地球物理学报 » 2011, Vol. 54 » Issue (8) :2072-2084
地球动力学★地震学★地磁学★地热学 最新目录 | 下期目录 | 过刊浏览 | 高级检索 << Previous Articles | Next Articles >>

引用本文:
兰海强, 刘佳, 白志明.VTI介质起伏地表地震波场模拟[J] 地球物理学报, 2011,V54(8): 2072-2084,DOI: 10.3969/j.issn.0001-5733.2011.08.014

LAN Hai-Qiang, LIU Jia, BAI Zhi-Ming.Wave-field simulation in VTI media with irregular free surface.Chinese J.Geophys. (in Chinese),2011,V54(8): 2072-2084,DOI: 10.3969/j.issn.0001-5733.2011.08.014

VTI介质起伏地表地震波场模拟

兰海强[1,2], 刘佳[1,2], 白志明[1]*

1. 中国科学院地质与地球物理研究所,岩石圈演化国家重点实验室,北京 100029;
2. 中国科学院研究生院,北京 100049

Wave-field simulation in VTI media with irregular free surface

LAN Hai-Qiang[1,2], LIU Jia[1,2], BAI Zhi-Ming[1]*

1. State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029,China;
2. Graduate School of Chinese Academy of Sciences, Beijing 100049,China

摘要 | 参考文献 | 相关文章

Download: PDF (833KB) HTML 1KB Export: BibTeX or EndNote (RIS) Supporting Info

摘要 起伏地表下地震波场模拟有助于解释主动源和被动源地震探测中穿过山脉和盆地的测线所获得的资料.然而传统的有限差分法处理起伏的自由边界比较困难,为了克服这一困难,我们将笛卡尔坐标系的各向异性介质弹性波方程和自由边界条件变换到曲线坐标系中,采用一种稳定的、显式的二阶精度有限差分方法离散(曲线坐标系)VTI介质中的弹性波方程;对地表自由边界条件处理时采用了一种修饰的差分算子来计算弹性波方程中的混合导数项在自由边界上的法向导数.兰姆问题的解析解与本文的数值解对比结果表明该方法可以有效地处理自由地表边界条件.模拟实例表明:起伏地表对地震波场有重要影响,各向异性导致弹性波波前形状复杂且具有明显的方向性.

关键词: 起伏地表 各向异性 曲线网格 波场模拟 有限差分

Abstract: Modeling of seismic wave propagation in anisotropic media with irregular topography is a powerful tool that may help to interpret seismic data acquired by active and passive source seismology conducted in areas of interest like mountain ranges and basins. The major challenge in this context is the numerical implementation of the free-surface boundary condition. To implement the free-surface boundary condition, we use the boundary-conforming grid and transform a rectangular grid onto a curved grid. We use a stable and explicit second-order finite difference scheme to discretize the elastic wave equations (in a curvilinear coordinate system) in heterogeneous anisotropic medium. The free-surface boundary conditions are numerically implemented by introducing a discretization that uses boundary-modified difference operators for the mixed derivatives in the governing equations. The accuracy of the proposed method is checked by comparing the numerical results obtained by the trial algorithm with the analytical solution of the Lamb's problem, for a transversely isotropic medium with a vertical symmetry axis. Efficiency tests performed by different numerical experiments illustrate clearly the influence of an irregular (non-flat) free surface on seismic wave propagation.

Keywords: Irregular free surface anisotropy Curvilinear grids Wave-field simulation Finite-difference

Received 2011-01-01;

Fund:

国家科技重大专项(2008ZX05008-006-4)、中国科学院知识创新工程重要方向项目(KZCX2-YW-I32)和国家自然科学基金(41074033)联合资助.

About author: 兰海强,男,1983年生,现为中国科学院地质与地球物理研究所博士研究生,主要从事复杂介质中地震波传播的数值模拟及地震资料处理的理论与方法等研究.E-mail:lanhq@mail.iggcas.ac.cn

链接本文:
http://www.geophy.cn/CN/10.3969/j.issn.0001-5733.2011.08.014 或 http://www.geophy.cn/CN/Y2011/V54/I8/2072