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贴体网格各向异性对坐标变换法求解起伏地表下地震初至波走时的影响

兰海强[1,2], 张智[3], 徐涛[1], 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;
3. 桂林理工大学地球科学学院, 广西地质工程中心区重点实验室, 桂林 541004

Effects due to the anisotropic stretching of the surface-fitting grid on the traveltime computation for irregular surface by the coordinate transforming method

LAN Hai-Qiang[1,2], ZHANG Zhi[3], XU Tao[1], 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;
3. Key Laboratory of Geological Engineering Centre of Guangxi Province, College of Earth Sciences, Guilin University of Technology, Guilin 541004, China

摘要 笛卡尔坐标系中的经典程函方程在静校正、叠前偏移、走时反演、地震定位、层析成像等很多地球物理工作中都有应用,然而用其计算起伏地表的地震波走时却比较困难.本文通过把曲线坐标系中的矩形网格映射到笛卡尔坐标系的贴体网格,推导出曲线坐标中的程函方程,而后,用Lax-Friedrichs快速扫描算法求解曲线坐标系的程函方程.研究表明本文方法能有效处理地表起伏的情况,得到准确稳定的计算结果.由于地表起伏,导致与之拟合的贴体网格在空间上的展布呈各向异性,且这种各向异性的强弱对坐标变换法求解地震初至波的走时具有重要影响.本文研究表明,随着贴体网格的各向异性增强,用坐标变换法求解地表起伏区域的走时计算误差增大,且计算效率降低,这在实际应用具有指导意义.

关键词 程函方程, 地震波走时, 起伏地表, 贴体网格, 各向异性

Abstract: The classical eikonal equation is commonly used in Cartesian coordinate system for problems that involve static correction, prestack migration, earthquake location and seismic tomography, but is less effective for calculating travel times in an earth model that has an irregular surface. We have presented a topography-dependent eikonal equation in a curvilinear coordinate system that makes use of the surface-fitting grid and map a rectangular grid onto a curved grid. Then, we utilized the efficient Lax-Friedrichs sweeping scheme to approximate the viscosity solutions of the eikonal equation in the curvilinear coordinate system. In this paper, we investigate the impacts due to the anisotropic stretching of the surface-fitting grid on the traveltime computation by using the topography-dependent eikonal equation, which has a significant meaning in the direction of our method in geophysical application.

Keywords Eikonal equation, Travel time, Topography, Surface-fitting grid, Anisotropy

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