IMPROVEMENT OF ACCURACY OF REFLECTION TRAVEL TIMES WITH THE SHORTEST PATH METHOD

Aihua Zhao[1] and Zhongjie Zhang[2]

[1]Institute of Geophysics, China Earthquake Administration, China
[2]Institute of Geology and Geophysics, Chinese Academy of Sciences, China

The shortest path method for seismic ray tracing is based on Huygens' Principle and Fermat's principle. The method has excellent robustness and is suitable for calculating travel times and ray paths of waves in a complex velocity model. For convenience, the model is usually divided into regular elements, such as squares with the same size. Interfaces are approximately specified by their boundary model nodes. The approximation of interface nodes results in travel time errors, especially for reflected waves. Such travel time errors can be reduced by reducing model elements, at the cost of much computational time. In this study, we attempt to improve the accuracy of reflection travel times while decreasing the efficiency slightly.

In our scheme to improve the accuracy of reflection travel times, we calculate the travel time of a secondary wave to an interface node using the first order Taylor series approximation of the travel time function from its nearest boundary model node, which is called an interface reference node. The calculated arrival time at the interface node is recorded at the corresponding interface reference node. As for the calculation of seismic rays, interface reference nodes are replaced with the corresponding interface nodes. The modification of travel times and ray paths results in more accurate results. Furthermore, the amount of additional calculations associated with interface nodes is relatively small because the number of interface nodes, in general, is much less than that of the model nodes.

The work is supported by the National Natural Science Foundation of China (40674044, 40974050).