Geophysical Research Abstracts
Vol. 19, EGU2017-2811, 2017
EGU General Assembly 2017

Viscoelastic Waves Simulation in a Blocky Medium with Fluid-Saturated Interlayers Using High-Performance Computing

Vladimir Sadovskii and Oxana Sadovskaya

Institute of Computational Modeling SB RAS, Krasnoyarsk, Russian Federation (sadov@icm.krasn.ru, o_sadov@icm.krasn.ru)

A thermodynamically consistent approach to the description of linear and nonlinear wave processes in a blocky medium, which consists of a large number of elastic blocks interacting with each other via pliant interlayers, is proposed. The mechanical properties of interlayers are defined by means of the rheological schemes of different levels of complexity. Elastic interaction between the blocks is considered in the framework of the linear elasticity theory [1]. The effects of viscoelastic shear in the interblock interlayers are taken into consideration using the Pointing–Thomson rheological scheme. The model of an elastic porous material is used in the interlayers, where the pores collapse if an abrupt compressive stress is applied. On the basis of the Biot equations for a fluid-saturated porous medium, a new mathematical model of a blocky medium is worked out, in which the interlayers provide a convective fluid motion due to the external perturbations. The collapse of pores is modeled within the generalized rheological approach, wherein the mechanical properties of a material are simulated using four rheological elements. Three of them are the traditional elastic, viscous and plastic elements, the fourth element is the so-called rigid contact [2], which is used to describe the behavior of materials with different resistance to tension and compression. Thermodynamic consistency of the equations in interlayers with the equations in blocks guarantees fulfillment of the energy conservation law for a blocky medium in a whole, i.e. kinetic and potential energy of the system is the sum of kinetic and potential energies of the blocks and interlayers. As a result of discretization of the equations of the model, robust computational algorithm is constructed, that is stable because of the thermodynamic consistency of the finite difference equations at a discrete level. The splitting method by the spatial variables and the Godunov gap decay scheme are used in the blocks, the dissipationless finite difference Ivanov scheme is applied in the interlayers. The parallel program is designed, using the MPI technology. By means of this software, nonlinear wave processes in the case of initial rotation of the central block in a rock mass as well as in the case of concentrated couple stress load, applied at the boundary of a rock mass, are analyzed. Results of computations on the multiprocessor computer systems demonstrate the strong anisotropy of a blocky medium.

This work was supported by the Complex Fundamental Research Program no. II.2P "Integration and Development" of Siberian Branch of the Russian Academy of Sciences.

References
1. Sadovskii V.M., Sadovskaya O.V. Modeling of Elastic Waves in a Blocky Medium Based on Equations of the Cosserat Continuum // Wave Motion. 2015. V. 52. P. 138–150.
2. Sadovskaya O., Sadovskii V. Mathematical Modeling in Mechanics of Granular Materials. Ser.: Advanced Structured Materials, V. 21. Heidelberg – New York – Dordrecht – London, Springer, 2012. 390 p.