

# Study of Digital Technology Application in Highway Measurement

Hua Qiao\*

Jinzhong Branch Survey Design Institute, Shanxi Province Highway Bureau, Jinzhong, Shanxi 030006, China

**ABSTRACTS** The digital surveying and mapping technology is widely used in engineering survey. The digital surveying and mapping technology keeps updating and improving along with the progress of science and technology and creates more contributions in engineering survey. The survey staffs shall keep studying and expanding their knowledge to improve their professional capability to serve our country better in surveying area. The author studied the application of digital surveying and mapping technology in highway measurement along with years of experience. This article is an important source of reference.

## KEYWORDS

Highway measurement  
Digital technology

## 1. Introduction

Highway measurement is the basic work in highway engineering design. The highway engineering design is the basis and foundation of construction. The quality of highway measurement plays essential role to determine the quality of the whole highway construction. The digital science technology develops rapidly since at the beginning of this new century; the extensive application of computer technology facilitated the tremendous progress made in highway digital measurement. It makes the precision of measurement more accurate and the measuring instruments more simple and practical in use. The development of highway measurement technology is towards an economical, practical and effective direction and will be more perfect in the future. This paper discussed Global Positioning System (GPS), (Topcon Positioning Systems) TPS, Auto (Computer Aided Design) CAD technologies and the application of 3D solid model in highway measurement. It indicates the application of those digital technologies will make the measurement results more accurate, reducing the workloads significantly and improving the measuring

techniques. Those technologies will play an important role in future highway measurement while providing ideas to related works.

## 2. Application of GPS Technology in Highway Measurement

GPS technology brings huge advantages to highway measurement. By using this technology, it does not require the visibility among measuring points; the limitation of selection of measuring points is fewer after use GPS technology. GPS has advantages in measuring short period of time with accuracy. It could measure the plane position to observation station also able measure the elevation. After repeated measurements by using GPS, we found that the shorter the measuring distance, the greater the level of accuracy with shorter time. As a conclusion, this technology has good performance in highway measurement. The GPS technology is mainly used in carrier phase measurement and field survey. There is a problem [3,5] that needs to pay attention in the use of GPS technology in measurement shall be operated in spacious area due to GPS will be affected by landform.

## 3. Application of TPS Technology in Highway Measurement

TPS technology is a positioning system consists of tachometer, total station and electronic theodolite. It can also be called as total station positioning system. TPS technology is a combination of computer technology and total station technology with high efficient measuring technology. Total station is the core device used in this technology and is an electronic distance measuring instrument which is a com-

Copyright © 2015 Hua Qiao

doi: 10.18686/utc.v2i1.3

Received: October 2, 2015; Accepted: November 4, 2015; Published online: December 1, 2015

This is an open-access article distributed under the terms of the Creative Commons Attribution Unported License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

\*Corresponding author: Jinzhong Branch Survey Design Institute, Shanxi Province Highway Bureau, Jinzhong, Shanxi 030006, China. E-mail: qiaohua178@cnav.com.cn

bination product of electronic calculation and optical theodolite. Total station is mainly used to measure distance, height and angles. Unlike other measuring instruments, TPS showed greater accuracy in measuring of height, angles and distances. It able to do automatic measurements, storage of data, conversion of data and calculation. The measurements showed in highway measurement can be read directly on the screen. The battery is integrated with the application in total station which improves the quality greatly. TPS can do both accurate measurement in total station and enables the data exchange between computer and total station creating a foundation for further computer aided design in the future. Total station has many functions and those functions would work in accordance with fixed program. TPS technology has dynamic performance in highway measurement. It is an indispensable technology in highway measurement in this era [1].

#### **4. Application of AUTO CAD Technology in Highway Measurement**

AUTO CAD is a computer aided design technology. It is mainly used in precision positioning calculation in highway measurement. Basically, the highway construction will be divided into several sections and each section consist of bridges, culverts and etc. In order to get accurate measurement results, precise coordinates need to calculated which are critical in effective measurements.

AUTO CAD technology is to calculate coordinates and the results would be more accurate than other technology. This technology could also reduce workloads while improving work efficiency and precision of measurements to ensure the progress of construction. The results produced by using AUTO CAD is accurate up to the value of millimeter. The highly precise measurements provide reliable data for highway construction and reduce the common errors [2].

#### **5. Application of 3D Solid Model in Highway Measurement**

Highway is a complicated geometrical figure consisting of vertical, horizontal and flat surfaces. To determine whether the shape of the highway is consistent with the surrounding environment, we need to measure the data of flat, horizontal and vertical surfaces. In order to measure the data of vertical and horizontal surfaces, we need to use three-dimension (3D) solid models, continuous perspective drawings and highway perspective drawings. 3D solid model is professional technique to build 3D prototypes. This technique could create perfect 3D geometrical prototype. People could generate the prototype based on needs and useful information related with highway construction. 3D solid model is frequently used in highway measurement at the present [4].

To get a better 3D solid model in highway measurement, engineers will need to have complete understand-

ing of the conditions of the highway. They shall improve the construction design and accelerate the approval process and construction progress. The 3D solid model could reflect the highway design completely, therefore, it does not need to have two-dimensional (2D) diagrams during highway measurement since 3D solid models able to provide complete construction drawings. Generally, 3D solid model could reduce workloads and increase measurement precision. It is an important session to optimize highway measurement. The highway measurement is a preparation step for the highway design. The design would be modified and compared repeatedly until a final optimized version. During the design process, the cross section has big difference with the actual ground; the center line of the plane needs to be adjusted due to the limitation of slope and geographic condition. To make the design more beautiful and feasible, designers would use 3D related optimization approaches. The earth volume is the major factor to control construction costs. It is important to calculate the volume of earth. To reduce the costs, we could use 3D solid model to calculate the earth volume. By using 3D solid model, we could calculate earth volume in effective, convenient and in low costs [6,7].

#### **6. Conclusion**

Highway measurement technology is an important part in highway construction. The measurement results have direct effects on the final construction quality. Therefore, the application of modern scientific highway measurement is very important. The development of information technology in our country is rapid and there are a lot of achievements done in digital technology, especially in GPS, TPS and AUTO CAD. With the development of digital technology, there are continuous emerging of digital function and the application range is advancing. The application in highway measurement is one of the examples. This paper introduces the GPS, TPS, AUTO CAD and 3D solid model applications in highway measurement. Digital technology application contribute more precise results in measurement while reducing workloads and improving measurement levels. We believe those technologies would play more important roles in future highway measurement. The usage of digital technologies will need the user to understand certain functions that will have certain requirements on conditions, for instance the application of GPS technology.

#### **References**

1. Bian, X. W., Liang, X. Z., & Li, D. F. (2011). RTK and Total Station Application in Highway Measurement and Comparison. *Shanxi Construction*, 14, 75–76.
2. Lv, F. C., & Li, Z. Z. (2010). Application of Digital Technology in Highway Measurement. *China New Technology Products*, 3, 97–99.
3. Jia, X. L. (2008). Application of GPSRTK Technology in Highway Construction. *Longyan College Journal*, 03,

13–15.

4. Chen, M. J. (2007). Study of 3D Solid Model Application in Highway Measurement. *Hehai University Master Paper*, 4.
5. Shao, Z. F., Zhu, G. Q., & Man, X. J. (2007). Discussion of GPS Application in Highway Measurement. *Shanxi Construction*, 22, 362–363.
6. Wang, X. B. (2009). Study of Digital Surveying Technology Application in Engineering Measurement. *Heilongjiang Science and Technology Information*, 16, 42.
7. Huang, R., Wang, L., & Lei, C. F. (2011). Application of New Surveying Technologies in Engineering Survey. *China Urban Economy*, 18, 186.