Data Quality Assessment and Inversion

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Analysis and evaluation of ERT data reliability in long-term geoelectric monitoring.

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High quality in geophysical measurements is a prerequisite condition to know the ground truth. It is much more demanded in geophysical monitoring for understanding ground condition changes in time since the temporal changes in geophysical responses are very weak. Even in cases that we are able to obtain the data having fairly high S/N ratio, careful examination and assessment of measured data reliability are still necessary as field data are always contaminated with noise. In a pre-inversion stage, accordingly, the data are edited, but usually by eye-inspections and/or through inversions in a trial-and-error manner. This approach to enhance data quality is hard to be systematically applied to long-term monitoring where data are regularly and continuously collected, since consistency in data editing is difficult to be achieved and considerable time should be consumed. As a more advanced approach, reciprocal measurements have frequently been adopted to assess the degree of data uncertainty or reliability. This method needs to perform additional repeated measurements, which consumes extra costs and time in data acquisition. Furthermore, electrode charge-up effects due to the reciprocal measurements may also introduce measurement errors.

To alleviate these difficulties and further to achieve enhanced imaging capabilities in geoelectric monitoring, we have developed algorithms firstly for filtering data outliers and secondly for accurately evaluating data reliability. The main functions are listed as:

- automatic evaluation of electrode status and filtering of the data associated to bad electrodes,
- filtering of anomalous data,
- time-series data filtering,
- interactive and graphical editing, and
- automatic evaluation of data reliability.

The filtering and editing methods are designed to provide the data with high S/N ratio to actual inversion process, while the evaluated reliabilities are to weight the data actually used in inversion according to their reliabilities. The data and parameters used for filtering and reliability assessment are not only usual ones measured in an ERT survey such as potential differences, injected currents, resistances, etc., but also the parameter values estimated from analysis of full time-series curves of injected current and sensed potential, e.g., S/N ratio, standard deviation of resistance, representative slopes of time-series curves, etc.

To easily implement the functions, two programs have been encoded: the first is to investigate and analyze a data set of a particular time-lapse in detail, while the second is to examine the 4-dimensional data on the whole and to process them along the time axis. Particularly addressed is to make various kinds of filtering (except graphical editing) and data quality evaluations automatic so that little efforts and time would be spent in pre-inversion stage. In addition to this, data weighting factors are always automatically evaluated taking account of the statistics of the measured data so that we are able to reconstruct more reliable and enhanced subsurface images as well as their changes in time.

The performance and effectiveness of the developed algorithm is examined and demonstrated with the field data monitored at the Gresten site, Austria.

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