Nonstationary resonant dynamics: new results and application

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Abstract

A new approach to non-stationary resonant dynamics based on the concept of Limiting Phase Trajectory (LPT) was presented five years ago in my keynote lecture (3th ICOVIS Conference). In this brief review a series of new results in this field are discussed. As it was underlined earlier the role of LPTs in the processes of intensive energy transfer and in the description of the transition to energy localization is similar to the role of Nonlinear Normal Modes in the stationary dynamics. At that, the adequate mathematical tool in the former case is qualitatively different because it deals with non-smooth transformations. During last years the most significant progress has been obtained in the following directions:

1) extension of the LPT concept onto the strongly nonlinear oscillatory chains functioning in the conditions of sonic vacuum (L. Manevitch, A. Vakakis, I. Koroleva, V. Smirnov);
2) formulation and solution for the first time of the strongly nonstationary problems for continuum systems (thin elastic shells, nanotubes) (V. Smirnov, L. Manevitch);
3) extension of the LPT concept onto the pendula chains, having numerous applications in classical and quantum mechanics (removal of the restrictions on the amplitudes of oscillations) (L. Manevitch, V. Smirnov, M. Kovaleva, F. Romeo);
4) construction of new non-conventional attractors in non-conservative systems on the basic of the LPT determined for underlying conservative system (M. Kovaleva, L. Manevitch, V. Pilipchuk, Yu. Starosvetsky, V. Kislovsky);
5) intensive energy exchange and localization in the dimer oscillatory chains (Yu. Starosvetsky, L. Manevitch);
6) the role of the LPTs in the formation of autoresonance processes (A. Kovaleva, L. Manevitch);
7) extension of the LPT concept to the vibro-impact models (O. Gendelman, N. Perchikov);
8) energy exchange and localization in the oscillatory chains, containing rotators or internal degrees of freedom(Yu. Starosvetsky, K. Vorotnikov, M. Kovaleva, V. Kislovsky).

The majority of these results are presented in the recently published book [L.I. Manevitch, A.S. Kovaleva, V.V. Smirnov, Yu. Starosvetsky. Nonstationary Resonant Dynamics of Oscillatory Chains and Nanostructures / Singapor: Springer Nature, 2017].

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