Chapter 7
System Approaches to the Problem of Dynamic Damping of Vibrations of Technical Objects of Transport and Technological Purpose:
Reduced Stiffness, State Sets, and Form Interactions

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ABSTRACT

The methodological basis for solving the problems of assessment, control, and formation of dynamic states of technical objects of transport and technological purposes in a state of vibration loading is being developed. Within the framework of structural mathematical modeling, mechanical oscillatory systems used as design schemes of technical objects are compared with schemes of dynamically equivalent automatic control systems. New results are presented in the field of technology for

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evaluating dynamic states and forms of interactions of elements of mechanical oscillatory systems with the reduced elastic characteristics. For mechanical oscillatory systems, an interpretation of dynamic states and forms of interactions in the form of an oriented graph has been developed, creating prerequisites for the classification of a set of dynamic states in which a system can be located under the condition of various types of force excitation

INTRODUCTION

Many technical facilities, including transport and technological purposes, are operated under conditions of increased dynamic loads. Such conditions imply the need for calculations at the stages of preliminary research and the adoption of constructive and technical solutions that ensure the necessary level of reliability and safety of operation of technical means (see DeSilva, 2000; Harris & Cred, 2002; Iwnicki, 2006). Technical objects can be quite complex systems that include not only mass-inertial elements, but a significant number of other elements that implement both elastic interactions and the dissipation of oscillation energy, as well as functional ties. Functional ties are capable of creating various dynamic states and specific forms of dynamic interactions of machine and equipment elements. Moreover, functional connections have the potential of new dynamic effects of practical significance.

Considerable attention is paid to the development of system approaches to the tasks of machine dynamics, ensuring operational safety, including protection from vibrations of technical objects of transport and technological purposes, vibration isolation of equipment, devices and equipment under the influence of vibration loading (see Banakh & Kempner, 2010; Karnovsky & Lebed, 2016; Panovko, 2006). The problems of machine dynamics are very diverse. However, it would be advisable to single out research areas related to the tasks of vibration protection and vibration isolation of machines, devices and equipment, as well as control modes of dynamic vibration damping, special forms of coherence of movement of system elements, as well as other specific manifestations of forms of interaction of elements (see Bykhovsky, 1969; Galiev, Nekhaev, & Nikolaev, 2010; Goncharevich & Frolov, 1981; Rocard, 1949). A wide range of research in the field of dynamics of mechanical oscillatory systems is aimed at creating a scientific and methodological basis (see Eliseev, Lukyanov, Reznik, & Khomenko, 2006; Eliseev, Reznik, & Khomenko, 2011; Eliseev, Reznik, Khomenko, & Zasyadko, 2008). Within the framework of such a theoretical foundation, the problems of the dynamics of machines, equipment and mechanisms operating under periodic (usually harmonic) external influences of a forceful or kinematic nature are solved, taking into account a certain degree