Application of Airborne Lidar Measurement Technology in Highway Survey and Design

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Abstract: In order to better study the application principle, characteristics and requirements of airborne lidar measurement technology, the problems that need to be paid attention to in the application of airborne lidar system need to be compared and analyzed with the traditional aerial photogrammetry technology, and countermeasures need to be formulated after its advantages are defined. Clear objectives and operation norms, better applied in the highway survey design, improve the level and quality of the survey, grasp the specific situation of the highway, easy to find problems in time, improve the problem, which can provide guidance and basis for the smooth progress of highway engineering projects in the later period. To this end, this paper mainly discusses the application research of airborne Lidar measurement technology in highway survey and design, analyzes the characteristics and key problems of airborne Lidar measurement technology, and then puts forward the comprehensive application.

Keywords: Airborne Lidar Measurement Technology; Highways; Survey And Design; Applied Research

1. Introduction

At present, in the survey and design of Chinese highway, it is necessary to draw the middle line of the highway by using large scale topographic map in a certain plane, then use special highway design software to define the plane linear relationship, calculate the road journey in detail, and then carry out field measurement on different sections to draw the ground elevation of the middle line and the elevation of cross section relative to the middle line. It is necessary to sort out the relevant data, and collect the original data such as plane, longitudinal plane and transverse plane, and finally carry out comprehensive design, so as to calculate the engineering quantity in detail. In short, it is necessary to make clear the main points and requirements of the investigation in the highway survey and design, and measure the topographic map and the section specifically. In the current continuous development of measurement technology, airborne LiDAR measurement technology as a new type of measurement technology is also applied to the highway survey and design, which can replace the traditional measurement technology because of its significant advantages and good effect.

2. Characteristics of Airborne Lidar Measurement Technology

2.1 Airborne Lidar System Structure and Application Principle

The airborne LiDAR system is a functionally advanced remote sensing data acquisition and analysis system, which

specifically includes the flight platform, laser scanner, positioning and inertial measurement unit, CCD camera, control unit and other links. Among them, the control unit plays an important role in controlling the airborne LIDAR system, for which the design needs to ensure that all parts of the system remain coordinated. When the airborne LIDAR system is used for measurement, the data information during the flight is obtained through the scanner, then the coordinate points in the scanner are collected through the positioning system, and finally the distance from the ground to the center of the radar equipment is obtained through the scanner. After acquiring all the above data information, accurate calculations can be made and the spatial coordinates are finally obtained. And under the system can integrate the data information in the camera, and automatically record the ground image data, and then decompose and calculate the data, and derive the final orientation information, and finally form the DOM under the laser point cloud data [1].

2.2 Airborne LiDAR Measurement Technology is Different from the Traditional Technology

Firstly, the point cloud classification of ground point cloud data is carried out by using the denoising and filtering method of point cloud data on vegetation and other noise point clouds, and the correctness of classification results is explored, which will pave the way for future research on point cloud data processing methods and accurate automatic classification of point cloud data.

Secondly, the fusion method of two kinds of data is applied to take the advantages and avoid the disadvantages of each, and the DEM data, DOM data, cross-sectional data and 3D data model obtained by the fusion of two kinds of data can provide accurate basic data for the survey and design of highway.

Thirdly, through the data fusion of highway survey and design, it can provide methodological pointers to the fusion of multi-source data, such as the fusion between data such as point cloud data and hyperspectral remote sensing images, InSAR data, etc.

Fourthly, through the study of the application of fusion of airborne LiDAR and UAV images in highway survey and design, it can provide some guidance for other projects [2].

3. Key Issues in Airborne Lidar Measurement Technology

3.1 Aerial Photography Flight Design

In the process of airborne LiDAR measurement need to carry out aerial photography flight design, the work is the core key, aerial photography design is directly related to the smooth implementation of the entire measurement work, which people need to pay more attention to, need to collect data information in real time, to ensure that the data information is complete, accurate and true, so as to derive reliable data results. Before the specific aerial flight design, people need to follow the principles of economy, safety, thoroughness and efficiency, and need to improve the data accuracy on the basis of ensuring the project results data. In the process of measurement, it is necessary to analyze the terrain, topography, meteorological conditions and structures in the survey area one by one, and then adjust and control the lens focal length, exposure speed, laser scanner Angle, scanning frequency power, etc., according to the functions of the equipment and system modules. In addition, it is also necessary to adjust and correct the overlap degree of navigation band, laser point distance and image resolution according to the actual situation, and finally select scientific and reasonable aerial photography parameters to lay the foundation for in-depth analysis in the later stage.

3.2 Coordinate and Elevation Conversion

Unlike other measurement technologies, airborne LiDAR measurement technology can obtain accurate and real-time three-dimensional coordinate data information of ground objects through internal double differential and precise single-point positioning technology, and then generate accurate positioning measurement results by automatically generating geodetic coordinate system. At present, the national coordinate system or project-specific coordinate system is mainly used in the highway survey and design projects, and only the positioning results and high-level system data conversion problems need to

be dealt with when working under this coordinate system, and the data information is finally applied in the project design. For the plane coordinate system, it is necessary to use the parametric method in the conversion, and the elevation system conversion is not difficult, and the operation is simple only to import the abnormal data information in the data points, so that the elevation system conversion of laser data can be realized smoothly [3].

3.3 Point Cloud Data Classification

Airborne LiDAR measurement technology can obtain comprehensive three-dimensional discrete point data, and the acquired data is more dense, so it is called point cloud, in which the point cloud data includes ground objects, buildings, vegetation and other data information that can be reflected from the ground, for which people need to pay attention to the classification of point cloud data in the field measurement. In the classification, it is necessary to extract the above data information of different height attributes that need to be accurately identified from the obtained Marine data. The principle of laser point cloud classification is to compare, analyze and calculate the laser point cloud data and the surrounding point elevation data. After using certain data information processing software to process and automatically classify the point cloud data, on the basis of judging its function and attributes also need to ensure the classification results, in this process also need personnel to cooperate with each other to ensure that in some complex areas can be accurately obtained. In the highway survey and design, need to create digital ground model according to the measurement results, before the specific creation of the ground point cloud laser data need to be classified, after the laser data in the three-dimensional coordinate values of discrete points for fusion, according to the fixed grid to form a certain model.

4. The Application of Airborne LiDAR Measurement Technology in Highway Survey and Design

4.1 Airborne LiDAR System Operation Process

In the survey and design of expressway, it is necessary to use large-scale route planning map, DEM, longitudinal and cross section map and other relevant data information. The application of airborne Lidar measurement technology can effectively meet the technical requirements, improve the design effect and quality, and ensure that the survey results are not affected. The current operational flow of airborne Lidar measurement technology in highway survey and design is shown as follows: Flight design, flight data information acquisition, positioning base station data acquisition, base station coordinate data acquisition, data solving, eccentricity adjustment, laser point earth orientation adjustment, azimuth element acquisition, original image acquisition, data verification, coordinate conversion, laser point cloud data classification, making various coordinate maps.

4.2 DEM and DOM Production

After classifying the data information, inaccurate vegetation points, ground heights, ground object points and water points should be deleted according to the requirements, and accurate ground point information should be obtained. After that, specialized processing software should be used to draw the elevation and make the DEM product with high precision, and the format conversion of the product should be done well. In this process, it is necessary to obtain true color digital influence through high-resolution cameras, and then combine with laser scanner to automatically generate digital elevation model, digital orthophoto, digital planning map and other high-precision ground products. In this process, it is necessary to always grasp the generation flow chart of digital products. However, because of its high measurement accuracy, high density and strong penetration, airborne Lidar has significant advantages, so it can be applied in projects in complex geological environment to automatically generate three-dimensional ground lines according to the specific conditions of cross sections. The ground line can avoid the problem of accuracy due to the complex ground, and can better guide the project unit to carry out highway expansion and determination, and meet the accuracy requirements of construction drawing design.

4.3 The Collaborative Design of Airborne Lidar Measurement Technology and Highway CAD Drawings

In the airborne lidar system, high-precision and high-density data can be obtained in real time. However, due to the difficulty in processing the original CAD drawings of highway projects, the point cloud data should be converted into a ground model before CAD design software is used for design. However, this method will cause deviation. It is necessary to combine CAD design with lidar measurement technology to form three-dimensional terrain data, so as to optimize the plan and determine the best route plan.

Conclusion

Airborne laser radar measurement technology is a very effective and reliable technical method, the application of this technology in the survey and design of highway can meet the requirements of engineering project construction, can improve the level of construction drawing design, improve the design efficiency and quality, can reduce the risk, reduce the cost of the project, effectively meet the relevant requirements. In this regard, people need to apply it scientifically according to relevant specifications, grasp the operation process, do a good job in digital product production, and finally point out the application direction of airborne lidar measurement technology.

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