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Application of Photogrammetry and Remote Sensing Technologies in Engineering Surveying

Xu Pengpeng, Wang Shujie
Jiangxi Vocational Transportation College of Communications, Nanchang, China

Abstract: Engineering survey runs through every phase of construction projects, and its performance directly affects the overall progress and quality of engineering works. It has become an inevitable trend for the trade to upgrade working modes and raise operational efficiency amid modern development. As two cutting-edge technical means, photogrammetry and remote sensing have brought fresh development opportunities to conventional engineering survey. This paper will analyze the application value of photogrammetry and remote sensing technology in engineering survey, and discuss the specific application path of these two technologies through the analysis of the specific application scenarios of photogrammetry and remote sensing technology. The purpose is to improve the quality of engineering survey and lay a solid foundation for the high-quality development of engineering construction.

Keywords: Photogrammetry; Remote Sensing Technology; Practical Application

1. Introduction

With the development of the times and the innovation of technology, photogrammetry and remote sensing technology have become the main methods used in modern engineering measurement. They not only improve the measurement efficiency, but also improve the safety and accuracy of measurement, and better meet the quality requirements of modern engineering construction. Photogrammetry restores the geometric position and morphological information of the target through image acquisition, combined with feature point matching and three-dimensional reconstruction technology. Remote sensing technology relies on sensors carried on different platforms to obtain electromagnetic wave information in the target area from a long distance. Through the interpretation and analysis of information, various types of geographic feature data required for engineering measurement are extracted. The deep fusion of the two can break through the bottleneck of traditional engineering measurement and provide efficient and accurate data support for the whole process of engineering measurement.

2. Functional Values of Photogrammetry and Remote Sensing in Engineering Survey

2.1 Improving On-Site Operation Safety

Traditional engineering survey relies heavily on field staff to complete on-site measurement. For regions with complex landforms or harsh natural conditions, manual field work always comes with considerable safety risks. The adoption of photogrammetry and remote sensing effectively addresses this pain point. Equipped with unmanned aerial vehicles and airborne survey devices, teams can finish data collection remotely without entering dangerous areas. This working mode largely lowers personal exposure risks and cuts down the probability of field safety incidents. Besides, such non-contact survey modes cause far less damage to local ecological environments compared with manual operations, which conforms to the basic principles of sustainable development.

2.2 Cutting Operational Expenses of Survey Works

Against the backdrop of high-quality development, cost control and efficiency growth have become core goals for all construction activities. Survey-related expenditure occupies a notable share of the total investment of a project. Traditional survey modes demand massive manpower, materials and equipment, which will inevitably increase overall project costs. Photogrammetry and remote sensing are applicable to diverse working scenarios; one single data acquisition process can cover a large scope of land areas. This not only shortens the whole survey cycle, but also reduces the input of

time, equipment and auxiliary resources, thus bringing better economic benefits to engineering survey activities.

2.3 Boosting the Accuracy of Measured Data

Economic and social development has put forward stricter requirements on data precision for engineering survey. Traditional survey techniques are limited by inherent defects such as large measurement errors and high operating costs. Supported by advanced technical systems, photogrammetry and remote sensing can conduct full-area, high-density data sampling within survey zones. Professional post-processing software can automatically correct and splice raw data, producing topographic results with centimeter-level or even higher precision. Such high-accuracy data can fully meet the technical standards of modern engineering, and serve as reliable references for project design and field construction.

3. Main Application Scenarios of Photogrammetry and Remote Sensing in Engineering Survey

3.1 Large-Scale Topographic Mapping

Under the background of modern society, the application of photogrammetry and remote sensing technology in engineering survey has become a common phenomenon. With the development of the times and the progress of science and technology, the application scenarios of this advanced measurement concept and technology are also expanding. Among them, large-scale topographic mapping is one of its main application scenarios. Traditional large-scale topographic mapping requires surveyors to carry out point-by-point measurement in the field. The operation cycle is long, the manpower and material resources are invested heavily, and there are many operational limitations in areas with complex topographic conditions. With the help of photogrammetry and remote sensing technology, the aerial flight platform can be equipped with measurement equipment to complete the image shooting and acquisition of the measurement area. It can quickly generate large-scale topographic maps that meet the requirements through subsequent processing, without requiring a large number of personnel to enter complex field operations, shortening the surveying and mapping cycle to ensure the accuracy of mapping, fully adapting to the needs of topographic data for pre-engineering planning and design, and effectively improving the efficiency of large-scale topographic mapping.

3.2 Deformation Monitoring of Large-Scale Projects

With the development of the times and the progress of social economy, large-scale engineering construction has become an important content in the process of social and economic development, which can better meet the needs of national and social development, enhance the comprehensive national strength and further plan for the well-being of the people. Engineering measurement is an important part of large-scale engineering deformation monitoring. With the help of photogrammetry and remote sensing technology, large-scale and long-term continuous observation can be carried out in the engineering area. By comparing the image data obtained in different periods, millimeter-level deformation information can be extracted, and the overall deformation trend of the project can be grasped in an all-round way, so as to provide timely and accurate early warning basis for engineering safety management and control.

3.3 Investigation and Design of Linear Projects

Field investigation and scheme design constitute the foundational work of modern engineering survey. A great number of linear projects extend for thousands of kilometers, accompanied by varied landforms and complicated geological conditions along the routes. Traditional survey means fail to collect complete geographic information of the whole line. Using photogrammetry and remote sensing, technicians can quickly obtain panoramic images along planned routes, so as to identify local landforms, geological structures and surrounding existing buildings and facilities. Based on these information, teams can select rational route schemes and find out potential adverse geological sections in advance.

Combined with UAV photogrammetry, workers can acquire high-resolution images of route belts and produce high-precision digital elevation models as well as digital line graphs. All these data provide solid topographic support for route optimization and construction drawing design of linear projects.

4. Development Strategies for Promoting

Photogrammetry and Remote Sensing in Engineering Survey

4.1 Developing Intelligent Survey Technologies for Special Working Conditions

The widespread use of photogrammetry and remote sensing has become an irreversible trend in engineering survey. As practical requirements grow more rigorous and working scenarios become more diversified, the industry needs to accelerate the research and development of targeted intelligent survey technologies. First, we need to categorize various survey tasks meticulously, and select matched technical solutions according to actual working demands. Taking mountainous regions covered with dense forests as an example, enterprises, universities and research institutes should launch joint research projects to integrate photogrammetry, remote sensing and artificial intelligence algorithms. Researchers need to optimize image interpretation, feature extraction and data calibration models adapted to complex environments, solve technical difficulties including data noise and missing information, improve data quality and collection efficiency, and fill the technical gaps in extreme survey environments.

In addition, we need to take full advantage of new productive forces and artificial intelligence technologies to expand the application boundary of existing techniques and realize technical upgrading. Customized functional modules should be developed to fit the survey demands of new-type engineering projects. Meanwhile, real-scene test sites need to be built to verify and polish newly developed technologies in practical environments. In this way, intelligent survey technologies can be fully applied to all kinds of complex engineering scenarios, and offer strong support for the implementation and high-quality development of construction projects[1].

4.2 Establishing a Unified Platform for Data Sharing

The application of photogrammetry and remote sensing technology in engineering survey is the inevitable result of the development of the times and science and technology. In order to give full play to the role of this modern technology in engineering survey, it is necessary to continuously speed up information sharing and build a unified data platform to provide strong data support for the application of photogrammetry and remote sensing technology in engineering survey. On the one hand, it is necessary to integrate different types of data such as multi-source remote sensing images and terrain results generated in the process of engineering measurement, break the data barriers between different project stages, realize the unified storage management and call of measurement data, ensure the interconnection between data, and quickly obtain the required measurement results for each link of subsequent engineering construction. At the same time, it also provides a data basis for cross-project measurement technology optimization, and further strengthens the application value of photogrammetry and remote sensing technology. On the other hand, it is necessary to construct a cooperative working mechanism between different subjects of engineering construction, break the data island between the subjects, make the measurement data flow smoothly between the subjects, ensure that all participants can obtain the latest measurement results in time, reduce the waste of resources caused by repeated measurement, and help each subject to work based on unified and accurate data, so as to avoid construction deviation or cooperation problems caused by data asymmetry, and further improve the application efficiency of photogrammetry and remote sensing technology in the whole process of engineering measurement[2].

4.3 Pushing Forward the Standardization of Relevant Technologies

The application of photogrammetry and remote sensing technology in engineering survey is an innovation of industry development and an inevitable choice for the development of engineering survey. Under the guidance of high-quality development requirements, the standardization process of photogrammetry and remote sensing technology should be continuously promoted to lay a solid foundation for the standardized development of engineering survey. On the one hand, it is necessary to establish a sense of innovation, promote the application of photogrammetry and remote sensing technology as the normalization work in engineering survey, summarize experience and refine unified standards in the process of continuous practice, and provide theoretical and practical support for the formulation of standardization process. On the other hand, it is

necessary to combine the measurement needs of different engineering types, sort out the core content of the technical application process and the output accuracy of the results, promote the formation of a unified technical application standard and achievement quality standard in the industry, and make the application of photogrammetry and remote sensing technology in engineering measurement have rules to follow. It provides a clear basis for the quality control of technology application to help the overall standardized development of the engineering measurement industry. In addition, it is necessary to rely on the unified data platform to promote the establishment of data sharing mechanism, clarify the data access rights and usage specifications of different subjects, and promote the orderly flow of measurement data in the industry under the premise of ensuring data security, so as to lay a solid foundation for the standardization process of photogrammetry and remote sensing technology in the field of engineering measurement[3].

5. Conclusion

The introduction of photogrammetry and remote sensing has brought conceptual and technical changes to the engineering survey sector. It endows traditional survey work with new development connotations, boosts the progress of the whole industry, and provides reliable guarantee for engineering investigation and quality control. Looking ahead, we should keep exploring new application directions of emerging technologies in engineering survey. By keeping pace with technological progress, the industry will achieve continuous upgrading, and make positive contributions to national development and high-quality economic growth.

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