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Approxiamtely solving hypocentral locus equations for complex velocity models by linear interpolation

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The graphical method is one of classic location approaches. The location method locates an event using its hypocentral loci, and therefore has outstanding advantages such as visuality and robustness. However, its location accuracy is not high because it is usually based on homogeneous or laterally homogeneous models far from the real Earth. When the velocity structure is complex, hypocentral locus equations can hardly be solved analytically. In order to overcome the disadvantage of the graphical location approach, a numerical scheme is presented for solving hypocentral locus equations by linear interpolation.

The equation of a hypocentral locus is solved in the residual (between observed and calculated arrival time difference or arrival time) field. As for each model node, it is combined with its adjacent nodes differing from it in residual polarity (positive, zero, or negative) into node pairs. Among these node pairs, the one with maximum absolute gradient is referred to as a normal node pair. Assuming that the residual varies linearly from positive to negative between the two ends of a normal node pair, the zero point of the residual between the two end nodes is determined as a solution to the hypocentral locus equation by linear interpolation.

Numerical examples show that the presented method is adapted to complex velocity models and has no restrictions in the stability and the number of hypocentral locus segments. Compared with other approximate solutions, such as nodes with small absolute residuals or nodes of the elements traversed by the hypocentral locus, the ones determined by the interpolation method have much higher accuracy.

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