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复杂介质地震定位中震源轨迹的计算

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摘要 在地震定位中常常需要求解震源轨迹，但由于复杂介质中的震源轨迹较为复杂，难以给出其解析解，因此震源轨迹的计算通常仅限于简单介质模型.本文基于最小走时树射线追踪技术，提出了一种计算复杂介质中震源轨迹的方法.为回避发震时间问题，以观测到时差作为震源轨迹的约束条件.首先从模型节点中选出少量理论到时差与观测到时差之绝对差，即双重时差较小的点作为震源轨迹的代表点，然后以其中双重时差最小的点为初始点，在双重时差场中利用最小走时树射线追踪方法计算出初始点到其他震源轨迹代表点的射线路径作为震源轨迹.当选的震源轨迹代表点较多时，得到的震源轨迹较为粗略，此时可去掉射线经过次数较少的代表点的射线路径使震源轨迹更为精细.为减少计算量，对最小走时树射线追踪方法的终止条件做了修正.以一个复杂介质模型中的地震为例，计算了包括速度扰动、到时扰动等不同情况下的震源轨迹，结果表明所提出的震源轨迹计算方法切实可行.

关键词 复杂介质 震源轨迹 地震定位 最小走时树算法

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Calculation of focal loci for earthquake location in complex media

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Abstract Focal loci are often required in earthquake location. However, it is extremely difficult to analytically express them when the earthquake lies in a complex model. Therefore, the calculation of focal loci is usually limited to simple media. In this paper, we present a method for calculating focal loci in complex media by means of a minimum traveltime tree algorithm for ray tracing. The focal loci are constrained with observed arrival time differences at seismic stations so that the problem of origin time is evaded. From all the model nodes, we select a small part with smaller absolute residuals between observed and calculated traveltime differences (or double-differences) as reference points of the focal locus. The reference point with minimum double difference is assigned as an initial point. The ray paths from the initial point to the other selected reference points in the double-difference field actually represent the focal locus, which are traced with a minimum traveltime tree algorithm. When the obtained focal locus is rather rough due to the excessive amount of selected reference points, it can be improved by removing some ray paths to the reference points that there are less rays going through. Additionally, the stop condition of the minimum traveltime tree algorithm is modified to reduce computational time. The results of numerical tests including velocity perturbations and noisy arrival data in a laterally heterogeneous model indicate that the presented method is feasible.

Key words Complex media; Focal loci; Earthquake location; Minimum traveltime tree algorithm

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