地球物理学报 2004, 47(4) 707-717 DOI: ISSN: 0001-5733 CN: 11-2074/P

论文

利用地质规则块体建模方法的频率域有限元弹性波速度反演

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摘要： 在频率域弹性波有限元正演方程的基础上，依据匹配函数（也就是观测数据和正演数据残差的二次范数）最小的准则，用矩阵压缩存储与LU分解技术来存储和求解频率域正演方程中的大型稀疏复系数矩阵、用可调阻尼因子的Levenberg Marquard方法求解反演方程组，直接求取地下介质的弹性波速度，导出了频率域弹性波有限元最小二乘反演算法. 为了利用地下地质体的分布规律，减少反演所求的未知数个数，本文又提出了规则地质块体建模方法引入到反演中来. 经数值模型验证，在噪声干扰很大（噪声达到50嗸）或初始模型与真实模型相差很大的情况下，反演也能取得很满意的效果，证明本方法具有很好的抗噪性与“强壮性”.

关键词： 频率域 弹性波 有限元 反演 矩阵压缩存储 LU分解技术 Levenberg Marquard方法 地质规则块体建模方法

Frequency domain finite element inversion of elastic wave velocity using the geological regular blocky model method

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Abstract: In order to obtain the elastic velocity of subsurface media directly, this paper derives a frequency domain elastic wave finite element least squares inversion method according to the criterion of minimizing the misfit function (the l2 norm of the data residuals between observational data and modeling data) on the basis of the frequency domain elastic wave finite element modeling equation. This inversion method includes the matrix compressional storage and LU decomposition techniques to save and solve the large sparse complex valued coefficient matrix in frequency domain modeling equation. Then the Levenberg Marquard technique with an adjustable damping term is used to solve the inverse equation group. To sufficiently exploit subsurface geologic distribution features to decrease the number of inverse unknowns, this paper introduces the regular blocky model method into the inversion. Being verified by numerical models, this inversion method can obtain satisfied results using the shot profile contaminated with great random noise even up to 50嗸 or the initial model parameters that have much difference from the original model parameters, which proves the inversion is noise resistable and ‘robust’.

Keywords: Frequency domain Elastic wave Finite element Inversion Matrix compression al storage LU decomposition technique Levenberg Marquard technique Geologic regular blocky model method

收稿日期 2003-03-17 修回日期 2003-12-13 网络版发布日期

DOI:

基金项目:

通讯作者:

作者简介:

作者Email:

PDF Preview

参考文献：

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