CRITICISM AND BIBLIOGRAPHY

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Abstract

Full Text

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K. M. Ragulskis, I. I. Vitkus, V. L. Ragulskene. *"Self-Synchronization of Mechanical Systems" (1. Self-Synchronous and Vibro-Impact Systems).* Edited by K. M. Ragulskis. "Mintis," Vilnius, 1965, 186 pp., with illustrations.

The monograph by K. M. Ragulskis, I. I. Vitkus, and V. L. Ragulskene is devoted to nonlinear oscillatory systems of a special type that arise in the study of the phenomenon of self-synchronization. With the aid of the methods of the modern theory of differential equations, the principal problems in the theory of certain self-synchronous and vibro-impact systems have been solved. The results obtained are applied to the calculation and design of the corresponding mechanical devices. Further study of such systems, as the authors show, leads to concrete mathematical problems requiring new methods for their solution. These problems may attract the attention of specialists in the theory of differential equations.

The monograph consists of two parts. In the first part, self-synchronous transmissions are considered. These mechanisms have two degrees of freedom and are described by holonomic systems of equations with Lagrangians that are periodic functions of the generalized coordinates. To construct conditions for existence and to determine the asymptotic character of the oscillations, linearized differential equations with constant coefficients are used. In the established regimes, the system self-synchronizes without forced constraints (combined self-synchronization), and various types of self-synchronization are possible, depending on the parameters of the system and on the initial data. Of interest is the use, as a first approximation, of equations with periodic coefficients. The realization of various profiles of self-synchronous transmissions is determined by a certain nonlinear differential equation of first order. A qualitative investigation of this differential equation would help advance the theory of transmissions.

In the second part of the monograph, vibro-impact systems are investigated, described by essentially nonlinear differential equations of second and fourth order. These equations are linear in the intervals between impacts, while at the moments of impact there is a jump in the first derivatives. It is shown that free impact oscillations of vibro-impact systems may be close to, and at the same time differ in distinctive properties from, free oscillations both of nonlinear oscillatory systems without discontinuities and of systems with continuously distributed mass. The monograph studies n-fold impact periodic regimes of motion, for which one impact occurs during n periods of excitation. The form of the excitation has a substantial influence on the dynamics of vibro-impact systems, sometimes sharply changing the type, existence, stability, and domain of attraction of the oscillation. Forced periodic impact oscillations arising from harmonic, or nearly harmonic, excitations are located mainly near the corresponding trajectories of free impact oscillations and those whose frequencies are integer multiples of them. The case is also considered in which the coefficient of restitution depends on the impact velocity itself. In this case, the variety of periodic impact regimes of motion may change. Transient regimes are represented by a system of polygonal lines which, taken together, resemble a system of integral curves of a differential equation without discontinuities in a neighborhood of a singular point. According to the character of these polygonal lines, the transient regimes are divided into several groups. For each group, its own method of approximate calculation of the process is indicated. By means of modeling and physical experiments it is shown that all analytically found stable periodic regimes of motion, including multi-valued ones, exist. The experiments did not confirm the presence, in vibro-impact systems in established regimes of motion, of almost periodic vibro-impact regimes.

The extensive factual material collected in the monograph reveals the diversity of qualitative patterns in the behavior of solutions of systems of differential equations describing self-synchronous and vibro-impact systems.

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Note: Figure translations are in progress. See original paper for figures.