

Chapter 6

Dyads as Mass Structures

ABSTRACT

A methodological basis is being developed for building mathematical models of dyads - autonomous structural formations from two mass-inertial elements. A feature of the dyad is the possibility of elastic interaction of elements and their isolated movements. Possibilities of estimation of dynamic properties of dyad on mathematical models in two coordinate systems are investigated. method is proposed to determine parameters of dyad motion based on introduction of transfer function and frequency of energy function. Using different coordinate systems allows you to identify new dynamic effects triggered by new dynamic links. These relationships form inertial and inertial-elastic type dependencies. The concept of dyads and the features of their interactions can become the basis for new methods of analysis and dynamic synthesis in the theory of mechanical oscillations and nanomechanics.

INTRODUCTION: DYADS IN MECHANICAL OSCILLATORY SYSTEMS—DYNAMIC INTERACTION GENERATION MODEL

Ensuring the reliability and safety of operation of technical and transport machines operating under conditions of intensive dynamic loading requires the development of mathematical modeling methods, assessment of dynamic properties and forms of manifestation of dynamic effects at all stages of the design life cycle, creation of operation of technical objects. Significant attention is paid to the dynamics of machines, equipment and apparatus, many tasks of dynamics, in particular, the tasks of vibration protection of machines, are reflected in the works (Frolov & Furman, 1980; Eliseev, Reznik, Khomenko, & Zasyadko, 2008; Eliseev & Artyunin, 2016). Mathematical modeling methods (Clarence & de Silva, 2000; Tarasik, 2004) are widely used, based on the use of electromechanical and dynamic analogies, in which the calculation schemes of technical objects are compared with equivalent electrical

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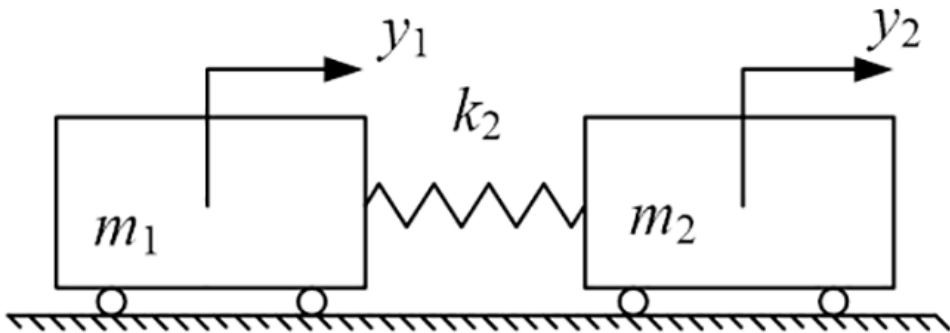
and mechanical circuits in dynamic terms, as well as structural diagrams of automatic control systems (Eliseev, Reznik, & Khomenko, 2011; Druzhinsky, 1977).

In the proposed report, the method of structural mathematical modeling is being developed in an application to the assessment of the dynamic properties of a structural formation in the form of a dyad, which is present in almost all chain oscillatory systems with two or more degrees of freedom with concentrated parameters.

Modeling a Dyads As a Mechanical System. Some General Provisions

1. A dyad is a structural formation consisting of two mass-inertial elements connected to each other by a spring. Dyad elements move in one line. The dyad can be considered as a mechanical circuit consisting of three series-connected elements (Figure 1).

Figure 1. Schematic diagram of a conventional dyad



As part of the structural mathematical modeling method (Eliseev, Reznik, Khomenko, & Zasyadko, 2008; Eliseev & Artyunin, 2016; Eliseev, Reznik, & Khomenko, 2011), typical elements m_1 , m_2 and k_2 can be presented in operator form; Note here that elements m_1 has transfer function $W_{m_1}(p) = m_1 p^2$, while element m_2 has $W_{m_2}(p) = m_2 p^2$; stiffness k_2 . Figure 2 shows a schematic diagram of a mechanical circuit consisting of three series-connected elements, which can be called a mechanical circuit (Druzhinsky, 1977; Eliseev & Kargapoltsev, 2014).

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