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BOOK OF ABSTRACTS

ADVANCED PROBLEMS IN MECHANICS

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number Nuselt for $Rag/Rag* = 4$ accepts value 1. It testifies to substantial growth heat transfer caused by the vibrating mechanism of convection in comparison with a heat transfer caused by the gravitational mechanism. Work is executed at partial financial support of the Russian fund of basic researches and Department of education and a science of Perm area Administration (grant 04-02-96038) and Fund of the USA of civil researches and development for the independent states of former Soviet Union CRDF (grant PE–009-0).

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HEAT VIBRATIONAL CONVECTION IN PLANE LAYER SUBJECTED OSCILLATIONS OF SPATIAL PENDULUM

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Thermal vibrational convection of liquid with a homogeneous internal thermal emission in a cavity subject to oscillations of spherical pendulum is studied experimentally and theoretically. The cavity has the form of a parallelepiped and models a flat layer. The layer boundaries are perpendicular to the pendulum shoulder; the rotation of the cavity concerning the shoulder is absent. The center of the pendulum is located above the layer. During the oscillation the pendulum shoulder draws the conic surface, the center of the layer moves along the circular trajectory. The lower layer boundary is isothermal; its temperature is kept constant. The top boundary - adiabatic, its temperature is determined by the intensity of internal thermal emission. This temperature distribution corresponds to stable stratification of liquid in the gravity field. Experiments find out two thresholds of critical growth of heat transfer with increase of vibrations intensity. The first (under conditions of the experiment) threshold is connected with the instability of Stokes boundary layer and manifests itself in the occurrence of three-dimensional vortical structure located in the boundary layer. It is revealed that the given instability can be found in isothermal liquid as well at the presence of density heterogeneity connected, for example, with the presence of fine firm inclusions with different from the liquid density. The second threshold is connected with the development of thermal vibrational convection itself. Convection occupies all the layer volume and is determined by the combined action of various thermovibrational mechanisms [1]. In theoretical part of the work the conditions of excitation of pendular vibrational convection in flat layer with an internal thermal emission are examined on the basis of the equations [1]. The equations are received by the method of averaging in approximation of high dimensionless frequencies (negligibly thin Stokes boundary layers). The results of theoretical analysis are in good agreement with experimental ones.

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MD MODELING OF LOW-CYCLE HIGH-AMPLITUDE LOADING OF MONOCRYSTAL MATERIAL WITH DEFECTS

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Fracture under low-cycle high-amplitude loading of 2D monocrystal material with predefined distribution of defects is studied using molecular dynamics technique. Influence of density of vacancies, lattice orientation, loading amplitude, loading period, thermal motion and interaction characteristics on the material strength, fracture process and crack topology are analyzed.

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THE SECOND VARIATION OF THE ENERGY FUNCTIONAL THAT ALLOWS FOR PHASE TRANSITION AND INSTABILITY OF PHASE BOUNDARIES.

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Phase boundaries in the Continuum Mechanics are traditionally modeled as the surfaces of the jump discontinuities of strain. It is well-known that the continuity of traction and the Maxwell rule at the interface are the necessary conditions for its stability. In this work we apply a variational procedure, which takes into account a variation of the interface, and calculate the second variation of the energy functional. From its positivity we derive new necessary algebraic conditions of stability involving the derivatives of the potential up to the second order. In contrast with the previous works on stability based on additional physical assumptions, our results follow directly from the variational formulation of the problem.

RAYLEIGH WAVES IN THE ISOTROPIC AND LINEAR, REDUCED COSSERAT CONTINUUM

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We continue in this paper the work on the modeling of rocks and soils in terms of the linear, elastic, reduced Cosserat continuum. The reduced Cosserat continuum is a continuum where each point possesses rotational degrees of freedom. Furthermore, the medium resists to rotation as well as to translation, while the couple stress is zero. The stress tensor is asymmetric. The objective of the model is to take into account the mictrostructure of rocks and soils which influences wave propagation. It was first suggested by Shwartz, Johnson, and Feng in 1984 to describe

granular materials. Wave propagation in an unbounded 3D reduced Cosserat continuum was investigated by Grekova and Herman (2003–2005). In this work, we consider the Rayleigh wave for the isotropic case, using analytical and numerical methods. Instead of a straight line in the classical medium, we obtain two dispersion curves. The polarization differs both from the case of the classical medium and the case of a Cosserat continuum with couple stresses. For some frequency range, we observe a strong frequency dependence. There is a forbidden band of frequencies, lying below the analogous forbidden band for an unbounded medium. It indicates the possibility of localization phenomena. For the upper branch of the dispersion relation, there is also a forbidden domain of wave numbers: long waves may propagate only with one frequency. Far from the domain of frequencies where the microstructure influences the wave propagation, the medium behaves analogously to the classical one (as expected). We make a comparison with the classical medium and the Cosserat medium with couple stress for which the Rayleigh wave was investigated by Kulesh et al.

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SURFACE WAVES PROPAGATION IN COSSERAT CONTINUUM: CONSTRUCTION OF SOLUTION AND ANALYSIS USING WAVELET TRANSFORM

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The problem of the surface elastic wave propagation in a half-space and in a thin layer within the framework of the Cosserat medium has been considered. Medium deformation in this model is described not only by the displacement vector, but also by kinematically independent rotation vector. This model can be used for the description of the media with microstructure, for example concrete, sand, sandy-gravel mixture, soil etc.

At the same time the applications of these models almost do not exist in praxis, since there are no reliable data about the material properties in nonsymmetrical elasticity theory and in fact there are no experiments which can demonstrate the effects of couple-stress behavior in solid under deformation.

Main models of elastic waves propagation in medium with microstructure have been proposed in 50-60th. At that time many significant theoretical results have been obtained, for example the fact of Rayleigh waves dispersion. But the classical elasticity theory does not describe this effect.

The main result of presented work consists in fact, that within the framework of the Cosserat medium in the half-space besides elliptical Rayleigh wave can be in existence a shear surface wave with only transversal component. Geometrically such wave is equal to Love wave, but the existence of the Love wave as shear elastic wave is defined by presence of a layer on a half-space in classical elasticity theory, and while a layer thickness vanish the Love wave is transformed to a plane wave. The same situation we can observe in case of thin layer while besides Lamb wave can be in existence a dispersive shear wave with only transversal displacement component. Thus, in the Cosserat medium the new wave modes are found out, and there is no analogue of it in classical elasticity theory.

As a second result of presented work the method of the displacement seismogram inversion has been proposed. This method is based on continues wavelet transform and allows to restore the wave number, phase and group velocities from experimental displacement seismograms.

These results can be effectively used in possible experiments which are aimed at the detection of couple-stress effects in medium and further at the identification of material constants of nonsymmetrical elasticity theory.

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ON A VARIOUS MATHEMATICAL MODELS OF A SKATEBOARD MOTION

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In our presentation we propose several mathematical models describing the motion of the rider on a skateboard. The motion of all models is considered in assumption, that the rider control is absent. The equations of motion of each of models are derived in the form of Gibbs - Appell equations and the analysis of these equations is fulfilled. In particular, the effect of varying vehicle parameters on stability of its motion for each of models is studied.

In the present time skateboarding - the art of riding on a skateboard - is one of the most popular recreational sports. Millions of people take a great interest in a skateboarding. Nevertheless, the serious researches concerning dynamics and stability of a skateboard motion are almost absent. At the late 70th - early 80th of the last century Mont Hubbard in his papers [1,2] proposed several mathematical models describing the motion of a rider on a skateboard. However these works are written very briefly (in particular, the derivation of the equations of motion is omitted, the detailed analysis of the obtained equations is not fulfilled), that does not allow to understand the basic mathematical principles of a skateboard dynamics. In our presentation we give the further development of models offered by Hubbard.

Besides the investigations by Hubbard it is necessary to mention also the paper by Yu.G. Ispolov and B.A. Smolnikov [3] and the recent paper by M. Wisse and A.L. Schwab [4], devoted to study a various mathematical models of a skateboard motion. However the model, proposed in [3], is two-dimensional while in the papers [1,2] a more realistic three-dimensional models are studied. As regards the paper [4], it contains only the brief review of the main results obtained in [1,2]. Thus, we can consider the papers [1,2] as a keyworks on a skateboard dynamics.