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Data reduction in scalar airborne gravimetry: Theory, software and case study in Taiwan ☆

Cheinway Hwang*, Yu-Shen Hsiao, Hsuan-Chang Shih

Department of Civil Engineering, National Chiao Tung University, 1001 Ta Hsueh Road, Hsinchu 300, Taiwan

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Abstract

The objective of this paper is to present theories of scalar airborne gravimetry and to publish the related software to interested readers for free access. Numerical procedures and techniques are developed to compute velocities and accelerations from GPS-determined positions. A method based on the correlation analysis of raw gravity reading and vertical acceleration of aircraft is used to correct for gravimeter times. A method and a computer program for crossover adjustment of gravity values along survey lines are developed. This method allows flexible selection of a fixed survey line to overcome the rank defect problem. A computer program is developed to compute gravity anomalies while applying corrections of gravimeter position and filtering. Upward and downward continuations of gravity anomalies are performed using Fast Fourier Transform. Using observed airborne gravity data along a survey line and simulated data in Taiwan, all the programs have been validated and produced reliable results.

Keywords: Airborne gravimetry; Crossover adjustment; Filtering; Taiwan; Upward continuation

1. Introduction

Airborne gravimetry is a tool for mapping local gravity fields using a combination of airborne sensors, aircraft and positioning systems. It is suitable for gravity survey over difficult terrains and areas mixed with land and ocean. An example of such places is Taiwan, which is surrounded by the Pacific Ocean to the east and the Taiwan Strait to the west. About 75% of Taiwan is covered by hills and high mountains, which make ground gravity survey rather difficult and expensive.

The principle of airborne gravimetry has been described in the geophysical literature. Examples of scalar gravimeters with a damping system are LaCoste and Romberg (LCR) Air–Sea Gravity System II (LCR, 2003) and Sea–Air–Gravimeter System Kss30/31. Other such gravimeters are discussed in Torge (1989). A number of papers, reports and lecture notes have discussed critical issues in airborne gravimetry. Torge (1989, Chapter 7) and Schwarz and Li (1997) summarize these issues. Torge (1989) also points out the accuracy requirements for aircraft positions, latitude, velocities and accelerations in order to achieve a sub-mgal accuracy in airborne gravimetry. Case studies

☆ Code available from server at http://www.iamg.org/CGEditor/index.htm

*Corresponding author. Tel.: +886 3 5724739; fax: +886 3 5716257.

E-mail address: hwang@geodesy.cv.nctu.edu.tw (C. Hwang).

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