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Essential Matlab for Engineers and Scientists - Brian Hahn 2009-09-15
The essential guide to MATLAB as a problem solving tool This text presents MATLAB both as a mathematical tool and a programming language, giving a concise and easy to master introduction to its potential and power. The fundamentals of MATLAB are illustrated throughout with many examples from a wide range of familiar scientific and engineering areas, as well as from everyday life. The new edition has been updated to include coverage of Symbolic Math and SIMULINK. It also adds new examples and applications, and uses the most recent release of Matlab. New chapters on Symbolic Math and SIMULINK provide complete coverage of all the functions available in the student edition of Matlab New: more exercises and examples, including new examples of beam bending, flow over an airfoil, and other physics-based problems New: A bibliography provides sources for the engineering problems and examples discussed in the text A chapter on algorithm development and program design Common errors and pitfalls highlighted
Digital Image Interpolation in Matlab - Chi-Wah Kok 2019-03-19
This book provides a comprehensive study in digital image interpolation with theoretical, analytical and Matlab® implementation. It includes all historically and practically important interpolation algorithms, accompanied with Matlab® source code on a website, which will assist readers to learn and understand the implementation details of each presented interpolation algorithm. Furthermore, sections in fundamental signal processing theories and image quality models are also included. The authors intend for the book to help readers develop a thorough consideration of the design of image interpolation algorithms and applications for their future research in the field of digital image processing. Introduces a wide range of traditional and advanced image interpolation methods concisely and provides thorough treatment of theoretical foundations Discusses in detail the assumptions and limitations of presented algorithms Investigates a variety of interpolation and implementation methods including transform domain, edge-directed, wavelet and scale-space, and fractal based methods Features simulation results for comparative analysis, summaries and computational and analytical exercises at the end of each chapter Digital Image Interpolation in Matlab® is an excellent guide for researchers and engineers working in digital imaging and digital video technologies. Graduate students studying digital image processing will also benefit from this practical reference text.
Communication and Networking - Dominik Slezak 2009-12-01
As future generation information technology (FGIT) becomes specialized and fr- mented, it is easy to lose sight that many topics in FGIT have common threads and, because of this, advances in one discipline may be transmitted to others. Presentation of recent results obtained in different disciplines encourages this interchange for the advancement of FGIT as a whole. Of particular interest are hybrid solutions that c- bine ideas taken from multiple disciplines in order to achieve something more signi- cant than the sum of the individual parts. Through such hybrid philosophy, a new principle can be discovered, which has the propensity to propagate throughout mul- faceted disciplines. FGIT 2009 was the first mega-conference that attempted to follow the above idea of hybridization in FGIT in a form of multiple events related to particular disciplines of IT, conducted by separate scientific committees, but coordinated in order to expose the most important contributions. It included the following international conferences: Advanced Software Engineering and Its Applications (ASEA), Bio-Science and Bio-Technology (BSBT), Control and Automation (CA), Database Theory and Application (DTA), D- aster Recovery and Business Continuity (DRBC; published independently), Future G- eration Communication and Networking (FGCN) that was combined with Advanced Communication and Networking (ACN), Grid and Distributed Computing (GDC), M- timedia, Computer Graphics and Broadcasting (MulGraB), Security Technology (SecTech), Signal Processing, Image Processing and Pattern Recognition (SIP), and- and e-Service, Science and Technology (UNESST).
Introduction to Numerical Ordinary and Partial Differential Equations Using MATLAB - Alexander Stanoyevitch 2011-10-14
Learn how to solve complex differential equations using MATLAB® Introduction to Numerical Ordinary and Partial Differential Equations Using MATLAB® teaches readers how to numerically solve both ordinary and partial differential equations with ease. This innovative publication brings together a skillful treatment of MATLAB and programming alongside theory and modeling. By presenting these topics in tandem, the author enables and encourages readers to perform their own computer experiments, leading them to a more profound understanding of differential equations. The text consists of three parts: Introduction to MATLAB and numerical preliminaries, which introduces readers to the software and itsgraphical capabilities and shows how to use it to write programs Ordinary Differential Equations Partial Differential Equations All the tools needed to master using MATLAB to solve differential equations are provided and include: "Exercises for the Reader" that range from routine computations to more advanced conceptual and theoretical questions (solutions appendix included) Illustrative examples, provided throughout the text, that demonstrate MATLAB's powerful ability to solve differential equations Explanations that are rigorous, yet written in a very accessible, user-friendly style Access to an FTP site that includes downloadable files of all the programs developed in the text This textbook can be tailored for courses in numerical differential equations and numerical analysis as well as traditional courses in ordinary and/or partial differential equations. All the material has been classroom-tested over the course of many years, with the result that any self-learner with an understanding of basic single-variable calculus can master this topic. Systematic use is made of MATLAB's superb graphical capabilities to display and analyze results. An extensive chapter on the finite element method covers enough practical aspects (including mesh generation) to enable the reader to numerically solve general elliptic boundary value problems. With its thorough coverage of analytic concepts, geometric concepts, programs and algorithms, and applications, this is an unsurpassed pedagogical tool.
Advanced Numerical and Semi-Analytical Methods for Differential Equations - Snehashish Chakraverty 2019-03-20
Examines numerical and semi-analytical methods for differential equations that can be used for solving practical ODEs and PDEs This student-friendly book deals with various approaches for solving differential equations numerically or semi-analytically depending on the type of equations and offers simple example problems to help readers along. Featuring both traditional and recent methods, Advanced Numerical and Semi Analytical Methods for Differential Equations begins with a review of basic numerical methods. It then looks at Laplace, Fourier, and weighted residual methods for solving differential equations. A new challenging method of Boundary Characteristics Orthogonal Polynomials (BCOPs) is introduced next. The book then discusses Finite Difference Method (FDM), Finite Element Method (FEM), Finite Volume Method (FVM), and Boundary Element Method (BEM). Following that, analytical/semi analytic methods like Akbari Ganji's Method (AGM) and Exp-function are used to solve nonlinear differential equations. Nonlinear differential equations using semi-analytical methods are also addressed, namely Adomian Decomposition Method (ADM), Homotopy Perturbation Method (HPM), Variational Iteration Method (VIM), and Homotopy Analysis Method (HAM). Other topics covered include: emerging areas of research related to the solution of differential equations based on differential quadrature and wavelet approach; combined and hybrid methods for solving differential equations; as well as an overview of fractal differential equations. Further, uncertainty in term of intervals and fuzzy numbers have also been included, along with the interval finite element method. This book:

Discusses various methods for solving linear and nonlinear ODEs and PDEs Covers basic numerical techniques for solving differential equations along with various discretization methods Investigates nonlinear differential equations using semi-analytical methods Examines differential equations in an uncertain environment Includes a new scenario in which uncertainty (in term of intervals and fuzzy numbers) has been included in differential equations Contains solved example problems, as well as some unsolved problems for self-validation of the topics covered Advanced Numerical and Semi Analytical Methods for Differential Equations is an excellent text for graduate as well as post graduate students and researchers studying various methods for solving differential equations, numerically and semi-analytically.

An Introduction to Reservoir Simulation Using MATLAB/GNU Octave - Knut-Andreas Lie 2019-06-30
This book provides a self-contained introduction to the simulation of flow and transport in porous media, written by a developer of numerical methods. The reader will learn how to implement reservoir simulation models and computational algorithms in a robust and efficient manner. The book contains a large number of numerical examples, all fully equipped with online code and data, allowing the reader to reproduce results, and use them as a starting point for their own work. All of the examples in the book are based on the MATLAB Reservoir Simulation Toolbox (MRST), an open-source toolbox popular popularity in both academic institutions and the petroleum industry. The book can also be seen as a user guide to the MRST software. It will prove invaluable for researchers, professionals and advanced students using reservoir simulation methods. This title is also available as Open Access on Cambridge Core.

Programming Mathematics Using MATLAB - Lisa A. Oberbroeckling 2020-05-09
Providing an alternative to engineering-focused resources in the area, Programming Mathematics Using MATLAB® introduces the basics of programming and of using MATLAB® by highlighting many mathematical examples. Emphasizing mathematical concepts through the visualization of programming throughout the book, this useful resource utilizes examples that may be familiar to math students (such as numerical integration) and others that may be new (such as fractals). Additionally, the text uniquely offers a variety of MATLAB® projects, all of which have been class-tested thoroughly, and which enable students to put MATLAB® programming into practice while expanding their comprehension of concepts such as Taylor polynomials and the Gram–Schmidt process. Programming Mathematics Using MATLAB® is appropriate for readers familiar with sophomore-level mathematics (vectors, matrices, multivariable calculus), and is useful for math courses focused on MATLAB® specifically and those focused on mathematical concepts which seek to utilize MATLAB® in the classroom. Provides useful visual examples throughout for student comprehension Includes valuable, class-tested projects to reinforce both familiarity with MATLAB® and a deeper understanding of mathematical principles Offers downloadable MATLAB® scripts to supplement practice and provide useful example

The Fractal Geometry of the Brain - Antonio Di Ieva 2016-08-03
Reviews the most intriguing applications of fractal analysis in neuroscience with a focus on current and future potential, limits, advantages, and disadvantages. Will bring an understanding of fractals to clinicians and researchers also if they do not have a mathematical background, and will serve as a good tool for teaching the translational applications of computational models to students and scholars of different disciplines. This comprehensive collection is organized in four parts: (1) Basics of fractal analysis; (2) Applications of fractals to the basic neurosciences; (3) Applications of fractals to the clinical neurosciences; (4) Analysis software, modeling and methodology.

Integrated Intelligent Computing, Communication and Security - A.N. Krishna 2018-09-14
This book highlights the emerging field of intelligent computing and developing smart systems. It includes chapters discussing the outcome of challenging research related to distributed computing, smart machines and their security related research, and also covers next-generation communication techniques and the networking technologies that have the potential to build the future communication infrastructure. Bringing together computing, communications and other aspects of intelligent and smart computing, it contributes to developing a roadmap for future research on intelligent systems.

Biomedical Signal and Image Processing - Kayvan Najarian 2016-04-19

Written for senior-level and first year graduate students in biomedical signal and image processing, this book describes fundamental signal and image processing techniques that are used to process biomedical information. The book also discusses application of these techniques in the processing of some of the main biomedical signals and images, such as EEG, ECG, MRI, and CT. New features of this edition include the technical updating of each chapter along with the addition of many more examples, the majority of which are MATLAB based.

Applied Fractional Calculus in Identification and Control - Utkal Mehta 2022-09-10
The book investigates the fractional calculus-based approaches and their benefits to adopting in complex real-time areas. Another objective is to provide initial solutions for new areas where fractional theory has yet to verify the expertise. The book focuses on the latest scientific interest and illustrates the basic idea of general fractional calculus with MATLAB codes. This book is ideal for researchers working on fractional calculus theory both in simulation and hardware. Researchers from academia and industry working or starting research in applied fractional calculus methods will find the book most useful. The scope of this book covers most of the theoretical and practical studies on linear and nonlinear systems using fractional-order integro-differential operators.

Applications of Chaos and Nonlinear Dynamics in Science and Engineering - Vol. 3 - Santo Banerjee 2013-06-12
Chaos and nonlinear dynamics initially developed as a new emergent field with its foundation in physics and applied mathematics. The highly generic, interdisciplinary quality of the insights gained in the last few decades has spawned myriad applications in almost all branches of science and technology—and even well beyond. Wherever quantitative modeling and analysis of complex, nonlinear phenomena is required, chaos theory and its methods can play a key role. This third volume concentrates on reviewing further relevant contemporary applications of chaotic nonlinear systems as they apply to the various cutting-edge branches of engineering. This encompasses, but is not limited to, topics such fluctuation relations and chaotic dynamics in physics, fractals and their applications in epileptic seizures, as well as chaos synchronization. Featuring contributions from active and leading research groups, this collection is ideal both as a reference and as a 'recipe book' full of tried and tested, successful engineering applications.

Computer Vision and Graphics - Leszek J. Chmielewski 2016-09-09
This book constitutes the refereed proceedings of the International Conference on Computer Vision and Graphic, ICCVG 2016, held in Warsaw, Poland, in September 2016. The 68 full papers presented were carefully reviewed and selected from various submissions. They show various opportunities for valuable research at the border of applied information sciences, agribusiness, veterinary medicine and the broadly understood domains of biology and economy.

Fractal Analyses: Statistical And Methodological Innovations And Best Practices - John G. Holden 2013-06-03
Many statistical and methodological developments regarding fractal analyses have appeared in the scientific literature since the publication of the seminal texts introducing Fractal Physiology. However, the lion's share of more recent work is distributed across many outlets and disciplines, including aquatic sciences, biology, computer science, ecology, economics, geology, mathematics, medicine, neuroscience, physics, physiology, psychology, and others. The purpose of this special topic is to solicit submissions regarding fractal and nonlinear statistical techniques from experts that span a wide range of disciplines. The articles will aggregate extensive cross-discipline expertise into comprehensive and broadly applicable resources that will support the application of fractal methods to physiology and related disciplines. The articles will be organized with respect to a continuum defined by the characteristics of the empirical measurements a given analysis is intended to confront. At one end of the continuum are stochastic techniques directed at assessing scale invariant but stochastic data. The next step in the continuum concerns self-affine random fractals and methods directed at systems that entail scale-invariant or $1/f$ patterns or related patterns of temporal and spatial fluctuation. Analyses directed at (noisy) deterministic signals correspond to the final stage of the continuum that relates the statistical treatments of nonlinear stochastic and deterministic signals. Each section will contain introductory articles, advanced articles, and application articles so readers with any level of expertise with fractal methods will find the special topic accessible and useful. Example stochastic methods include probability density estimation for the inverse power-law, the lognormal, and related distributions. Articles describing statistical issues and tools for

discriminating different classes of distributions will be included. An example issue is distinguishing power-law distributions from exponential distributions. Modeling issues and problems regarding statistical mimicking will be addressed as well. The random fractal section will present introductions to several one-dimensional monofractal time-series analysis. Introductory articles will be accompanied by advanced articles that will supply comprehensive treatments of all the key fractal time series methods such as dispersion analysis, detrended fluctuation analysis, power spectral density analysis, and wavelet techniques. Box counting and related techniques will be introduced and described for spatial analyses of two and three dimensional domains as well. Tutorial articles on the execution and interpretation of multifractal analyses will be solicited. There are several standard wavelet based and detrended fluctuation based methods for estimating a multifractal spectrum. We hope to include articles that contrast the different methods and compare their statistical performance as well. The deterministic methods section will include articles that present methods of phase space reconstruction, recurrence analysis, and cross-recurrence analysis. Recurrence methods are widely applicable, but motivated by signals that contain deterministic patterns. Nonetheless recent developments such as the analysis of recurrence interval scaling relations suggest applicability to fractal systems. Several related statistical procedures will be included in this section. Examples include average mutual information statistics and false nearest neighbor analyses.

Numerical Methods - Anne Greenbaum 2012-04-01
A rigorous and comprehensive introduction to numerical analysis Numerical Methods provides a clear and concise exploration of standard numerical analysis topics, as well as nontraditional ones, including mathematical modeling, Monte Carlo methods, Markov chains, and fractals. Filled with appealing examples that will motivate students, the textbook considers modern application areas, such as information retrieval and animation, and classical topics from physics and engineering. Exercises use MATLAB and promote understanding of computational results. The book gives instructors the flexibility to emphasize different aspects—design, analysis, or computer implementation—of numerical algorithms, depending on the background and interests of students. Designed for upper-division undergraduates in mathematics or computer science classes, the textbook assumes that students have prior knowledge of linear algebra and calculus, although these topics are reviewed in the text. Short discussions of the history of numerical methods are interspersed throughout the chapters. The book also includes polynomial interpolation at Chebyshev points, use of the MATLAB package Chebfun, and a section on the fast Fourier transform. Supplementary materials are available online. Clear and concise exposition of standard numerical analysis topics Explores nontraditional topics, such as mathematical modeling and Monte Carlo methods Covers modern applications, including information retrieval and animation, and classical applications from physics and engineering Promotes understanding of computational results through MATLAB exercises Provides flexibility so instructors can emphasize mathematical or applied/computational aspects of numerical methods or a combination Includes recent results on polynomial interpolation at Chebyshev points and use of the MATLAB package Chebfun Short discussions of the history of numerical methods interspersed throughout Supplementary materials available online

Rock Characterisation, Modelling and Engineering Design Methods - Xia-Ting Feng 2013-05-17
Rock Characterisation, Modelling and Engineering Design Methods contains the contributions presented at the 3rd ISRM SINOROCK Symposium (Shanghai, China, 1820 June 2013). The papers contribute to the further development of the overall rock engineering design process through the sequential linkage of the three themes of rock characterisation, model

Fractal and Multifractal Facets in the Structure and Dynamics of Physiological Systems and Applications to Homeostatic Control, Disease Diagnosis and Integrated Cyber-Physical Platforms - Paul Bogdan 2020-06-25
Widespread chronic diseases (e.g., heart diseases, diabetes and its complications, stroke, cancer, brain diseases) constitute a significant cause of rising healthcare costs and pose a significant burden on quality-of-life for many individuals. Despite the increased need for smart healthcare sensing systems that monitor / measure patients' body balance, there is no coherent theory that facilitates the modeling of human physiological processes and the design and optimization of future healthcare cyber-physical systems (HCPS). The HCPS are expected to

mine the patient's physiological state based on available continuous sensing, quantify risk indices corresponding to the onset of abnormality, signal the need for critical medical intervention in real-time by communicating patient's medical information via a network from individual to hospital, and most importantly control (actuate) vital health signals (e.g., cardiac pacing, insulin level, blood pressure) within personalized homeostasis. To prevent health complications, maintain good health and/or avoid fatal conditions calls for a cross-disciplinary approach to HCPS design where recent statistical-physics inspired discoveries done by collaborations between physicists and physicians are shared and enriched by applied mathematicians, control theorists and bioengineers. This critical and urgent multi-disciplinary approach has to unify the current state of knowledge and address the following fundamental challenges: One fundamental challenge is represented by the need to mine and understand the complexity of the structure and dynamics of the physiological systems in healthy homeostasis and associated with a disease (such as diabetes). Along the same lines, we need rigorous mathematical techniques for identifying the interactions between integrated physiologic systems and understanding their role within the overall networking architecture of healthy dynamics. Another fundamental challenge calls for a deeper understanding of stochastic feedback and variability in biological systems and physiological processes, in particular, and for deciphering their implications not only on how to mathematically characterize homeostasis, but also on defining new control strategies that are accounting for intra- and inter-patient specificity – a truly mathematical approach to personalized medicine. Numerous recent studies have demonstrated that heart rate variability, blood glucose, neural signals and other interdependent physiological processes demonstrate fractal and non-stationary characteristics. Exploiting statistical physics concepts, numerous recent research studies demonstrated that healthy human physiological processes exhibit complex critical phenomena with deep implications for how homeostasis should be defined and how control strategies should be developed when prolonged abnormal deviations are observed. In addition, several efforts have tried to connect these fractal characteristics with new optimal control strategies that implemented in medical devices such as pacemakers and artificial pancreas could improve the efficiency of medical therapies and the quality-of-life of patients but neglecting the overall networking architecture of human physiology. Consequently, rigorously analyzing the complexity and dynamics of physiological processes (e.g., blood glucose and its associated implications and interdependencies with other physiological processes) represents a fundamental step towards providing a quantifiable (mathematical) definition of homeostasis in the context of critical phenomena, understanding the onset of chronic diseases, predicting deviations from healthy homeostasis and developing new more efficient medical therapies that carefully account for the physiological complexity, intra- and inter-patient variability, rather than ignoring it. This Research Topic aims to open a synergetic and timely effort between physicians, physicists, applied mathematicians, signal processing, bioengineering and biomedical experts to organize the state of knowledge in mining the complexity of physiological systems and their implications for constructing more accurate mathematical models and designing QoL-aware control strategies implemented in the new generation of HCPS devices. By bringing together multi-disciplinary researchers seeking to understand the many aspects of human physiology and its complexity, we aim at enabling a paradigm shift in designing future medical devices that translates mathematical characteristics in predictable mathematical models quantifying not only the degree of homeostasis, but also providing fundamentally new control strategies within the personalized medicine era.

MATLAB - Vasilios Katsikis 2012-09-26
This excellent book represents the final part of three-volumes regarding MATLAB-based applications in almost every branch of science. The book consists of 19 excellent, insightful articles and the readers will find the results very useful to their work. In particular, the book consists of three parts, the first one is devoted to mathematical methods in the applied sciences by using MATLAB, the second is devoted to MATLAB applications of general interest and the third one discusses MATLAB for educational purposes. This collection of high quality articles, refers to a large range of professional fields and can be used for science as well as for various educational purposes.

MATLAB for Brain and Cognitive Scientists - Mike X Cohen 2017-07-14
An introduction to a popular programming language for neuroscience

research, taking the reader from beginning to intermediate and advanced levels of MATLAB programming. MATLAB is one of the most popular programming languages for neuroscience and psychology research. Its balance of usability, visualization, and widespread use makes it one of the most powerful tools in a scientist's toolbox. In this book, Mike Cohen teaches brain scientists how to program in MATLAB, with a focus on applications most commonly used in neuroscience and psychology. Although most MATLAB tutorials will abandon users at the beginner's level, leaving them to sink or swim, MATLAB for Brain and Cognitive Scientists takes readers from beginning to intermediate and advanced levels of MATLAB programming, helping them gain real expertise in applications that they will use in their work. The book offers a mix of instructive text and rigorous explanations of MATLAB code along with programming tips and tricks. The goal is to teach the reader how to program data analyses in neuroscience and psychology. Readers will learn not only how to but also how not to program, with examples of bad code that they are invited to correct or improve. Chapters end with exercises that test and develop the skills taught in each chapter. Interviews with neuroscientists and cognitive scientists who have made significant contributions their field using MATLAB appear throughout the book. MATLAB for Brain and Cognitive Scientists is an essential resource for both students and instructors, in the classroom or for independent study.

Wavelet Analysis and Applications - Tao Qian 2007-02-24
This volume reflects the latest developments in the area of wavelet analysis and its applications. Since the cornerstone lecture of Yves Meyer presented at the ICM 1990 in Kyoto, to some extent, wavelet analysis has often been said to be mainly an applied area. However, a significant percentage of contributions now are connected to theoretical mathematical areas, and the concept of wavelets continuously stretches across various disciplines of mathematics. Key topics: Approximation and Fourier Analysis Construction of Wavelets and Frame Theory Fractal and Multifractal Theory Wavelets in Numerical Analysis Time-Frequency Analysis Adaptive Representation of Nonlinear and Non-stationary Signals Applications, particularly in image processing Through the broad spectrum, ranging from pure and applied mathematics to real applications, the book will be most useful for researchers, engineers and developers alike.

Alternative Decision-Making Models for Financial Portfolio Management: Emerging Research and Opportunities - Spaseski, Narela 2017-08-11
Economics is an integral aspect to every successful society, yet basic financial practices have gone unchanged for decades. Analyzing unconventional finance methods can provide new ways to ensure personal financial futures on an individual level, as well as boosting international economies. Alternative Decision-Making Models for Financial Portfolio Management: Emerging Research and Opportunities is an essential reference source that discusses methods and techniques that make financial administration more efficient for professionals in economic fields. Featuring relevant topics such as mean-variance portfolio theory, decision tree analysis, risk protection strategies, and asset-liability management, this publication is ideal for academicians, students, economists, and researchers that would like to stay current on new and innovative methods to transform the financial realm.

Fractals And Chaos In Chemical Engineering: Proceedings Of The Cfic '96 Conference - Biardi Giuseppe 1997-07-01
This volume is a collection of the papers presented at the International Conference on Fractal Concepts and the Application of Chaos in Chemical Engineering Problems. The book provides a detailed description of the current research on the application of fractal concepts, nonlinear dynamics and disordered systems in chemical engineering, with emphasis on interdisciplinary connections with related fields, such as control theory of nonlinear systems, dynamic theory of fractals, transport theory and physical chemistry of heterogeneous materials.

Systems Science - Yi Lin 2012-11-26
By making use of the principles of systems science, the scientific community can explain many complicated matters of the world and shed new light on unsettled problems. Each real science has its own particular methodology for not only qualitative but also quantitative analyses, so it is important to understand the organic whole of systems research with operable mathematical methods. Systems Science: Methodological Approaches presents a mathematical explanation of systems science, giving readers a complete technical formulation of different systemic laws. It enables them to use a unified methodology to attack different problems that are hard, if not impossible, for modern science to handle. Following a brief history of systems science, the book explores: Basic

concepts, characteristics, properties, and classifications of general systems Nonlinear systems dynamics and the theory of catastrophe Dissipative structures and synergistics Studies of chaos, including logistic mapping, phase space reconstruction, Lyapunov exponents, and chaos of general single relation systems Different aspects and concepts of fractals, including a presentation of L systems analysis and design Complex systems and complexity, with a discussion of how the phenomena of "three" and complexity are related, and how various cellular automata can be constructed to generate useful simulations and figurative patterns Complex adaptive systems and open complex giant systems, with introduction of the yoyo model and practical applications Complex networks and related concepts and methods The book concludes with several case studies that demonstrate how various concepts and the logic of systems can be practically applied to resolve real-life problems, such as the prediction of natural disasters. The book will be useful in directing future research and applications of systems science on a commonly accepted platform and playground.

Chaos and Fractals - C.A. Pickover 1998-08-03
These days computer-generated fractal patterns are everywhere, from squiggly designs on computer art posters to illustrations in the most serious of physics journals. Interest continues to grow among scientists and, rather surprisingly, artists and designers. This book provides visual demonstrations of complicated and beautiful structures that can arise in systems, based on simple rules. It also presents papers on seemingly paradoxical combinations of randomness and structure in systems of mathematical, physical, biological, electrical, chemical, and artistic interest. Topics include: iteration, cellular automata, bifurcation maps, fractals, dynamical systems, patterns of nature created through simple rules, and aesthetic graphics drawn from the universe of mathematics and art. Chaos and Fractals is divided into six parts: Geometry and Nature; Attractors; Cellular Automata, Gaskets, and Koch Curves; Mandelbrot, Julia and Other Complex Maps; Iterated Function Systems; and Computer Art. Additionally, information on the latest practical applications of fractals and on the use of fractals in commercial products such as the antennas and reaction vessels is presented. In short, fractals are increasingly finding application in practical products where computer graphics and simulations are integral to the design process. Each of the six sections has an introduction by the editor including the latest research, references, and updates in the field. This book is enhanced with numerous color illustrations, a comprehensive index, and the many computer program examples encourage reader involvement.

A Laboratory Manual in Biophotonics - Vadim Backman 2018-05-15
Biophotonics is a burgeoning field that has afforded researchers and medical practitioners alike an invaluable tool for implementing optical microscopy. Recent advances in research have enabled scientists to measure and visualize the structural composition of cells and tissue while generating applications that aid in the detection of diseases such as cancer, Alzheimer's, and atherosclerosis. Rather than divulge a perfunctory glance into the field of biophotonics, this textbook aims to fully immerse senior undergraduates, graduates, and research professionals in the fundamental knowledge necessary for acquiring a more advanced awareness of concepts and pushing the field beyond its current boundaries. The authors furnish readers with a pragmatic, quantitative, and systematic view of biophotonics, engaging such topics as light-tissue interaction, the use of optical instrumentation, and formulating new methods for performing analysis. Designed for use in classroom lectures, seminars, or professional laboratories, the inclusion and incorporation of this textbook can greatly benefit readers as it serves as a comprehensive introduction to current optical techniques used in biomedical applications. Caters to the needs of graduate and undergraduate students as well as R&D professionals engaged in biophotonics research. Guides readers in the field of biophotonics, beginning with basic concepts before proceeding to more advanced topics and applications. Serves as a primary text for attaining an in-depth, systematic view of principles and applications related to biophotonics. Presents a quantitative overview of the fundamentals of biophotonic technologies. Equips readers to apply fundamentals to practical aspects of biophotonics.

Foundations of Solid State Physics - Siegmar Roth 2019-04-02
An essential guide to solid state physics through the lens of dimensionality and symmetry Foundations of Solid State Physics introduces the essential topics of solid state physics as taught globally with a focus on understanding the properties of solids from the viewpoint of dimensionality and symmetry. Written in a conversational manner and designed to be accessible, the book contains a minimal amount of

mathematics. The authors?noted experts on the topic?offer an insightful review of the basic topics, such as the static and dynamic lattice in real space, the reciprocal lattice, electrons in solids, and transport in materials and devices. The book also includes more advanced topics: the quasi-particle concept (phonons, solitons, polarons, excitons), strong electron-electron correlation, light-matter interactions, and spin systems. The authors' approach makes it possible to gain a clear understanding of conducting polymers, carbon nanotubes, nanowires, two-dimensional chalcogenides, perovskites and organic crystals in terms of their expressed dimension, topological connectedness, and quantum confinement. This important guide: -Offers an understanding of a variety of technology-relevant solid-state materials in terms of their dimension, topology and quantum confinement -Contains end-of-chapter problems with different degrees of difficulty to enhance understanding -Treats all classical topics of solid state physics courses - plus the physics of low-dimensional systems Written for students in physics, material sciences, and chemistry, lecturers, and other academics, Foundations of Solid State Physics explores the basic and advanced topics of solid state physics with a unique focus on dimensionality and symmetry.

Random Fields for Spatial Data Modeling - Dionissios T. Hristopulos 2020-02-17
This book provides an inter-disciplinary introduction to the theory of random fields and its applications. Spatial models and spatial data analysis are integral parts of many scientific and engineering disciplines. Random fields provide a general theoretical framework for the development of spatial models and their applications in data analysis. The contents of the book include topics from classical statistics and random field theory (regression models, Gaussian random fields, stationarity, correlation functions) spatial statistics (variogram estimation, model inference, kriging-based prediction) and statistical physics (fractals, Ising model, simulated annealing, maximum entropy, functional integral representations, perturbation and variational methods). The book also explores links between random fields, Gaussian processes and neural networks used in machine learning. Connections with applied mathematics are highlighted by means of models based on stochastic partial differential equations. An interlude on autoregressive time series provides useful lower-dimensional analogies and a connection with the classical linear harmonic oscillator. Other chapters focus on non-Gaussian random fields and stochastic simulation methods. The book also presents results based on the author's research on Spartan random fields that were inspired by statistical field theories originating in physics. The equivalence of the one-dimensional Spartan random field model with the classical, linear, damped harmonic oscillator driven by white noise is highlighted. Ideas with potentially significant computational gains for the processing of big spatial data are presented and discussed. The final chapter concludes with a description of the Karhunen-Loève expansion of the Spartan model. The book will appeal to engineers, physicists, and geoscientists whose research involves spatial models or spatial data analysis. Anyone with background in probability and statistics can read at least parts of the book. Some chapters will be easier to understand by readers familiar with differential equations and Fourier transforms.

Linear Algebra for the 21st Century - Anthony Roberts 2020-10-09
Customarily, much of traditional mathematics curricula was predicated on 'by hand' calculation. However, ubiquitous computing requires us to refresh what we teach and how it is taught. This is especially true in the rapidly broadening fields of Data Mining and Artificial Intelligence, and also in fields such as Bioinformatics, which all require the use of Singular Value Decomposition (SVD). Indeed, SVD is sometimes called the jewel in the crown of linear algebra. Linear Algebra for 21st Century Applications adapts linear algebra to best suit modern teaching and application, and it places the SVD as central to the text early on to empower science and engineering students to learn and use potent practical and theoretical techniques. No rigour is lost in this new route as the text demonstrates that most theory is better proved with an SVD. In addition to this, there is earlier introduction, development, and emphasis on orthogonality that is vital in so many applied disciplines throughout science, engineering, computing and increasingly within the social sciences. To assimilate the so-called third arm of science, namely computing, Matlab/Octave computation is explicitly integrated into developing the mathematical concepts and applications. A strong graphical emphasis takes advantage of the power of visualisation in the human brain and examples are included to exhibit modern applications of linear algebra, such as GPS, text mining, and image processing. Active learning is encouraged with exercises throughout that are aimed to enhance ectures, quizzes, or

'flipped' teaching.

Microsystems for Enhanced Control of Cell Behavior - Andrés Díaz Lantada 2016-03-23
This handbook focuses on the entire development process of biomedical microsystems that promote special interactions with cells. Fundamentals of cell biology and mechanobiology are described as necessary preparatory input for design tasks. Advanced design, simulation, and micro/nanomanufacturing resources, whose combined use enables the development of biomedical microsystems capable of interacting at a cellular level, are covered in depth. A detailed series of chapters is then devoted to applications based on microsystems that offer enhanced cellular control, including microfluidic devices for diagnosis and therapy, cell-based sensors and actuators (smart biodevices), microstructured prostheses for improvement of biocompatibility, microstructured and microtextured cell culture matrices for promotion of cell growth and differentiation, electrophoretic microsystems for study of cell mechanics, microstructured and microtextured biodevices for study of cell adhesion and dynamics, and biomimetic microsystems (including organs-on-chips), among others. Challenges relating to the development of reliable in vitro biomimetic microsystems, the design and manufacture of complex geometries, and biofabrication are also discussed.

Recent Advances in Mathematical and Statistical Methods - D. Marc Kilgour 2018-11-04
This book focuses on the recent development of methodologies and computation methods in mathematical and statistical modelling, computational science and applied mathematics. It emphasizes the development of theories and applications, and promotes interdisciplinary endeavour among mathematicians, statisticians, scientists, engineers and researchers from other disciplines. The book provides ideas, methods and tools in mathematical and statistical modelling that have been developed for a wide range of research fields, including medical, health sciences, biology, environmental science, engineering, physics and chemistry, finance, economics and social sciences. It presents original results addressing real-world problems. The contributions are products of a highly successful meeting held in August 2017 on the main campus of Wilfrid Laurier University, in Waterloo, Canada, the International Conference on Applied Mathematics, Modeling and Computational Science (AMMCS-2017). They make this book a valuable resource for readers interested not only in a broader overview of the methods, ideas and tools in mathematical and statistical approaches, but also in how they can attain valuable insights into problems arising in other disciplines.

Wavelets and Wavelet Transform Systems and Their Applications - Cajetan M. Akujuobi 2022
This textbook is unique because of its in-depth treatment of the applications of wavelets and wavelet transforms to many areas, across many disciplines. The book is written to serve the needs of a one or two semester course at either the undergraduate or graduate level. The author uses a very simplified, accessible approach that de-emphasizes mathematical rigor. The presentation includes many diagrams to illustrate points being discussed and uses MATLAB for all of application code. The author reinforces concepts introduced in the book with easy to grasp review questions and problems, tailored to each specific chapter for better mastery of the subject matter. This book enables students to understand the fundamental concepts of wavelets and wavelet transforms, as well as how to use them for problem solutions in digital signal and image processing, mixed-signal testing, space applications, aerospace applications, biomedical, cyber security, homeland security and many other application areas. Provides textbook coverage of Wavelets and applications, suitable for one and two semester courses, either at the undergraduate or graduate level; Discusses many types of wavelets and their applications across many disciplines; Includes MATLAB code illustrations to simplify the understanding of the various applications; Uses many illustrations, figures, tables, and visual comparisons to simplify and clarify the various concepts of wavelets, wavelet transforms and the various application areas; Ends each chapter with review questions/answers, as well as exercises to reinforce and test concepts introduced; Solutions manual and PowerPoint slides for each chapter available for instructors.

Heart Rate Variability and other Autonomic Markers in Children and Adolescents - Jerzy Sacha 2019-11-27

Nonlinear Modeling of Solar Radiation and Wind Speed Time Series - Luigi Fortuna 2016-06-21
This brief is a clear, concise description of the main techniques of time

series analysis —stationary, autocorrelation, mutual information, fractal and multifractal analysis, chaos analysis, etc.— as they are applied to the influence of wind speed and solar radiation on the production of electrical energy from these renewable sources. The problem of implementing prediction models is addressed by using the embedding-phase-space approach: a powerful technique for the modeling of complex systems. Readers are also guided in applying the main machine learning techniques for classification of the patterns hidden in their time series and so will be able to perform statistical analyses that are not possible by using conventional techniques. The conceptual exposition avoids unnecessary mathematical details and focuses on concrete examples in order to ensure a better understanding of the proposed techniques. Results are well-illustrated by figures and tables.

Dynamical Systems with Applications using MATLAB® - Stephen Lynch 2004-06-10
This introduction to dynamical systems theory guides readers through theory via example and the graphical MATLAB interface; the SIMULINK® accessory is used to simulate real-world dynamical processes. Examples included are from mechanics, electrical circuits, economics, population dynamics, epidemiology, nonlinear optics, materials science and neural networks. The book contains over 330 illustrations, 300 examples, and exercises with solutions.

Understanding Complex Ecosystem Dynamics - William S. Yackinous 2015-06-03
Understanding Complex Ecosystem Dynamics: A Systems and Engineering Perspective takes a fresh, interdisciplinary perspective on complex system dynamics, beginning with a discussion of relevant systems and engineering skills and practices, including an explanation of the systems approach and its major elements. From this perspective, the author formulates an ecosystem dynamics functionality-based framework to guide ecological investigations. Next, because complex system theory (across many subject matter areas) is crucial to the work of this book, relevant network theory, nonlinear dynamics theory, cellular automata theory, and roughness (fractal) theory is covered in some detail. This material serves as an important resource as the book proceeds. In the context of all of the foregoing discussion and investigation, a view of the characteristics of ecological network dynamics is constructed. This view, in turn, is the basis for the central hypothesis of the book, i.e., ecological networks are ever-changing networks with propagation dynamics that are punctuated, local-to-global, and perhaps most importantly fractal. To analyze and fully test this hypothesis, an innovative ecological network dynamics model is defined, designed, and developed. The modeling approach, which seeks to emulate features of real-world ecological networks, does not make a priori assumptions about ecological network dynamics, but rather lets the dynamics develop as the model simulation runs. Model analysis results corroborate the central hypothesis. Additional important insights and principles are suggested by the model analysis results and by the other supporting investigations of this book – and can serve as a basis for going-forward complex system dynamics research, not only for ecological systems but for complex systems in general. Provides a fresh interdisciplinary perspective, offers a broad integrated development, and contains many new ideas Clearly explains the elements of the systems approach and applies them throughout the book Takes on the challenging and open issues of complex system network dynamics Develops and utilizes a new, innovative ecosystem dynamics modeling approach Contains over 135 graphic illustrations to help the reader visualize and understand important concepts

Introductory Biophysics - James R. Claycomb 2011
Designed for biology, physics, and medical students, Introductory Biophysics: Perspectives on the Living State, provides a comprehensive overview of the complex subject of biological physics. The companion CD-ROM, with MATLAB examples and the student version of QuickFieldTM, allows the student to perform biophysical simulations and modify the textbook example files. Included in the text are computer simulations of thermodynamics, astrobiology, the response of living cells to external fields, chaos in population dynamics, numerical models of evolution, electrical circuit models of cell suspension, gap junctions, and neuronal action potentials. With this text students will be able to perform biophysical simulations within hours. MATLAB examples include; the Hodgkin Huxley equations; the FitzHugh-Nagumo model of action potentials; fractal structures in biology; chaos in population dynamics;

the cellular automaton model (the game of life); pattern formation in reaction-diffusion systems. QuickFieldTM tutorials and examples include; calculation of currents in biological tissue; cells under electrical stimulation; induced membrane potentials; heat transfer and analysis of stress in biomaterials.

Numerical Computing with MATLAB - Cleve B. Moler 2010-08-12
A revised textbook for introductory courses in numerical methods, MATLAB and technical computing, which emphasises the use of mathematical software.

Diagnostic Radiology Physics with MATLAB® - Johan Helmenkamp 2020-11-23
Imaging modalities in radiology produce ever-increasing amounts of data which need to be displayed, optimized, analyzed and archived: a "big data" as well as an "image processing" problem. Computer programming skills are rarely emphasized during the education and training of medical physicists, meaning that many individuals enter the workplace without the ability to efficiently solve many real-world clinical problems. This book provides a foundation for the teaching and learning of programming for medical physicists and other professions in the field of Radiology and offers valuable content for novices and more experienced readers alike. It focuses on providing readers with practical skills on how to implement MATLAB® as an everyday tool, rather than on solving academic and abstract physics problems. Further, it recognizes that MATLAB is only one tool in a medical physicist's toolkit and shows how it can be used as the "glue" to integrate other software and processes together. Yet, with great power comes great responsibility. The pitfalls to deploying your own software in a clinical environment are also clearly explained. This book is an ideal companion for all medical physicists and medical professionals looking to learn how to utilize MATLAB in their work. Features Encompasses a wide range of medical physics applications in diagnostic and interventional radiology Advances the skill of the reader by taking them through real-world practical examples and solutions with access to an online resource of example code The diverse examples of varying difficulty make the book suitable for readers from a variety of backgrounds and with different levels of programming experience.

Colloids and Interfaces in Oil Recovery - Spencer Taylor 2019-06-21
It is well-known that colloid and interface science and petroleum production are inextricably linked. Whether in the reservoir, with its porous structure, or during recovery, crude oil is intimately associated with rock surfaces and with water, often in the form of emulsions. This situation leads to highly complex systems, comprising multiple colloids and interfaces, which require to be optimized if oil is to be recovered efficiently, both in terms of economic cost and with due concern for the environment. This book contains a compilation of contemporary research topics which illustrate various aspects of the importance of colloids and interfaces in crude oil recovery through modifying conditions between the rock, crude oil, and water in the reservoir, in order to achieve improved oil recovery. The specific topics covered relate both to conventional oils, in which waterflooding is the most common secondary and tertiary means of recovery, and to non-conventional heavy oil and natural bitumen, which require thermal recovery methods, owing to their high viscosity.

Handbook of Research on Advancements in Manufacturing, Materials, and Mechanical Engineering - Burstein, Leonid 2020-09-18
Production, new materials development, and mechanics are the central subjects of modern industry and advanced science. With a very broad reach across several different disciplines, selecting the most forward-thinking research to review can be a hefty task, especially for study in niche applications that receive little coverage. For those subjects, collecting the research available is of utmost importance. The Handbook of Research on Advancements in Manufacturing, Materials, and Mechanical Engineering is an essential reference source that examines emerging obstacles in these fields of engineering and the methods and tools used to find solutions. Featuring coverage of a broad range of topics including fabricating procedures, automated control, and material selection, this book is ideally designed for academics; tribology and materials researchers; mechanical, physics, and materials engineers; professionals in related industries; scientists; and students.