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Microcontinuum Field Theories - A. Cemal Eringen 2012-12-06
Microcontinuum field theories extend classical field theories to microscopic spaces and short time scales. This volume is concerned with the kinematics of microcontinua. It begins with a discussion of strain, stress tensors, balance laws, and constitutive equations, and then discusses applications of the fundamental ideas to the theory of elasticity. The ideas developed here are important in modeling the fluid or elastic properties of porous media, polymers, liquid crystals, slurries, and composite materials.
Highway Vehicle-bridge Coupled Vibrations: Numerical Simulations And Applications - Steve C S Cai 2020-09-28
Vehicle-bridge interaction happens all the time on roadway bridges and this interaction performance carries much useful information. On one hand, while vehicles are traditionally viewed as loads for bridges, they can also be deemed as sensors for bridges' structural response. On the other hand, while bridges are traditionally viewed as carriers for vehicle weight, they can also be deemed as scales that can weigh the vehicle loads. Based on these observations, a broad area of studies based on the vehicle-bridge interaction have been conducted in the authors' research group. Understanding the vehicle and bridge interaction can help develop strategies for bridge condition assessment, bridge design, and bridge maintenance, as well as develop insight for new research needs.This book documents fundamental knowledge, new developments, and state-of-the-art applications related to vehicle-bridge interactions. It thus provides useful information for graduate students and researchers and therefore straddles the gap between theoretical research and practical applications.
Nonlinear Mechanics, Second Edition - Demeter G. Fertis 1998-12-21
Complicated problems in nonlinear mechanics pose a challenge - many cannot be solved with existing closed-form methods. You would probably like easier methods for obtaining analytical and numerically exact solutions for finite elements, updated or total Lagrangian formulation, and arc-length methods of nonlinear elastic problem solving. Nonlinear Mechanics, Second Edition gives you what you want - convenient methods of analysis and valuable data for comparison. This is the only book to offer a comprehensive treatment of structural components with

variable thickness and a variable modulus of elasticity. It is also the only one to cover closed-form solutions for the dynamic and inelastic analysis of members and plates that are subjected to small and large deformations by including axial and vertical restraints. The author uses exact and approximate solutions for static, dynamic, and inelastic analysis. It also discusses aspects of nonlinear vibration of elastically supported beams, nonlinear response of nonuniform rotor blades, and a new concept of airfoil design. With more than 30% updated and new material, this edition is revised and reorganized to meet the needs of both academia and industry. Easy-to-follow equation derivations, example problems, step-by-step procedures, and iterative approaches create a thorough reference that fills present needs and equips you for the challenges of the future.

What Every Engineer Should Know about Finite Element Analysis, Second Edition, - John Brauer 1993-05-05

Summarizing the history and basic concepts of finite elements in a manner easily understood by all engineers, this concise reference describes specific finite element software applications to structural, thermal, electromagnetic and fluid analysis - detailing the latest developments in design optimization, finite element model building and results processing and future trends.;Requiring no previous knowledge of finite elements analysis, the Second Edition provides new material on: p elements; iterative solvers; design optimization; dynamic open boundary finite elements; electric circuits coupled to finite elements; anisotropic and complex materials; electromagnetic eigenvalues; and automated pre- and post-processing software.;Containing more than 120 tables and computer-drawn illustrations - and including two full-colour plates - What Every Engineer Should Know About Finite Element Analysis should be of use to engineers, engineering students and other professionals involved with product design or analysis.

Advances in Civil Engineering and Architecture - Chao He Chen 2011-05-17

This volume comprises a collection of papers which were subjected to strict peer-review by 2 to 4 expert referees. It aims to present the latest advances in, and applications of, structural engineering, bridge engineering, tunnel, subway and underground facilities, seismic engineering, environment-friendly construction and development, monitoring and control of structures, structural rehabilitation, retrofitting and strengthening, reliability and durability of structures, computational mechanics, construction technology, etc. This will be essential reading matter for those involved in public works, at every level.

Geometrically Nonlinear Analysis of Plan trusses and Frames - Vera Galishnikova 2009-06-01

This book is an outcome of academic cooperation between the Volgograd State University of Architecture and Civil Engineering in Russia, Stellenbosch University in South Africa and the Technische Universit„t Berlin in Germany. The authors performed coordinated and cooperative research on nonlinear structural analysis and on computer-supported civil engineering over a period of several years. Many of the innovative aspects of this book were invented and developed in the course of the research effort.

Nonlinear Analysis of Thin-Walled Structures - James F. Doyle 2013-03-09

Mechanical engineering, an engineering discipline born of the needs of the Industrial Revolution, is once again asked to do its substantial share in the call for industrial renewal. The general call is urgent as we face the profound issues of productivity and competitiveness that require engineering solutions, among others. The Mechanical Engineering Series is a new series, featuring graduate texts and research monographs, intended to address the need for information in contemporary areas of mechanical engineering. The series is conceived as a comprehensive one that will cover a broad range of concentrations important to mechanical engineering graduate education and research. We are fortunate to have a distinguished roster of consulting editors, each an expert in one of the areas of concentration. The names of the consult ing editors are listed on page vi. The areas of concentration are applied mechanics, biomechanics, computational mechanics, dynamic systems and control,

energetics, mechanics of materials, processing, thermal science, and tribology. We are pleased to present Nonlinear Analysis of Thin-Walled Structures by James F. Doyle. Austin, Texas Frederick F. Ling Preface This book is concerned with the challenging subject of the nonlinear static, dynamic, and stability analyses of thin-walled structures. It carries on from where Static and Dynamic Analysis of Structures, published by Kluwer 1991, left off; that book concentrated on frames and linear analysis, while the present book is focused on plated structures, nonlinear analysis, and a greater emphasis on stability analysis.

Smoothed Finite Element Methods - G.R. Liu 2016-04-19

Generating a quality finite element mesh is difficult and often very time-consuming. Mesh-free methods operations can also be complicated and quite costly in terms of computational effort and resources. Developed by the authors and their colleagues, the smoothed finite element method (S-FEM) only requires a triangular/tetrahedral mesh to achieve more accurate results, a generally higher convergence rate in energy without increasing computational cost, and easier auto-meshing of the problem domain. Drawing on the authors' extensive research results, Smoothed Finite Element Methods presents the theoretical framework and development of various S-FEM models. After introducing background material, basic equations, and an abstracted version of the FEM, the book discusses the overall modeling procedure, fundamental theories, error assessment matters, and necessary building blocks to construct useful S-FEM models. It then focuses on several specific S-FEM models, including cell-based (CS-FEM), node-based (NS-FEM), edge-based (ES-FEM), face-based (FS-FEM), and a combination of FEM and NS-FEM (αFEM). These models are then applied to a wide range of physical problems in solid mechanics, fracture mechanics, viscoelastoplasticity, plates, piezoelectric structures, heat transfer, and structural acoustics. Requiring no previous knowledge of FEM, this book shows how computational methods and numerical techniques like the S-FEM help in the design and analysis of advanced engineering systems in rapid and cost-effective ways since the modeling and simulation can be performed automatically in a virtual environment without physically building the system. Readers can easily apply the methods presented in the text to their own engineering problems for reliable and certified solutions.

ABAQUS/standard - 1997

Signal Processing Techniques for Nonlinearity Identification of Structures Using Transient Response - Joseph E. Dinardo 2009

In this work, an alternate method for determining nonlinearity of vibrating structures is investigated. In contrast to previous approaches, transient vibrations have been used in combination with advanced signal processing techniques to determine hardening or softening effects and strength of nonlinearity. The nonlinear characteristics of a structure can play a significant role in its behavior or response to stimuli. Thus, knowing these characteristics can lead to better design analysis and predictions of system responses. In order to demonstrate this method's practicality and how transient vibrations can be used to determine nonlinearity, an experiment involving a cantilever beam has been subjected to vibratory analysis. The simple structure of a cantilever beam is used widely in numerous applications. In particular, Micro-Electro-Mechanical Systems (MEMS) devices known as Micromachined Vibratory Gyroscopes (MVG) make use of tuning fork type designs which utilize cantilever beams and thus can be modeled as such. In order to utilize the dynamics of MVGs to measure angular rate, their response to specific stimuli must be known. Specifically, the tuning fork tines will be subjected to parametric excitation and Coriolis forces. An essential aspect of an MVG requires predictability. Hence, knowing the response of the system to these stimuli is crucial for design applications. MVGs require precision design and manufacturing for optimal performance. In previous works, simulated and experimental parametric excitation of a cantilever beam has been a subject of question, as results are often contradicting. Specifically, determining whether the beam's response is characterized by a hardening or a softening effect has proven to be difficult to obtain. Moreover, theoretical response curves frequently fail to match experimental data. Within this work, the viability of using transient vibratory analysis to determine the nonlinear characteristics of

a cantilever beam has been explored. Experimental data has first been processed by using either a Butterworth 4th order low pass digital filter or the empirical mode decomposition. Furthermore, a novel signal tracking technique, known as the Harmonics Tracking Method, has been used in conjunction with experimental data for signal analysis. This method was then compared to two other more traditional signal tracking techniques, the Teager-Kaiser algorithm and the Hilbert-Huang transform. Through this analysis it has been determined that a nonlinear softening effect exists within the transient response of the cantilever beam. Additionally, the effect of gravity upon the beam's response has been investigated and shown to have a slight hardening effect. It has also been determined that for transient nonlinear analysis, the Harmonics Tracking Method used in conjunction with the empirical mode decomposition yields the best results.

Statics and Rotational Dynamics of Composite Beams - Mehrdaad Ghorashi 2016-02-06

This book presents a comprehensive study of the nonlinear statics and dynamics of composite beams and consists of solutions with and without active elements embedded in the beams. The static solution provides the initial conditions for the dynamic analysis. The dynamic problems considered include the analyses of clamped (hingeless) and articulated (hinged) accelerating rotating beams. Two independent numerical solutions for the steady state and the transient responses are presented. The author illustrates that the transient solution of the nonlinear formulation of accelerating rotating beam converges to the steady state solution obtained by the shooting method. Other key areas considered include calculation of the effect of perturbing the steady state solution, coupled nonlinear flap-lag dynamics of a rotating articulated beam with hinge offset and aerodynamic damping, and static and dynamic responses of nonlinear composite beams with embedded anisotropic piezo-composite actuators. The book is intended as a thorough study of nonlinear elasticity of slender beams and is targeted to researchers, graduate students, and practicing engineers in the fields of structural dynamics, aerospace structures, and mechanical engineering.

The Shock and Vibration Digest - 1985

Analytical or Semi-analytical Solutions of Functionally Graded Material Structures - Zheng Zhong 2021-04-23

This book provides a comprehensive introduction to the analysis of functionally graded materials and structures. Functionally graded materials (FGMs), in which the volume fractions of two or more constituent materials are designed to vary continuously as a function of position along certain direction(s), have been developed and studied over the past three decades. The major advantage of FGMs is that no distinct internal boundaries exist, and failures from interfacial stress concentrations developed in conventional components can be avoided. The gradual change of material properties can be tailored to different applications and working environments. As these materials’ range of application expands, new methodologies have to be developed to characterize them, and to design and analyze structural components made of them. Despite a number of existing papers on the analysis of functionally graded materials and structures, there is no single book that is devoted entirely to the analysis of functionally graded beams, plates and shells using different methods, e.g.,analytical or semi-analytical methods. Filling this gap in the literature, the book offers a valuable reference resource for senior undergraduates, graduate students, researchers, and engineers in this field. The results presented here can be used as a benchmark for checking the validity and accuracy of other numerical solutions. They can also be used directly in the design of functionally graded materials and structures.

Boundary Element Methods - Q. Du 2014-05-23

Significant developments in the boundary element method during the last two decades have made it a powerful alternative to the domain-type numerical methods of solution such as the finite element method. The advances made in the BEM are more or less due to the innovation of efficient computational techniques by introducing boundary elements for discretization of the boundary integral equations resulting from the so-called direct formulation. BEM has therefore become an efficient tool for

optimal design and other inverse problems. These proceedings include discussion of the applications of BEM in mechanical engineering and the principles that have developed to make it an increasingly useful method of problem solving.

Computational Science and Its Applications - ICCSA 2008 - Osvaldo Gervasi 2008-06-28

This two-volume set is assembled following the 2008 International Conference on Computational Science and Its Applications, ICCSA 2008, a premium int- national event held in Perugia, Italy, from June 30 to July 3, 2008. The collection of fully refereed high-quality original works accepted as theme papers for presentation at ICCSA 2008 are published in this LNCS proceedings set. This outstanding collection complements the volume of workshop papers, traditionally published by IEEE Computer Society. The continuous support of computational science researchers has helped ICCSA to become a ?rmly established forum in the area of scienti?c computing and the conference itself become a recurring scienti?c and professional meeting that cannot be given up. The computational science ?eld, based on fundamental disciplines such as mathematics, physics, and chemistry, is ?nding new computational approaches to foster the human progress in heterogeneous and fundamental areas such as aerospace and automotive industries, bioinformatics and nanotechnology studies, networks and grid computing, computational geometry and biometrics, computer education, virtual reality, and art. Due to the growing complexity of many ch- lenges in computational science, the use of sophisticated algorithms and eme- ing technologies is inevitable. Together, these far-reaching scienti?c areas help to shape this conference in the areas of state-of-the-art computational science research and applications, encompassing the facilitating theoretical foundations and the innovative applications of such results in other areas.

Nonlinear Vibrations of Cantilever Beams and Plates - Mohammad Amin Rashidifar 2015-05-12

Many engineering problems can be solved using a linear approximation. In the Finite Element Analysis (FEA) the set of equations, describing the structural behaviour is then linear K d = F (1.1) In this matrix equation, K is the stiffness matrix of the structure, d is the nodal displacements vector and F is the external nodal force vector. Characteristics of linear problems is that the displacements are proportional to the loads, the stiffness of the structure is independent on the value of the load level. Though behaviour of real structures is nonlinear, e.g. displacements are not proportional to the loads; nonlinearities are usually unimportant and may be neglected in most practical problems.

Mathematical Modelling and Numerical Analysis of Size-Dependent Structural Members in Temperature Fields - Jan Awrejcewicz 2020-10-08

This book is devoted to researchers and teachers, as well as graduate students, undergraduates and bachelors in engineering mechanics, nano-mechanics, nanomaterials, nanostructures and applied mathematics. It presents a collection of the latest developments in the field of nonlinear (chaotic) dynamics of mass distributed-parameter nanomechanical structures, providing a rigorous and comprehensive study of modeling nonlinear phenomena. It is written in a unique pedagogical style particularly suitable for independent study and self-education. In addition, the book achieves a good balance between Western and Eastern extensive studies of the mathematical problems of nonlinear vibrations of structural members.

Beam Structures - Erasmo Carrera 2011-07-28

Beam theories are exploited worldwide to analyze civil, mechanical, automotive, and aerospace structures. Many beam approaches have been proposed during the last centuries by eminent scientists such as Euler, Bernoulli, Navier, Timoshenko, Vlasov, etc. Most of these models are problem dependent: they provide reliable results for a given problem, for instance a given section and cannot be applied to a different one. Beam Structures: Classical and Advanced Theories proposes a new original unified approach to beam theory that includes practically all classical and advanced models for beams and which has become established and recognised globally as the most important contribution to the field in the last quarter of a century. The Carrera Unified Formulation (CUF) has hierarchical properties, that is, the error can be reduced by increasing

the number of the unknown variables. This formulation is extremely suitable for computer implementations and can deal with most typical engineering challenges. It overcomes the problem of classical formulae that require different formulas for tension, bending, shear and torsion; it can be applied to any beam geometries and loading conditions, reaching a high level of accuracy with low computational cost, and can tackle problems that in most cases are solved by employing plate/shell and 3D formulations. Key features: compares classical and modern approaches to beam theory, including classical well-known results related to Euler-Bernoulli and Timoshenko beam theories pays particular attention to typical applications related to bridge structures, aircraft wings, helicopters and propeller blades provides a number of numerical examples including typical Aerospace and Civil Engineering problems proposes many benchmark assessments to help the reader implement the CUF if they wish to do so accompanied by a companion website hosting dedicated software MUL2 that is used to obtain the numerical solutions in the book, allowing the reader to reproduce the examples given in the book as well as to solve other problems of their own www.mul2.com Researchers of continuum mechanics of solids and structures and structural analysts in industry will find this book extremely insightful. It will also be of great interest to graduate and postgraduate students of mechanical, civil and aerospace engineering.

Nonlinear Analysis of Structures (1997) - Muthukrishnan Sathyamoorthy 2017-11-22

Nonlinear Analysis of Structures presents a complete evaluation of the nonlinear static and dynamic behavior of beams, rods, plates, trusses, frames, mechanisms, stiffened structures, sandwich plates, and shells. These elements are important components in a wide variety of structures and vehicles such as spacecraft and missiles, underwater vessels and structures, and modern housing. Today's engineers and designers must understand these elements and their behavior when they are subjected to various types of loads. Coverage includes the various types of nonlinearities, stress-strain relations and the development of nonlinear governing equations derived from nonlinear elastic theory. This complete guide includes both mathematical treatment and real-world applications, with a wealth of problems and examples to support the text. Special topics include a useful and informative chapter on nonlinear analysis of composite structures, and another on recent developments in symbolic computation. Designed for both self-study and classroom instruction, Nonlinear Analysis of Structures is also an authoritative reference for practicing engineers and scientists. One of the world's leaders in the study of nonlinear structural analysis, Professor Sathyamoorthy has made significant research contributions to the field of nonlinear mechanics for twenty-seven years. His foremost contribution to date has been the development of a unique transverse shear deformation theory for plates undergoing large amplitude vibrations and the examination of multiple mode solutions for plates. In addition to his notable research, Professor Sathyamoorthy has also developed and taught courses in the field at universities in India, Canada, and the United States.

Sensors, Circuits & Instrumentation Systems - Olfa Kanoun 2018-07-23

Signal Processing is one of the large specializations in electrical engineering, mechanical engineering and computer sciences. It derives input from physics, mathematics and is an indispensable feature of all natural- and life sciences in research and in application. The snew series "Advanced Issues on Signals, Systems and Devices" presents original publications mainly from speakers on the International Conferences on Signal Systems and Devices but also from other international authors. The Conference is a forum for researchers and specialists in different fields covering all types of sensors and measurement systems as for example: Biomedical and Environmental Measurements & Instrumentation; Optical, Chemical and Biomedical Sensors; Mechanical and Thermal Sensors; Micro-Sensors and MEMS-Technology; Nano Sensors, Nano Systems and Nano Technology; Spectroscopy Methods; Signal Processing and Modelling; Multi Sensor Data Fusion; Data Acquisition & Distributed Measurements; Medical and Environmental Applications; Circuit Test, Device Characterization and Modelling; Custom and Semi-Custom Circuits; Analog Circuit Design; Low-Voltage, Low-Power VLSI Design; Hardware Implementation; Materials, Devices

and Interconnects; Packaging and Reliability; Battery Monitoring: Impedance Spectroscopy for Measurement and Sensor Solutions; Energy Harvesting and Wireless power Transfer Systems; Wireless Sensor Networks in Industrial Plants This first volume of the new series mainly devotes to the most recent research and implementation of sensors-, circuit systems in signal processing, energy harvesting, nano- and molecular electronics.

Iron Compounds: Advances in Research and Application: 2011 Edition - 2012-01-09

Iron Compounds: Advances in Research and Application: 2011 Edition is a ScholarlyBrief™ that delivers timely, authoritative, comprehensive, and specialized information about Iron Compounds in a concise format. The editors have built Iron Compounds: Advances in Research and Application: 2011 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Iron Compounds in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Iron Compounds: Advances in Research and Application: 2011 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.

The Bending Theory of Fully Nonlinear Beams - Angelo Marcello Tarantino 2019-03-13

This book presents the bending theory of hyperelastic beams in the context of finite elasticity. The main difficulties in addressing this issue are due to its fully nonlinear framework, which makes no assumptions regarding the size of the deformation and displacement fields. Despite the complexity of its mathematical formulation, the inflexion problem of nonlinear beams is frequently used in practice, and has numerous applications in the industrial, mechanical and civil sectors. Adopting a semi-inverse approach, the book formulates a three-dimensional kinematic model in which the longitudinal bending is accompanied by the transversal deformation of cross-sections. The results provided by the theoretical model are subsequently compared with those of numerical and experimental analyses. The numerical analysis is based on the finite element method (FEM), whereas a test equipment prototype was designed and fabricated for the experimental analysis. The experimental data was acquired using digital image correlation (DIC) instrumentation. These two further analyses serve to confirm the hypotheses underlying the theoretical model. In the book's closing section, the analysis is generalized to the case of variable bending moment. The governing equations then take the form of a coupled system of three equations in integral form, which can be applied to a very wide class of equilibrium problems for nonlinear beams.

Proceedings of the 15th International Modal Analysis Conference - Society for Experimental Mechanics (U.S.) 1997

A Two-Step Perturbation Method in Nonlinear Analysis of Beams, Plates and Shells - Hui-Shen Shen 2013-07-03

The capability to predict the nonlinear response of beams, plates and shells when subjected to thermal and mechanical loads is of prime interest to structural analysis. In fact, many structures are subjected to high load levels that may result in nonlinear load-deflection relationships due to large deformations. One of the important problems deserving special attention is the study of their nonlinear response to large deflection, postbuckling and nonlinear vibration. A two-step perturbation method is firstly proposed by Shen and Zhang (1988) for postbuckling analysis of isotropic plates. This approach gives parametrical analytical expressions of the variables in the postbuckling range and has been generalized to other plate postbuckling situations. This approach is then successfully used in solving many nonlinear bending, postbuckling, and nonlinear vibration problems of composite laminated plates and shells, in particular for some difficult tasks, for example, shear deformable plates with four free edges resting on elastic foundations, contact postbuckling

of laminated plates and shells, nonlinear vibration of anisotropic cylindrical shells. This approach may be found its more extensive applications in nonlinear analysis of nano-scale structures. Concentrates on three types of nonlinear analyses: vibration, bending and postbuckling Presents not only the theoretical aspect of the techniques, but also engineering applications of the method A Two-Step Perturbation Method in Nonlinear Analysis of Beams, Plates and Shells is an original and unique technique devoted entirely to solve geometrically nonlinear problems of beams, plates and shells. It is ideal for academics, researchers and postgraduates in mechanical engineering, civil engineering and aeronautical engineering.

Parametric Resonance in Dynamical Systems - Thor I. Fossen 2011-12-14

Parametric Resonance in Dynamical Systems discusses the phenomenon of parametric resonance and its occurrence in mechanical systems, vehicles, motorcycles, aircraft and marine craft, along micro-electro-mechanical systems. The contributors provides an introduction to the root causes of this phenomenon and its mathematical equivalent, the Mathieu-Hill equation. Also included is a discussion of how parametric resonance occurs on ships and offshore systems, and its frequency in mechanical and electrical systems. This volume is ideal for researchers and mechanical engineers working in application fields such as MEMS, maritime, aircraft and ground vehicle engineering.

Vibration Engineering and Technology of Machinery - Jyoti K. Sinha 2014-08-14

The VETOMAC-X Conference covered a holistic plethora of relevant topics in vibration and engineering technology including condition monitoring, machinery and structural dynamics, rotor dynamics, experimental techniques, finite element model updating, industrial case studies, vibration control and energy harvesting, and signal processing. These proceedings contain not only all of the nearly one-hundred peer-reviewed presentations from authors representing more than twenty countries, but also include six invited lectures from renowned experts: Professor K. Gupta, Mr W. Hahn, Professor A.W. Lees, Professor John Mottershead, Professor J.S. Rao, and Dr P. Russhard. This work is of interest to researchers and practitioners alike, and is an essential book for most of libraries of higher academic institutes.

Topics in Nonlinear Mechanics and Physics - Mohamed Belhaq 2019-08-14

This book presents a selection of contributions from the 4th International Conference on Structural Nonlinear Dynamics and Diagnostics, reflecting diverse aspects of nonlinear and complex dynamics. Fifteen chapters discuss the latest findings and applications in active research areas in nonlinear mechanics and physics. These includes the dynamics of ships with liquid sloshing interaction, dynamics of drops and bubbles, nonlinear drying processes, suppression of time-delayed induced vibrations, dynamics of robotic systems, chaos detection in rolling element, dynamics of a planetary gear system with faults, vibro-impact systems, complex fractional moments for nonlinear systems, oscillations under hysteretic conditions, as well as topics in nonlinear energy harvesting and control.

Asymptotic Analysis of the Vibrations of Variable Length Cantilever Beams - Mahmoud Aly Younis 1991

Superelastic Shape Memory Alloy Cantilever Beam of Variable X-Section - Md. Arefin Kowser 2010-07

Cantilever beams, made of shape memory alloy (SMA), undergo much larger deflection in comparison to those made of other materials. Again, cantilever beams with reducing cross-section along the span show larger deflections compared to those of constant X-section beams.Furthermore, the degree of complexity will further increase if the material or physical non- linearity is involved, typically for an SMA beam.That takes such a study in the domain of geometric nonlinearity together with material nonlinearity. Problems of physical and geometric nonlinearities are always challenges for the engineers. Analysis was conducted for such a cantilever beam with reducing X- sectional area, made of SMA with highly nonlinear stress-strain curves.The book explains the numerical analysis of SMA beam and provides experimental investigation on SS

beam. Initially, experiments were conducted for SS beams with non-linear stress-strain curves. In addition to the experiment, a numerical simulation have been conducted for SMA beam.Effective modulus-curvature relations obtained from the nonlinear stress-strain relations for different sections of the beam that are used for the analysis.

Nonlinear Structural Mechanics - Walter Lacarbonara 2013-01-09

This book reviews the theoretical framework of nonlinear mechanics, covering computational methods, applications, parametric investigations of nonlinear phenomena and mechanical interpretation towards design. Builds skills via increasing levels of complexity.

Linear and Non-Linear Deformations of Elastic Solids - Arabinda Roy 2019-12-06

Linear and Non-Linear Deformations of Elastic Solids aims to compile the advances in the field of linear and non-linear elasticity through discussion of advanced topics. Broadly classified into two parts, it includes crack, contact, scattering and wave propagation in linear elastic solids and bending vibration, stability in non-linear elastic solids supported by MATLAB examples. This book is aimed at graduate students and researchers in applied mathematics, solid mechanics, applied mechanics, structural mechanics and includes comprehensive discussion of related analytical/numerical methods.

IUTAM Symposium on Nonlinear Analysis of Fracture - J.R. Willis 2012-12-06

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.

Applied Mechanics Reviews - 1984

Normal Modes and Localization in Nonlinear Systems - Alexander F. Vakakis 2013-06-29

The nonlinear normal modes of a parametrically excited cantilever beam are constructed by directly applying the method of multiple scales to the governing integral-partial differential equation and associated boundary conditions. The effect of the inertia and curvature nonlin earities and the parametric excitation on the spatial distribution of the deflection is examined. The results are compared with those obtained by using a single-mode discretization. In the absence of linear viscous and quadratic damping, it is shown that there are nonlinear normal modes, as defined by Rosenberg, even in the presence of a principal parametric excitation. Furthermore, the nonlinear mode shape obtained with the direct approach is compared with that obtained with the discretization approach for some values of the excitation frequency. In the single-mode discretization, the spatial distribution of the deflection is assumed a priori to be given by the linear mode shape ¢n, which is parametrically excited, as Equation (41). Thus, the mode shape is not influenced by the nonlinear curvature and nonlinear damping. On the other hand, in the direct approach, the mode shape is not assumed a priori; the nonlinear effects modify the linear mode shape ¢n. Therefore, in the case of large-amplitude oscillations, the single-mode discretization may yield

inaccurate mode shapes. References 1. Vakakis, A. F., Manevitch, L. I., Mikhlin, Y. v., Pilipchuk, V. N., and Zevin A. A., Nonnal Modes and Localization in Nonlinear Systems, Wiley, New York, 1996.
Nonlinear Structures & Systems, Volume 1 - Gaetan Kerschen 2021-11-16

Nonlinear Analysis of Thin-Walled Structures - James F. Doyle 2001-05-11
Mechanical engineering, an engineering discipline born of the needs of the Industrial Revolution, is once again asked to do its substantial share in the call for industrial renewal. The general call is urgent as we face the profound issues of productivity and competitiveness that require engineering solutions, among others. The Mechanical Engineering Series is a new series, featuring graduate texts and research monographs, intended to address the need for information in contemporary areas of mechanical engineering. The series is conceived as a comprehensive one that will cover a broad range of concentrations important to mechanical engineering graduate education and research. We are fortunate to have a distinguished roster of consulting editors, each an expert in one of the areas of concentration. The names of the consult ing editors are listed on page vi. The areas of concentration are applied mechanics, biomechanics, computational mechanics, dynamic systems and control, energetics, mechanics of materials, processing, thermal science, and tribology. We are pleased to present Nonlinear Analysis of Thin-Walled Structures by James F. Doyle. Austin, Texas Frederick F. Ling Preface This book is concerned with the challenging subject of the nonlinear static, dynamic, and stability analyses of thin-walled structures. It carries on from where Static and Dynamic Analysis of Structures, published by Kluwer 1991, left off; that book concentrated on frames and linear analysis, while the present book is focused on plated structures, nonlinear analysis, and a greater emphasis on stability analysis.
The Finite Element Analysis of Shells - Fundamentals - Dominique Chapelle 2010-11-09
This book presents a modern continuum mechanics and mathematical framework to study shell physical behaviors, and to formulate and evaluate finite element procedures. With a view towards the synergy that results from physical and mathematical understanding, the book focuses on the fundamentals of shell theories, their mathematical bases and finite element discretizations. The complexity of the physical behaviors of shells is analysed, and the difficulties to obtain uniformly optimal finite element procedures are identified and studied. Some modern finite element methods are presented for linear and nonlinear analyses. In this Second Edition the authors give new developments in the field and - to make the book more complete - more explanations throughout the text, an enlarged section on general variational formulations and new sections on 3D-shell models, dynamic analyses, and triangular elements. The analysis of shells represents one of the most challenging fields in all of mechanics, and encompasses various fundamental and generally applicable components. Specifically, the material presented in this book regarding geometric descriptions, tensors and mixed variational formulations is fundamental and widely applicable also in other areas of mechanics.
MEMS Linear and Nonlinear Statics and Dynamics - Mohammad I. Younis 2011-06-27
MEMS Linear and Nonlinear Statics and Dynamics presents the necessary analytical and computational tools for MEMS designers to model and simulate most known MEMS devices, structures, and phenomena. This book also provides an in-depth analysis and treatment of the most common static and dynamic phenomena in MEMS that are encountered by engineers. Coverage also includes nonlinear modeling approaches to modeling various MEMS phenomena of a nonlinear nature, such as those due to electrostatic forces, squeeze-film damping, and large deflection of structures. The book also: Includes examples of numerous MEMS devices and structures that require static or dynamic modeling Provides code for programs in Matlab, Mathematica, and ANSYS for simulating the behavior of MEMS structures Provides real world problems related to the dynamics of MEMS such as dynamics of electrostatically actuated devices, stiction and adhesion of microbeams

due to electrostatic and capillary forces MEMS Linear and Nonlinear Statics and Dynamics is an ideal volume for researchers and engineers working in MEMS design and fabrication.

Scientific and Technical Aerospace Reports - 1987

Computational Structural Engineering - Yong Yuan 2009-06-05

Following the great progress made in computing technology, both in computer and programming technology, computation has become one of the most powerful tools for researchers and practicing engineers. It has led to tremendous achievements in computer-based structural engineering and there is evidence that current devel- ments will even accelerate in the near future. To acknowledge this trend, Tongji University, Vienna University of Technology, and Chinese Academy of Engine- ing, co-organized the International Symposium on Computational Structural En- neering 2009 in Shanghai (CSE'09). CSE'09 aimed at providing a forum for presentation and discussion of sta- of-the-art development in scientific computing applied to engineering sciences. Emphasis was given to basic methodologies, scientific development and engine- ing applications. Therefore, it became a central academic activity of the Inter- tional Association for Computational Mechanics (IACM), the European Com- nity on Computational Methods in Applied Sciences (ECCOMAS), The Chinese Society of Theoretical and Applied Mechanic, the China Civil Engineering So- ety, and the Architectural Society of China. A total of 10 invited papers, and around 140 contributed papers were p- sented in the proceedings of the symposium. Contributors of papers came from 20 countries around the world and covered a wide spectrum related to the compu- tional structural engineering.