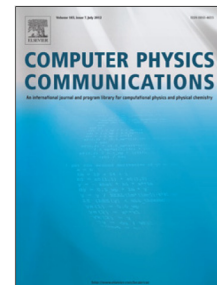


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Modified symplectic schemes with nearly-analytic discrete operators for acoustic wave simulations

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1 **Modified symplectic schemes with nearly-analytic discrete**
2 **operators for acoustic wave simulations**

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12

Abstract

13 Using a structure-preserving algorithm significantly increases the computational efficiency of

14 solving wave equations. However, only a few explicit symplectic schemes are available in the

15 literature, and the capabilities of these symplectic schemes have not been sufficiently

16 exploited. Here, we propose a modified strategy to construct explicit symplectic schemes for

17 time advance. The acoustic wave equation is transformed into a Hamiltonian system. The

18 classical symplectic partitioned Runge-Kutta (PRK) method is used for the temporal

19 discretization. Additional spatial differential terms are added to the PRK schemes to form the

20 modified symplectic methods and then two modified time-advancing symplectic methods

21 with all of positive symplectic coefficients are then constructed. The spatial differential

22 operators are approximated by nearly-analytic discrete (NAD) operators, and we call the fully

23 discretized scheme modified symplectic nearly-analytic discrete (MSNAD) method.

24 Theoretical analyses show that the MSNAD methods exhibit less numerical dispersion and

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