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最短路径算法下三维层状介质中多次波追踪

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Multiple ray tracing within 3-D layered media with the shortest path method

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摘要

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摘要 本文使用改进后的最短路径算法(MSPM)结合分区多步计算技术实现了三维复杂层状起伏介质中的多次透射、反射及转换波波前传播的数值模拟,以及相应走时和射线路径的跟踪计算.其原理是将三维复杂层状模型按速度界面分成若干个独立的计算区域,采用分步计算技术进行多次波的跟踪计算.基于多次波是通过速度界面简单的入射、透射、反射及转换波按一定规律及原理的不同组合,因此可实施分区多步计算技术.数值模拟实例及误差分析表明分区多步计算技术具有单步最短路径算法中的诸多优点:算法简单、数值计算稳健、计算精度高、速度快及全球解等,因此是解决多次波跟踪计算行之有效的方法.

关键词 MSPM算法, 分区多步计算, 多波波前传播模拟, 多次波追踪

Abstract: The purpose of this study is to introduce a multistage scheme incorporating the modified shortest-path method (MSPM) for tracking multiple arrivals and simulating wavefront evolutions composed of any kind of combinations of transmissions, conversions and reflections in complex 3-D layered media. The principle is first to divide the layered model into several different computational domains, and then to use the multistage technique to trace the multiple arrivals. It is possible to realize the multiple arrival tracking with the multistage technique because the multiple arrivals are different combinations or conjugations of the simple incident, transmitted and reflected waves at the velocity boundaries (or discontinuities). Numerical tests and error analysis indicate that the multistage MSPM method retains the basic characteristics of the single-stage MSPM approach, that is algorithm simplicity, numerical stability, high computational accuracy, fast, global solution and etc. Therefore it is a practical algorithm to track the multiple arrivals.

Keywords MSPM algorithm, Multistage scheme, Multiple wavefront simulation, Multiple arrival tracing

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