Application of seismic ray-tracing using the fast marching method for velocity structure expressed by irregular grid

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Seismic ray tracing is one of the method to analyse the seismic propagation phenomena which restricted in first arrival time. To solve the eikonal function in complex media,several methods have been developed. Generally, finite difference method is used to calculate the travel-time field by eikonal function in very complex velocity strucuture.The ray path can be retrieved by Eular method in travel time field.The fast marching method(FMM) is one of the eikonal solver in travel time field.FMM is extendible to irregular grid with triangle mesh in 2D or tetrahedral mesh in 3D.

FMM needs the queue to researve the grid as a narrow band in wave front in order to simulate the diffraction.We add the secondary queue to reduce the irregular-grid-specific error which is caused by obtuse edge angle in element.

We carried out the synthetic comparative examination between regular grid and irregular grid to asess the performance limitation in the accuracy, computational cost and the trade off between them.

The result revealed the advantage which is attributed to the irregularity of the grid.

FMM in regular grid needs much more grid to achieve the same accuracy as irregular grid even in simple velocity field. However the computational cost of FMM using irregular grid is more expensive than that using irregular one. i.e., FMM using regular grid with adequately number of grid is more practical.

Some restricted purpose might be considered to practical use with advantage of irregular grid. Application for seismic tomography using tetrahdral mesh is available. Furthermore, we are preparing the experiment in the velocity discontinuity which is hard for regular grid to express.