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A modified symplectic PRK scheme for seismic wave modeling

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Abstract

A new scheme for the temporal discretization of the seismic wave equation is constructed based on symplectic geometric theory and a modified strategy. The ordinary differential equation in terms of time, which is obtained after spatial discretization via the spectral-element method, is transformed into a Hamiltonian system. A symplectic partitioned Runge-Kutta (PRK) scheme is used to solve the Hamiltonian system. A term related to the multiplication of the spatial discretization operator with the seismic wave velocity vector is added into the symplectic PRK scheme to create a modified symplectic PRK scheme. The symplectic coefficients of the new scheme are determined via Taylor series expansion. The positive coefficients of the scheme indicate that its long-term computational capability is more powerful than that of conventional symplectic schemes. An exhaustive theoretical analysis reveals that the new scheme is highly stable and has low numerical dispersion. The results of three numerical experiments demonstrate the high efficiency of this method for

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