Floods And Flood Management Fluid Mechanics And Its Applications

The thrust of modern research on turbulence in fluids is concerned with coherent structures and modelling. Riblets have been shown to reduce drag, and the papers presented in this volume tackle the main question of the mechanism responsible for this behaviour in turbulent flow. The contributions in this volume were presented at the Sixth Drag Reduction Meeting held at Eindhoven during November 1991. This volume will be a useful reference work for engineers, physicists and applied mathematicians interested in the topic of fluid turbulence.

The book provides a broad overview of the full spectrum of state-of-the-art computational activities in multiphase flow as presented by top practitioners in the field. It starts with well-established approaches and builds up to newer methods. These methods are illustrated with applications to a broad spectrum of problems involving particle dispersion and deposition, turbulence modulation, environmental flows, fluidized beds, bubbly flows, and many others.

The desire to understand the mechanics of elastic and plastic solids, new materials and the stability, reliability and dynamic behaviour of structures and their components under extreme environmental conditions has dominated research in structural engineering for many decades. Advances in these areas have revolutionized design methods, codes of practice, and the teaching of structural engineers. In this volume an international body of leading authorities presents some forty papers on current research directions in the specific areas of solid mechanics, structural computation, modern materials and their application, buckling and instability, design of structural systems and components, reliability, seismic analysis, and engineering education. They were presented at a symposium held July 10-12, 1994, at the University of Waterloo, Canada, to honour Professor Archibald Norbert Sherbourne who recently retired from a long and active career of teaching, research and academic administration at this University. The themes of the work contained within this volume reflect Professor Sherbourne's own research interests and will be of interest to both academics and practicing structural engineers.

I was introduced to structural control by Raphael Haftka and Bill Hallauer during a one year stay at the Aerospace and Ocean Engineering department of Virginia Tech., during the academic year 1985-1986. At that time, there was a tremendous interest in large space structures in the USA, mainly because of the Strategic Defense Initiative and the space station program. Most of the work was theoretical or numerical, but Bill Hallauer was one of the few experimen talists trying to implement control systems which worked on actual structures. When I returned to Belgium, I was appointed at the chair of Mechanical Engi neering and Robotics at ULB, and I decided to start some basic vibration control experiments on my own. A little later, smart materials became widely available and offered completely new possibilities, particularly for precision structures, but also brought new difficulties due to the strong coupling in their constitutive equations, which requires a complete reformulation of the classical modelling techniques such as finite elements. We started in this new field with the sup port of the national and regional governments, the European Space Agency, and some bilateral collaborations with European aerospace companies. Our Active Structures Laboratory was inaugurated in October 1995.

One of the great twentieth-century achievements in the mechanics of fluids was the full elucidation of the physics of shock waves and the later comprehensive development of understanding of how shock waves propagate (i) through otherwise undisturbed fluid and (ii) in interaction either with solid bodies or with independently generated fluid flows. The interaction problems (ii) were soon found to raise some very special difficulties (beginning with the common formation of "Mach stems" in shock-wave reflection) yet they also turned out to possess enormous scientific interest as well as being highly important in practical applications. For all these reasons the appearance of this book on "Interaction of Shock Waves" by one of the world's major contributors to knowledge in that field is most particularly to be welcomed. It covers all those approaches to the subject which have been found fruitful, and most satisfactorily goes into comprehensive detail about each. At last the important achievements of the leading research workers, experimental as well as theoretical, on shockwave interaction problems are brought together in a single convenient and well written volume. I warmly congratulate the author and the publisher on having performed, for the benefit of everyone interested in the mechanics of fluids, this immensely valuable service.

Failures of many mechanical components in service result from fatigue. The cracks which grow may either originate from some pre-existing macroscopic defect, or, if the component is of high integrity but highly stressed, a region of localized stress concentration. In turn, such concentrators may be caused by some minute defect, such as a tiny inclusion, or inadvertent machining damage. Another source of surface damage which may exist between notionally 'bonded' components is associated with minute relative motion along the interface, brought about usually be cyclic tangential loading. Such fretting damage is quite insidious, and may lead to many kinds of problems such as wear, but it is its influence on the promotion of embryo cracks with which we are concerned here. When the presence of fretting is associated with decreased fatigue performance the effect is known as fretting fatigue. Fretting fatigue is a subject drawing equally on materials science and applied mechanics, but it is the intention in this book to concentrate attention entirely on the latter aspects, in a search for the quantification of the influence of fretting on both crack nucleation and propagation. There have been very few previous texts in this area, and the present volume seeks to cover five principal areas; (a) The modelling of contact problems including partial slip under tangentialloading, which produces the surface damage. (b) The modelling of short cracks by rigorous methods which deal effectively with steep stress gradients, kinking and closure. (c) The experimental simulation of fretting fatigue.

Modern fracture mechanics considers phenomena at many levels, macro and micro; it is therefore inextricably linked to methods of theoretical and mathematical physics. This book introduces these sophisticated methods in a straightforward manner. The methods are applied to several important phenomena of solid state physics which impinge on fracture mechanics: adhesion, defect nucleation and growth, dislocation emission, sintering, the electron beam effect and fractal cracks. The book shows how the mathematical models for such processes may be set up, and how the equations so formulated may be solved and interpreted. The many open problems which are encountered will provide topics for MSc and PhD theses in fracture mechanics, and in theoretical and experimental physics. As a supplementary text, the book can be used in graduate level courses on fracture mechanics, solid matter physics, and mechanics of solids, or in a special course on the application of fracture mechanics methods in solid matter physics.

New developments in the applications of fracture mechanics to engineering problems have taken place in the last years. Composite materials have extensively been used in engineering problems. Quasi-brittle materials including concrete, cement pastes, rock, soil, etc. all benefit from these developments. Layered materials and especially thin film/substrate systems are becoming important in small volume systems used in micro and nanoelectromechancial systems (MEMS and NEMS). Nanostructured materials are being introduced in our every day life. In all these problems fracture mechanics plays a major role for the prediction of failure and safe design of materials and structures. These new challenges motivated the author to proceed with the second edition of the book. The second edition of the book contains four new chapters in addition to the ten chapters of the first edition. The fourteen chapters of the book cover the basic principles and traditional applications, as well as the latest developments of fracture mechanics as applied to problems of composite materials, thin films, nanoindentation and cementitious materials. Thus the book provides an introductory coverage of the traditional and contemporary applications of fracture mechanics in problems of utmost technological importance. With the addition of the four new chapters the book presents a comprehensive treatment of fracture mechanics. It includes the basic principles and traditional applications as well as the new frontiers of research of fracture mechanics during the last three decades in topics of contemporary importance, like composites, thin films, nanoindentation and cementitious materials. The book contains fifty example problems and more than two hundred unsolved problems. A "Solutions Manual" is available upon request for course instructors from the author.

The call for papers for the rUTAM-Symposium on Mechanics of Passive and Active Flow Control brought an overwhelming response of applications for contributions. Fi nally 12 invited lectures, 48 papers and 23 posters were selected by thc Scientific Com mittee to be presented in the conference. 58 papers are published in this volume. Due to the limited number of pages available, poster presentations could not be considered for publication. The editors would like to thank all the members of the Scientific Committee for their very valuable assistance. The papers presented at the rUT AM Symposium were classified under three groups de voted to • Passive Control Methods, • Active Control Methods and • Control Concepts. This was done to contrast at first between the passive techniques where the control power is mainly supplied by the flow itself and the active techniques where the power is pro vided by external sources; the third group was devoted to control concepts for presenting methods of control theory and new techniques of flow control.

To Turbulence by ARKADY TSINOBER Department of Fluid Mechanics, Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel KLUWER ACADEMIC PUBLISHERS NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW eBookISBN: 0-306-48384-X Print ISBN: 1-4020-0110-X ©2004 Kluwer Academic Publishers NewYork, Boston, Dordrecht, London, Moscow Print ©2001 Kluwer Academic Publishers Dordrecht All rights reserved No part of this eBook maybe reproducedor transmitted inanyform or byanymeans, electronic, mechanical, recording, or otherwise, without written consent from the Publisher Created in the United States of America Visit Kluwer Online at: http://kluweronline. com and Kluwer's eBookstoreat: http://ebooks. kluweronline. com TO My WITS TABLE OF CONTENTS 1 INTRODUCTION 1 Brief history 1 1. 1 1. 2 Nature and major qualitative universal features of turbulent flows 2 1. 2. 1 Representative examples of turbulent flows 2 1. 2. 2 In lieu of definition: major qualitative universal f- tures of turbulent flows 15 1. 3 Why turbulence is so impossibly difficult? The three N's 19 On the Navier-Stokes equations 19 1. 3. 1 1. 3. 2 On the nature of the problem 21 1. 3. 3 Nonlinearity 22 1. 3. 4 Noninegrability 22 Nonlocality 1. 3. 5 23 1. 3. 6 On physics of turbulence 24 1. 3. 7 On statistical theories 24 1. 4 Outline of the following material 25 1. 5 In lieu of summary 26 2 ORIGINS OF TURBULENCE 27 2. 1 Instability 27 2. 2 Transition to turbulence versus routes to chaos 29 2.

In recent years there have been a number of catastrophic floods that have resulted in a tragic loss of life. These natural disasters highlight the need to further understand the occurrence phenomena, to improve forecasting techniques, and to develop procedures and contingency plans to minimise the flood impact. This volume contains contributions from the 3rd International Conference on Floods and Flood Management held in Florence in November 1992. The volume is timely and provides an important overview for engineers, scientists, managers and researchers of the latest developments in technology, analysis and management.

This book is concerned with the numerical solution of crack problems. The techniques to be developed are particularly appropriate when cracks are relatively short, and are growing in the neighbourhood of some stress raising feature, causing a relatively steep stress gradient. It is therefore practicable to represent the geometry in an idealised way, so that a precise solution may be obtained. This contrasts with, say, the finite element method in which the geometry is modelled exactly, but the subsequent solution is approximate, and computationally more taxing. The family of techniques presented in this book, based loosely on the pioneering work of Eshelby in the late 1950's, and developed by Erdogan, Keer, Mura and many others cited in the text, present an attractive alternative. The basic idea is to use the superposition of the stress field present in the unfiawed body, together with an unknown distribution of 'strain nuclei' (in this book, the strain nucleus employed is the dislocation), chosen so that the crack faces become traction-free. The solution used for the stress field for the nucleus is chosen so that other boundary conditions are satisfied. The technique is therefore efficient, and may be used to model the evolution of a developing crack in two or three dimensions. Solution techniques are described in some detail, and the book should be readily accessible to most engineers, whilst preserving the rigour demanded by the researcher who wishes to develop the method itself.

During the last decades, applications of dynamical analysis in advanced, often nonlinear, engineering systems have been evolved in a revolutionary way. In this context one can think of applications in aerospace engineering like satellites, in naval engineering like ship motion, in mechanical engineering like rotating machinery, vehicle systems, robots and biomechanics, and in civil engineering like earthquake dynamics and offshore technology. One could continue with this list for a long time. The application of advanced dynamics in the above fields has been possible due to the use of sophisticated computational techniques employing powerful concepts of nonlinear dynamics. These concepts have been and are being developed in mathematics, mechanics and physics. It should be remarked that careful experimental studies are vitally needed to establish the real existence and observability of the predicted dynamical phenomena. The interaction between nonlinear dynamics and nonlinear control in advanced engineering systems is becoming of increasing importance because of several reasons. Firstly, control strategies in nonlinear systems are used to obtain desired dynamic behaviour and improved reliability during operation, Applications include power plant rotating machinery, vehicle systems, robotics, etc. Terms like motion control, optimal control and adaptive control are used in this field of interest. Since mechanical and electronic components are often necessary to realize the desired action in practice, the engineers use the term mechatronics to indicate this field. If the desired dynamic behaviour is achieved by changing design variables (mostly called system parameters), one can think of fields like control of chaos.

During the last decades a considerable effort has been made on the computation of the isothermal flow of viscoelastic fluids. In fact the activities related to this particular field of non-Newtonian fluid mechanics have focused on the following questions: which type of constitutive equation describes non-Newtonian fluid behaviour; how to measure fluid parameters; and what type of computational scheme leads to reliable, stable and cost-effective computer programs. During the same period, typical non-Newtonian fluid phenomena have been experimentally examined, such as the flow through a `four-to-one' contraction, the flow around a sphere or separation flow, providing fresh challenges for numerical modellers. Apart from momentum transport, however, fluid flow is strongly influenced by heat treansport in most real industrial operations in which non-Newtonian fluids are processed. The IUTAM Symposium on `Numerical Simulation of Nonisothermal Flow of Viscoelastic Liquids' held at Rolduc Abbey in Kerkrade, the Netherlands, November 1--3, 1993, was organised to monitor the state of affairs in regard to the influence of nonisothermal effects on the flow of a viscoelastic liquid. The present collection of papers gives an overview of what has been achieved so far. It is a milestone in the rapidly emerging and exciting new field in non-Newtonian fluid mechanics.

This volume contains papers presented at the IUTAM Symposium on Bubble Dynamics and Interface Phenomena held at the University of Birmingham from 6-9 September 1993. In many respects it follows on a decade later from the very successful IUTAM Symposium held at CALTECH in June 1981 on the Mechanics and physics of bubbles in liquids which was organised by the late Milton Plesset and Leen van Wijngaarden. The intervening period has seen major development with both experiment and theory. On the experimental side there have been ad vances with very high speed photography and data recording that provide detailed information on fluid and interface motion. Major developments in both computer hardware and software have also led to extensive improvement in our understand ing of bubble and interface dynamics although development is still limited by the sheer complexity of the laminar and turbulent flow regimes often associated with bubbly flows. The symposium attracts wide and extensive interest from engineers, physical, chemical, biological and medical scientists and applied mathematicians. The sci entific committee sought to achieve a balance between theory and experiment over a range of fields in bubble dynamics and interface phenomena. It was our intention to emphasise both the breadth and recent developments in these various fields and to encourage cross-fertilisation of ideas on both experimental techniques and theo retical developments. The programme, and the proceedings recorded herein, cover bubble dynamics, sound and wave propagation, bubbles in flow, sonoluminescence, acoustic cavitation, underwater explosions, bursting bubbles and ESWL.

In Mechanics of Poroelastic Media the classical theory of poroelasticity developed by Biot is developed and extended to the study of problems in geomechanics, biomechanics, environmental mechanics and materials science. The contributions are grouped into sections covering constitutive modelling, analytical aspects, numerical modelling, and applications to problems. The applications of the classical theory of poroelasticity to a wider class of problems will be of particular interest. The text is a standard reference for researchers interested in developing mathematical models of poroelasticity in geoenvironmental mechanics, and in the application of advanced theories of poroelastic biomaterials to the mechanics of biomaterials.

This book provides a brief introduction to rational continuum mechanics in a form suitable for students of engineering, mathematics and science. The presentation is tightly focused on the simplest case of the classical mechanics of nonpolar materials, leaving aside the effects of internal structure, temperature and electromagnetism, and excluding other mathematical models, such as statistical mechanics, relativistic mechanics and quantum mechanics. Within the limitations of the simplest mechanical theory, the author had provided a text that is largely self-contained. Though the book is primarily an introduction to continuum mechanics, the lure and attraction inherent in the subject may also recommend the book as a vehicle by which the student can obtain a broader appreciation of certain important methods and results from classical and modern analysis.

for the fluctuations around the means but rather fluctuations, and appearing in the following incompressible system of equations: on any wall; at initial time, and are assumed known. This contribution arose from discussion with J. P. Guiraud on attempts to push forward our last co-signed paper (1986) and the main idea is to put a stochastic structure on fluctuations and to identify the large eddies with a part of the probability space. The Reynolds stresses are derived from a kind of Monte-Carlo process on equations for fluctuations. Those are themselves modelled against a technique, using the Guiraud and Zeytounian (1986). The scheme consists in a set of like equations, considered as random, because they mimic the large eddy fluctuations. The Reynolds stresses are got from stochastic averaging over a family of their solutions. Asymptotics underlies the scheme, but in a rather loose hidden way. We explain this in relation with homogenizati- localization processes (described within the §3. 4 ofChapter 3). Ofcourse the mathematical well posedness of the scheme is not known and the numerics would be formidable! Whether this attempt will inspire researchers in the field of highly complex turbulent flows is not foreseeable and we have hope that the idea will prove useful.

This volume is the first in a new series to cover different aspects related to Safety and Security Engineering in order to reach a comprehensive view on risk mitigation.The volume is devoted to floods, as one-third of the annual natural disasters and economic losses, and more than half of the respective victims are flood-related. A burgeoning global population and growing wealth, particularly in the last two or three decades, have increased the risk and the demand for protection from flooding. These features, together with climate change predictions and urban development, are affecting the way flood risk is managed.Knowledge and scientific tools play a role of paramount importance in the strain of coping with flooding problems, along with the capacity building in the context of political and administrative framework. Therefore, governments need to establish clear institutional, financial and social mechanisms and processes for flood risk management in order to ensure the safety of people and property and, thereby, contribute to both flood defence and sustainable development.The present volume contains selected papers presented at the Conferences organized by the Wessex Institute of Technology. The papers have been revised by the Authors, in order to be up-to-date and integrated in the book, which covers the following topics: - Risk assessment - Mathematical models for flood propagation - Effect of topographic data resolution - Social and psychological aspects - Decision making and management - Legislations and directives - Alternatives in flood protection - Response and recovery - Damages and economic-related problems - Case studies The quality of the material makes the volume a most valuable and up-to-date tool for professionals, scientists, and managers to appreciate the state-of-the-art in this important field of knowledge.

This volume contains the proceedings of the first ICASE/LaRC Work shop on Computational Electromagnetics and Its Applications conducted by the Institute for Computer Applications in Science and Engineering and NASA Langley Research Center. We had several goals in mind when we decided, jointly with the Elec tromagnetics Research Branch, to organize this workshop on Computa tional Electromagnetics (CEM). Among our goals were a desire to obtain an overview of the current state of CEM, covering both algorithms and ap plications and their effect on NASA's activities in this area. In addition, we wanted to provide an attractive setting for computational scientists with expertise in other fields, especially computational fluid dynamics (CFD), to observe the algorithms and tools of CEM at work. Our expectation was that scientists from both fields would discover mutually beneficial inter connections and relationships. Another goal was to learn of progress in solution algorithms for electromagnetic optimization and design problems; such problems make extensive use of field solvers and computational effi ciency is at a premium. To achieve these goals we assembled the renowned group of speakers from academia and industry whose talks are contained in this volume. The papers are printed in the same order in which the talks were pre sented at the meeting. The first paper is an overview of work currently being performed in the Electromagnetic Research Branch at the Langley Research Center.

Inverse Problems in Scattering exposes some of the mathematics which has been developed in attempts to solve the one-dimensional inverse scattering problem. Layered media are treated in Chapters 1--6 and quantum mechanical models in Chapters 7--10. Thus, Chapters 2 and 6 show the connections between matrix theory, Schur's lemma in complex analysis, the Levinson--Durbin algorithm, filter theory, moment problems and orthogonal polynomials. The chapters devoted to the simplest inverse scattering problems in quantum mechanics show how the Gel'fand--Levitan and Marchenko equations arose. The introduction to this problem is an excursion through the inverse problem related to a finite difference version of Schrödinger's equation. One of the basic problems in inverse quantum scattering is to determine what conditions must be imposed on the scattering data to ensure that they correspond to a regular potential, which involves Lebesque integrable functions, which are introduced in Chapter 9.

This book deals with the simulation of the incompressible Navier-Stokes equations for laminar and turbulent flows. The book is limited to explaining and employing the finite difference method. It furnishes a large number of source codes which permit to play with the Navier-Stokes equations and to understand the complex physics related to fluid mechanics. Numerical simulations are useful tools to understand the complexity of the flows, which often is difficult to derive from laboratory experiments. This book, then, can be very useful to scholars doing laboratory experiments, since they often do not have extra time to study the large variety of numerical methods; furthermore they cannot spend more time in transferring one of the methods into a computer language. By means of numerical simulations, for example, insights into the vorticity field can be obtained which are difficult to obtain by measurements. This book can be used by graduate as well as undergraduate students while reading books on theoretical fluid mechanics; it teaches how to simulate the dynamics of flow fields on personal computers. This will provide a better way of understanding the theory. Two chapters on Large Eddy Simulations have been included, since this is a methodology that in the near future will allow more universal turbulence models for practical applications. The direct simulation of the Navier-Stokes equations (DNS) is simple by finite-differences, that are satisfactory to reproduce the dynamics of turbulent flows. A large part of the book is devoted to the study of homogeneous and wall turbulent flows. In the second chapter the elementary concept of finite difference is given to solve parabolic and elliptical partial differential equations. In successive chapters the 1D, 2D, and 3D Navier-Stokes equations are solved in Cartesian and cylindrical coordinates. Finally, Large Eddy Simulations are performed to check the importance of the subgrid scale models. Results for turbulent and laminar flows are discussed, with particular emphasis on vortex dynamics. This volume will be of interest to graduate students and researchers wanting to compare experiments and numerical simulations, and to workers in the mechanical and aeronautic industries.

Fluid Vortices is a comprehensive, up-to-date, research-level overview covering all salient flows in which fluid vortices play a significant role. The various chapters have been written by specialists from North America, Europe and Asia, making for unsurpassed depth and breadth of coverage. Topics addressed include fundamental vortex flows (mixing layer vortices, vortex rings, wake vortices, vortex stability, etc.), industrial and environmental vortex flows (aero-propulsion system vortices, vortex-structure interaction, atmospheric vortices, computational methods with vortices, etc.), and multiphase vortex flows (free-surface effects, vortex cavitation, and bubble and particle interactions with vortices). The book can also be recommended as an advanced graduate-level supplementary textbook. The first nine chapters of the book are suitable for a one-term course; chapters 10--19 form the basis for a second one-term course.

Modern experiments and numerical simulations show that the long-known coherent structures in turbulence take the form of elongated vortex tubes and vortex sheets. The evolution of vortex tubes may result in spiral structures which can be associated with the spectral power laws of turbulence. The mutual stretching of skewed vortex tubes, when they are close to each other, causes rapid growth of vorticity. Whether this process may or may not lead to a finite-time singularity is one of the famous open problems of fluid dynamics. This book contains the proceedings of the NATO ARW and IUTAM Symposium held in Zakopane, Poland, 2-7 September 2001. The papers presented, carefully reviewed by the International Scientific Committee, cover various aspects of the dynamics of vortex tubes and sheets and of their analogues in magnetohydrodynamics and in quantum turbulence. The book should be a useful reference for all researchers and students of modern fluid dynamics.

Under the auspices of the Euromech Committee, the Fifth European Turbulence Conference was held in Siena on 5-8 July 1994. Following the previous ETC meeting in Lyon (1986), Berlin (1988), Stockholm (1990) and Delft (1992), the Fifth ETC was aimed at providing a review of the fundamental aspects of turbulence from a theoretical, numerical and experimental point of view. In the magnificent town of Siena, more than 250 scientists from all over the world, spent four days discussing new ideas on turbulence. As a research worker in the field of turbulence, I must say that the works presented at the Conference, on which this book is based, covered almost all areas in this field. I also think that this book provides a major opportunity to have a complete overview of the most recent research works. I am extremely grateful to Prof. C. Cercignani, Dr. M. Loffredo, and Prof. R. Piva who, as members of the local organizing committee, share the success of the Conference. I also want to thank Mrs. Liu' Catena, for her invaluable contribution to the work done by the local organizing committee and the European Turbulence Committee in the scientific organization of the meeting. The "Servizio Congressi" of the University of Siena provided perfect organization in Siena and wonderful hospitality. The Conference has been supported by CNR, Cira, Alenia, the Universities of Rome "Tor Vergata" and "La Sapienza".

This volume constitutes the Proceedings of the IUTAM Symposium on 'Nonlinear Analysis of Fracture', held in Cambridge from 3rd to 7th Septem ber 1995. Its objective was to assess and place on record the current state of understanding of this important class of phenomena, from the standpoints of mathematics, materials science, physics and engineering. All fracture phenomena are nonlinear; the reason for inclusion of this qualification in the title was to reflect the intention that emphasis should be placed on distinctive aspects of nonlinearity, not only with regard to material consti tutive behaviour but also with regard to insights gained, particularly from the mathematics and physics communities, during the recent dramatic ad vances in understanding of nonlinear systems in general. The expertise represented in the Symposium was accordingly very wide, and many of the world's greatest authorities in their respective fields participated. The Symposium remained focussed on issues of practical significance for fracture phenomena, with concentration on aspects that are still im perfectly understood. The most significant unifying issue in this regard is that of scale: this theme was addressed from several perspectives. One important aspect is the problem of passing information on one scale up or down, as an input for analysis at another scale. Although this is not always the case, it may be that the microscopic process of fracture is understood in some particular class of materials.

... a wise man knows all things in a manner in which this is possible, not, however, knowing them individually. Aristotle. Metaphysics * The problem of consideration of vortex fields' influence on solid body dynamics has a long history. One constantly comes upon it in flight dynamics of airplanes, helicopters, and other flying vehicles (FV) moving in the atmosphere, in dynamics of ships with hydrofoils, and in dynamics of rocket carriers (RC) and spacecrafts (SC) with liquid-propellant rocket engines (LPRE), that are equipped with special damping devices and other structural elements inside fluid tanks. Similar problems occur when solving problems related to attitude control and stabilization of artificial Earth satellites (AES) and spacecrafts with magnetic (electro magnetic) systems, in conducting elements of which eddy currents are induced while control of those vehicles' angular position. It is also true with special test facilities for dynamic testing of space vehicles and their systems, with modern high-speed magnetic suspension transport systems (those based on the phenomenon of 'magnetic levitation'), with generators having rotors carried in 'magnetic bearings', and so on.

Nonlinearity and stochastic structural dynamics is of common interest to engineers and applied scientists belonging to many disciplines. Recent research in this area has been concentrated on the response and stability of nonlinear mechanical and structural systems subjected to random escitation. Simultaneously the focus of research has also been directed towards understanding intrinsic nonlinear phenomena like bifurcation and chaos in deterministic systems. These problems demand a high degree of sophistication in the analytical and numerical approaches. At the same time they arise from considerations of nonlinear system response to turbulence, earthquacke, wind, wave and guidancy excitations. The topic thus attracts votaries of both analytical rigour and practical applications. This books gives important and latest developments in the field presenting in a coherent fashion the research findings of leading international groups working in the area of nonlinear random vibration and chaos.

The aim of this book is to provide an account of the state of the art in Com putational Kinematics. We understand here under this term ,that branch of kinematics research involving intensive computations not only of the numer ical type, but also of a symbolic nature. Research in kinematics over the last decade has been remarkably ori ented towards the computational aspects of kinematics problems. In fact, this work has been prompted by the need to answer fundamental question s such as the number of solutions, whether real or complex, that a given problem can admit. Problems of this kind occur frequently in the analysis and synthesis of kinematic chains, when finite displacements are considered. The associated models, that are derived from kinematic relations known as closure equations, lead to systems of nonlinear algebraic equations in the variables or parameters sought. What we mean by algebraic equations here is equations whereby the unknowns are numbers, as opposed to differen tial equations, where the unknowns are functions. The algebraic equations at hand can take on the form of multivariate polynomials or may involve trigonometric functions of unknown angles. Because of the nonlinear nature of the underlying kinematic models, purely numerical methods turn out to be too restrictive, for they involve iterative procedures whose convergence cannot, in general, be guaranteed. Additionally, when these methods converge, they do so to only isolated solu tions, and the question as to the number of solutions to expect still remains.