Research on the Application of UAV Tilt Photography Technology in Engineering Project

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Abstract. Based on the teaching building project, the three-dimensional model generated by the fusion of tilt photography data processing process and panoramic image is applied to compare the three-dimensional model in the construction network plan with the real three-dimensional model. By using the advantages of fast modeling of tilt photography, the 3D real scene under 360 degree panorama is combined with different construction stages, and the models of different stages are visualized to realize the real preview of the project, so as to improve the quality of project construction, solve the problems in the construction process, and ensure the smooth progress of construction.

1. Introduction
By carrying multiple sensors on the same aircraft and taking images from different perspectives at the same time, tilt photography can relatively accurately obtain the side texture information of ground targets and introduce customers. The main purpose of BIM is visualization, 3D visualization, collision detection and simulation. It can centralize all the linked project information, the entire process, and the resources of all new projects in one physical model. GIS technology lacks accurate attribute information of components, and BIM technology is too idealized to combine with the actual situation. The two are integrated, complementary and win-win. BIM+GIS technology can comprehensively analyze the physical geospatial data entity model, and check the physical geospatial data of senior talents in the construction site, so as to complete the practical significance of the combination of the two[1]. This will be more perfect in the project construction and improve the quality of project construction.

2. Technical method of tilt photogrammetry
2.1. Technical process of aerial triangulation
Empty three encryption: Aerial triangulation is a necessary step in model generation. After aerial triangulation is completed, new blocks are obtained, each image has different internal and external bit elements, and the encrypted results can be viewed under 3D view. There are no major errors after query, and the 3D model can be measured. The actual operation flow of the empty three solution is shown in Figure 1.
Create a "New project" project
Select the project location option
Select "photos" in the empty block to select the import image type
Enter the properties of the image
Select a spatial coordinate system
Add a new control point
Enter control point coordinates
Input image measurement points
Click "Submit Aerotriangulation" in the "Reconstruction" interface to submit the task

1. New projects
2. Add Image
3. Control point image association
4. Submit empty three tasks
5. Submit a rebuild task
6. Submit the result product

Under the "General" interface in the generated "Reconstruction", click "Submit new publication"
Enter product name: determine the output form in the "Purpose" option
Under the "Format/Options" option, select the appropriate schema format
Click "Engine" to start the calculation
After completing the empty space, get a new block and click submit "Submit Reconstruction"
Click "Spatial framework" in the generated "Reconstruction" to limit the scope of reconstruction.
Under the "Reconstruction" option, configure "mode" to "Regular planar grid"
Set the appropriate output tile size

Figure 1. Flow chart of empty three processing operation of Context Capture software

Model output: According to the size of the computer memory, the software will divide the project into tiles for reconstruction. We need to pay attention to the storage path and the size of the generated model. In the software, you can set the size range of the output model in the interface above by clicking spatial framework. You can enter coordinates or import through Import from KML, The scope of the import can be drawn in Google Earth and saved in Kml mode[2].

2.2. Aerial triangulation operation
The data needed for empty three calculation are: The setting of side overlap degree, such as aerial photograph, POS value of photo, actual image control data on the ground, control point layout map, etc. First, create a project and name it; then choose a path for it, get a file in S3 format under the path, and save it; Then create a new block and import the image data in the S3 format file, select the coordinate system and add the image control point coordinates in the S3 format file; Finally, submit the air three tasks in the software.[3]. The specific technical flow of aerial triangulation is shown in figure 2.
3. Key Technology-related Technology Analysis

3.1. BIM model and panoramic data
The key points in the room we see on the 3D drawing are all points, lines, faces and some elements, and the language expression ability is limited. Now you can use the 3D visualization model created by Revit to visualize all the details, such as the construction column, the material of the building component, the fabric, the height and so on. The simulation system function and 3D rendering function of the software can develop more specific design layout program or construction drawing. These functions can reduce the time of later update and conversion, save costs, and make wise decisions to solve problems in time.

3.2. BIM+GIS technology combination
The advantage of BIM is that the model is highly refined and detailed, which contains a lot of building information. But the problem is that it can not be tightly integrated with the surrounding terrain and the content of terrain information, but it can be filled by 3D GIS. The advantage of 3D GIS is the scientific research of physical geography indoor space. 3D GIS can assist BIM entities, which executes investment decisions, while BIM solid model data information can assist 3D GIS investment decisions. The combination of the two advantages not only enables BIM to analyze the surrounding geographical environment, but also makes 3D GIS have a better space to play with the support of BIM model data, and realizes the significance of the integration of the two.

3.3. Technical difficulties
The aerial photography operation of UAV is highly professional, and flight controllers need to be able to operate UAV skillfully. At the same time, it is necessary to survey the tall structures and obstacles within the planning height of the surrounding route, so as to avoid these dangerous areas when planning the route. Safety measures and emergency plans must be made when flying aerial photos in densely populated areas.

The image quality directly determines the quality of the 3D model generated in the later stage, and the site conditions, such as meteorology and terrain shooting time, are the factors that directly affect the shooting. Therefore, the modeling site should be surveyed in the early stage of the project, and the shooting route should be planned reasonably according to the situation of the site and the requirement of image repetition rate. For complex structures, it is sometimes necessary to retake images.
4. Case analysis
This project is a new project of the teaching building, with a construction area of 10940m², five floors on the ground and a building height of 22.5m.

4.1. Data acquisition

4.1.1 Acquisition method. The use of tilt photography 3D modeling has the characteristics of easy data collection, less manual control in the whole process of the model, and fast modeling speed, which can truly show the real shooting situation of new projects. The specific data acquisition process is shown in figure 3.

![Figure 3. Flow chart of accurate measurement data acquisition by tilt photography](image)

GIS data acquisition-360 degree clockwise or counterclockwise photographs are taken at equal intervals around the building; Take 3-5 photos for each photo spot from 3 different angles. The overlap area of the continuous image is not less than 70%; An Angle of less than 15° should be maintained between different viewing angles of the same object.

BIM data collection -- go to relevant departments to collect drawings of teaching buildings, conduct 3D model modeling according to 2D drawings to achieve 3D visualization.

- Projects under construction: Data is input while modeling during construction. The main force is the construction and installation units.
- Completed project: take property operation and maintenance as the main force and collect relevant data.

4.1.2 Flight mission preparation. During the normal operation of the drone, it is necessary to accurately determine the approximate location of the drone. If you encounter an emergency, you can prepare it in advance and switch to manual operation anytime and anywhere. Check whether the rechargeable battery of the drone is firm and control Whether the power consumption of the camera is sufficient, whether the propeller of the aircraft is suitable to ensure the navigation conditions, and whether the camera is shooting normally. The specific UAV route planning diagram is shown in Figure 4.
The image control point uses the actual coordinates of the image control point and the check point coordinates selected by the DJI drone on the previous image. First, select an address with a wide and unobstructed line of sight as the unmanned aircraft take-off and landing point in the survey area, and then connect the UAV with flight control software and route planning software to guide the navigation area file previously selected on the map. In the flight control software, network inspections of unmanned aircraft and road flight control systems are carried out[4]. Finally, turn on the switch of UAV and let UAV carry out measurement and acquisition tasks.

4.1.3 Data collected by drones. In the current surveying and mapping industry, it is inevitable to encounter surveying and mapping areas with complex terrain. If the surveying and mapping objects are under dense buildings, it is difficult to carry out surveying and mapping work. At this time, oblique photography technology is needed to eliminate the interference of ground objects. In remote areas, due to the complex terrain, there is a certain degree of danger, so manual surveying is not suitable. Therefore, aerial photography can be carried out with the help of drones, and the wall texture of surveying and mapping buildings can be obtained.

The initial image will inevitably have color inconsistencies. If some image geometry is deformed, you must correct the image before triangulating the image. Choose a set of photos from it, and the obtained image must ensure that the colors are consistent and clear.

4.2. Data application
To create a new project in the Context Capture Center platform, first open the Engine (Or it can be opened when you are committing the null three operation and the reconstruction three model operation). Then open the Master module. After opening the module for the first time, a dialog box will pop up to set the engine path. That's Jobqueue. After setting the path, you can build the project.

4.2.1 Application process. Create a new project to create a project directory. (Save file path cannot contain Chinese characters)
In the empty three calculation, it will indicate the total number of missing images. If there are too many missing images, insufficient overlap, or incorrect type of data information, it is likely that the empty three calculation was not successful. If the overlap is not enough or the input is incorrect and the image is lost, the following methods can be used in this case:

- Return to the input block, modify the attribute information as needed, and then try a new empty three calculation.
- Use the output block as an intermediate result, and then try to perform a new empty three calculation from this block to calculate the missing attributes.

3D modeling result: Import the original record into Context Capture software, perform triangulation, texture projection and solid model repair to form a real 3D model.
After completing the construction of the 3D model, minor adjustments to the format of the model are needed to improve the accuracy credibility of the model. Accurately determine the surveying and mapping area and accurately improve the texture 3D real scene model.

4.2.2 Common problems in generating real scene models. Most of the 3D models caused by aerial photography blind spots will have defects. The line of sight may be blocked, the target has wind movement, the camera is unstable, and the structure of the building is peculiar. This leads to loopholes in the 3D model, model distortion, and mutual adhesion of the models. And other issues[5]. These problems need to be manually repaired and optimized later. The specific problem of generating deformed images is shown in Figure 5.

![Figure 5. 3D Model Deformation Problem Loophole(left) and Distortion(right)](image)

The errors in determining the photos taken by UAV come from: the internal determination errors caused by the unmanned camera; the determination errors caused by the photo processing method; the determination errors caused by the instability of the aircraft take-off attitude. It is precisely because of the harm of the determination error that the obtained image is blurred and the plane composition is changed.

4.2.3 Features of BIM 3D model. The Revit BIM model can view complex nodes and attribute information in practice. The BIM 3D model can view planes in different directions at any time, and the display and hiding of each view can be managed through the mode. Each view point plane has relative independence to view component visibility, detail level, scale range, etc. Make building modeling information, improve efficiency and precision[6]. Figure 6 shows the Revit BIM model.

![Figure 6. Revit BIM Building Models](image)

In order to obtain the expression of architectural effects, including autumn, snow and the interior of the classroom, we use Lumion's 3D visualization function to achieve this. Through the expression of these architectural effects, the real appearance of the teaching building is expressed to the greatest extent.

4.2.4 BIM panorama. From the perspective of virtual hazards, three-dimensional panoramas can be divided into 360-degree spherical panoramas. According to the application panorama, the overall goals of the machines and equipment in the horizontal and vertical directions are collected. 360° multi-scale
image data acquisition, and then based on the image acquisition to the panoramic image processing software for stitching, and then develop and design panoramic data roaming software customization, display three-dimensional panoramic data roaming plus navigation map, photos, small topographic maps and network hot spots.

4.2.5 Data preprocessing of 3D model and panoramic image in oblique photography. Taking advantage of the fast modeling of oblique photography, the 3D real scene under 360 degree panorama is combined with different construction stages. It uses a camera to collect data from multiple angles, then uses image mosaic technology, and finally plays the 3D panorama. Complete the actual drilling of construction projects, improve the quality of new projects, solve the problems in the whole process of construction, and ensure the smooth progress of construction[7].

5. Concluding remarks
Considering the advantages of oblique photography, we have carried out scientific research and demonstration from data collection to data processing methods and solid model creation. The whole process of tilt photography model has less manual control and faster modeling speed, which can truly show the characteristics of the real shooting situation of the new project. The BIM software itself is intuitive and visual. But in today's world, with the increasing progress and prosperity, these characteristics are not enough. The integration and application of BIM+GIS has become an important part. Context Capture software system has been used in the industry for a long time, and the system software is relatively stable, which can greatly improve productivity. The actual effect of the match line is usually very good. Using oblique photography 3D modeling and panoramic data fusion can not only save the time and cost of 3D modeling, but also make the construction management more convenient, and truly restore the original appearance of the building itself and the embodiment of the scene. Based on these advantages, we can better interact in technical software such as Lumion, VR, 720 cloud platform, so as to reflect the authenticity and visualization of the data, in order to achieve high-precision modeling and production.

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