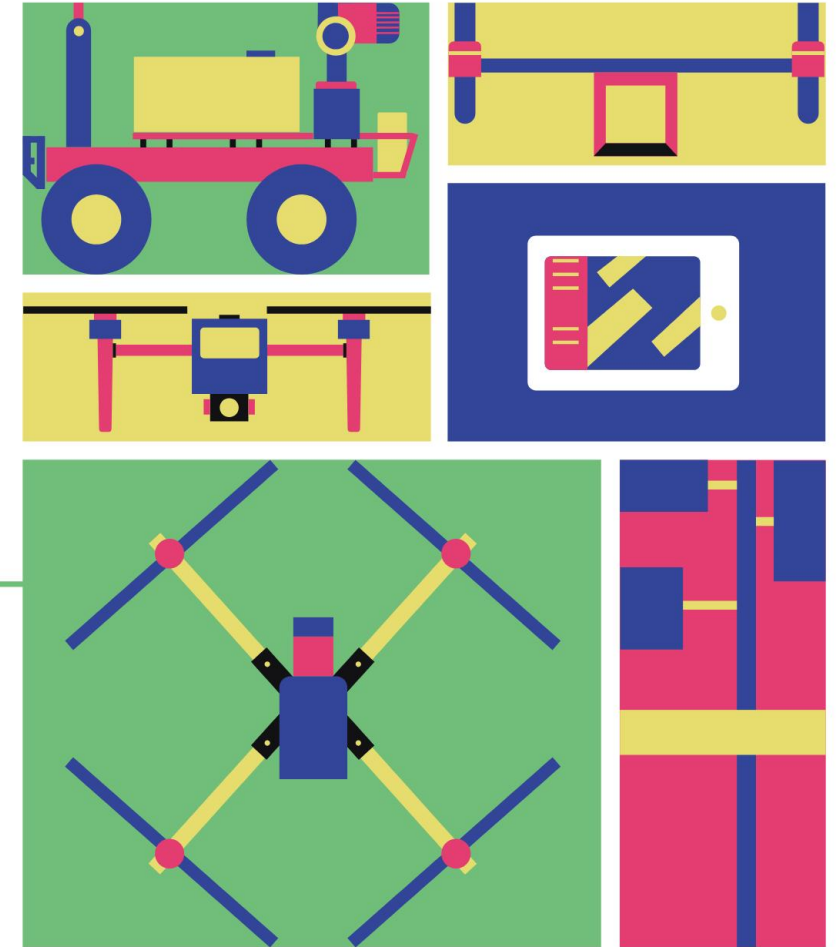


Flight data analysis and flight accident cases



Topic

01 | 1、Flight control principle

02 | 2、Use and explanation of software

03 | 3、Data analysis logic

04 | 4、Case study



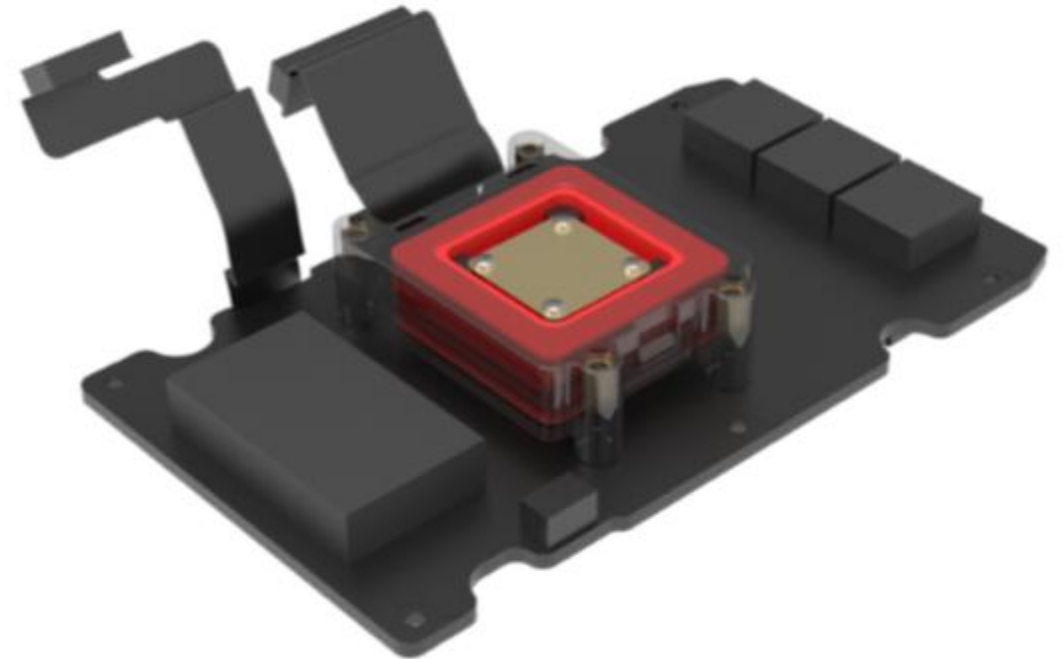
Topic 1

—、Flight control principle

Update of intelligent control system



Chip(brain)



IMU(cerebellum)

Main programs components of FC software



Chip(brain)

TPS : Responsible for task management and communication with APP on behalf of devices ;

NAV : Responsible for processing sensor data (forward radar), making decision calculation (obstacle avoidance, two-point planning, etc ;

Spray : Responsible for managing spraying and spreading system, including spraying and spreading business and fault management;

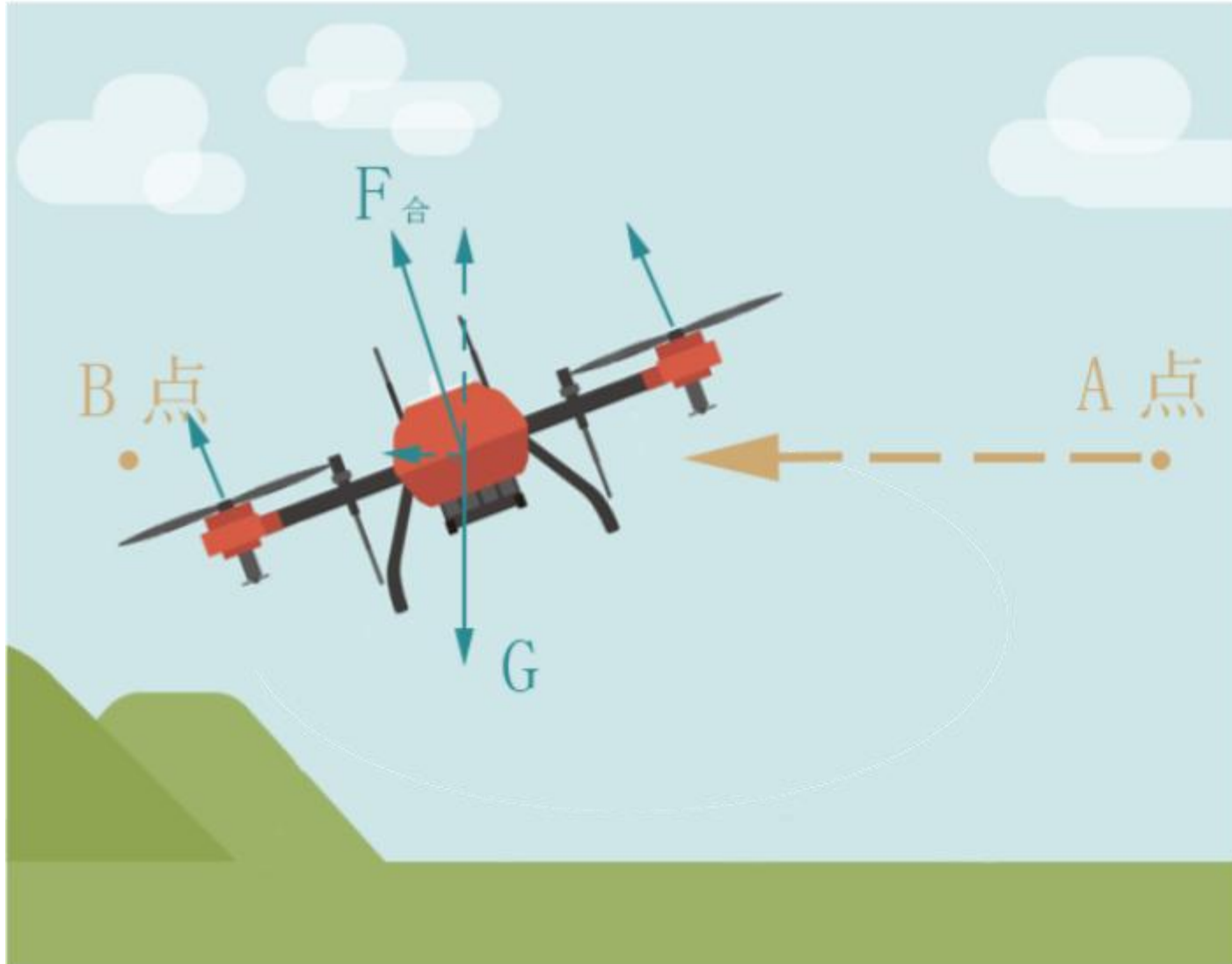
BMS : Manage the battery module;

Router : Manage the communication between the Chip and IMU ;

Xnet : Responsible for network communication management at service level ;

DLS : Responsible for data loop management;

Flight control process of Drone



Motor RPM change

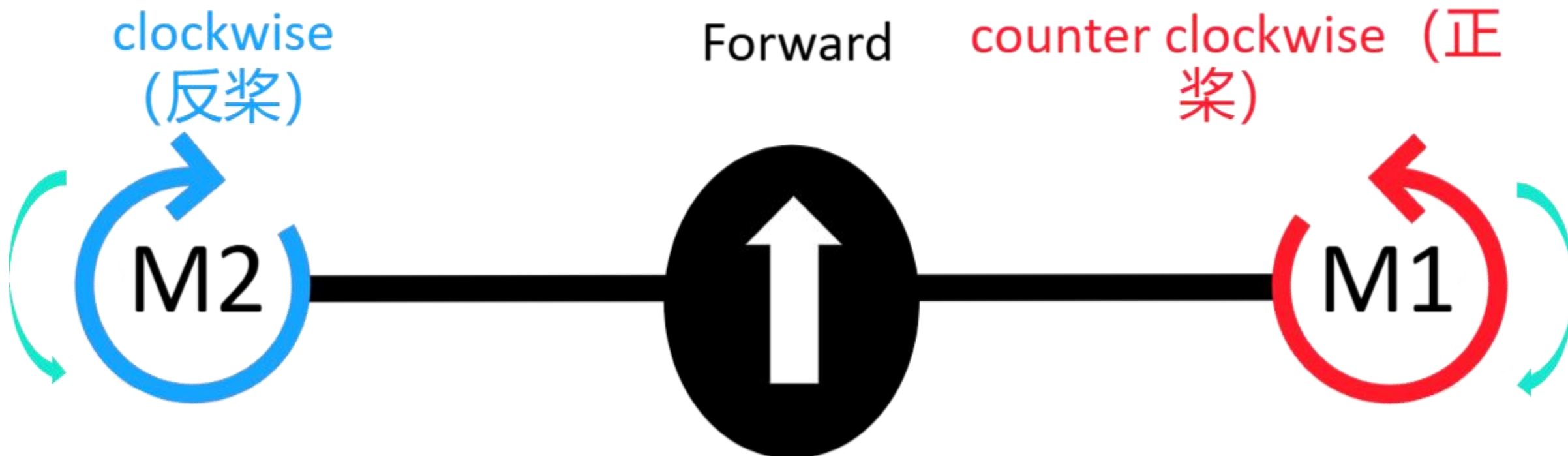
Motor lift change

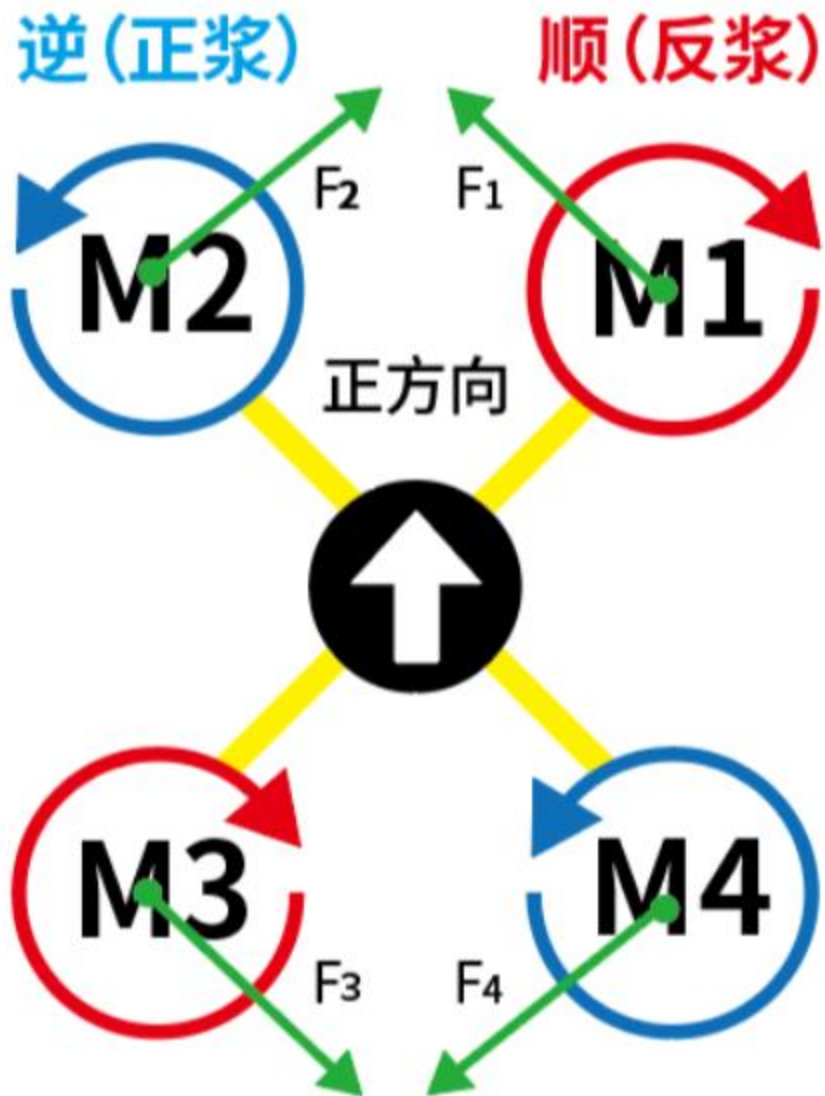
Drone attitude change

Applied force on body

Velocity change

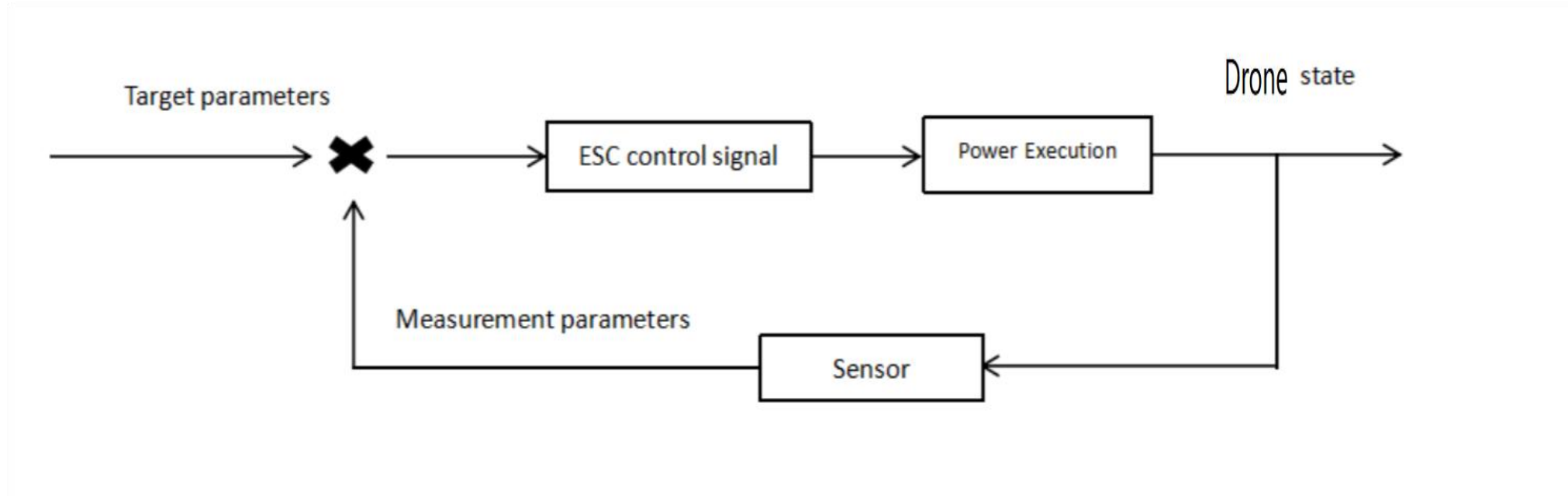
Drone position



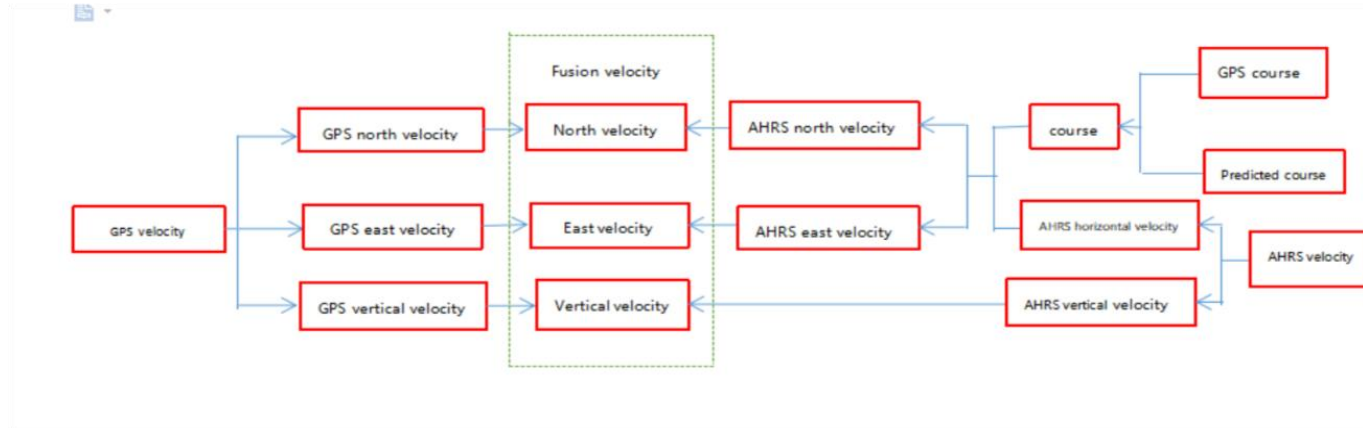


During the normal flight of Drone according to Newton's third law - force and reaction , while the motor drives the propeller to rotate, the propeller will also bring torque to the motor in the opposite direction of rotation.

Feedback Control Principle of Flight Control



Method for calculating velocity in flight control

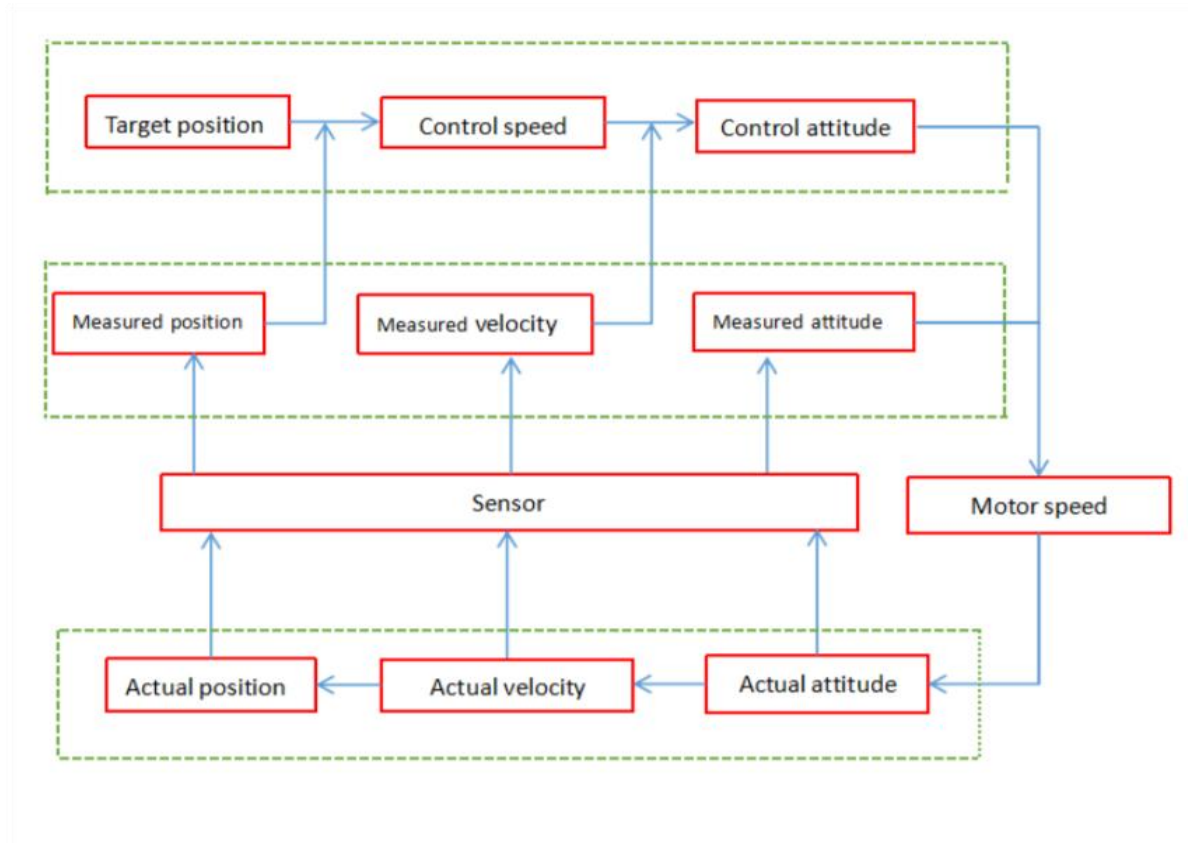


Horizontal velocity can be divided into east velocity and north velocity

GPS horizontal velocity + AHRS horizontal velocity $\xrightarrow{\text{yaw}}$ horizontal velocity
After fusion

GPS vertical velocity + AHRS vertical velocity $\longrightarrow$ Vertical velocity

Basic flight control operating principles diagram



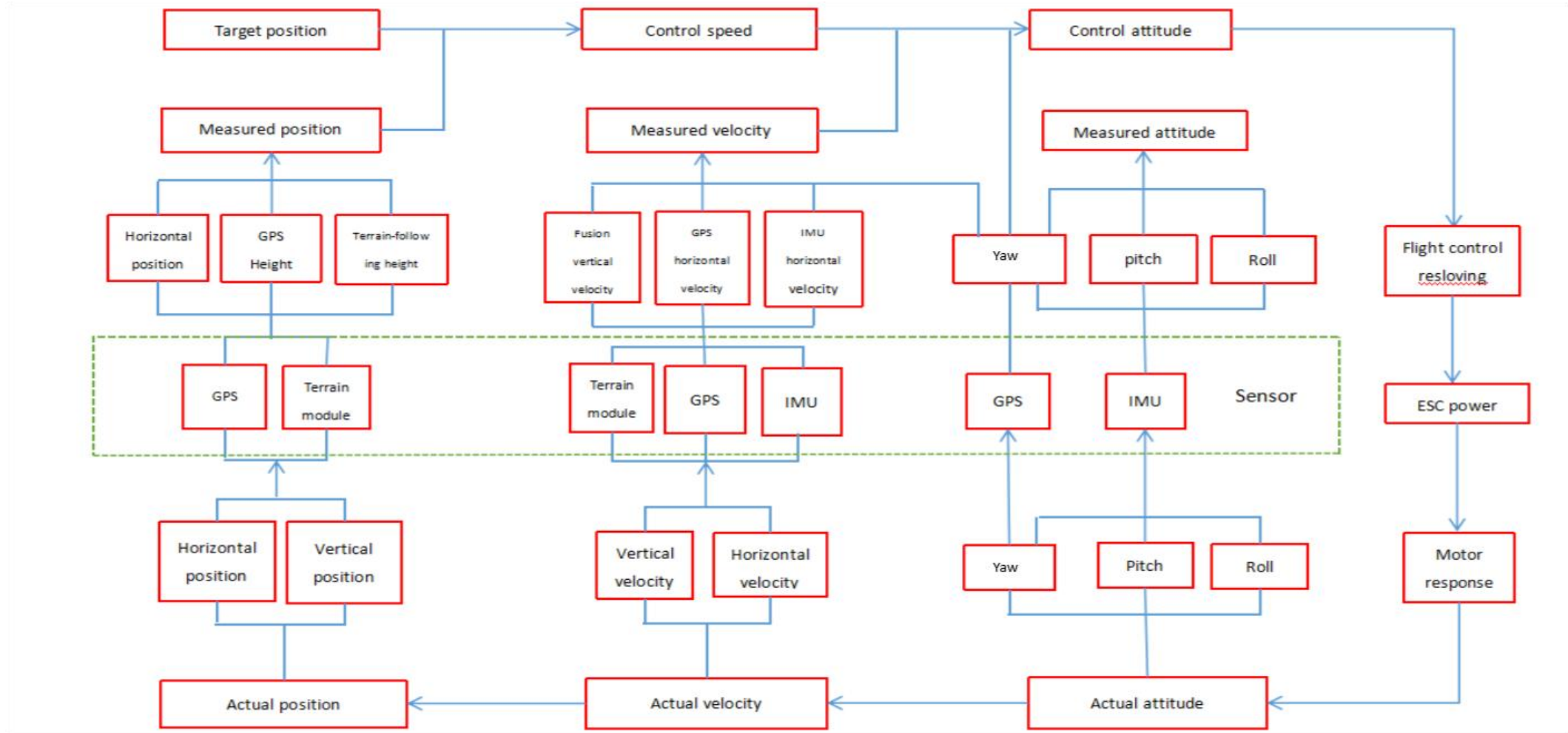
① Flight control resolving principle

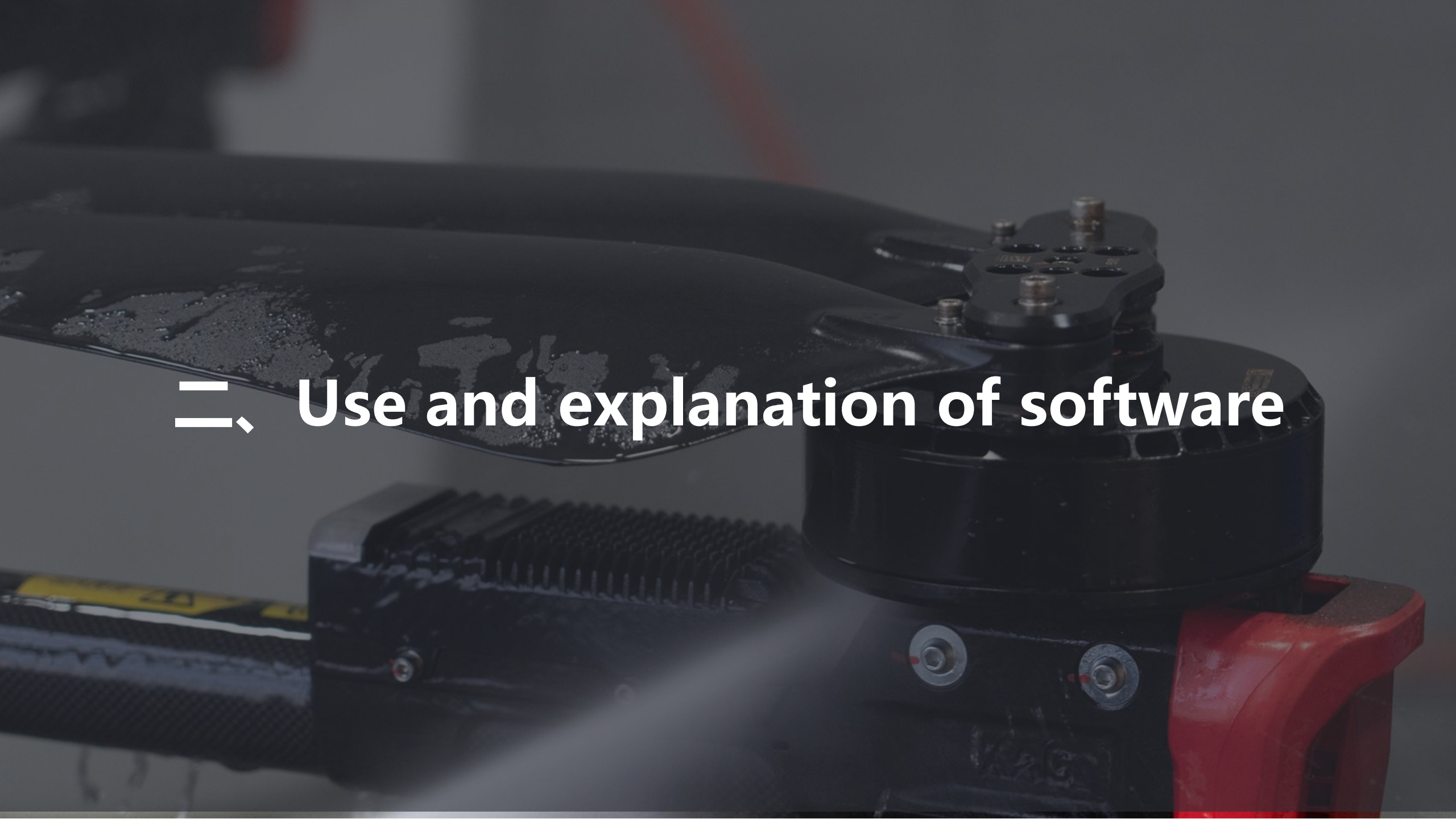
② What are the target state parameters, measured state parameters and actual state parameters?

③ What is the relationship among position loop, velocity loop and attitude loop?

※ The motion parameters measured by UAV are not necessarily equal to the actual motion parameters of UAV.

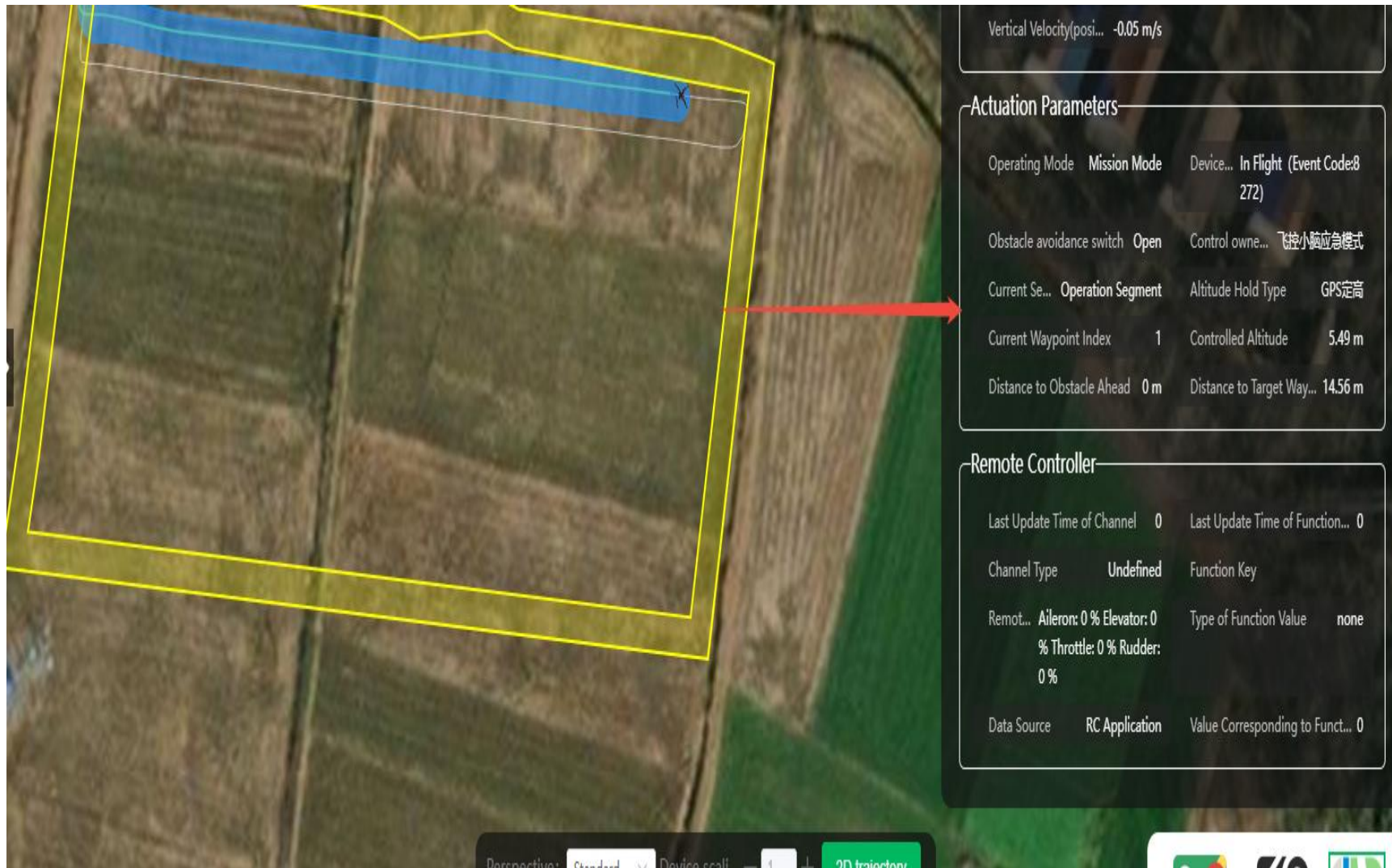
Detailed control relationship for Drone





二、Use and explanation of software





Flight Controller Sortie Parameters [Flight Controller ID - 3030302E3030303030302C32]

Expand all

架次时间戳

Module Merge Type: 合并到a_log, 展示模块内有数据的帧

Module display timestamp type: a_log的时间戳

a_vcontrol_store, the module is not added to the chart

i If some charts are not displayed and the corresponding modules are not missing, you can switch to Module Merge Type - Module Original Data Frame to view it.
The modules that need to be loaded are as follows: a_log_store (main chart) , a_vcontrol_store (3.1, 3.2, 3.3) (v-series), rc_data_store (5.1), a_fcextern_store (7.1), tps2_data_store (7.4), nav_data_store (7.3, 7.4, 8.1),

Usage Guide

(1) Flight status position

(2) Positioning system

(3) Gear related

(4) Dynamic execution

(5) Posture and control

(6) Speed

(7) Location

(8) Sensors

Sortie information

Mission information

Time2024-05-27 19:24:22

Mission service

Application status

APP command

Instruction reply

ESC

battery

Sowing (2024)

Mission information

Event Center

Group IDNo data

Camera logs

Task IDEce51245417b4090800b3845d3f9f60a

Brain firmware

Module data

Subtask ID ece51245417b4090800b3845d3f9f60a

Task typeSow

Mission sourceAPP

Task execution app["spread"]

Build time1716809047077

Route typeRound-trip routes

User ID 0194BF82-2B6B-C698-2052-21DE6A51893A

Platform task information

Waypoint configuration modeUse the global configuration parameters

chart

Ranging

Route

11 abnormal

Legend

Help

operator

data

The motor has two outputs37.50 %

The motor has two speeds986r/min

Motor three outputs37.50 %

The motor has three speeds994r/min

The motor has four outputs37.50 %

The motor has four speeds979r/min

Position and speed

RTK positioning statusrtk

Elevation of the take-off point153.029 m

RTK satellite numbers38

Take-off point longitude122.9274566

RTK delay0

Latitude of the take-off point45.5890239

Hover error0

Distance from take-off point1.78 m

route error0

Current longitude122.9274562

RTK height0 m

Current latitude45.5890079

Ground-like height0.00 m

Horizontal speed0.01 m/s

Vertical velocity (positive indication up)0 m/s

Execution parameters

Working modeMission mode

Device eventsStarting self-test (event code: 8224)

Obstacle avoidance modeOpen the obstacle avoidance mode

Ownership of controllerControl is in the flight controller

Current flight segmentNo flight segments

Set height type

Current execution waypoint0

Control height0.00 m

Distance to obstacles directly ahead0 meters

Target point distance dataThere is no next waypoint

The remote control is offline

Heading 0

Throttle 0

Pitch 0

Roll 0

X2

00:00/00:21

previous frame

next frame

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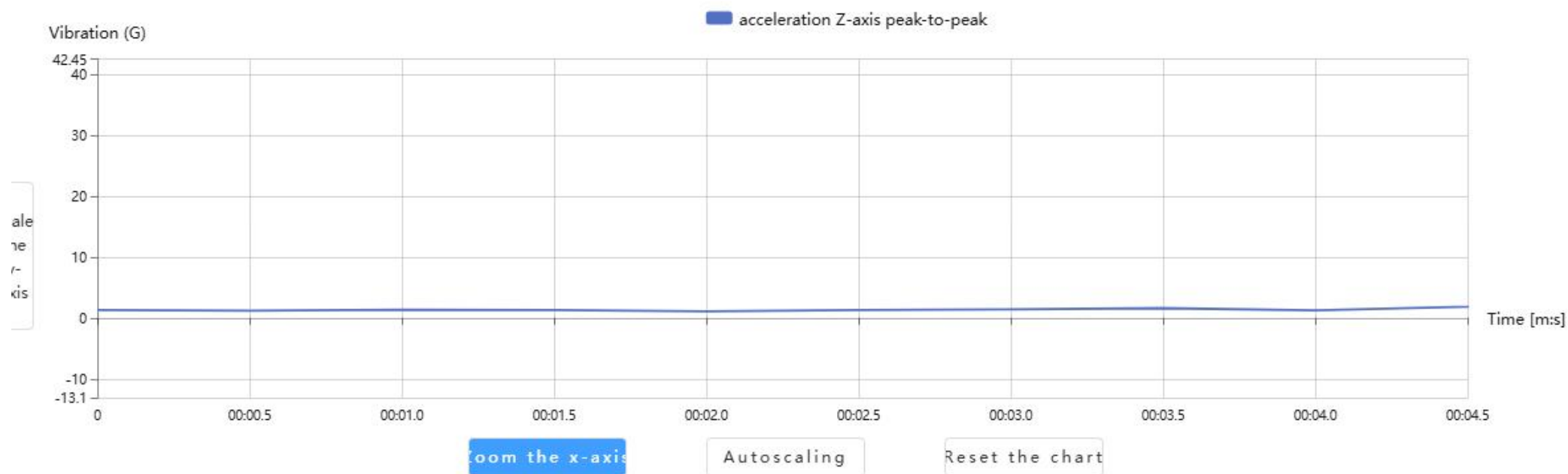
1、Power system issues

8.2 Accelerometer peak peak

View in full screen

Zoom the x-axis

Download image





Sortie information

Mission information

Time2024-05-27 19:24:27

Mission service

Application status

ESC

APP command

battery

Instruction reply

Sowing (2024)

Mission information

Event Center

Group IDNo data

Camera logs

Task IDEce51245417b4090800b3845d3f9f60a

Brain firmware

Subtask IDEce51245417b4090800b3845d3f9f60a

Module data

Task typeSow

Mission sourceAPP

Task execution app["spread"]

Build time1716809047077

Route typeRound-trip routes

User ID0194BF82-2B6B-C698-2052-21DE6A51893A

Platform task information

Waypoint configuration parameters

Route

chartRanging

11 abnormal

legend

Help

operator

data

Basic parameters

Sortie IDece51245417b4090800b3845d3f9f60a_199_1

Battery voltage50.60 V

Sortie number199-1

ADC sampling voltage23.50 V

Flight frames14

UTC time2024-05-27 19:24:27

GNSS time2024-05-27 19:24:45.2

Stance angle

Pitch angle0.10 °

pitch velocity0.00 °/s

Roll angle-0.80 °

Roll angular velocity0.00 °/s

Integrate heading angles87.70 °

Heading angular velocity-0.20 °/s

motor output and speed

The motor is output58.88 %

One speed of the motor1368r/min

The motor has two outputs60.13 %

The motor has two speeds1372r/min

Motor three outputs60.25 %

The motor has three speeds1385r/min

The motor has four outputs58.63 %

The motor has four speeds1344r/min

Position and speed

RTK positioning statusrtk

Elevation of the take-off point153.054 m

RTK satellite numbers38

Take-off point longitude122.9274562

RTK delay1

Latitude of the take-off point45.589008

Hover error0.09

Distance from take-off point0.01 m

route error0

Current longitude122.9274563

RTK height0 m

Current latitude45.589008

Ground-like height0.00 m

Horizontal speed0.00 m/s

The remote control is offline

Heading 0

Roll 0

Throttle 0

Pitch 0

00:05/00:21

previous frame

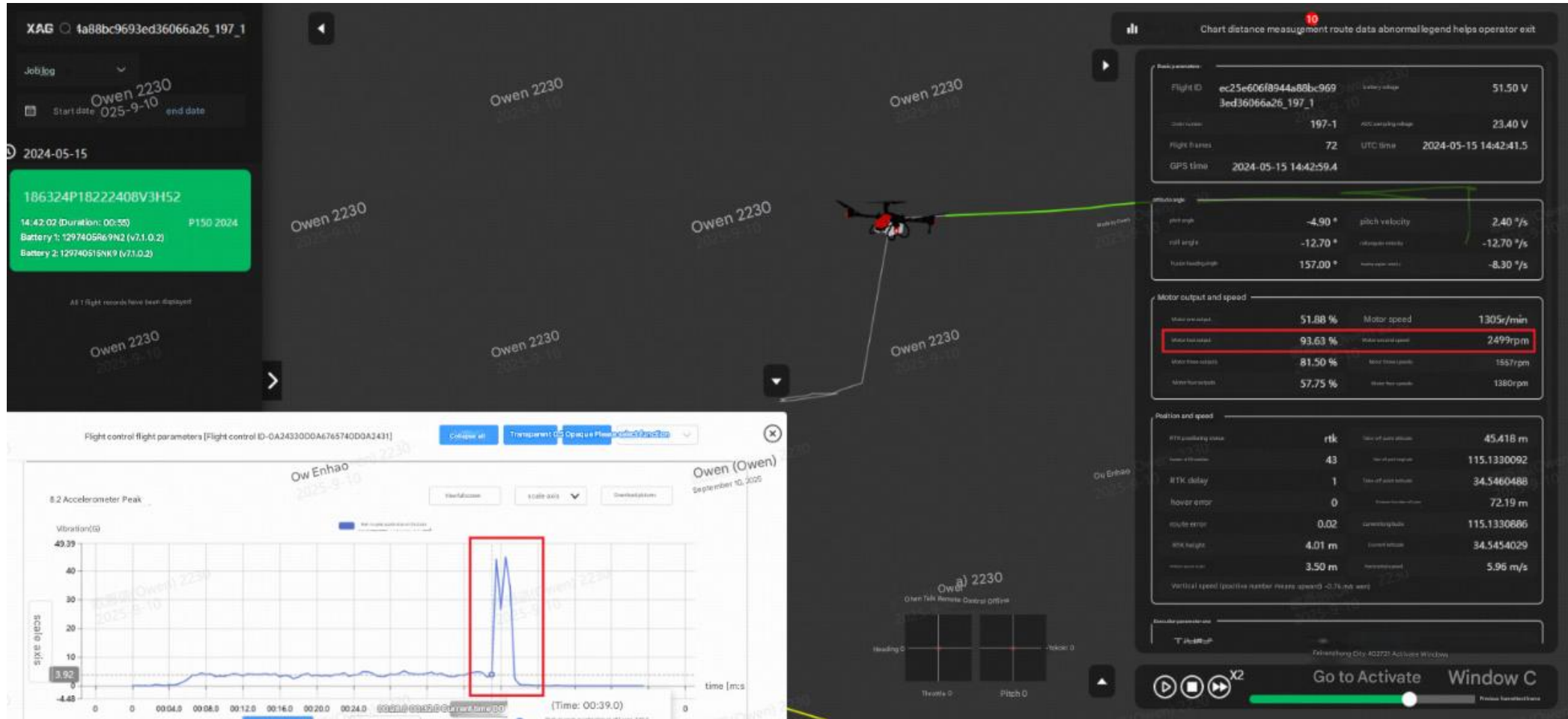
next frame

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2、Flight control and sensor system issues

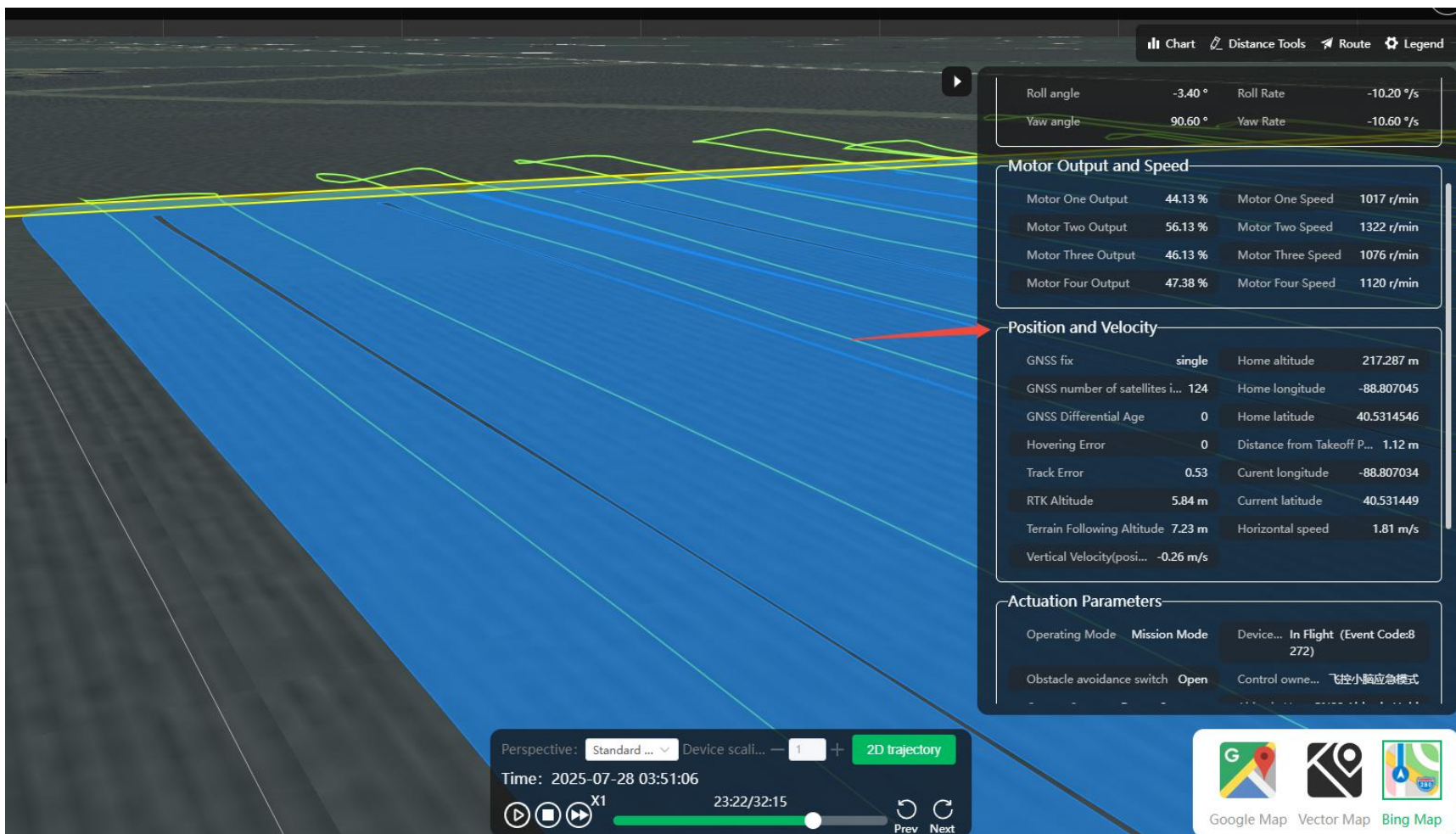




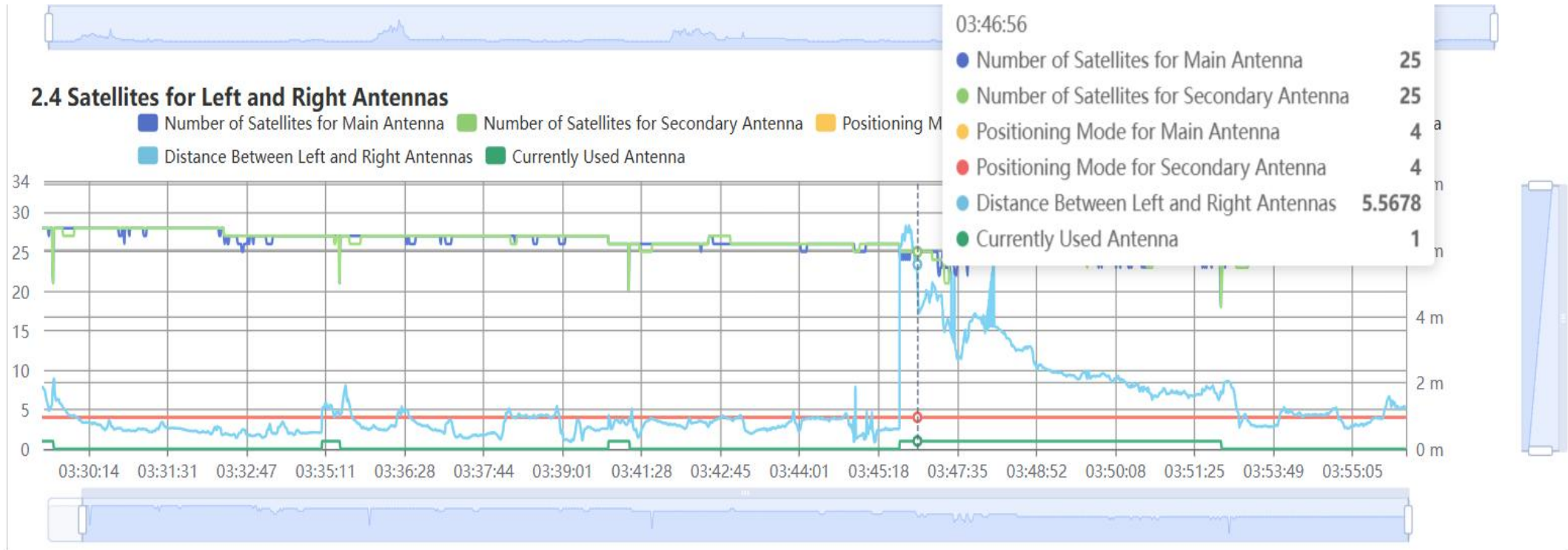
Attitude measurement and control



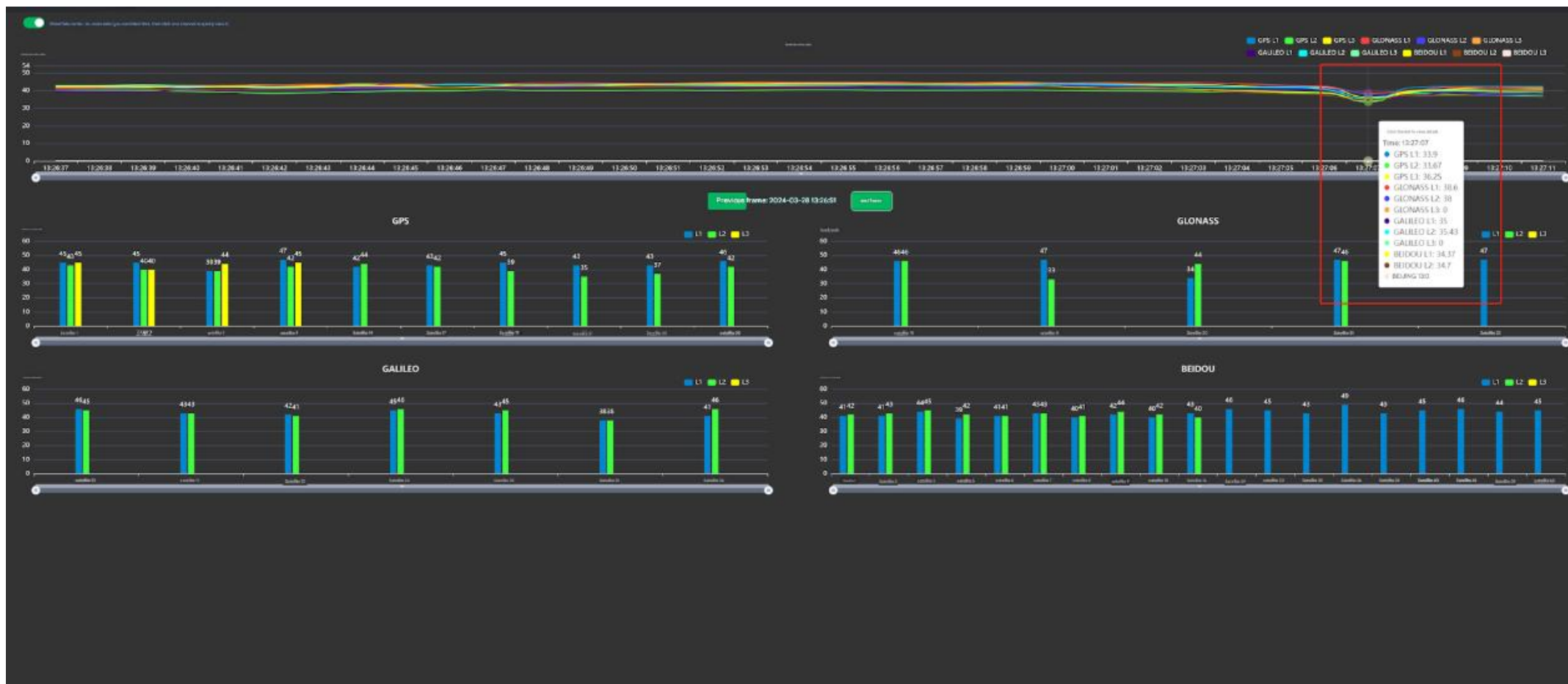
Terrain-following radar altitude data



3、Positioning system issues



Signal-to-Noise Ratio(SNR)





三、Data analysis logic

Flight Data Analysis Process

Reconstruct
Flight Path



Check
Parameters



Compare Data



Identify
Anomalies

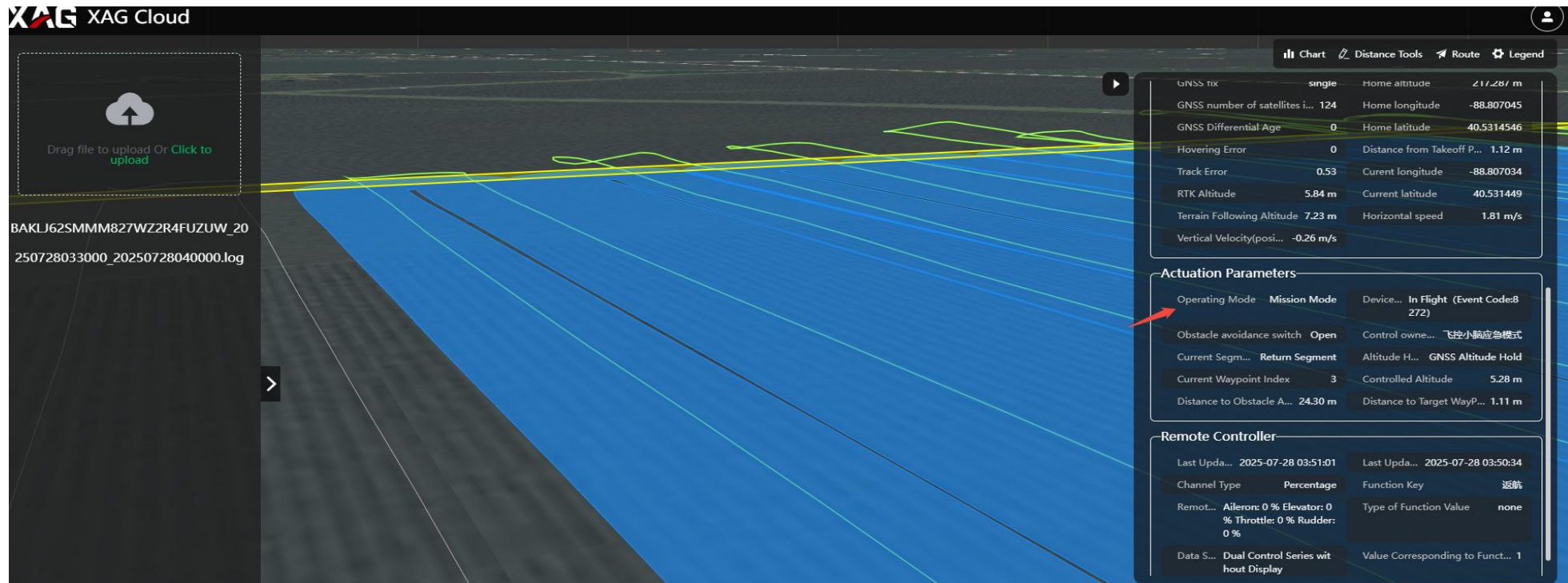


Draw
Conclusions



1、Reconstruct the flight path

Scroll through the log to determine at which stage the incident occurred (takeoff / operation / return / manual flight).



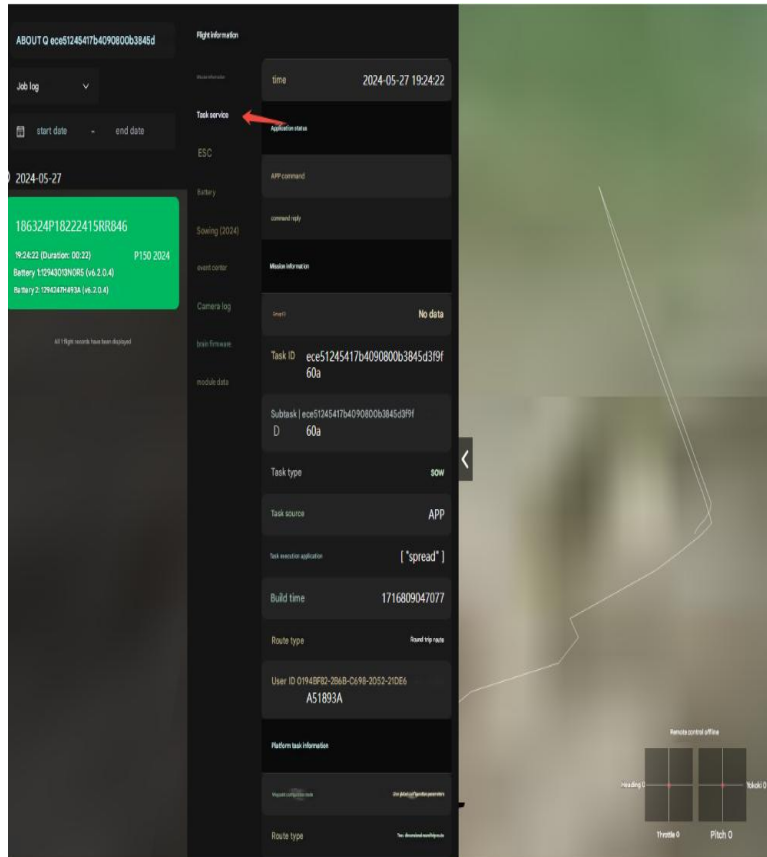
2、Check parameters

Look at the corresponding stage' s altitude mode (RTK fixed altitude / terrain following), set altitude/speed, and whether obstacle avoidance was enabled.

Position and Velocity			
GNSS fix	single	Home altitude	217.287 m
GNSS number of satellites i...	124	Home longitude	-88.807045
GNSS Differential Age	0	Home latitude	40.5314546
Hovering Error	0	Distance from Takeoff P...	1.12 m
Track Error	0.53	Curent longitude	-88.807034
RTK Altitude	5.84 m	Current latitude	40.531449
Terrain Following Altitude	7.23 m	Horizontal speed	1.81 m/s
Vertical Velocity(posi...	-0.26 m/s		
Actuation Parameters			
Operating Mode	Mission Mode	Device...	In Flight (Event Code:8 272)
Obstacle avoidance switch	Open	Control owne...	飞控小脑应急模式
Current Segm...	Return Segment	Altitude H...	GNSS Altitude Hold
Current Waypoint Index	3	Controlled Altitude	5.28 m
Distance to Obstacle A...	24.30 m	Distance to Target WayP...	1.11 m

3、Compare data

Match the set parameters (expected behavior) against the actual data, focusing on:



Altitude → Does the actual altitude match the set value? Is the climb/descend trend reasonable?

Attitude → Are the attitude angles abnormal?

Speed → Are GNSS speed and fused speed consistent?

Motors → Are motor power/RPM balanced across all motors?

Position and Velocity			
GNSS fix	single	Home altitude	217.287 m
GNSS number of satellites i...	124	Home longitude	-88.807045
GNSS Differential Age	0	Home latitude	40.5314546
Hovering Error	0	Distance from Takeoff P...	1.12 m
Track Error	0.53	Current longitude	-88.807034
RTK Altitude	5.84 m	Current latitude	40.531449
Terrain Following Altitude	7.23 m	Horizontal speed	1.81 m/s
Vertical Velocity(posi...	-0.26 m/s		

Actuation Parameters			
Operating Mode	Mission Mode	Device...	In Flight (Event Code:8 272)
Obstacle avoidance switch	Open	Control owne...	飞行小脑应急模式
Current Segm...	Return Segment	Altitude H...	GNSS Altitude Hold
Current Waypoint Index	3	Controlled Altitude	5.28 m
Distance to Obstacle A...	24.30 m	Distance to Target WayP...	1.11 m

4、Identify anomalies

Once inconsistencies are found, focus on checking:

- 1、Signs of impact (accelerometer spikes)
- 2、Environmental interference (terrain/obstacles)
- 3、Hardware issues (motor, ESC)
- 4、Navigation issues (heading/positioning errors)

5、 Draw conclusions

Connect all information to determine the root cause →

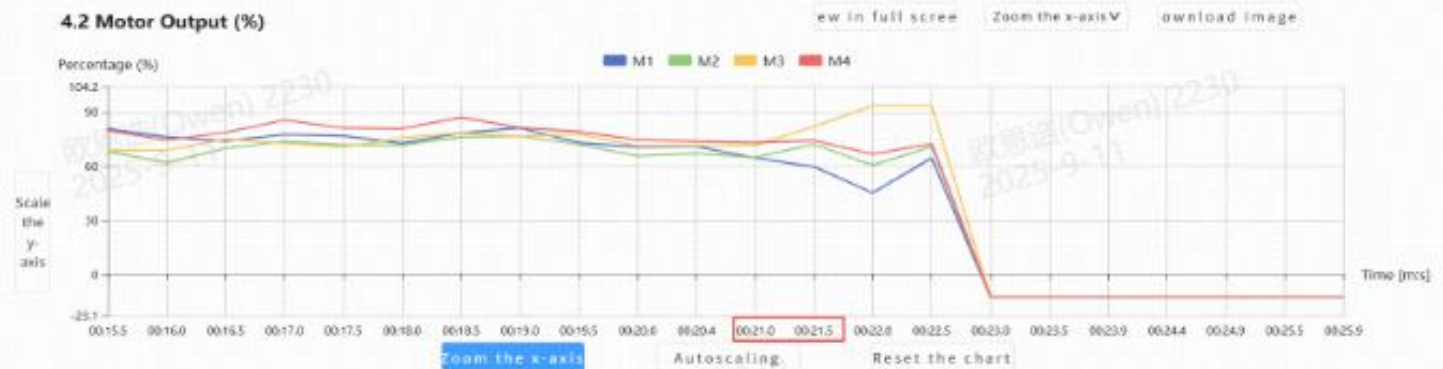
parameter setting / operational error / complex environment / hardware failure.



4、Case Share

Power System

1.Motor Response Abnormality



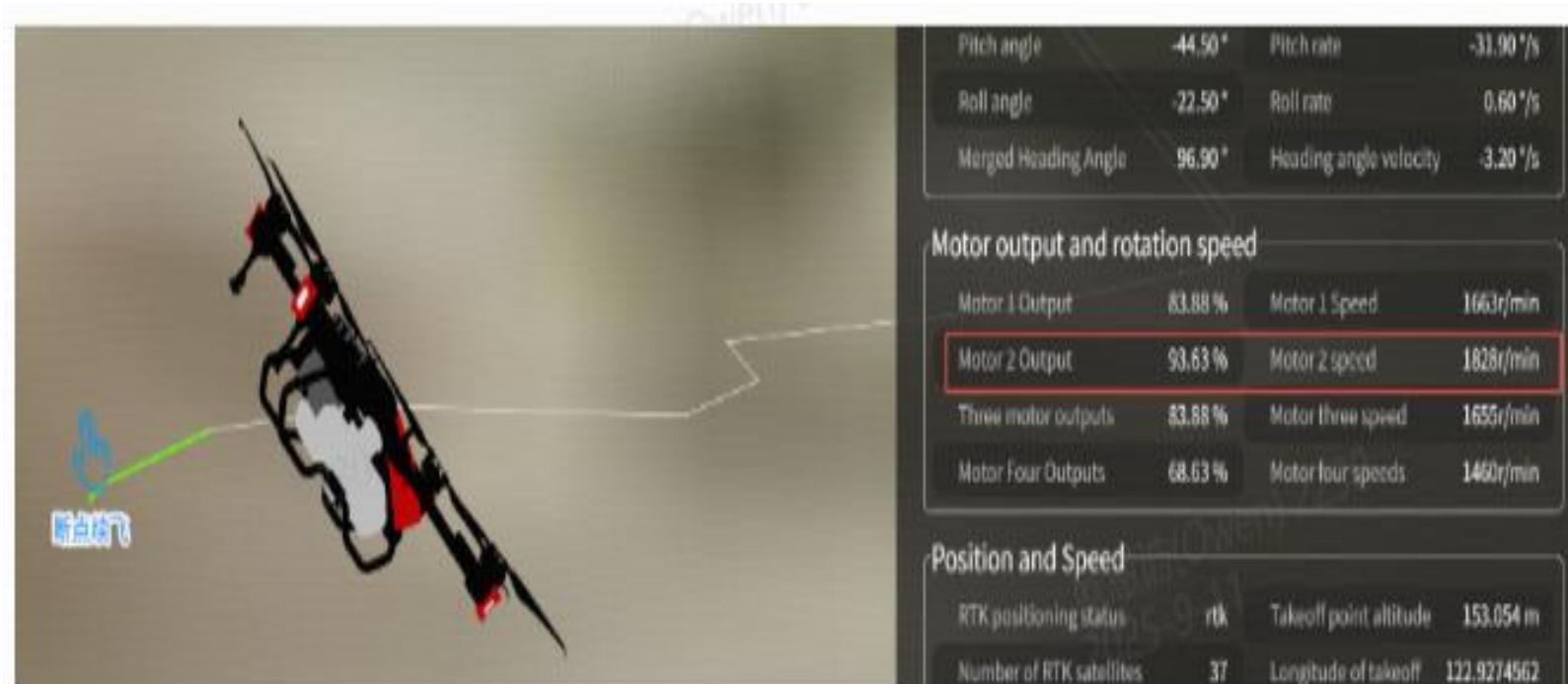
Motor output and rotation speed			
Motor 1 Output	59.75 %	Motor 1 Speed	1358r/min
Motor 2 Output	72.25 %	Motor 2 speed	1517r/min
Motor 3 output	82.00 %	Motor three speed	1453r/min
Motor Four Outputs	74.25 %	Motor four speeds	1660r/min



Motor 1 Output	93.63 %	Motor 1 Speed	1352r/min
Motor 2 Output	70.50 %	Motor 2 speed	1549r/min
Motor 3 output	63.25 %	Motor three speed	1333r/min
Motor Four Outputs	71.50 %	Motor four speeds	1607r/min

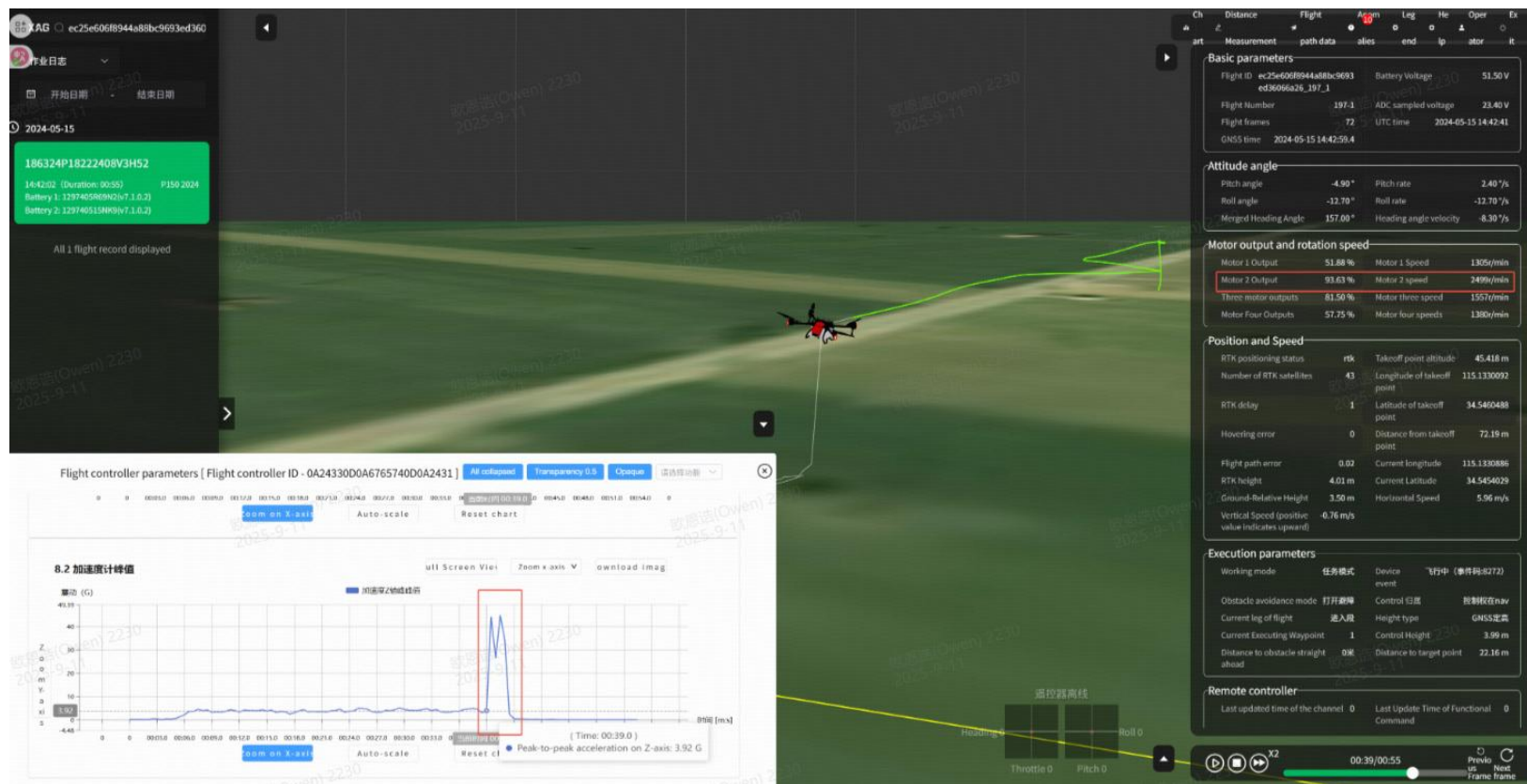
Power System

4. Insufficient Power



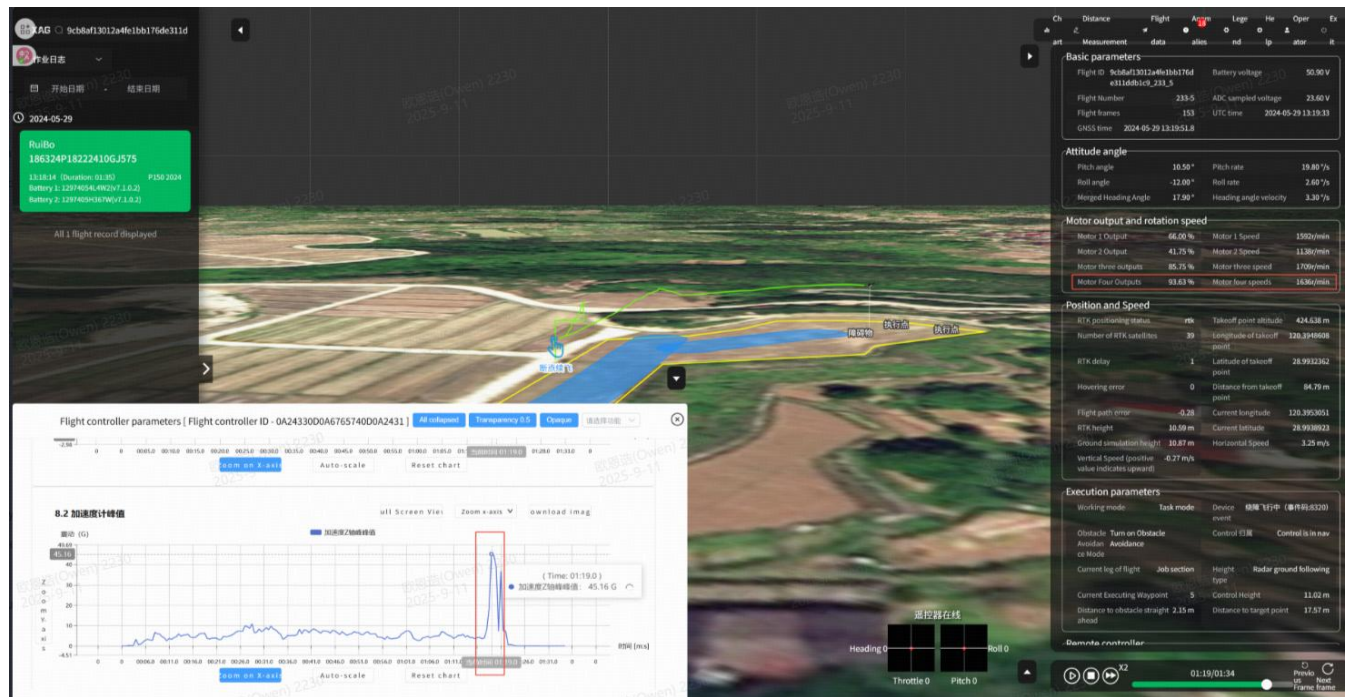
Flight Control and Sensor System

1.Obstacle Collision with Obstacle Avoidance Enabled

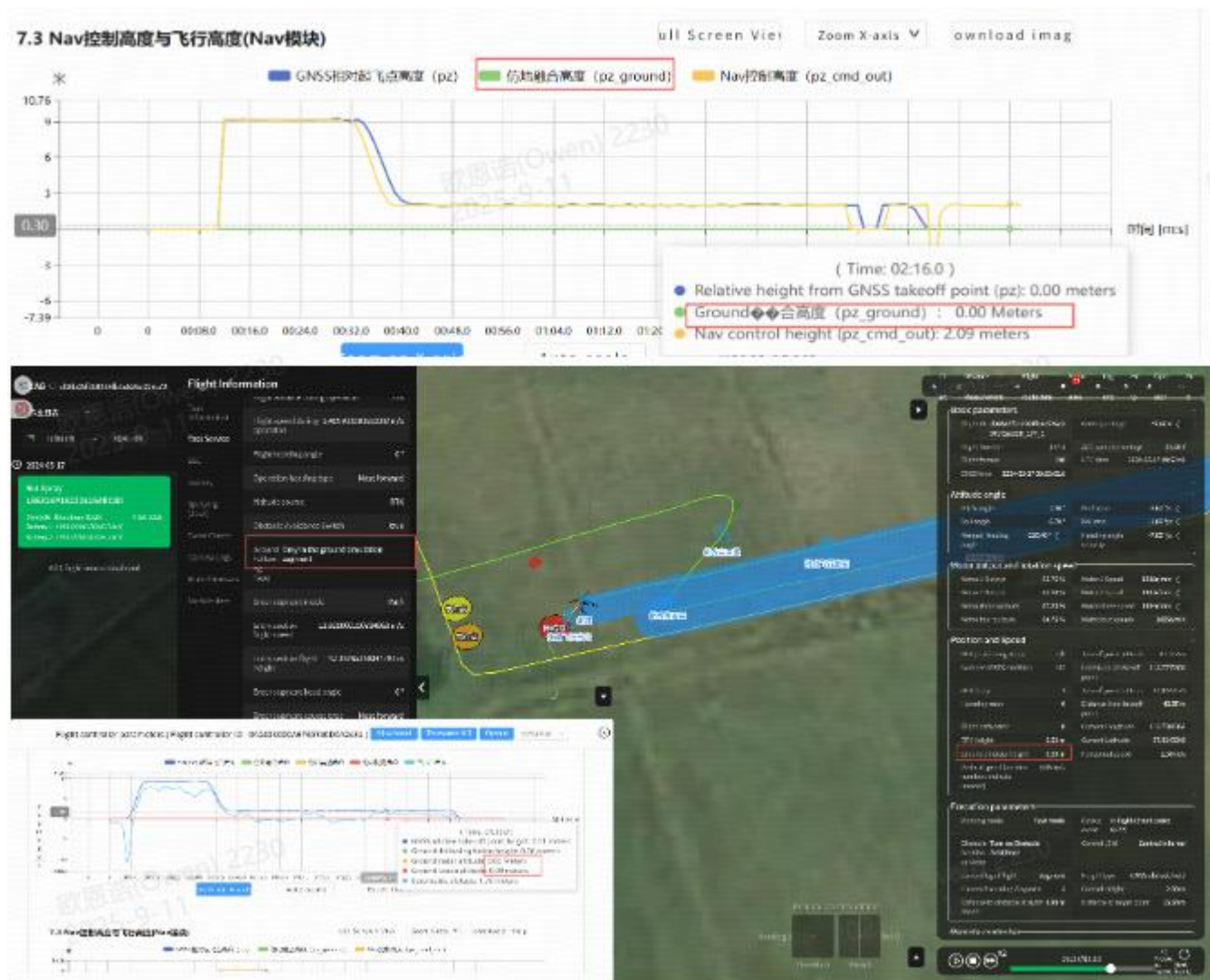


Flight Control and Sensor System

2. Use obstacle avoidance to hit smaller obstacles



3. Terrain Radar Altitude Error



Positioning System

1.RTK Antenna Issues

Causes: Loose, improper installation, or damage

Symptoms:

- Abnormal satellite acquisition
- Significant difference in satellite count between antennas (>3)
- One antenna showing zero satellites
- Problem persists across multiple flights

Positioning System

2.Environmental Issues

Possible Causes:

Local environment (trees, buildings, blockage)

RTK signal delays

Distance from base station

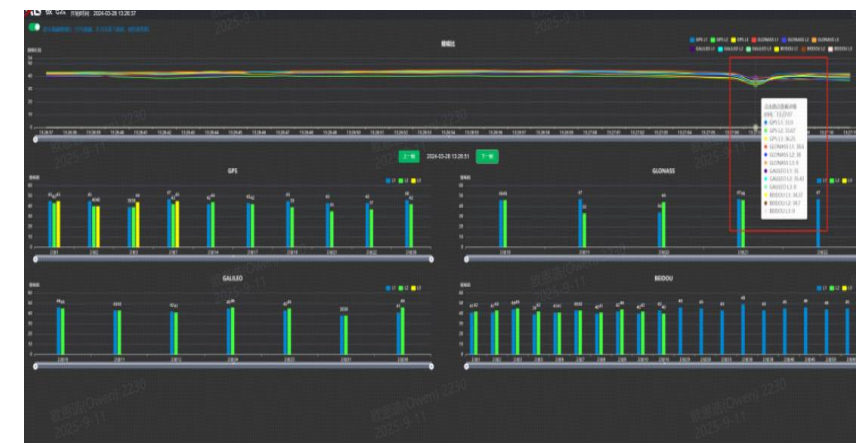
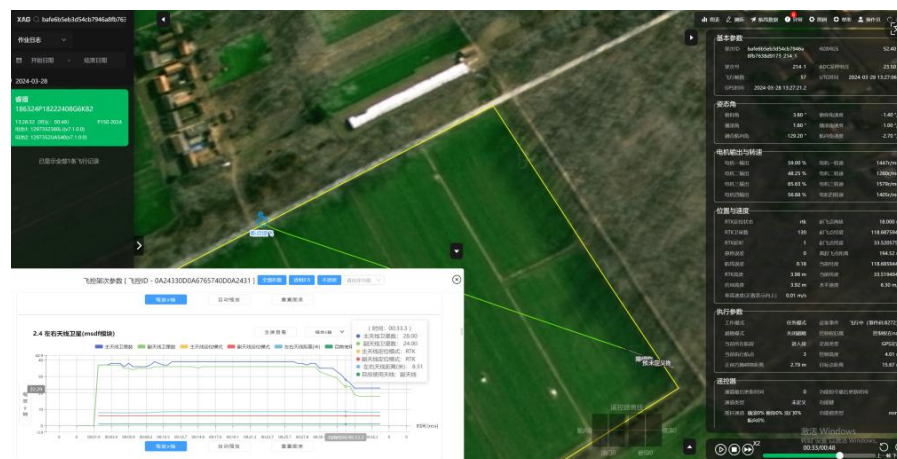
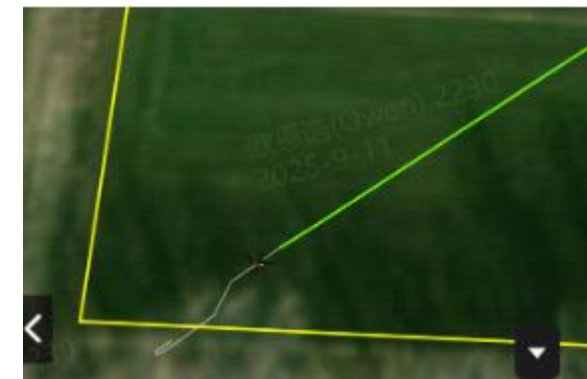
Ionospheric activity (varies by period)

Tip: Check ionospheric conditions via gnssplanning.com

Positioning System

3.GPS Signal Abnormality

Start Time	Duration	Exception Type	Exception Details
2024-03-28 13:26:32	10s	Event Center	Remote controller and device WiFi communication not connected, unable to fly manually (will not appear simultaneously with 1)
2024-03-28 13:26:32	10s	Event Center	RTK status is poor (calculated distance between two aircraft antennas: agricultural drones: greater than 1.5m, M series: greater than 1m), flight deviation may occur during flight. Reason: far from the base station, ionosphere is active.
2024-03-28 13:27:07	13s	Event Center	Large-angle landing
2024-03-28 13:27:07	13s	Event Center	Remote controller and device WiFi connection failed, unable to fly manually (will not appear simultaneously with 1)





Q&A



Thank You