



Research on Channel Management Based on UAV Application Technology

Yingxin Cheng^{1a}, Zhifeng Mao^{1b*}

¹Liuzhou City Vocational College Liuzhou, Guangxi, China

^{b*}1225778151@qq.com

Abstract. From a theoretical and practical perspective, waterway maintenance is a very important task that can promote the good development of the waterway. However, due to traditional aerial survey methods, it is difficult to accurately understand the actual situation of the waterway during the maintenance process, and the corresponding level of waterway maintenance is also not high. Based on this, this article takes Liujiang as the research object. In the process of using drones to maintain the 20 meter deep water channel of Liuzhou section of the Liujiang River, in order to gain a detailed understanding of the changes in the channel water area, the drones were used to cruise and set reasonable take-off and landing points and shooting angles for photography facilities based on the range. Then, the drones were placed on the application site by the operators. This article focuses on the analysis and exploration of the application of drones in the maintenance of important inland waterways, including the selection of drones, route planning, channel cruising, and aerial survey of channel facilities. It is hoped that this will provide some reference for the maintenance of important inland waterways.

Keywords: UAV, Channel Management, Application.

1 Introduction

China has a vast territory and a large number of inland rivers, and the corresponding waterway development trend is good. However, in order to keep the development of the channel in a good state, it is necessary to strengthen the management of important inland waterways, that is, to understand the actual situation of the channel through channel cruising, and to carry out targeted maintenance, so that the ship can pass the channel smoothly. Therefore, UAV technology should be actively used in the maintenance of important inland waterways. Through the flexible operation of UAV along the route into the channel waters, the advanced photography technology is used to obtain high-resolution images and data, understand the actual situation of the channel, clarify the existing problems, and then strengthen the channel maintenance. Taking Liujiang River as the research object, this paper focuses on the analysis and discussion of the application of UAV in the maintenance of important inland waterways, including the selection of UAV, route planning, waterway cruise, and aerial survey of

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waterway facilities, hoping to play a certain reference role in the maintenance of important inland waterways.

2 Inland waterway maintenance

In recent years, the actual situation of domestic inland waterway maintenance and the level of water transport development have been understood. The classification of inland waterway maintenance needs to consider the grade of the waterway and the volume of passenger and freight traffic. At the same time, it is necessary to consider the status and role of the area where the waterway is located, and appropriately adjust the classification criteria, and then reasonably classify. For example, although the waterway and passenger and freight traffic in some special river sections have not reached the higher level of maintenance classification criteria, they will also improve the maintenance level due to frequent practical application. Specifically, the main contents of inland waterway maintenance are:

(1) Channel maintenance observation. As an important basic work content of inland waterway maintenance, it is necessary to select suitable maintenance observation methods in strict accordance with the relevant specifications of 'Water Transportation Engineering Survey Specification', and then carry out roadway maintenance hydrological survey, shoal waterway maintenance survey and long river waterway mapping.

(2) Maintenance of navigation mark. Inland navigation mark is an important navigation aid for the safe navigation of ships in inland waterways. Its distribution is divided into four categories. The maintenance standards of different types of navigation marks are not only the same. Therefore, in the process of specific implementation of navigation mark maintenance work, it is necessary to clarify the maintenance requirements and work indicators, and standardize and reasonably carry out navigation mark setting, adjustment, inspection, maintenance and maintenance [1-5].

(3) Beach section maintenance.

Beach dangerous section refers to shoal, rapids, dangerous shoal and curved narrow river. It is the key content of waterway maintenance. It is necessary to grasp the relevant information in detail, so as to understand the actual situation of the river section, clarify the existing adverse situation, and deal with it in a targeted manner. For example, in order to avoid shallow water, curved and narrow river sections hindering the normal navigation of ships, it is necessary to regularly or irregularly survey and investigate the above river sections, so as to accurately grasp the silt accumulation in the river section as much as possible, and then improve the river section through local widening, dredging and clearing obstacles, so as to promote the smooth navigation of ships.

3 Analysis of the maintenance status of important inland waterways

Based on the understanding of the maintenance work of inland waterways, this work has many contents and has certain difficulty. It requires a lot of manpower, material and financial resources, overall planning, reasonable arrangement, continuous and effective development of this work, so as to ensure the smoothness of inland waterways. Further analysis of the actual situation of important inland waterway maintenance, there are some problems to be solved, namely:

(1) Improper preservation of waterway information.

In order to obtain a good maintenance effect of important inland waterways, it is necessary to collect, sort out and store waterway-related information as much as possible in the process of specific maintenance work, so as to clarify the problems existing in important inland waterways through the analysis and application of information data, so as to formulate targeted maintenance measures and deal with them. However, in the process of carrying out maintenance work, the maintenance personnel only record the channel information simply and record some of the content with images, which increases the complexity and tediousness of channel information collation and archiving. On the other hand, it affects the utilization rate of channel information extraction [6].

(2) High maintenance costs.

The maintenance of important inland waterways needs to be carried out in strict accordance with the relevant norms and requirements promulgated and implemented by the state, adopt appropriate maintenance methods, carry out maintenance work regularly or irregularly, and collect information on important inland waterways in the early stage; later, feasible maintenance measures should be formulated and implemented. This process requires a lot of manpower and financial resources. Because of the increasingly frequent navigation of domestic ships in recent years, higher requirements have been put forward for the use of inland waterways, and the maintenance level needs to be further improved, which makes the maintenance cost of important inland waterways increasing.

(3) Real-time monitoring is not effective.

Real-time observation is needed in the process of maintenance of important inland waterways in order to grasp the actual situation of waterways relatively accurately and provide reference for targeted maintenance of waterways. The actual situation of the maintenance of important inland waterways is analyzed. Due to the backward monitoring equipment and other factors, the accuracy and reliability of river monitoring are greatly reduced, and the actual situation of important inland waterways cannot be accurately reflected.

4 The advanced nature of UAV aerial survey

In order to understand the actual situation of the maintenance of important inland waterways in the past, it is necessary for staff to travel to the waterway site and cruise

by boat. In this process, it may be affected by factors such as ships and reefs, resulting in the inability to cruise at close range. It is difficult to obtain accurate aerial survey data, and then it is impossible to understand the actual situation of the waterway more deeply, find problems in time, and provide targeted maintenance. With the continuous development of science and technology, the level of domestic UAV technology has been continuously improved, and it has been applied in many fields and played an important role. In this case, the application of UAV technology in the maintenance of inland waterways can replace the traditional aerial survey method, that is, the remote control of UAV into the waterway waters, the use of camera technology for camera, can obtain the channel video, pictures and data, to be processed and analyzed, can show the real situation of inland waterways, to create conditions for more scientific and rational maintenance of waterways [7]. UAV aerial survey technology is an emerging technology based on remote sensing technology, remote sensing technology and remote control technology and computer technology and other technologies. Applying it to the maintenance of inland waterways can not only obtain high-resolution images and information data, but also save manpower, material and financial resources, and promote the scientific, economic and effective maintenance of inland waterways. Greatly improve. This paper uses the DJI M300 multi-rotor UAV, as shown in Figure 1.



Fig. 1. DJI M300 multi-rotor UAV

5 The effective application of UAV in the maintenance of important inland waterways

5.1 UAV application advantages

The advantages of applying UAV in inland waterway maintenance are as follows:

First, drones are more suitable for the geographical environment of important inland waterways. Some important inland waterways are located in remote and remote areas. If more silt or other conditions occur, it will lead to difficulties in navigation.

The UAV is applied to the maintenance of important inland waterways. It can not only carry out long-distance aerial survey, but also can cruise in detail through low speed or hover, so that the maintenance personnel can understand the actual situation of the waterway more clearly and accurately.

Second, the application range is wide. With the improvement of domestic scientific research level, there are many types of UAVs with different functions. According to the maintenance needs of important inland waterways, suitable UAVs and camera equipment can be selected to cruise in real time and transmit high-definition video to the monitoring center, so that maintenance personnel can view the video content, analyze the actual situation of the waterway in detail and deeply, and clarify the factors affecting the normal navigation of the ship [8].

Third, the reaction is rapid and the application effect is good. The UAV is relatively light. Through the targeted operation of the UAV, it can quickly respond and fly to the destination quickly, and then effectively monitor the important waterways so that maintenance personnel can track and understand the changes in the waterway.

5.2 UAV model selection

The water regime of important inland waterways is complicated, and it is necessary to use waterway facilities to view and inspect in real time. Using UAVs instead of traditional monitoring methods can not only reduce the difficulty of monitoring but also improve the accuracy of monitoring. The main reason is that the safety, efficiency and convenience of UAV aerial survey are high. Of course, in order to make the UAV play a full role in the maintenance of important inland waterways, it is necessary to select the UAV model reasonably and then apply it effectively.

At present, the application of UAV in the maintenance of important inland waterways is in its infancy. Due to the lack of rich application experience, UAV aerial survey may be affected by many factors, resulting in inaccurate aerial survey results. In order to avoid this situation as much as possible, we should select the appropriate UAV according to the characteristics and requirements of the maintenance work of the important inland waterway, that is, the relevant staff should sort out the relevant information of the maintenance of the important inland waterway, such as the normative documents and work materials promulgated and implemented by the state, so as to obtain the analysis results with high application value. For example, the cruise distance of the waterway is long, and the corresponding UAV aerial survey distance is long and difficult. The cruise process will pass through multiple areas, which means that the UAV may be affected by meteorological conditions, so that its safety is greatly reduced; the accuracy of aerial survey requires that the UAV should be equipped with high-definition camera equipment, and ensure its small size and light weight [9]. Therefore, the channel department can choose a suitable UAV, such as the fixed-wing UAV, which has the advantages of long range, fast navigation speed and large task load. It can be flexibly operated according to the actual application requirements to meet the needs of channel maintenance. Rotor UAV is selected, which has the characteristics of simple structure, high cost performance, convenient carrying and flexible operation. It is applied to the maintenance of important inland waterways, which can

flexibly adjust the flight height and flight speed of UAV, and obtain more accurate, comprehensive and detailed waterway information.

5.3 Effective application of UAV

(1) Route planning

The route planning is the preparation work of UAV cruise and an important technical document to guide aerial photography. The process of UAV cruise may be affected by many factors, such as climatic conditions, topography, etc. In addition, the maintenance of important inland waterways requires high requirements. If the preparatory work is not done in the early stage, the UAV cruise effect will be greatly reduced. It is difficult to meet the work requirements and waste human, material and financial resources. In order to avoid this situation as much as possible, maintenance personnel first need to clarify the relevant regulatory requirements promulgated by the state before using UAV cruise, and master the requirements of waterway maintenance work and applicable maintenance methods. On this basis, the maintenance data of important inland waterways in the past are sorted out in order to clarify the basic situation of the waterway. Then, the operation scope, bottom characteristics, accuracy requirements, photographic parameters, image use and so on are comprehensively considered to optimize the design route. After completing the route planning, it is necessary to strictly check it to determine whether the route is optimal, whether the channel area is fully covered, whether the regional division is reasonable, and whether the flight height will be affected by the terrain height. If there is a planning problem, it should be adjusted to improve the feasibility of route planning.

(2) Channel cruises

On the basis of reasonable route planning, it is necessary to check whether the performance of the unmanned photography system is intact. On the basis of determining the good functions of the UAV photography system, control the UAV, fly quickly, monitor the channel along the route, and collect the channel information in real time. In this process, the maintenance personnel should guide the operator to operate the UAV reasonably according to the video recording of the photographic equipment on the UAV, such as changing the direction, adjusting the flight speed, adjusting the flight height, etc., so that through the use of infrared, color and black and white camera technology, the image data of the channel waters can be accurately collected, and synchronously transmitted to the computer, and the image data can be directly processed on the computer, so as to obtain higher cruise data and grasp the actual situation of the important inland waterway[10].

Zhu'e Creek is the largest tributary of the Liujiang River in the urban area of Liuzhou, and the importance of water conservation is self-evident. Due to the impact of high temperature weather, Zhu'e Creek has dried up, and some citizens have illegally cultivated river beds and planted vegetables on protective slopes. This not only damages the ecological environment, but also generates garbage, sewage, and other pollutants that affect water quality. This article uses a large latitude and longitude M300 multi rotor unmanned aerial vehicle to conduct aerial survey and maintenance of the Zhu'exi River system. In order to gain a detailed understanding of the changes in the

waterway water area, during the specific process of using unmanned aerial vehicles for cruising, the takeoff and landing points and shooting angles of photography facilities are first reasonably set based on the flight range. Then, the operator places the unmanned aerial vehicle at the deployment location, and operates the control handle to make the unmanned aerial vehicle fly. During the process of unmanned aerial vehicle flight, synchronous cameras are taken, After completing the channel camera, export the video and images and view them to understand the actual situation of the channel water area. Drones are also suitable for emergency cruising in navigation channels, where operators quickly operate the drone to fly to the accident site and rotate it in all directions around the accident site, so that the camera facility can shoot in all directions. Relevant staff can understand the emergency situation by viewing pictures and videos, and jointly explore and study feasible maintenance measures to better maintain the navigation channel. The partial model of unmanned aerial vehicle aerial survey is shown in Figure 2.



Fig. 2. 3D model of Zhu'exi aerial survey

(3) Maintenance of waterway facilities

Various facilities set up in important inland waterways may be affected by certain factors. If equipment problems are not found and dealt with in time, once the waterway facilities fail to operate normally, it will bring certain negative effects to the use of the waterway. In order to avoid this situation, it is necessary to use drones to conduct aerial surveys of waterway equipment during the maintenance of inland waterways. By obtaining pictures and videos about waterway facilities and reviewing them in detail, we can understand whether there are abnormalities or hidden dangers in waterway facilities. According to the maintenance standards of waterway facilities, the problematic waterway facilities are targeted to ensure the stable operation of waterway facilities. Similarly, taking the maintenance of the first phase of the 12.5 m deep-water channel below Nanjing in the Yangtze River as an example, the 8 # ~ 13 # floating Baimaoshu regulation building of the Baimaoshu waterway in the lower reaches of the Yangtze River may be affected by waters, climate and other factors. Quality problems have led to a significant reduction in its application value. According to the relevant maintenance requirements, Baimaoshu renovation buildings should

be surveyed regularly or irregularly. In the process of specific maintenance of Baimaoshan regulation building, firstly, based on the basic situation of channel waters and channel facilities, the route, image control points and checkpoints are rationally planned and designed. Then, the drone is operated to enter the channel, and the camera is taken at different image control points. After checking at different checkpoints, the acquired video, images and data are processed, such as establishing a three-dimensional model, BIM result analysis, etc., to clarify the deformation of the water part of Baimaoshan regulation building, and based on this, formulate targeted maintenance measures, optimize and adjust the regulation building, and improve its safety [11].

6 Conclusion

There are many contents, high requirements and great difficulties in the maintenance of important inland waterways. It is difficult to obtain accurate images and data by using traditional aerial survey methods, and objectively reflect the waterway water regime, which makes it difficult to carry out waterway maintenance in a targeted manner, and its scientificity, effectiveness and rationality are not high. UAV technology is applied to the maintenance of important inland waterways. Through the rational planning and design of routes, waterway navigation and waterway facilities aerial survey, high-resolution images and data can be obtained, and then processed to understand the important inland waterways. The real situation of waterways and waterway facilities, timely detection of problems, targeted maintenance, can improve the quality of waterway maintenance.

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