FFproc - an improved multivariate robust statistical data processing software for the estimation of MT transfer functions

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The presence of cultural electromagnetic (EM) noise hampers the estimation of Magnetotelluric (MT) transfer functions and therefore distorts the imaging of subsurface resistivity structures. Many advanced processing approaches are available to improve the quality of EM signals. However, very few of them are capable to identify and remove time segments contaminated by correlated (anthropogenic) electromagnetic noise.

We present FFproc, an MT multi-site/multi-device robust remote reference processing code, that is implemented as a MATLAB© Graphical User Interface (GUI). The presented processing software builds on the eigenvalue decomposition method by Egbert (1997) and includes a robust estimation of the spectral density and the noise covariance matrices. The multivariate approach accounts for the statistical dependence between regression residuals related to the data channels at a single site (Advanced Noise Model, ANM) and therefore significantly reduces the impact from locally coherent noise signals.

The code also provides a semi-automatic algorithm, that analyzes the number of source-field processes in the multivariate data space. Here, an eigenvalue criterion, calculated for each single time window, favors time segments with high MT signal-to-noise ratio and simultaneously reduces the influence of regional coherent noise signals.

The modular software package allows the user to apply uni- or multi-variate processing routines to data collected with most of the common commercial data loggers (e.g. Metronix, Phoenix). The results can be exported to different data formats and can be analyzed and manipulated within the visualization environment of our MT software package - FFMT.

The processing algorithm is validated using simulated MT signals related to a 3-D resistivity benchmark model. Additionally, MT data from the Azores are used to compare the code to well established processing codes and to highlight its efficiency. See presentation “Three-Dimensional Interpretation of Broadband Magnetotelluric data at Fogo Volcano, Azores Islands” (Hogg et al.).