Chapter 3
Some Applications of Structural Mathematical Modeling Methods

ABSTRACT

The application of structural mathematical modeling methods in various fields is considered, including the problems of vibration isolation and protection of technical objects. Attention is paid to the concept of a lever and its manifestation in mechanical oscillatory systems. Dynamic interactions in mechanical systems are described, where partial systems reflect the properties of solids making angular vibrations. In such cases, the lever is realized in the form of levers of the first and second kind, their various forms of simple and complex connections. Examples of the use of two-wire groups in problems of dynamics of flat mechanisms are given. Peculiarities of lever development in mechanical chains and mechanisms are discussed, which requires development of specific methods for construction of mathematical models of technical objects and analysis of their dynamic properties.

INTRODUCTION

As was shown in the previous chapters, leverage and mechanisms are widely represented in various structural and technical forms characteristic of solving many problems of machine dynamics, including in the tasks of vibration isolation and vibration protection of technical objects. In conventional mechanical oscillatory systems, leverage manifests itself in specific forms, which is quite simply disclosed

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using structural mathematical models of the system and the corresponding apparatus for frequency analysis of dynamic systems.

In a more visual form, leverage manifests itself when considering dynamic interactions in mechanical oscillatory systems, where partial systems reflect the properties of solids making angular vibrations. In such cases, leverage is realized in the form of levers of the first and second kinds, their various forms of simple and complex connections. Mechanical oscillating systems as design diagrams of technical systems and vibration protection systems, in particular, can include various structural formations from standard elementary links, including mechanisms consisting of solid bodies connected by certain kinematic pairs. Most often, such formations are considered in the form of separate blocks having zero degrees of freedom or the so-called Assur groups.

Two-lead groups are widely used in problems of dynamics of flat mechanisms. (Dimentberg & Kolesnikov, 1980) reflected the issues of evaluation of dynamic properties of vibration protection systems, in which linkage is implemented by articulated linkage mechanisms. As for the display of dynamic properties of this kind, it is necessary to take into account the peculiarities of the movement of such structural formations, since the vibration protection system is considered, as a rule, in states of small oscillations relative to the position of static equilibrium. Similar cases are typical for the dynamics of vehicles and vibration-type technological machines.

Although, as shown in the previous chapters, linkage is also characteristic of conventional mechanical oscillating systems, a wide variety of linkage is distinguished by mechanical systems that include devices for transforming motion, as well as mechanical chains and mechanisms of various nature. Such approaches are often implemented in the designs of suspensions of transport machines, in the development of vibration technological machines, during the creation of which the issues of creating certain spatial structures of the vibration field are solved.

Taking into account the peculiarities of leverage introduced by mechanical chains and mechanisms, it is necessary to develop quite specific techniques for building mathematical models of technical objects and analyzing their dynamic properties. Further materials use some structural and technical solutions protected by patents for utility models.

ADDITIONAL MASSES IN THE LINKAGE STRUCTURE

Mechanisms in the structures of vibration protection systems are most often considered in modes of small vibrations relative to the position of static equilibrium or steady motion. In such cases, the mechanisms implement the functions of superimposing additional connections that create certain conditions in solving

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