A Deep Exploration of the Mounting Issues Related to Six Rotor UVA

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Abstract

In recent years, the hexacopter UAV has developed rapidly, the technological breakthrough in the field of automatic driving, which is of great significance in both military and civilian fields. The six-rotor UAV uses six rotors as the power source and adjusts the attitude by changing the rotor speed to further achieve position control. It has excellent hovering ability and sensitivity, and is equipped with a precise positioning system and advanced sensors. However, there are still common problems such as weak mounting capacity and single mounting mode, in view of this problem, this paper will test the fuselage structure, avionics system and power system one by one from two aspects: changing the fuselage structure and installing the motor position.

Keywords： the hexacopter UAV, weak mounting capacity, changing the fuselage structure, installing the motor position

1. Introduction

With the continuous development of science and technology, drones have become an important tool in the modern military and civilian fields.

As a new type of UAV, hexagoning UAV has the characteristics of high flight altitude and long endurance, so it has a wide range of application prospects in military reconnaissance, geological exploration, agricultural plant protection and other fields.

However, in actual use, hexagoning UAVs often encounter some technical and performance problems in the process of mounting, such as weak mount capacity and single mount mode, which limits its wider application. Therefore, it is of great significance to conduct in-depth discussion and research on the mounting problem of hexagoned UAV.

2. The Development Process and Characteristics of Hexagoning UAVs

2.1 Development history

The development history of hexagoning UAVs can be traced back to the earliest quadrotors. With the continuous innovation of technology and the continuous expansion of demand, hexarotor UAVs, as a multi-rotor aircraft, have gradually emerged in various fields. Early six-rotor UAVs were mainly used in scientific research and military applications to perform tasks that required high maneuverability and flexibility. With the rise of aerial photography technology, hexacopter UAVs have begun to be widely used in the civilian field for aerial photography, monitoring and survey work. In recent years, the application of hexacopter UAVs in emergency rescue, agriculture, logistics and other fields has also increased.

2.2 Features

Just as shown in Fig. 1, the hexacopter UAVs have the following characteristics. (1) The multi-rotor design: Compared to quadcopter drones, six-rotors employ more

rotors, making them more stable during vertical take-off, landing and hovering. This design improves mobility and adaptability to complex environments, making it ideal for performing specific tasks. (2) High maneuverability: Hexacopter UAVs have excellent maneuverability due to more rotors and are able to flexibly cope with a variety of flight missions. This mobility makes it particularly advantageous when performing search and rescue missions in emergency situations. (3) Load capacity: Hexacopter drones typically have a higher load capacity and are able to carry more sensors, cameras, or other equipment.

Fig. 1 A hexacopter UAV

This makes it stand out for tasks that require large equipment, such as scientific research, monitoring, and surveys. Diversification: Due to its flexibility and stability, the application of hexacopter UAV in various fields is constantly expanding, including but not limited to military reconnaissance, aerial photography, agricultural spraying, cargo transportation, etc., showing diversified application scenarios.

3. The Function of the Six-wing UAV is Realized

3.1Positioning system

Global Positioning System (GPS): GPS is one of the most common and widely used positioning systems that determines the location, speed, and altitude of a drone through satellite signals. It provides global location information for flight, but in some environments, such as urban canyons or dense woodlands, there may be signal occlusion issues.Inertial

Navigation System (INS): An inertial navigation system uses sensors such as accelerometers and gyroscopes to measure the linear acceleration and angular velocity of an aircraft to estimate its position and orientation. However, errors that accumulate over time can lead to navigation drift and are therefore often used in conjunction with other positioning systems.

Visual positioning system: Hexacopter drones can achieve visual positioning through cameras or multiple cameras. Computer vision algorithms can identify landmarks, landmarks, or environmental structures to determine the drone's position relative to these reference objects.

3.2. Sensor system

Inertial Measurement Unit (IMU): The IMU includes accelerometers and gyroscopes to measure the linear acceleration and angular velocity of the aircraft, supporting flight control and navigation. Magnetometer: Magnetometers are used to detect the geomagnetic field to help determine the direction and heading of an aircraft.

Barometer: A barometer is used to measure atmospheric pressure, which provides altitude information. It is often used in combination with other sensors to improve the accuracy of altitude measurements.

Millimeter-wave radar: Provides high-precision obstacle detection and ranging capabilities, suitable for flying in complex environments.

Infrared sensor: Used to detect thermal radiation for target detection and identification at night or in low-light conditions. Optical Flow Sensor: Used to measure motion relative to the ground to help achieve hovering and stable flight.

Temperature sensors: monitor the ambient temperature and play an important role in some special applications such as meteorological research, cold chain logistics, etc.

4. Analysis of the Current Situation of the Mounting Problem of Hexagophoid UAV

4.1 Mountability issues

Load capacity limitations: The structure and power system of a hexacopter drone may not be designed to withstand large or heavy equipment, resulting in reduced performance or unstable flight when loaded.

Reduced flight time: Large loads often cause the drone to consume more power, resulting in a lower flight time. The weak payload capacity may limit the durability of the UAV to perform tasks in the air.

Height impacted: Hexacopter drones with heavy loads can lead to increased sensitivity to altitude changes and difficulty in stable flight at different altitudes, especially at low altitudes or in complex environments.

Reduced handling performance: Large or heavy loads may increase the inertia of the drone, making it more sluggish or inflexible when maneuvering, affecting the maneuverability of the flight.

4.2 Single mount type

The reason for the single type of hexacopter UAV mount may involve the following factors:

Technical limitations: When manufacturing hexacopter drones, technical and engineering constraints may result in limited payload types. For example, flight controls, powertrains, or structural design may make it more complex or impractical to support multifunctional mounts.

Cost considerations: Versatile mount systems can add to manufacturing costs and complexity. In order to keep costs under control or to offer a more competitive price, manufacturers may choose to adopt a design with a single mount type.

Regulatory and compliance: Regulatory requirements in specific industries or regions may impose restrictions on the design and use of drones, leading manufacturers to select specific payload types to comply with regulatory requirements.

5. The Solution to the Mounting Problem of the Six-wing UAV

In response to the above problems, we put forward some possible solutions and suggestions:

5.1. Performance optimization

Structural and powertrain optimization：The structure and power system of the drone were redesigned to enhance its load capacity. This could include the use of lighter but stronger materials, optimized motor and propeller configurations, and improved battery technology to provide greater power output. A fixed-time control scheme based on integral terminal sliding mode can be designed to realize the trajectory tracking control of UAV, and the fixed-time convergence performance of the closed-loop control system is analyzed through the Lyapunov theory [1].

Multi-Functional Mounting System: Design a system that supports multi-functional mounting, allowing for quick replacement and integration of different types of devices or sensors. Sensors such as gyroscope, accelerometer and magnetometer can be used to obtain the current attitude information of the aircraft in real time, the whole flight control system can be designed as a whole by using the modular idea, and the complementary filtering algorithm based on the quaternion and the cascade PID control algorithm can be used to realize the current attitude solution and control output of the aircraft.

Intelligent flight control system: The intelligent flight control system is introduced to achieve more accurate flight control through advanced algorithm and sensor data fusion, and improve stability and maneuverability when loading loads. Fault-state controllers can be designed using a backstepping method that sacrifices yaw control to achieve hovering and simple trajectory tracking.

Efficient Power Management: Optimize power management systems to increase battery capacity and performance to support sustained flight time when mounting large equipment. The use of advanced energy storage technology and power management systems is a key factor.

System integration and collaborative optimization: Implement comprehensive optimization in the entire system, including the collaborative work of the mounting system, flight control system, power system, etc. By considering the individual components together, the overall performance can be improved. Technological Improvements

5.2. Function optimization

Design a universal mount system: Design a system that supports multi-functional mounts, allowing users to swap out different types of devices or sensors. Such a system can increase the flexibility of the drone, making it suitable for a variety of application scenarios. Simulink was used to model the UAV with six degrees of freedom, and the motion attitude characteristics of the UAV during the gliding process, the influence of ailerons on the motion of the UAV, and the movement attitude characteristics of the UAV in the environment of wind interference were analyzed [3].

Modular design: The modular design allows the mount system to be easily integrated and replaced. This allows users to quickly adjust the mount to the needs of the specific task, thus achieving versatility.

Open interface standards: Develop or adopt open interface standards to ensure that a wide range of devices and sensors are compatible with the drone's payload system. This helps drive industry standards and improve device interoperability.

Technology Upgrades and Updates: Regular technology upgrades and updates are carried out to support the integration of new types of devices and sensors. This helps to keep the drone's technology competitive and adapt to the development of emerging technologies. Combined with the sliding mode observer to estimate the fault information matrix, a fault-tolerant controller for a six-rotor actuator based on the switching system was designed by using the handover control algorithm. The simulation analysis shows that the designed fault-tolerant control system has good control performance and robustness, which can effectively reduce the impact of actuator monowing damage on flight [2].

6. Future Research Directions and Development Trends

With the continuous development of science and technology, the research on the mounting problem of hexapopter UAV will become an important direction in the future. In future research, we can try to apply advanced materials and technologies to the mounted equipment to improve the performance and stability of the equipment, and at the same time, we can further study the co-design method of the aircraft and the mounted equipment to achieve better coordination and overall performance. These research results will provide stronger support for the application of hexagophoid UAVs and promote the continuous progress of UAV technology.

7. Conclusion

In this paper, the mounting problem of hexacopter UAV is studied in depth, and the types of mounting equipment and their influence in different application scenarios are discussed. Through the analysis of camera mounting, multi-rotor design, high maneuverability, etc., the development process and characteristics of six-rotor UAV are comprehensively demonstrated.

The paper mentions the methods to solve the problem of weak payload capacity, including structural optimization, multi-functional payload system and intelligent flight control system.

Finally, the importance of improving the adaptability and flexibility of UAVs to meet the needs of different missions was emphasized. Through the discussion of the single problem of sensor and mount type, it provides useful theoretical support for the field of UAV research and points out the direction for future technology development.

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