“Many of us secretly dream of six months without gravity”

Allan Fotheringham

COURSE DESCRIPTION

This course will examine the processing and interpretation of potential field data. Labs will focus on the processing of gridded potential field data, that is, interpolation to a grid, regional residual separation, continuation, vertical and horizontal derivatives, Werner and Euler deconvolution and depth estimates. Forward Modeling of selected profiles will be performed with GMSYS.

MARKING SCHEME

Mid Term Exam 25%
Labs 25%
Final Exam 50%

The text is:

*Potential Theory in Gravity and Magnetics Applications* by Richard Blakeley.

Also useful are:

*An Introduction to Applied and Environmental Geophysics* by John Reynolds;
*Interpretation of Gravity and Magnetic Anomalies for Non Specialists*, these are notes
for a short course given by the Canadian Geophysical Union.

*Interpretation Theory in Applied Geophysics* by Grant and West;

*Gravity and Magnetics in Oil Prospecting* by Nettleton;

*Time Sequence Analysis in Geophysics* by Kanasewich.

Other literature (e.g. SEG extended abstracts and SAGEEP papers) will be referred to as needed.

**Labs and handouts are available in pdf format on PAWS**

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**SUMMARY**

**WEEK 1** Uses of potential fields (gravity and magnetics) in geophysics. Definition of a Potential Field. The fundamental ambiguity of potential fields - its origin, and the limitations it puts on interpretation. A review of the drift correction, latitude, free air, and Bouguer corrections and how they relate to survey design. Leveling in aeromag.

**WEEK 2** Simple concepts of survey design, station spacing vs. target depth. Flight line and tie line spacing in aeromag. The terrain density, and the terrain correction. Methods of determining the terrain density: Nettleton, co-variance, scatterplot and others.

**WEEK 3** Introduction to processing. Gravity vs. magnetics in terms of targets, processing, interpretation. 1-D Fourier transforms and convolutions

**WEEK 4** 2-D Fourier Transforms and convolutions. The use of 2-D transforms in potential fields.

**WEEK 5** Regional-residual separation, and anomaly separation. Graphical, spectral factorization, polynomial fitting and other techniques are discussed.

**WEEK 6** Gauss' Theorem and the derivation of the excess mass calculation. Limitations on the excess mass, corrections for under-sampled flanks.

**WEEK 7** Magnetic potentials. The fundamental differences between gravity and magnetics as
potential fields.

**WEEK 8**  Downward continuation in integral form and in FFT form. Upward continuation. Limitations on the depths or heights to which data can be continued.

**WEEK 9**  The equivalent stratum and its use. The region of validity of equivalent strata.

**WEEK 10**  Survey parameters and survey design.

**WEEK 11**  Second vertical derivative, uses, examples, problems. Source depth estimates for gravity and mag. Locating the center of mass in gravity.

**WEEK 12**  First vertical derivative and horizontal derivatives, strike filters, trend filters. Reduction to pole.

**WEEK 13**  New methods in potential field processing and interpretation: Werner deconvolution, Euler deconvolution, fractals and potential fields. Trends in exploration, high resolution magnetics and vector magnetics, the analytic signal.

**LABS**

*All Labs must be completed within one week.*

**LAB 1**  Drift corrections on mag and gravity data. Examination of repeats. All gravity (with elevations) and mag data should be on disk in a suitable format before the first LAB.

**LAB 2**  Latitude, free air and Bouguer corrections. Profiles of all three should be presented at the end of the labs.

**LAB 3**  Gridding and Contouring.

**LAB 4**  Exercise on Fourier transforms I and II

**LAB 5**  Terrain Density determination with Nettleton, scatterplots, covariance etc.

**LAB 6**  Terrain corrections for gravity profiles.
LAB 7  Regional residual separation.

LAB 8  Depth estimates.

LAB 9  Gravity and Mag modeling with GM-SYS.

LAB 10  DIPOLE and DIPOLE2 on MATLAB. Their use in simple modeling.

LAB 11  Leveling in aeromag surveys.

REFERENCES


Fairhead, J.D., M Green, Denizar Blitzkow, 2003, The use of GPS in gravity surveys. The Leading Edge, 22, No 10, p945-959


* LeFehr, T.R., Standardization in gravity reduction, Geophysics, 56, 1170-1178.


Fedi, M. T. Quarta, and A. DeSantis, Inherent power law behaviour of magnetic field power spectra from a Spector and Grant ensemble, Geophys, 63 No 4 1143-1150.


Also, the Geological Survey of Canada, publishes summaries of papers by its staff on the WWW. The Regional Geophysics Section

http://www.gdcinfo.agg.nrcan.gc.ca

has a list of several topical summaries.

* THESE ARE VERY IMPORTANT AND YOU SHOULD READ THEM.