PS1 - 6

AEMPY - A Pyhton Toolbox for Processing and Inversion of Frequency- and Time-Domain Airborne ElectroMagnetic Data

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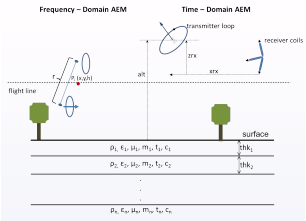
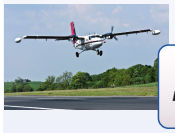
INTRODUCTION

The frequency- and time-domain Airborne ElectroMagnetic (AEM) data collected under the Tellus surveys of the Geological Survey Ireland (GSI) represent a wealth of information on the multi-dimensional electrical structure of Ireland's near-surface. Our project aims to develop and implement inverse techniques based on various Bayesian methods for the densely sampled Tellus data. We have developed a highly flexible toolbox using Python language for the one-dimensional inversion of AEM data along the flight lines. The computational core is based on an adapted frequency- and time-domain forward modelling core derived from the well-tested open-source code AirBeo[1], which was developed by the CSIRO (Australia) and the AMIRA consortium. The processing and inversion methods implemented in the toolbox have been tested on synthetic and field data. This contribution will introduce the toolbox and present a case study on the AEM data from the Tellus Project.

AEMPY





Input File
Tellus
FDEM & TDEM Data
(www.tellus.ie)

Conversion to Internal Data Format

FDEM Format
XUTM, YUTM, GPS, RADAR, IP912-24510Hz, Q912-24510Hz, PWLM
TDEM Format
XUTM, YUYM, GPS, RADAR, X1-X11, Z1-Z11
Define Dataset:
flightline, polygon, profile projection

Pre-processing

Flag negative values & high fly areas
Interpolate
Average/Block[2] ***data over a number of stations***
PCA filter[3,4]

Inversion along Flight Lines

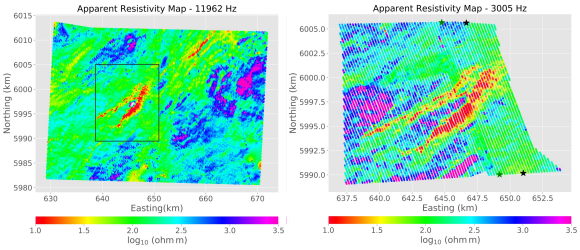
Deterministic Approach
Tikhonov-type inversion[5]
MAP inversion[6]
Minimum-Gradient Support inversion[7]
Stochastic Approach
Markov Chain Monte Carlo[8]

IMPLEMENTATION

Python & Fortran 90
Modules and Scripts
Numpy, Scipy, Matplotlib

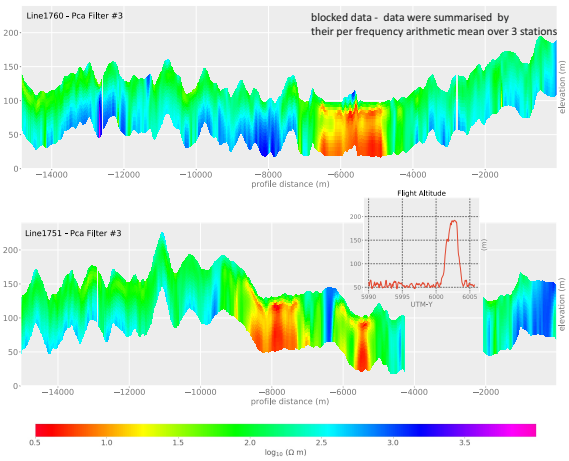
DIAS GIT Repository
Free Access

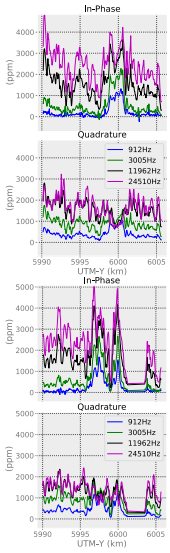
DATA VISUALISATION and INVERSION



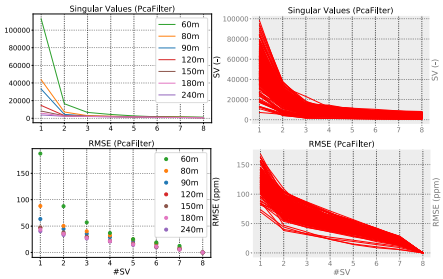
Frequency-domain data from the Tellus Border Survey[9], which was carried out using the JAC airborne EM system: AEM-05. The system operates at four frequencies, 912 Hz, 3005 Hz, 11962 Hz, and 24510 Hz.

Inversion Along the Flight Lines





How to Estimate Data Errors?



Examination of data errors for In-Phase and Quadrature data, which are to be used in the inversion algorithm.

Left Panel: The data is from a test line close to town Bundoran (Ireland). The test line is flown at seven different heights.

Right Panel: Frequency-domain data from the Tellus A1 survey, which was carried out with the JAC airborne EM system (AEM-05).

SUMMARY and CONCLUSIONS

State of the Toolbox:

✓Free Python framework exists for processing and inversion of frequency- and time-domain airborne EM

✓Numerous algorithms are implemented for processing (imputation/interpolation of gaps, PCA analysis) and inversion (Tikhonov and MAP deterministic inversion, MCMC)

On-going and Future Work:

✦Fill public repository with tested scripts
✦Case studies for real world data
✦More AEM systems (legacy GEOTEM data)
✦More algorithms for inversion:
Deterministic (sharp boundaries, image guided)
Stochastic (e.g. trans-dimensional)
✦Work flows for large data sets (parallelism)

ACKNOWLEDGEMENTS

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