Research and Analysis of UAV Application Technology in Geological Engineering

Yingxin Cheng[1], Zhifeng Mao[1,b*]

[1]Liuzhou City Vocational College Liuzhou, Guangxi, China

[b*]1225778151@qq.com

Abstract. In recent years, with the rapid development of society, the utilization rate of land and resources has been significantly improved. In order to achieve stable use and reduce loss, relevant personnel need to actively carry out planning and design, and gradually expand the scope of surveying and mapping. Today, geological engineering surveying and mapping has formed an inherent system. With the support of data, the analysis accuracy has been significantly improved, but there are still unstable factors. Especially in the face of complex terrain and environmental factors, the process is not smooth, and many data cannot be collected. Based on this, this paper focuses on the UAV technology commonly used to solve the above situation, analyzes its concept and technical advantages, and expounds the application channels and precautions, in order to improve the efficiency of surveying and mapping. suggest admit the mapping.

Keywords: UAV, UAV Application Technology, Geological Engineering, Surveying And Mapping

1 Introduction

At present, geological engineering surveying and mapping has become the primary work of most construction projects. It is necessary to collect data from the surrounding environment and geographic information, and then gradually analyze its use in combination with the actual situation. Considering the shortcomings of the existing mechanism, continuous optimization is carried out to ensure the objective and stable results of surveying and mapping. However, in the process of land surveying and mapping, many complex terrains cannot be directly deepened, or there are sudden risks inside. Blind entry may cause financial losses and casualties. The use of UAV application technology, equipped with detection instruments to enter, to achieve remote precision mapping, can effectively solve the above problems.

2 Overview of UAV technology

UAV technology has successively integrated a number of new technologies, significantly improved environmental adaptability, and improved information protection. In

B. K. Kandel et al. (eds.), *Proceedings of the 2023 8th International Conference on Engineering Management (ICEM 2023)*, Atlantis Highlights in Engineering 23,
https://doi.org/10.2991/978-94-6463-308-5_2

actual work, a safe GPS signal receiving and transmitting device will be set up first, and then remote sensing surveying and mapping technology will be used to collect all surveying and mapping information to form three-dimensional coordinates. Subsequently, reference datum such as center line can be selected to explore the shortcomings of drawings. In addition, as an important product of the information age, UAV technology will also be affected while it is innovating in science and technology. The work calculation and mapping process can also be integrated with CAD to form a more stable new system and further demonstrate the technical advantages. Applying UAV technology to the geological engineering industry can effectively control costs, save time and improve efficiency.

At present, the known UAV needs to determine the basic parameters before flying, calculate the flight height and accuracy, and analyze the linear relationship between the two. When the reflectivity of the local object is 10 % of the standard, the detection distance is about 190 m, the stable flight height needs to be controlled within 150 m, and the height accuracy needs to be about 50 ~ 100 m. When the subsequent corresponding parameters change, the predicted flight height can be calculated by means of its positive correlation. Then, with the help of the scale requirement of detection drawing, the point cloud density and flight speed can be fused to achieve accurate and stable detection.

3 Advantages of UAV application technology

(1) High Precision

The traditional geological engineering surveying and mapping needs to set up a professional work team, and then carry the monitoring instrument to the site to complete the time measurement, and then summarize the data and analyze it by the data processing department. However, with the increase of application time, its disadvantages gradually appear. Workers ' measurement will lead to large measurement errors and low accuracy. The use of UAV technology for measurement can reach 1cm + 1ppm horizontally and 1.5cm + 1ppm vertically[1-7].For example, in the investigation of land use in a certain area of Liuzhou City, the UAV aerial survey results are close to the field measurement results, and the error is within 5 centimeters, as shown in Figure 1.

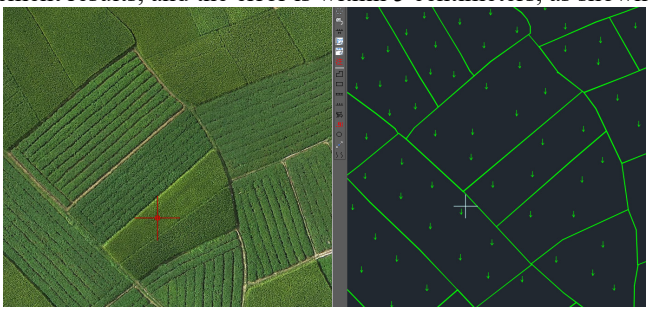

Fig. 1. UAV aerial survey results and field measurement results comparison

(2) wide measuring range

The UAV can select the measurement mode according to the flight height and the change of the time difference value in the measurement stage, and then combine the system performance to ensure the safety and work efficiency as the primary index. At present, the most common methods are high space measurement and large area measurement. At the same time, with different hardware specifications, it can also achieve low altitude and small range frequency measurement. The main control system is used to ensure the stable operation of multiple devices. The subsequent reference angle and data are more, and the results are more accurate. Secondly, the staff can analysis in the case of multi-spectral, and then obtain the monitoring data in the large area of the survey area, and integrate it with the traditional points, and realize the macro analysis of the survey area with the help of three-dimensional simulation, so as to provide multiple guarantees for the subsequent decision-making. suggest show the three-dimensional simulation[8,9].For example, in the investigation of land use in a certain area of Liuzhou City, the use of UAV measurement can quickly complete the aerial survey work in the 1 : 500 aerial survey area, as shown in Figure 2.

Fig. 2. a UAV aerial image of a certain area in Liuzhou City

(3) High Efficiency

Traditional geological engineering surveying and mapping needs to go deep into the field, measure the numerical changes in the specified position and time, use the accurate parameters directly, calculate the stable threshold with variable parameters, and carry out subsequent work. Once extreme weather or complex terrain is encountered, the monitoring efficiency will be greatly reduced.

However, after the application of UAV technology, first of all, in the preliminary preparation stage, there is no need to prepare equipment and materials, configure human resources, and set up a work plan. It is only necessary to detect the running state of the UAV and test whether the functional modules are stable or not. Secondly, the operation of the UAV will not be affected by the topography, and its control connection

can be deepened stably. The emergency plan that needs to be prepared is not complicated, resulting in a shorter monitoring time and a significant reduction in the number of accidents. However, after the application of UAV technology, its measurement accuracy has been significantly improved, mainly due to its modern hardware performance. First of all, the real-time interaction between UAV and main control equipment can be realized by means of signal transmission device and data sharing platform. The fluency and real-time performance of data transmission are significantly improved. The operation can be carried out in real time during data transmission. With the help of big data technology, there is no need to consider the risk of untimely processing of massive data. Secondly, UAV technology is highly integrated. When going out for measurement, there is no need to carry a variety of equipment. After a short period of time to form a measurement image, the hardware system can be directly used to complete the transmission. Compared with the traditional measurement system, its work efficiency will be more than 8 times higher. About 20 days can complete the workload that took more than half a year in the past.

4 Application of UAV technology in geological engineering survey

As an important derivative of information technology in the new era, UAV technology has stable performance and strong adaptability. Its application in geological engineering surveying and mapping can accurately understand the surrounding environmental information, further give full play to its technical advantages, and reduce the difficulty of subsequent work.

(1) Topographic map drawing

At present, UAV technology has been widely used in large-scale geological engineering surveying and mapping. Many cases have confirmed its high adaptability and can stably meet the needs of various proportions of graphics rendering. It is an important boost for the future development of geological engineering related industries. The main working modes are as follows:

First, the UAV equipment will load the DOM data obtained at the stage time into the large-area topographic map drawing software, and use the data information fed back by the subsequent systems to complete the initial overall classification. The specific categories can include: data type, measurement unit, actual use and numerical size, laying the foundation for subsequent data use.

Second, the staff needs to understand the proportion requirements of the drawings required for geological engineering surveying and mapping, especially the large-scale drawings such as 1: 2000, and the drawing accuracy needs to reach a certain standard. Then, the staff needs to combine the hardware equipment used to develop an initial work plan, calibrate resource allocation and work routes.

Thirdly, in the process of UAV remote sensing measurement, the staff need to load the acquired data into the ArcGIS system, flexibly use the geographic information, establish multiple layers, and gradually improve the data upload between the follow-up,

clarify the characteristics of the surrounding building features, and further go back to the more stable vector data results.

(2) Low-altitude measurements

At present, geological engineering surveying and mapping is widely used, in addition to the conventional construction system, it also includes complex dangerous areas such as mines. Therefore, in actual conditions, more detailed geological information is usually required, but the height is too high. The data cannot be accurate to a certain extent, so the staff need to learn low-altitude flight measurement, and do a good job in the work plan.

First, the staff need to do a good job of equipment debugging, taking into account the low-altitude flight of UAV equipment, vulnerable to the surrounding structure, trees, so you need to ensure that the detection and return device is stable, and technical personnel need to have a solid experience and strain capacity, in case of emergency, can make a timely response, so as not to damage the equipment.

Secondly, considering that it is difficult for UAV to take off and land in high altitude areas and extreme weather, the staff need to combine their own detection with the information notification of the meteorological department to clarify the weather changes and try to choose a relatively stable environment to carry out their work. If there is no inevitable need to choose to use protective measures externally.

Thirdly, it is necessary to pay attention to equipment optimization, cooperate with UAV technical analysis, develop a dedicated low-altitude aerial survey system, and use special calibration software to ensure photo overlap, reduce the possible damage of light and thin fuselage structure, follow-up with the flexible use of automation system, continuously improve the measurement accuracy, and improve the instability of resolution and clarity in the process of image data processing.

(3) Mine surveying

It belongs to the representative application area of geological engineering surveying and mapping UAV technology, which is the mine structure. It is formed by the influence of natural environment, so the structure is complex, and there will be the risk of interference. Therefore, the staff needs to understand the importance of mine surveying in combination with their own actual situation, and then carry out surveying and mapping work in a standardized way.

First, considering the particularity of the mine structure, real-time inspection analysis and calculation cannot be directly carried out. It is necessary to complete the survey on site first, obtain the topographic conditions and resource allocation required for the subsequent plan formulation, and then process the data centrally to provide sufficient and complete data reference for the plan formulation.

Second, the internal resources of the mine are of great significance to the development of the country. Therefore, in order to ensure the stability of the follow-up monitoring standards, the staff need to first combine the renewal of surveying and mapping, gradually find out the model and nature of the mineral material, and then establish a mutually beneficial working mode to reduce the loss of resources.

Third, it is necessary to use new technologies such as radar, multi-spectral and true color flexibly. After obtaining real data, qualitative and quantitative analysis should be

carried out to lay a good foundation for subsequent mine construction and management, and improve the objectivity and representativeness of the results.

(4) Special case response

For geological engineering survey work, in recent years, it is not only equipment problems and system shortcomings that affect its work efficiency, but also delays the work progress due to emergencies, and even joint capital losses and even casualties. Therefore, it is necessary to understand the dangers of special situations and establish corresponding work processes and emergency plans.

First, it mainly pays attention to the collection of historical data. If you want to analyze emergencies, the existing data does not have enough reference value. Therefore, the staff needs to establish a sound data upload mechanism. After coping with and recording, it is placed in the main control device. After preliminary analysis, it is transferred to the cloud database for stable storage.

Second, the staff needs to consider the emergency response. If there is extreme weather, it is necessary to do a good job in the mediation of personnel and equipment to avoid affecting its structural stability. If it cannot be completely evacuated, large equipment needs to be handled with protective devices. If it is a geological disaster, such as debris flow and earthquake, the staff needs to obtain the surrounding parameter changes at the first time, analyze the causes, and further realize the effective scheme. At the same time, it can also improve the service life of the equipment and reduce the number of accidents.

Third, it is necessary to establish an emergency plan. In addition to process adjustment, it is also necessary to measure the post-prevention management mechanism to ensure timely response to problems, and to use massive data to complete innovative development.

5 Notice

(1) Regular inspection of equipment

UAV technology and geological engineering surveying and mapping both need hardware equipment to carry out their work. Therefore, in addition to strengthening the implementation of the process, relevant personnel need to pay attention to equipment management to effectively extend their service life. In the future, they can also establish a complete maintenance and operation plan based on actual needs to improve work efficiency.

First, we need to fully understand the structure type of long-term operation of UAV technology when it is implemented, and analyze the historical data to understand its structural characteristics, and then establish corresponding work management standards. If the equipment is updated quickly in the near future, it is more necessary to understand the market environment, based on the original system to avoid unstable operation quality.

Second, it is necessary to establish a perfect operation and maintenance management cycle and determine the interval of operation and maintenance. If the equipment is used more frequently, it is necessary to moderately shorten the detection cycle, find hidden

problems in time, and remove them in advance. In addition, a professional work team should be set up to correct the wrong behavior, ensure the operation specification, and detect the numerical changes to ensure the stability of the work.

(2) Optimize the image control point measurement process

In the actual measurement process, in order to better apply UAV technology, it is necessary to determine the coordinates of the measurement points in combination with the actual situation, and then gradually transfer and transmit data in real time in combination with the established scheme. However, considering the complex environment on site, the selection of control points is difficult, and staff need to gradually overcome it to ensure the steady progress of follow-up work.

Firstly, starting from the shooting angle and range of the UAV, through the regular inspection of the image quality and free network effect in the area, the stability of its work is further analyzed, and the free network puzzle is quickly generated in the follow-up. When the image control points are laid out, the position information can be obtained intuitively, and the test market can be shortened and the work efficiency can be stabilized with the computer.

Second, when collecting and processing images, the staff should bear in mind that the original data information cannot be deleted at will, otherwise the initial construction plan will not be objective. In addition, it is necessary to note that when selecting and analyzing points, no instructions can be issued to rearrange the data, otherwise the subsequent adjustment will encounter great difficulty and even lead to stagnation.

(3) Focus on industry development

Considering the diversity of the existing environment, in order to reduce the occurrence of data errors, the staff will simultaneously carry out dynamic surveying and mapping, use the technical advantages, realize the whole process supervision, analyze the risk factors, and formulate the follow-up response plan. However, considering the excessive variable factors, it is necessary to pay attention to the specific needs of dynamic surveying and mapping and determine the working mode.

First, in the information age, dynamic surveying and mapping is an indispensable working mode when the UAV is running. Therefore, it is necessary to establish a real-time monitoring system based on the site conditions to assist the staff to complete the debugging one by one for the drawing content and reduce the negative factors of unstable factors.

Secondly, it is necessary to do a good job in supervision and management and accident prevention for each variable. At the same time, combined with the analysis of natural environment information, correct installation of GPS receivers, etc., to ensure stable cost. At the same time, it can also use the all-round monitoring system to obtain on-site information, timely point out the problem, help the data to plan changes, and reduce risk problems.

(4) Focus on innovative development

UAV technology is a load-type structure derived from the background of modern science and technology. It can use its high integration to achieve performance integration, but it has technical advantages and also inherits its shortcomings. Equipment needs real-time innovation to meet social needs, which is very difficult[10,11].

First, effectively change the wrong cognition of employees and management, and clarify the important position of science and technology as the first productive force. In the actual work process, historical data need to be collected every time the work is completed, and the shortcomings of the follow-up system are improved one by one. In addition, innovation and development are the driving force of the industry. Managers need to pay attention to and continuously adjust to avoid issuing wrong instructions.

Second, the staff need to connect to the market in real time, understand the new equipment and technical means, after a preliminary analysis of its suitability, to be pilot practical test, confirm the correct replacement in time. In addition, it is necessary to formulate an innovative development strategy and determine the reference values in combination with the actual situation. In addition to the basic structural values, we should also pay attention to the development of derivative data to lay the foundation for subsequent institutional changes.

6 Conclusion

In summary, under the background of the information age, the traditional surveying and mapping technology has been unable to meet the needs of the work. Once an emergency occurs, it will lead to a decline in work efficiency and even casualties. Using UAV technology to carry a variety of loads, reduce the difficulty of geological engineering measurement, save costs and improve efficiency. However, considering the strong variability of the on-site environment, the staff needs to determine the optimization direction, and then conform to the development needs of the times to further promote the stable development of the industry.

Acknowledgment

This work was supported by Research on the Application of UAVs in the Maintenance of Important Inland Waterways -- A Case Study of Liuzhou Urban Reach of Liujiang River (2023KYYB28) and Research on the Application of UAVs in Campus Security (2022KY1479).

References

1. Xu Xiaoming. Application of UAV mapping technology in engineering survey [J]. Engineering technology research, 2022,7 (01) : 72-73 + 77.
2. Chen Meng. This paper discusses the application of UAV remote sensing technology in surveying and mapping engineering survey [J]. Housing, 2020 (33) : 36-37.
3. Wang Yanhui. The application of UAV remote sensing technology in surveying and mapping engineering survey [J]. World Nonferrous Metals, 2021 (05) : 141-142.
4. Zhang Huayang, Bao Jian, Wang Saisai. The application of UAV aerial photography technology in engineering surveying and mapping [J]. Network security technology and application, 2021 (02) : 137-138.

5. Zhao Yongping. Application of UAV in geological engineering surveying and mapping [J]. China Residential Facilities, 2021 (01) : 63-64.
6. Xu Lin. Application of UAV in geological engineering surveying and mapping [J].World Nonferrous Metals, 2020 (13) : 151-152.
7. Jia Haiguang. Application of UAV aerial photography technology in geological engineering surveying and mapping [J]. World Nonferrous Metals, 2017 (12) : 48-49.
8. Kshitij Srivastava, Aman Jain Bhutoria, Jyoti K. Sharma, et al, UAVs technology for the development of GUI based application for precision agriculture and environmental research, Remote Sensing Applications: Society and Environment, Volume 16,2019,100258.
9. Shuai Sun, Biao Wang, Low-altitude UAV 3D modeling technology in the application of ancient buildings protection situation assessment, Energy Procedia, Volume 153, 2018, Pages 320-324.
10. [10] Hassan Jalil Hadi, Yue Cao, Khaleeq Un Nisa, et al, A comprehensive survey on security, privacy issues and emerging defence technologies for UAVs, Journal of Network and Computer Applications, Volume 213,2023,103607.
11. Oluwatosin Ahmed Amodu, Chedia Jarray , Sherif Adeshina Busari, et al, THz-enabled UAV communications: Motivations, results, applications, challenges, and future considerations, Ad Hoc Networks, Volume 140,2023,103073,ISSN 1570-8705.