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水平层状非均质横向同性地层中阵列多分量感应测井响应的快速计算

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Fast algorithm of responses of array multicomponent induction logging tool in horizontally stratified inhomogeneous TI media

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摘要

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摘要 应用模式匹配算法研究建立水平层状非均质横向同性地层中多分量感应测井响应的快速算法. 首先, 利用Fourier级数展开法将多分量感应响应的数值模拟转化为三个轴对称问题, 并利用电阻率径向导数的奇异表达式, 引入两个附加奇异微分算子, 用于描述柱状分界面上的积累面电荷对共面线圈系电磁响应的影响. 然后通过模式匹配算法求解轴对称问题, 得到水平层状非均质横向同性地层中多分量感应磁场的半解析解以及测井响应计算方法, 最后通过数值模拟结果对该算法进行检验并进一步考察阵列多分量感应仪器的响应特征.

关键词 层状非均质各向异性地层, 阵列多分量感应响应, 快速算法, 奇异微分算子

Abstract: In this paper, we present a fast algorithm of the responses of an array multicomponent induction logging (AMCIL) tool in horizontally stratified inhomogeneous TI media by numerical matching mode method (NMM). The computation of the AMCIL responses is transformed into three axially symmetrical problems about the EM fields by means of the Fourier series expanding. On base of the singularities of the derivatives of conductivity functions with respect to the radial distance, we derive the two extra singular differential operators about the EM fields. The operators describe the influence of the accumulation surface charges at cylindrical interfaces on the EM fields excited by the coplanar coil system. The NMM is used to fast simulate the axially symmetrical problems, and obtain the semianalytic solutions of the EM fields excited by the triaxial transmitter in the inhomogeneous TI media. Then, the method is given to compute the MCIL responses. Finally, numerical results validate the algorithm and further investigate the response characteristic of AMCIL.

Keywords Horizontally stratified inhomogeneous TI media, An array multicomponent induction logging (AMCIL) tool, Fast algorithm, Singular differential operators

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