Multiscale Modeling In Solid Mechanics Computational Approaches Computational And Experimental Methods In Structures

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Nano Mechanics and Materials - Wing Kam Liu 2006-08-30
Nanotechnology is a progressive research and development topic with large amounts of venture capital and government funding being invested worldwide. Nano mechanics, in particular, is the study and characterization of the mechanical behaviour of individual atoms, systems and structures in response to various types of forces and loading conditions. This text, written by respected researchers in the field, informs researchers and practitioners about the fundamental concepts in nano mechanics and materials, focusing on their modelling via multiple scale methods and techniques. The book systematically covers the theory behind multi-particle and nanoscale systems, introduces multiple scale methods, and finally looks at contemporary applications in nano-structured and bio-inspired materials.
Multiphysics and Multiscale Modeling - Young W. Kwon 2015-10-05
Written to appeal to a wide field of engineers and scientists who work on multiscale and multiphysics analysis, Multiphysics and Multiscale Modeling: Techniques and Applications is dedicated to the many computational techniques and methods used to develop man-made systems as well as understand living systems that exist in nature. Presenting a body
Multiscale Materials Modeling for Nanomechanics - Christopher R. Weinberger 2016-08-30
This book presents a unique combination of chapters that together provide a practical introduction to multiscale modeling applied to nanoscale materials mechanics. The goal of this book is to present a balanced treatment of both the theory of the methodology, as well as some practical aspects of conducting the simulations and models. The first half of the book covers some fundamental modeling and simulation techniques ranging from ab-inito methods to the continuum scale. Included in this set of methods are several different concurrent multiscale methods for bridging time and length scales applicable to mechanics at the nanoscale regime. The second half of the book presents a range of case studies from a varied selection of research groups focusing either on a the application of multiscale modeling to a specific nanomaterial, or novel analysis techniques aimed at exploring nanomechanics. Readers are also directed to helpful sites and other resources throughout the book where the simulation codes and methodologies discussed herein can be accessed. Emphasis on the

practicality of the detailed techniques is especially felt in the latter half of the book, which is dedicated to specific examples to study nanomechanics and multiscale materials behavior. An instructive avenue for learning how to effectively apply these simulation tools to solve nanomechanics problems is to study previous endeavors. Therefore, each chapter is written by a unique team of experts who have used multiscale materials modeling to solve a practical nanomechanics problem. These chapters provide an extensive picture of the multiscale materials landscape from problem statement through the final results and outlook, providing readers with a roadmap for incorporating these techniques into their own research.

Multiscale Analysis of Deformation and Failure of Materials - Jinghong Fan 2011-06-28

Presenting cutting-edge research and development within multiscale modeling techniques and frameworks, Multiscale Analysis of Deformation and Failure of Materials systematically describes the background, principles and methods within this exciting new & interdisciplinary field. The author’s approach emphasizes the principles and methods of atomistic simulation and its transition to the nano and sub-micron scale of a continuum, which is technically important for nanotechnology and biotechnology. He also pays close attention to multiscale analysis across the micro/meso/macroscopy of a continuum, which has a broad scope of applications encompassing different disciplines and practices, and is an essential extension of mesomechanics. Of equal interest to engineers, scientists, academics and students, Multiscale Analysis of Deformation and Failure of Materials is a multidisciplinary text relevant to those working in the areas of materials science, solid and computational mechanics, bioengineering and biomaterials, and aerospace, automotive, civil, and environmental engineering. Provides a deep understanding of multiscale analysis and its implementation Shows in detail how multiscale models can be developed from practical problems and how to use the multiscale methods and software to carry out simulations Discusses two interlinked categories of multiscale analysis; analysis spanning from the atomistic to the micro-continuum scales, and analysis across the micro/meso/macro scale of continuum.

Multiscale Cancer Modeling - Thomas S. Deisboeck 2010-12-08

Cancer is a complex disease process that spans multiple scales in space and time. Driven by cutting-edge mathematical and computational techniques, in silico biology provides powerful tools to investigate the mechanistic relationships of genes, cells, and tissues. It enables the creation of experimentally testable hypotheses, the integration of data across scales, and the prediction of tumor progression and treatment outcome (in silico oncology). Drawing on an interdisciplinary group of distinguished international experts, Multiscale Cancer Modeling discusses the scientific and technical expertise necessary to conduct innovative cancer modeling research across scales. It presents contributions from some of the top in silico modeling groups in the United States and Europe. The ultimate goal of multiscale modeling and simulation approaches is their use in clinical practice, such as supporting patient-specific treatment optimization. This volume covers state-of-the-art methods of multiscale cancer modeling and addresses the field’s potential as well as future challenges. It encourages collaborations among researchers in various disciplines to achieve breakthroughs in cancer modeling.

Micromechanics of Composite Materials - Jacob Aboudi 2012-12-31

With composites under increasing use in industry to replace traditional materials in components and structures, the modeling of composite performance, damage and failure has never been more important. Micromechanics of Composite Materials: A Generalized Multiscale Analysis Approach brings together comprehensive background information on the multiscale nature of the composite, constituent material behaviour, damage models and key techniques for multiscale modelling, as well as presenting the findings and methods, developed over a lifetime’s research, of three leading experts in the field. The unified approach presented in the book for conducting multiscale analysis and design of conventional and smart composite materials is also applicable for structures with complete linear and nonlinear

material behavior, with numerous applications provided to illustrate use. Modeling composite behaviour is a key challenge in research and industry; when done efficiently and reliably it can save money, decrease time to market with new innovations and prevent component failure. This book provides the tools and knowledge from leading micromechanics research, allowing researchers and senior engineers within academia and industry with to improve results and streamline development workflows. Brings together for the first time the findings of a lifetime’s research in micromechanics by recognized leaders in the field Provides a comprehensive overview of all micromechanics formulations in use today and a unified approach that works for the multiscale analysis and design of multi-phased composite materials, considering both small strain and large strain formulations Combines otherwise disparate theory, code and techniques in a step-by-step manner for efficient and reliable modeling of composites

Multiscale Modelling and Simulation - Sabine Attinger 2004-07-12

In August 2003, ETHZ Computational Laboratory (CoLab), together with the Swiss Center for Scientific Computing in Manno and the Università della Svizzera Italiana (USI), organized the Summer School in "Multiscale Modelling and Simulation" in Lugano, Switzerland. This summer school brought together experts in different disciplines to exchange ideas on how to link methodologies on different scales. Relevant examples of practical interest include: structural analysis of materials, flow through porous media, turbulent transport in high Reynolds number flows, large-scale molecular dynamic simulations, ab-initio physics and chemistry, and a multitude of others. Though multiple scale models are not new, the topic has recently taken on a new sense of urgency. A number of hybrid approaches are now created in which ideas coming from distinct disciplines or modelling approaches are unified to produce new and computationally efficient techniques.

Active Control Of Aircraft Cabin Noise - Ignazio Dimino 2015-07-13

'The text is well written and supported by clear and useful illustrations. This would be a useful textbook for postgraduate or advanced undergraduate studies and would also make a good introductory text for engineers moving into the field. The literature survey and bibliography provide a useful starting point for further study.'The Aeronautical JournalActive Control of Aircraft Cabin Noise provides a bridge to fill the gap between robust control theory and practical applications of active noise control systems in aircraft cabin. Both the possibilities and limitations of structural solutions to enhance aircraft cabin comfort by reducing interior noise are discussed supported by a wide range of topics in engineering, from finite element modeling to multichannel adaptive feed-forward control, usually dealt separately in the literature. In addition, experimental noise attenuation results with passengers' subjective perceptions predicting the effects of cabin noise on comfort assessments is examined. Theoretical and experimental research is detailed enough to capture the interest of the non-expert in engineering who wishes to have an overview of some of the active noise control applications in aircraft. This book may be used as an advanced textbook by graduate and undergraduate students in aeronautical engineering, and would be an authoritative resource book for research into the subject.

Computational Multiscale Modeling of Multiphase Nanosystems - Alexander V. Vakhrushev 2017-10-10

Computational Multiscale Modeling of Multiphase Nanosystems: Theory and Applications presents a systematic description of the theory of multiscale modeling of nanotechnology applications in various fields of science and technology. The problems of computing nanoscale systems at different structural scales are defined, and algorithms are given for their numerical solutions by the quantum/continuum mechanics, molecular dynamics, and mesodynamics methods. Emphasis is given to the processes of the formation, movement, and interaction of nanoparticles; the formation of nanocomposites; and the processes accompanying the application of nanocomposites. The book concentrates on different types of nanosystems: solid, liquid, gaseous, and multi-phase, consisting of various elements interacting with each other, and with other elements of the nanosystem and with the environment. The book includes a large number of examples of numerical modeling of

nanosystems. The valuable information presented here will be useful to engineers, researchers, and postgraduate students engaged in the design and research in the field of nanotechnology.

Mathematical Methods And Models In Composites - Vladislav Mantic 2013-10-25

This book provides a representative selection of the most relevant, innovative, and useful mathematical methods and models applied to the analysis and characterization of composites and their behaviour on micro-, meso-, and macroscale. It establishes the fundamentals for meaningful and accurate theoretical and computer modelling of these materials in the future. Although the book is primarily concerned with fibre-reinforced composites, which have ever-increasing applications in fields such as aerospace, many of the results presented can be applied to other kinds of composites. The topics covered include: scaling and homogenization procedures in composite structures, thin plate and wave solutions in anisotropic materials, laminated structures, instabilities, fracture and damage analysis of composites, and highly efficient methods for simulation of composites manufacturing. The results presented are useful in the design, fabrication, testing, and industrial applications of composite components and structures. The book is written by well-known experts in different areas of applied mathematics, physics, and composite engineering and is an essential source of reference for graduate and doctoral students, as well as researchers. It is also suitable for non-experts in composites who wish to have an overview of both the mathematical methods and models used in this area and the related open problems requiring further research.

Multiscale Modeling of Heterogeneous Structures - Jurica Sorić 2017-11-30

This book provides an overview of multiscale approaches and homogenization procedures as well as damage evaluation and crack initiation, and addresses recent advances in the analysis and discretization of heterogeneous materials. It also highlights the state of the art in this research area with respect to different computational methods, software development and applications to engineering structures. The first part focuses on defects in composite materials including their numerical and experimental investigations; elastic as well as elastoplastic constitutive models are considered, where the modeling has been performed at macro- and micro levels. The second part is devoted to novel computational schemes applied on different scales and discusses the validation of numerical results. The third part discusses gradient enhanced modeling, in particular quasi-brittle and ductile damage, using the gradient enhanced approach. The final part addresses thermoplasticity, solid-liquid mixtures and ferroelectric models. The contents are based on the international workshop “Multiscale Modeling of Heterogeneous Structures” (MUMO 2016), held in Dubrovnik, Croatia in September 2016.

Integrated Computational Materials Engineering (ICME) for Metals - Mark F. Horstemeyer 2012-06-07

State-of-the-technology tools for designing, optimizing, and manufacturing new materials Integrated computational materials engineering (ICME) uses computational materials science tools within a holistic system in order to accelerate materials development, improve design optimization, and unify design and manufacturing. Increasingly, ICME is the preferred paradigm for design, development, and manufacturing of structural products. Written by one of the world's leading ICME experts, this text delivers a comprehensive, practical introduction to the field, guiding readers through multiscale materials processing modeling and simulation with easy-to-follow explanations and examples. Following an introductory chapter exploring the core concepts and the various disciplines that have contributed to the development of ICME, the text covers the following important topics with their associated length scale bridging methodologies: Macroscale continuum internal state variable plasticity and damage theory and multistage fatigue Mesoscale analysis: continuum theory methods with discrete features and methods Discrete dislocation dynamics simulations Atomistic modeling methods Electronics structures calculations Next, the author provides three chapters dedicated to detailed case studies, including "From Atoms to Autos: A Redesign of a Cadillac Control Arm,"

that show how the principles and methods of ICME work in practice. The final chapter examines the future of ICME, forecasting the development of new materials and engineering structures with the help of a cyberinfrastructure that has been recently established. Integrated Computational Materials Engineering (ICME) for Metals is recommended for both students and professionals in engineering and materials science, providing them with new state-of-the-technology tools for selecting, designing, optimizing, and manufacturing new materials. Instructors who adopt this text for coursework can take advantage of PowerPoint lecture notes, a questions and solutions manual, and tutorials to guide students through the models and codes discussed in the text.

Computational Multiscale Modeling of Fluids and Solids - Martin Oliver Steinhauser 2008

The idea of the book is to provide a comprehensive overview of computational physics methods and techniques, that are used for materials modeling on different length and time scales. Each chapter first provides an overview of the physical basic principles which are the basis for the numerical and mathematical modeling on the respective length-scale. The book includes the micro-scale, the meso-scale and the macro-scale. The chapters follow this classification. The book will explain in detail many tricks of the trade of some of the most important methods and techniques that are used to simulate materials on the perspective levels of spatial and temporal resolution. Case studies are occasionally included to further illustrate some methods or theoretical considerations. Example applications for all techniques are provided, some of which are from the author’s own contributions to some of the research areas. Methods are explained, if possible, on the basis of the original publications but also references to standard text books established in the various fields are mentioned.

Materials with Internal Structure - Patrizia Trovalusci 2015-10-17

The book presents a series of concise papers by researchers specialized in various fields of continuum and computational mechanics and of material science. The focus is on principles and strategies for multiscale modeling and simulation of complex heterogeneous materials, with periodic or random microstructure, subjected to various types of mechanical, thermal, chemical loadings and environmental effects. A wide overview of complex behavior of materials (plasticity, damage, fracture, growth, etc.) is provided. Among various approaches, attention is given to advanced non-classical continua modeling which, provided by constitutive characterization for the internal and external actions (in particular boundary conditions), is a very powerful frame for the gross mechanical description of complex material behaviors, able to circumvent the restrictions of classical coarse–graining multiscale approaches.

Multiscale Modeling in Biomechanics and Mechanobiology - Suvranu De 2014-10-10

Presenting a state-of-the-art overview of theoretical and computational models that link characteristic biomechanical phenomena, this book provides guidelines and examples for creating multiscale models in representative systems and organisms. It develops the reader's understanding of and intuition for multiscale phenomena in biomechanics and mechanobiology, and introduces a mathematical framework and computational techniques paramount to creating predictive multiscale models. Biomechanics involves the study of the interactions of physical forces with biological systems at all scales – including molecular, cellular, tissue and organ scales. The emerging field of mechanobiology focuses on the way that cells produce and respond to mechanical forces – bridging the science of mechanics with the disciplines of genetics and molecular biology. Linking disparate spatial and temporal scales using computational techniques is emerging as a key concept in investigating some of the complex problems underlying these disciplines. Providing an invaluable field manual for graduate students and researchers of theoretical and computational modelling in biology, this book is also intended for readers interested in biomedical engineering, applied mechanics and mathematical biology.

Modeling Materials - Ellad B. Tadmor 2011-11-24

Material properties emerge from phenomena on scales ranging from Angstroms to millimeters, and only a multiscale treatment can provide a

complete understanding. Materials researchers must therefore understand fundamental concepts and techniques from different fields, and these are presented in a comprehensive and integrated fashion for the first time in this book. Incorporating continuum mechanics, quantum mechanics, statistical mechanics, atomistic simulations and multiscale techniques, the book explains many of the key theoretical ideas behind multiscale modeling. Classical topics are blended with new techniques to demonstrate the connections between different fields and highlight current research trends. Example applications drawn from modern research on the thermo-mechanical properties of crystalline solids are used as a unifying focus throughout the text. Together with its companion book, Continuum Mechanics and Thermodynamics (Cambridge University Press, 2011), this work presents the complete fundamentals of materials modeling for graduate students and researchers in physics, materials science, chemistry and engineering.

Multiscale Modeling in Solid Mechanics - Ugo Galvanetto 2010

This unique volume presents the state of the art in the field of multiscale modeling in solid mechanics, with particular emphasis on computational approaches. For the first time, contributions from both leading experts in the field and younger promising researchers are combined to give a comprehensive description of the recently proposed techniques and the engineering problems tackled using these techniques. The book begins with a detailed introduction to the theories on which different multiscale approaches are based, with regards to linear Homogenisation as well as various nonlinear approaches. It then presents advanced applications of multiscale approaches applied to nonlinear mechanical problems. Finally, the novel topic of materials with self-similar structure is discussed. Sample Chapter(s). Chapter 1: Computational Homogenisation for Non-Linear Heterogeneous Solids (808 KB). Contents: Computational Homogenisation for Non-Linear Heterogeneous Solids (V G Kouznetsova et al.); Two-Scale Asymptotic Homogenisation-Based Finite Element Analysis of Composite Materials (Q-Z Xiao & B L Karihaloo); Multi-Scale Boundary Element Modelling of Material Degradation and Fracture (G K Sfantos & M H Aliabadi); Non-Uniform Transformation Field Analysis: A Reduced Model for Multiscale Non-Linear Problems in Solid Mechanics (J-C Michel & P Suquet); Multiscale Approach for the Thermomechanical Analysis of Hierarchical Structures (M J Lefik et al.); Recent Advances in Masonry Modelling: Micro-Modelling and Homogenisation (P B Louren o); Mechanics of Materials with Self-Similar Hierarchical Microstructure (R C Picu & M A Soare). Readership: Researchers and academics in the field of heterogeneous materials and mechanical engineering; professionals in aeronautical engineering and materials science.

Computational Multiscale Modeling of Fluids and Solids - Martin Oliver Steinhauser 2016-11-29

The idea of the book is to provide a comprehensive overview of computational physics methods and techniques, that are used for materials modeling on different length and time scales. Each chapter first provides an overview of the basic physical principles which are the basis for the numerical and mathematical modeling on the respective length-scale. The book includes the micro-scale, the meso-scale and the macro-scale, and the chapters follow this classification. The book explains in detail many tricks of the trade of some of the most important methods and techniques that are used to simulate materials on the perspective levels of spatial and temporal resolution. Case studies are included to further illustrate some methods or theoretical considerations. Example applications for all techniques are provided, some of which are from the author’s own contributions to some of the research areas. The second edition has been expanded by new sections in computational models on meso/macroscopic scales for ocean and atmosphere dynamics. Numerous applications in environmental physics and geophysics had been added.

Multiscale Modeling and Simulation of Composite Materials and Structures - Young W. Kwon 2007-10-23

This book presents the state-of-the-art in multiscale modeling and simulation techniques for composite materials and structures. It focuses on the structural and functional properties of engineering composites and the sustainable high performance of components and structures. The multiscale techniques can be also applied to nanocomposites which are

important application areas in nanotechnology. There are few books available on this topic.

Multiscale Modeling of Heterogeneous Structures - Jurica Sorić 2018-08-31

This book provides an overview of multiscale approaches and homogenization procedures as well as damage evaluation and crack initiation, and addresses recent advances in the analysis and discretization of heterogeneous materials. It also highlights the state of the art in this research area with respect to different computational methods, software development and applications to engineering structures. The first part focuses on defects in composite materials including their numerical and experimental investigations; elastic as well as elastoplastic constitutive models are considered, where the modeling has been performed at macro- and micro levels. The second part is devoted to novel computational schemes applied on different scales and discusses the validation of numerical results. The third part discusses gradient enhanced modeling, in particular quasi-brittle and ductile damage, using the gradient enhanced approach. The final part addresses thermoplasticity, solid-liquid mixtures and ferroelectric models. The contents are based on the international workshop “Multiscale Modeling of Heterogeneous Structures” (MUMO 2016), held in Dubrovnik, Croatia in September 2016.

Multiscale Modeling and Simulation in Science - Björn Engquist 2008-12-01

Most problems in science involve many scales in time and space. An example is turbulent ?ow where the important large scale quantities of lift and drag of a wing depend on the behavior of the small vortices in the boundarylayer. Another example is chemical reactions with concentrations of the species varying over seconds and hours while the time scale of the oscillations of the chemical bonds is of the order of femtoseconds. A third example from structural mechanics is the stress and strain in a solid beam which is well described by macroscopic equations but at the tip of a crack modeling details on a microscale are needed. A common dif?culty with the simulation of these problems and many others in physics, chemistry and biology is that an attempt to represent all scales will lead to an enormous computational problem with unacceptably long computation times and large memory requirements. On the other hand, if the discretization at a coarse level ignoresthe?nescale informationthenthesolutionwillnotbephysicallymeaningful. The in?uence of the ?ne scales must be incorporated into the model. This volume is the result of a Summer School on Multiscale Modeling and S- ulation in Science held at Boso ¤n, Lidingo ¤ outside Stockholm, Sweden, in June 2007. Sixty PhD students from applied mathematics, the sciences and engineering parti- pated in the summer school.

Microstructural Modeling and Computational Homogenization of the Physically Linear and Nonlinear Constitutive Behavior of Micro-heterogeneous Materials - Felix Fritzen 2014-08-22

Engineering materials show a pronounced heterogeneity on a smaller scale that influences the macroscopic constitutive behavior. Algorithms for the periodic discretization of microstructures are presented. These are used within the Nonuniform Transformation Field Analysis (NTFA) which is an order reduction based nonlinear homogenization method with micro-mechanical background. Theoretical and numerical aspects of the method are discussed and its computational efficiency is validated.

Computational Methods for Solids and Fluids - Adnan Ibrahimbegovic 2016-03-15

This volume contains the best papers presented at the 2nd ECCOMAS International Conference on Multiscale Computations for Solids and Fluids, held June 10-12, 2015. Topics dealt with include multiscale strategy for efficient development of scientific software for large-scale computations, coupled probability-nonlinear-mechanics problems and solution methods, and modern mathematical and computational setting for multi-phase flows and fluid-structure interaction. The papers consist of contributions by six experts who taught short courses prior to the conference, along with several selected articles from other participants dealing with complementary issues, covering both solid mechanics and applied mathematics.

Woven Composites - Aliabadi M H Ferri 2015-02-09
This unique volume presents the latest developments in the field of advanced woven and braided textile composites, with particular emphasis on computational approaches (finite elements, meshfree). Advanced textile composites such as woven, braided, knitted and stitched fabrics are increasingly being used as structural materials in industrial applications due to their efficiency at reinforcing more directions within a single layer and their ability to conform to surfaces with complex curvatures. Furthermore, textile composites provide improved impact resistance, exceptional thermal, fatigue and corrosion resistance, as well as being easier and cheaper to handle and fabricate compared to UD composites.Topics covered in this book include: 2D and 3D plain, twill, satin woven and braided composites, micro-level and macro-level modelling, failure mechanisms, theoretical studies on cryogenic crack behaviour and the specific deformation modes of textile reinforcements, which include the kinematic and hypoelastic models.This book will be particularly relevant to professional engineers, graduate students and researchers interested in composite materials.

Principles of Multiscale Modeling - Weinan E 2011-07-07
A systematic discussion of the fundamental principles, written by a leading contributor to the field.

Practical Micromechanics of Composite Materials - Jacob Aboudi 2021-08-31
Practical Micromechanics of Composite Materials provides an accessible treatment of micromechanical theories for the analysis and design of multi-phased composites. Written with both students and practitioners in mind and coupled with a fully functional MATLAB code to enable the solution of technologically relevant micromechanics problems, the book features an array of illustrative example problems and exercises highlighting key concepts and integrating the MATLAB code. The MATLAB scripts and functions empower readers to enhance and create new functionality tailored to their needs, and the book and code highly complement one another. The book presents classical lamination theory and then proceeds to describe how to obtain effective anisotropic properties of a unidirectional composite (ply) via micromechanics and multiscale analysis. Calculation of local fields via mechanical and thermal strain concentration tensors is presented in a unified way across several micromechanics theories. The importance of these local fields is demonstrated through the determination of consistent Margins of Safety (MoS) and failure envelopes for thermal and mechanical loading. Finally, micromechanics-based multiscale progressive damage is discussed and implemented in the accompanying MATLAB code. Emphasizes appropriate application of micromechanics theories to composite behavior Addresses multiple popular micromechanics theories, which are provided in MATLAB Discusses stresses and strains resulting from realistic thermal and mechanical loading Includes availability of solution manual for professors using the book in the classroom

Uncertainty Quantification in Multiscale Materials Modeling - Yan Wang 2020-03-12
Uncertainty Quantification in Multiscale Materials Modeling provides a complete overview of uncertainty quantification (UQ) in computational materials science. It provides practical tools and methods along with examples of their application to problems in materials modeling. UQ methods are applied to various multiscale models ranging from the nanoscale to macroscale. This book presents a thorough synthesis of the state-of-the-art in UQ methods for materials modeling, including Bayesian inference, surrogate modeling, random fields, interval analysis, and sensitivity analysis, providing insight into the unique characteristics of models framed at each scale, as well as common issues in modeling across scales.

Multiscale Methods in Computational Mechanics - Rene de Borst 2012-12-05
This work gives a modern, up-to-date account of recent developments in computational multiscale mechanics. Both upscaling and concurrent computing methodologies will be addressed for a range of application areas in computational solid and fluid mechanics: Scale transitions in materials, turbulence in fluid-structure interaction problems, multiscale/multilevel optimization, multiscale poromechanics. A Dutch-

German research group that consists of qualified and well-known researchers in the field has worked for six years on the topic of computational multiscale mechanics. This text provides a unique opportunity to consolidate and disseminate the knowledge gained in this project. The addition of chapters written by experts outside this working group provides a broad and multifaceted view of this rapidly evolving field.

Structural Health Monitoring For Advanced Composite Structures - Aliabadi M H Ferri 2017-12-18

Structural health monitoring (SHM) is a relatively new and alternative way of non-destructive inspection (NDI). It is the process of implementing a damage detection and characterization strategy for composite structures. The basis of SHM is the application of permanent fixed sensors on a structure, combined with minimum manual intervention to monitor its structural integrity. These sensors detect changes to the material and/or geometric properties of a structural system, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance. This book's primary focus is on the diagnostics element of SHM, namely damage detection in composite structures. The techniques covered include the use of Piezoelectric transducers for active and passive Ultrasonics guided waves and electromechanical impedance measurements, and fiber optic sensors for strain sensing. It also includes numerical modeling of wave propagation in composite structures. Contributed chapters written by leading researchers in the field describe each of these techniques, making it a key text for researchers and NDI practitioners as well as postgraduate students in a number of specialties including materials, aerospace, mechanical and computational engineering. Contents: Damage Detection and Characterization with Piezoelectric Transducers — Active Sensing (Z Sharif Khodaei and M H Aliabadi)Modeling Guided Wave Propagation in Composite Structures Using Local Interaction Simulation Approach (Yanfeng Shen and Carlos E S Cesnik)Design and Development of a Phased Array System for Damage Detection in Structures (Bruno Rocha, Mehmet Yildiz & Afzal Suleman)Degradation Detection in Composite Structures with PZT Transducers (Wiesław M Ostachowicz, Paweł H Malinowski & Tomasz Wandowski)Numerical Modelling of Wave Propagation in Composite Structures (Sourav Banerjee)SHM of Composite Structures by Fibre Optic Sensors (Alfredo Guemes)Impact Detection and Identification with Piezoceramic Sensors — Passive Sensing (Z Sharif Khodaei and M H Aliabadi) Readership: Researchers and NDI practitioners as well as postgraduate students in a number of specialties including materials, aerospace, mechanical and computational engineering. Keywords: Structural Health Modelling;Non-Destrctive Inspection;Dignostic SHM;Aerospace Engineering;Microelectromechanical Systems;Acoustic Emission Monitoring;AccelerometersReview:0

Multiscale Modeling and Simulation in Science - Björn Engquist 2009-02-11

Most problems in science involve many scales in time and space. An example is turbulent ?ow where the important large scale quantities of lift and drag of a wing depend on the behavior of the small vortices in the boundarylayer. Another example is chemical reactions with concentrations of the species varying over seconds and hours while the time scale of the oscillations of the chemical bonds is of the order of femtoseconds. A third example from structural mechanics is the stress and strain in a solid beam which is well described by macroscopic equations but at the tip of a crack modeling details on a microscale are needed. A common dif?culty with the simulation of these problems and many others in physics, chemistry and biology is that an attempt to represent all scales will lead to an enormous computational problem with unacceptably long computation times and large memory requirements. On the other hand, if the discretization at a coarse level ignoresthe?nescale informationthenthesolutionwillnotbephysicallymeaningful. The in?uence of the ?ne scales must be incorporated into the model. This volume is the result of a Summer School on Multiscale Modeling and S- ulation in Science held at Boso ¤n, Lidingo ¤ outside Stockholm, Sweden, in June 2007. Sixty PhD students from applied mathematics, the sciences and

engineering parti- pated in the summer school.

Practical Aspects of Computational Chemistry - Jerzy Leszczynski 2009-10-03

"Practical Aspects of Computational Chemistry" presents contributions on a range of aspects of Computational Chemistry applied to a variety of research fields. The chapters focus on recent theoretical developments which have been used to investigate structures and properties of large systems with minimal computational resources. Studies include those in the gas phase, various solvents, various aspects of computational multiscale modeling, Monte Carlo simulations, chirality, the multiple minima problem for protein folding, the nature of binding in different species and dihydrogen bonds, carbon nanotubes and hydrogen storage, adsorption and decomposition of organophosphorus compounds, X-ray crystallography, proton transfer, structure-activity relationships, a description of the REACH programs of the European Union for chemical regulatory purposes, reactions of nucleic acid bases with endogenous and exogenous reactive oxygen species and different aspects of nucleic acid bases, base pairs and base tetrads.

Multiscale Modeling to Tackle the Complexity of Load-Bearing Organ and Tissue Regulation - Jerome Noailly 2022-03-11

Non-standard Discretisation Methods in Solid Mechanics - Jörg Schröder 2022

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.

Advances in Applied Mechanics - 2022-11-01

Advances in Applied Mechanics, Volume 55 in this ongoing series, highlights new advances in the field, with this new volume presenting interesting chapters on topics such as Towards stochastic multi-scale methods in continuum solid mechanics, Fracture in soft elastic materials: Continuum description, molecular aspects and applications, Bio-Chemo-Mechanical Coupling Models of Soft Biological Materials: A Review, Viscoelasticity and cell swirling motion, Model selection and sensitivity analysis in the biomechanics of soft tissues: A case study on the human knee meniscus, Oncology and mechanics: Landmark studies and promising clinical. Provides the authority and expertise of leading contributors from an international board of authors Presents the latest release in the Advances in Applied Mechanics series Edited by some of the best scientists in the field

Boundary Element Methods in Engineering and Sciences - M. H. Aliabadi 2011

The boundary element method (BEM), also known as the boundary integral equation method (BIEM), is a modern numerical technique. It is an established alternative to traditional computational methods of engineering analysis. This book provides a comprehensive account of the method and its application to problems in engineering and science.

Computational Modelling of Concrete Structures - Günther Meschke 2018-01-31

The EURO-C conference series (Split 1984, Zell am See 1990, Innsbruck 1994, Badgastein 1998, St. Johann im Pongau 2003, Mayrhofen 2006, Schladming 2010, St. Anton am Arlberg 2014, and Bad Hofgastein 2018) brings together researchers and practising engineers concerned with theoretical, algorithmic and validation aspects associated with computational simulations of concrete and concrete structures. Computational Modelling of Concrete Structures reviews and discusses

research advancements and the applicability and robustness of methods and models for reliable analysis of complex concrete, reinforced concrete and pre-stressed concrete structures in engineering practice. The contributions cover both computational mechanics and computational modelling aspects of the analysis and design of concrete and concrete structures: Multi-scale cement and concrete research: experiments and modelling Aging concrete: from very early ages to decades-long durability Advances in material modelling of plain concrete Analysis of reinforced concrete structures Steel-concrete interaction, fibre-reinforced concrete, and masonry Dynamic behaviour: from seismic retrofit to impact simulation Computational Modelling of Concrete Structures is of special interest to academics and researchers in computational concrete mechanics, as well as industry experts in complex nonlinear simulations of concrete structures.

Multiscale Modeling Approaches for Composites - George Chatzigeorgiou 2022-01-15

Multiscale Modeling Approaches for Composites outlines the fundamentals of common multiscale modeling techniques and provides detailed guidance for putting them into practice. Various homogenization methods are presented in a simple, didactic manner, with an array of numerical examples. The book starts by covering the theoretical underpinnings of tensors and continuum mechanics concepts, then passes to actual micromechanic techniques for composite media and laminate plates. In the last chapters the book covers advanced topics in homogenization, including Green's tensor, Hashin-Shtrikman bounds, and special types of problems. All chapters feature comprehensive analytical and numerical examples (Python and ABAQUS scripts) to better illustrate the theory. Bridges theory and practice, providing step-by-step instructions for implementing multiscale modeling approaches for composites and the theoretical concepts behind them Covers boundary conditions, data-exchange between scales, the Hill-Mandel principle, average stress and strain theorems, and more Discusses how to obtain composite properties using different boundary conditions Includes access to a companion site, featuring the numerical examples, Python and ABACUS codes discussed in the book

Materials with Internal Structure - Patrizia Trovalusci 2016-08-23

The book presents a series of concise papers by researchers specialized in various fields of continuum and computational mechanics and of material science. The focus is on principles and strategies for multiscale modeling and simulation of complex heterogeneous materials, with periodic or random microstructure, subjected to various types of mechanical, thermal, chemical loadings and environmental effects. A wide overview of complex behavior of materials (plasticity, damage, fracture, growth, etc.) is provided. Among various approaches, attention is given to advanced non-classical continua modeling which, provided by constitutive characterization for the internal and external actions (in particular boundary conditions), is a very powerful frame for the gross mechanical description of complex material behaviors, able to circumvent the restrictions of classical coarse–graining multiscale approaches.

Advanced Computational Materials Modeling - Miguel Vaz Junior 2011-09-22

With its discussion of strategies for modeling complex materials using new numerical techniques, mainly those based on the finite element method, this monograph covers a range of topics including computational plasticity, multi-scale formulations, optimization and parameter identification, damage mechanics and nonlinear finite elements.

Computational Modelling of Concrete and Concrete Structures - Günther Meschke 2022-05-19

Computational Modelling of Concrete and Concrete Structures contains the contributions to the EURO-C 2022 conference (Vienna, Austria, 23-26 May 2022). The papers review and discuss research advancements and assess the applicability and robustness of methods and models for the analysis and design of concrete, fibre-reinforced and prestressed concrete structures, as well as masonry structures. Recent developments include methods of machine learning, novel discretisation methods, probabilistic models, and consideration of a growing number of micro-

structural aspects in multi-scale and multi-physics settings. In addition, trends towards the material scale with new fibres and 3D printable concretes, and life-cycle oriented models for ageing and durability of existing and new concrete infrastructure are clearly visible. Overall computational robustness of numerical predictions and mathematical rigour have further increased, accompanied by careful model validation based on respective experimental programmes. The book will serve as an important reference for both academics and professionals, stimulating new research directions in the field of computational modelling of concrete and its application to the analysis of concrete structures. EURO-C 2022 is the eighth edition of the EURO-C conference series after Innsbruck 1994, Bad Gastein 1998, St. Johann im Pongau 2003, Mayrhofen 2006, Schladming 2010, St. Anton am Arlberg 2014, and Bad Hofgastein 2018. The overarching focus of the conferences is on computational methods and numerical models for the analysis of concrete and concrete structures.