

Preface to the Revised Edition

When this book first appeared, in 1983, it soon went out of print, and on several occasions the authors were approached with photocopy requests. After almost 30 years, it seems to have turned out in a collector's item, and a few accidentally found copies were sold at enormous prices. Meanwhile, the first of the authors (ADD) passed away in 2000, leaving behind a tremendous work in science and engineering, especially in the target area of the book, and the second of the authors (SAP) jointly with the first of the revising authors (ThGC), paying a tribute to his memory, decided to proceed with an updated edition of it. SPRINGER agreed to handle the project, and the result produced by several months of hard work is now visible.

In this second edition, the various chapters were revised and updated to a different extent. There was not much to add to the first chapters, which contained fundamental knowledge or general theory of analytical methods (Chaps. 1–4). However, extended revisions along with substantial additions, reflecting the progress achieved during the last three decades in the area of each of the remaining (Chaps. 5–8), were carried out, especially on the dynamics of cracked rotors, and its use on the identification of cracks and their depth and orientation as well as on their influence on the dynamic stability and life expectancy of rotating elements and even stationary structures. Finally, what is new is the introduction of variational methods, which, being quite a bulk of material, it was not thought wise to have them squeezed in the existing chapters, therefore, two new (Chaps. 9–10) dealing with variational applications in prismatic bars and rods and turbine rotors respectively.

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Preface

The design and construction of rotating machinery operating at supercritical speeds was, in the 1920s, an event of revolutionary importance for the then new branch of dynamics known as rotor dynamics. Out of the treatment of a number of new problems thus created, such as dynamic balancing, accelerating through critical speeds, effects of material damping, and the mechanical behaviour of the various types of bearings, along with the influence of all these factors on the stability of the rotatoiy motion, an individual discipline was in fact born. These problems were exhaustively treated in the classical monographs by Dimentberg and Tondl ([Chap. 1](#), Refs. 1 and 2, respectively), while particular aspects are even included in standard vibration textbooks.

In the 1960s, another revolution occurred: in less than a decade, imposed by operational and economic needs, an increase in the power of turbomachinery by one order of magnitude took place. This was achieved by means of advanced design methods, aided by fast digital computers and modern optimization techniques. The new situation demanded higher and faster rotors, operating above the second and sometimes the third critical speed, as is the case with steam or gas turbines and aircraft engines. Inevitably, a whole class of new problems were created: increased power concentration entails considerable interaction between the dynamic behavior of rotors on the one hand and the associated thermal and/or fluid flow fields on the other. The dynamic analysis of complex rotor forms became a necessity, while the importance of approximate methods for dynamic analysis was stressed, because of their capability to provide both straightforward solutions and means of checking computer results based on complicated algorithms. Finally, the appearance of fracture mechanics in the last two decades, as another new branch of applied mechanics, provided the analytical tools for the investigation of cracks on the dynamic behavior of rotors. The importance of this latter development becomes evident if one bears in mind that the new philosophy of design to the limit renders complete control over such phenomena as low- or high-cycle fatigue, dynamic failure, etc., to an absolute necessity.

The scope of this book is based on these new developments. It was found that no topics related to the well-known classical problems needed to be included, but

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