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# 用最小二乘两步迭代法求解磁性球体几何与磁性参数

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## Applying two-step iterative least square approach to determine the geometry and physical parameters of magnetic sphere sources

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**摘要** 通过对常规最小二乘法在求解磁性球体参数过程中产生发散解的原因分析表明:非线性方程组中待定参数过多,特别是角度参数,是影响最小二乘法收敛性的主要因素.为此,提出将磁异常三分量作为观测值,用矢量磁矩作为待定参数,以替代磁化强度磁倾角和磁偏角,从而消除了非线性观测方程中的角度参数影响.根据观测值与磁矩的线性关系以及磁性球体中心位置的非线性关系,采用最小二乘两步迭代法对磁性球体几何与磁性参数进行分步求解,使得在利用最小二乘法时仅含有3个未知参数,大大减少了参数的维数.理论模型推导过程中,顾及了地磁背景场影响和多磁性体情况,给出了相应的数据处理方法.通过实测数据验证表明:提出的方法是收敛的,能达到很高的磁性体几何及磁性参数精度.

**关键词:** 磁性体 最小二乘法 非线性问题 球体磁场模型

Abstract: Through the causation analysis of divergent solution in determining the magnetic sphere parameters with normal least square method, the result indicates that redundant parameters, especially the angle parameters, in non-linear equations are the main factor to affect the convergence. Therefore, an approach was proposed here to eliminate the influence of angle parameters by regarding the magnetic anomaly components as observed values and substituting magnetic moment vector for magnetic inclination as well as magnetic declination. Based on the linear/non-linear relationship between observed value and magnetic moment/ center position, the geometry and physical parameters of magnetic sources could be precisely figured out by applying two-step iterative least square approach. In the calculation process of non-linear least square, there are only three unknown parameters, so the parameter dimensions were reduced extremely. Considering the influence of background field and multi-sources situation, corresponding data processing methods were also put forward. The effectiveness of the suggested techniques has been illustrated by real magnetic data from a collection of environmental ferro-metallic objects. The conclusion shows that the presented approach is convergent and the calculated geometry together with physical parameters has very high precision.

Keywords: Magnetic source Least square method Non-linear problem Sphere magnetic model

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