

Numerical Modeling of Heterogeneous Media for the Compressional Wave using High-Order Finite-Differences

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ABSTRACT

A numerical solution to the wave equation in heterogeneous acoustic media is presented. The differential equation for the compressional field is written in terms of spatial derivatives and derivative with respect to time. Initially, presents a general method for approximating the operator spatial differentials of second order. This approximation is calculated using the values of the field at a point P of the computational grid and its adjacent points according to the degree of approximation used. It was subsequently implemented in a computational algorithm where the initial conditions of the field of P are set; a seismic source is implemented; and the corresponding numeric scheme is developed. The temporal part of the derivatives is solved using a second order approximation through "centered" operators. In the spatial derivatives, different orders of approximation are used starting with a second order, fourth, sixth, eighth and tenth order, respectively. The conditions of stability and numerical dispersion are treated to prevent error growth exponentially and generation of numerical artifacts. The graphs of numerical dispersion for the different values for the passage of spatial and temporal mesh is presented. Finally the numerical solutions using different orders of approximation on simple geological models are compared.