Mathematical Methods And Algorithms For Signal Processing

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Mathematical Methods and Algorithms for Signal Processing - Todd K. Moon 2005-02-01

Introduction to Digital Signal Processing Using MATLAB with Application to Digital Communications - K.S. Thyagarajan 2018-05-28
This textbook provides engineering students with instruction on processing signals encountered in speech, music, and wireless communications using software or hardware by employing basic mathematical methods. The book starts with an overview of signal processing, introducing readers to the field. It goes on to give instruction in converting continuous time signals into digital signals and discusses various methods to process the digital signals, such as filtering. The author uses MATLAB throughout as a user-friendly software tool to perform various digital signal processing algorithms and to simulate real-time systems. Readers learn how to convert analog signals into digital signals; how to process these signals using software or hardware; and how to write algorithms to perform useful operations on the acquired signals such as filtering, detecting digitally modulated signals, correcting channel distortions, etc. Students are also shown how to convert MATLAB codes into firmware codes. Further, students will be able to apply the basic digital signal processing techniques in their workplace. The book is based on the author's popular online course at University of California, San Diego.
Fast Algorithms for Digital Signal Processing - Richard E. Blahut 1985
Introduction to abstract algebra. Fast algorithms for short convolutions. Fast algorithms for the discrete Fourier transform. Number theory and algebraic field theory. Computation in surrogate fields. Fast algorithms and multidimensional convolutions. Fast algorithms and multidimensional transforms. Architecture of filters and transforms. Fast algorithms based on doubling strategies. Fast algorithms for solving Toeplitz systems. Fast algorithms for Trellis and tree search. A collection of cyclic convolution algorithms. A collection

of Winograd small FFT algorithms.

Mathematical Methods in Computer Vision - Peter J. Olver 2010-11-16

This volume comprises some of the key work presented at two IMA Workshops on Computer Vision during fall of 2000. Recent years have seen significant advances in the application of sophisticated mathematical theories to the problems arising in image processing. Basic issues include image smoothing and denoising, image enhancement, morphology, image compression, and segmentation (determining boundaries of objects-including problems of camera distortion and partial occlusion). Several mathematical approaches have emerged, including methods based on nonlinear partial differential equations, stochastic and statistical methods, and signal processing techniques, including wavelets and other transform theories. Shape theory is of fundamental importance since it is the bottleneck between high and low level vision, and formed the bridge between the two workshops on vision. The recent geometric partial differential equation methods have been essential in throwing new light on this very difficult problem area. Further, stochastic processes, including Markov random fields, have been used in a Bayesian framework to incorporate prior constraints on smoothness and the regularities of discontinuities into algorithms for image restoration and reconstruction. A number of applications are considered including optical character and handwriting recognizers, printed-circuit board inspection systems and quality control devices, motion detection, robotic control by visual feedback, reconstruction of objects from stereoscopic view and/or motion, autonomous road vehicles, and many others.

Digital Signal Processing Using MATLAB for Students and Researchers - John W. Leis 2011-10-14

Quickly Engages in Applying Algorithmic Techniques to Solve Practical Signal Processing Problems With its active, hands-on learning approach, this text enables readers to master the underlying principles of digital signal processing and its many applications in industries such as digital television, mobile and broadband communications, and medical/scientific devices. Carefully developed MATLAB® examples throughout the text illustrate the mathematical concepts and use of digital signal processing algorithms. Readers will develop a deeper understanding of how to apply the algorithms by manipulating the codes in the examples to see their effect. Moreover, plenty of exercises help to put knowledge into practice solving real-world signal processing challenges. Following an introductory chapter, the text explores: Sampled signals and digital processing Random signals Representing signals and systems Temporal and spatial signal processing Frequency analysis of signals Discrete-time filters and recursive filters Each chapter begins with chapter objectives and an introduction. A summary at the end of each chapter ensures that one has mastered all the key concepts and techniques before progressing in the text. Lastly, appendices listing selected web resources, research papers, and related textbooks enable the investigation of individual topics in greater depth. Upon completion of this text, readers will understand how to apply key algorithmic techniques to address practical signal processing problems as well as develop their own signal processing algorithms. Moreover, the text provides a solid foundation for evaluating and applying new digital

processing signal techniques as they are developed.

An Introduction to Compressed Sensing - M. Vidyasagar 2019-12-03

Compressed sensing is a relatively recent area of research that refers to the recovery of high-dimensional but low-complexity objects from a limited number of measurements. The topic has applications to signal/image processing and computer algorithms, and it draws from a variety of mathematical techniques such as graph theory, probability theory, linear algebra, and optimization. The author presents significant concepts never before discussed as well as new advances in the theory, providing an in-depth initiation to the field of compressed sensing. An Introduction to Compressed Sensing contains substantial material on graph theory and the design of binary measurement matrices, which is missing in recent texts despite being poised to play a key role in the future of compressed sensing theory. It also covers several new developments in the field and is the only book to thoroughly study the problem of matrix recovery. The book supplies relevant results alongside their proofs in a compact and streamlined presentation that is easy to navigate. The core audience for this book is engineers, computer scientists, and statisticians who are interested in compressed sensing. Professionals working in image processing, speech processing, or seismic signal processing will also find the book of interest.

Robust Technology with Analysis of Interference in Signal Processing - Telman Aliev 2012-12-06

Robust Technology with Analysis of Interference in Signal Processing discusses for the first time the theoretical fundamentals and algorithms of analysis of noise as an information carrier. On their basis the robust technology of noisy signals processing is developed. This technology can be applied to solving the problems of control, identification, diagnostics, and pattern recognition in petrochemistry, energetics, geophysics, medicine, physics, aviation, and other sciences and industries. The text explores the emergent possibility of forecasting failures on various objects, in conjunction with the fact that failures follow the hidden microchanges revealed via interference estimates. This monograph is of interest to students, postgraduates, engineers, scientific associates and others who are concerned with the processing of measuring information on computers.

Statistical Signal Processing - Swagata Nandi 2020-08-21

This book introduces readers to various signal processing models that have been used in analyzing periodic data, and discusses the statistical and computational methods involved. Signal processing can broadly be considered to be the recovery of information from physical observations. The received signals are usually disturbed by thermal, electrical, atmospheric or intentional interferences, and due to their random nature, statistical techniques play an important role in their analysis. Statistics is also used in the formulation of appropriate models to describe the behavior of systems, the development of appropriate techniques for estimation of model parameters and the assessment of the model performances. Analyzing different real-world data sets to illustrate how different models can be used in practice, and highlighting open problems for future research, the book is a valuable resource for senior undergraduate and graduate

students specializing in mathematics or statistics.

Digital Signal Processing - Jonathan M Blackledge 2006-03-01

This book forms the first part of a complete MSc course in an area that is fundamental to the continuing revolution in information technology and communication systems. Massively exhaustive, authoritative, comprehensive and reinforced with software, this is an introduction to modern methods in the developing field of Digital Signal Processing (DSP). The focus is on the design of algorithms and the processing of digital signals in areas of communications and control, providing the reader with a comprehensive introduction to the underlying principles and mathematical models. Provides an introduction to modern methods in the developing field of Digital Signal Processing (DSP) Focuses on the design of algorithms and the processing of digital signals in areas of communications and control Provides a comprehensive introduction to the underlying principles and mathematical models of Digital Signal Processing

DSP Primer - C. Britton Rorabaugh 1999

Digital Signal Processing (DSP) has applications in many areas of electrical engineering from telecommunications to computer hardware. This text and CD-ROM provide nearly 200 mathematical methods, processing algorithms and design procedures in a step-by-step format.

Understanding Digital Signal Processing - Richard G. Lyons 2010-11-01

Amazon.com’s Top-Selling DSP Book for Seven Straight Years—Now Fully Updated! Understanding Digital Signal Processing, Third Edition, is quite simply the best resource for engineers and other technical professionals who want to master and apply today’s latest DSP techniques. Richard G. Lyons has updated and expanded his best-selling second edition to reflect the newest technologies, building on the exceptionally readable coverage that made it the favorite of DSP professionals worldwide. He has also added hands-on problems to every chapter, giving students even more of the practical experience they need to succeed. Comprehensive in scope and clear in approach, this book achieves the perfect balance between theory and practice, keeps math at a tolerable level, and makes DSP exceptionally accessible to beginners without ever oversimplifying it. Readers can thoroughly grasp the basics and quickly move on to more sophisticated techniques. This edition adds extensive new coverage of FIR and IIR filter analysis techniques, digital differentiators, integrators, and matched filters. Lyons has significantly updated and expanded his discussions of multirate processing techniques, which are crucial to modern wireless and satellite communications. He also presents nearly twice as many DSP Tricks as in the second edition—including techniques even seasoned DSP professionals may have overlooked. Coverage includes New homework problems that deepen your understanding and help you apply what you’ve learned Practical, day-to-day DSP implementations and problem-solving throughout Useful new guidance on generalized digital networks, including discrete differentiators, integrators, and matched filters Clear descriptions of statistical measures of signals, variance reduction by averaging, and real-world signal-to-noise ratio (SNR) computation A significantly expanded chapter on sample rate conversion (multirate systems) and

associated filtering techniques New guidance on implementing fast convolution, IIR filter scaling, and more Enhanced coverage of analyzing digital filter behavior and performance for diverse communications and biomedical applications Discrete sequences/systems, periodic sampling, DFT, FFT, finite/infinite impulse response filters, quadrature (I/Q) processing, discrete Hilbert transforms, binary number formats, and much more

Error Correction Coding - Todd K. Moon 2005-06-06

An unparalleled learning tool and guide to error correction coding Error correction coding techniques allow the detection and correction of errors occurring during the transmission of data in digital communication systems. These techniques are nearly universally employed in modern communication systems, and are thus an important component of the modern information economy. Error Correction Coding: Mathematical Methods and Algorithms provides a comprehensive introduction to both the theoretical and practical aspects of error correction coding, with a presentation suitable for a wide variety of audiences, including graduate students in electrical engineering, mathematics, or computer science. The pedagogy is arranged so that the mathematical concepts are presented incrementally, followed immediately by applications to coding. A large number of exercises expand and deepen students' understanding. A unique feature of the book is a set of programming laboratories, supplemented with over 250 programs and functions on an associated Web site, which provides hands-on experience and a better understanding of the material. These laboratories lead students through the implementation and evaluation of Hamming codes, CRC codes, BCH and R-S codes, convolutional codes, turbo codes, and LDPC codes. This text offers both "classical" coding theory-such as Hamming, BCH, Reed-Solomon, Reed-Muller, and convolutional codes-as well as modern codes and decoding methods, including turbo codes, LDPC codes, repeat-accumulate codes, space time codes, factor graphs, soft-decision decoding, Guruswami-Sudan decoding, EXIT charts, and iterative decoding. Theoretical complements on performance and bounds are presented. Coding is also put into its communications and information theoretic context and connections are drawn to public key cryptosystems. Ideal as a classroom resource and a professional reference, this thorough guide will benefit electrical and computer engineers, mathematicians, students, researchers, and scientists.

Error Correction Coding - Todd K. Moon 2020-12-22

Providing in-depth treatment of error correction Error Correction Coding: Mathematical Methods and Algorithms, 2nd Edition provides a comprehensive introduction to classical and modern methods of error correction. The presentation provides a clear, practical introduction to using a lab-oriented approach. Readers are encouraged to implement the encoding and decoding algorithms with explicit algorithm statements and the mathematics used in error correction, balanced with an algorithmic development on how to actually do the encoding and decoding. Both block and stream (convolutional) codes are discussed, and the mathematics required to understand them are introduced on a “just-in-time” basis as the reader progresses through the book. The second edition increases the impact and reach of the book, updating it to discuss recent

important technological advances. New material includes: Extensive coverage of LDPC codes, including a variety of decoding algorithms. A comprehensive introduction to polar codes, including systematic encoding/decoding and list decoding. An introduction to fountain codes. Modern applications to systems such as HDTV, DVBT2, and cell phones Error Correction Coding includes extensive program files (for example, C++ code for all LDPC decoders and polar code decoders), laboratory materials for students to implement algorithms, and an updated solutions manual, all of which are perfect to help the reader understand and retain the content. The book covers classical BCH, Reed Solomon, Golay, Reed Muller, Hamming, and convolutional codes which are still component codes in virtually every modern communication system. There are also fulsome discussions of recently developed polar codes and fountain codes that serve to educate the reader on the newest developments in error correction.

Mathematical Methods for Signal and Image Analysis and Representation - Luc Florack 2012-01-12

Mathematical Methods for Signal and Image Analysis and Representation presents the mathematical methodology for generic image analysis tasks. In the context of this book an image may be any m-dimensional empirical signal living on an n-dimensional smooth manifold (typically, but not necessarily, a subset of spacetime). The existing literature on image methodology is rather scattered and often limited to either a deterministic or a statistical point of view. In contrast, this book brings together these seemingly different points of view in order to stress their conceptual relations and formal analogies. Furthermore, it does not focus on specific applications, although some are detailed for the sake of illustration, but on the methodological frameworks on which such applications are built, making it an ideal companion for those seeking a rigorous methodological basis for specific algorithms as well as for those interested in the fundamental methodology per se. Covering many topics at the forefront of current research, including anisotropic diffusion filtering of tensor fields, this book will be of particular interest to graduate and postgraduate students and researchers in the fields of computer vision, medical imaging and visual perception.

Mathematics for Machine Learning - Marc Peter Deisenroth 2020-04-23

The fundamental mathematical tools needed to understand machine learning include linear algebra, analytic geometry, matrix decompositions, vector calculus, optimization, probability and statistics. These topics are traditionally taught in disparate courses, making it hard for data science or computer science students, or professionals, to efficiently learn the mathematics. This self-contained textbook bridges the gap between mathematical and machine learning texts, introducing the mathematical concepts with a minimum of prerequisites. It uses these concepts to derive four central machine learning methods: linear regression, principal component analysis, Gaussian mixture models and support vector machines. For students and others with a mathematical background, these derivations provide a starting point to machine learning texts. For those learning the mathematics for the first time, the methods help build intuition and practical experience with applying mathematical concepts. Every chapter includes worked examples and exercises to test understanding.

Programming tutorials are offered on the book's web site.

Digital Signal Processing 101 - Michael Parker 2017-06-28

Digital Signal Processing 101: Everything You Need to Know to Get Started provides a basic tutorial on digital signal processing (DSP). Beginning with discussions of numerical representation and complex numbers and exponentials, it goes on to explain difficult concepts such as sampling, aliasing, imaginary numbers, and frequency response. It does so using easy-to-understand examples with minimum mathematics. In addition, there is an overview of the DSP functions and implementation used in several DSP-intensive fields or applications, from error correction to CDMA mobile communication to airborne radar systems. This book has been updated to include the latest developments in Digital Signal Processing, and has eight new chapters on: Automotive Radar Signal Processing Space-Time Adaptive Processing Radar Field Orientated Motor Control Matrix Inversion algorithms GPUs for computing Machine Learning Entropy and Predictive Coding Video compression Features eight new chapters on Automotive Radar Signal Processing, Space-Time Adaptive Processing Radar, Field Orientated Motor Control, Matrix Inversion algorithms, GPUs for computing, Machine Learning, Entropy and Predictive Coding, and Video compression Provides clear examples and a non-mathematical approach to get you up to speed quickly Includes an overview of the DSP functions and implementation used in typical DSP-intensive applications, including error correction, CDMA mobile communication, and radar systems

Mathematical Methods in Computer Vision - Peter J. Olver 2003-10

"Comprises some of the key work presented at two IMA Wokshops on Computer Vision during fall of 2000."--Pref.

New Digital Signal Processing Methods - Raoul R. Nigmatullin 2020-05-23

This book is intended as a manual on modern advanced statistical methods for signal processing. The objectives of signal processing are the analysis, synthesis, and modification of signals measured from different natural phenomena, including engineering applications as well. Often the measured signals are affected by noise, distortion and incompleteness, and this makes it difficult to extract significant signal information. The main topic of the book is the extraction of significant information from measured data, with the aim of reducing the data size while keeping the basic information/knowledge about the peculiarities and properties of the analyzed system; to this aim, advanced and recently developed methods in signal analysis and treatment are introduced and described in depth. More in details, the book covers the following new advanced topics (and the corresponding algorithms), including detailed descriptions and discussions: the Eigen-Coordinates (ECs) method, The statistics of the fractional moments, The quantitative "universal" label (QUL) and the universal distribution function for the relative fluctuations (UDFRF), the generalized Prony spectrum, the Non-orthogonal Amplitude Frequency Analysis of the Smoothed Signals (NAFASS), the discrete geometrical invariants (DGI) serving as the common platform for quantitative comparison of different random functions. Although advanced topics are discussed in signal analysis, each subject is introduced gradually, with the use of only the necessary mathematics, and avoiding unnecessary abstractions. Each chapter presents

testing and verification examples on real data for each proposed method. In comparison with other books, here it is adopted a more practical approach with numerous real case studies.

Fractal Geometry - J M Blackledge 2002-09-01

International authorities from Canada, Denmark, England, Germany, Russia and South Africa focus on research on fractal geometry and the best practices in software, theoretical mathematical algorithms, and analysis. They address the rich panoply of manifold applications of fractal geometry available for study and research in science and industry: i.e., remote sensing, mapping, texture creations, pattern recognition, image compression, aeromechanical systems, cryptography and financial analysis. Economically priced, this important and authoritative reference source for research and study cites over 230 references to the literature, copiously illustrated with over 320 diagrams and photographs. The book is published for The Institute of Mathematics and its Applications, co-sponsored with The Institute of Physics and The Institution of Electrical Engineers. Outlines research on fractal geometry and the best practices in software, theoretical mathematical algorithms, and analysis International authorities from around the world address the rich panoply of manifold applications of fractal geometry available for study and research in science and industry Addresses applications in key research fields of remote sensing, mapping, texture creations, pattern recognition, image compression, aeromechanical systems, cryptography and financial analysis

Digital and Statistical Signal Processing - Anastasia Veloni 2018-10-03

Nowadays, many aspects of electrical and electronic engineering are essentially applications of DSP. This is due to the focus on processing information in the form of digital signals, using certain DSP hardware designed to execute software. Fundamental topics in digital signal processing are introduced with theory, analytical tables, and applications with simulation tools. The book provides a collection of solved problems on digital signal processing and statistical signal processing. The solutions are based directly on the math-formulas given in extensive tables throughout the book, so the reader can solve practical problems on signal processing quickly and efficiently. FEATURES Explains how applications of DSP can be implemented in certain programming environments designed for real time systems, ex. biomedical signal analysis and medical image processing. Pairs theory with basic concepts and supporting analytical tables. Includes an extensive collection of solved problems throughout the text. Fosters the ability to solve practical problems on signal processing without focusing on extended theory. Covers the modeling process and addresses broader fundamental issues.

Machine Learning for Signal Processing - Max A. Little 2019-08-13

This book describes in detail the fundamental mathematics and algorithms of machine learning (an example of artificial intelligence) and signal processing, two of the most important and exciting technologies in the modern information economy. Taking a gradual approach, it builds up concepts in a solid, step-by-step fashion so that the ideas and algorithms can be implemented in practical software applications. Digital signal processing (DSP) is one of the

'foundational' engineering topics of the modern world, without which technologies such the mobile phone, television, CD and MP3 players, WiFi and radar, would not be possible. A relative newcomer by comparison, statistical machine learning is the theoretical backbone of exciting technologies such as automatic techniques for car registration plate recognition, speech recognition, stock market prediction, defect detection on assembly lines, robot guidance, and autonomous car navigation. Statistical machine learning exploits the analogy between intelligent information processing in biological brains and sophisticated statistical modelling and inference. DSP and statistical machine learning are of such wide importance to the knowledge economy that both have undergone rapid changes and seen radical improvements in scope and applicability. Both make use of key topics in applied mathematics such as probability and statistics, algebra, calculus, graphs and networks. Intimate formal links between the two subjects exist and because of this many overlaps exist between the two subjects that can be exploited to produce new DSP tools of surprising utility, highly suited to the contemporary world of pervasive digital sensors and high-powered, yet cheap, computing hardware. This book gives a solid mathematical foundation to, and details the key concepts and algorithms in this important topic.

Mathematical Methods and Algorithms for Signal Processing - Todd K. Moon 2000

This previously included a CD. The CD contents can be accessed via World Wide Web.

Mathematical Methods in Time Series Analysis and Digital Image Processing - Rainer Dahlhaus 2007-12-20

This coherent and articulate volume summarizes work carried out in the field of theoretical signal and image processing. It focuses on non-linear and non-parametric models for time series as well as on adaptive methods in image processing. The aim of this volume is to bring together research directions in theoretical signal and imaging processing developed rather independently in electrical engineering, theoretical physics, mathematics and the computer sciences.

Image Processing III - Jonathan M. Blackledge 2001

International specialists report recent research and development, focusing on new applications: The book records proceedings of the IMA (Institution of Mathematics and Applications) conference co-sponsored with the Institute of Physics and the Institution of Electrical Engineers. Contents: Noise analysis: binary random images superposition: probabilistic image smoothing; Segmentation and pattern recognition; image segmentation; colour pattern recognition: Finger print identification; algorithms of 3-D Iso surfaces; mathematical model of image segmentation 3-D on parametric segmentation method: Artificial intelligence; Automatic satellite target detection; Analysis in light, confocal and electron microscopes; Compression Issues; Artificial neural networks; Coefficient video modelling; Progressive transmission: smoothing facsimile images; Human face identification; Fractals and wavelets; lacunarity; Wavelet processing of coloured images; Optical flow analysis; Computing optical fl

Image Processing II - Martin J. Turner 2000

This work presents an up-to-date record of international research on image restoration on the interaction of image processing as it relates to mathematical modelling. It covers in

great detail its reconstruction and restoration, image comprehension, fractals and wavelets, pattern recognition and image understanding. The level is appropriate for advanced study and advanced research for applied mathematicians, computer scientists, electrical and electro-mechanical engineers, and scientists working in IT, remote sensing, medical imaging, vision systems, spectroscopy, virtual reality, military technology, electro-optics, biochemistry and cartigraphy.

Mathematical Foundations for Signal Processing, Communications, and Networking - Erchin Serpedin 2017-12-04

Mathematical Foundations for Signal Processing, Communications, and Networking describes mathematical concepts and results important in the design, analysis, and optimization of signal processing algorithms, modern communication systems, and networks. Helping readers master key techniques and comprehend the current research literature, the book offers a comprehensive overview of methods and applications from linear algebra, numerical analysis, statistics, probability, stochastic processes, and optimization. From basic transforms to Monte Carlo simulation to linear programming, the text covers a broad range of mathematical techniques essential to understanding the concepts and results in signal processing, telecommunications, and networking. Along with discussing mathematical theory, each self-contained chapter presents examples that illustrate the use of various mathematical concepts to solve different applications. Each chapter also includes a set of homework exercises and readings for additional study. This text helps readers understand fundamental and advanced results as well as recent research trends in the interrelated fields of signal processing, telecommunications, and networking. It provides all the necessary mathematical background to prepare students for more advanced courses and train specialists working in these areas.

Applied Digital Signal Processing - Dimitris G. Manolakis 2011-11-21

Master the basic concepts and methodologies of digital signal processing with this systematic introduction, without the need for an extensive mathematical background. The authors lead the reader through the fundamental mathematical principles underlying the operation of key signal processing techniques, providing simple arguments and cases rather than detailed general proofs. Coverage of practical implementation, discussion of the limitations of particular methods and plentiful MATLAB illustrations allow readers to better connect theory and practice. A focus on algorithms that are of theoretical importance or useful in real-world applications ensures that students cover material relevant to engineering practice, and equips students and practitioners alike with the basic principles necessary to apply DSP techniques to a variety of applications. Chapters include worked examples, problems and computer experiments, helping students to absorb the material they have just read. Lecture slides for all figures and solutions to the numerous problems are available to instructors.

Approximation Theory and Algorithms for Data Analysis - Armin Iske 2018-12-14

This textbook offers an accessible introduction to the theory and numerics of approximation methods, combining classical topics of approximation with recent advances in mathematical signal processing, and adopting a constructive approach, in

which the development of numerical algorithms for data analysis plays an important role. The following topics are covered: * least-squares approximation and regularization methods * interpolation by algebraic and trigonometric polynomials * basic results on best approximations * Euclidean approximation * Chebyshev approximation * asymptotic concepts: error estimates and convergence rates * signal approximation by Fourier and wavelet methods * kernel-based multivariate approximation * approximation methods in computerized tomography Providing numerous supporting examples, graphical illustrations, and carefully selected exercises, this textbook is suitable for introductory courses, seminars, and distance learning programs on approximation for undergraduate students.

Mathematical Methods and Algorithms for Signal Processing(Paperback) - Moon 2000-01-01

Compressed Sensing & Sparse Filtering - Avishy Y. Carmi 2013-09-13

This book is aimed at presenting concepts, methods and algorithms ableto cope with undersampled and limited data. One such trend that recently gained popularity and to some extent revolutionised signal processing is compressed sensing. Compressed sensing builds upon the observation that many signals in nature are nearly sparse (or compressible, as they are normally referred to) in some domain, and consequently they can be reconstructed to within high accuracy from far fewer observations than traditionally held to be necessary. Apart from compressed sensing this book contains other related approaches. Each methodology has its own formalities for dealing with such problems. As an example, in the Bayesian approach, sparseness promoting priors such as Laplace and Cauchy are normally used for penalising improbable model variables, thus promoting low complexity solutions. Compressed sensing techniques and homotopy-type solutions, such as the LASSO, utilise l1-norm penalties for obtaining sparse solutions using fewer observations than conventionally needed. The book emphasizes on the role of sparsity as a machinery for promoting low complexity representations and likewise its connections to variable selection and dimensionality reduction in various engineering problems. This book is intended for researchers, academics and practitioners with interest in various aspects and applications of sparse signal processing.

Foundations of Signal Processing - Martin Vetterli 2014-09-04

This comprehensive and engaging textbook introduces the basic principles and techniques of signal processing, from the fundamental ideas of signals and systems theory to real-world applications. Students are introduced to the powerful foundations of modern signal processing, including the basic geometry of Hilbert space, the mathematics of Fourier transforms, and essentials of sampling, interpolation, approximation and compression The authors discuss real-world issues and hurdles to using these tools, and ways of adapting them to overcome problems of finiteness and localization, the limitations of uncertainty, and computational costs. It includes over 160 homework problems and over 220 worked examples, specifically designed to test and expand students' understanding of the fundamentals of signal processing, and is accompanied by extensive online materials designed to aid learning, including Mathematica® resources and

interactive demonstrations.

Theory of Remote Image Formation - Richard E. Blahut 2004-11-18

This book was first published in 2004. In many applications, images, such as ultrasonic or X-ray signals, are recorded and then analyzed with digital or optical processors in order to extract information. Such processing requires the development of algorithms of great precision and sophistication. This book presents a unified treatment of the mathematical methods that underpin the various algorithms used in remote image formation. The author begins with a review of transform and filter theory. He then discusses two- and three-dimensional Fourier transform theory, the ambiguity function, image construction and reconstruction, tomography, baseband surveillance systems, and passive systems (where the signal source might be an earthquake or a galaxy). Information-theoretic methods in image formation are also covered, as are phase errors and phase noise. Throughout the book, practical applications illustrate theoretical concepts, and there are many homework problems. The book is aimed at graduate students of electrical engineering and computer science, and practitioners in industry.

Fundamentals of Adaptive Signal Processing - Aurelio Uncini 2014-12-30

This book is an accessible guide to adaptive signal processing methods that equips the reader with advanced theoretical and practical tools for the study and development of circuit structures and provides robust algorithms relevant to a wide variety of application scenarios. Examples include multimodal and multimedia communications, the biological and biomedical fields, economic models, environmental sciences, acoustics, telecommunications, remote sensing, monitoring and in general, the modeling and prediction of complex physical phenomena. The reader will learn not only how to design and implement the algorithms but also how to evaluate their performance for specific applications utilizing the tools provided. While using a simple mathematical language, the employed approach is very rigorous. The text will be of value both for research purposes and for courses of study.

Digital Signal Processing with Examples in MATLAB®, Second Edition - Samuel D. Stearns 2002-08-28

In a field as rapidly expanding as digital signal processing, even the topics relevant to the basics change over time both in their nature and their relative importance. It is important, therefore, to have an up-to-date text that not only covers the fundamentals, but that also follows a logical development that leaves no gaps readers must somehow bridge by themselves. Digital Signal Processing with Examples in MATLAB® is just such a text. The presentation does not focus on DSP in isolation, but relates it to continuous signal processing and treats digital signals as samples of physical phenomena. The author also takes care to introduce important topics not usually addressed in signal processing texts, including the discrete cosine and wavelet transforms, multirate signal processing, signal coding and compression, least squares systems design, and adaptive signal processing. He also uses the industry-standard software MATLAB to provide examples of signal processing, system design, spectral analysis, filtering, coding and compression, and exercise solutions. All of the examples and functions used in the text are available online at www.crcpress.com. Designed for a one-semester upper-level course but also ideal for self-study and

reference, Digital Signal Processing with Examples in MATLAB is complete, self-contained, and rigorous. For basic DSP, it is quite simply the only book you need.

Applications of Mathematics and Informatics in Military Science - Nicholas Daras 2012-08-18

Analysis, assessment, and data management are core tools required for operation research analysts. The April 2011 conference held at the Helenic Military Academy addressed these issues with efforts to collect valuable recommendations for improving analysts' capabilities to assess and communicate the necessary qualitative data to military leaders. This unique volume is an outgrowth of the April conference and comprises of contributions from the fields of science, mathematics, and the military, bringing Greek research findings to the world. Topics cover a wide variety of mathematical methods used with application to defense and security. Each contribution considers directions and pursuits of scientists that pertain to the military as well as the theoretical background required for methods, algorithms, and techniques used in military applications. The direction of theoretical results in these applications is conveyed and open problems and future areas of focus are highlighted. A foreword will be composed by a member of N.A.T.O. or a ranking member of the armed forces. Topics covered include: applied OR and military applications, signal processing, scattering, scientific computing and applications, combat simulation and statistical modeling, satellite remote sensing, and applied informatics – cryptography and coding. The contents of this volume will be of interest to a diverse audience including military operations research analysts, the military community at large, and practitioners working with mathematical methods and applications to informatics and military science.

Signal Processing for Neuroscientists - Wim van Drongelen 2006-12-18

Signal Processing for Neuroscientists introduces analysis techniques primarily aimed at neuroscientists and biomedical engineering students with a reasonable but modest background in mathematics, physics, and computer programming. The focus of this text is on what can be considered the 'golden trio' in the signal processing field: averaging, Fourier analysis, and filtering. Techniques such as convolution, correlation, coherence, and wavelet analysis are considered in the context of time and frequency domain analysis. The whole spectrum of signal analysis is covered, ranging from data acquisition to data processing; and from the mathematical background of the analysis to the practical application of processing algorithms. Overall, the approach to the mathematics is informal with a focus on basic understanding of the methods and their interrelationships rather than detailed proofs or derivations. One of the principle goals is to provide the reader with the background required to understand the principles of commercially available analyses software, and to allow him/her to construct his/her own analysis tools in an environment such as MATLAB®. Multiple color illustrations are integrated in the text Includes an introduction to biomedical signals, noise characteristics, and recording techniques Basics and background for more advanced topics can be found in extensive notes and appendices A Companion Website hosts the MATLAB scripts and several data files: http://www.elsevierdirect.com/companion.jsp?ISBN=9780123708670

Mathematical Methods And Algorithms

For Signal Processing,1/e - Todd K. Moon 20??

Theory of Conditional Games - Wynn C. Stirling 2012
This book describes conditional games, a form of game theory that accommodates multiple stakeholder decision-making scenarios where cooperation and negotiation are significant issues and where notions of concordant group behavior are important. The book extends the concept of a preference ordering that permits stakeholders to modulate their preferences as functions of the preferences of others.
Wavelets - Charles K. Chui 1997-01-01
Wavelets continue to be powerful mathematical tools that can be used to solve problems for which the Fourier (spectral) method does not perform well or cannot handle. This book is for engineers, applied mathematicians, and other scientists who want to learn about using wavelets to analyze, process, and synthesize images and signals. Applications are described in detail and there are step-by-step instructions about how to construct and apply wavelets. The only mathematically rigorous monograph written by a mathematician specifically for nonspecialists, it describes the basic concepts of these mathematical techniques, outlines the procedures for using them, compares the performance of various approaches, and provides information for problem solving, putting the reader at the forefront of current research.
Signal Processing - Charles L. Byrne 2014-11-12
Signal Processing: A Mathematical Approach is designed to show how many of the mathematical tools the reader knows can be used to understand and employ signal processing techniques in an applied environment. Assuming an advanced undergraduate- or graduate-level understanding of mathematics-including familiarity with Fourier series, matrices, probab