

Preface

In the frame of engineering education, vibration mechanics has served as a core of several courses, such as mechanical vibrations and structural dynamics, for the undergraduate students majoring in aerospace engineering, mechanical engineering, and civil engineering. Vibration mechanics has also played an important role in a great variety of engineering fields. As such, future engineers should be able to perform the dynamic modeling, computations, and tests of industrial products.

The author has been studying the dynamics and control of aerospace structures, with an emphasis on the integrated computational and experimental methods of nonlinear dynamics, since the 1980s. As for teaching, the author taught "structural vibrations" of four credits for the undergraduate students in the program of aircraft engineering at *Nanjing University of Aeronautics and Astronautics* in the 1980s and 1990s. In recent years, the author has been teaching "fundamentals of structural dynamics" of two credits for the undergraduate students majoring in aerospace engineering at *Beijing Institute of Technology*. In 1998 and 2005, the author had two textbooks published in Chinese, which have served as the teaching materials of the courses of four credits and two credits, respectively.

The above experience of teaching and researches well confirms the importance of fundamental concepts and theories in vibration mechanics. The author tried to assist readers to gain an insight into vibration mechanics in the above two textbooks. Yet, it was not possible to address some issues in detail in those textbooks because of a well-established theoretical frame of both linear vibrations and teaching materials.

The new century has witnessed a global reform of engineering education with the rapid developments of information technology. As a consequence, the above courses with a core of vibration mechanics have been subject to a great reduction of teaching periods. Many undergraduate students have paid attention to the software of computational mechanics only. Some graduates with engineering degrees have shown their weakness in fundamental concepts, theoretical foundations, and experimental skills while working in either academia or industry. They have shown a strong intention of upgrading their understanding to vibration mechanics.

The above background stimulated the author to write a new book in order to help readers improve themselves. The majority of readers of this book may be those, who have taken an elementary course, such as mechanical vibration and structural

dynamics, of two credits or more. The objective of the book is to assist those readers to conduct the research-oriented study on linear vibrations, and to gain an insight into this subject via a helical upgrade of understanding level.

As a trial of the above ideas of engineering education, the book is an attempt to make a different design of content and a new style of writing in comparison with other available textbooks. The main features of the book are as follows.

First, the book focuses on some interesting problems of linear vibrations and waves of mechanical or structural systems and does not touch upon the scope of nonlinear vibrations, random vibrations, and dynamic measurements in other textbooks of graduate levels. That is, the priority of the book is an academic depth, rather than a broad scope.

Second, the writing style of the book embodies the process of research-oriented study. That is, the book presents how to find problems in a research or engineering practice, how to clearly define the problems to be studied, how to solve the problems, and how to look forward to future studies. This style may guide readers to think independently and to conduct the research-oriented study of vibration mechanics step by step. Of course, readers need to prepare themselves adaptive to such a writing style of the book, which begins with the problems to be studied and then turns to the necessary preparations for dealing with those problems before solving them. This is a practical sequence of most researches oriented from real problems, rather than available knowledge.

The major content of the book came from the experience of the author in education, researches, and engineering consultations over the past decades. The main body of the book looks like a collection of research papers, but serves as the teaching materials for readers who have learnt an elementary course of linear vibrations and need to upgrade their understanding to this useful subject.

The first two chapters of the book provide readers with an introduction to the problems proposed and to be solved, and then a review of elementary course of linear vibrations from a perspective of aesthetics of science. The remaining chapters are relatively independent, presenting theories and methods of linear vibrations and waves. They provide readers with some optional reading materials as an introduction to specific topics and also a guide to further studies.

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