Torsional Vibration Analysis

Thanks to the potential of reducing fuel consumption and emissions, hybrid electric vehicles (HEVs) have been attracting more and more attention from car manufacturers and researchers. Due to involving two energy sources, i.e., engine and battery, the powertrain in HEVs is a complicated electromechanical coupling system that generates noise and vibration different from that of a traditional vehicle. Accordingly, it is very important to explore the noise and vibration characteristics of HEVs. In this book, a hybrid vehicle with two motors is taken as an example, consisting of a compound planetary gear set (CPGS) as the power-split device, to analyze the noise and vibration characteristics. It is specifically intended for graduates and anyone with an interest in the electrification of full hybrid vehicles. The book begins with the research background and significance of the HEV. The second chapter presents the structural description and working principal of the target hybrid vehicle. Chapter 3 highlights the noise, vibration, and harshness (NVH) tests and corresponding analysis of the hybrid powertrain. Chapter 4 provides transmission system parameters and meshing stiffness calculation. Chapter 5 discusses the mathematical modeling and analyzes torsional vibration (TV) of HEVs. Finally, modeling of the hybrid powertrain with ADAMS is given in Chapter 6.

A theoretical investigation of structural vibration characteristics of rotor blades was carried out. Coupled equations of motion for flapwise bending and torsion were formulated for rotor blades with noncollinear elastic and mass axes. The finite element method was applied for a detailed representation of blade structural properties. Coupled structural mass and stiffness coefficients were evaluated. The range of validity of a set of coupled equations of motion linearized with respect to eccentricity between elastic and mass axes was investigated. The sensitivity of blade vibration characteristics to torsion were evaluated by varying blade geometric properties, boundary conditions, and eccentricities between mass and elastic axes.

Vibrations are extremely important in all areas of human activities, for all sciences, technologies and industrial applications. Sometimes these Vibrations are useful but other times they are undesirable. In any case, understanding and analysis of vibrations are crucial. This book reports on the state of the art research and development findings on this very broad matter through 22 original and innovative research studies exhibiting various investigation directions. The present book is a result of contributions of experts from international scientific community working in different aspects of vibration analysis. The text is addressed not only to researchers, but also to professional engineers, students and other experts in a variety of disciplines, both academic and industrial seeking to gain a better understanding of what has been done in the field recently, and what kind of open problems are in this area.

A theoretical investigation of dynamic response characteristics of rotor blades was carried out with special emphasis on torsional degrees-of-freedom. Coupled equations of motion for flapwise bending and torsion were formulated at varying azimuth positions for rotor blades with noncollinear aerodynamic, elastic and mass axes. Both structural and aerodynamic mass, damping and stiffness coefficients were included. The variations of a sample blade at different flight conditions were investigated from these equations. The obtained numerical results were illustrated. The sensitivity of overall blade vibration characteristics to torsional oscillations was also investigated from the equations of motion for the sample blade. The illustrated results show the importance of torsional degrees-of-freedom in rotor blade analysis. Various possibilities of improving the overall response by tuning blade geometric, structural and aerodynamic characteristics are discussed.

The report describes tests and results obtained from vibration testing of a marine diesel engine.

Torsional vibration is an oscillatory angular twisting motion in the rotating members of a system. It can be deemed quite dangerous in that it cannot be detected as easily as other forms of vibration, and hence, subsequent failures that it leads to are often abrupt and may cause direct breakage of the shafts of the drive train. The need for sufficient analysis during the design stage of a rotating machine is, thus, well justified in order to avoid expensive modifications during later stages of the manufacturing process. In 1998, a project was initiated by the Turbomachinery Research Consortium (TRC) at Texas A & M University, College Station, TX, to develop a suite of computer codes to model torsional vibration of large drive trains. The author had the privilege of developing some modules in Visual Basic for Applications (VBA-Excel) for this suite of torsional vibration analysis codes, now collectively called XLTRC-Torsion. This treatise parleys the theory behind torsional vibration analysis using both the Transfer Matrix approach and the Finite Element approach, and in particular, validates the results generated by XLTRC-Torsion based on those approaches using experimental data available from tests on a 66,000 HP Air Compressor.

Machinery Vibration Analysis and Predictive Maintenance provides a detailed examination of the detection, location and diagnosis of faults in rotating and reciprocating machinery using vibration analysis. The basics and underlying physics of vibration signals are first examined. The acquisition and processing of signals is then reviewed followed by a discussion of machinery fault diagnosis using vibration analysis. Hereafter the important issue of rectifying faults that have been identified using vibration analysis is covered. The book also covers the other techniques of predictive maintenance such as oil and particle analysis, ultrasound and infrared thermography. The latest approaches and equipment used together with the latest techniques in vibration analysis emerging from current research are also highlighted. Understand the basics of vibration measurement Apply vibration analysis for different machinery faults Diagnose machinery-related problems with vibration analysis techniques

Vibration, excessive noise and other dynamics-related problems that limit or prevent operation are a major manufacturing concern in airplanes, auto crankshafts, home appliances, etc. This detailed monograph provides in-depth coverage of state-of-the-art vibration analysis techniques used to prevent design and operational malfunction. * Torsional vibration mathematical modeling * Forced response analysis * Vibration measurement methods and monitoring * Application case studies * SI units used throughout