

Common Types of UAV Flight Faults and Emergency Treatment Strategies

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Abstract. With the rapid development of UAV technology, UAV has been widely used in agriculture, logistics, surveying and mapping, public safety and other fields. However, in the actual flight process, the UAV may encounter various faults, which not only affect the completion of the flight mission, but also may lead to safety hazards. The purpose of this paper is to discuss the common failure types of UAV in flight, including signal loss, battery failure, mechanical failure, software failure and environmental factors. According to each fault type, this paper provides corresponding emergency treatment strategies to help pilots respond quickly in case of emergency and ensure flight safety. Through the analysis of practical cases, this paper summarizes the experience and lessons of flying hands in fault handling, and emphasizes the importance of pre-flight preparation and real-time monitoring in flight. Finally, this paper looks forward to the future development trend of UAV fault handling, pointing out that with the progress of technology, the intelligence and automation of fault handling will become the development direction of the industry, providing a safer and more efficient flight experience for flying hands.

Keywords: UAV; Flight Failure; Signal Loss.

1. Introduction

Unmanned Aerial Vehicle, UAV), as a new type of aircraft, has been widely used in the world in recent years. With the continuous progress of technology, the functions of unmanned aerial vehicle (UAV) are increasingly enriched, and its application fields are constantly expanding, from the initial military use to the civilian market, including agriculture, logistics, surveying and mapping, environmental monitoring and other fields. According to the data of market research institutions, the global UAV market is expected to continue to grow at a compound annual growth rate of more than 20% in the next few years. However, with the increasing use frequency of unmanned aerial vehicles (UAVs), the possible faults in flight have attracted increasing attention. These failures may not only lead to the failure of the flight mission, but also cause safety hazards to the flying hand and the surrounding environment. Therefore, it is very important to understand the common types of UAV flight failures and their emergency treatment strategies for the career development and flight safety of flying hands. In actual flight, UAV may encounter a variety of failures, including signal loss, battery failure, mechanical failure, software failure and environmental factors. Each fault type has its specific causes and manifestations, and the flying hand needs to have the corresponding emergency handling ability to ensure the safe flight of UAV. In this paper, these fault types will be discussed in depth, and effective emergency treatment strategies will be provided, aiming at providing practical guidance and reference for UAV pilots, improving their ability to deal with emergencies, and ensuring flight safety and successful completion of tasks.

2. Common Types of UAV Flight Failures

2.1 Signal Loss

Signal loss refers to the interruption of communication between the UAV and the remote controller, which makes the UAV unable to receive control instructions. It may be caused by too long flight distance, obstacle interference, signal interference and other reasons. The loss of signal may cause the UAV to lose control, fly in an unknown direction, or even crash.

Flying distance is too far: the effective communication distance between the drone and the remote controller is limited. When the flying distance exceeds this range, the signal may be weakened or completely lost; Obstacle interference: obstacles such as buildings and trees may block signal transmission, especially in urban environment, the risk of signal interference is higher; Signal interference: Other wireless devices (such as Wi-Fi, Bluetooth, etc.) may interfere with the signal of the drone, resulting in communication interruption; There is also equipment failure: hardware failure of UAV or remote controller (such as antenna damage, receiving module failure, etc.) may also lead to signal loss.

2.2 Battery Failure

Battery failures include insufficient battery power, overheating and short circuit. Factors such as battery aging, improper charging and high ambient temperature may lead to battery failure.

Insufficient battery power: it was not fully charged before the flight, or failed to monitor the power in time during the flight, resulting in insufficient battery power and unable to support the normal flight of the drone; Overheating: The battery may overheat in high-temperature environment or during long-term high-load flight, which may lead to battery performance degradation and even lead to safety hazards; Short circuit: Short circuit inside or outside the battery may cause battery damage, which may cause fire or explosion in severe cases; Battery aging: with the increase of service time, the capacity of the battery will gradually decrease, and the aging battery can not provide enough power, which may lead to shorter flight time; Improper charging: Using an inappropriate charger or charging method may lead to battery damage or low charging efficiency.

Battery failure may cause the UAV to suddenly lose power during flight, resulting in crash or mission failure. In addition, battery failure may also cause safety hazards to the flying hand and the surrounding environment, especially when flying in cities or crowded areas.

2.3 Mechanical Failure

Mechanical failure mainly refers to the damage or failure of the propeller, fuselage, landing gear and other parts of the drone, as well as the looseness of the connecting parts. And environmental factors such as strong wind, collision and material fatigue may lead to mechanical failure during flight.

Propeller damage: Propeller is the key component of UAV to generate lift. If the propeller is damaged due to collision, material fatigue or manufacturing defects, it will directly affect flight performance; Fatigue of fuselage structure: When the UAV flies for a long time or encounters strong wind, the fuselage may be fatigued, resulting in structural damage or deformation; Landing gear failure: the damage of landing gear may lead to the instability of UAV during takeoff or landing, increasing the risk of crash; Loose connection parts **: All parts of the UAV are connected by screws and buckles, and if the connection is not firm, the parts may become loose or fall off during flight; Environmental factors: In bad weather conditions (such as strong wind, rain and snow, etc.), the mechanical parts of the UAV may be subjected to extra pressure, increasing the risk of failure.

2.4 Software Failure

Software failures include program errors in flight control system and abnormal sensor data. Improper software update, insufficient system resources, external interference, program bugs and sensor failures may lead to software failures.

Program error: Bugs or logic errors in the software may lead to abnormal behavior of the UAV during flight, such as failure to respond to remote control instructions correctly; Abnormal sensor data: UAV relies on various sensors (such as GPS, gyroscope, accelerometer, etc.) to provide flight data. If the sensor data is abnormal, it may cause the flight control system to make wrong decisions; Improper software update: if you do not follow the correct steps when updating the software, it may lead to software incompatibility or functional failure; Insufficient system resources **: UAV needs to process a lot of data during flight. If the system resources (such as memory and CPU) are insufficient, the software may crash or respond slowly; External interference: Strong electromagnetic

interference or other wireless signal interference may affect the communication and data transmission of UAV, resulting in software failure.

Software failure may cause UAV to lose control during flight, resulting in crash or mission failure. In addition, software failure may also cause security risks to the flying hand and the surrounding environment, especially in the complex flight environment.

2.5 Environmental Factors

Environmental factors include weather changes, temperature changes, excessive wind speed, humidity, terrain factors and so on. The weather conditions were not fully evaluated before the flight, which led to the UAV flying in an unsuitable environment.

Weather change: Bad weather (such as rainstorm, thunder and lightning, snowy days, etc.) will have a serious impact on the flight of UAV, which may lead to unstable or out-of-control flight; Temperature change: extreme high or low temperature may affect the battery performance and the normal operation of electronic equipment, resulting in shortened flight time or equipment failure; Excessive wind speed: strong wind or sudden airflow changes will affect the flight stability of UAV, especially for small UAV, which may cause it to lose control; Humidity: The high humidity environment may cause the electronic components inside the UAV to get wet, increasing the risk of short circuit and failure; Terrain factors: the terrain of the flight area (such as mountains, canyons, etc.) may lead to unstable airflow and increase flight difficulty.

The change of environmental factors may lead to the instability of UAV during flight and increase the risk of crash. In addition, environmental factors may also affect the operation judgment of flying hands, leading to wrong flight decisions.

3. Emergency Response Strategy

3.1 Coping with Signal Loss

Before flying, make sure the signal between the drone and the remote controller is good, and check the signal strength of the equipment regularly. When the signal is lost, the flying hand should immediately switch to the automatic return mode to ensure that the drone can return safely.

Signal monitoring: Before flying, the pilot should check the signal strength between the drone and the remote controller to ensure good signal; Setting Automatic Return: In the flight setting of UAV, enable the automatic return function. When the signal is lost, the drone can automatically return to the take-off point, reducing the risk of accidents; Maintain line-of-sight flight: try to fly within the line-of-sight range to avoid signal loss caused by flying too far; Choose a suitable flight environment: try to choose an open flight area to avoid flying in an environment with large signal interference; Check the equipment regularly: Maintain and check the UAV and remote controller regularly to ensure the normal operation of the equipment and reduce the possibility of failure.

3.2 Battery Fault Handling

Check the battery charge before flight to ensure it is sufficient. During the flight, monitor the battery status regularly, and land in time if it is abnormal. If the battery is overheated, stop flying immediately and cool it.

Pre-flight inspection: before each flight, the pilot should check the battery charge to ensure that the battery is sufficient, and check whether the battery appearance is damaged or expanded; Real-time monitoring of battery status: during the flight, regularly monitor the battery power and temperature to find abnormal conditions in time; Set the low battery alarm: in the flight setting of the UAV, enable the low battery alarm function, and remind the pilot to land in time when the battery is lower than the set value; Avoid high temperature environment: try to avoid flying in high temperature environment, especially in summer or in direct sunlight, to avoid overheating of the battery; Replace the battery regularly: according to the frequency of use and the health of the battery, replace the battery regularly to ensure that the battery with good performance is used for flight; Use the

appropriate charger * *: Make sure to use the charger recommended by the manufacturer to avoid battery damage due to improper charging.

3.3 Mechanical Failure Response

Conduct a comprehensive equipment inspection before the flight to ensure that all mechanical parts are in good condition. During the flight, if you find abnormal vibration or noise, you should land immediately and check the mechanical parts.

Pre-flight inspection: Before each flight, the pilot should conduct a comprehensive mechanical inspection of the drone to ensure that all parts are intact, especially the propeller, fuselage and landing gear; Regular maintenance: carry out regular maintenance on the UAV, check the wear and tear of each component, and replace the damaged components in time; Avoid flying in strong wind: avoid flying as much as possible under strong wind or bad weather conditions to reduce the risk of mechanical failure; Use appropriate flight mode: when flying in complex environment, choose appropriate flight mode (such as stable mode) to improve flight stability; Training and experience accumulation: Flying hands should take part in training regularly to learn the identification and handling skills of mechanical faults, accumulate practical experience and improve their ability to deal with emergencies.

3.4 Software Fault Handling

Update UAV software regularly to ensure the latest version is used. Carry out system self-check before flying, stop flying immediately when software failure is found, and conduct fault investigation.

Regular software updates: ensure that the software of the drone is kept up to date, and regularly check and install the updates released by the manufacturer to fix known bugs and security vulnerabilities; Pre-flight self-inspection: Before each flight, carry out system self-inspection to ensure that all software components work normally and the sensor data are accurate; Backup system: backup important flight data and settings before flight, so as to recover quickly when software failure occurs; Set fail-safe mode: In the flight setting of UAV, enable fail-safe mode. When a software failure occurs, the UAV can automatically enter the safe mode, reduce the flying height and return to the take-off point; Training and learning: Flying hands should participate in training regularly to learn the skills of identifying and handling software faults, accumulate practical experience and improve their ability to deal with emergencies.

3.5 Respond to Environmental Factors

Fully evaluate the weather conditions before flying to avoid flying in bad weather. If you encounter sudden weather changes during the flight, you should adjust your flight plan in time to ensure a safe landing.

Weather assessment: before flying, the pilot should fully assess the weather conditions to avoid flying in bad weather conditions; Real-time monitoring: during the flight, monitor the environmental changes in real time, especially the changes of wind speed and temperature, and adjust the flight plan in time; Choose the appropriate flight time: try to choose a time period with good weather conditions to avoid flying in the case of strong wind speed or unstable weather; Use suitable flight mode: when flying in complex environment, choose suitable flight mode (such as stable mode) to improve flight stability; Training and experience accumulation: pilots should participate in training regularly to learn how to deal with the influence of environmental factors on flight, accumulate practical experience and improve their ability to deal with emergencies.

4. Case Study

4.1 Case 1: Flight Accident Caused by Signal Loss

When a flying hand flies in an urban environment, the UAV loses control due to signal interference. The flying hand quickly switched to the automatic return mode and successfully landed the drone safely.

4.2 Case 2: Emergency Landing Caused by Battery Failure

A flying hand found that the battery was insufficient during the flight, which made the drone unable to continue flying. The flying hand judged the situation in time and chose the nearest open space for emergency landing, thus avoiding the accident.

4.3 Case 3: Emergency Treatment of Mechanical Failure

During the flight, a flying hand found that the drone had abnormal vibration. The pilot immediately landed and checked, and found that the propeller was damaged. After timely replacement, he continued to fly.

5. Summary and Prospect

The rapid development of unmanned aerial vehicle (UAV) technology has brought revolutionary changes to all walks of life. However, the possible faults in flight also bring challenges to the safety and reliability of UAV. By discussing the common types of UAV flight failures and their emergency treatment strategies, this paper summarizes various failure types such as signal loss, battery failure, mechanical failure, software failure and environmental factors, and provides corresponding emergency treatment measures for each failure. These strategies not only help the pilot to respond quickly when encountering unexpected situations, but also effectively reduce the risk of accidents and ensure the smooth completion of the flight mission.

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