

Preface

Forced vibrations of the system are, usually, theoretically considered under influence of a periodical force whose frequency and amplitude are constant. The force is assumed to be absolutely independent of the motion of the system. The source of this force is called 'ideal', and the vibrating system is 'ideal'. However, in the real system, the action of the excitation force, which is produced by a particular motor energy source (for example), may depend on the motion of the oscillating system. For that case, the excitation force is the function of the parameters of oscillatory motion. The force and energy source is called 'nonlinear' while the oscillator–non-ideal source system is named 'non-ideal'. The study of non-ideal vibrational systems, where the excitation source is influenced by the dynamics of the driven nonlinear system behavior, has been considered a great challenge in the theoretical and practical research in engineering science. It is worth to be said that the model of non-ideal vibrating system is closer to real situations encountered in practice. Only such a non-ideal model can eliminate the non-correspondence between theoretical predictions of motion with observed properties of the oscillating system. Generally, in the system the power supply is limited and it causes the behavior of the vibrating systems to depart from the case of ideal power supply. For this kind of non-ideal dynamic system, an equation that describes the interaction of the power supply with the driven system must be added. Thus, the non-ideal vibrating systems have one degree of freedom more than the corresponding ideal system.

In this book, dynamics of the non-ideal oscillatory system in which the excitation is influenced by the response of oscillator is considered. Various types of non-ideal systems are investigated: linear and nonlinear oscillators with one or more degrees of freedom interacted with one or more energy sources. For example: oscillating system excited by an elastic connection which is deformed by a crank driven by a rotating motor, system excited by an unbalanced rotating mass which is driven by a motor, system of parametrically excited oscillator and an energy source, frictionally self-excited oscillator and an energy source, energy harvesting system, portal frame–non-ideal source system, non-ideal rotor system, planar mechanism–non-ideal source interaction. For the systems the regular motion and irregular motion are tested. The effect of self-synchronization is discussed. Chaos and

methods for suppressing chaos in non-ideal systems are considered. In the book, various types of motion control are suggested. The most important property of the non-ideal system connected with the jump-like transition from a resonant state to a non-resonant one is discussed. The so-called Sommerfeld effect, when the resonant state becomes unstable and the system jumps into a new stable state of motion, which is above the resonant region, is deeply explained. Mathematical model of the system is solved analytically and numerically. Approximate analytical solving procedures are developed. The obtained results are numerically proved. Besides, the simulation of the motion of the non-ideal system is presented. The obtained results are compared with those for the ideal case. Significant difference is evident.

This book aims to present the already known results and to increase the literature in non-ideal vibrating systems. Besides, the intention of the book is to give a prediction of the effects for a system where the interaction between an oscillator and the energy source exists. This book is recommended for engineers and technicians dealing with the problem of source–machine system, and also for Ph.D. students and researchers interested in nonlinear and non-ideal problems.

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