

IDO scheme for highly accurate computation of seismic wavefields: 2D SH case

koji Ohkawauchi[1]; Hiroshi Takenaka[1]

[1] Dept. Earth & Planet. Sci., Kyushu Univ.

We develop a new method for calculation of seismic wavefields using the interpolated differential operator (IDO, Aoki, 1997) which is a numerical method for solving partial differential equations, based on a highly accurate interpolation of the profile for the field quantities over a local area. It improves accuracy of the wave computation because the local interpolation can represent high-order behavior of the wavefields between grid points. In addition, locality of this approach makes possible the treatment of boundary conditions exactly. We have proposed a scheme for computation of plane-wave responses of vertically inhomogeneous structure models before (Ohkawauchi and Takenaka, 2006). Here we propose a scheme for calculation of 2D SH wave excited by a point source. The equations to be actually solved in our method are not only velocity-stress elastodynamic equations but also their integrated ones over each segment between the adjacent grid points. To solve them, we use two staggered-grid systems which can be non-uniform, and then discretize the equations using a finite-difference scheme of the second-order accuracy in time and the second-order Hermite interpolation in space. In this method the second-order Hermite interpolation of a particle velocity or a stress component at a specific point is obtained from the values at four corners (grid points) of the cell including the interpolation point and the integration values along two edges of the cell. The time marching of the original and the integrated field quantities are proceeded, and in the following time step the quantities are computed on the alternative grid system to that used in the current time step. In implementation of a free-surface boundary condition, all field quantities are located just on the free surface. We also implement the exact interface condition using double node grid for discontinuous components of stress on the interfaces. In the presentation we demonstrate the accuracy and feasibility of our method by some numerical examples as well as introduction of the schemes.