

Study on The Applicability of Drones in The Process of Forming Towers of 500KV Transmission and Substation Lines in Highland Areas

Bin Du, Baowen Wei, Suai Li and Guohui Liu

China Aneng Group Second Engineering Bureau Co, Xiamen 361021, China

Abstract: With the continuous development of science and technology in China, China's aviation field has also been expanding, the rapid development of aviation technology, China has gradually achieved leapfrog development in UAV equipment, and gradually tends to civilization, practicality and commercialization. At present, more and more UAVs are not only opening up in the domestic market, but also have flowed to overseas markets, and the modern advanced technology represented by UAVs has gradually become the current trend development trend. In the field of electric power engineering construction, the use of drone technology is short and wide, and there are drones in both high-altitude areas and plain areas. In terms of the engineering field, the UAV technology involves the construction, monitoring and management of power grids, fault and equipment maintenance of power grids and transmission line inspection, etc.

Keywords: Drones; Power Engineering; High altitude areas; Electricity Network.

1. Purpose and Meaning

With the rapid development of high-end science and technology, the application of drone technology has gradually involved in various fields. The electric power industry is an important basic industry in the national economy, but also in China's existing industrial industry has the largest asset size of the industry, with China's economic development model from high-speed development to high-quality development, electricity as an extremely important factor of production, the high quality development of the electric power industry is a key indicator of high-quality economic development^[1]. At present, the State Grid Corporation's power grid construction projects are increasing, investment is increasing, and drones have been widely used in the transmission and substation project erection construction guide rope exhibition and power disaster emergency rescue work. For the electric power industry, the introduction and application of inspection drones can be described as a solution to the urgent need. In recent years, China's power grid construction speed up, all aspects of electricity demand continues to rise, which brings enormous pressure on the power inspection. Under heavy pressure, the traditional manual inspection of the way began to reveal the efficiency, safety, cost and other aspects of the shortcomings and drawbacks, completely unable to keep pace with the development of the industry, in this context, the urgent need to find a new way to replace. And the emergence of drone inspection, just brought the gospel^[2]. Because the drone can inspect a wide range from the air, and 24-hour operation, with sensors, cameras and other equipment, the accuracy of inspection is also very high. Plus the drone inspection breaks the terrain, weather and other influential restrictions, more security and efficiency, for the inspection of the upgrade plus a very big.

2. Review of the Level of Domestic and International Research

Today's research and development of UAV countries, the United States is a ride, other countries are based on their own technology and national conditions to follow the development. When our country was ready to Israel to introduce the Faircom drone was stopped by the United States, after the continuous efforts of our researchers, now China's drone technology is in the world's advanced and world-class level, from many sources, currently in the world's advanced, in many areas can see the shadow of China's drones, good and affordable, drones have long been, China's drones are ahead of most countries, it is because China's drones are ahead of most countries because of its accumulation of "model" and "target" aircraft and gliders, and of course, the most important Beidou system. In the civilian sector, China is now the leading manufacturer of drones, and is almost the only country in the civilian sector, accounting for 85 percent of the global market^[3].

3. Theoretical and Practical Basis of The Study

3.1. Research Theory

3.1.1. Ground measurement and control station

The role of the UAV is in the air, but the information collection system is on the ground, and the docking of the two depends on the ground measurement and control station subsystem. The solution to the problem of how to control the flight status, navigate, and obtain the data collected by the sensors is dependent on the ground measurement and control station subsystem. The ground measurement and control system can not only monitor in real time^[4], but also make basic processing of flight data. Multi-sensor ground control system, UAV platform ground control system, real-time data analysis system and data coding and decoding system are all important parts of it.

3.1.2. Data communication link system

It can be said that without the data communication link system, the whole system cannot be connected for communication, and its main components include the UAV communication relay equipment and the signal transmitting and receiving devices of the ground-based measurement and control station on the UAV. Without the data communication link system, the UAV flight platform and the ground measurement and control station will lose the conditions for data transmission, and the two will lose contact with each other. In the mountainous areas with complex terrain and harsh environment, the superiority of the system is better demonstrated in the case of poor communication conditions. Ground measurement and control personnel must transmit data in real time if they want to directly see the first-hand video of the flight or the field situation^[5].

3.1.3. Ground Data Processing System

Processing, application, and storage of later data rely on this subsystem. The ground data processing system includes three subsystems. (i) a three-dimensional visualization system for line channels; (ii) a multi-sensor data integration processing and geometry processing system; and (iii) a GIS-based inspection system for electric lines. Photogrammetry as well as GIS can help process various data in a geometrical way. For example, point clouds, poses, images, videos, etc. Not only fast but also high accuracy. Hidden dangers and defects that cannot be identified and judged using traditional tools can be done using pattern recognition, artificial intelligence and visualization techniques. The system is also prominent in ensuring line safety and determining the location of applause.

3.1.4. Interface standardization and transmission transparency

The UAV inspection system involves many professions and complex business, and it is necessary to develop unified data link transmission standards and communication equipment interface standards. Uniform interface type, rate, impedance, electrical level and other technical indicators, so that each subsystem with flexible, adaptable, for the practical period of each subsystem equipment merit integration and centralized procurement to lay the foundation. All subsystems and sub-professional information services that are connected to the transmission of UAV inspection data chain must be connected to the communication transmission link with unified interface standards, and the transparent transmission of business information of each sub-system is realized with unified functional modules^[6].

3.1.5. Practicality of indicators and priority of security

As the higher the resolution of the transmitted image, the greater the need for channel broadband, equipment transmitting power, coding compression ratio, the shorter the signal propagation distance under the same conditions, the lower the channel utilization rate, image restoration quality. In the practical stage should first ensure the safety of the inspection flight, according to the actual flight experience, real-time transmission of lower resolution "standard definition" video images can meet the UAV inspection flight measurement and control needs, higher resolution "HD" photos can be retained in the UAV to complete Inspection operations, return to the ground in the later extraction analysis, so that the limited channel resources priority to protect the command measurement and control, keep the communication

link security smooth, to ensure that the UAV inspection flight safety and control.

3.1.6. Create Relay Resource Database

During the UAV transmission line inspection, the relay station resource information database of the communication data chain should be created according to the medium and long-term inspection line plan. The information data such as latitude, longitude, elevation, driving road and flight airspace of the ground fixed relay point, mobile relay vehicle, fiber optic relay station and air relay corresponding to the transmission line to be inspected will be embedded in the "relay management" module of the "UAV Power Line Comprehensive Inspection System" developed in advance, and displayed in three dimensions through the line. The system synchronously displays the corresponding relay station location and data parameters of the relevant inspection line. When the plan of inspection line operation is received, the corresponding relay mode and station of the inspection line are confirmed, and the relevant relay equipment is turned on within the specified time to form a communication relay link to perform the communication guarantee task of UAV long-distance and wide-range inspection flight.

3.2. Practice basis

In the electric power construction project in the high altitude area for the construction of the wire release needs to use the drone to drive the $\phi 8\text{mm}$ Dyneema traction rope, then use the $\phi 8\text{mm}$ Dyneema traction rope to drive the $\phi 16\text{mm}$ Dyneema traction rope, and finally use the $\phi 16\text{mm}$ Dyneema traction rope to drive the JL3/G1A-400/50 steel core aluminum strand (outside diameter 15.2mm). Through this small rope pulling big rope way to complete the high voltage area construction erection process.

4. Analysis of the Application of Drone Technology in The Power Industry

In the process of power grid planning and construction operations, involving more mechanical equipment and measurement data, the need for staff to draw and consider the content is also more complex, to increase the safety and stability of the power grid construction process, to ensure the quality of power grid construction, UAV technology can play a very critical role, which is mainly reflected in the following four aspects.

4.1. Planning and construction of power grids

Since UAVs can operate at low altitudes and obtain high-resolution topographic images and transmission line images, the mapping system of UAVs not only enables comprehensive mapping and information collection of the power grid planning area, obtaining efficient and accurate data information, but also reduces the impact on the environment in the collection process. Through accurate data collection, the staff can analyze the data comprehensively, plan the power grid area, optimize and establish the route of the line, and minimize the cost of building transmission lines in the country. In the process of construction, as the construction site usually requires the erection of large lifting equipment, traction more, resulting in the entry and exit of equipment are more susceptible to the influence of the surrounding environment. At this time, the image information provided by the UAV can be used to accurately survey the surrounding terrain and generate three-dimensional three-

dimensional images, so as to correctly develop the construction direction, set up safety exclusion zones, and erect construction lines with the help of the UAV's release guide rope, so as to avoid conflicts with ecological and environmental issues during construction and construction, and thus better protect the natural ecological environment of China.

4.2. Monitoring and management of the power grid

Falls from height are the most common construction accident during the process of conducting power grid construction. However, because the staff supervising the power grid line is usually on the ground for monitoring and management, resulting in the construction status of the construction work at height can not be understood in a timely manner. At this time, with the help of drones in advance to the high altitude image acquisition, to ensure that the high altitude does not exist under the premise of safety risks before allowing construction personnel to work aloft. At the same time, the drone can take aerial photos of the construction site, and then generate a three-dimensional model and construction panorama, which helps supervisors to conduct more detailed inspections of the quality of power grid construction.

4.3. Grid inspection

UAV technology can not only real-time access to the specific information of the current environment in which the line is located, but also to find out the possible danger factors in the construction process, the timely adjustment of the line to avoid accidents. In the process of inspection, the drone identifies some metal debris through the visible light camera photoelectric bin it carries, and can also carry out ultraviolet detection through the ultraviolet imager photoelectric bin it carries, so as to check whether there are safety hazards in the equipment, and timely exclusion, to ensure the smooth progress of power grid construction.

4.4. Grid Emergency Response

In the process of power grid construction, once a disaster occurs, it will lead to the smooth flow of the ground road is obstructed, resulting in great safety risks, but the staff can not carry out timely inspection of the problem. At this time will need to apply to the drone technology. The current stage of UAV technology can comfortably cope with normal inspection, post-disaster inspection and special situation inspection. Therefore, when a disaster occurs and emergency equipment is inducted, drone technology can be used to

inspect transmission lines, capture impact photos, so as to accurately locate the construction of the line fault area and conduct timely processing of line problems. At the same time, the UAV can also be used to remove foreign objects from the lines without damaging the grid environment through its own mounted fire-breathing device, eliminating excess safety hazards and ensuring construction quality.

5. Summary

With the rapid development of China's aviation technology, aerial survey technology is also constantly innovating and optimizing, and UAV technology is increasingly inclined to more intelligent development, and its application in the electric power industry has covered many aspects such as planning and construction of power grids, monitoring management, inspection and response. It is believed that with the continuous development of the electric power industry and the increasing number of electric power construction projects, in the future, the use of UAV aerial survey technology in the electric power industry will be more diversified, which can not only greatly enhance the efficiency of electric power enterprises and reduce the cost budget in the process of electric power construction, but also reduce the failure of electric power construction and reduce the risk factor, which also has an important contribution to the development of China's electric power industry.

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