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RILEY TOWNSEND

Canonical Duality Theory Springer

Nature
Advances in Engineering Materials, Structures and Systems: Innovations, Mechanics and Applications comprises 411 papers that were presented at SEMC 2019, the Seventh International Conference on Structural Engineering, Mechanics and Computation, held in Cape Town, South Africa, from 2 to 4 September 2019. The subject matter reflects the broad scope of SEMC conferences, and covers a wide variety of engineering materials (both traditional and innovative) and many types of structures. The many topics featured in these Proceedings can be classified into six broad categories that deal with: (i) the mechanics of materials and fluids (elasticity, plasticity, flow through porous media, fluid dynamics, fracture, fatigue, damage, delamination, corrosion, bond, creep, shrinkage, etc); (ii) the mechanics of structures and systems (structural dynamics, vibration, seismic response, soil-structure interaction, fluid-structure interaction, response to blast and impact, response to fire, structural stability, buckling, collapse behaviour); (iii) the numerical modelling and experimental testing of materials and structures (numerical methods, simulation techniques, multi-scale modelling, computational modelling, laboratory testing, field testing, experimental measurements); (iv) innovations and special structures (nanostructures, adaptive structures, smart structures, composite structures, bio-inspired structures, shell structures, membranes, space structures,

lightweight structures, long-span structures, tall buildings, wind turbines, etc); (v) design in traditional engineering materials (steel, concrete, steel-concrete composite, aluminium, masonry, timber, glass); (vi) the process of structural engineering (conceptualisation, planning, analysis, design, optimization, construction, assembly, manufacture, testing, maintenance, monitoring, assessment, repair, strengthening, retrofitting, decommissioning). The SEMC 2019 Proceedings will be of interest to civil, structural, mechanical, marine and aerospace engineers. Researchers, developers, practitioners and academics in these disciplines will find them useful. Two versions of the papers are available. Short versions, intended to be concise but self-contained summaries of the full papers, are in this printed book. The full versions of the papers are in the e-book.

Nonlinear Approaches in Engineering Applications Springer Science & Business

The book presents an overview of the state of research of advanced finite element technologies. Besides the mathematical analysis, the finite element development and their engineering applications are shown to the reader. The authors give a survey of the methods and technologies concerning efficiency, robustness and performance aspects. The book covers the topics of mathematical foundations for variational approaches and the mathematical understanding of the analytical requirements of modern finite element methods. Special attention is

paid to finite deformations, adaptive strategies, incompressible, isotropic or anisotropic material behavior and the mathematical and numerical treatment of the well-known locking phenomenon. Beyond that new results for the introduced approaches are presented especially for challenging nonlinear problems.

Finite Element Method Springer Nature

Contact mechanics is an active research area with deep theoretical and numerical roots. The links between nonsmooth analysis and optimization with mechanics have been investigated intensively during the last decades, especially in Europe. The study of complementarity problems, variational -, quasivariational- and hemivariational inequalities arising in contact mechanics and beyond is a hot topic for interdisciplinary research and cooperation. The needs of industry for robust solution algorithms suitable for large scale applications and the regular updates of the respective elements in major commercial computational mechanics codes, demonstrate that this interaction is not restricted to the academic environment. The contributions of this book have been selected from the participants of the CMIS 2009 international conference which took place in Crete and continued a successful series of specialized contact mechanics conferences.

Springer

This book presents a novel continuum finite deformation framework addressing

the complex interactions among electrostatics, species transport, and mechanics in solid networks immersed in a fluid phase of solvent and ions. Grounded on cutting-edge multiphysics theories for soft active materials, the proposed model is primarily applied to ionic polymer metal composites (IPMCs). First, the influence of shear deformation on the IPMC response is analyzed through semi-analytical solutions obtained via the method of matched asymptotic expansions. Second, the novel electrochemo-poromechanical theory is used to predict the curvature relaxation and electric discharge that are observed in IPMC actuation and sensing, respectively, under a sustained stimulus. This newly formulated theory is, in turn, applied to biological cell clusters. Here, important mechanical considerations are integrated into classical bioelectrical models, thus offering novel insights into the interplay of mechanical and electrical signaling in the coordination of developmental processes.

Automated Solution of Differential Equations by the Finite Element Method

John Wiley & Sons

The main goal of the book is a coherent treatment of the theory of propagation in materials of nonlinearly elastic waves of displacements, which corresponds to one modern line of development of the nonlinear theory of elastic waves. The book is divided on five basic parts: the necessary information on waves and materials; the necessary information on nonlinear theory of elasticity and elastic materials; analysis of one-dimensional

nonlinear elastic waves of displacement – longitudinal, vertically and horizontally polarized transverse plane nonlinear elastic waves of displacement; analysis of one-dimensional nonlinear elastic waves of displacement – cylindrical and torsional nonlinear elastic waves of displacement; analysis of two-dimensional nonlinear elastic waves of displacement – Rayleigh and Love nonlinear elastic surface waves. The book is addressed first of all to people working in solid mechanics – from the students at an advanced undergraduate and graduate level to the scientists, professionally interesting in waves. But mechanics is understood in the broad sense, when it includes mechanical and other engineering, material science, applied mathematics and physics and so forth. The genesis of this book can be found in author's years of research and teaching while a head of department at SP Timoshenko Institute of Mechanics (National Academy of Sciences of Ukraine), a member of Center for Micro and Nanomechanics at Engineering School of University of Aberdeen (Scotland) and a professor at Physical-Mathematical Faculty of National Technical University of Ukraine "KPI". The book comprises 11 chapters. Each chapter is complemented by exercises, which can be used for the next development of the theory of nonlinear waves.

Modeling the Electrochemo-poromechanics of Ionic Polymer Metal Composites and Cell Clusters Walter de Gruyter

Elastomers are found in many applications ranging from technology to daily life applications for example in tires, drive systems, sealings and print rollers. Dynamical operation conditions put extremely high demands on the performance and stability of these materials and their elastic and flow properties can be easily adjusted by simple manipulations on their elastic and viscous properties. However, the required service life suffers often from material damage as a result of wear processes such as abrasion and wear fatigue, mostly caused by crack formation and propagation. This book covers interdisciplinary research between physics, physical chemistry, material sciences and engineering of elastomers within the range from nanometres to millimetres and connects these aspects with the constitutive material properties. The different chapters describe reliable lifetime and durability predictions based on new fracture mechanical testing concepts and advanced material-theoretical methods which are finally implemented in the finite element method for structural simulations. The use of this approach allows a realistic description of complex geometrical and loading conditions which includes the peculiarities of the mechanical behaviour of elastomeric materials in detail. Furthermore, this approach demonstrates how multi-scale research concepts provide an ambitious interdisciplinary challenge at the interface between engineering and

natural sciences. This book covers the interests of academic researchers, graduate students and professionals working in polymer science, rubber and tire technology and in materials science at the interface of academic and industrial research.

Cardiovascular Solid Mechanics Springer

Numerical mathematics is a subtopic of scientific computing. The focus lies on the efficiency of algorithms, i.e. speed, reliability, and robustness. This leads to adaptive algorithms. The theoretical derivation und analyses of algorithms are kept as elementary as possible in this book; the needed sligtly advanced mathematical theory is summarized in the appendix. Numerous figures and illustrating examples explain the complex data, as non-trivial examples serve problems from nanotechnology, chirurgy, and physiology. The book addresses students as well as practitioners in mathematics, natural sciences, and engineering. It is designed as a textbook but also suitable for self study.

Computational Contact and Impact Mechanics John Wiley & Sons

Many physical systems require the description of mechanical interaction across interfaces if they are to be successfully analyzed. Examples in the engineered world range from the design of prosthetics in biomedical engi neering (e. g. , hip replacements); to characterization of the response and durability of head/disk interfaces in computer magnetic storage devices; to development of pneumatic tires with

better handling characteristics and increased longevity in automotive engineering; to description of the adhe sion and/or relative slip between concrete and reinforcing steel in structural engineering. Such mechanical interactions, often called contact/impact in teractions, usually necessitate at minimum the determination of areas over which compressive pressures must act to prevent interpenetration of the mechanical entities involved. Depending on the application, frictional be havior, transient interaction of interfaces with their surroundings (e. g. , in termittent stick/slip), thermo-mechanical coupling, interaction with an in tervening lubricant and/or fluid layer, and damage of the interface (i. e. , wear) may also be featured. When taken together (or even separately!), these features have the effect of making the equations of mechanical evolu tion not only highly nonlinear, but highly nonsmooth as well. While many modern engineering simulation packages possess impressive capabilities in the general area of nonlinear mechanics, it can be contended that methodologies typically utilized for contact interactions are relatively immature in comparison to other components of a nonlinear finite element package, such as large deformation kinematics, inelastic material modeling, nonlinear equation solving, or linear solver technology.

Real-time Biomechanical Modeling for Intraoperative Soft Tissue Registration Springer Science & Business Media

This book surveys research results on the physical and mathematical modeling, as well as the numerical simulation of complex fluid and structural mechanical processes occurring in the human blood circulation system. Topics treated include continuum mechanical description; choice of suitable liquid and wall models; mathematical analysis of coupled models; numerical methods for flow simulation; parameter identification and model calibration; fluid-solid interaction; mathematical analysis of piping systems; particle transport in channels and pipes; artificial boundary conditions, and many more. The book was developed from lectures presented by the authors at the Oberwolfach Research Institute (MFO), in Oberwolfach-Walke, Germany, November, 2005.

Variational Views in Mechanics Springer Science & Business Media

International Young Physicists' Tournament (IYPT), is one of the most prestigious international physics contests among high school students. This book is based on the solutions of 2014 IYPT problems. The authors are undergraduate students who participated in the CUPT (Chinese Undergraduate Physics Tournament). It is intended as a college level solution to the challenging open-ended problems. It provides original, quantitative solutions in fulfilling seemingly impossible tasks. This book is not limited to the tasks required by the problems and it is not confined to the models and methods in present literatures. Many of the articles

include modification and extension to existing models in references, or derivation and computation based on fundamental physics. This book provides quantitative solutions to practical problems in everyday life. This is a good reference book for undergraduates, advanced high-school students, physics educators and curious public interested in the intriguing phenomena in daily life. List of supplementary materials: More solutions not included in the book: Solution to problem 4. Ball sound (2 MB) Solution to problem 13. Rotating saddle (2 MB) Solution to problem 14. Rubber motor (3 MB) Others Problem 2: Hologram Video1, IYPT display (16 MB) Video2, parallax of real objects (1 MB) Video3, parallax of 'hologram' image (14 MB) Problem 3: Twisted Rope Video1, twist process of a silicon gel rope (twisted 8 rounds) (16 MB) Video2, twist process of a multi-strand rope (twisted 20 rounds) (17 MB) Problem 6: Bubble crystal Video 1, the attraction of two bubbles (4 MB) Video 2, bubble crystal formation (1 MB) Video 3, vacancy and replacement (1 MB) Problem 8: Freezing droplets Video1, freezing of water droplets (10 MB) Video2, freezing of a paraffin droplet (9 MB) Problem 10: Coefficient of diffusion Video1, Diffusion of particles (3 MB) Source Code, The full set of program we used in experiment (2 MB) Problem 12: Cold balloon Video1, sphere.avi: Change of strain energy density distribution of a spherical balloon. The lower part has a larger deformation so that the temperature increase is larger. The color scale is the

same as in Fig. 13. Red indicates larger energy density, blue the smaller one. (17 MB) Video2, realballoon.avi: Change of strain energy density distribution of a real balloon. The color scale is the same as in Fig. 15. Red indicates larger energy density and larger temperature increase, blue for smaller change. (17 MB) Problem 15: Oil Stars Video1, six-crests.mov: stable faraday waves of six crests (2 MB) Video2, one-and-two crests.gif: faraday waves of one and two crests (1 MB) Video3, three-crests.gif: faraday waves of three crests (1 MB) Video4, four-crests.gif: faraday waves of four crests (1 MB) Request Inspection Copy

International Young Physicists' Tournament Springer Science & Business Media

This text presents a general introduction to soft tissue biomechanics. One of its primary goals is to introduce basic analytical, experimental and computational methods. In doing so, it enables readers to gain a relatively complete understanding of the biomechanics of the heart and vasculature.

Mechanics and Electrodynamics of Magneto- and Electro-elastic Materials Springer Nature

This book introduces the subject of hyperelasticity in a concise manner mainly directed to students of solid mechanics who have a familiarity with continuum mechanics. It focuses on important introductory topics in the field of nonlinear material behavior and presents a number of example problems

and solutions to greatly aid the student in mastering the difficulty of the subject and gaining necessary insight. Professor Hackett delineates the concepts and applications of hyperelasticity in such a way that a new student of the subject can absorb the intricate details without having to wade through excessively complicated formulations. The book further presents significant review material on intricately related subjects such as tensor calculus and introduces some new formulations.

Continuum Mechanics and Thermodynamics of Matter Springer Science & Business Media

This book provides a unified theory on nonlinear electro-magnetomechanical interactions of soft materials capable of large elastic deformations. The authors include an overview of the basic principles of the classic theory of electromagnetism from the fundamental notions of point charges and magnetic dipoles through to distributions of charge and current in a non-deformable continuum, time-dependent electromagnetic fields and Maxwell's equations. They summarize relevant theories of continuum mechanics, required to account for the deformability of material and present a constitutive framework for the nonlinear magneto- and electroelastic interactions in a highly deformable material. The equations contained in the book formulate and solve a variety of representative boundary-value problems for both nonlinear magnetoelasticity and electroelasticity.

Nonsmooth Mechanics and Convex Optimization Springer
"This book concerns matter that is intrinsically difficult: convex optimization, complementarity and duality, nonsmooth analysis, linear and nonlinear programming, etc. The author has skillfully introduced these and many more concepts, and woven them into a seamless whole by retaining an easy and consistent style throughout. The book is not all theory: There are many real-life applications in structural engineering, cable networks, frictional contact problems, and plasticity... I recommend it to any reader who desires a modern, authoritative account of nonsmooth mechanics and convex optimization." — Prof. Graham M.L. Gladwell, Distinguished Professor Emeritus, University of Waterloo, Fellow of the Royal Society of Canada "... reads very well—the structure is good, the language and style are clear and fluent, and the material is rendered accessible by a careful presentation that contains many concrete examples. The range of applications, particularly to problems in mechanics, is admirable and a valuable complement to theoretical and computational investigations that are at the forefront of the areas concerned." — Prof. B. Daya Reddy, Department of Mathematics and Applied Mathematics, Director of Centre for Research in Computational and Applied Mechanics, University of Cape Town, South Africa "Many materials and structures (e.g., cable networks, membrane) involved in practical engineering applications have

complex responses that cannot be described by smooth constitutive relations. ... The author shows how these difficult problems can be tackled in the framework of convex analysis by arranging the carefully chosen materials in an elegant way. Most of the contents of the book are from the original contributions of the author. They are both mathematically rigorous and readable. This book is a must-read for anyone who intends to get an authoritative and state-of-art description for the analysis of nonsmooth mechanics problems with theory and tools from convex analysis." — Prof. Xu Guo, State Key Laboratory of Structural Analysis for Industrial Equipment, Department of Engineering Mechanics, Dalian University of Technology

Modern Mechanics and Applications Springer
Providing a modern and comprehensive coverage of continuum mechanics, this volume includes information on "variational principles"--Significant, as this is the only method by which such material is actually utilized in engineering practice.
Nonlinear Finite Element Analysis of Solids and Structures Springer Nature
This book thoroughly describes a theory concerning the yield and failure of materials under multi-axial stresses – the Unified Strength Theory, which was first proposed by the author and has been frequently quoted since. It provides a system of yield and failure criteria adopted for most materials, from metals to rocks, concretes, soils, and polymers.

This new edition includes six additional chapters: General behavior of Strength theory function; Visualization of the Unified Strength Theory; Equivalent Stress of the UST and Comparisons with other criteria; Economic Signification of the UST; General form of failure criterion; Beauty of Strength Theories. It is intended for researchers and graduate students in various fields, including engineering mechanics, material mechanics, plasticity, soil mechanics, rock mechanics, mechanics of metallic materials and civil engineering, hydraulic engineering, geotechnical engineering, mechanical engineering and military engineering.

Fracture Mechanics and Statistical Mechanics of Reinforced Elastomeric Blends Springer Science & Business Media

This edited volume summarizes research being pursued within the DFG Priority Programme 1748: "Reliable Simulation Methods in Solid Mechanics. Development of non-standard discretisation methods, mechanical and mathematical analysis", the aim of which was to develop novel discretisation methods based e.g. on mixed finite element methods, isogeometric approaches as well as discontinuous Galerkin formulations, including a sound mathematical analysis for geometrically as well as physically nonlinear problems. The Priority Programme has established an international framework for mechanical and applied mathematical research to pursue open challenges on an inter-disciplinary level. The compiled

results can be understood as state of the art in the research field and show promising ways of further research in the respective areas. The book is intended for doctoral and post-doctoral students in civil engineering, mechanical engineering, applied mathematics and physics, as well as industrial researchers interested in the field.

Generalized Models and Non-classical Approaches in Complex Materials 1 CRC Press

This book is a tutorial written by researchers and developers behind the FEniCS Project and explores an advanced, expressive approach to the development of mathematical software. The presentation spans mathematical background, software design and the use of FEniCS in applications. Theoretical aspects are complemented with computer code which is available as free/open source software. The book begins with a special introductory tutorial for beginners. Following are chapters in Part I addressing fundamental aspects of the approach to automating the creation of finite element solvers. Chapters in Part II address the design and implementation of the FEnicS software. Chapters in Part III present the application of FEniCS to a wide range of applications, including fluid flow, solid mechanics, electromagnetics and geophysics.

Computational Continuum Mechanics Springer Science & Business Media

This book focuses on the latest applications of nonlinear approaches in engineering and addresses a range of

scientific problems. Examples focus on issues in automotive technology, including automotive dynamics, control for electric and hybrid vehicles, and autodriver algorithm for autonomous vehicles. Also included are discussions on renewable energy plants, data modeling, driver-aid methods, and low-frequency vibration. Chapters are based on invited contributions from world-class experts who advance the future of engineering by discussing the development of more optimal, accurate, efficient, cost, and energy effective systems. This book is appropriate for researchers, students, and practising engineers who are interested in the applications of nonlinear approaches to solving engineering and science problems. Presents a broad range of practical topics and approaches; Explains approaches to better, safer, and cheaper systems; Emphasises automotive applications, physical meaning, and methodologies.

The Finite Element Method for Three-Dimensional Thermomechanical Applications

Springer Science & Business Media

This book provides the fundamental basics for solving fluidstructure interaction problems, and describes different algorithmsand numerical methods used to solve problems where fluid andstructure can be weakly or strongly coupled. These approaches areillustrated with examples arising from industrial or academicapplications. Each of these approaches has its own performance andlimitations. Given the

book’s comprehensive coverage,engineers, graduate students and researchers involved in thesimulation of practical fluid structure interaction problems willfind this book extremely useful.