Principles Of Multiscale Modeling Princeton University

Currently considered a bridge between basic and Twopossibilities exist to expand landscape ecol applied ecology, landscape ecology occupies an ogy: one consists of developing new research, and important new niche in ecology,representing a new the other in developing a good educational frame star in the galaxy of the ecological sciences. work. Both are important and not in conflict. In this However, the broad spectrum of conceptual and spirit I have prepared this book, with the aim of methodological approaches has created a non summarizing the best theories, concepts, principles focused science strongly influenced by the more and methods in landscape ecology. It is an attempt dominant disciplines, such as landscape planning to reinforce the ecological research perspective, to and restoration, forest management, landscape consolidate principles and methods, validate proce architecture etc. dures and reconcile different positions, including The uncertain position of landscape ecology the geobotanic, animal and human perspectives. among the ecological disciplines is in contradiction The concept is very simple. I have no ambition with the general recognition that landscape is a spa to present new ideas and theories: I have worked to tial dimension in which important ecological create a tool mainly for classroom use but also processes occur, and landscape is becoming very appealing to a broad range of scientists and practi popular in many ecology-related fields, from plant tioners dealing with landscape ecology and its disease to animal behaviour. problems.

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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.

A systematic discussion of the fundamental principles, written by a leading contributor to the field.

This volume deals with the pressing issue of uncertainty in archaeological modeling. Detecting where and when

uncertainty is introduced to the modeling process is critical, as are strategies for minimizing, reconciling, or accommodating such uncertainty. Included chapters provide unique perspectives on uncertainty in archaeological modeling, ranging in both theoretical and methodological orientation. The strengths and weaknesses of various identification and mitigation techniques are discussed, in particular sensitivity analysis. The chapters demonstrate that for archaeological modeling purposes, there is no quick fix for uncertainty; indeed, each archaeological model requires intensive consideration of uncertainty and specific applications for calibration and validation. As very few such techniques have been problematized in a systematic manner or published in the archaeological literature, this volume aims to provide guidance and direction to other modelers in the field by distilling some basic principles for model testing derived from insight gathered in the case studies presented. Additionally, model applications and their attendant uncertainties are presented from distinct spatio-temporal contexts and will appeal to a broad range of archaeological modelers. This volume will also be of interest to non-modeling archaeologists, as consideration of uncertainty when interpreting the archaeological record is also a vital concern for the development of non-formal (or implicit) models of human behavior in the past.

Multiscale Signal Analysis and Modeling presents recent advances in multiscale analysis and modeling using wavelets and other systems. This book also presents applications in digital signal processing using sampling theory and techniques from various function spaces, filter design, feature extraction and classification, signal and image representation/transmission, coding, nonparametric statistical signal processing, and statistical learning theory.

This represents the final report for two years of research at UCLA by the PI and her group on the gun tube erosion problem. In the past two years, they created new quantum-based simulation tools (both first principles and multiscale modeling techniques) and investigated surface, bulk, and interfacial materials aspects of the gun tube erosion problem. In brief, they developed: (i) two new versions of their spin-dependent pseudopotential theory that provides a more ab initio and more accurate description of magnetic transition metals such as Fe, (ii) a multiscale model that couples chemistry and mechanics to study hydrogen embrittlement in steel, and (iii) a scheme for calculating fracture energies of materials with mobile impurities (such as hydrogen in iron). They applied our spin-dependent pseudopotential theory to evaluate magnetism of vanadium surfaces, and applied density functional theory (DFT) to evaluate TiC and ZrC as possible protective coatings for steel. They also characterized via DFT the energetics and kinetics of how hydrogen and carbon adsorb and diffuse into iron, the structure and relative stability of cementite (iron carbide) surfaces, as well as predicting pathways for CO and H2S adsorption, diffusion, and dissociation on Fe surfaces.

The purpose of this book is to provide an up-to-date introduction to the time-domain finite element methods for Maxwell’s

equations involving metamaterials. Since the first successful construction of a metamaterial with both negative permittivity and permeability in 2000, the study of metamaterials has attracted significant attention from researchers across many disciplines. Thanks to enormous efforts on the part of engineers and physicists, metamaterials present great potential applications in antenna and radar design, sub-wavelength imaging, and invisibility cloak design. Hence the efficient simulation of electromagnetic phenomena in metamaterials has become a very important issue and is the subject of this book, in which various metamaterial modeling equations are introduced and justified mathematically. The development and practical implementation of edge finite element methods for metamaterial Maxwell's equations are the main focus of the book. The book finishes with some interesting simulations such as backward wave propagation and time-domain cloaking with metamaterials.

Vapor deposition is increasingly used to synthesize thin films and coatings that underpin numerous technologies from microelectronics to aircraft engines. As the structural and compositional complexity of these vapor-deposited materials increases, many new methods of vapor deposition have been developed. The design of which is founded upon an understanding of the atomic-scale mechanisms of growth. This book, first published in 2000, explores these issues and their applications in micro- and magnetoelectronics, hard coatings, photovoltaics, high-Tc thin films and the group-three nitrides. It is organized so that many of the new methods of vapor deposition are introduced first. This is followed by chapters on vapor deposition including the use of in situ characterization techniques to observe them and exploration of modeling techniques to simulate the growth of vapor-deposited structures. The use of in situ sensors to validate simulations is also widely covered. This provides a detailed view of the state of the art and should be beneficial to all who are engaged in its research and development.

This book includes papers in cross-disciplinary applications of mathematical modelling: from medicine to linguistics, social problems, and more. Based on cutting-edge research, each chapter is focused on a different problem of modelling human behaviour or engineering problems at different levels. The reader would find this book to be a useful reference in identifying problems of interest in social, medicine and engineering sciences, and in developing mathematical models that could be used to successfully predict behaviours and obtain practical information for specialised practitioners. This book is a must-read for anyone interested in the new developments of applied mathematics in connection with epidemics, medical modelling, social issues, random differential equations and numerical methods.

This unique , authoritative book introduces and accurately depicts the current state-of-the art in the field of space storms. Professor Koskinen, renowned expert in the field, takes the basic understanding of the system, together with the pyhsics of space plasmas, and produces a treatment of space storms. He combines a solid base describing space physics

phenomena with a rigourous theoretical basis. The topics range from the storms in the solar atmosphere through the solar wind, magnetosphere and ionosphere to the production of the storm-related geoelectric field on the ground. The most up-to-date information available ist presented in a clear, analytical and quantitative way. The book is divided into three parts. Part 1 is a phenomenological introduction to space weather from the Sun to the Earth. Part 2 comprehensively presents the fundamental concepts of space plasma physics. It consists of discussions of fundamental concepts of plasma physics, starting from underlying electrodynamics and statistical physics of charged particles and continuing to single particle motion in homogeneous electromagnetic fields, waves in cold plasma approximation, Vlasov theory, magnetohydrodynamics, instabilities in space plasmas, reconnection and dynamo. Part 3 bridges the gap between the fundamental plasma physics and research level physics of space storms. This part discusses radiation and scattering processes, transport and diffiusion, shocks and shock acceleration, storms on the Sun, in the magnetosphere, the coupling to the atmosphere and ground. The book is concluded wtih a brief review of what is known of space stroms on other planets. One tool for building this briege ist extensive cross-referencing between the various chapters. Exercise problems of varying difficulty are embedded within the main body of the text.

This book constitutes the refereed proceedings of the 14th International Conference on Unconventional Computation and Natural Computation, UCNC 2015, held in Auckland, New Zealand, in August/September 2015. The 16 revised full papers were carefully reviewed and selected from 38 submissions. The papers cover a wide range of topics including among others molecular (DNA) computing; quantum computing; optical computing; chaos computing; physarum computing; computation in hyperbolic spaces; collision-based computing; cellular automata; neural computation; evolutionary computation; swarm intelligence; nature-inspired algorithms; artificial immune systems; artificial life; membrane computing; amorphous computing; computational systems biology; genetic networks; protein-protein networks; transport networks; synthetic biology; cellular (in vivo) computing; and computations beyond the Turing model and philosophical aspects of computing.

This fifth edition of the highly regarded family of titles that first published in 1965 is now a three-volume set and over 3,000 pages. All chapters have been revised and expanded, either by the fourth edition authors alone or jointly with new co-authors. Chapters have been added on the physical metallurgy of light alloys, the physical metallurgy of titanium alloys, atom probe field ion microscopy, computational metallurgy, and orientational imaging microscopy. The books incorporate the latest experimental research results and theoretical insights. Several thousand citations to the research and review literature are included. Exhaustively synthesizes the pertinent, contemporary developments within physical metallurgy so scientists have authoritative information at their fingertips Replaces existing articles and monographs with a

single, complete solution Enables metallurgists to predict changes and create novel alloys and processes

During the 1990s the computing industry has witnessed many advances in mobile and enterprise computing. Many of these advances have been made possible by developments in the areas such as modeling, simulation, and artificial intelligence. Within the different areas of enterprise computing - such as manufacturing, health organisation, and commerce - the need for a disciplined, multifaceted, and unified approach to modeling and simulation has become essential. This new book provides a forum for scientists, academics, and professionals to present their latest research findings from the various fields: artificial intelligence, collaborative/distributed computing, modeling, and simulation.

Genomic signal processing (GSP) can be defined as the analysis, processing, and use of genomic signals to gain biological knowledge, and the translation of that knowledge into systems-based applications that can be used to diagnose and treat genetic diseases. Situated at the crossroads of engineering, biology, mathematics, statistics, and computer science, GSP requires the development of both nonlinear dynamical models that adequately represent genomic regulation, and diagnostic and therapeutic tools based on these models. This book facilitates these developments by providing rigorous mathematical definitions and propositions for the main elements of GSP and by paying attention to the validity of models relative to the data. Ilya Shmulevich and Edward Dougherty cover real-world situations and explain their mathematical modeling in relation to systems biology and systems medicine. Genomic Signal Processing makes a major contribution to computational biology, systems biology, and translational genomics by providing a self-contained explanation of the fundamental mathematical issues facing researchers in four areas: classification, clustering, network modeling, and network intervention.

Since modeling multiscale phenomena in systems biology and neuroscience is a highly interdisciplinary task, the editor of the book invited experts in bio-engineering, chemistry, cardiology, neuroscience, computer science, and applied mathematics, to provide their perspectives. Each chapter is a window into the current state of the art in the areas of research discussed and the book is intended for advanced researchers interested in recent developments in these fields. While multiscale analysis is the major integrating theme of the book, its subtitle does not call for bridging the scales from genes to behavior, but rather stresses the unifying perspective offered by the concepts referred to in the title. It is believed that the interdisciplinary approach adopted here will be beneficial for all the above mentioned fields.

This book examines the latest research results from combined multi-component and multi-scale explorations. It provides theory, considers underlying numerical methods and presents brilliant computational experimentation. Engineering computations featured in this monograph further offer particular interest to many researchers, engineers and computational scientists working in frontier modeling and applications of multicomponent and multiscale problems. Professor Geiser gives specific attention to the aspects of decomposing and splitting delicate

structures and controlling decomposition and the rationale behind many important applications of multi-component and multi-scale analysis. Multicomponent and Multiscale Systems: Theory, Methods and Applications in Engineering also considers the question of why iterative methods can be powerful and more appropriate for well-balanced multiscale and multicomponent coupled nonlinear problems. The book is ideal for engineers and scientists working in theoretical and applied areas.

Multiscale problems naturally pose severe challenges for computational science and engineering. The smaller scales must be well resolved over the range of the larger scales. Challenging multiscale problems are very common and are found in e.g. materials science, fluid mechanics, electrical and mechanical engineering. Homogenization, subgrid modelling, heterogeneous multiscale methods, multigrid, multipole, and adaptive algorithms are examples of methods to tackle these problems. This volume is an overview of current mathematical and computational methods for problems with multiple scales with applications in chemistry, physics and engineering.

A single-resource volume of information on the most current and effective techniques of wildlife modeling, Models for Planning Wildlife Conservation in Large Landscapes is appropriate for students and researchers alike. The unique blend of conceptual, methodological, and application chapters discusses research, applications and concepts of modeling and presents new ideas and strategies for wildlife habitat models used in conservation planning. The book makes important contributions to wildlife conservation of animals in several ways: (1) it highlights historical and contemporary advancements in the development of wildlife habitat models and their implementation in conservation planning; (2) it provides practical advice for the ecologist conducting such studies; and (3) it supplies directions for future research including new strategies for successful studies. Intended to provide a recipe for successful development of wildlife habitat models and their implementation in conservation planning, the book could be used in studying wildlife habitat models, conservation planning, and management techniques. Additionally it may be a supplemental text in courses dealing with quantitative assessment of wildlife populations. Additionally, the length of the book would be ideal for graduate student seminar course. Using wildlife habitat models in conservation planning is of considerable interest to wildlife biologists. With ever tightening budgets for wildlife research and planning activities, there is a growing need to use computer methods. Use of simulation models represents the single best alternative. However, it is imperative that these techniques be described in a single source. Moreover, biologists should be made aware of alternative modeling techniques. It is also important that practical guidance be provided to biologists along with a demonstration of utility of these procedures. Currently there is little guidance in the wildlife or natural resource planning literature on how best to incorporate wildlife planning activities, particularly community-based approaches. Now is the perfect time for a synthestic publication that clearly outlines the concepts and available methods, and illustrates them. Only single resource book of information not only on various wildlife modeling techniques, but also with practical guidance on the demonstrated utility of each based on real-world conditions. Provides concepts, methods and applications for wildlife ecologists and others within a GIS context. Written by a team of subject-area experts

Multiscale Simulations and Mechanics of BiologicalMaterials A compilation of recent developments in multiscalesimulation and computational biomaterials written by leadingspecialists in the field Presenting the latest developments in multiscale mechanics andmultiscale simulations, and offering a unique viewpoint onmultiscale modelling of biological materials, this book outlinesthe latest developments in computational biological materials fromatomistic and molecular scale simulation on DNA, proteins, andnano-particles, to meoscale soft matter modelling of cells, and tomacroscale soft tissue and blood vessel, and bone simulations.Traditionally, computational biomaterials researchers come frombiological chemistry and biomedical engineering, so this isprobably the first edited book to present work from these

talentedcomputational mechanics researchers. The book has been written to honor Professor Wing Liu ofNorthwestern University, USA, who has made pioneering contributionsin multiscale simulation and computational biomaterial in specificsimulation of drag delivery at atomistic and molecular scale andcomputational cardiovascular fluid mechanics via immersed finiteelement method. Key features: Offers a unique interdisciplinary approach to multiscalebiomaterial modelling aimed at both accessible introductory andadvanced levels Presents a breadth of computational approaches for modellingbiological materials across multiple length scales (molecular towhole-tissue scale), including solid and fluid basedapproaches A companion website for supplementary materials plus links tocontributors' websites (www.wiley.com/go/li/multiscale)

The first reference of its kind in the rapidly emerging field of computational approachs to materials research, this is a compendium of perspective-providing and topical articles written to inform students and non-specialists of the current status and capabilities of modelling and simulation. From the standpoint of methodology, the development follows a multiscale approach with emphasis on electronic-structure, atomistic, and mesoscale methods, as well as mathematical analysis and rate processes. Basic models are treated across traditional disciplines, not only in the discussion of methods but also in chapters on crystal defects, microstructure, fluids, polymers and soft matter. Written by authors who are actively participating in the current development, this collection of 150 articles has the breadth and depth to be a major contributor toward defining the field of computational materials. In addition, there are 40 commentaries by highly respected researchers, presenting various views that should interest the future generations of the community. Subject Editors: Martin Bazant, MIT; Bruce Boghosian, Tufts University; Richard Catlow, Royal Institution; Long-Qing Chen, Pennsylvania State University; William Curtin, Brown University; Tomas Diaz de la Rubia, Lawrence Livermore National Laboratory; Nicolas Hadjiconstantinou, MIT; Mark F. Horstemeyer, Mississippi State University; Efthimios Kaxiras, Harvard University; L. Mahadevan, Harvard University; Dimitrios Maroudas, University of Massachusetts; Nicola Marzari, MIT; Horia Metiu, University of California Santa Barbara; Gregory C. Rutledge, MIT; David J. Srolovitz, Princeton University; Bernhardt L. Trout, MIT; Dieter Wolf, Argonne National Laboratory.

This is the most authoritative and accessible single-volume reference book on applied mathematics. Featuring numerous entries by leading experts and organized thematically, it introduces readers to applied mathematics and its uses; explains key concepts; describes important equations, laws, and functions; looks at exciting areas of research; covers modeling and simulation; explores areas of application; and more. Modeled on the popular Princeton Companion to Mathematics, this volume is an indispensable resource for undergraduate and graduate students, researchers, and practitioners in other disciplines seeking a user-friendly reference book on applied mathematics. Features nearly 200 entries organized thematically and written by an international team of distinguished contributors Presents the major ideas and branches of applied mathematics in a clear and accessible way Explains important mathematical concepts, methods, equations, and applications Introduces the language of applied mathematics and the goals of applied mathematical research Gives a wide range of examples of mathematical modeling Covers continuum mechanics, dynamical systems, numerical analysis, discrete and combinatorial mathematics, mathematical physics, and much more Explores the connections between applied mathematics and other disciplines Includes suggestions for further reading, cross-references, and a comprehensive index

This illuminating text/reference presents a review of the key aspects of the modeling and simulation (M&S) life cycle, and examines the challenges of M&S in different application areas. The authoritative work offers valuable perspectives on the future of research in M&S, and its role in engineering complex systems. Topics and features: reviews the challenges of M&S for urban infrastructure, healthcare delivery,

automated vehicle manufacturing, deep space missions, and acquisitions enterprise; outlines research issues relating to conceptual modeling, covering the development of explicit and unambiguous models, communication and decision-making, and architecture and services; considers key computational challenges in the execution of simulation models, in order to best exploit emerging computing platforms and technologies; examines efforts to understand and manage uncertainty inherent in M&S processes, and how these can be unified under a consistent theoretical and philosophical foundation; discusses the reuse of models and simulations to accelerate the simulation model development process. This thought-provoking volume offers important insights for all researchers involved in modeling and simulation across the full spectrum of disciplines and applications, defining a common research agenda to support the entire M&S research community.

Integrated Design of Multiscale, Multifunctional Materials and Products is the first of its type to consider not only design of materials, but concurrent design of materials and products. In other words, materials are not just selected on the basis of properties, but the composition and/or microstructure iw designed to satisfy specific ranged sets of performance requirements. This book presents the motivation for pursuing concurrent design of materials and products, thoroughly discussing the details of multiscale modeling and multilevel robust design and provides details of the design methods/strategies along with selected examples of designing material attributes for specified system performance. It is intended as a monograph to serve as a foundational reference for instructors of courses at the senior and introductory graduate level in departments of materials science and engineering, mechanical engineering, aerospace engineering and civil engineering who are interested in next generation systems-based design of materials. First of its kind to consider not only design of materials, but concurrent design of materials and products Treatment of uncertainty via robust design of materials Integrates the "materials by design approach" of Olson/Ques Tek LLC with the "materials selection" approach of Ashby/Granta Distinquishes the processes of concurrent design of materials and products as an overall systems design problem from the field of multiscale modeling Systematic mathematical algorithms and methods are introduced for robust design of materials, rather than ad hoc heuristics--it is oriented towards a true systems approach to design of materials and products

This volume provides a broad and uniform introduction of PDE-constrained optimization as well as to document a number of interesting and challenging applications. Many science and engineering applications necessitate the solution of optimization problems constrained by physical laws that are described by systems of partial differential equations (PDEs)?. As a result, PDE-constrained optimization problems arise in a variety of disciplines including geophysics, earth and climate science, material science, chemical and mechanical engineering, medical imaging and physics. This volume is divided into two parts. The first part provides a comprehensive treatment of PDE-constrained optimization including discussions of problems constrained by PDEs with uncertain inputs and problems constrained by variational inequalities. Special emphasis is placed on algorithm development and numerical computation. In addition, a comprehensive treatment of inverse problems arising in the oil and gas industry is provided. The second part of this volume focuses on the application of PDE-constrained optimization, including problems in optimal control, optimal design, and inverse problems, among other topics.

Promoted by advanced experimental techniques for obtaining high-quality data and the steadily accumulating knowledge about the complexity of life, modeling biological systems at multiple interrelated levels of organization attracts more and more attention recently. Current approaches for modeling multilevel systems typically lack an accessible formal modeling language or have major limitations with respect to expressiveness. The aim of this thesis is to provide a comprehensive discussion on associated problems and needs and to propose a

concrete solution addressing them. At first, several formal modeling approaches are examined regarding their suitability for describing biological models at multiple organizational levels. Thereby, diverse aspects are taken into account, such as the ability to describe dynamically changing hierarchical model structures and how upward and downward causation between different levels can be expressed. Based on the results of this study, a domain-specific language concept is developed to facilitate multilevel modeling in systems biology. The presented approach combines a rule-based modeling paradigm with dynamically nested model structures, attributed entities, and flexibly constrained reaction rates. Its expressive power, accessibility, and general usefulness for describing biological multilevel models are illustrated with the help of two exemplary case studies.

This book presents a systematic treatise on micromechanics and nanomechanics, which encompasses many important research and development areas such as composite materials and homogenizations, mechanics of quantum dots, multiscale analysis and mechanics, defect mechanics of solids including fracture and dislocation mechanics, etc. In this second edition, some previous chapters are revised, and some new chapters added — crystal plasticity, multiscale crystal defect dynamics, quantum force and stress, micromechanics of metamaterials, and micromorphic theory. The book serves primarily as a graduate textbook and intended as a reference book for the next generation of scientists and engineers. It also has a unique pedagogical style that is specially suitable for self-study and self-learning for many researchers and professionals who do not have time attending classes and lectures.

This book presents the latest research, conducted by leading philosophers and scientists from various fields, on the topic of top-down causation. The chapters combine to form a unique, interdisciplinary perspective, drawing upon George Ellis's extensive research and novel perspectives on topics including downwards causation, weak and strong emergence, mental causation, biological relativity, effective field theory and levels in nature. The collection also serves as a Festschrift in honour of George Ellis' 80th birthday. The extensive and interdisciplinary scope of this book makes it vital reading for anyone interested in the work of George Ellis and current research on the topics of causation and emergence.

Introducing the physical principles of rock physics, this upper-level textbook includes problem sets, focus boxes and MATLAB exercises.

Mark Wilson aims to reconnect analytic philosophy with the evolving practicalities within science from which many of its grander concerns originally sprang. He offers an alternative history of how the subject might have developed had the insights of its philosopher/scientist forebears not been cast aside in the vain pursuit of "ersatz rigor".

This is the second monograph by the author on biological materials of marine origin. The initial book is dedicated to the biological materials of marine invertebrates. This work is a source of modern knowledge on biomineralization, biomimetics and materials science with respect to marine vertebrates. For the first time in scientific literature the author gives the most coherent analysis of the nature, origin and evolution of biocomposites and biopolymers isolated from and observed in the broad variety of marine vertebrate organisms (fish, reptilian, birds and mammals) and within their unique hierarchically organized structural formations. There is a wealth of new and newly synthesized information, including dozens of previously unpublished images of unique marine creatures including extinct, extant and living taxa and their biocomposite-based structures from nano- to micro – and macroscale. This monograph reviews the most relevant advances in the marine biological materials research field, pointing out several approaches being introduced and explored by distinct modern laboratories.

Dye Sensitized Solar Cells: Mathematical Modelling and Materials Design and Optimization presents the latest information as edited from leaders in the field. It covers advances in DSSC design, fabrication and mathematical modelling and optimization, providing a comprehensive

coverage of various DSSC advances that includes different system scales, from electronic to macroscopic level, and a consolidation of the results with fundamentals. The book is extremely useful as a monograph for graduate students and researchers, but is also a comprehensive, general reference on state-of-the-art techniques in modelling, optimization and design of DSSCs. Includes chapter contributions from worldwide leaders in the field Offers first-principles of modelling solar cells with different system scales, from the electronic to macroscopic level References, in a single resource, state-of-the-art techniques in modelling, optimization and design of DSSC

Theoretical neuroscience provides a quantitative basis for describing what nervous systems do, determining how they function, and uncovering the general principles by which they operate. This text introduces the basic mathematical and computational methods of theoretical neuroscience and presents applications in a variety of areas including vision, sensory-motor integration, development, learning, and memory. The book is divided into three parts. Part I discusses the relationship between sensory stimuli and neural responses, focusing on the representation of information by the spiking activity of neurons. Part II discusses the modeling of neurons and neural circuits on the basis of cellular and synaptic biophysics. Part III analyzes the role of plasticity in development and learning. An appendix covers the mathematical methods used, and exercises are available on the book's Web site.

Principles of Multiscale ModelingCambridge University Press

An introduction to the fundamental concepts of the emerging field of Artificial Chemistries, covering both theory and practical applications. The field of Artificial Life (ALife) is now firmly established in the scientific world, but it has yet to achieve one of its original goals: an understanding of the emergence of life on Earth. The new field of Artificial Chemistries draws from chemistry, biology, computer science, mathematics, and other disciplines to work toward that goal. For if, as it has been argued, life emerged from primitive, prebiotic forms of self-organization, then studying models of chemical reaction systems could bring ALife closer to understanding the origins of life. In Artificial Chemistries (ACs), the emphasis is on creating new interactions rather than new materials. The results can be found both in the virtual world, in certain multiagent systems, and in the physical world, in new (artificial) reaction systems. This book offers an introduction to the fundamental concepts of ACs, covering both theory and practical applications. After a general overview of the field and its methodology, the book reviews important aspects of biology, including basic mechanisms of evolution; discusses examples of ACs drawn from the literature; considers fundamental questions of how order can emerge, emphasizing the concept of chemical organization (a closed and self-maintaining set of chemicals); and surveys a range of applications, which include computing, systems modeling in biology, and synthetic life. An appendix provides a Python toolkit for implementing ACs.

The essays and lectures collected in this book center around knowledge transfer from the complex-system sciences to

applications in business, industry and society, as viewed from a broad perspective. The contributions aim to raise awareness across the spectrum to meet the increasing need to integrate lessons from complexity research into everyday planning, decision making, logistics or optimization procedures and forecasting. The writing has been largely kept non-technical.

This book gives a unified presentation of the research performed in the field of multiscale modelling in sheet metal forming over the course of more than thirty years by the members of six teams from internationally acclaimed universities. The first chapter is devoted to the presentation of some recent phenomenological yield criteria (BBC 2005 and BBC 2008) developed at the CERTETA center from the Technical University of Cluj-Napoca. An overview on the crystallographic texture and plastic anisotropy is presented in Chapter 2. Chapter 3 is dedicated to multiscale modelling of plastic anisotropy. The authors describe a new hierarchical multi-scale framework that allows taking into account the evolution of plastic anisotropy during sheet forming processes. Chapter 4 is focused on modelling the evolution of voids in porous metals with applications to forming limit curves and ductile fracture. The chapter details the steps needed for the development of dissipation functions and Gurson-type models for non-quadratic anisotropic plasticity criteria like BBC 2005 and those based on linear transformations. Chapter 5 describes advanced models for the prediction of forming limit curves developed by the authors. Chapter 6 is devoted to anisotropic damage in elasto-plastic materials with structural defects. Finally, Chapter 7 deals with modelling of the Portevin-Le Chatelier (PLC) effect. This volume contains contributions from leading researchers from the Technical University of Cluj-Napoca, Romania, the Catholic University of Leuven, Belgium, Clausthal University of Technology, Germany, Amirkabir University of Technology, Iran, the University of Bucharest, Romania, and the Institute of Mathematics of the Romanian Academy, Romania. It will prove useful to postgraduate students, researchers and engineers who are interested in the mechanical modeling and numerical simulation of sheet metal forming processes.

This book constitutes the refereed proceedings of the 5th European Conference on Principles of Data Mining and Knowledge Discovery, PKDD 2001, held in Freiburg, Germany, in September 2001. The 40 revised full papers presented together with four invited contributions were carefully reviewed and selected from close to 100 submissions. Among the topics addressed are hidden Markov models, text summarization, supervised learning, unsupervised learning, demographic data analysis, phenotype data mining, spatio-temporal clustering, Web-usage analysis, association rules, clustering algorithms, time series analysis, rule discovery, text categorization, self-organizing maps, filtering, reinforcemant learning, support vector machines, visual data mining, and machine learning.

Design, analysis and simulation of tissue constructs is an integral part of the ever-evolving field of biomedical

engineering. The study of reaction kinetics, particularly when coupled with complex physical phenomena such as the transport of heat, mass and momentum, is required to determine or predict performance of biologically-based systems wheth