ISSN: 2664-9640

3D Map Reconstruction Based on ArcGIS

Lei Shi[1], Peng Huo[1], Mengzhou Li[1], Wenshuo Li[1], Jinze Cui[2]

[1] School of Electrical and Electronic Engineering, Shijiazhuang Tiedao Universit, Shijiazhuang, Hebei, 050000, China

[2] School of Information Science and Technology, Shijiazhuang Tiedao Universit, Shijiazhuang, Hebei, 050000, China

Abstract

In this paper, we expound the steps of 3D modeling through the support of ArcGIS platform, which mainly include three aspects: data acquisition, data model establishment and graphics optimization. The innovation of this paper is that in terms of data acquisition, in addition to introducing traditional data acquisition methods, it also introduces the method of using PCD format pictures to transform raster data, which provides a reference for the subsequent 3D model establishment of methods and operations, and also describes ArcGIS. Broad application prospects in the subsequent development.

Keywords

ArcGIS, DEM data, orthophoto map, 3D model.

1. Introduction

With the rapid development of society, people's exploration of the earth has become more and more in-depth, such as the US GPS global positioning system and my country's BDS Beidou satellite navigation system. This has led to an increasing demand for a high-precision geographic model. Although the traditional surveying and mapping industry is still playing a huge role, relying solely on surveying and mapping for 3D modeling is far from enough to meet today's needs. Now, people hope to be able to model more accurately and efficiently, and with the rapid development of computers, computers can process data at high speed, so the GIS geographic information system came into being. This paper studies and discusses the process from the use of drones for surveying and mapping to extract data and analyze the data for modeling.

UAV remote sensing technology refers to remote control and telemetry in the air by controlling some unmanned aerial vehicles that can take pictures, and realizes convenient and automatic acquisition of geographic information through sensors and GPS. For example, to obtain some land resources information and disaster information. Because our country has a rich climate, generally it is rainy in summer, and satellite mapping requires good weather, and the cloud layer should not be too thick, so the shooting restrictions on satellite remote sensing in summer are more serious, and compared with space satellites, UAVs The advantage of remote sensing is that it can be more flexible, fast, and it takes less time to realize all-weather mapping work. The mature image processing in the industry is to use some professional modeling software suitable for drones in the industry to collect photos and images collected in the field, perform photo alignment, noise reduction, correction, and build a space model, which is beneficial to the later GIS system application.

Using the function of ArcGIS can realize the function of extracting the value of the target object to the point. After processing the preprocessed DSM (digital surface) data extraction and analysis, the two-dimensional coordinates of each elevation point can be calculated through the

ISSN: 2664-9640

function of the software, a contour line can be generated by importing their coordinates x, y values. The second step is to extract the elevation value, load the digital surface model data into ArcGIS-map to take points, then convert the attributes, extract the elevation value according to the method described above, and then draw the contour line. The digital surface data model is represented in the form of computer data to form a digital information topographic map. Through the technology of capturing and extracting elevation information from drone images, we can achieve some simple geographic surveying and mapping more efficiently. Low is unimaginable in the era of using professional equipment in the past. We generate a three-dimensional landscape by combining the generated DOM map and elevation information data. With the rapid development of UAVs, it will play an increasingly important role in the field of surveying and mapping.

2. 3D Map Making Based on ArcGIS

2.1. Acquisition of digital elevation model

2.1.1. Obtaining data from satellites

First of all, there must be terrain data. In order to obtain the DEM data of the specified location area [1], the DEM data can be downloaded from the NASA Earth observation data with a resolution of 12.5m. The DEM data can be represented by a solid ground model in the form of an ordered numerical array come out. The picture shows the 12.5m DEM image of Chang'an district, Shijiazhuang obtained on NASA EARTHDATA as shown in Fig. 1.

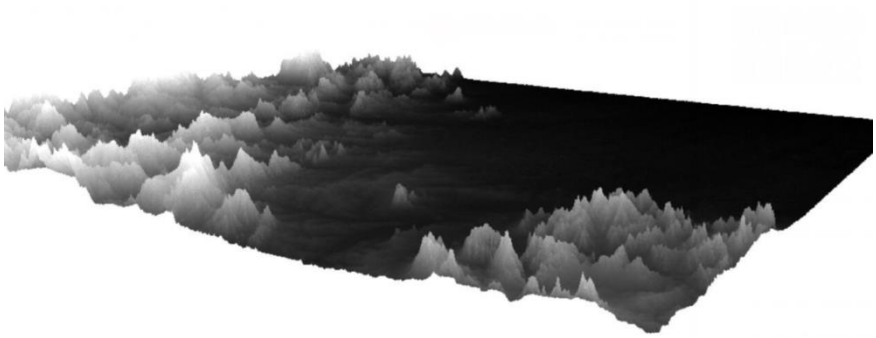

Figure 1 DEM image of Chang'an district, Shijiazhuang

2.1.2. Using pcd las to convert raster data to obtain DEM

In terms of aerial survey, DEM is often used for elevation point extraction and earthwork calculation. PhotoScan software can be used to complete the work of proposing ground points and forming a triangulation network. However, the classification effect is not ideal, and the generated DEM is smooth or point. Accuracy is not ideal. Therefore, the drone is used for aerial scanning, and the obtained data is generated into a PCD file. CloudCompare is used to merge multiple PCD files and convert them into las point cloud files, which is shown in Fig.2.

Figure 2 las point cloud file

In the actual project process, we will have the need to merge multiple files into one point cloud file, and CloudCompare satisfies our needs very well. The following details how to combine multiple pcd point clouds into one las file.

First, select all the pcd point cloud files, use the merge function of CloudCompare to merge them into a pcd, then click save, select the las format, and name the file.

Then use ArcGIS to realize the conversion of las point cloud file to DEM file, and finally complete the establishment of 3D map combined with orthographic projection image.

1. Steps to create a las dataset using ArcGIS:

(1) Click on the toolbox in the catalog part on the right and find the Data Management Tools (Data Management Tools).

(2) Click to create a las dataset, and select the location of the input and output files to save.

2. Steps to convert las dataset to raster:

(1) Click the directory toolbox to find the conversion tool.

(2) Find Convert to Raster, click las dataset to raster, select the input dataset, and select the output raster.

(3) Value field settings: Elevation – Interpolation Type: Natural Neighborhood Method – Sampling Value: 3.

3. Global mapper raster to DEM:

Open the grid data data, file–export–export elevation grid format, select DEM for the output type, default parameters, and define the output path. Afterwards, the transformed DEM data can be obtained for subsequent 3D data modeling processing.

2.2. Acquisition of digital orthophoto images

In addition to DEM data, a digital orthophoto map is also required. The digital orthophoto map can be edged, corrected mosaic, and color adjusted through aerospace images such as drones, and cropped according to a certain range to generate digital orthophoto data [2]. The picture shows the digital orthophoto image of a mountain obtained by aviation equipment as shown in Fig. 3.

ISSN: 2664-9640

Figure 3 Digital orthophoto image of a mountain

2.3. ArcGIS-based data processing

Firstly, running ArcScene in the ArcGIS section, note that you need to check each function part of the 3D analysis extension module, and use the projection data as the best data for 3D modeling, add the acquired image (or vector) data into it, set the map Layer properties, set the acquisition elevation value to float on the custom surface, and add the resulting DEM data in the file link [3]. After adjusting the coefficients used to convert the layer elevation values to scene units to appropriate parameters, the resulting 3D topographic map is shown in Fig. 4.

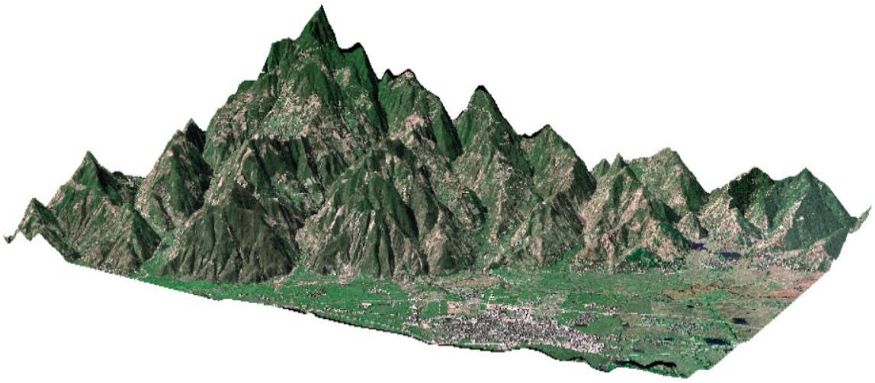

Figure 4 3D topographic map

2.4. Optimization of graphics

(1) In terms of data acquisition, it is necessary to obtain high-definition data as much as possible, and DEM data should obtain high-resolution images as much as possible.

(2) Point cloud denoising: Noise will have a great impact on the generation results of DEM, and the comparison of DEM effects generated in the presence of noise will be very different. Generally, point cloud filtering needs to be performed in the following situations: The irregular density of point cloud data needs to be smoothed. Outliers need to be removed due to occlusion and other issues. A large amount of data needs to be downsampled. Noise data needs to be removed.

(3) Point cloud interpolation (up-sampling, up-sampling): The original data points may be unevenly distributed, and the original data image will become smoother and smoother after the denoised point cloud needs to be interpolated.

(4) When processing data in ArcGIS, in the graphics settings, the raster image quality enhancement in the rendering graphics panel is adjusted to the highest value, and the corresponding parameters can be adjusted for vertical exaggeration in the scene properties in order to obtain a more three-dimensional model.

3. Applications of ArcGIS

Urban development is very rapid, but space is limited, so the rational use and development of underground space has become one of the keys to urban development. The underground environment is harsh and the situation is complex, and it cannot be detected intuitively in the process of development, construction or maintenance. Traditional exploration methods can no longer meet the needs of urban development. The underground city space management system designed based on ArcGIS can effectively solve the problem of underground space development. By importing geographic information data and pipeline data, and connecting them in series according to a specific structural sequence, a comprehensive database is established,and an underground city space model is constructed to realize intelligent management of underground space. It mainly consists of the following application methods: graphic browsing, data management and editing, line analysis, and output display.

With the advent of the information age, and the growth of Internet penetration, the three-dimensional digital campus has become the foundation of the smart campus construction. The application methods include the overall design of the system and the acquisition of building shape and elevation data through UAV laser scanning. Due to application limitations, the 3D model only has the basic functions of ordinary browsing and roaming. In the future application prospects, it can be based on actual conditions. It is required to develop a more characteristic three-dimensional digital campus system.

References

[1] Liu Lu.30-meter seamless DEM product reconstruction based on multi-source data fusion. 2019. Wuhan University, MA thesis.

[2] Zhou Yi, Li Qi, Ma Xizhao, Gu Hui. Analysis of key technologies for orthophoto image production from different data sources in dynamic remote sensing monitoring of land use [J]. Mineral Exploration, 2011, 2(06): 827-833.

[3] Wang Shuzhen, Zheng Guoqiang, Wang Guangsheng, Hu Yumin, Zhang Dehuai, Qi Wei. Refinement modeling of buildings based on multi-source point cloud data fusion [J]. Surveying and Mapping Bulletin, 2020(08): 28-32+38. DOI :10.13474/j.cnki.11-2246.2020.0243.