Application of UAV Oblique Photography in Scheme Design of Water Environment Comprehensive Governance

Fei Yan*, Rong Chen, Hongyuan Gao, Yixia He, Hong Chen and Ning Wang
Changjiang Survey, Planning, Design and Research Limited Co., Ltd., 1863 Jiefang Avenue, Wuhan, Hubei, China.
Email: yanfei@cjwsjy.com.cn

Abstract. With the increasingly prominent problems of water ecology and water environment, regional overall planning and systematic management of water environment is a new mode of water pollution harnessing work under the background of the new era. The effectiveness of water environment governance largely depends on whether the scheme is reasonable or not. Therefore, intuitively reflecting the design results is the first step of water environment comprehensive treatment. At present, the scheme design mode of water environment governance mainly uses CAD to design and renderer to render, which can no longer fully meet the needs of design with a fixed perspective. Based on this, this paper proposes a scheme design method of water environment comprehensive treatment based on UAV tilt photography technology. Firstly, the three-dimensional model of the research area is obtained by UAV tilt photography, and then the scheme is designed based on the three-dimensional model. Finally, the scheme based on the three-dimensional model is compared with the traditional design scheme. The results show that the water environment comprehensive treatment scheme based on oblique photography has more diverse functions.

1. Introduction

Comprehensive treatment of water environment is a comprehensive treatment of the overall water environment based on regional overall planning. It is an important method to achieve smooth river, clear water, green slope and beautiful bank. Besides, it is also an important guarantee for the virtuous cycle of regional water resources and water ecosystem, and an important support for regional scientific development, orderly development and high-quality development. Therefore, formulating a good and practical water environment governance plan is the key to the implementation of water environment governance, which plays an important guiding role in ensuring the effectiveness of water environment governance and consolidating the achievements of water environment governance.

The scheme design of water environment comprehensive treatment is the prerequisite for the implementation of water environment treatment projects. At present, the scheme design method of water environment comprehensive treatment is mainly based on the traditional way, that is, the preliminary design is carried out by CAD firstly, and next the preliminary design results are imported into the 3D modeling software for reconstruction, then the model is rendered, and finally the design scheme with fixed angle is obtained. From the steps of the traditional method, the disadvantage of the approach is very obvious, on the one hand, the design plan cannot be viewed from any angle, and on the other hand, the design plan is easily divorced from reality. With the development of GIS and remote sensing technology, three dimensional real scene modeling technology has been rapidly developed, especially the use of consumer-grade UAVs can easily realize the real 3D scene modeling, making the scheme design method based on the real three-dimensional model become feasible. Generally, the most original basic data can be obtained by using UAV tilt photography, and the
scheme design can be carried out based on this can not only take into account the actual situation but also ensure the design scheme meet the reality to the greatest extent. Research shows that the use of oblique photography technology to obtain 3D real scene model aided design is helpful for designers to integrate the scheme with the surrounding environment during the design process, so as to improve the design efficiency and quality, and improve the harmony degree between the scheme and humans and nature [1].

The most significant role of water environment comprehensive governance is to improve the local ecological environment. Therefore, whether the improved environment through the design scheme can adapt to the local actual environment is the key issue that needs to be considered in the scheme design stage of water environment governance. In order to ensure that the design scheme is feasible and coordinated with the actual situation, it is very important to carry out the scheme design based on the real scene to ensure the implementation of the comprehensive water environment governance project. Based on this, this paper proposes a scheme design method of water environment comprehensive governance based on UAV tilt photography. Firstly, the real three-dimensional scene model of the research area is obtained by using the consumer-grade UAV based on tilt photography technology; then, the scheme design is carried out on the basis of the real three-dimensional scene model; finally, the design scheme based on the real three-dimensional scene is compared with the traditional design scheme.

2. 3D Modelling of Real Scene Based on Consumer-grade UAV Tilt Photography

UAV low-altitude tilt photogrammetry, as a common 3D modelling technology, has become an important method of geographic data acquisition and 3D real scene reconstruction. Low-altitude tilt photogrammetry takes UAV as the platform to collect the images of front, back, left, right and top of the target area with multi view aerial cameras, and then build a three-dimensional scene model through specific calculation methods, and finally obtain a variety of output results. Moreover, with the rapid development of computer technology and sensor technology, the cost of aerial photography equipment is becoming lower and lower, and the accuracy is higher and higher. Therefore, tilt photography technology has been widely used in basic geographic mapping [2, 3], engineering change detection [4], land and resources monitoring [5, 6, 7], environmental change monitoring [5], and post-disaster assessment [8]. However, the oblique photography technique is not frequently used in architectural design and engineering design. Besides, it has also not been widely used in the comprehensive water environment governance. Therefore, the research on the application of UAV tilt photography technology has a good directive function in the governance of water environment.

In order to obtain the 3D scene model of the study area by oblique photography technology, certain working steps should be followed. The working steps of UAV tilt photography are mainly divided into two phases, the first phase is the field data acquisition, and the second phase is the internal data processing. In the first stage, first of all, preparations should be made before aerial photography, including confirmation of flight environment (such as weather conditions), inspection of the drone and battery status, etc. Secondly, flight path should be planned in advance, and appropriate heading, side overlap and flight height should be set. Due to the limited flight time of the aircraft, reasonable flight plans should be made to ensure the integrity of flight operation. Then, after arriving at the aerial photography area, select the appropriate position to set the control points according to the regional range. After that, according to the actual weather conditions, set appropriate camera parameters in the remote control equipment, and recheck the camera parameters through the head-mounted drone controller. Finally, execute the flight plans to obtain the remote sensing images of the aerial photography area. After obtaining the data, the second phase is beginning, firstly, the acquired images are classified and processed to remove the blurred images and non-textured images (such as water area images). In the next place, the sorted image data are imported into the 3D modelling software, and at the same time the appropriate coordinate system and control point information are set. Then after all settings are done, the operation is carried out. And finally, the three-dimensional real scene model is obtained. The main steps of oblique photography 3D modelling are shown in the figure below.
Prepare for the flight with consideration of weather, UVA, battery etc.

Plan the UVA flight including route, overlap and height

Set ground phase control point

Set suitable camera parameters

Execute the flight plan

Obtain the remote sensing images data

Data sorting and processing

Import the sorted image data into 3D modeling software and set suitable coordinate and control points to process

Obtain the 3D model files

**Figure 1.** 3D scene modelling process based on UAV

Based on the above steps, this paper uses DJI MAVIC 2 pro professional single-lens UAV for data acquisition, and plans two flight routes with camera angle of 45° and a flight route with vertical angle; and sets the forward and side overlap to 80% and 60% respectively; and selects the default coordinate system; and sets the exposure time to $1/1000$ seconds according to the weather environment. After obtaining the images, the 3D scene model of the study area is obtained through 3D modelling software, as shown in figure 2.

**Figure 2.** The 3D scene model of the study area
3. The Scheme Design of Water Environment Governance Based on the 3D Model

Scheme design of water environment comprehensive governance based on three-dimensional real scene model refers to the scheme design carried out by modifying, deleting and adding new design model on the basis of oblique photography 3D real scene model during scheme design stage. The main process of this method is as follows. Firstly, the 3D real scene model is reconstructed by 3D modeling software, and export the model to general 3D model files, such as obj, fbx and other format files. Secondly, import the exported 3D model file into the decoration software to modify the model. Thirdly, import the modified model into the 3D modeling software for reconstruction and export the new model. Then, import the new model into the design software, such as 3D Max, Lumion, etc. Finally, in the design software, the new model is repaired and deleted again according to the design scheme, and the new design models are added; after this the design scheme integrating the real scene model is obtained. The specific design process is depicted in figure 3.

![Figure 3. The scheme design of water environment governance based on 3D model](image)

Through the above method, the three-dimensional scheme design model of the water environment governance in the study are is obtained, as shown in figure 4.

![Figure 4. The 3D scheme design model of water environment governance of the study area](image)
4. Comparative Analysis of Water Environment Governance Programs

4.1. Analysis of Water Environment Comprehensive Governance Scheme Design Based on Traditional Way

The traditional way of scheme design of water environment comprehensive governance mainly uses CAD, and then imports the CAD scheme into the modelling software to construct the three-dimensional models, and finally obtains the final design scheme by using the rendering tools. It can be clearly seen that the traditional method inevitably has many problems as follows:

(1) Coordination issues. It is a very important issue whether the effect of water environment comprehensive governance is in harmony with the surrounding environment, especially after the reparation of water environment. If there is no actual environment as the design background, it is easy to lead to the problem that the design scheme is not coordinated with the actual environment. The traditional CAD method often uses photos or Google maps as the background in the absence of basic data, especially for the large scene area. Due to the current situation, the accuracy of the environmental background may not be very good, which can easily lead to the mismatch between the design scheme and the real scene.

(2) Efficiency issues. Using CAD method to design and using modeling software to carry out 3D modeling according to the scheme results in repetitive work and affects the design efficiency.

(3) Cost issues. The water environment comprehensive governance is often carried out for large scene area. In order to integrate the actual design scheme with the real environment by traditional CAD and 3D manual modelling methods, it will inevitably need to invest a lot of manpower and material resources to reconstruct the real scene, which will cause great cost of time, manpower and material resources. Moreover, due to the problems of modeling accuracy and rendering settings, the final model is not necessarily consistent with the actual situation.

4.2. Analysis of Water Environment Comprehensive Governance Scheme Design Based on Oblique Photography

As aforesaid, the scheme design based on unmanned aerial vehicle oblique photography takes the real three-dimensional scene model obtained as the basic data, and adds a water environment comprehensive governance scheme design model on the basic model, and then integrates the basic model and the design model into the final design scheme. This scheme design method inherits many advantages of UAV tilt photography, such as simple operation, high efficiency, strong real-time performance [9], and rich output results [10]. In addition, the results of oblique photography can also be used to investigate and analyze the current situation, reduce the number of on-site surveys, and save manpower and material costs. Besides, it can also be used for simple measurements to calculate length, area, volume, etc., which has a good reference role for the estimation of engineering quantity and is convenient for investment estimation. Among them, the most important role is to be able to clearly see whether the effect of design scheme of the water environment governance is in harmony with the real environment, which has a very important guiding role for the implementation of the scheme.

5. Conclusion

In general, the scheme design of water environment governance based on UAV tilt photography technology is innovative. Scheme design method based on 3D scene model of the engineering area obtained by UAV technology can improve the design efficiency and reduce the cost. And at the same time, the design scheme can coordinate with the real environment, which helps to improve the rationality of the design scheme.

Comprehensive governance of water environment is a complex project, but also a project with high requirements for timeliness, which requires strict demands for scheme design. Traditional methods can no longer meet the design requirements, and the use of new technologies and new methods to improve design methods is of great significance for improving design efficiency and design quality. Although there are still some deficiencies in UAV tilt photography technology, but with the development of technology, tilt photography 3D scene modelling will be more and more used in the scheme design of
water environment governance, as well as in the construction, management, operation and maintenance process after the implementation of water environment governance.

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7. References
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