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重磁位场转换计算中迭代法的综合分析与研究

姚长利, 李宏伟, 郑元满, 孟小红, 张聿文*

1. 地下信息探测技术与仪器教育部重点实验室和地质过程与矿产资源国家重点实验室, 北京　100083;
2. 中国地质大学(北京)地球物理与信息技术学院, 北京　100083

Research on iteration method using in potential field transformations

YAO Chang-Li, LI Hong-Wei, ZHENG Yuan-Man, MENG Xiao-Hong, ZHANG Yu-Wen*

1. Key Laboratory of Geo-detection (China University of Geosciences, Beijing), Ministry of Education, Beijing 100083, China State Key Laboratory of Geological Processes and Mineral Resources, Beijing 100083, China;
2. School of Geophysics and Information Technology, China University of Geosciences, Beijing 100083, China

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摘要 处理转换计算在重磁资料解释中发挥着重要的作用,但一些计算如向下延拓、化极等有时是很不稳定的,在频率域中则表现为其转换因子具有明显的放大作用,所以其FFT理论计算结果是不稳定的.因此,很多研究工作都是围绕增加计算的稳定性、提高计算效果进行的,其中迭代法是近来在研究中受到普遍重视的方法技术,并取得了较好的成果.但也存在对迭代法研究还不够深入,对其存在的缺点认识不够充分、客观等问题,例如,迭代法进行延拓及化极等计算时,对一些具体应用虽能在一定程度上获得较好的计算结果,但却存在计算结果并不会随着迭代次数的增加而得到持续改善的问题,对于原本不稳定的计算,迭代法在迭代次数比较大时,所得的结果依然是不稳定的.为此,本文在对迭代法进行分析研究的基础上,进一步推导了迭代法的通式,并分析了对迭代法收敛性影响的各种因素.分析结果表明:迭代法收敛到FFT理论直接计算结果的决定因素是计算过程中如何选择原始数据到目标数据的映射函数;在选择了合适的映射函数的情况下,迭代次数不仅仅是决定计算成本,而是决定结果好坏的关键因素;增加迭代次数虽然能够使计算收敛到FFT直接计算理论结果,但如果该理论结果本身就是不稳定的,则迭代法计算如果收敛,也是收敛到一个不稳定的结果.所以针对位场处理转换中一些不稳定计算采用迭代法,并没有从根本上解决计算的不稳定性问题.

关键词 位场转换, 迭代法, FFT直接转换, 收敛性, 收敛条件

Abstract：Data processing and transformations play an important role in the interpretations of gravity and magnetic data, but some calculations, such as downward continuation, reduction to the pole of magnetic anomalies and so on, are unstable at times, because their transformation factors generally have a significant amplifying effect, so that the results obtained directly from FFT are unstable. Many studies are focused on increasing the stability and the effectiveness of the calculations, one of which is iterative method which has achieved good results and has recently received wide attention. But the study of iterative problem is not deep enough, and obviously there exists a lack of awareness of its shortcomings fully. In this paper, the general iterative formula is deduced based on an analytical study of the iterative method, and convergence effect of various factors on the iteration are analyzed. The results show that the main factor which determinants whether the iteration methods will convergence to the FFT theoretical results is how to choose the mapping function from the raw data to the target data, and in the case of a suitable mapping function chosen, the number of iteration in calculation is not just a cost, but is a key factor in determining the outcome good or bad. But if the FFT theoretical calculation of the transformation is unstable, the iteration will converge to an unstable result. So the iteration method can't fundamentally resolve the instability of an unstable.

Keywords Potential field transformation, Iteration method, FFT transformation, Convergence, Condition of convergence

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About author: 姚长利,男,1965年生,教授,主要从事重磁勘探方法技术研究.E-mail:clyao@cugb.edu.cn

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