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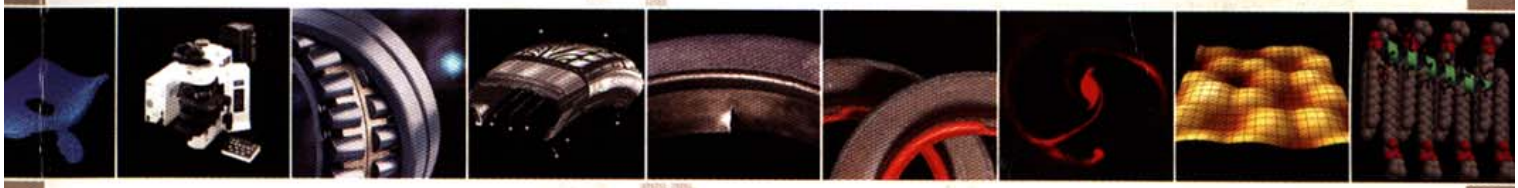

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ANALYTICAL AND NUMERICAL INVESTIGATIONS OF DYNAMIC PROBLEMS IN THE FRAMEWORK OF ASYMMETRIC ELASTICITY THEORY

V.V. KOREPANOV M.A. KULESH
V.P. MATVEYENKO M.V. ULITIN I.N. SHARDAKOV

kvv@icmm.ru kma@icmm.ru mvp@icmm.ru
ulitin@prognoz.ru shardakov@icmm.ru

In 2009 the world scientific community will mark the 100th anniversary of publication of the fundamental Cosserat brothers study, in which they defined theoretical grounds of the asymmetric (couple-stress) elasticity theory for isotropic solid. However, up to the present we have no a clear understanding as to the role and the place of this theory in the continuum mechanics. One way to clarify this question is to develop a thoroughly elaborated experiment which could provide evidence for couple-stress behavior of elastic materials and identify all material constants entering the constitutive relations of the Cosserat continuum model. In this paper, the wave problems and the problem of natural vibrations are considered in search of such experimental scheme.

The wave experiments especially in geological media may be highly informative from the viewpoint of identification of the asymmetric continuum models. Geological media are rather difficult to investigate because they are the place of simultaneous generation of various wave modes, such as direct and reflected volume waves, Rayleigh waves, as well as Love, Lamb and Stoneley waves. In such experiments, the phase velocities and polarization characteristics of waves can be considered as constructive measurable macroparameters. The natural vibration problems can be also used as informative schemes of experiments, in which the best candidate for constructively measurable macroparameter is the natural vibration frequency.

Thus, it may be safely suggested that the development and analysis of various wave solutions and solution of natural vibration problems for various microstructural models are still the question of present interest. This paper is concerned with construction of general motion equation for a linear isotropic Cosserat medium. This equation yields a general analytical solution to the linear wave problem in terms of displacements, from which one can derive solutions for Rayleigh, Lamb and Stoneley waves and also for a plane volume wave in the Cosserat space. A number of marked differences of the obtained solutions from the classical symmetric case have been demonstrated. The finite-element algorithm has been developed to solve problems on natural vibrations of elastic bodies in the framework of the developed model. This algorithm has been applied to some practical problems on natural vibrations. The obtained results can be used to identify an important characteristic of the considered system the spectrum of natural frequencies, which is an experimentally measurable macroparameter responding to the couple-stress properties of the medium.

The obtained analytical and numerical solutions are analyzed for their applicability to experiments on identification of elastic constants and recording the fact of couple stress behavior of elastic materials.

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Valery V. Korepanov, Acad. Korolev Str., 1, Perm, 614013, Russia

FEM SIMULATION OF DAMAGE EVOLUTION INCLUDING DISTRIBUTION OF FATIGUE STRENGTHS

IGOR K. KOROLEV SERGEI V. PETINOV
ALEXANDER B. FREIDIN

morolt@yandex.ru, psv@mech.ipme.ru,
freidin@mechanics.ipme.ru

Investigations of a damage evolution in materials with random fatigue strengths have received increased attention in recent years. Our paper presents the studies of a damage evolution in a plate with a stress concentrator (a recess) under cycling loading. Fatigue strength of a material is a stochastic variable governed by the normal distribution. The parameters of the distribution are found from experimental data using the Buskin's approximation. We study the influence of the fatigue strength dispersion on the position of an initial defect with respect to the stress concentrator and the defect evolution. We develop a finite element algorithm to describe the fracture of a material element as a result of damage accumulation in arbitrary stress fields. We demonstrate that the defect appears at the peak of stress (at the top of the recess) if the dispersion of fatigue strength is small. Then the defect spreads along the symmetry line. Increasing of the fatigue strength dispersion can result in the deviation of a defect initiation point from the recess top. The trajectory remains to be parallel to the symmetry line. Further increasing of the dispersion leads to the possibility of the trajectory deflections from the straight line if the number exponent of Buskin's approximation is not large. If the number exponent of Buskin's approximation is large then the trajectory does not deflect from the line parallel to the symmetry line even if the dispersion is of a large number. The last feature is explained by the dominant role of stress concentration at the defect tip in the defect evolution.

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Igor K. Korolev, Sergei V. Petinov, Alexander B. Freidin Institute of Mechanical Engineering Problems of RAS, Bolshoy Pr. 61, V.O., St.Petersburg 199178, Russia

THE EFFECT OF CHOLESTEROL ON THE STRUCTURE AND DYNAMICS PROPERTIES OF UNSATURATED LIPID BILAYERS: MOLECULAR DYNAMICS SIMULATION

V.V. KORNILOV A.L. RABINOVICH
N.K. BALABAEV

basil@psn.ru

Molecular dynamics simulations were carried out for five different hydrated unsaturated phosphatidylcholine (PC) lipid bilayers with deferent number of cis double $C = C$ bonds of the $sn - 2$ hydrocarbon chains (18:0/18:1(n-9)*cis* PC