Abstract

The thesis deals with development of a fast imaging technique for the interpretation of very low frequency electromagnetic data. Further, development is also made to enhance the quality of the resistivity image using cooperative and joint inversion for electrical and plane wave electromagnetic data. First, a fast imaging technique was developed for interpretation of very low frequency electromagnetic data. The results of the presented approach were compared with different qualitative and quantitative interpretation approaches. The results of the presented approach were closer to the results of rigorous resistivity inversion (which is the best); they were improved with respect to the images obtained using filtering techniques. As for as computation time is concerned, the presented approach is very fast due to the analytical expression used in comparison to resistivity imaging using numerical techniques. Second, the developed imaging technique was generalized for data measured over variable topography. To depict the topography accurately, octree mesh discretization was incorporated. The conjugate gradient method was utilized to reduce the computation time and memory. Synthetic and field data with and without topography were interpreted to assess the suitability of the developed approach. Third, an inversion technique (termed "fuzzy cooperative resistivity tomography") was developed to enhance the resistivity image using cooperative inversion by utilizing fuzzy c means clustering. Two additional second types of observed input data were utilized to enhance the quality of the imaging. The presented inversion algorithm optimizes the resistivity distribution and geologic separation results simultaneously so that no post-inversion step will be needed since the recovered resistivity model is guided by additional a priori parametric information. Thus, recovered resistivity model is found to be more reliable than the recovered resistivity model obtained from the conventional inversion technique which only satisfies the fitting between observed data. The algorithm was tested on various synthetic and field data sets. Lastly, a joint clustering inversion algorithm of direct current resistivity and gravity data was developed to enhance the quality of resistivity imaging with application to mineral exploration. A fuzzy c means clustering procedure was used to establish the relationship between density and resistivity. The results showed that jointly inverted resistivity and density images were better compared to individual inverted models.

Keywords: *Electrical and electromagnetic methods*; *Resistivity; Inversion*; *Cooperative and joint inversion; Fuzzy c means clustering; geologic units*.