Unstructured Grid based Fuzzy Cooperative Resistivity Tomography for Electrical and Electromagnetic data

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There are many inversion algorithms that have been developed in the literature to obtain the resistivity distribution of the subsurface. Recovered resistivity values are usually lower/higher than the actual resistivity as a consequence of the inversion algorithms. As a consequence, identification of geologic units based on resistivity distribution can be done on a relative scale. In general, identification of different geologic units is a post step inversion process based on resistivity distribution in the study region. I have presented a technique to enhance the resistivity image using cooperative inversion (named as fuzzy cooperative resistivity tomography) where two additional input parameters are added as the number of geologic units in the model (i.e. number of cluster) and the cluster center values of the geologic units (mean resistivity value of each geologic unit). Fuzzy cooperative resistivity tomography fulfills three needs: (1) to obtain a resistivity model which will satisfy the fitting between measured and modeled data, (2) the recovered resistivity model will be guided by additional a priori parametric information, and (3) resistivity distribution and geologic separation will be accomplished simultaneously (i.e. no post inversion step will be needed). Fuzzy cooperative resistivity tomography is based on fuzzy c-means clustering technique which is an unsupervised machine learning algorithm. The highest membership value which is a direct outcome from the FCRT corresponds to a geology separation result. To obtain a geology separation result, I adopted the defuzzification method to assign a single geologic unit for each model cell based on the membership values. Various synthetic and field example data show that FCRT is an effective approach to differentiate between various geologic units. However, I have also noted that this approach is only effective when measured data sets are sensitive to particular geologic units. This is the limitation of the presented FCRT.