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基于Tikhonov正则化的双频电磁波电导率成像反演

王文娟[1,2],潘克家[2], 曹俊兴[1,2*], 谭永基[2]

1 成都理工大学油气藏地质及开发工程国家重点实验室，地球探测与信息技术教育部重点实验室，成都 610059

2 复旦大学数学科学学院，上海 200433

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摘要 本文将Tikhonov正则化方法与active-set算法相结合，利用双频电磁波电导率成像原理，求解其反演成像方程.不仅对现有算法进行了改进，也促进了算法的实际应用.本文研究了在双频电磁波电导率成像方程建立后，如何根据其严重病态性质，选择合适的算法求解矩阵成像方程.针对电导率非负的特性，引入正则化参数，将问题转化为一个非负最小二乘问题，并用active-set算法求解.采用改进后的迭代算法对理论模型进行了数值模拟计算，验证了该方法的有效性.应用到实际电导率成像反演，与常规的LSQR、SP-LSQR、Tikhonov正则化等算法进行比较，取得了满意的结果.

关键词 电导率成像 线性反演 不适定方程 正则化参数

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Electrical conductivity imaging using dual-frequency EM data based on Tikhonov regularization

WANG Wen-Juan[1,2], PAN Ke-Jia[2], CAO Jun-Xing[1,2*], TAN Yong-Ji[2]

1 State Laboratory of Oil/Gas Reservoir Geology and Exploitation, Key Lab of Earth Exploration &Information Techniques of Ministry of Education, Chengdu University of Technology, Chengdu 610059, China

2 School of Mathematical Sciences, Fudan University, Shanghai 200433, China

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Abstract Using a combination of Tikhonov regularization and active-set method, this paper introduces an algorithm to numerically resolve electrical conductivity imaging equation using dual-frequency EM data, so that we develop not only the existing algorithms, but also its implementation. The linear-equation system, however, generated from dual-frequency electrical conductivity imaging, is exceedingly ill-posed, and this paper just focuses on its resolution. Considering the non-negativity of the electrical conductivity, we introduce a proper regularization parameter to reduce the problem to a non-negative least square problem, and then solve it with active-set algorithm. Afterwards some numerical examples are carried out to test the validity of the proposed method. And finally, we implement it to the actual inversion problem of conductivity imaging using dual-frequency EM data, and gain satisfactory results compared to normal methods such as LSQR, SP-LSQR and shear Tikhonov regularization.

Key words Electrical conductivity imaging; Linear inversion; Ill-posed equation; Regularization parameter

通讯作者:
曹俊兴 caojx@cdut.edu.cn
作者个人主页: 王文娟[1;2];潘克家[2]; 曹俊兴[1;2*]; 谭永基[2]