TECHNICAL REPORT ON AUTOMATIC DATA CORRECTION

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Noise contamination is a commonly encountered issue in electrical resistivity surveys. Such noise can undermine the reliability of resistivity models derived from the survey; therefore, data correction is essential prior to the inversion process. This report presents an automated data-improvement approach and compares its performance with conventional data-improvement methods through validation against borehole data at the test site (Figure 1).

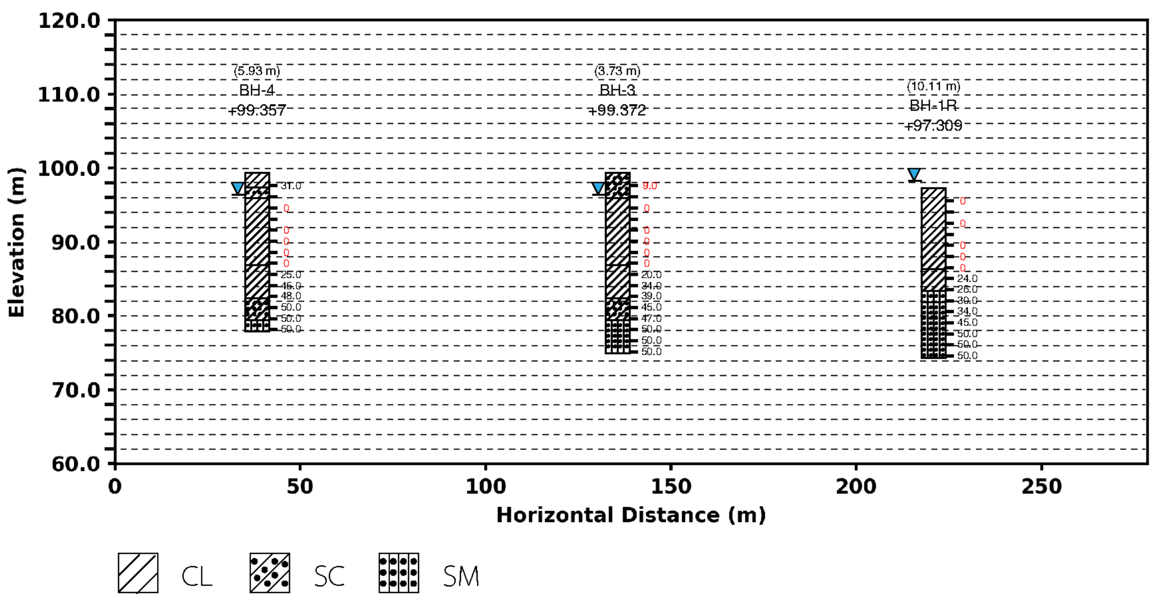

Figure 1 Borehole data at the test site. Symbols denote soil types, and blue arrows indicate the groundwater level in each borehole at the time of drilling.

1.11.1 APPARENT RESISTIVITY DATA

The raw dataset used in this test was acquired from a riverbank protection and landscape-improvement project along Khlong Prem Prachakorn, Suan Prik Thai Subdistrict, Mueang Pathum Thani District, Pathum Thani Province. The survey employed a Reciprocal Schlumberger electrode configuration (Figure 2a). The data quality is evidently poor, exhibiting numerous abrupt jumps over the 0–150 m interval. A standard approach for correcting this type of dataset is to filter out measurements whose standard deviation exceeds a prescribed threshold; for example, excluding data with a standard deviation greater than 3 (Figure 2b). In this case, the number of data points decreases from 1,311 to

1,032, resulting in substantial data loss within the 0–150 m interval. Excessive data removal may adversely affect the reliability of the model in this interval. When data removal is undesirable, the use of the instrument-provided despike procedure may be considered. In this study, the raw data were processed using the Despike function in PROSYS II. After despiking (Figure 2c), the magnitude of data jumps decreases; however, some seemingly normal data are also modified. The proposed automated data-correction method leverages model response information to score the raw measurements. Subsequently, the raw data are corrected by averaging in logarithmic space to obtain representative values, and the assigned uncertainty is rescaled from 1% to 10%. This procedure iteratively starts with the lowest-quality measurements and continues until a specified criterion is satisfied. The resulting dataset from the automated correction (Figure 2d) shows markedly reduced data jumps, and most deep red data points within the 0–150 m interval are nearly eliminated.

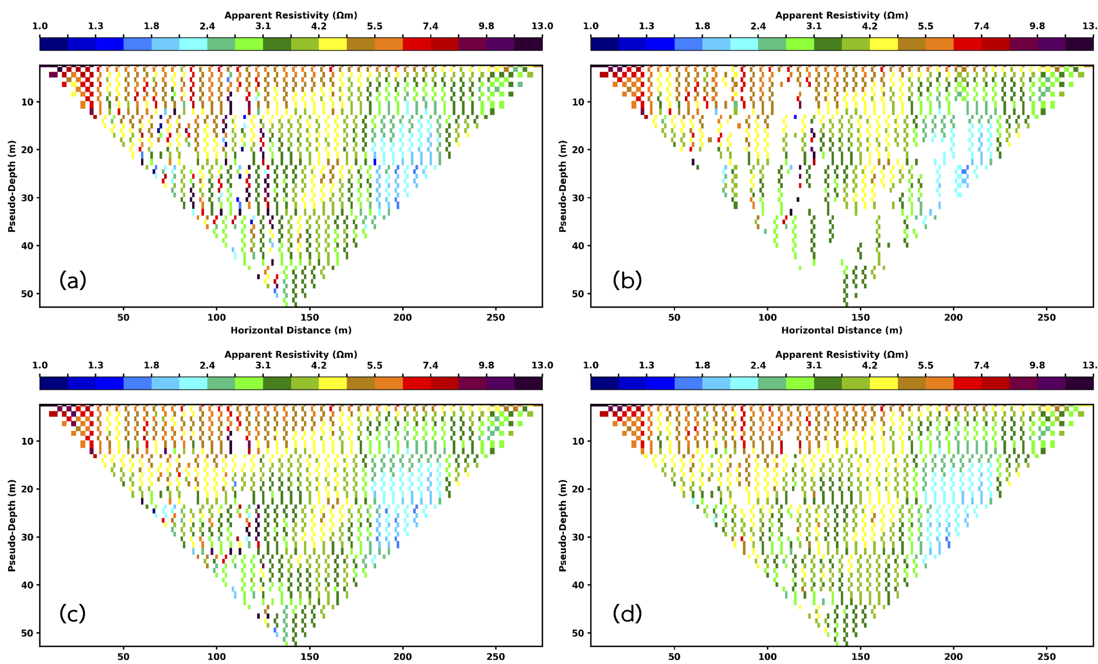

Figure 2 Apparent resistivity data from the riverbank protection and landscape-improvement site along Khlong Prem Prachakorn, Suan Prik Thai Subdistrict, Mueang Pathum Thani District, Pathum Thani Province, acquired using the Reciprocal Schlumberger array: (a) raw data; (b) data filtered using a standard deviation threshold of < 3; (c) data processed by the PROSYS II Despike routine; and (d) data processed by the proposed automated correction procedure.

1.21.2 RESISTIVITY MODELS

The apparent resistivity data were processed using DGS-INV2DERT with an identical parameter set for all cases. In addition, the data were also processed using RES2DINV to benchmark the resulting resistivity models. All models are presented together with the borehole data for comparison.

For the raw dataset (Figure 2a), the model obtained from DGS-INV2DERT yields an RMS misfit of 32.92 (Figure 3a), whereas the model obtained from RES2DINV yields an RMS misfit of 32.59 (Figure 3b). The two models are similar at shallow depths but differ substantially at greater depths, particularly beyond 125 m. Comparison with the borehole logs indicates that Borehole BH-4, located at electrode 9, shows no discernible correspondence between stratigraphy and resistivity. For Borehole BH-3, located between electrodes 28 and 29, both models exhibit a decrease in resistivity upon entering the very stiff soil layer; however, upon entering the very dense sand layer, only the RES2DINV result indicates a tendency for resistivity to decrease. Borehole BH-1R, located between electrodes 45 and 46, similarly shows no clear correspondence between stratigraphy and resistivity.

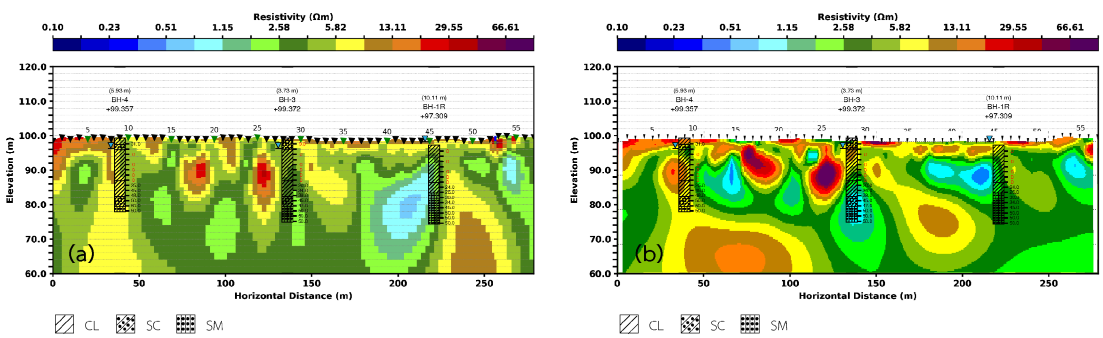

Figure 3 Resistivity models for the raw data: (a) model from DGS-INV2DERT with an RMS misfit of 32.92; and (b) model from RES2DINV with an RMS misfit of 32.59.

For the dataset filtered using a standard deviation threshold of < 3 (Figure 2b), the model obtained from DGS-INV2DERT yields an RMS misfit of 15.55 (Figure 4a), whereas the model obtained from RES2DINV yields an RMS misfit of 15.33 (Figure 4b). The two models exhibit improved agreement; however, no correspondence is observed between the borehole logs of BH-4 and BH-1R and the resistivity variations. For BH-3, the DGS-INV2DERT model begins to show a resistivity decrease upon entering the very dense sand layer, although the trend is less distinct than that observed in the RES2DINV model.

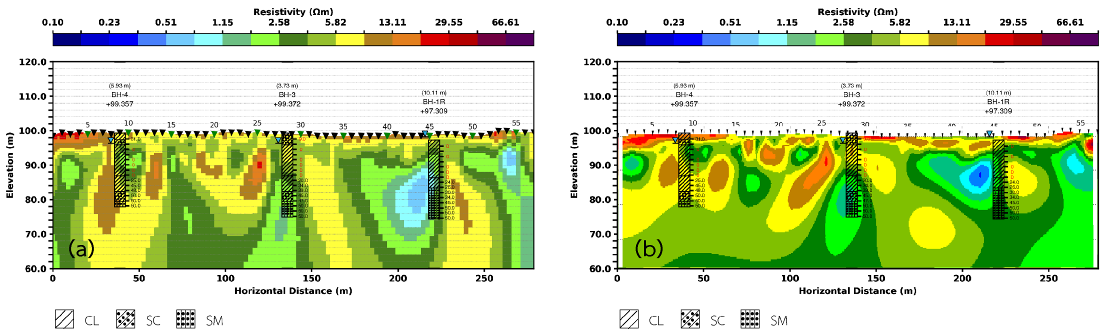

Figure 4 Resistivity models for the dataset filtered using a standard deviation threshold of < 3: (a) model from DGS-INV2DERT with an RMS misfit of 15.55; and (b) model from RES2DINV with an RMS misfit of 15.33.

For the dataset processed by Despike (Figure 2c), the model obtained from DGS-INV2DERT yields an RMS misfit of 20.91 (Figure 5a), whereas the model obtained from RES2DINV yields an RMS misfit of 20.60 (Figure 5b). Both models tend to resemble the raw-data case, but they differ markedly from the raw case within the 0–150 m interval. In this interval, a relationship begins to emerge between the stratigraphic transition in BH-4 from soft soil to very stiff soil and an increase in resistivity. Concurrently, the DGS-INV2DERT model indicates a decrease in resistivity upon entering the very dense sand layer in BH-3, consistent with the trend observed in the RES2DINV result.

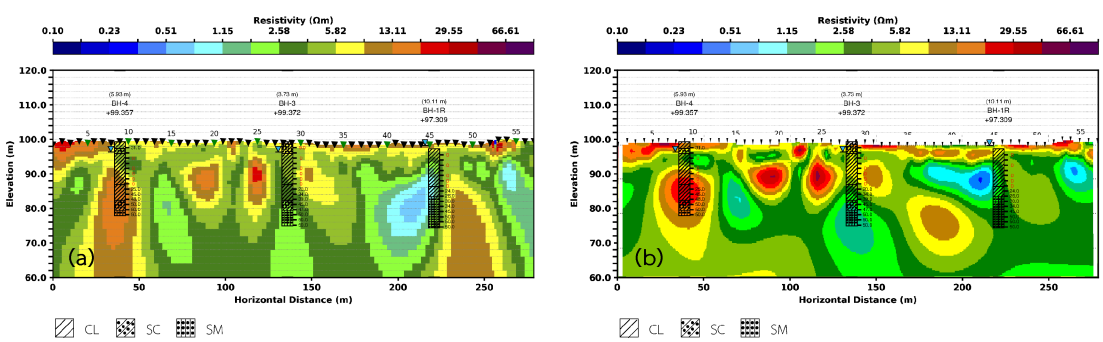

Figure 5 Resistivity models for the dataset processed by Despike: (a) model from DGS-INV2DERT with an RMS misfit of 20.91; and (b) model from RES2DINV with an RMS misfit of 20.60.

For the dataset processed by the proposed automated correction (Figure 2d), the model obtained from DGS-INV2DERT yields an RMS misfit of 4.4 (Figure 6). The resulting model is broadly similar to the Despike case; however, the resistivity contrast associated with the transition from soft to very stiff soil observed in BH-4 is more consistent. Nevertheless, the model does not clearly indicate a resistivity change upon entering the very stiff soil layer in BH-3.

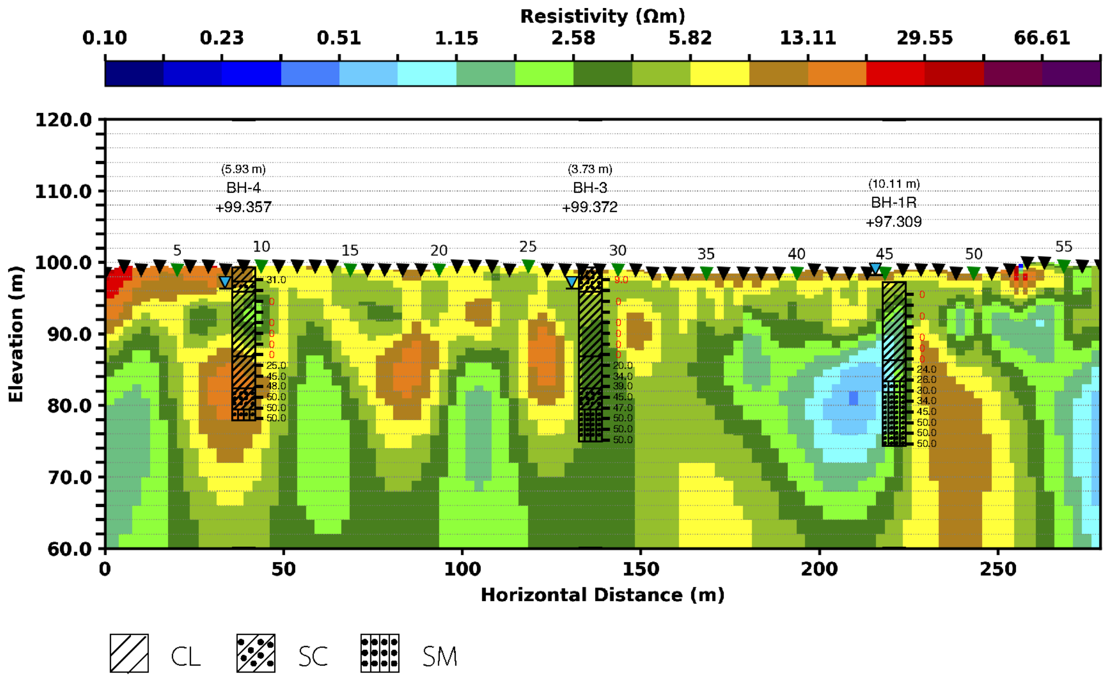

Figure 6 Resistivity model for the dataset processed by the proposed automated correction, produced by DGS-INV2DERT with an RMS misfit of 4.4.

1.31.3 SUMMARY OF TEST RESULTS

The results indicate that the models obtained after data improvement—both for the Despike procedure and for the proposed automated correction—exhibit broadly consistent trends. This contrasts markedly with the case in which data were filtered using a standard deviation threshold of < 3, which likely reflects the removal of a large number of measurements and the consequent loss of constraints that guide model evolution. When compared with the borehole logs, the improved-data models show better consistency with the drilling results.

The automated correction procedure produces data that are more internally consistent than those processed by Despike, resulting in an RMS misfit of 4.4, which is substantially lower than the RMS misfit of 20.91 obtained for the Despike case. If the RMS misfit alone is considered, the automated correction would be regarded as more reliable. Furthermore, when the borehole data are incorporated, the model variations are found to be more consistent with changes in stratigraphy observed in the boreholes.