

Lab 3: Gravity Network

CE334 Modern Methods in Geoinformatics

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In this lab, gravity measurements are taken along a horizontal profile at the specified site using a terrestrial gravimeter. These measurements are then corrected to determine the relative gravity value at each point, along with the drift parameter, as detailed in the following sections.

Network

The gravity network consists of points (usually control points) where gravity measurements are observed using a CG-6 gravimeter. The data was collected using the step method shown in 1.

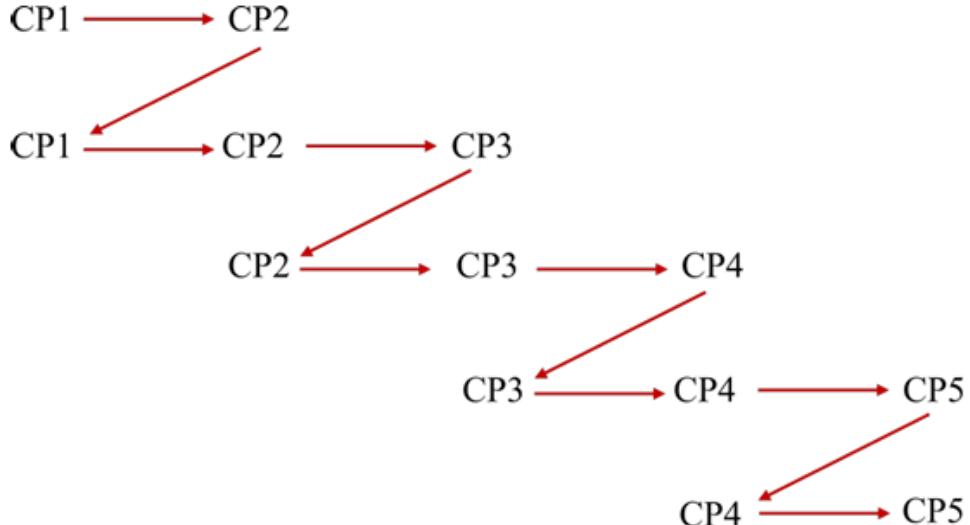


Figure 1: Step approach for gravity data collection

Data set

The gravimeter observation file consists of the gravity values at each point, the corresponding standard deviation at a particular time, and the corrections that have been applied. The following $y_n(t_k)$ is the gravity observation at the point n and time t_k , which has been corrected for tides and other effects that can be easily modeled. As we are dealing with relative gravity, the observation made at a point is not equal to the absolute gravity g_n at that point. However, it is a relative difference from the gravity measured at the preceding point. Furthermore, the measurement has an unknown bias b , and the sensor undergoes a drift d , which we assume to be linear. Over a long period, the drift will be non-linear.

Tasks

1. Parse the data file and retrieve the data from the columns.
2. The gravity measured at a point by the gravimeter can be thought of as

$$y_n(t_k) = g_n + b + dt_k + e \quad (1)$$

where g_n is true gravity, b unknown bias, d is the linear drift.

In order to get rid of the bias term and estimate the drift term, the following difference operation is performed:

$$\Delta y_n(t_k) = y_n(t_k) - y_1(t_1) = \Delta g_n + d\Delta t_k + \epsilon \quad (2)$$

Use equation 2 to carry out the adjustment and t_k should be in decimal hour format while the adjustment is performed.

3. Use the standard deviations of the individual measurements to construct the weight matrix of the adjustment.
4. Calculate *a priori* reference variance, *a posteriori* reference variance. Also state, the number of observations – n , the number of parameters – u and redundancy – r
5. Compute the variance-covariance information for all estimated quantities.

Notes A network of gravity points obtained from relative gravimetry is similar to height networks. They have one degree of freedom, which requires one datum point with a given gravity value. For further details, refer to lecture notes by Sneeuw and Geodesy by Torge et.al.,