Choose" button to save. If this step is ignored, the changes may not be saved. 2.

2. Test the shooting function:

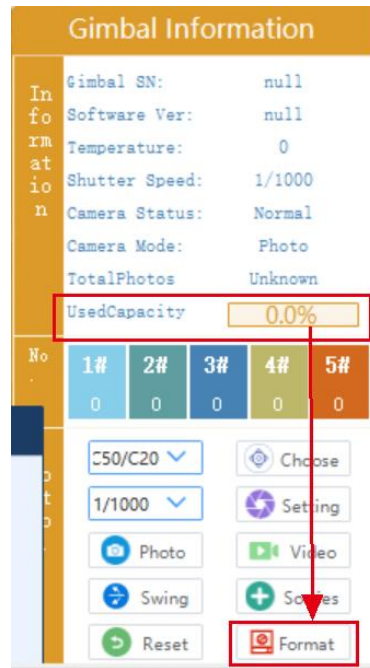
In order to verify that the camera is working properly, it is recommended to take a test shot manually before taking off. Click on the "Photo" button to take two photos, then check that the number of photos under the camera increases and that the quality of the photos is as expected and that all camera functions work properly.



Performing these checks in advance avoids encountering unforeseen problems during the flight, thus ensuring that high quality mapping data is obtained.



If one of the cameras stops taking pictures, click the "Reset" button and restart the airplane.



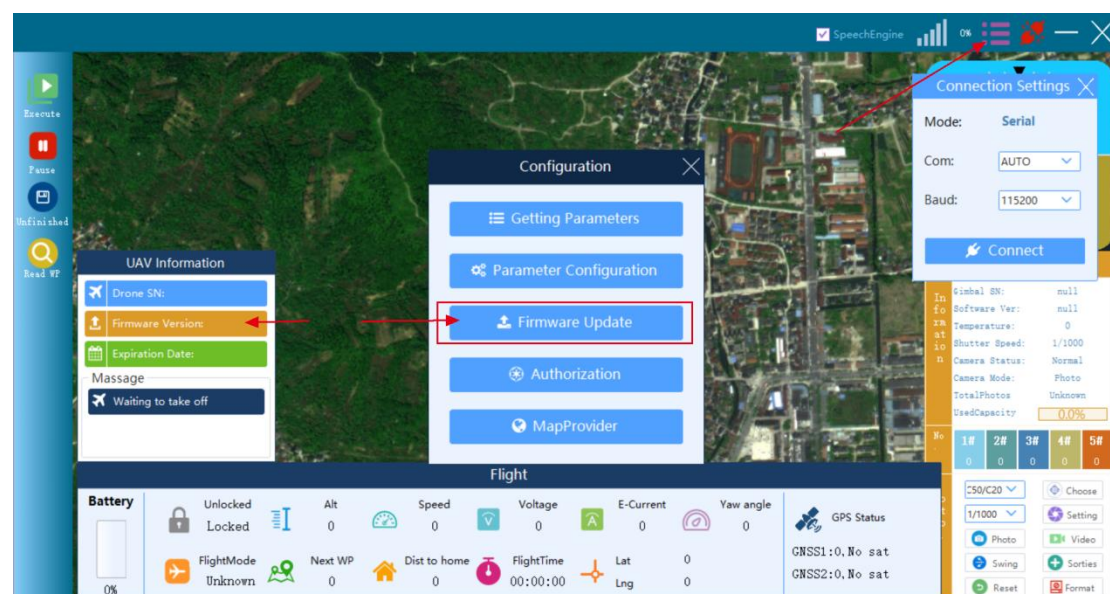
2.2 Format Function

Using the "Format" button you can quickly erase all photo data from the camera and free up enough storage space for a new mission. However, special care should be taken when performing this operation.

Be sure to check and save all important photos and data before formatting. Once data is formatted, it will not be recoverable and may result in data loss or loss of important information.

Before each flight, you should check the camera's storage capacity to make sure there is enough space to store new mapping photos. This step will prevent data loss due to insufficient storage space while the mission is in progress.

2.3 Firmware Upgrade



After connecting the airplane, click on Firmware Upgrade and select the firmware to be upgraded.

PLEASE NOTE: Before starting the firmware upgrade, make sure the airplane is completely shut down and powered off to avoid possible firmware corruption or device failure.

2.4 Point Break Flying Function

The breakpoint renewal function ensures the UAV's mission continuity in different situations, especially in long time or large area mapping missions.

Breakpoint renewal flight operation process:

1. Read the route:

Only one route is stored in the flight control. When needed, the route can be read, especially when performing breakpoint renewal.

2. mission interruption:

If the airplane needs to be interrupted and return to flight for some reasons (e.g., low battery), perform the following actions:

- Do not click on "Pause": Selecting "Pause" will stop the aircraft immediately without performing any subsequent maneuvers.

- Click on "End Mission": this will interrupt the current mission and allow the aircraft to begin the return procedure. This will also be done automatically if the airplane is low on battery power.

3. Aircraft Return:

At the end of the mission, the airplane will automatically return to the airport and land.

4. Battery Change:

After the airplane is landed and locked, the battery is changed in preparation for the next flight.

5. Break Point:

To continue an unfinished mission, click the "Unfinished" button. The system will automatically save and read the unfinished part of the route, and then automatically upload the route to the flight control.

Through this process, the drone can easily continue an unfinished mission after an interruption, increasing productivity and data integrity. Ensure that each step is followed correctly to ensure safe flight and mission continuity.

2.5 Manual operation of the E300

Note: The E300 can't change the landing site, if you want to adjust it, you can only land manually by remote control.

Manual operation is an important mode in UAV flight, especially when automated tasks cannot be accomplished or are deviated from.

Manual drone operation process (no remote control version):

1. Keypad control:

- Use the keyboard to simulate remote control operation, but please note that there may be some delay in this operation.

- WASD: corresponds to the basic movement control of the airplane.
- RF: corresponds to the elevation of the airplane. r is rise, f is fall, but the airplane will not completely land on the ground, only within a certain range.
- Y: confirm landing.

2. If you touch the software interface by mistake:

- If the software interface is touched by mistake during the flight, the airplane will enter the "Guidance Mode", in which the operation prompts will be popped up.
- In this mode, the aircraft will terminate the current mission and hover in the air.
- In this mode, the aircraft will terminate the current mission and hover in the air. If you want to continue the mission, just click the "Continue" button.

3. Manual Operation Scenario:

- For example, when the automatic positioning of the aircraft is inaccurate or there is an offset when landing, you need to adjust the landing position manually.

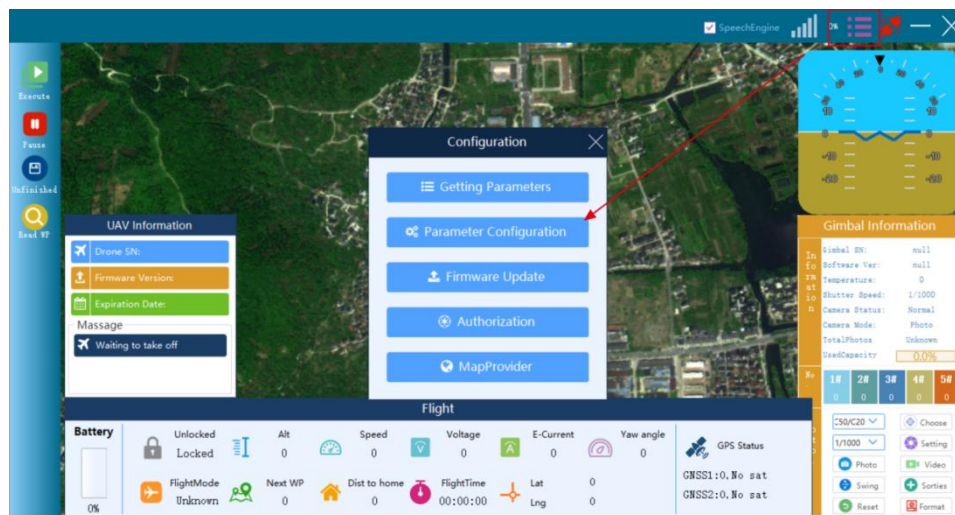
4. View flight sensor data:

- Use Ctrl+E shortcut to bring up the "Vibrate Box" to view flight data and parameters, such as gyro and magnetic compass data.
- If you are worried about accidentally touching other functions, you can use Ctrl+E to switch to the "Vibrate Box" interface specifically for viewing and operating.

This manual mode of operation requires a certain degree of flight experience and reflexes, especially in emergency situations. It is recommended to practice manual operation in a safe environment to familiarize yourself with the various functions and operations to ensure that you can respond quickly and accurately in real flight.

3. VH2 Radar with E300

Note: To use the VH2 radar please read the VH2 radar manual first.



3.1 Parameter Configuration

There is an 8-word parameter when using radar mount - Adjust radar parameters. -Import the parameter file directly. Usually it has been set at the factory and no change is needed by default.

3.2 Flight path setup

When using the VH-2 radar for aerial survey missions, there are some key operational and configuration recommendations that must be followed to ensure data quality and flight safety. Below you will find the precautions and their explanations:

1. Flight altitude:

- The altitude should not exceed 120m as higher than this may result in degradation of data quality or poor reception when vegetation cover is present.

2. degree of overlap:

- The radar's heading overlap degree does not have a significant effect on data collection and can therefore be left at the default value of 80%.

- The degree of side-to-side overlap varies according to requirements:

- If orthoimage data needs to be acquired and assigned color, the bypass overlap should be set to 35%.

- If no color data is required, only the bypass overlap should be set to 30%.

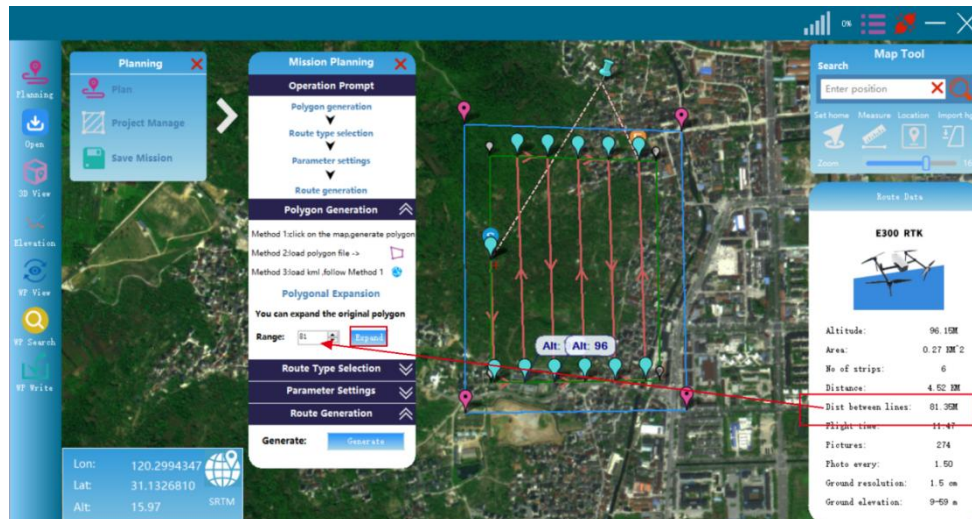
3. Flight Speed:

- Flat terrain: Recommended flight speed is 8m/s to 9m/s.

- Flat terrain: Recommended flight speed is 8m/s to 9m/s. Areas with trees or other obstacles: Recommended speed is 6m/s to 7m/s.

4. Extended flight path:

- To ensure data quality in marginal areas, it is recommended that the flight paths be spaced out by a distance, typically 80m.



5. Radar calibration:

- The VH-2 radar automatically performs a figure-of-eight motion to calibrate its IMU at the beginning and end of the voyage to minimize errors and ensure accurate data.

6. Route Length Recommendation:

- To ensure data continuity and minimize calibration errors, it is recommended that the length of each route be kept within 100m.

3.3 Radar mount parameter configuration (default factory configured, no need for user modification)

1. Quick Configuration: Quick import using a parameter file specifically set for the radar to simplify the parameter configuration process (default configuration is already done at the factory).

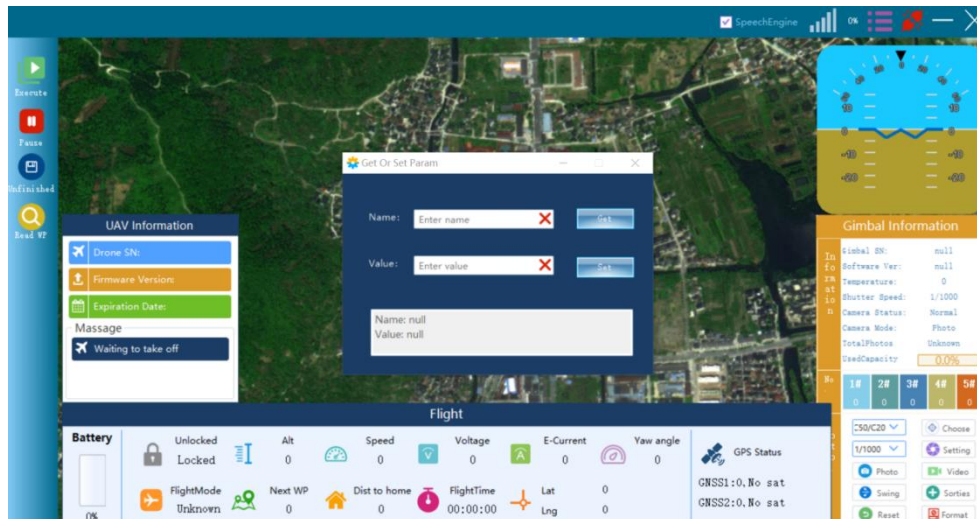
2. Manual configuration:

- Shortcut key: Use `Ctrl + Alt + O` to enter the parameter setting interface.
- The operation process:
 1. Input the parameter name to be modified.
 2. Click the "Get" button, the software will display the current parameter value.
 3. Modify the parameter value as needed.
 4. Click the "Set" button to complete the parameter change.

3. 8 Character Parameter Setting (ZR_8_CICLE):

- 0: Turn off this function, usually select this setting when the camera is mounted.
- 2: Enable this function, it needs to be enabled when performing radar mapping.

To ensure the accuracy and safety of the mapping, please check the parameter configurations carefully before each mission to make sure they match the mission requirements and the mounted device. Especially when changing the mounted device, be sure to change the parameters according to the actual needs.



3.2 Radar version of aircraft remote control map transmission

1. Radar camera:

- The front camera of the radar version of the UAV is primarily used to display flight mapping and is not responsible for mapping or other functions.
- This camera is specific to the radar version remote control only and provides a live video stream in flight to help the operator obtain real-time terrain and environmental information while in flight.

2. H12 Assistant Software:

- This software is built into the radar version of the remote control and is used to assist in flight operations and monitoring.
- The operator can view real-time video and photographic footage transmitted from the camera in front of the aircraft.

3. VH2 Remote Control

GPS Mode-The upper two gears. The leftmost gear is Attitude Mode.

4. Common Errors and Solutions

4.1 GPS problem prompt:

- Description: After powering on the device, it prompts "GNSS1 position offset", indicating that there is a deviation in positioning.
- Solution: Wait for a few moments in the open area, in most cases the problem will disappear automatically.

4.2 Proximity sensor error

- Description: Before takeoff, the radar obstacle avoidance module recognizes a nearby obstacle.
- Solution: Adjust the orientation of the aircraft to keep it away from the obstacle and restart the aircraft, the reported error will usually disappear.

4.3 Mission Mode Switching Failed

- Description: The toggle of the remote control is used for mission mode switching, if it is set wrongly, it may lead to failure to unlock and "Mode Switching Failed".
- Solution: Before takeoff, make sure the flight mode has been switched to satellite positioning mode.

4.4 Low Voltage Fault Protection

- Description: When the aircraft's battery voltage is too low, the return-to-flight procedure will be automatically initiated to prevent accidents.
- Solution: Fully charge the airplane and make sure the battery is in good condition. The default setting is below V20.5 to initiate a return to flight, but it is recommended to check and confirm the setting periodically.

4.5 Geomagnetic anomalies

- Description: The aircraft's compass detected an anomaly in the geomagnetic field.
- Solution: Perform a compass calibration operation in the aircraft settings.

When conducting flight operations, it is recommended that operators familiarize themselves with a variety of tips and solutions to common errors to ensure safe and accurate flights. System checks and environmental assessments prior to flight can be effective in preventing many common problems.

5. Guidelines for checking flight data fields

The Flight Data field provides the pilot with the real-time status and key parameters of the UAV in flight. The following are important references and checkpoints:

5.1 Battery Level

- DESCRIPTION: Displays the current battery level of the drone. It is an estimated value and is used for reference.
- NOTE: While the power level is a good reference, the voltage should be used as the primary reference in flight decisions.

5.2 Voltage

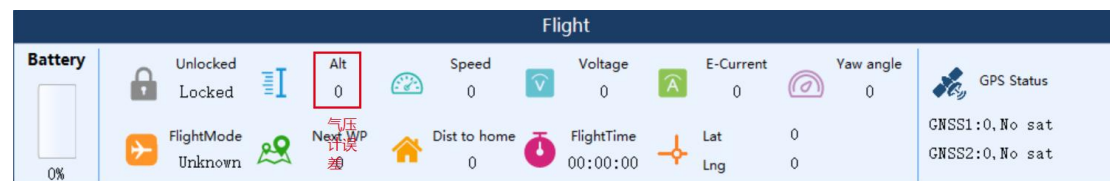
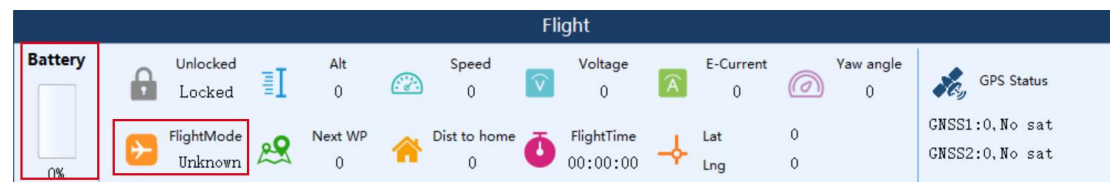
- DESCRIPTION: Displays the real-time voltage of the UAV battery.
- Reference value: for a 6S battery, the voltage is 25.2V at full charge.
- Note: During flight, check the voltage regularly to ensure it stays within a safe range. Low battery voltage may cause the drone to suddenly lose power.

5.3 Flight Mode

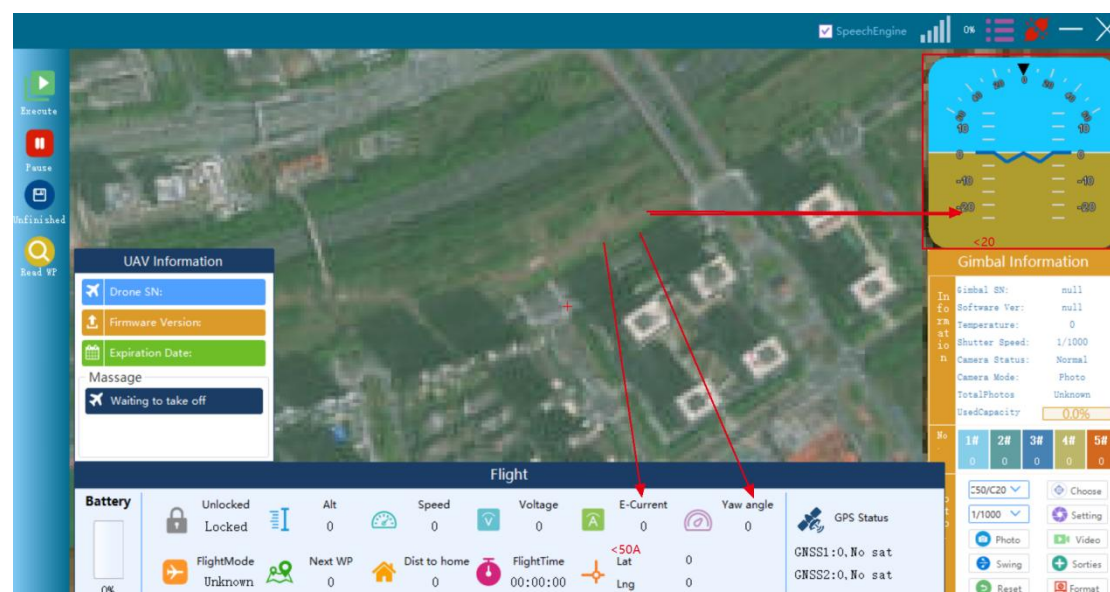
- Description: shows the current flight mode of the UAV.
- Common Mode:
 - Return: the UAV will automatically return to the predetermined takeoff point or the set return point.
 - Manual: The pilot can control the UAV directly without being constrained by GPS or other auxiliary systems.
 - Satellite Positioning: The drone relies on GPS and other satellite systems for stable flight.
 - Mission Execution: The drone flies automatically on a preset mission course.

Always ensure that the UAV is in the correct flight mode, especially when performing automated missions or manual control transitions.

Before conducting a flight, the pilot should perform a thorough check of the flight data fields to ensure that all parameters are within normal and safe limits. It is also important to check the flight data regularly during the flight to prevent any undesired situations.



Note that Alt shows the barometer fix height, which may have 10m error, GPS position is recommended.



5.4 Current and Wind Speed

- DESCRIPTION: Current can be used as a reference to determine wind speed. When the current is too high, it may mean that the airplane is struggling to remain stable against the wind.
- Safety standard: Current must be less than 50A; flight inclination less than 20 degrees.
- Action Suggestion: If the real-time data exceeds the above criteria, it is recommended to return to the flight immediately to avoid unstable flight or excessive battery depletion due to strong winds.

5.5 Number of Satellites

- DESCRIPTION: UAVs use satellite signals for positioning, and the number of satellites is directly related to the accuracy of positioning.
- Types of satellites: GNSS2 is for RTK positioning, which can generally reach 40-50 satellites; GNSS1 is for single-point status, with a relatively small number of satellites.
- Safety Standard: At least one kind of satellite has reached 13 satellites before the airplane can be unlocked for takeoff.
- Action Suggestion: Observe the change of the number of satellites, if you find a sudden decrease in the number of satellites, you may be subject to some kind of interference and should consider returning to the flight.

5.6 Gyro and Magnetic Compass Data

- Checking method: Press Ctrl+E to pop up the vibration box during flight to check the relevant parameters.
- Safety standard: parameter value is not higher than 0.5.
- Interference situation: mainly originated from magnetic compass interference. When subjected to large interference, the data increases instantly and the airplane may experience flight anomalies.
- Action Suggestion: If you find the magnetic compass data abnormal, you should immediately switch to the return mode. Once the aircraft leaves the interference area, it will usually return to normal on its own and continue back to flight.

Real-time monitoring of flight data must be maintained during flight to ensure that the flight is conducted under safe conditions. Any abnormal data can mean an increase in flight risk, so timely response and decision-making is critical.

6. Sensor Calibration

6.1 Gyro Calibration

- Purpose: To ensure that the airplane's attitude perception is accurate and to prevent the airplane from tilting or rotating unnecessarily in the air.
- Check Method: On the flight interface, observe whether the gyro indication is in a horizontal position.
- Operation: If you observe that the gyro indication is not horizontal, you need to enter the calibration section of the setup interface. Follow the prompts and animations in the software to calibrate the gyro.

6.2 Magnetic Compass Calibration

- Purpose: To ensure that the aircraft can accurately sense the geomagnetic field and thus maintain the correct heading.
- Check method: Check the magnetic compass reading. If the reading consistently exceeds 0.5 and turns yellow, it means calibration is required.
- Action: Perform a magnetic compass calibration in the setup screen. Although the system may not always report an error, always ensure that the magnetic compass has been properly calibrated for safe flight.

6.3 Flight Pointing Line and Yaw Angle Calibration

- Purpose: To ensure that the airplane flies in the same direction as its preset course.
- Check Method: On the flight interface, observe the yaw angle of the flight pointing line. Use a compass to measure the angle between the airplane and the north, and compare it with the compass function of the cell phone.
- Standard: The error between the two measured angles should be within 30 degrees.
- Operation: If the error is more than 30 degrees, it is recommended to re-calibrate the magnetic compass and make sure that there is no strong magnetic interference in the flight environment.

The above check and calibration work should be carried out before each flight, especially after a change of flying site or a crash, to ensure the flight performance and safety of the airplane.