STABILIZATION OF LAMINAR AND TURBULENT FLOWS BY SANDWICH-TYPE COATING

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Fluid flows in distensible tubes are characterized by a number of unstable modes and flow stabilization is an important problem for the fluid motion in the tubes of the heat and mass exchangers; the artificial heart, oxygenators and other biomedical devices; microfluidic and nanofluidic cells [1–3]. Flow instability in compliant ducts serves as a cause of flow- and pressure-limitation effects, high-frequency wall oscillations, noise generation, damage of the innermost layer (endothelium) of the blood vessel wall (endothelium thickening), and sound transmission in veins, airways, larynx and glottis. Many important problems of the blood flow through stents and grafts, collapse of airways and apnea in snorers, speech generation and others are determined by the flow interaction with compliant walls and flow instability. Therefore, keen understanding of the mechanics of those instabilities and the precise control over them is needed. In this study a review of the proposed methods of the steady laminar and developed turbulent flows in tubes by means of a proper choice of the rheological parameters of the multi-layer sandwich-type coating is given. The previously elaborated approaches [4–15] as well as some novel results are presented.

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NONLINEAR NORMAL MODES IN SYSTEMS WITH PENDULUM ABSORBERS

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Dynamics of systems containing the pendulum absorber is considered by using the nonlinear normal modes (NNMs) approach. The pendulum systems are classical models on nonlinear dynamics. Besides, it is known numerous applications of such systems in engineering, in particular, in vibro-absorption problems. Here the Kauderer–Rosenberg concept of nonlinear normal modes in combination with some analytical–numeric procedures is used to construct the NNMs and to analyze their stability for two models: the two-DOF system containing the pendulum absorber (Fig.1), and the three-DOF non-ideal system having the pendulum absorber (Flg.2).

In these systems two nonlinear vibration modes can be selected: a) the coupled vibration mode when the vibration amplitudes of the pendulum and the elastic subsystem have the same order; b) the localized vibration mode when the pendulum vibration amplitudes are essentially larger than ones of the elastic subsystem. The last mode is appropriate for absorption of vibrations of the elastic subsystem.