APG4005F Assignment 3 - Free Network Adjustment

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07/05/2015

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1 Introduction

The aim of this assignment is to conduct an Epoch deformation analysis using ficticious data with a Free Network least squares adjustment.

2 Background

2.1 Classification of Deformation Analysis

There are three main classifications of deformation analysis monitoring methods, Permanent, Semi-permanet and Epoch. There are advantages and disadvatages of all three methods. The main advatages of the Permenatn and Semi-permanent methods are that they are continous and offer a very high precsion. These two methods make use of a multitude of sensors, such as capacitive, strain, inductance and elctro-optical sensors. These sensors are able to produce data in realtime which is useful for situations in which immediate data is required in order to, for example, raise an alarm. Some of the disadvatages of these two methods of deformation analyis is that the senors are expensive, and require regular calibration. Epoch monitoring involves geodetic and/or photogramerric techniqies to capture data, this is benefitial in that relative and/or absolut postions of many points can be obtained, as apposed to just relative postions in the case of the Permanent and Semi-permanent methods mentioned above. Another advantage of Epoch monitering is that it is much more cost effective.

2.2 Network Classifications

Typically, when constructing a network for Epoch deformation anaylis, a free or minimum constrained network is used, perferably free. In a free network adjustment, no paramter is held fixed, and as a result, precision estimates for all points are provided in the variance-covariance matrices. The effect of holding no paramters fixed is that the shape of the network is defined only by the observations. One of the main advantages of not holding any paramters fixed is that the shape of the network is not affected by erros in the coordintes of the points defining the datum (because the network is not tied to the datum and is allowed to 'float'). Free netowkrs are espicially useful in cases where precise surveys are connected to existing point coordiantes of lower preceions. A caveat of the free network adjustment is that because the datum is not defined (no points are fixed) a singular normal equation matrix will occur (a rank defect occurs in the normal equation matrix). As singular matrices have a determinant of zero (because one of the eigen values is zero) the normal equation matrix cannot be inversed, and so a solution vector 'x' cannot be obtained. In order to negate the singular normal equation matrix, special mathematical treatment based on the determinateion of a generalized inverse is applied. To remove the singularty in the normal equation matrix, a set of speudo-obseravtion equations

are added to to the normal equation matrix in such a way that these equations remove the singularity and do not affect the result vector 'x'.

2.3 Concepts of deformation analysis using geodetic methos

2.3.1 Points selection

Points representing the feature to be monitoired are selected.

2.3.2 Network

A netopwrk pre-analyisis based on the least squares adjustment theory should be undertaken. Then, a conventional netowkr of appropriate accuracy should be executed in at least two epochs.

2.3.3 Testing

One of a variety of avaliable deformation analyiss techniques based on statistical testing is used to detect if point deformations have occured. Often, a second method is employed to confirm the first analyiss.

2.3.4 Inspection

The quantities and directions of deformations are determined.

3 Problem Statement

4 Method

5 Results

6 Discussion

7 Conclusion