Compressed Dynamic Mode Decomposition For Real Time Object

The Hilbert-Huang Transform (HHT) represents a desperate attempt to break the suffocating hold on the field of data analysis by the twin assumptions of linearity and stationarity. Unlike spectrograms, wavelet analysis, or the Wigner-Ville Distribution, HHT is truly a time-frequency analysis, but it does not require an a priori functional basis and, therefore, the convolution computation of frequency. The method provides a magnifying glass to examine the data, and also offers a different view of data from nonlinear processes, with the results no longer shackled by spurious harmonics ? the artifacts of imposing a linearity property on a nonlinear system or of limiting by the uncertainty principle, and a consequence of Fourier transform pairs in data analysis. This is the first HHT book containing papers covering a wide variety of interests. The chapters are divided into mathematical aspects and applications, with the applications further grouped into geophysics, structural safety and visualization.

This book describes fundamental computational methods for image reconstruction in computed tomography (CT) with a focus on a pedagogical presentation of these methods and their underlying concepts. Insights into the advantages, limitations, and theoretical and computational aspects of the methods are included, giving a balanced presentation that allows readers to understand and implement CT reconstruction algorithms. Unique in its emphasis on the interplay between modeling, computing, and algorithm development, Computed Tomography: Algorithms, Insight, and Just Enough Theory develops the mathematical and computational aspects of three main classes of reconstruction methods: classical filtered back-projection, algebraic iterative methods, and variational methods based on nonlinear numerical optimization algorithms. It spotlights the link between CT and numerical methods, which is rarely discussed in current literature, and describes the effects of incomplete data using both microlocal analysis and singular value decomposition (SVD). This book sets the stage for further exploration of CT algorithms. Readers will be able to grasp the underlying mathematical models to motivate and derive the basic principles of CT reconstruction and will gain basic understanding of fundamental computational challenges of CT, such as the influence of noisy and incomplete data, as well as the reconstruction capabilities and the convergence of the iterative algorithms. Exercises using MATLAB are included, allowing readers to experiment with the algorithms and making the book suitable for teaching and self-study. Computed Tomography: Algorithms, Insight, and Just Enough Theory is primarily aimed at students, researchers, and practitioners interested in the computational aspects of X-ray CT and is also relevant for anyone working with other forms of tomography, such as neutron and electron tomography, that share the same mathematical formulation. With its basis in lecture notes developed for a PhD course, it is appropriate as a textbook for courses on computational methods for X-ray CT and computational methods for inverse problems.

An in-depth introduction to subspace methods for system identification in discrete-time linear systems thoroughly augmented with advanced and novel results, this text is structured into three parts. Part I deals with the mathematical preliminaries: numerical linear algebra; system theory; stochastic processes; and Kalman filtering. Part II explains realization theory as applied to subspace identification. Stochastic realization results based on spectral factorization and Riccati equations, and on canonical correlation analysis for stationary processes are included. Part III demonstrates the closed-loop application of subspace identification methods. Subspace Methods for System Identification is an excellent reference for researchers and a useful text for tutors and graduate students involved in control and signal processing courses. It can be used for self-study and will be of interest to applied scientists or engineers wishing to use advanced methods in modeling and identification of complex systems.

This book includes selected, high-quality papers presented at the International Conference on Intelligent Manufacturing and Energy Sustainability (ICIMES 2019) held at the Department of Mechanical Engineering, Malla Reddy College of Engineering & Technology (MRCET), Maisammaguda, Hyderabad, India, from 21 to 22 June 2019. It covers topics in the areas of automation, manufacturing technology and energy sustainability.

H.264 and MPEG-4 Video Compression

Sparse Representations and Compressive Sensing for Imaging and Vision

Robust Real-time Image Processing Through Dynamic Mode Decomposition

Intelligent Image and Video Compression

Ultracondensed Matter by Dynamic Compression

Whither Turbulence and Big Data in the 21st Century?

Stochastic Tools in Turbulence discusses the available mathematical tools to describe stochastic vector fields to solve problems related to these fields. The book deals with the needs of turbulence in relation to stochastic vector fields, particularly, on three-dimensional aspects, linear problems, and stochastic model building. The text describes probability distributions and densities, including Lebesgue integration, conditional probabilities, conditional expectations, statistical independence, lack of correlation. The book also explains the significance of the moments, the properties of the characteristic function, and the Gaussian distribution from a more physical point of view. In considering fields, one must account for single-valued functions of one or more parameters, or collections of single-valued functions of one or more parameters such as time or space coordinates. The text also discusses multidimensional vector fields of finite energy, the characteristic eddies for a homogenous vector field, as well as, the distribution of solutions of an algebraic equation. Engineers, algebra students, and professors of statistics and advanced mathematics will find the book highly useful.

Each edition of Introduction to Data Compression has widely been considered the best introduction and reference text on the art and science of data compression, and the third edition continues in this tradition. Data compression techniques and technology are ever-evolving with new applications in image, speech, text, audio, and video. The third edition includes all the cutting edge updates the reader will need during the work day and in class. Khalid Sayood provides an extensive introduction to the theory underlying today's compression techniques with detailed instruction for their applications using several examples to explain the concepts. Encompassing the entire field of data compression Introduction to Data Compression, includes lossless and lossy compression, Huffman coding, arithmetic coding, dictionary techniques, context based compression, scalar and vector quantization. Khalid Sayood provides a working knowledge of data compression, giving the reader the tools to develop a complete and concise compression package upon completion of his book. *New content added on the topic of audio compression including a description of the mp3 algorithm *New video coding standard and new facsimile standard explained *Completely explains established and emerging standards in depth including JPEG 2000, JPEG-LS, MPEG-2, Group 3 and 4 faxes, JBIG 2, ADPCM, LPC, CELP, and MELP *Source code provided via companion web site that gives readers the opportunity to build their own algorithms, choose and implement techniques in their own applications

The articles in this volume present the state-of-the-art in noise prediction, modeling and measurement. The articles are partially based on class notes provided during the course `Noise sources in turbulent shear flows', given at CISM on April 2011. The first part contains general concepts of aero acoustics, including vortex sound theory and acoustic analogies, in the second part particular emphasis is put into arguments of interest for engineers and relevant for aircraft design: jet noise, airfoil broadband noise, boundary layer noise (including interior noise and its control) and the concept of noise sources, their theoretical modeling and identification in turbulent lows. All these arguments are treated extensively with the inclusion of many practical examples and references to engineering applications.

Higher Order Dynamic Mode Decomposition and Its Applications provides detailed background theory, as well as several fully explained applications from a range of industrial contexts to help readers understand and use this innovative algorithm. Data-driven modelling of complex systems is a rapidly evolving field, which has applications in domains including engineering, medical, biological, and physical sciences, where it is providing ground-breaking insights into complex systems that exhibit rich multi-scale phenomena in both time and space. Starting with an introductory summary of established order reduction techniques like POD, DEIM, Koopman, and DMD, this book proceeds to provide a detailed explanation of higher order DMD, and to explain its advantages over other methods. Technical details of how the HODMD can be applied to a range of industrial problems will help the reader decide how to use the method in the most appropriate way, along with example MATLAB codes and advice on how to analyse and present results. Includes instructions for the implementation of the HODMD, MATLAB codes, and extended discussions of the algorithm Includes descriptions of other order reduction techniques, and compares their strengths and weaknesses Provides examples of applications involving complex flow fields, in contexts including aerospace engineering, geophysical flows, and wind turbine design

Stochastic Tools in Turbulence

Select Proceedings of ICNETS2, Volume I

IBM Cognos Dynamic Query

Intelligent Manufacturing and Energy Sustainability

Data-Driven Modeling & Scientific Computation

The Complete Reference

this part is supported by two useful appendices on some of the mathematical tools used and the physical units of plasma physics. State-space models, state observers, H control, and process simulations are some of the familiar techniques used by ? the authors to meet the demanding spatial control specifications for these processes; however, the research reported in the monograph is more that just simulation studies and proposals for possible future hypothetical controllers, for the authors have worked with some of the world's leading existing tokamak facilities. Chapter 5, 8, and 9 respectively, give practical results of implementations of their control schemes on the FTU Tokamak (Italy), the TCV Tokamak (Switzerland), and the JET Tokamak (United Kingdom). Additionally, the authors present simulation results of their ideas for the control of the new tokamak proposed for the ITER project. In conclusion, being very aware that most control engineers will not be conversant with the complexities of tokamak nuclear fusion reactor control, the authors have taken special care to give a useful introduction to the background of nuclear fusion, the science of plasma physics and appropriate models in the first part of the monograph (Chapters 1 to 3). This introduction is followed by six chapters (4 to 9) of control studies. In Chapter 4, the generic control problem is established and then five case study chapters follow.

This open access book provides a concise explanation of the fundamentals and background of the surround sound recording and playback technology Ambisonics. It equips readers with the psychoacoustical, signal processing, acoustical, and mathematical knowledge needed to understand the inner workings of modern processing utilities, special equipment for recording, manipulation, and reproduction in the higher-order Ambisonic format. The book comes with various practical examples based on free software tools and open scientific data for reproducible research. The book's introductory section offers a perspective on Ambisonics spanning from the origins of coincident recordings in the 1930s to the Ambisonic concepts of the 1970s, as well as classical ways of applying Ambisonics in first-order coincident sound scene recording and reproduction that have been practiced since the 1980s. As, from time to time, the underlying mathematics become quite involved, but should be comprehensive without sacrificing readability, the book includes an extensive mathematical appendix. The book offers readers a deeper understanding of Ambisonic technologies, and will especially benefit scientists, audio-system and audio-recording engineers. In the advanced sections of the book, fundamentals and modern techniques as higher-order Ambisonic decoding, 3D audio effects, and higher-order recording are explained. Those techniques are shown to be suitable to supply audience areas ranging from studio-sized to hundreds of listeners, or headphone-based playback, regardless whether it is live, interactive, or studio-produced 3D audio material.

H.264 Advanced Video Coding or MPEG-4 Part 10 is fundamental to a growing range of markets such as high definition broadcasting, internet video sharing, mobile video and digital surveillance. This book reflects the growing importance and implementation of H.264 video technology. Offering a detailed overview of the system, it explains the syntax, tools and features of H.264 and equips readers with practical advice on how to get the most out of the standard. Packed with clear examples and illustrations to explain H.264 technology in an accessible and practical way. Covers basic video coding concepts, video formats and visual quality. Explains how to measure and optimise the performance of H.264 and how to balance bitrate, computation and video quality. Analyses recent work on scalable and multi-view versions of H.264, case studies of H.264 codecs and new technological developments such as the popular High Profile extensions. An invaluable companion for developers, broadcasters, system integrators, academics and students who want to master this burgeoning state-of-the-art technology. "[This book] unravels the mysteries behind the latest H.264 standard and delves deeper into each of the operations in the codec. The reader can implement (simulate, design, evaluate, optimize) the codec with all profiles and levels. The book ends with extensions and directions (such as SVC and MVC) for further research." Professor K. R. Rao, The University of Texas at Arlington, co-inventor of the Discrete Cosine Transform

This book discusses reliability applications for power systems, renewable energy and smart grids and highlights trends in reliable communication, fault-tolerant systems, VLSI system design and embedded systems. Further, it includes chapters on software reliability and other computer engineering and software management-related disciplines, and also examines areas such as big data analytics and ubiquitous computing. Outlining novel, innovative concepts in applied areas of reliability in electrical, electronics and computer engineering disciplines, it is a valuable resource for researchers and practitioners of reliability theory in circuit-based engineering domains.

Applications to Electrical, Electronics and Computer Science and Engineering

Data-Driven Modeling of Complex Systems

The Theory of Open Quantum Systems

Computed Tomography

Shock Wave-Boundary-Layer Interactions

Concepts, Methodologies, and Applications

This book treats the central physical concepts and mathematical techniques used to investigate the dynamics of open quantum systems. To provide a self-contained presentation the text begins with a survey of classical probability theory and with an introduction into the foundations of quantum mechanics with particular emphasis on its statistical interpretation. The fundamentals of density matrix theory, quantum Markov processes and dynamical semigroups are developed. The most important master equations used in quantum optics and in the theory of quantum Brownian motion are applied to the study of many examples. Special attention is paid to the theory of environment induced decoherence, its role in the dynamical description of the measurement process and to the experimental observation of decohering Schrodinger cat states. The book includes the modern formulation of open quantum systems in terms of stochastic processes in Hilbert space. Stochastic wave function methods and Monte Carlo algorithms are designed and applied to important examples from quantum optics and atomic physics, such as Levy statistics in the laser cooling of atoms, and the damped Jaynes-Cummings model. The basic features of the non-Markovian quantum behaviour of open systems are examined on the basis of projection operator techniques. In addition, the book expounds the relativistic theory of quantum measurements and discusses several examples from a unified perspective, e.g. non-local measurements and quantum teleportation. Influence functional and super-operator techniques are employed to study the density matrix theory in quantum electrodynamics and applications to the destruction of quantum coherence are presented. The text addresses graduate students and lecturers in physics and applied mathematics, as well as researchers with interests in fundamental questions in quantum mechanics and its applications. Many analytical methods and computer simulation techniques are developed and illustrated with the help of numerous specific examples. Only a basic understanding of quantum mechanics and of elementary concepts of probability theory is assumed.

In many areas of research, robust and efficient data-mining, and data-driven modeling, have become essential to progressing our understanding of increasingly complex and nonlinear relations often embedded in cluttered and/or corrupted data. Applications in the industry and technology sectors are demanding high-performance algorithms that can tease out important information in real-time, and help humans interact better with computers. Researchers are starting to explore sparse modeling techniques that can sample sparsely and project onto a low-dimensional bases, where the essential information that drives the system can be extracted without having to build and run costly models of the full dynamics of the entire system. The focus of this work will be on the development of data analysis techniques that can be applied to solving the gesture recognition problem, with the goal of improving performance. One of the most exciting results of the research presented here is found in the use of dynamic mode decomposition (DMD) as a viable and effective method for subtracting out the backgrounds for moving objects in videos. The method will be introduced and compared against the current standard method in the background subtraction field, namely robust principal component analysis (RPCA). The computational speed and accuracy of the DMD separation method offers a comfortable margin for real-time, online data processing. The fact that DMD approximates RPCA's low-rank/sparse separation of data matrices opens the possibilities of various applications in the time-scale separation of dynamics arena, and even in the data compression and sparse sensing fields. It will be shown that through enhanced pre-processing techniques, robust, accurate, and real-time gesture recognition can be achieved, even on heavily down-sampled images where gestures are nearly indistinguishable to the human eye. This is compared to the current trend in the computer vision field that advocates more complicated and computationally expensive feature selection and statistical learning routines that become problem specific and often still suffer from gesture irregularity in the data. Gesture recognition can be further improved by selecting the most appropriate gestures for the given task, accounting for ergonomic, vernacular, and algorithmic considerations. A new method, which combines these subjective and objective constraints into a single measure that indicates which gestures are best for the given application, is developed and tested on a real hand gesture recognition problem. Insights from the way that gestures render themselves in feature space help guarantee that this best lexicon methodology will be useful and reliable for realistic recognition problems. In the appendix of this work, the theoretical background and practical implementation techniques needed in order to model a high-power Raman fiber laser/amplifier system that includes stimulated Brillouin scattering (SBS) and four-wave mixing (FWM) effects will be delineated, and the strengths and weaknesses of the computer model will be discussed.

Welcome to Scientific Python and its community. If you ' re a scientist who programs with Python, this practical guide not only teaches you the fundamental parts of SciPy and libraries related to it, but also gives you a taste for beautiful, easy-to-read code that you can use in practice. You ' ll learn how to write elegant code that ' s clear, concise, and efficient at executing the task at hand. Throughout the book, you ' ll work with examples from the wider scientific Python ecosystem, using code that illustrates principles outlined in the book. Using actual scientific data, you ' ll work on real-world problems with SciPy, NumPy, Pandas, scikit-image, and other Python libraries. Explore the NumPy array, the data structure that underlies numerical scientific computation Use quantile normalization to ensure that measurements fit a specific distribution Represent separate regions in an image with a Region Adjacency Graph Convert temporal or spatial data into frequency domain data with the Fast Fourier Transform Solve sparse matrix problems, including image segmentations, with SciPy ' s sparse module Perform linear algebra by using SciPy packages Explore image alignment (registration) with SciPy ' s optimize module Process large datasets with Python data streaming primitives and the Toolz library

Combining scientific computing methods and algorithms with modern data analysis techniques, including basic applications of compressive sensing and machine learning, this book develops techniques that allow for the integration of the dynamics of complex systems and big data. MATLAB is used throughout for mathematical solution strategies.

Magnetic Control of Tokamak Plasmas

Advances and Applications

Snapshot-Based Methods and Algorithms

Manifolds, Tensor Analysis, and Applications

The Koopman Operator in Systems and Control

Business Dynamics: Systems Thinking and Modeling for a Complex World with CD-ROM

This book presents methodologies for analysing large data sets produced by the direct numerical simulation (DNS) of turbulence and combustion. It describes the development of models that can be used to analyse large eddy simulations, and highlights both the most common techniques and newly emerging ones. The chapters, written by internationally respected experts, invite readers to consider DNS of turbulence and combustion from a formal, data-driven standpoint, rather than one led by experience and intuition. This perspective allows readers to recognise the shortcomings of existing models, with the ultimate goal of quantifying and reducing model-based uncertainty. In addition, recent advances in machine learning and statistical inferences offer new insights on the interpretation of DNS data. The book will especially benefit graduate-level students and researchers in mechanical and aerospace engineering, e.g. those with an interest in general fluid mechanics, applied mathematics, and the environmental and atmospheric sciences.

This IBM® Redbooks® publication explains how IBM Cognos® Business Intelligence (BI) administrators, authors, modelers, and power users can use the dynamic query layer effectively. It provides guidance for determining which technology within the dynamic query layer can best satisfy your business requirements. Administrators can learn how to tune the query service effectively and preferred practices for managing their business intelligence content. This book includes information about metadata modeling of relational data sources with IBM Cognos Framework Manager. It includes considerations that can help you author high-performing applications that satisfy analytical requirements of users. This book provides guidance for troubleshooting issues related to the dynamic query layer of Cognos BI. Related documents: Solution Guide : Big Data Analytics with IBM Cognos BI Dynamic Query Blog post : IBM Cognos Dynamic Query Extensibility

An increasing complexity of models used to predict real-world systems leads to the need for algorithms to replace complex models with far simpler ones, while preserving the accuracy of the predictions. This two-volume handbook covers methods as well as applications. This second volume focuses on applications in engineering, biomedical engineering, computational physics and computer science.

A comprehensive reference for the many different types and methods of compression, including a detailed and helpful taxonomy, an analysis of the most common methods, and discussions on their use and comparative benefits. The presentation is organized into the main branches of the field: run length encoding, statistical methods, dictionary-based methods, image compression, audio compression, and video compression. Detailed descriptions and explanations of the most well- known and frequently used methods are covered in a self-contained fashion, with an accessible style and technical level for specialists and nonspecialists. In short, the book provides an invaluable reference and guide for all computer scientists, computer engineers, electrical engineers, signal/image processing engineers and other scientists needing a comprehensive compilation for a broad range of compression methods.

MORCOS 2018

The Art of Scientific Python

Dynamic Mode Decomposition

Data-Driven Science and Engineering

Computational Signal Processing and Analysis

An Introduction to Computational Fluid Dynamics The Finite Volume Method, 2/e

Describes methods revealing the structures and dynamics of turbulence for engineering, physical science and mathematics researchers working in fluid dynamics.

Following on from the successful MPEG-2 standard, MPEG-4 Visual is enabling a new wave of multimedia applications from Internet video streaming to mobile video conferencing. The new H.264 'Advanced Video Coding' standard promises impressive compression performance and is gaining support from developers and manufacturers. The first book to cover H.264 in technical detail, this unique resource takes an application-based approach to the two standards and the coding concepts that underpin them. Presents a practical, step-by-step, guide to the MPEG-4 Visual and H.264 standards for video compression. Introduces the basic concepts of digital video and covers essential background material required for an understanding of both standards. Provides side-by-side performance comparisons of MPEG-4 Visual and H.264 and advice on how to approach and interpret them to ensure conformance. Examines the way that the standards have been shaped and developed, discussing the composition and procedures of the VCEG and MPEG standardisation groups. Focussing on compression tools and profiles for practical multimedia applications, this book 'decodes' the standards, enabling developers, researchers, engineers and students to rapidly get to grips with both H.264 and MPEG-4 Visual. Dr Iain Richardson leads the Image Communication Technology research group at the Robert Gordon University in Scotland and is the author of over 40 research papers and two previous books on video compression technology.

The purpose of this book is to provide core material in nonlinear analysis for mathematicians, physicists, engineers, and mathematical biologists. The main goal is to provide a working knowledge of manifolds, dynamical systems, tensors, and differential forms. Some applications to Hamiltonian mechanics, fluid me chanics, electromagnetism, plasma dynamics and control thcory arc given in Chapter 8, using both invariant and index notation. The current edition of the book does not deal with Riemannian geometry in much detail, and it does not treat Lie groups, principal bundles, or Morse theory. Some of this is planned for a subsequent edition. Meanwhile, the authors will make available to interested readers supplementary chapters on Lie Groups and Differential Topology and invite comments on the book's contents and development. Throughout the text supplementary topics are given, marked with the symbols ~ and {l:;J. This device enables the reader to skip various topics without disturbing the main flow of the text. Some of these provide additional background material intended for completeness, to minimize the necessity of consulting too many outside references. We treat finite and infinite-dimensional manifolds simultaneously. This is partly for efficiency of exposition. Without advanced applications, using manifolds of mappings, the study of infinite-dimensional manifolds can be hard to motivate.

This book comprises a collection of papers by international experts, presented at the International Conference on NextGen Electronic Technologies (ICNETS2-2017). ICNETS2 encompassed six symposia covering all aspects of electronics and communications engineering domains, including relevant nano/micro materials and devices. Featuring the latest research on computational signal processing and analysis, the book is useful to researchers, professionals, and students working in the core areas of electronics and their applications, especially signal processing, embedded systems, and networking.

Methods for Complex Systems & Big Data

Data Analysis for Direct Numerical Simulations of Turbulent Combustion

Proceedings of ICIMES 2019

Hilbert-Huang Transform and Its Applications

ICICCT 2019 – System Reliability, Quality Control, Safety, Maintenance and Management

Matrices, Spectra, and Filtering

This book provides a broad overview of state-of-the-art research at the intersection of the Koopman operator theory and control theory. It also reviews novel theoretical results obtained and efficient numerical methods developed within the framework of Koopman operator theory. The contributions discuss the latest findings and techniques in several areas of control theory, including model predictive control, optimal control, observer design, systems identification and structural analysis of controlled systems, addressing both theoretical and numerical aspects and presenting open research directions, as well as detailed numerical schemes and data-driven methods. Each contribution addresses a specific problem. After a brief introduction of the Koopman operator framework, including basic notions and definitions, the book explores numerical methods, such as the dynamic mode decomposition (DMD) algorithm and Arnoldi-based methods, which are used to represent the operator in a finite-dimensional basis and to compute its spectral properties from data. The main body of the book is divided into three parts: theoretical results and numerical techniques for observer design, synthesis analysis, stability analysis, parameter estimation, and identification; data-driven techniques based on DMD, which extract the spectral properties of the Koopman operator from data for the structural analysis of controlled systems; and Koopman operator techniques with specific applications in systems and control, which range from heat transfer analysis to robot control. A useful reference resource on the Koopman operator theory for control theorists and practitioners, the book is also of interest to graduate students, researchers, and engineers looking for an introduction to a novel and comprehensive approach to systems and control, from pure theory to data-driven methods.

Dynamic compression is an experimental technique with interdisciplinary uses, ranging from enabling the creation of ultracondensed matter under previously impossible conditions to understanding the likely cause of unusual planetary magnetic fields. Readers can now gain an intuitive understanding of dynamic compression; clear and authoritative chapters examine its history and experimental method, as well as key topics including dynamic compression of liquid hydrogen, rare gas fluids and shock-induced opacity. Through an up-to-date history of dynamic compression research, Nellis also clearly shows how dynamic compression addresses and will continue to address major unanswered questions across the scientific disciplines. The past and future role of dynamic compression in studying and making materials at extreme conditions of pressure, density and temperature is made clear, and the means of doing so are explained in practical language perfectly suited for researchers and graduate students alike.

Compressed sensing or compressive sensing is a new concept in signal processing where one measures a small number of non-adaptive linear combinations of the signal. These measurements are usually much smaller than the number of samples that define the signal. From these small numbers of measurements, the signal is then reconstructed by non-linear procedure. Compressed sensing has recently emerged as a powerful tool for efficiently processing data in non-traditional ways. In this book, we highlight some of the key mathematical insights underlying sparse representation and compressed sensing and illustrate the role of these theories in classical vision, imaging and biometrics problems.

This volume contains the proceedings of the IUTAM Symposium on Model Order Reduction of Coupled System, held in Stuttgart, Germany, May 22 – 25, 2018. For the understanding and development of complex technical systems, such as the human body or mechatronic systems, an integrated, multiphysics and multidisciplinary view is essential. Many problems can be solved within one physical domain. For the simulation and optimization of the combined system, the different domains are connected with each other. Very often, the combination is only possible by using reduced order models such that the large-scale dynamical system is approximated with a system of much smaller dimension where the most dominant features of the large-scale system are retained as much as possible. The field of model order reduction (MOR) is interdisciplinary. Researchers from Engineering, Mathematics and Computer Science identify, explore and compare the potentials, challenges and limitations of recent and new advances.

Higher Order Dynamic Mode Decomposition and Its Applications

Turbulence, Coherent Structures, Dynamical Systems and Symmetry

Algorithms, Insight, and Just Enough Theory

Knowledge Modelling and Big Data Analytics in Healthcare

The H.264 Advanced Video Compression Standard

Machine Learning Control – Taming Nonlinear Dynamics and Turbulence

Data-driven discovery is revolutionizing the modeling, prediction, and control of complex systems. This textbook brings together machine learning, engineering mathematics, and mathematical physics to integrate modeling and control of dynamical systems with modern methods in data science. It highlights many of the recent advances in scientific computing that enable data-driven methods to be applied to a diverse range of complex systems, such as turbulence, the brain, climate, epidemiology, finance, robotics, and autonomy. Aimed at advanced undergraduate and beginning graduate students in the engineering and physical sciences, the text presents a range of topics and methods from introductory to state of the art.

Shock wave-boundary-layer interaction (SBLI) is a fundamental phenomenon in gas dynamics that is observed in many practical situations, ranging from transonic aircraft wings to hypersonic vehicles and engines. SBLIs have the potential to pose serious problems in a flowfield; hence they often prove to be a critical - or even design limiting - issue for many aerospace applications. This is the first book devoted solely to a comprehensive, state-of-the-art explanation of this phenomenon. It includes a description of the basic fluid mechanics of SBLIs plus contributions from leading international experts who share their insight into their physics and the impact they have in practical flow situations. This book is for practitioners and graduate students in aerodynamics who wish to familiarize themselves with all aspects of SBLI flows. It is a valuable resource for specialists because it compiles experimental, computational and theoretical knowledge in one place.

A textbook covering data-science and machine learning methods for modelling and control in engineering and science, with Python and MATLAB®.

Describes the deblurring algorithms and techniques collectively known as spectral filtering methods, in which the singular value decomposition, or a similar decomposition with spectral properties, is used to introduce the necessary regularization or filtering in the reconstructed image.

The concise MATLAB® implementations described in the book provide a template of techniques that can be used to restore blurred images from many applications.

Machine Learning, Dynamical Systems, and Control

Deblurring Images

Noise Sources in Turbulent Shear Flows: Fundamentals and Applications

A Practical 3D Audio Theory for Recording, Studio Production, Sound Reinforcement, and Virtual Reality

Ambisonics

Elegant SciPy

This volume provides a snapshot of the current and future trends in turbulence research across a range of disciplines. It provides an overview of the key challenges that face scientific and engineering communities in the context of huge databases of turbulence information currently being generated, yet poorly mined. These challenges include coherent structures and their control, wall turbulence and control, multi-scale turbulence, the impact of turbulence on energy generation and turbulence data manipulation strategies. The motivation for this volume is to assist the reader to make physical sense of these data deluges so as to inform both the research community as well as to advance practical outcomes from what is learned. Outcomes presented in this collection provide industry with information that impacts their activities, such as minimizing impact of wind farms, opportunities for understanding large scale wind events and large eddy simulation of the hydrodynamics of bays and lakes thereby increasing energy efficiencies, and minimizing emissions and noise from jet engines. Elucidates established, contemporary, and novel aspects of fluid turbulence - a ubiquitous yet poorly understood phenomena; Explores computer simulation of turbulence in the context of the emerging, unprecedented profusion of experimental data,which will need to be stewarded and archived; Examines a compendium of problems and issues that investigators can use to help formulate new promising research ideas; Makes the case for why funding agencies and scientists around the world need to lead a global effort to establish and steward large stores of turbulence data, rather than leaving them to individual researchers.

Today's leading authority on the subject of this text is the author, MIT Standish Professor of Management and Director of the System Dynamics Group, John D. Sterman. Sterman's objective is to explain, in a true textbook format, what system dynamics is, and how it can be successfully applied to solve business and organizational problems. System dynamics is both a currently utilized approach to organizational problem solving at the professional level, and a field of study in business, engineering, and social and physical sciences.

Intelligent Image and Video Compression: Communicating Pictures, Second Edition explains the requirements, analysis, design and application of a modern video coding system. It draws on the authors' extensive academic and professional experience in this field to deliver a text that is algorithmically rigorous yet accessible, relevant to modern standards and practical. It builds on a thorough grounding in mathematical foundations and visual perception to demonstrate how modern image and video compression methods can be designed to meet the rate-quality performance levels demanded by today's applications and users, in the context of prevailing network constraints. An approach that combines algorithmic rigor with practical implementation using numerous worked examples Explains how video compression methods exploit statistical redundancies, natural correlations, and knowledge of human perception to improve performance Uses contemporary video coding standards (AVC, HEVC and VVC) as a vehicle for explaining block-based compression Provides broad coverage of important topics such as visual quality assessment and video streaming

This contributed volume convenes a rich selection of works with a focus on innovative mathematical methods with applications in real-world, industrial problems. Studies included in this book are all motivated by a relevant industrial challenge, and demonstrate that mathematics for industry can be extremely rewarding, leading to new mathematical methods and sometimes even to entirely new fields within mathematics. The book is organized into two parts: Computational Sciences and Engineering, and Data Analysis and Finance. In every chapter, readers will find a brief description of why such work fits into this volume; an explanation on which industrial challenges have been instrumental for their inspiration; and which methods have been developed as a result. All these contribute to a greater unity of the text, benefiting not only practitioners and professionals seeking information on novel techniques but also graduate students in applied mathematics, engineering, and related fields.

Data Compression

Introduction to Data Compression

From Equation-Based Analysis to Machine Learning

Video Coding for Next-generation Multimedia

Subspace Methods for System Identification

IUTAM Symposium on Model Order Reduction of Coupled Systems, Stuttgart, Germany, May 22–25, 2018

Knowledge Modelling and Big Data Analytics in Healthcare: Advances and Applications focuses on automated analytical techniques for healthcare applications used to extract knowledge from a vast amount of data. It brings together a variety of different aspects of the healthcare system and aids in the decision-making processes for healthcare professionals. The editors connec research rarely brought together in one book: artificial intelligence, big data analytics, knowledge modelling, and healthcare. They present state-of-the-art research from the healthcare sector, including research on medical imaging, healthcare analysis, and the applications of artificial intelligence in drug discovery. This book is intended for data scientists, academicians, and indus healthcare sector.

This is the first textbook on a generally applicable control strategy for turbulence and other complex nonlinear systems. The approach of the book employs powerful methods of machine learning for optimal nonlinear control laws. This machine learning control (MLC) is motivated and detailed in Chapters 1 and 2. In Chapter 3, methods of linear control theory are reviewed. In Cha reproduce known optimal control laws for linear dynamics (LQR, LQG). In Chapter 5, MLC detects and exploits a strongly nonlinear actuation mechanism of a low-dimensional dynamical system when linear control methods are shown to fail. Experimental control demonstrations from a laminar shear-layer to turbulent boundary-layers are reviewed in Chapter 6, followed by gener experiments in Chapter 7. The book concludes with an outlook on the vast future applications of MLC in Chapter 8. Matlab codes are provided for easy reproducibility of the presented results. The book includes interviews with leading researchers in turbulence control (S. Bagheri, B. Batten, M. Glauser, D. Williams) and machine learning (M. Schoenauer) for a broader perspectiv exercises and supplemental videos will be available through YouTube.

Data-driven dynamical systems is a burgeoning field?it connects how measurements of nonlinear dynamical systems and/or complex systems can be used with well-established methods in dynamical systems theory. This is a critically important new direction because the governing equations of many problems under consideration by practitioners in various scientific fields are no using data alone to help derive, in an optimal sense, the best dynamical system representation of a given application allows for important new insights. The recently developed dynamic mode decomposition (DMD) is an innovative tool for integrating data with dynamical systems theory. The DMD has deep connections with traditional dynamical systems theory and many recent i sensing and machine learning. Dynamic Mode Decomposition: Data-Driven Modeling of Complex Systems, the first book to address the DMD algorithm, presents a pedagogical and comprehensive approach to all aspects of DMD currently developed or under development; blends theoretical development, example codes, and applications to showcase the theory and its many in

highlights the numerous innovations around the DMD algorithm and demonstrates its efficacy using example problems from engineering and the physical and biological sciences; and provides extensive MATLAB code, data for intuitive examples of key methods, and graphical presentations.

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