Teaching Course of Automatic Measurement with Georobot

Changlin LUO

School of Geodesy and Geomatics
Wuhan University

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Main Contents

1 Background

Traditional teaching practice courses of science and technology of surveying and mapping include:

—— Surveying

—— Cadastral surveying

—— Geodesy

—— Engineering surveying

—— High application surveying

—— ……

These teaching practice courses are mainly operated by manually,

—— reading, recording, limit value checking

—— data calculation and comprehensive analysis

Roles:

play an important role in bringing up lots of excellent surveyors

Disadvantages:

time-consuming, low efficiency, making reading or calculating errors easily, and being scarce of integration of inside and outside work

Nowadays, our teaching practices of some surveying courses must also keep up with the times and be reformed.

Special capabilities and applications of Georobot make it possible and necessary to set up a new course——'Teaching Practice of Automatic Measurement with Georobot'.

This course will provide new conditions and views for the practicers and make them understand and use advanced instruments and technologies more skillfully, efficiently.

2 Basic information about this teaching practice

1) Elementary requirements of this teaching practice

- having knowledge of the basic principle of Georobot and its application for automatic deformation monitoring of engineering construction;
- mastering the basic principle, application situations and the general operation process of two automatic deformation monitoring systems with Georobot.

2) Time arrangement

Totally includes three class periods:

- one class period for the teacher’s tutorial introduction, explanation and guidance
- the other two are arranged for outdoor visit and practice

3) Practice contents

- Monitoring method and general process of mobile network automatic measuring and data processing;
- Monitoring method and general process of fixed automatic deformation monitoring

4) Tutorial guidance contents

- Component and basic principle of Georobot;
- Component and application of mobile network automatic measuring and data processing system;
- Component and application of fixed automatic deformation monitoring system;
- Differential data processing method of fixed automatic deformation monitoring system;
- Brief using introduction of two automatic monitoring systems.

5) Necessary instruments

- One Leica Georobot, installed mobile network automatic measuring software;
- One portable computer, installed mobile automatic network data processing system and fixed Georobot automatic deformation monitoring system.;
- One communication cable;
- Several tripods and prisms;
- One measuring umbrella;
- Several steel tapes.

3 Introduction of Georobot

1□Definition of Georobot

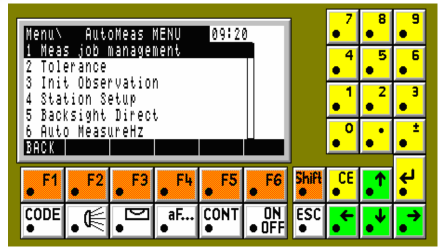
Georobot is one kind of intelligent electronic total station, also called as measurement robot, which can replace man to automatically search, track, identify and collimate accurately targets, and get some data information, such as angle, distance, three-dimensional coordinate and image.

2□Technical components of Georobot

- coordinate reference system
- manipulator system
- Actuator
- computer/controller
- closed loop control sensors
- decision making
- target finding integration of sensors

4 Two automatic monitoring systems

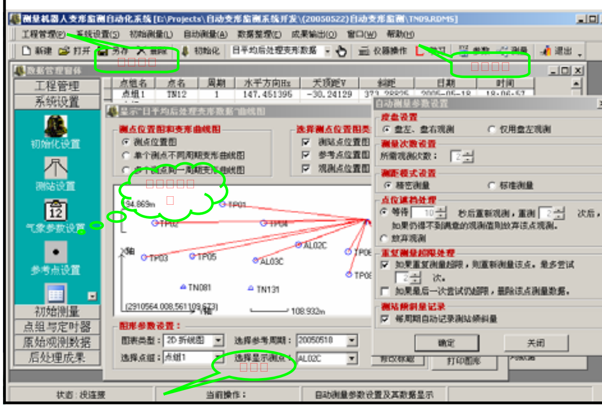
1) Mobile network automatic measuring and data processing system



Georobot automatic measuring system

Georobot data processing system

2) Fixed automatic deformation monitoring system



5 Differential data processing method

- **Differential correction of horizontal angle**
- **Differential correction of inclined distance**
- **Differential correction of elevation difference**

1) Differential correction of horizontal angle

$$\delta = \frac{\sum_{i=1}^{n}(Hz_{ij} - Hz_{ik})}{n}$$

$$Hz_P = Hz'_P + \delta$$

$j=1,2,L\ ,m$

m — the times of measuring

n — the count of base points

— the correction value of horizontal angles

— the horizontal angles of base points in measuring cycle j

— the horizontal angles of base points in measuring cycle

2) Differential correction of inclined distance

$$\Delta d = \frac{\sum_{i=1}^{n} \frac{d_{i1} - d_{ik}}{d_{ik}}}{n}$$

$$d_p = (1 + \Delta d) d_p^{'}$$

$k=1,2,L\ ,m$

m — the times of measuring

n — the count of base points

— proportional coefficient of meteorological correction

— the inclined distance of base points in the first measuring cycle

— the inclined distance of base points in the first measuring cycle

3) Differential correction of elevation difference

$$\begin{cases} c_i = \dfrac{h_{i1} - h_{ik}}{(d_{ik} \cdot \cos\alpha_{i1})^2} \\ c = \dfrac{\sum_{i=1}^{n} c_i}{n} \end{cases}$$

$$h_{pk} = d_{pk} \cdot \sin\alpha_{pk} + c \cdot (d_{pk} \cdot \cos\alpha_{pk})^2$$

$$D_p = \sqrt{d_P^2 + h_P^2}$$

6 Practice steps

The main operations of instrument and software are made by teacher, and the students can visit and take part in it.

7 Practice results

1) Mobile network automatic measuring and data processing

- Output original observation recording book, including horizontal angle, distance and vertical angle;
- Output adjustment file;
- Closure error calculation and adjustment calculation

2) Fixed Georobot automatic deformation monitoring

- Output original observation
- Output deformation analysis result.

8 Conclusions

'Teaching Practice of Automatic Measurement with Georobot' can provide new conditions and views for the students and make them understand and learn how to use advanced instruments and technologies more skillfully, efficiently.

And it's necessary to set up this teaching practice.

Thank you very much for your attention!