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Internal resonances in nonlinear vibrations of a continuous rod with microstructure

Igor Andrianov, Jan Awrejcewicz, Vladyslav Danishevskyy, Bernd Markert

Abstract: Nonlinear longitudinal vibrations of a periodically heterogeneous rod are considered. Geometrical nonlinearity is described by the Cauchy–Green strain tensor. Physical nonlinearity is modelled expressing the energy of deformation as a series expansion in powers of the strains. The governing macroscopic dynamical equation is obtained by the higher-order asymptotic homogenization method. An asymptotic solution is developed by the method of multiple time scales. The effects of internal resonances and modes coupling are predicted. The specific objective of the paper is to analyse how the presence of the microstructure influences on the processes of mode interactions. It is shown that depending on a scaling relation between the amplitude of the vibrations and the size of the unit cell different scenarios of the modes coupling can be realised.

[1)] Igor Andrianov, Professor: Institute of General Mechanics, RWTH Aachen University, Templergraben 64, Aachen 52062, GERMANY (igor_andrianov@hotmail.com), the author presented this work at the conference.

[2)] Jan Awrejcewicz, Professor: Department of Automatics and Biomechanics, Technical University of Łódź, 1/15 Stefanowski Street, 90-924 Łódź, POLAND (awrejcew@p.lodz.pl).

[3)] Vladyslav Danishevskyy, Professor: Department of Structural Mechanics and Strength of Materials, Prydniprovska State Academy of Civil Engineering and Architecture, Chernyshevsky St. 24a, Dnipropetrovsk 49600, UKRAINE (vdanish@ukr.net).

[4)] Bernd Markert, Professor: Institute of General Mechanics, RWTH Aachen University, Templergraben 64, Aachen 52062, GERMANY (markert@iam.rwth-aachen.de).