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Nonlinear Inversion of Resistivity Sounding Data for 1-D Earth Models Using the Neighbourhood Algorithm

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Abstract

To reduce ambiguity related to nonlinearities in the resistivity model-data relationships, an efficient direct-search scheme employing the Neighbourhood Algorithm (NA) was implemented to solve the 1-D resistivity problem. In addition to finding a range of best-fit models which are more likely to be global minimums, this method investigates the entire multi-dimensional model space and provides additional information about the posterior model covariance matrix, marginal probability density function and an ensemble of acceptable models. This provides new insights into how well the model parameters are constrained and make assessing trade-offs between them possible, thus avoiding some common interpretation pitfalls. The efficacy of the newly developed program is tested by inverting both synthetic (noisy and noise-free) data and field data from other authors employing different inversion methods so as to provide a good base for comparative performance. In all cases, the inverted model parameters were in good agreement with the true and recovered model parameters from other methods and remarkably correlate with the available borehole litho-log and known geology for the field dataset. The NA method has proven to be useful whilst a good starting model is not available and the reduced number of unknowns in the 1-D resistivity inverse problem makes it an attractive alternative to the linearized methods. Hence, it is concluded that the newly developed program offers an excellent complementary tool for the global inversion of the layered resistivity structure.

Keywords: Geoelectrical Sounding; Neighbourhood Algorithm; VES; Schlumberger Array; Electrical Resistivity.