Electrical resistivity tomography image enhancement using neural network

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SUMMARY

The development of neural networks is gradually improving in recent years. It shows excellent performance in data pattern learning for several applications. Several types of neural networks are successful in image processing. This work applies the neural network to enhance subsurface resistivity tomography images given by a geophysical prospecting method called the direct-current resistivity (DCR) method.

The resistivity tomography images or resistivity models from the inversion process of the direct-current resistivity (DCR) method are mostly vague, requiring professional analysis to deduce the appropriated models of the subsurface. A framework of image enhancement using a neural network, ResEN, is constructed to reduce professional biases and increase the resolution in the interpretation process of DCR.

The data used in the neural network are synthetic resistivity models and their corresponding inverted models. Resistivity models from the inversion process are computed by reliable software. Several validation cases are tested to show the enhancement ability of the developed framework using a neural network architecture. The results show that the framework can improve over 90 percent of inverted models in validating data. The framework is also tested with our developed straightforward data-driven inversion and commercial software with edge enhancement feature. Results show that the developed algorithm gives a reasonable accuracy in recovering true resistivity models compared to those approaches. The developed algorithm shows the ability to resolve the ambiguity problem of the resistivity distribution from the DCR method for various structures depending on the training set of the data.

Keywords: Neural network, Direct-current resistivity survey, Image processing