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基于广义S变换的大地电磁测深数据处理

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Magnetotelluric sounding data processing based on generalized S transformation

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摘要

S变换是一种优于短时傅里叶变换和小波变换的时频分析方法.采用广义S变换进行大地电磁场时间序列频谱分析,一方面能够提高对电磁噪声成分的时间定位能力,便于实现电磁噪声的滤波处理;另一方面可以增加频谱系数的个数,从而改善大地电磁阻抗张量元素的统计特性.本文从广义S变换和大地电磁测深数据处理方法的原理出发,给出了采用叠加窗函数的离散广义S变换形式,讨论了广义S变换窗口宽度比例因子、窗口宽度与可提取频谱系数个数之间的关系,定义了利用离散广义S变换时频谱计算大地电磁场分量功率谱公式;在此基础上,研究了基于S变换时谱频的大地电磁测深数据ROBUST处理方法.最后,通过实测资料进行方法检验,结果表明本文方法比短时傅里叶变换处理效果更好,并且有利于识别和压制电磁噪声.

关键词 S变换, 大地电磁资料处理, 谱估计, 阻抗张量

Abstract：

S transform is one of the methods for signal time-frequency analysis, which is better than short-time Fourier transform and wavelet transform. There exist two advantages by using S transform method to analyze Magnetotelluric(MT) field time series. On one hand, the method can locate electromagnetic noise accurately in the MT data and facilitate the design of time-frequency filter. On the other hand, the method can improve the statistical properties of the power spectrum by getting more spectrum coefficients. According to the principle of generalized S transform and MT sounding data processing method, the formula of discrete generalized S transform (DGST) with folded window is proposed, the relationship is discussed among scaling factor of DGST and sampling interval and the number of spectrum coefficient, expression of average spectrum density of electromagnetic component is defined using DGST time-frequency spectrum. Through the theoretical research, The ROBUST method and program of MT sounding data processing are developed by using of S transform time-frequency spectrum. Field data is processed using the developed program and the results demonstrate that MT data processing method based on S transform method is effective and superior to one based on short-time window Fourier transform and contributes to identify and suppress electromagnetic noise.

Keywords S transform, Magnetotelluric data processing, Spectrum estimation, Impedance tensor