

## **Abstract...**

An effective vibration isolation system is important for hard disk drives (HDD) used in a harsh mechanical environment.

This paper describes how to design concepts on how to achieve satisfactory shock and vibration isolation for HDD are described. The concepts are tested and further enhanced by the design case studies presented here. It is shown that an effective vibration isolation system, that will allow a HDD to operate well when subjected to severe shock and random vibration, is feasible.

## **1. Introduction**

The topic on how to design an optimum shock and vibration isolation for general type of devices has been discussed quite extensively in the literatures. However, the vibration isolation design for sophisticated systems needs to be attended in a special manner. For instance, the design of vibration isolation for an infrared equipment has been discussed in detail. In this paper, the authors would like to focus on the design and analysis of shock and vibration isolation of hard disk drives. The vibration in HDD has been increasingly studied due to the fact that HDDs have been increasingly used in various mobile applications, in which the HDD may be subjected to severe shock and random vibration inputs. It remains a big challenge for HDD manufacturers to make the HDD robust to harsh environmental conditions. This is predominantly due to the fact that originally HDD used to be designed for operation in stationary environments. There are basically three methods to handle the shock and vibration problems in HDD. The first is to design a robust servo control mechanism to prevent read/write head error. The second is to design a robust mechanical system and slider/disk interface. The third is to design suitable vibration isolation for the HDD. The first and second methods have been widely used in the academic and industrial research, but the third has not been addressed sufficiently in the literature. Some research work done focused on vibration isolators installed inside the HDD. But little attention is given to external vibration isolation of HDD. There has been a published work related to this specific area by the same authors. However, the previous work did not address the shock problem.

# Shock Vibration Concepts In Eng Design

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Subcommittee on Energy and Water  
Development**

## **Shock Vibration Concepts In Eng Design:**

*Engineering Noise Control* David A. Bies, Colin H. Hansen, Carl Q. Howard, Kristy L. Hansen, 2023-08-08 This classic and authoritative textbook contains material that is not over simplified and can be used to solve real world noise control engineering problems It covers the principles with practical application of current noise control technology Topics new or revised from the 5th edition include beating addition and subtraction of noise levels combining multi path noise level reductions hearing damage assessment and protection speech intelligibility noise weighting curves instrumentation including MEMS IEPE and TEDS sensors noise source types including transportation noise and equipment noise estimations outdoor sound propagation including noise barriers meteorological effects and sloping ground effects sound in rooms muffling devices including 4 pole analysis self noise and pressure drop calculations sound transmission through single double and triple partitions vibration measurement and control finite element analysis boundary element methods and statistical energy analysis Covers all aspects of industrial and environmental noise control Core advanced undergraduate and graduate textbook and reference text for acoustic consultants and engineers Practical applications demonstrate the theoretical concepts A wide range of example problems and solutions that are linked to noise control practice are available for download from [www.causalsystems.com](http://www.causalsystems.com)

*Dynamics of Structures: Second Edition* J. Humar, 2002-01-01 This major textbook provides comprehensive coverage of the analytical tools required to determine the dynamic response of structures The topics covered include formulation of the equations of motion for single as well as multi degree of freedom discrete systems using the principles of both vector mechanics and analytical mechanics free vibration response determination of frequencies and mode shapes forced vibration response to harmonic and general forcing functions dynamic analysis of continuous systems and wave propagation analysis The key assets of the book include comprehensive coverage of both the traditional and state of the art numerical techniques of response analysis such as the analysis by numerical integration of the equations of motion and analysis through frequency domain The large number of illustrative examples and exercise problems are of great assistance in improving clarity and enhancing reader comprehension The text aims to benefit students and engineers in the civil mechanical and aerospace sectors

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*Structural Sensitivity Analysis and Optimization 1*  
 Kyung K. Choi, Nam-Ho Kim, 2006-12-30 Structural design sensitivity analysis concerns the relationship between design variables available to the design engineer and structural responses determined by the laws of mechanics The dependence of response measures such as displacement stress strain natural frequency buckling load acoustic response frequency response noise vibration harshness NVH thermo elastic response and fatigue life on the material property sizing component shape and configuration design variables is defined through the governing equations of structural mechanics In this 2 volume set first and second order design sensitivity analyses are presented for static and dynamics responses of both linear and nonlinear elastic structural systems including elasto plastic and frictional contact problems Book I introduces structural design concepts that include the CAD based design model design parameterization performance measures costs and constraints It also discusses design sensitivity analysis of linear structural systems and discrete and continuum design sensitivity analysis methods

*Optimization of Large Structural Systems* George I. N. Rozvany, 2013-11-21 G I N Rozvany ASI Director Professor of Structural Design FB 10 Essen University Essen Germany Structural optimization deals with the optimal design of all systems that consist at least partially of solids and are subject to stresses and deformations This integrated discipline plays an increasingly important role in all branches of technology including aerospace structural mechanical civil and chemical engineering as well as energy generation and building technology In fact the design of most man made objects ranging from space ships and long span bridges to tennis rackets and artificial organs can be improved considerably if human intuition is enhanced by means of computer aided systematic decisions In analysing highly complex structural systems in practice discretization is unavoidable because closed form analytical solutions are only available for relatively simple idealized problems To keep discretization errors to a minimum it is desirable to use a relatively large number of elements Modern computer technology enables us to analyse systems with many thousand degrees of freedom In the optimization of structural systems however most currently available methods are restricted to at most a few hundred variables or a few hundred active constraints

**Introduction to Engineering Design** Andrew Samuel, John Weir, 1999-10-22 Introduction to Engineering Design is a completely novel text covering the basic elements of engineering design for structural integrity Some of the most important concepts that students must grasp are those relating to design thinking and reasoning and not just those that relate to simple theoretical and analytical approaches This is what will enable them to get to grips with practical design problems and the starting point is thinking about problems in a deconstructionist sense By analysing design problems as sophisticated systems made up of simpler constituents and evolving a solution from known experience of such building blocks it is possible to develop an approach that will enable the student to tackle even

completely alien design scenarios with confidence The other essential aspect of the design process the concept of failure and its avoidance is also examined in detail and the importance not only of contemplating expected failure conditions at the design stage but also checking those conditions as they apply to the completed design is stressed These facets in combination offer a systematic method of considering the design process and one that will undoubtedly find favour with many students teaching staff and practising engineers alike

**Dynamical Systems and Control** Firdaus E. Udwadia, H.I. Weber, George Leitmann, 2004-05-10 The 11th International Workshop on Dynamics and Control brought together scientists and engineers from diverse fields and gave them a venue to develop a greater understanding of this discipline and how it relates to many areas in science engineering economics and biology The event gave researchers an opportunity to investigate ideas and techniques

**Advanced Design Concepts for Engineers** B.S. Dhillon, 1998-03-24 This book provides the design engineer with concise information on the most important advanced methods that have emerged in recent years for the design of structures products and components While these methods have been discussed in the professional literature this is the first full presentation of their key principles and features in a single c

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**Foundations of Vibroacoustics** Colin

Hansen,2018-03-05 This text provides the foundation material for solving problems in vibroacoustics These include the prediction of structural vibration levels and sound pressure levels in enclosed spaces resulting from known force or acoustic pressure excitations and the prediction of sound levels radiated by vibrating structures The book also provides an excellent theoretical basis for understanding the processes involved in software that predicts structural vibration levels and structural sound radiation resulting from force excitation of the structure as well as sound levels in enclosed spaces resulting from vibration of part of the enclosing structure or resulting from acoustic sources within the enclosure The book is written in an easy to understand style with detailed explanations of important concepts It begins with fundamental concepts in vibroacoustics and provides a framework for problem solution in both low and high frequency ranges It forms a primer for students and for those already well versed in vibroacoustics the book provides an extremely useful reference It offers a unified treatment of both acoustics and vibration fundamentals to provide a basis for solving problems involving structural vibration sound radiation from vibrating structures sound in enclosed spaces and propagation of sound and vibration

*Energy and Water Development Appropriations for 2001: Department of Energy fiscal year 2001 budget justifications*  
United States. Congress. House. Committee on Appropriations. Subcommittee on Energy and Water Development,2000

**Energy and Water Development Appropriations for 2001** United States. Congress. House. Committee on Appropriations. Subcommittee on Energy and Water Development,2000     The Shock and Vibration Bulletin ,1972

Scientific and Technical Aerospace Reports ,1990-07     **Biosystems Engineering Promoting Resilience to Climate Change - AIIA 2024 - Mid-Term Conference** Luigi Sartori,Paolo Tarolli,Lorenzo Guerrini,Giulia Zuecco,Andrea Pezzuolo,2025-04-12 This book gathers the latest advances and innovations in the field of innovative biosystems engineering for sustainable agriculture forestry and food production as presented at the International Mid Term Conference of the Italian Association of Agricultural Engineering AIIA held in Padova Italy on June 17 19 2024 Focusing on the challenges of implementing sustainability in various contexts in the fields of biosystems engineering it shows how the research has addressed the sustainable use of renewable and non renewable resources It also presents possible solutions to help achieve sustainable production The Mid Term Conference of the Italian Association of Agricultural Engineering AIIA is part of a series of conferences seminars and meetings that the AIIA organizes together with other public and private stakeholders to promote the creation and dissemination of new knowledge in the sector The contributions included in the book were selected by means of a rigorous peer review process and offer an extensive and multidisciplinary overview of interesting solutions in the field of innovative biosystems engineering for sustainable agriculture     *Working on the Boundaries: Philosophies and Practices of the Design Process* R. Ryan,1996     Engineering Optimization Singiresu S. Rao,2009-07-20 Technology Engineering Mechanical Helps you move from theory to optimizing engineering systems in almost any industry Now in its Fourth Edition Professor Singiresu Rao s acclaimed text Engineering Optimization enables readers to quickly master and

apply all the important optimization methods in use today across a broad range of industries Covering both the latest and classical optimization methods the text starts off with the basics and then progressively builds to advanced principles and applications This comprehensive text covers nonlinear linear geometric dynamic and stochastic programming techniques as well as more specialized methods such as multiobjective genetic algorithms simulated annealing neural networks particle swarm optimization ant colony optimization and fuzzy optimization Each method is presented in clear straightforward language making even the more sophisticated techniques easy to grasp Moreover the author provides Case examples that show how each method is applied to solve real world problems across a variety of industries Review questions and problems at the end of each chapter to engage readers in applying their newfound skills and knowledge Examples that demonstrate the use of MATLAB for the solution of different types of practical optimization problems References and bibliography at the end of each chapter for exploring topics in greater depth Answers to Review Questions available on the author s Web site to help readers to test their understanding of the basic concepts With its emphasis on problem solving and applications Engineering Optimization is ideal for upper level undergraduates and graduate students in mechanical civil electrical chemical and aerospace engineering In addition the text helps practicing engineers in almost any industry design improved more efficient systems at less cost

Systems Engineering for Commercial Aircraft Scott Jackson, 2016-03-03 The key principle of systems engineering is that an aircraft should be considered as a whole and not as a collection of parts Another principle is that the requirements for the aircraft and its subsystems emanate from a logical set of organized functions and from economic or customer oriented requirements as well as the regulatory requirements for certification The resulting process promises to synthesize and validate the design of aircraft which are higher in quality better meet customer requirements and are most economical to operate This book is more of a how to and a why to rather than a what to guide It stresses systems engineering is an integrated technical managerial process that can be adapted without sacrificing quality in which risk handling and management is a major part It explains that the systems view applies to both the aircraft and the entire air transport system The book emphasizes that system engineering is not an added layer of processes on top of the existing design processes it is the glue that holds all the other processes together The readership includes the aircraft industry suppliers and regulatory communities especially technical program and procurement managers systems design and specialty engineers human factors reliability safety etc students of aeronautical and systems engineering and technical management and government agencies such as FAA and JAA

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