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Multiscale Methods in Computational Mechanics Cambridge University Press

This book provides a comprehensive introduction to the mathematical and algorithmic methods for the Multidisciplinary Design Optimization (MDO) of complex mechanical systems such as aircraft or car engines. We have focused on the presentation of strategies efficiently and economically managing the different levels of complexity in coupled disciplines (e.g. structure, fluid, thermal, acoustics, etc.), ranging from Reduced Order Models (ROM) to full-scale Finite Element (FE) or Finite Volume (FV) simulations. Particular focus is given to the uncertainty quantification and its impact on the robustness of the optimal designs. A large collection of examples from academia, software editing and industry should also help the reader to develop a practical insight on MDO methods.

Computational Contact Mechanics Springer Nature

Computational Mechanics of the Classical Guitar describes a new dynamic paradigm in instrument acoustics based on time-dependent transient analysis and simulation of complete musical instruments. It describes the current state of theoretical and experimental research into the guitar for engineers, instrument makers and musicians. This includes a summary of the basic equations for the mechanics of vibrating bodies and a presentation of the FDM (finite difference method) model with which the true vibrational behaviour of the instrument as an entire system can be understood for the first time. This monograph presents various new theoretical and experimental results and insights into guitar playing such as the coupling between the strings and the top plate or a description of the finger noise made when the fingers slide over the strings before plucking.

Recent Developments CRC Press

This book is intended to provide a compilation of the state-of-the-art numerical methods for nonlinear fluid-structure interaction using the moving boundary Lagrangian-Eulerian formulation. Single and two-phase viscous incompressible fluid flows are considered with the increasing complexity of structures ranging from rigid-body, linear elastic and nonlinear large deformation to fully-coupled flexible multibody system. This book is unique with regard to computational modeling of such complex fluid-structure interaction problems at high Reynolds numbers, whereby various coupling techniques are introduced and systematically discussed. The techniques are demonstrated for large-scale practical problems in aerospace and marine/offshore engineering. This book also provides a comprehensive understanding of underlying unsteady physics and coupled mechanical aspects of the fluid-structure interaction from a computational point of view. Using the body-fitted and moving mesh formulations, the physical insights associated with structure-to-fluid mass ratios (i.e., added mass effects), Reynolds number, large structural deformation, free surface, and other interacting physical fields are covered. The book includes the basic tools necessary to build the concepts required for modeling such coupled fluid-structure interaction problems, thus exposing the reader to advanced topics of multiphysics and multiscale phenomena.

Special Issue Fourth World Congress on Computational Mechanics MDPI

This book (Vol. - I) presents select proceedings of the first Online International Conference on Recent Advances in Computational and Experimental Mechanics (ICRACEM 2020) and focuses on theoretical, computational and experimental aspects of solid and fluid mechanics. Various topics covered are computational modelling of extreme events; mechanical modelling of robots; mechanics and design of cellular materials; mechanics of soft materials; mechanics of thin-film and multi-layer structures; meshfree and particle based formulations in continuum mechanics; multi-scale computations in solid mechanics, and materials; multiscale mechanics of brittle and ductile materials; topology and shape optimization techniques; acoustics including aero-acoustics and wave propagation; aerodynamics; dynamics and control in micro/nano engineering; dynamic instability and buckling; flow-induced noise and vibration; inverse problems in mechanics and system identification; measurement and analysis techniques in nonlinear dynamic systems; multibody dynamical systems and applications; nonlinear dynamics and control; stochastic mechanics; structural dynamics and earthquake engineering; structural health monitoring and damage assessment; turbomachinery noise; vibrations of continuous systems, characterization of advanced materials; damage identification and non-destructive evaluation; experimental fire mechanics and damage; experimental fluid mechanics; experimental solid mechanics; measurement in extreme environments; modal testing and dynamics; experimental hydraulics; mechanism of scour under steady and unsteady flows; vibration measurement and control; bio-inspired materials; constitutive modelling of materials; fracture mechanics; mechanics of adhesion, tribology and wear; mechanics of composite materials; mechanics of multifunctional materials; multiscale modelling of materials; phase transformations in materials; plasticity and creep in materials; fluid mechanics, computational fluid dynamics; fluid-structure interaction; free surface, moving boundary and pipe flow; hydrodynamics; multiphase flows; propulsion; internal flow physics; turbulence modelling; wave mechanics; flow through porous media; shock-boundary layer interactions; sediment transport; wave-structure interaction; reduced-order models; turbo-machinery; experimental hydraulics; mechanism of scour under steady and unsteady flows; applications of machine learning and artificial intelligence in mechanics; transport phenomena and soft computing tools in fluid mechanics. The contents of these two volumes (Volumes I and II) discusses various attributes of modern-age mechanics in various disciplines, such as aerospace, civil, mechanical, ocean engineering and naval architecture. The book will be a valuable reference for beginners, researchers, and professionals interested in solid and fluid mechanics and allied fields.

Special Issue on Computational Mechanics Springer Nature

Advances in Applied Mechanics draws together recent significant advances in various topics in applied mechanics. Published since 1948, Advances in Applied Mechanics aims to provide authoritative review articles on topics in the mechanical sciences, primarily of interest to scientists and engineers working in the various branches of mechanics, but also of interest to the many who use the results of investigations in mechanics in various application areas, such as aerospace, chemical, civil, environmental, mechanical and nuclear engineering. Covers all fields of the mechanical sciences Highlights classical and modern areas of mechanics that are ready for review Provides comprehensive coverage of the field in question

Multidisciplinary Design Optimization in Computational Mechanics Saxe-Coburg Publications

The present volume of Applied Mechanics and Materials contains 107 selected full-length papers from the 2nd Australasian Conference on Computational Mechanics held in Brisbane, Australia on 30 November 2015 to 1 December 2015 (ACCM2015). The collected articles well reflect the latest progress made in some emerging areas of computational mechanics, including finite element method, finite volume method, meshless method, atomic and multiscale modelling method, structural and solid mechanics, computational fluid dynamics, geomechanics, computational biomechanics, structural and topology optimization, fracture and damage mechanics, and vibration and dynamics.

Recent Advances in Computational and Experimental Mechanics, Vol—I Springer

An updated and expanded edition of the popular guide to basic continuum mechanics and computational techniques This updated third edition of the popular reference covers state-of-the-art computational techniques for basic continuum mechanics modeling of both small and large deformations. Approaches to developing complex models are described in detail, and numerous examples are presented demonstrating how computational algorithms can be developed using basic continuum mechanics approaches. The integration of geometry and analysis for the study of the motion and behaviors of materials under varying conditions is an increasingly popular approach in continuum mechanics, and absolute nodal coordinate formulation (ANCF) is rapidly emerging as the best way to achieve that integration. At the same time, simulation software is undergoing significant changes which will lead to the seamless fusion of CAD, finite element, and multibody system computer codes in one computational environment. Computational Continuum Mechanics, Third Edition is the only book to provide in-depth coverage of the formulations required to achieve this integration. Provides detailed coverage of the absolute nodal coordinate formulation (ANCF), a popular new approach to the integration of geometry and analysis Provides detailed coverage of the floating frame of reference (FFR) formulation, a popular well-established approach for solving small deformation problems Supplies numerous examples of how complex models have been developed to solve an array of real-world problems Covers modeling of both small and large deformations in detail Demonstrates how to develop computational algorithms using basic continuum mechanics approaches Computational Continuum Mechanics, Third Edition is designed to function equally well as a text for advanced undergraduates and first-year graduate students and as a working reference for researchers, practicing engineers, and scientists working in computational mechanics, bio-mechanics, computational biology, multibody system dynamics, and other fields of science and engineering using the general continuum mechanics theory.

Computational Fluid and Solid Mechanics 2003 Springer Science & Business Media

The use of machine learning in mechanics is booming. Algorithms inspired by developments in the field of artificial intelligence today cover increasingly varied fields of application. This book illustrates recent results on coupling machine learning with computational mechanics, particularly for the construction of surrogate models or reduced order models. The articles contained in this compilation were presented at the EUROMECH Colloquium 597, « Reduced Order Modeling in Mechanics of Materials », held in Bad Herrenalb, Germany, from August 28th to August 31th 2018. In this book, Artificial Neural Networks are coupled to physics-based models. The tensor format of simulation data is exploited in surrogate models or for data pruning. Various reduced order models are proposed via machine learning strategies applied to simulation data. Since reduced order models have specific approximation errors, error estimators are also proposed in this book. The proposed numerical examples are very close to engineering problems. The reader would find this book to be a useful reference in identifying progress in machine learning and reduced order modeling for computational mechanics.

Selected Papers from WCCM II, Second World Congress of Computational Mechanics Allied Publishers

This conference book contains papers presented at the 8th GACM Colloquium on Computational Mechanics for Young Scientists from Academia and Industry. The conference was held from August 28th – 30th, 2019 in Kassel, hosted by the Institute of Mechanics and Dynamics of the department for civil and environmental engineering and by the chair of Engineering Mechanics / Continuum Mechanics of the department for mechanical engineering of the University of Kassel. The aim of the conference is, to bring together young scientits who are engaged in academic and industrial research on Computational Mechanics and Computer Methods in Applied Sciences. It provides a plattform to present and discuss recent results from research efforts and industrial applications. In more than 150 presentations, given by young scientists, current scientific

developments and advances in engineering practice in this field are presented and discussed. The contributions of the young researchers are supplemented by a poster session and plenary talks from four senior scientists from academia and industry as well as from the GACM Best PhD Award winners 2017 and 2018.

Proceedings of 8th GACM Colloquium on Computational Mechanics Trans Tech Publications Ltd

The Second Sino-US Symposium Workshop on Recent Advancement of Computational Mechanics in Structural Engineering was held between May 25-28, 1998, in Dalian, China. The objectives were: to share the insights and experiences gained from recent developments in theory and practice; to assess the current state of knowledge in various topic areas of mechanics and computational methods and to identify joint research opportunities; to stimulate future cooperative research and to develop joint efforts in subjects of common needs and interests; to build and to strengthen the long-term bilateral scientific relationship between academic and professional practicing communities. Topics discussed covered the entire field of computational structural mechanics. These topics have advanced broad applications in the engineering practice of modern structural analysis, design and construction of buildings and other structures, and in natural hazard mitigation.

Computational Continuum Mechanics Springer Nature

Volume is indexed by Thomson Reuters CPCI-S (WoS). Following the great progress made in Computational Mechanics and Materials, the 2011 International Workshop on Computational Mechanics, Materials and Engineering Applications (CMMEA 2011) aimed at providing a forum for the presentation and discussion of state-of-the-art developments in Computational Mechanics and Engineering Applications, Building Materials, Geotechnical & Soil Engineering and Materials Science and Engineering Applications. The emphasis was placed on basic methodologies, scientific developments and engineering applications.

Advances in Applied Mechanics Academic Press

The field of rock mechanics and rock engineering utilizes the basic laws of continuum mechanics and the techniques developed in computational mechanics. This book describes the basic concepts behind these fundamental laws and their utilization in practice irrespective of whether rock/rock mass contains discontinuities. This book consists of nine chapters and six appendices. The first four chapters are concerned with continuum mechanics aspects, which include the basic operations, definition of stress and strain tensors, and derivation of four fundamental conservation laws in the simplest yet precise manner. The next two chapters are the preparation for computational mechanics, which require constitutive laws of geomaterials relevant to each conservation law and the procedures for how to determine required parameters of the constitutive laws. Computational mechanics solves the resulting ordinary and partial differential equations. In Chapter 7, the methods of exact (closed-form) solutions are explained and they are applied to ordinary/partial differential equations with solvable boundary and initial conditions. In Chapter 8, the fundamentals of approximate solution methods are explained for one dimension first and then how to extend them to multi-dimensional problems. The readers are expected to learn and clearly understand how they are derived and applied to various problems in geomechanics. The final chapter involves the applications of the approximate methods to the actual problems in practice for geomechanical engineers, which cover the continuum to discontinuum, including the stress state of the earth as well as the ground motions induced by earthquakes. Six appendices are provided to have a clear understanding of continuum mechanics operations and procedures for how to deal with discontinuities/interfaces often encountered in rock mechanics and rock engineering.

Computational Mechanics John Wiley & Sons

Bringing together the world's leading researchers and practitioners of computational mechanics, these new volumes meet and build on the eight key challenges for research and development in computational mechanics. Researchers have recently identified eight critical research tasks facing the field of computational mechanics. These tasks have come about because it appears possible to reach a new level of mathematical modelling and numerical solution that will lead to a much deeper understanding of nature and to great improvements in engineering design. The eight tasks are: The automatic solution of mathematical models Effective numerical schemes for fluid flows The development of an effective mesh-free numerical solution method The development of numerical procedures for multiphysics problems The development of numerical procedures for multiscale problems The modelling of uncertainties The analysis of complete life cycles of systems Education - teaching sound engineering and scientific judgement Readers of Computational Fluid and Solid Mechanics 2003 will be able to apply the combined experience of many of the world's leading researchers to their own research needs. Those in academic environments will gain a better insight into the needs and constraints of the industries they are involved with; those in industry will gain a competitive advantage by gaining insight into the cutting edge research being carried out by colleagues in academia. Features Bridges the gap between academic researchers and practitioners in industry Outlines the eight main challenges facing Research and Design in Computational mechanics and offers new insights into the shifting the research agenda Provides a vision of how strong, basic and exciting education at university can be harmonized with life-long learning to obtain maximum value from the new powerful tools of analysis

Advanced Computational Vibroacoustics Academic Press

This book explores the numerical algorithms underpinning modern finite element based computational mechanics software. It covers all the major numerical methods that are used in computational mechanics. It reviews the basic concepts in linear algebra and advanced matrix theory, before covering solution of systems of equations, symmetric eigenvalue solution methods, and direct integration of discrete dynamic equations of motion, illustrated with numerical examples. This book suits a graduate course in mechanics based disciplines, and will help software developers in computational mechanics. Increased understanding of the underlying numerical methods will also help practicing engineers to use the computational mechanics software more effectively.

Advances in Boundary Element Techniques Springer Science & Business Media

It is often said that these days there are too many conferences on general areas of computational mechanics. mechanics. and numer ical methods. vJhile this may be true. the his tory of scientific conferences is itself quite short. According to Abraham Pais (in "Subtle is the Lord ... • " Oxford University Press. 1982. p.80). the first international scientific conference ever held was the Karlsruhe Congress of Chemists. 3-5 September 1860 in Karlsruhe. Germany. There were 127 chemists in attendance. and the participants came from Austria. Belgium. France. Germany. Great Britain. Italy. Mexico. Poland. Russia. Spain. Sweden. and Switzerland. At the top of the agenda of the points to be discussed at this conference was the question: "Shall a difference be made between the expressions molecule and atom?" Pais goes on to note: "The conference did not at once succeed in bringing chemists closer together ... It is possible that the older men were offended by the impetuous behavior and imposing manner of the younger scientists" (see references cited in Pais' book). It may be observed that history. in general. repeats itself. However. at ICCM-86 in Tokyo. roughly 500 participants from both the West and the East were in attendance; there were only scholarly exchanges; the young tried to learn from the more experienced. and a spirit of international academic cooperation prevailed.

State-of-the-art Surveys on Computational Mechanics Springer

Advanced Computational Vibroacoustics presents an advanced computational method for the prediction of sound and structural vibrations, in low- and medium-frequency ranges - complex structural acoustics and fluid-structure interaction systems encountered in aerospace, automotive, railway, naval, and energy-production industries. The formulations are presented within a unified computational strategy and are adapted for the present and future generation of massively parallel computers. A reduced-order computational model is constructed using the finite element method for the damped structure and the dissipative internal acoustic fluid (gas or liquid with or without free surface) and using an appropriate symmetric boundary-element method for the external acoustic fluid (gas or liquid). This book allows direct access to computational methods that have been adapted for the future evolution of general commercial software. Written for the global market, it is an invaluable resource for academic researchers, graduate students, and practising engineers.

Advances in Computational Mechanics John Wiley & Sons

Computational Fluid-Structure Interaction: Methods andApplications takes the reader from the fundamentals ofcomputational fluid and solid mechanics to the state-of-the-art incomputational FSI methods, special FSI techniques, and solution ofreal-world problems. Leading experts in the field present thematerial using a unique approach that combines advanced methods,special techniques, and challenging applications. This book begins with the differential equations governing thefluid and solid mechanics, coupling conditions at thefluid – solid interface, and the basics of the finite elementmethod. It continues with the ALE and space – time FSI methods,spatial discretization and time integration strategies for thecoupled FSI equations, solution techniques for thefully-discretized coupled equations, and advanced FSI andspace – time methods. It ends with special FSI techniquestargeting cardiovascular FSI, parachute FSI, and wind-turbineaerodynamics and FSI. Key features: First book to address the state-of-the-art in computationalFSI Combines the fundamentals of computational fluid and solidmechanics, the state-of-the-art in FSI methods, and specialFSI techniques targeting challenging classes of real-worldproblems Covers modern computational mechanics techniques, includingstabilized, variational multiscale, and space – time methods,isogeometric analysis, and advanced FSI coupling methods Is in full color, with diagrams illustrating the fundamentalconcepts and advanced methods and with insightful visualizationillustrating the complexities of the problems that can be solvedwith the FSI methods covered in the book. Authors are award winning, leading global experts incomputational FSI, who are known for solving some of the mostchallenging FSI problems Computational Fluid-Structure Interaction: Methods andApplications is a comprehensive reference for researchers andpracticing engineers who would like to advance their existingknowledge on these subjects. It is also an ideal text for graduateand senior-level undergraduate courses in computational fluidmechanics and computational FSI.

Computational Mechanics in Structural Engineering John Wiley & Sons

Volume is indexed by Thomson Reuters CPCI-S (WoS). This collection of peer-reviewed papers describes the latest advances in, and applications of: basic mechanics and research methods, dynamics and vibration, solid mechanics, fluid mechanics and thermodynamics, biomechanics and environmental mechanics, new materials and advanced materials, functional materials, materials processing technology, welding and mechanical connections, fracture, etc. the work is thus a usefully up-to-date guide to these topics.

Computational Mechanics for the Twenty-first Century Elsevier

Topics of this book span the range from spatial and temporal discretization techniques for contact and impact problems with small and finite deformations over investigations on the reliability of micromechanical contact models over emerging techniques for rolling contact mechanics to homogenization methods and multi-scale approaches in contact problems.

Computational Mechanics Amer Society of Mechanical

Mechanics of Discontinua is the first book to comprehensively tackle both the theory ofthis rapidly developing topic and the applications that span a broad field of scientific and engineering disciplines, from traditional engineering to physics of particulates, nano-technology and micro-flows. Authored by a leading researcher who has been at the cutting edge of discontinua simulation developments over the last 15 years, the book is organized into four parts: introductory knowledge, solvers, methods and applications. In the first chapter a short revision of Continuum Mechanics together with tensorial calculus is introduced. Also, a short introduction to the finite element method is given. The second part of the book introduces key aspects of the subject. These include a diverse field of applications, together with fundamental theoretical and algorithmic aspects common to all methods of Mechanics of Discontinua. The third part of the book proceeds with the most important computational and simulation methods including Discrete Element Methods, the Combined Finite-Discrete Element Method, Molecular Dynamics Methods, Fracture and Fragmentation solvers and Fluid Coupling. After these the reader is introduced to applications stretching from traditional engineering and industry (such as mining, oil industry, powders) to nanotechnology, medical and science.