

Exploration of the Application of UAV Remote Sensing Technology in Engineering Surveying and Mapping

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Abstract:

The application of UAV remote sensing technology in engineering surveying and mapping has gradually become widespread due to its high efficiency and accuracy. It cannot only quickly obtain high-definition mapping data to provide accurate and complete information support for engineering design and construction but also make up for the limitations of traditional engineering surveying and mapping and promote the innovation and development of the surveying and mapping field. Therefore, this paper explores the application of UAV remote sensing technology in engineering mapping. The exploration of UAV remote sensing technology is of great practical significance for achieving the goal of high-quality mapping data and high efficiency of the mapping process. Surveying and mapping staff need to have a correct perception and logic of the workflow of UAV remote sensing technology in the field of engineering surveying and mapping, analyze the needs of engineering surveying and mapping step by step, study the use of the technology and specific scenes, and promote the rapid development of technology and innovation, to give full play to the role of remote sensing technology of UAVs, and to arrive at more accurate measurement results.

Keywords: UAV remote sensing technology; Engineering mapping survey; Application discussion

1. Introduction

With the rapid development of China's economy, the construction of various infrastructure projects has been strongly developed. Engineering surveying and mapping needs to summarize and plan the construction program based on the various types of information measured [1]. Due to engineering surveying and mapping in the measurement of different geographic locations, building shapes, engineering scales, and a series of features such as information, they have different characteristics, so it requires engineering surveying and mapping information and the strictness of the drawings [2,3]. Engineering surveying and mapping are an important part of the project. Modern high-precision mapping equipment is needed to improve the efficiency and quality of engineering surveying and mapping.

However, the traditional engineering approach to mapping is slow, and it isn't easy to ensure the quality of the mapping project. This has led to the fact that traditional engineering mapping methods are not sufficient to satisfy the information support in today's mapping field and are not helpful for the prosperous development of the engineering mapping field [2, 4]. With the continuous progress and development of science and technology, traditional

engineering surveying and mapping methods are combined with new technologies and equipment to promote further development of the engineering surveying and mapping field. Among them, the application scale of UAV remote sensing technology in engineering surveying and mapping has gradually become extensive. With its efficient and precise characteristics, UAV remote sensing technology maximizes the mapping advantages of UAV remote sensing technology in engineering surveying and mapping. Also, it provides a new perspective and method for engineering surveying and mapping [5]. At the same time, UAV remote sensing technology provides accurate information support for harsh environment mapping, photographic data obtaining, directional information collection, low-altitude surveying, and handling unexpected mapping conditions [4-6]. In addition, through the UAV remote sensing technology, the relevant staff can quickly obtain high-definition mapping data of the mapping area at high altitude on the ground to provide more accurate and complete information support for the engineering design and construction and also to make the whole mapping method to be developed in an automated way [4]. UAV remote sensing technology makes up for the limitations of traditional engineering surveying and mapping, showing the necessity of UAV remote sensing technology in the

field of engineering surveying and mapping. Through the rationalization of the application of UAV remote sensing technology, the traditional engineering surveying and mapping mode has been innovatively improved, which plays an important role in the future development of this field and is of great practical significance for realizing the goal of high-quality surveying and mapping data and high efficiency of surveying and mapping process.

Based on the characteristics of the strong applicability of UAV remote sensing mapping technology in engineering mapping, this essay intends to explore the specific exploration of UAV remote sensing technology in engineering mapping. First, the advantages and disadvantages of UAV remote sensing technology are analyzed. Then, the mapping process of UAV remote sensing technology in engineering mapping is explored. Finally, the specific examples are analyzed from the specific application scenarios to provide a reference for the following engineering mapping work.

2. Advantages and disadvantages of UAV remote sensing technology in practical applications

UAV remote sensing (UA-VRS) uses advanced unmanned aerial vehicle technology, remote sensing sensor technology, telemetry and control technology, and other space information technologies to obtain professional and accurate space remote sensing information. High-resolution optical images, videos, photogrammetry, and other data are obtained through real-time processing, modeling, and analysis [7-9]. Next, this section introduces the advantages and disadvantages of UAV remote sensing technology in practical applications.

2.1 Advantages of UAV remote sensing technology in practical applications

With the continuous development of technology, the application of UAV remote sensing technology in the field of engineering surveying and mapping is expanding and gradually showing its unique advantages. First, the flexibility of UAV remote sensing technology enables it to monitor various terrains and environments. For example, when surveying and mapping staff want to detect a mine, the flexibility of the UAV can carry out all-round detection from the inside of the mine to the outside of the mine and the surrounding environment. It can detect the measured data in real-time and control the UAV to reach the target position using the remote sensing system. In addition, UAV remote sensing technology, in the actual measurement process, can be located in the measured area through the GPS positioning system on its body, and at the same time, according to the operation control of the mea-

surement software, the UAV positioning to the required area. Therefore, the UAV remote sensing measurement technology can be applied to the measurement work in a variety of different environments, which greatly improves the flexibility and scope of the mapping work [6].

At the same time, with the help of UAV, remote sensing can realize three-dimensional monitoring so that the monitoring method can be detected in the target area of the data situation is fully presented [3]. Promote the data information to be intuitive and accurate to the surveying and mapping staff. Third, in the actual application of UAV remote sensing technology, its advantages in engineering surveying and mapping efficiency, which mainly refers to the UAV remote sensing technology, can be formulated in the process of regional surveying and mapping of the various regions and their corresponding data for rapid processing and analysis [3]. For example, if the high-altitude measurement is used, the traditional surveying and mapping technology will be used by the surveying and mapping staff to climb to the corresponding height in the measurement. Traditional surveying and mapping methods not only have a high risk of danger but also take a long time to measure, and the measured data can not ensure accuracy because there are risks of human error and so on. However, we can't ignore the advantages brought by UAV remote sensing technology, which can improve the efficiency, accuracy, and safety of surveying and mapping work and provide strong support for engineering surveying and mapping.

Overall, the efficiency of UAV remote sensing technology is very high both in the mapping process and in data analysis and processing. At the same time, the application of UAV remote sensing technology, in the actual application of surveying and mapping process problems, can be found in time and get a reasonable solution; surveying and mapping work efficiency is improved in all aspects [6]. In addition, the UAV has a rapid response capability so that high-resolution data and images can be quickly captured and transmitted [10]. This efficient data capture capability and the advantage of being dispatched at any time improve efficiency.

2.2 Disadvantages in the practical application of drone remote sensing technology

Although UAVs have the advantages of wide range, accurate data, and high efficiency, they also have the limitations of being sensitive to weather and overly dependent on communication systems. Due to the problem of the UAV's light body weight, when the UAV flies to a certain height, the UAV is susceptible to weather. For example, when the UAV faces weather conditions such as gusty winds, torrential rains, and tsunamis, it is difficult for the

body to maintain a good flight condition and smoothly capture and detect images and data in the desired area. When the UAV is unable to resist weather conditions such as wind influence, the clarity of its images will be reduced, and problems such as the UAV departing from the original flight path will seriously affect the orderly development of the mapping work [8]. In addition, UAV remote sensing technology is overly dependent on the communication system, which is weak to interference, and the information data can be easily intercepted. Therefore, the information transmission of UAV remote sensing technology should be established in the scientific operation of sensors and mapping staff; if there is incorrect operation, invasion of lawless elements, etc., it will cause a series of security accidents that are not beneficial to the transmission of information and interferes with the normal flight state of the UAV [5,8], which ultimately leads to the failure of the mapping work to be completed on schedule.

3. Mapping process of UAV remote sensing technology in engineering mapping

In the measurement of modern engineering mapping, UAV remote sensing technology plays a very important role. For example, UAV remote sensing technology is often used in the measurement of modern mines. In this case, transportation is inconvenient due to the complex terrain around the mine and other unfavorable factors, so the traditional surveying and mapping work can not ensure the safety of the equipment and surveying and mapping staff. Utilizing the advantages of UAV remote sensing technology allows the mapping staff to avoid the influence of external factors and to complete the mapping efficiently and accurately [11]. In general, the application of UAV remote sensing technology for mapping needs to follow the following five processes:

1)The demand research is carried out, and the range of the measured area and the area of the UAV camera are determined first. According to the range of the measured area and the accuracy requirements of the results, the resolution of the 3D, DOM, and DEM are set [12,13].

2)Carry out UAV flight planning and design. Firstly, the surrounding environment is surveyed, which includes collecting the terrain, geology, climate, and other related information about the mapped area. Secondly, the ground resolution should be set, and a certain number of ground control points (GCP) should be arranged [14]. According to the coordinates of the control points and geographic information, further flight planning design is carried out, which includes the height, direction, overlap, angle, etc., of the UAV flight [12].

3)Field photography is carried out. This step requires the use of UAV remote sensing technology in combination with the Global Positioning System (GPS), Inertial Measurement Unit (IMU), and specific sensors. When obtaining image data through specific sensors, such as optical cameras, staff need to fully understand the survey area and optimize the flight route and height of the drone to ensure safe flight [6]. If faced with complex terrain and special buildings in surveying and mapping projects, directional information collection is required to support and help the staff obtain complete surveying and mapping results.

In the process of formal mapping of complex mapping problems, the mapping staff should not only confirm the focus or specific areas of the mapped area according to the real situation of the mapped area on site. After comprehensive monitoring of the mapping area, the key and difficult areas need to be repeatedly and efficiently monitored in order to lay a strong foundation for ensuring the accuracy of the data and the integrity of the evidence [7]. However, manual data collection technology has been unable to meet the needs of the surveying and mapping field. Nowadays, surveying and mapping staff are more likely to utilize automatic encrypted data collection technology. Moreover, UAV remote sensing technology can realize data encryption and reasonably set the use authority of mapping staff [4]. Automatically encrypted data collection is used to summarize the collected data as a whole, protect it from being stolen or tampered with, and ensure the accuracy of the measured data and the orderly advancement of the subsequent work content [4,7].

4)Carry out internal processing. After the directional information collection work, the mapping staff needs to process and screen the data and information. In the traditional surveying and mapping method, the data from surveying and mapping are mainly processed manually, whose disadvantage is that the efficiency and accuracy are difficult to guarantee, as well as the subjective factors bring influence and negative consequences [8]. Therefore, the wide application of UAV remote sensing technology has greatly reduced the emergence of this problem. Its mapping data and images are highly accurate and practical. It makes the specific data processing effect more optimized and the direction more clear [6]. Finally, the image data, as well as geographic data and other information embedded in Agisoft Photoscan Professional, smart3D, info, Arcgis, and other software for processing and deep processing, and ultimately constructed DEM, DOM, and three-dimensional model [12,14].

5)Carry out results quality assessment. The image and data information will be compared and checked with the image results to ensure that its data accuracy quality standards meet the requirements of the relevant standards [12].

4. Specific application scenes of UAV remote sensing technology in engineering surveying and mapping and its analysis

4.1 Low-altitude measurements

In engineering surveying and mapping work, low-altitude operation is often affected by various factors, which challenges the accuracy of data mapping. In order to ensure the accuracy of the mapping data and improve the safety of the work, the relevant staff need to flexibly choose a reasonable and scientific mapping method according to the actual situation of the construction site. This can reduce the uncertainty and risk of low-altitude operations and provide accurate and reliable mapping data for the engineering department, thus optimizing the implementation of the entire mapping work. Through scientific selection and flexible application, engineering surveying and mapping work can maintain efficient and accurate operation in the complex and changing field environment [7]. In addition, when the surveying and mapping work area is a mountainous area with high altitude, it is difficult to obtain accurate image data by traditional surveying and mapping methods due to external factors such as complicated terrain and unsightly line of sight. At this time, UAV remote sensing technology can play its unique role. By fully analyzing the local terrain and external environment and formulating a suitable mapping program, the UAV operates at low altitude for aerial photography, can maintain smooth flight, and complete self-checking, thus effectively reducing measurement error and providing technicians with a clear picture of the photographed data, which greatly facilitates the smooth progress of the follow-up work [3].

4.2 Harsh Environment Measurement

When UAV remote sensing technology is in the mapping project, it is unavoidable to encounter some harsh environmental conditions; UAV remote sensing technology needs to take a series of measures to deal with the challenges brought by the harsh environment to ensure that it can safely and accurately complete the task of mapping, and improve the efficiency and quality of the mapping project. In order to make UAV remote sensing technology play its due value and ability in the process of surveying and mapping, the surveying and mapping staff need to carry out the following two points.

- 1) Staff should strengthen the protective measures of the UAV. When the UAV encounters unfavorable weather conditions such as sand, dust, storms, wind, and rain, or complex terrain conditions such as mines, in order to reduce the impact of the external environment on the UAV,

the installation of a dust cover and a rain cover become necessary for the protection of the equipment [4].

- 2) Intelligent optimization of UAV flight routes and autonomous flight altitudes is one of the key applications in UAV remote sensing mapping. Modern UAVs are equipped with advanced navigation systems and sensors, which make UAVs quickly and accurately obtain the information and data of the mapped targets. Unlike the traditional remote sensing technology, it can greatly reduce the influence of subjective factors brought about by manual operation and the influence of human factors such as technical errors on data collection. At the same time, the UAV automatically plans the optimal flight route and the best altitude according to the set task requirements. It avoids unfavorable weather conditions and complex terrain to realize safe flight and high-precision data collection [10].

4.2 Combination of UAV remote sensing technology and artificial intelligence

Allowing UAV remote sensing technology to be combined with artificial intelligence enables UAVs to autonomously recognize features, sense the surrounding environment, and avoid obstacles and the boundaries of features [10]. For example, combining UAV remote sensing technology with the image recognition technology of artificial intelligence allows the UAV to automatically recognize and present high-precision real-time landscape jigsaw puzzles of areas such as forests, farmlands, and buildings. In addition to this, artificial intelligence technology will be enabled in the UAV to achieve a wide range of real-time monitoring of the detected area and timely detection of abnormal changes [11]. UAVs combined with artificial intelligence technology have already realized real-time monitoring of forest fires. Thanks to the high-performance inference engine, which has been integrated into advanced AI technology, it has demonstrated excellent cross-platform deployment capabilities. This is due to its modular construction, which makes the whole system more flexible and easy to expand. With simple profile manipulation, we can easily build a variety of detection models specialized for smoke and fire point identification. This technology provides strong support for large-scale monitoring of forest fires. Once a fire is detected, the system will immediately send an alarm to the control center, assisting the forest management department to quickly link all parties to respond to the fire, thus ensuring forest safety [12].

5. Conclusion

This paper provides an in-depth study of the exploration of UAV remote sensing technology in engineering mapping. This paper mainly explores the application of UAV

remote sensing technology in engineering surveying and mapping, its advantages and disadvantages, the specific mapping process, and the application of actual scenarios. It was found that UAV remote sensing technology has unique advantages in the field of engineering surveying and mapping, such as wide surveying and mapping range, high surveying and mapping efficiency, and strong adaptability. Especially in complex environments and bad weather, its fast response and accurate measurement ability are remarkable. However, the technology also has problems, such as susceptibility to weather and dependence on communication systems. The mapping process includes five key steps: demand research, flight planning and design, external shooting, internal processing, and results quality assessment. In addition, the specific application scenarios of UAV remote sensing technology in engineering surveying and mapping are also studied, including low-altitude surveying, harsh environment surveying, and the combination with artificial intelligence. The combination with artificial intelligence allows the UAV to recognize, sense, and avoid obstacles autonomously, further improving the mapping efficiency and accuracy. These findings provide strong support for the wide application of UAV remote sensing technology in engineering mapping. UAV remote sensing technology has excellent space for use in surveying and mapping engineering and has a broad application prospect. In this context, UAV remote sensing technology provides scientific information data and high-precision image data for the field of engineering surveying and mapping. In the future, UAV remote sensing technology will play a greater role in engineering surveying and mapping and promote the continuous development of the surveying and mapping industry.

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