3D modeling of Unmanned Aerial Vehicles Tilt Photogrammetry

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Abstract: Unmanned Aerial Vehicles (UAV) tilt photogrammetry technology can quickly acquire image data in a short time. This technology has been widely used in all walks of life with the rapid development in recent years especially in the rapid acquisition of high-resolution remote sensing images, because of its advantages of high efficiency, reliability, low cost and high precision. Fully using the UAV tilt photogrammetry technology, the construction image progress can be observed by stages, and the construction site can be reasonably and optimally arranged through three-dimensional modeling to create a civilized, safe and tidy construction environment.

Key words: Unmanned aerial vehicle (UAV); Tilt photogrammetry; Three-dimensional modeling; Multi-view image dense matching; Smart3D

1 Introduction

The development of photogrammetry has gone through three stages: digital photography, analytical photography and analog photography. With the development of science and technology, photogrammetry has entered the stage of all digital photogrammetry. Digital photography measurement using digital image and realizing the function of photogrammetry software system, and based on computer and other auxiliary equipment integration platform that is formed by photogrammetric workstations, in automatic or semi-automatic way to obtain geometry information subject, this kind of technology can offer various measurements with high precision and economy of the 4 D products, mainly include digital line graph DLG, DRG digital raster map, digital elevation model (DEM) and digital orthogonal projection(DOM).

2 Project overview

Laiwu Dongsheng community resettlement area of China Railway 14th Bureau Group Co., Ltd. is located in Laiwu District, Jinan City. It is divided into two plots, North and south, with Changqing street as the boundary. Plot A is located in the north of Changqing street, and plot B is located in the south of Changqing street, including 5 residential buildings, commercial and underground garages, with a building area of 163932.47 m² .

The construction site is adjacent to Fengcheng West Street in the north, Wenhua South Road in the East and Changshao South Road in the West. The construction area covers a large area, the material turnover space is small, and the construction land is compact.

3 UAV tilt Photogrammetry

3.1 Introduction and components of UAV tilt Photogrammetry System

3.1.1 Introduction of UAV tilt Photogrammetry System

UAV tilt photography system is based on UAV as flight platform, equipped with sensors to quickly and efficiently acquire high-resolution remote

sensing images, combined with integrated remote control technology, GPS positioning technology and communication technology to realize field flight data processing, generate three-dimensional model, apply analysis to realize automation, intelligence and rapidity, and get relevant spatial information in the fastest time, And timely processing of information, modeling surveying and mapping system.

UAV tilt photogrammetry system is the necessary supplement of satellite remote sensing and traditional aerial photogrammetry, and the cost of traditional measurement is high, which is seriously affected by weather. Therefore, UAV tilt photogrammetry has the following advantages: Flexible and real-time; Simple operation and low cost; High resolution and wide application range.

3.1.2 Components of UAV tilt Photogrammetry System

UAV tilt photogrammetry system is mainly composed of UAV flight platform system, flight navigation and control system, mission equipment and its control system, data transmission system, ground monitoring and support system, etc.

3.2 Relevant principles and technologies of UAV tilt Photogrammetry

The tilt photogrammetry technology of UAV is to carry five sensors on the platform of UAV. At the same time, high-resolution aerial images and texture information of objects are obtained from a vertical, four inclined and many different angles to obtain multi perspective images of objects. Combined with the GPS / IMU system on the UAV flight platform, POS data is obtained, and the altitude, speed and course overlap are recorded at the same time. Through field control survey, multi view image dense matching of interior image data, production of digital surface model, texture mapping, etc., a three-dimensional real scene model with real geographic location information is established, and users or vector data are collected to obtain large-scale topographic map.

4 Research on 3D modeling method based on tilt Photogrammetry

4.1 3D modeling technology based on tilt Photogrammetry

The 3D modeling technology based on UAV tilt photogrammetry is a new technology developed in recent years. Before that, the main modeling methods include CAD based modeling technology, laser scanning modeling technology and photogrammetry based 3D modeling technology[2].

As a new technology in the field of Surveying and mapping in recent years, tilt photogrammetry is mainly used to acquire more comprehensive information data by installing multiple cameras on a certain flight platform, and then collecting images from various angles from the enterprises that need to be measured.

Its main features are as follows:

(1) It can observe the ground from all angles, so as to understand the real situation of the measurement area more clearly, and make up for the defects in the orthophoto measurement.

(2) In all kinds of conditions on the ground, new information can be collected clearly by using tilt image, and the collected information is very comprehensive[1].

(3) After the effective processing of the collected image, the related modeling software can be used to build the 3D model.

4.2 Data processing flow and key technologies of 3D modeling based on tilt Photogrammetry

The processing flow of 3D modeling data of tilt photogrammetry is as follows: Image preprocessing → multi view image joint adjustment → multi view image dense matching → high precision DSM automatic extraction → 3D modeling.

4.2.1 Multi view image preprocessing

In the process of image preprocessing, the deformity was corrected and the light and color were evenly treated. Due to the camera installation error and lens deformity will produce image on image quality, so it is necessary to check and correct the equipment before flying. Using the solution method, get the calibration information, and then effectively use the relevant software to correct the distortion.

In addition, in order to avoid the influence of light, CCD characteristics and the arrival of optical lens, the image light and color should be evenly processed before data processing.

4.2.2 Joint adjustment of multi view image area network

The image data obtained by tilt photography mainly includes side view image data and vertical image data. Therefore, in the process of multi view image joint adjustment, the geometric deformation and occlusion

caused by large angle of view should be reasonably considered.In this process, control point coordinates and POS auxiliary data can be used to establish the adjustment equation between multi view images, which can effectively improve the accuracy of the adjustment results after the solution[3].

4.2.3 Multi view image dense matching

For image processing, the most important problem in image matching is the use of a single matching primitive in the past. In this case, it is easy to generate ill conditioned solution, the reliability and accuracy of image to matching. If multi view image is used, this technology has the advantages of high resolution and wide coverage. It can get different operability from many aspects in the same location. When matching, it can effectively use the relevant redundant information, and use the dense matching model of multi view image to extract the feature point coordinates on the multi view image at the first time, so as to get the three-dimensional information of the terrain Rest.

4.2.4 High precision DSM automatic extraction

After dense matching of multi view images, the digital surface models obtained have very high accuracy and resolution, and more clearly show the specific situation of the ground objects, which is very important to form the spatial basic framework. After the combination of multi view images and multi view images, the exterior orientation elements of each image can be calculated by itself, and have a high accuracy. In this case According to the actual situation, multi view image matching unit can be selected to perform pixel by pixel dense matching, so as to better get the ultra-high density point cloud of the image area features, and then through the point cloud network, high-precision and high-resolution DSM can be extracted from it.

4.2.5 Real 3D modeling

After getting the ultra-high density point cloud, the three-dimensional TIN model can be built in different layers and different fineness. According to the specific situation of the terrain, the triangulation network is automatically adjusted to build the vector structure of the 3D TIN model of the regional 3D model[4].

5 Conclusion

As a new measurement technology, tilt photogrammetry has the characteristics of high measurement accuracy, wide range and multiple angles, which is widely used in the process of building three-dimensional model. This paper mainly discusses the content of tilt photogrammetry, mainly including the following aspects:

(1) This paper summarizes the principle, system composition and data post-processing software of tilt photogrammetry. On this basis, it analyzes the processing flow and key technologies involved in the construction of real 3D model of tilt photogrammetry.

(2) The main technology used in UAV tilt photogrammetry is multi view image matching technology. In image acquisition, this technology has great side direction overlap and heading overlap, which can effectively promote the establishment of 3D model.

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