Application of Multi-dimensional Technology in Water Conservation Monitoring of Power Transmission and Transformation Production and Construction Project

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Abstract. Under the background of the new era, as the production and construction projects of soil and water conservation began to fully promote the “integration of heaven and earth”, the traditional application technology has been unable to meet the needs of practical development, and the power transmission and transformation production and construction projects put forward higher application requirements. Therefore, on the basis of understanding the current implementation of soil and water conservation monitoring work, this paper analyzes how to reasonably use UAV technology in practical monitoring work according to the multi-dimensional technical means proposed in the new era, and conducts performance analysis according to the practical verification.

1. Introduction
In the process of urban construction and development, China attaches more and more importance to soil and water conservation. As the basic content of ecological civilization construction, it plays a positive role in optimizing ecological environment and promoting economic construction and development. According to the our country government proposed the policies of soil and water conservation monitoring analysis shows that at present the production of electric power construction project quality requirements is very high, so the traditional technology, though still can play a role in the practical work, but it can’t meet the demand of increasingly innovative monitoring investigation and analysis, and easily affected by factors such as regional conditions, the monitoring time, Water and soil loss in the construction area of the project cannot be presented scientifically and intuitively. In addition to effectively integrating the advantages of space and earth, multi-dimensional technological means are selected to obtain various factors
required for soil and water conservation monitoring work by taking advantage of their own field advantages. The effective use of drones, remote sensing and ground monitoring technologies will enable them to fully control the soil erosion in the construction area in a complementary way, and thus to monitor and control important areas with ground monitoring technologies.

2. Methods

2.1. UAV technology
First of all, we must plan the sailing route. This work needs to be scientifically designed according to the actual monitoring target area, and priority should be given to the selection of high-level and high-performance UAV equipment, and the configuration of appropriate sensors to ensure that the lens resolution can be accurate aerial photography of the disturbed area. Secondly, the image should be processed scientifically. Through the use of professional software PixMapper to process aerial photography recruitment, and in the initial processing process of measurement and digital surface model, orthophoric image processing, and then build a regional scope of three-dimensional model. Finally, the monitoring data should be used reasonably. The geographic information processed by professional software should be classified and statistically processed. Combined with the requirements of soil and water conservation monitoring work, the relevant data and information should be obtained from the practical work results, and then a number of field work can be transformed into the internal form of fine measurement[1-3].

2.2. Remote sensing technology
Remote sensing technology is selected to patrol the target area regularly, and spatial vision is used to reduce the working pressure on the site. The specific structure is shown in Figure 1 below. On the one hand, make clear the concrete information of soil erosion. The resolution of the satellite image is obtained according to the coordinate axis of the target area, and then it is used in the work of soil and water conservation in the interpretation and translation, and the location information of soil and water loss in the region is quickly obtained according to the satellite image. At the same time, the proposed treatment measures and application areas should be accurately marked, and then put forward to the relevant construction management units for orderly promotion, so as to avoid soil erosion continue to affect the site construction. On the other hand, interpretation and extraction. Arc GIS is selected to interpret the acquired remote sensing image information, and the corresponding data information database is constructed. After that, relevant monitoring information, such as occupation area and high-line topographic map, is acquired while scientific control and visualization application is carried out.

![Structure diagram of remote sensing technology](image)

**Fig. 1** Structure diagram of remote sensing technology
3. Empirical analysis

3.1. Application analysis based on UAV technology
First, operating conditions. In the application of UAV technology in soil and water conservation monitoring, it is necessary to consider the influence of time factor on the imaging quality. Usually, it will work in sunny or cloudy days with wind speed below 8m/s and visibility over 5km. The takeoff and landing site should avoid the no-fly and no-fly areas, as well as the areas with tall buildings, and ensure the safety of their own flight.

Second, route planning. Due to the difference between point-type and linear production and construction projects, the point-type function should be selected first to carry out aerial photography of the overall target area in the working state of the UAV. In linear production, important areas should be selected for aerial photography, such as construction sites, slag disposal sites and other areas with serious soil erosion. In general, it is necessary to ensure that the heading coverage exceeds the operating range by at least one baseline, and the lateral coverage exceeds the operating range boundary by not less than 50% of the image amplitude. In addition, practical height design needs to be analyzed using the following formula:

\[ H = \left( \frac{f \times GSD}{a} \right) \]

In the above formula, H represents the relative altitude of UAV flight, unit is m; F represents the focal length of the camera lens mounted, in mm; GSD stands for the resolution of the ground in cm; A stands for unit size in um.

Third, extract data. After the completion of aerial photography, it is necessary to use Smart3D software or Pix4D to process the aerial images scientifically, and thus constitute the digital surface model(DSM) and digital orthoimage(DOM). At the same time, in practice, human-computer interaction interpretation method is used to obtain the site construction progress, construction scope, construction area and project soil and water conservation countermeasures.

Fourth, calculate the indicators. In terms of soil and water conservation monitoring work in China, the existing six indexes of prevention and control are the main contents of evaluating the soil and water conservation situation of production and construction projects. Based on the analysis of disturbance area, plant area, engineering area, building area, hardening area of road site, water area, and amount of waste earth obtained from Su Opera, the following calculation results can be finally obtained:

\[ \text{Disturbance land consolidation rate} = \frac{\text{Disturbance land consolidation area}}{\text{Total area of disturbed land in the project construction area}} \times 100\% \]  

(1)

In the above formula, the remediation area of disturbed land refers to the sum of plant area, engineering area, building area, road site and water area.

\[ \text{Total degree of soil erosion control} = \frac{\text{Soil erosion control area}}{\text{Total area of soil and water loss in project construction area}} \times 100\% \]  

(2)

In the above formula, the soil erosion control area refers to the sum of the project area and the plant area, while the total area of soil erosion in the target area refers to the area of the project area except the construction area, hardened road area and water area.

\[ \text{Stop slag rate} = \frac{\text{The actual amount of abandoned soil (slag)}}{\text{Total amount of abandoned soil (slag)}} \times 100\% \]  

(3)

In the above formula, the actual amount of abandoned soil blocked represents the sum of the square quantities of all the abandoned soil fields calculated by the DSM difference. The total
amount of abandoned soil represents the total amount of all abandoned soil sites included in the construction project.

\[
\text{Restoration rate of forest and grass vegetation} = \frac{\text{Vegetation area}}{\text{The recoverable vegetation area in the project construction area}} \times 100\%
\]

(4)

In the above formula, the vegetation area represents the measures area of plants, and the area in the construction area where the vegetation can be restored refers to the soil erosion area within the construction area of the project minus the measures area.

\[
\text{Forest coverage} = \frac{\text{Vegetation area}}{\text{Area of project construction area}} \times 100\%
\]

(5)

In the above formula, vegetation area represents the measure area of plants. Generally speaking, the project construction area represents the disturbed land area within the project construction area.

\[
\text{Soil loss control ratio} = \frac{\text{Allowable soil loss}}{\text{Average intensity of soil loss after treatment}} \times 100\%
\]

(6)

In the above formula, the amount of allowable soil loss needs to be studied according to the grading standards of the region, while the average soil loss intensity after treatment needs to be treated by analogy method and runoff plot method, etc., and there is no convenient acquisition strategy.

3.2. Result analysis

Taking a certain place as an example, this paper uses Agisoft Photoscan software to process the data taken by the UAV in accordance with the specified process, and thereby obtains the connection points, interactive map tiles, orthophetical influence and three-dimensional models. According to the horizontal accuracy analysis of UAV orthophoto by researchers in recent years, the research in this paper pays more attention to the elevation accuracy of data acquired by UAV, and the specific formula is as follows:

\[
m = \pm \sqrt{\frac{\sum_{i=1}^{n}(z_i - Z)^2}{n}}
\]

(7)

In the above formula, \( n \) represents the total number of test points; MP stands for the error in the point position in meters; Z represents the detection value of the ordinate of point I, in meters; Z represents the original detection value of the ordinate, in meters.

According to the selected software, a number of pictures taken by the UAV were processed scientifically, 10 points were selected as the inspection points in balance, and the elevation accuracy was tested. By comparing the elevation values calculated by the UAV detection with those calculated by the actual inspection, the error between the two was only 0.26m, as shown in Table 1 below. Therefore, it can be seen that the rational use of UAV as a multi-dimensional technology in soil and water conservation monitoring of power transmission and transformation production and construction projects is very effective[4-6].

| Table 1. Elevation accuracy test and analysis results |
|-----------------------------------------------------|
| The serial number | The drone measures the elevation | Actual inspection of the elevation value | Error in elevation |
|-------------------|----------------------------------|----------------------------------------|--------------------|
| 00                 | 1017.49                          | 1017.26                                |                    |
In the acquisition of detection data, on the one hand, a single UAV and interactive map will be effectively combined, and the UAV will carry out low-altitude video shooting and inspection work; On the other hand, the computer should be used to obtain the required data information. Based on the analysis of land use classification in recent years, it can be seen that the actual accuracy will be affected by many factors. Therefore, this paper mainly starts from this aspect to analyze the influence of the difference of classification methods on the accuracy composition of classification results. Due to the delay of direct discrimination of satellite remote sensing images and the comparative value of relevant classification data, this paper selects three methods, namely manual field investigation, auxiliary classification and manual discrimination of interactive map tile data, to carry out comparative analysis of results. At the same time, it is regarded as the main basis for the actual classification. A comparative analysis is made on the UAV data GIS assisted classification, interactive map tile automatic matching artificial judgment and other classification methods. The specific results are shown in Table 2 below [7-9].

| Table 2. Compares and analyzes the results of the three classifications |
|-----------------------|-----------------|-----------------|-----------------|-----------------|
| Classification method | vegetation (m²) | Slag Packing Site (m²) | Building Site (m²) | Other land (m²) |
| Manual field survey method | 84691 | 11910 | 19488 | 6609 |
| UAV GIS Assisted Classification | 77613 | 19473 | 14653 | 11781 |
| UAVs map tiles manual classification | 87791 | 11437 | 19946 | 3842 |

| Table 3. Classification error |
|-------------------------|-----------------|-----------------|-----------------|-----------------|
| Classification method | vegetation error (%) | Slag Packing error (%) | Building error (%) | Other land error (%) |
| UAV GIS Assisted Classification | 8.15% | 76.41% | 26.29% | 91.06% |
| UAVs map tiles manual classification | 3.57% | 3.97% | 2.35% | 48.71% |

Based on the analysis in Table 2 and Table 3 above, it can be seen that the error of manual discrimination classification method for interactive map tile matching is lower than that of GIS
assisted classification, and the actual land use type classification results are more in line with the actual situation.

By comparing the disadvantages of the methods shown in Table 4 below, it can be seen that in the monitoring of soil and water conservation, the land use type in the past is usually dominated by artificial, the data information obtained is more accurate, and the discrimination of the land use type in the target area is also more clear. However, because most of the production and construction projects cover a large area and the sub-type is too complex, the traditional classification method can not solve the problem, and it will consume more time and energy. In recent years, with the rapid development of satellite remote sensing technology, part of the staff of water conservation detection began to use satellite remote sensing images to classify the land use in the target area, which can not only improve the practical work efficiency, but also reduce the operational intensity of work. It should be noted that it is difficult to apply remote sensing images to soil and water conservation monitoring for a long time because of the delay in acquiring remote sensing images and the low actual resolution. And GIS auxiliary classification method need combined with ENVI CLASSIC, such as ARCGIS software science processing uav aerial orthogonal projection images can be obtained, and put forward the higher request to the equipment hardware and software, internal processing also requires more complex consumption more often than not, but because the actual classification effect is not significant, so are unable to meet the expected requirements in practical application. The artificial classification of the interactive map tiles only requires integrating the KMZ data obtained by the UAV into the small software Google Erath. The KMZ data will be automatically matched with the satellite remote sensing images in the interactive map software, and then the operator can independently judge the land use situation of the target area. This method has very low requirements on hardware and software, and the actual error is small. Therefore, in the current development of power transmission and transformation production and construction projects, the application and promotion of multi-dimensional technology should be paid attention to in soil and water conservation monitoring work, and it should be integrated into practical scientific research projects, so as to improve the level of power transmission and transformation production and construction.

| Table 4. Comparison and analysis of the disadvantages of classification methods |
|-------------------------------|-------------------------|-----------------------------|
| Land type classification method | advantages | disadvantages |
| Manual field survey method | Detailed classification, accurate data | It consumes more time, the working intensity is big, and is restricted by the terrain very much |
| Direct discrimination of satellite remote sensing images | The work efficiency is improved and the work intensity is reduced | It has time lag and insufficient resolution |
4. Conclusion
To sum up, through a comprehensive understanding of the implementation of soil and water conservation monitoring in the current power transmission and transformation production and construction projects, as well as the multi-dimensional technical means selected in the practical work, it can be seen that both remote sensing technology and UAV technology have played a positive role in the practical development and management. Therefore, in the process of continuous construction and research, relevant enterprises and researchers should pay attention to strengthen the analysis and discussion of multi-dimensional technology, and pay attention to propose more valuable research topics in combination with the practical development needs. Only in this way can soil and water conservation monitoring be guided to the modernization and standardization of the direction of innovation.

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