Nonlinear Solid Mechanics A Continuum Approach For Engineering Mechanical Engineering

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Nonlinear Solid Mechanics A Continuum Approach For Engineering Mechanical Engineering ***2024-03-03***

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Mathematical Methods in Continuum Mechanics of Solids John Wiley & Sons
Nonlinear Finite Elements for Continua and Structures p>Nonlinear Finite Elements for Continua and Structures This updated and expanded edition of the bestselling textbook provides a comprehensive introduction to the methods and theory of nonlinear finite element analysis. New material provides a concise introduction to some of the cutting-edge methods that have evolved in recent years in the field of nonlinear finite element modeling, and includes the eXtended Finite Element Method (XFEM), multiresolution continuum theory for multiscale microstructures, and dislocation- density-based crystalline plasticity. Nonlinear Finite Elements for Continua and Structures, Second Edition focuses on the formulation and solution of discrete equations for various classes of problems that are of principal interest in applications to solid and structural mechanics. Topics covered include the discretization by finite elements of continua in one dimension and in multi-dimensions; the formulation of constitutive equations for nonlinear materials and large deformations; procedures for the solution of the discrete equations, including considerations of both numerical and multiscale physical instabilities; and the treatment of structural and contact-impact problems. Key features: Presents a detailed and rigorous treatment of nonlinear solid mechanics and how it can be implemented in finite element analysis Covers many of the material laws used in today’s software and research Introduces advanced topics in nonlinear finite element modelling of continua Introduction of multiresolution continuum theory and XFEM Accompanied by a website hosting a solution manual and MATLAB® and FORTRAN code Nonlinear Finite Elements for Continua and Structures, Second Edition is a must-have textbook for graduate students in mechanical engineering, civil engineering, applied mathematics, engineering mechanics, and materials science, and is also an excellent source of information for researchers and practitioners.
The Mechanics and Thermodynamics of Continua Springer Science & Business Media
A clear and complete postgraduate introduction to the theory and computer programming for the complex simulation of material behavior.
Continuum Mechanics and Thermodynamics Springer
The new edition includes additional analytical methods in the classical theory of viscoelasticity. This leads to a new theory of finite linear viscoelasticity of incompressible isotropic materials. Anisotropic viscoplasticity is completely reformulated and extended to a general constitutive theory that covers crystal plasticity as a special case.
Cardiovascular Solid Mechanics Cambridge University Press
This publication is aimed at students, teachers, and researchers of Continuum Mechanics and focused extensively on stating and developing Initial Boundary Value equations used to solve physical problems. With respect to notation, the tensorial, indicial and Voigt notations have been used indiscriminately. The book is divided into twelve chapters with the following topics: Tensors, Continuum Kinematics, Stress, The Objectivity of Tensors, The Fundamental Equations of Continuum Mechanics, An Introduction to Constitutive Equations, Linear Elasticity, Hyperelasticity, Plasticity (small and large deformations), Thermoelasticity (small and large deformations), Damage Mechanics (small and large deformations), and An Introduction to Fluids. Moreover, the text is supplemented with over 280 figures, over 100 solved problems, and 130 references.
Nonlinear Solid Mechanics for Finite Element Analysis: Statics Springer Science & Business Media
Finite element methods have become ever more important to engineers as tools for design and optimization, now even for solving non-linear technological problems. However, several aspects must be considered for finite-element simulations which are specific for non-linear problems: These problems require the knowledge and the understanding of theoretical foundations and their finite-element discretization as well as algorithms for solving the non-linear equations. This book provides the reader with the required knowledge covering the complete field of finite element analyses in solid mechanics. It is written for advanced students in engineering fields but serves also as an introduction into non-linear simulation for the practising engineer.
Continuum Mechanics in the Earth Sciences CRC Press
This book provides physical and mathematical foundation as well as complete derivation of the mathematical descriptions and constitutive theories for deformation of solid and fluent continua, both compressible and incompressible with clear distinction between Lagrangian and Eulerian descriptions as well as co- and contra-variant bases. Definitions of co- and contra-variant tensors and tensor calculus are introduced using curvilinear frame and then specialized for Cartesian frame. Both Galilean and non-Galilean coordinate transformations are presented and used in establishing objective tensors and objective rates. Convected time derivatives are derived using the conventional approach as well as non-Galilean transformation and their significance is illustrated in finite deformation of solid continua as well as in the case of fluent continua. Constitutive theories are derived using entropy inequality and representation theorem. Decomposition of total deformation for solid and fluent continua into volumetric and distortional deformation is essential in providing a sound, general and rigorous framework for deriving constitutive theories. Energy methods and the principle of virtual work are demonstrated to be a small isolated subset of the calculus of variations. Differential form of the mathematical models and calculus of variations preclude energy methods and the principle of virtual work. The material in this book is developed from fundamental concepts at very basic level with gradual progression to advanced topics. This book contains core scientific knowledge associated with mathematical concepts and theories for deforming continuous matter to prepare graduate students for fundamental and basic research in engineering and sciences. The book presents detailed and consistent derivations with clarity and is ideal for self-study.
Constitutive Modelling of Solid Continua Springer Science & Business Media
This book describes behavior of crystalline solids primarily via methods of modern continuum mechanics. Emphasis is given to geometrically nonlinear descriptions, i.e., finite deformations. Primary topics include anisotropic crystal elasticity, plasticity, and methods for representing effects of defects in the solid on the material's mechanical response. Defects include crystal dislocations, point defects, twins, voids or pores, and micro-cracks. Thermoelastic, dielectric, and piezoelectric behaviors are addressed. Traditional and higher-order gradient theories of mechanical behavior of crystalline solids are discussed. Differential-geometric representations of kinematics of finite deformations and lattice defect distributions are presented. Multi-scale modeling concepts are described in the context of elastic and plastic material behavior. Representative substances towards which modeling techniques may be applied are single- and poly- crystalline metals and alloys, ceramics, and minerals. This book is intended for use by scientists and engineers involved in advanced constitutive modeling of nonlinear mechanical behavior of solid crystalline materials. Knowledge of fundamentals of continuum mechanics and tensor calculus is a prerequisite for accessing much of the text. This book could be used as supplemental material for graduate courses on continuum mechanics, elasticity, plasticity, micromechanics, or dislocation mechanics, for students in various disciplines of engineering, materials science, applied mathematics, and condensed matter physics.
Nonlinear Continuum Mechanics of Solids Springer
Modern computer simulations make stress analysis easy. As they continue to replace classical mathematical methods of analysis, these software programs require users to have a solid understanding of the fundamental principles on which they are based.Develop Intuitive Ability to Identify and Avoid Physically Meaningless PredictionsApplied Mechanics o
Localization And Solitary Waves In Solid Mechanics Springer
This book focuses on the need for an Eulerian formulation of constitutive equations. After introducing tensor analysis using both index and direct notation, nonlinear kinematics of continua is presented. The balance laws of the purely mechanical theory are discussed along with restrictions on constitutive equations due to superposed rigid body motion. The balance laws of the thermomechanical theory are discussed and specific constitutive equations are presented for: hyperelastic materials; elastic–inelastic materials; thermoelastic–inelastic materials with application to shock waves; thermoelastic–inelastic porous materials; and thermoelastic–inelastic growing biological tissues.
Nonlinear Finite Elements for Continua and Structures Springer Science & Business Media
Addresses behaviour of materials under extreme mechanical conditions and of failure in terms of non-linear continuum mechanics and instability theory.
Mechanics of Deformable Solids John Wiley & Sons
This book is a collection of recent reprints and new material on fundamentally nonlinear problems in structural systems which demonstrate localized responses to continuous inputs. It has two intended audiences. For mathematicians and physicists it should provide useful new insights into a classical yet rapidly developing area of application of the rich subject of dynamical systems theory. For workers in structural and solid mechanics it introduces a new methodology for dealing with structural localization and the related topic of the generation of solitary waves. Applications range from classical problems such as the buckling of cylindrical shells, twisted rods and pipelines, to the folding of geological strata, the failure of sandwich structures and the propagation of solitary waves in suspended beam systems.
Applied Asymptotic Methods in Nonlinear Oscillations Springer Science & Business Media
Finite element analysis for non-linear solids and structure porblems.
Computational Continuum Mechanics CRC Press
The aim of the book is the presentation of the fundamental mathematical and physical concepts of continuum mechanics of solids in a unified description so as to bring young researchers rapidly close to their research area. Accordingly, emphasis is given to concepts of permanent interest, and details of minor importance are omitted. The formulation is achieved systematically in absolute tensor notation, which is almost exclusively used in modern literature. This mathematical tool is presented such that study of the book is possible without permanent reference to other works.
Applied Mechanics of Solids Springer Science & Business Media
This interdisciplinary book provides graduate students in geophysics, planetary physics and geology with a class-tested, accessible overview of continuum mechanics.
Continuum Mechanics Through the Twentieth Century Springer Science & Business Media
This book presents the theory of continuum mechanics for mechanical, thermodynamical, and electrodynamical systems. It shows how to obtain governing equations and it applies them by computing the reality. It uses only open-source codes developed under the FEniCS project and includes

codes for 20 engineering applications from mechanics, fluid dynamics, applied thermodynamics, and electromagnetism. Moreover, it derives and utilizes the constitutive equations including coupling terms, which allow to compute multiphysics problems by incorporating interactions between primitive variables, namely, motion, temperature, and electromagnetic fields. An engineering system is described by the primitive variables satisfying field equations that are partial differential equations in space and time. The field equations are mostly coupled and nonlinear, in other words, difficult to solve. In order to solve the coupled, nonlinear system of partial differential equations, the book uses a novel collection of open-source packages developed under the FEniCS project. All primitive variables are solved at once in a fully coupled fashion by using finite difference method in time and finite element method in space.

Nonlinear Solid Mechanics for Finite Element Analysis McGraw Hill Professional

"Designing engineering components that make optimal use of materials requires consideration of the nonlinear static and dynamic characteristics associated with both manufacturing and working environments. The modeling of these characteristics can only be done through numerical formulation and simulation, which requires an understanding of both the theoretical background and associated computer solution techniques. The first book in the series Nonlinear Solid Mechanics for Finite Element Analysis considered static behaviour whilst this second text extends the subject to dynamics. By presenting nonlinear solid mechanics, dynamic conservation laws and principles and the associated finite element techniques together, the authors provide in this second book, a unified treatment of the dynamic simulation of nonlinear solids. Alongside a number of worked examples and exercises are user instructions, program descriptions, and examples for two MATLAB computer implementations for which source codes are available online. The dynamic version of the statics book program FLagSHyP is based on a displacement formulation and an innovative dynamic program PG DYNA LAWS is presented for the solution of problems expressed directly in the form of a system of first order conservation laws. While this book is designed to complement postgraduate courses, it is also relevant to those in industry requiring an appreciation of the way their computer simulation programs work"--

Schaum's Outline of Continuum Mechanics Springer Nature

Temam and Miranville present core topics within the general themes of fluid and solid mechanics. The brisk style allows the text to cover a wide range of topics including viscous flow, magnetohydrodynamics, atmospheric flows, shock equations, turbulence, nonlinear solid mechanics, solitons, and the nonlinear Schrödinger equation. This second edition will be a unique resource for those studying continuum mechanics at the advanced undergraduate and beginning graduate level whether in engineering, mathematics, physics or the applied sciences. Exercises and hints for solutions have been added to the majority of chapters, and the final part on solid mechanics has been substantially expanded. These additions have now made it appropriate for use as a textbook, but it also remains an ideal reference book for students and anyone interested in continuum mechanics.

Nonlinear Mechanics of Complex Structures Cambridge University Press

Continuum mechanics and thermodynamics are foundational theories of many fields of science and engineering. This book presents a fresh perspective on these fundamental topics, connecting micro- and nanoscopic theories and emphasizing topics relevant to understanding solid-state thermo-mechanical behavior. Providing clear, in-depth coverage, the book gives a self-contained treatment of topics directly related to nonlinear materials modeling. It starts with vectors and tensors, finite deformation kinematics, the fundamental balance and conservation laws, and classical thermodynamics. It then discusses the principles of constitutive theory and examples of constitutive models, presents a foundational treatment of energy principles and stability theory, and concludes with example closed-form solutions and the essentials of finite elements. Together with its companion book, Modeling Materials, (Cambridge University Press, 2011), this work presents the fundamentals of multiscale materials modeling for graduate students and researchers in physics, materials science, chemistry and engineering.

Continuum Mechanics with Eulerian Formulations of Constitutive Equations Springer Nature

For comprehensive—and comprehensible—coverage of both theory and real-world applications, you can’t find a better study guide than Schaum’s Outline of Continuum Mechanics. It gives you everything you need to get ready for tests and earn better grades! You get plenty of worked problems—solved for you step by step—along with hundreds of practice problems. From the mathematical foundations to fluid mechanics and viscoelasticity, this guide covers all the fundamentals—plus it shows you how theory is applied. This is the study guide to choose if you want to ace continuum mechanics!

Nonlinear Mechanics of Crystals Springer Science & Business Media

This book presents theories of deformable elastic strings and rods and their application to broad classes of problems. Readers will gain insights into the formulation and analysis of models for mechanical and biological systems. Emphasis is placed on how the balance laws interplay with constitutive relations to form a set of governing equations. For certain classes of problems, it is shown how a balance of material momentum can play a key role in forming the equations of motion. The first half of the book is devoted to the purely mechanical theory of a string and its applications. The second half of the book is devoted to rod theories, including Euler’s theory of the elastica, Kirchhoff ’s theory of an elastic rod, and a range of Cosserat rod theories. A variety of classic and recent applications of these rod theories are examined. Two supplemental chapters, the first on continuum mechanics of three-dimensional continua and the second on methods from variational calculus, are included to provide relevant background for students. This book is suited for graduate-level courses on the dynamics of nonlinearly elastic rods and strings.