

6

Speech processing with fractals

6.1

Introduction

A signal is defined as any physical quantity that varies with time, space or any other independent variable or variables. Mathematically, we describe a signal as a function of one or more independent variables. For example, the functions

$$S_1(t) = 5t \quad (6.1)$$

$$S_2(t) = 20t^2 \quad (6.2)$$

describe two signals, one that varies linearly with the independent variable t (time) and a second that varies quadratically with t . As another example, consider the function

$$S(x, y) = 3x + 2xy + 10y^2 \quad (6.3)$$

This signal function has two independent variables x and y , which might represent the two spatial coordinates in a plane.

The signals described by Eqns 6.1 and 6.2 belong to a class of signals that are precisely defined by specifying the functional dependence on the independent variable. However, there are cases where such a functional relationship is unknown or too highly complicated to be of any practical use. For example, the speech signal depicted in Figure 6.1 cannot be described functionally by expressions such as in Eqn 1. In general, a segment of speech can be represented to a high accuracy as a sum of several sinusoids of different amplitudes and frequencies,

$$\sum_{i=1}^N A_i(t) \sin [2\pi F_i(t)t + \theta_i(t)] \quad (6.4)$$

where $A_i(t)$, $F_i(t)$ and $\theta_i(t)$ are the (time-varying) amplitude, frequency and phase respectively of sinusoid i . In fact, one way to interpret the information content or message conveyed by any short-time segment of the speech signal is to measure the amplitudes, frequencies and phases contained in the short-time segment.

Another example of a natural signal is an electrocardiogram. Such a signal provides a doctor with information about the operation of the patient's heart. Similarly,

Fractal Speech Processing

Xiang Xie



Fractal Speech Processing:

Fractal Speech Processing ,2004

Fractal Speech Processing ,2004

Advances in Nonlinear Speech

Processing Carlos M. Travieso-González, Jesús Alonso-Hernández, 2011-10-26 This book constitutes the proceedings of the 5th International Conference on Nonlinear Speech Processing NoLISP 2011 held in Las Palmas de Gran Canaria Spain in November 2011 The purpose of the workshop is to present and discuss new ideas techniques and results related to alternative approaches in speech processing that may depart from the main stream The 33 papers presented together with 2 keynote talks were carefully reviewed and selected for inclusion in this book The topics of NOLISP 2011 were non linear approximation and estimation non linear oscillators and predictors higher order statistics independent component analysis nearest neighbors neural networks decision trees non parametric models dynamics of non linear systems fractal methods chaos modeling and non linear differential equations

Advances in Nonlinear Speech Processing Thomas

Drugman, Thierry Dutoit, 2013-06-12 This book constitutes the proceedings of the 6th International Conference on Nonlinear Speech Processing NOLISP 2013 held in Mons Belgium in June 2013 The 27 refereed papers included in this volume were carefully reviewed and selected from 34 submissions The paper are organized in topical sections on speech and audio analysis speech synthesis speech based biomedical applications automatic speech recognition and speech enhancement

Recent Advances in Nonlinear Speech Processing Anna Esposito, Marcos Faundez-Zanuy, Antonietta M.

Esposito, Gennaro Cordasco, Thomas Drugman, Jordi Solé-Casals, Francesco Carlo Morabito, 2016-01-22 This book presents recent advances in nonlinear speech processing beyond nonlinear techniques It shows that it exploits heuristic and psychological models of human interaction in order to succeed in the implementations of socially believable VUIs and applications for human health and psychological support The book takes into account the multifunctional role of speech and what is outside of the box see Björn Schuller's foreword To this aim the book is organized in 6 sections each collecting a small number of short chapters reporting advances inside and outside themes related to nonlinear speech research The themes emphasize theoretical and practical issues for modelling socially believable speech interfaces ranging from efforts to capture the nature of sound changes in linguistic contexts and the timing nature of speech labors to identify and detect speech features that help in the diagnosis of psychological and neuronal disease attempts to improve the effectiveness and performance of Voice User Interfaces new front end algorithms for the coding decoding of effective and computationally efficient acoustic and linguistic speech representations as well as investigations capturing the social nature of speech in signaling personality traits emotions and improving human machine interactions

The Geometry of Fractals: A New Perspective Pasquale De Marco, 2025-07-07 Embark on a captivating journey into the realm of fractals where intricate patterns and self similarity unveil the hidden beauty and complexity of the natural world This comprehensive guide delves into the mathematical foundations applications and cultural significance of fractals offering a fresh perspective on these

fascinating geometric structures From the delicate branching of snowflakes to the mesmerizing spirals of seashells fractals are found in abundance in nature revealing a level of order within apparent chaos Botanists geologists and meteorologists alike have discovered the fractal patterns that govern the growth of plants the formation of mountains and the behavior of clouds This book takes you on an exploration of the history of fractals tracing their origins from early mathematical investigations to the groundbreaking work of Benoit Mandelbrot who brought fractals to the forefront of scientific study Discover the mathematical concepts that underlie fractal geometry including set theory topology and measure theory Beyond their mathematical elegance fractals have found practical applications in diverse fields Computer scientists utilize fractals to generate realistic images and animations while engineers harness their properties for signal processing and data compression Fractals have also inspired new forms of art and music captivating audiences with their intricate patterns and dynamic forms This book is not just a scientific treatise it is an invitation to appreciate the beauty and wonder of fractals Whether you are a mathematician a scientist an artist or simply someone curious about the world around you you will find something to engage and inspire you within these pages Unveil the Secrets of Fractals Explore the mathematical underpinnings of fractal geometry including set theory topology and measure theory Delve into the history of fractals from early investigations to the groundbreaking work of Benoit Mandelbrot Discover the diverse applications of fractals in fields such as computer graphics image processing and signal processing Appreciate the cultural significance of fractals in art music and literature Gain a deeper understanding of the beauty and complexity of the natural world through the lens of fractals If you like this book write a review on google books

Physiological Signal Processing, Modelling and System Implementation in Cardiography, Speech and Hearing R. H. Mitchell,1994 **Musical Signal Processing** Curtis Roads,Stephen Travis Pope,Aldo Piccialli,Giovanni De Poli,2013-12-19 Compiled by an international array of musical and technical specialists this book deals with some of the most important topics in modern musical signal processing Beginning with basic concepts and leading to advanced applications it covers such essential areas as sound synthesis including detailed studies of physical modelling and granular synthesis control signal synthesis sound transformation including convolution analysis resynthesis phase vocoder wavelets analysis by chaotic functions object oriented and artificial intelligence representations musical interfaces and the integration of signal processing techniques in concert performance **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

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The Digital Signal Processing Handbook VIJAY MADISETTI,1997-12-29 The field of digital signal processing DSP has spurred developments from basic theory of discrete time signals and processing tools to diverse applications in telecommunications speech and acoustics radar and video This volume provides an accessible reference offering theoretical and practical information to the audience of DSP users This immense compilation outlines both introductory and specialized aspects of information bearing signals in digital form creating a resource relevant to the expanding needs of the engineering community It also explores the use of computers and special purpose digital hardware in extracting information or transforming signals in advantageous ways Impacted areas presented include Telecommunications Computer engineering Acoustics Seismic data analysis DSP software and hardware Image and video processing Remote sensing Multimedia applications Medical technology Radar and sonar applications This authoritative collaboration written by the foremost researchers and practitioners in their fields comprehensively presents the range of DSP from theory to application from algorithms to hardware

Fractal Geometry Kenneth Falconer,2014-02-03 The seminal text on fractal geometry for students and researchers extensively revised and updated with new material notes and references that reflect recent directions Interest in fractal geometry continues to grow rapidly both as a subject that is fascinating in its own right and as a concept that is central to many areas of mathematics science and scientific research Since its initial publication in 1990 Fractal Geometry Mathematical Foundations and Applications has become a seminal text on the mathematics of fractals The book introduces and develops the general theory and applications of fractals in a way that is accessible to students and researchers from a wide range of disciplines Fractal Geometry Mathematical Foundations and Applications is an excellent course book for undergraduate and graduate students studying fractal geometry with suggestions for material appropriate for a first course indicated The book also provides an invaluable foundation and reference for researchers who encounter fractals not only in mathematics but also in other areas across physics engineering and the applied sciences Provides a comprehensive and accessible introduction to the mathematical theory and applications of fractals Carefully explains each topic using illustrative examples and diagrams Includes the necessary mathematical background material along with notes and references to enable the reader to pursue individual topics Features a wide range of exercises enabling readers to consolidate their understanding Supported by a website with solutions to exercises and additional material www.wiley-europe.com/fractal Leads onto the more advanced sequel Techniques in Fractal Geometry also by Kenneth Falconer and available from Wiley

Scaling, Fractals and Wavelets Patrice Abry,Paolo Goncalves,Jacques Levy Vehel,2013-03-01 Scaling is a mathematical transformation that enlarges or diminishes objects The technique is used in a variety of areas including finance and image processing This book is organized around the notions of scaling phenomena and scale invariance The various stochastic

models commonly used to describe scaling self similarity long range dependence and multi fractals are introduced These models are compared and related to one another Next fractional integration a mathematical tool closely related to the notion of scale invariance is discussed and stochastic processes with prescribed scaling properties self similar processes locally self similar processes fractionally filtered processes iterated function systems are defined A number of applications where the scaling paradigm proved fruitful are detailed image processing financial and stock market fluctuations geophysics scale relativity and fractal time space

Wireless, Networking, Radar, Sensor Array Processing, and Nonlinear Signal Processing Vijay Madisetti, 2018-09-03 Now available in a three volume set this updated and expanded edition of the bestselling The Digital Signal Processing Handbook continues to provide the engineering community with authoritative coverage of the fundamental and specialized aspects of information bearing signals in digital form Encompassing essential background material technical details standards and software the second edition reflects cutting edge information on signal processing algorithms and protocols related to speech audio multimedia and video processing technology associated with standards ranging from WiMax to MP3 audio low power high performance DSPs color image processing and chips on video Drawing on the experience of leading engineers researchers and scholars the three volume set contains 29 new chapters that address multimedia and Internet technologies tomography radar systems architecture standards and future applications in speech acoustics video radar and telecommunications This volume Wireless Networking Radar Sensor Array Processing and Nonlinear Signal Processing provides complete coverage of the foundations of signal processing related to wireless radar space time coding and mobile communications together with associated applications to networking storage and communications

Fractals in Multimedia Michael F. Barnsley, Dietmar Saupe, Edward R. Vrscay, 2012-12-06 This IMA Volume in Mathematics and its Applications FRACTALS IN MULTIMEDIA is a result of a very successful three day minisymposium on the same title The event was an integral part of the IMA annual program on Mathematics in Multimedia 2000 2001 We would like to thank Michael F Barnsley Department of Mathematics and Statistics University of Melbourne Dietmar Saupe Institut für Informatik Universität Leipzig and Edward R Vrscay Department of Applied Mathematics University of Waterloo for their excellent work as organizers of the meeting and for editing the proceedings We take this opportunity to thank the National Science Foundation for their support of the IMA Series Editors Douglas N Arnold Director of the IMA Fadil Santosa Deputy Director of the IMA

PREFACE This volume grew out of a meeting on Fractals in Multimedia held at the IMA in January 2001 The meeting was an exciting and intense one focused on fractal image compression analysis and synthesis iterated function systems and fractals in education The central concerns of the meeting were to establish within these areas where we are now and to develop a vision for the future

Computing, Communication and Signal Processing Brijesh Iyer, S.L. Nalbalwar, Nagendra Prasad Pathak, 2018-09-12 This book highlights cutting edge research on various aspects of human computer interaction HCI It includes selected research papers presented at the Third International

Conference on Computing Communication and Signal Processing ICCASP 2018 organized by Dr Babasaheb Ambedkar Technological University in Lonere Raigad India on January 26 27 2018 It covers pioneering topics in the field of computer electrical and electronics engineering e g signal and image processing RF and microwave engineering and emerging technologies such as IoT cloud computing HCI and green computing As such the book offers a valuable guide for all scientists engineers and research students in the areas of engineering and technology

Thinking In Patterns: Fractals And Related Phenomena In Nature Miroslav M Novak,2004-03-09 Fractal geometry together with the broader fields of nonlinear dynamics and complexity represented a large segment of modern science at the end of the 20th century Penetration of the resulting new paradigms into practically all academic disciplines has confirmed the fundamental assertion of universal formalism common to a wide range of human endeavors This book contains an extended article by B B Mandelbrot reviewing his contribution to fractal geometry and outlining some unsolved problems with illustrations especially of finance and physics It covers a range of multidisciplinary topics from the biology of aging through the self similar shape of plants image decompression and solar magnetic fields to sound reflection in the street The book is a treasure trove for innovative researchers working in fields related to fractal geometry The proceedings have been selected for coverage in Index to Scientific Technical Proceedings ISTP ISI Proceedings Index to Scientific Technical Proceedings ISTP CDROM version ISI Proceedings CC Proceedings Engineering Physical Sciences

Video, Speech, and Audio Signal Processing and Associated Standards Vijay Madiseti,2018-09-03 Now available in a three volume set this updated and expanded edition of the bestselling The Digital Signal Processing Handbook continues to provide the engineering community with authoritative coverage of the fundamental and specialized aspects of information bearing signals in digital form Encompassing essential background material technical details standards and software the second edition reflects cutting edge information on signal processing algorithms and protocols related to speech audio multimedia and video processing technology associated with standards ranging from WiMax to MP3 audio low power high performance DSPs color image processing and chips on video Drawing on the experience of leading engineers researchers and scholars the three volume set contains 29 new chapters that address multimedia and Internet technologies tomography radar systems architecture standards and future applications in speech acoustics video radar and telecommunications This volume Video Speech and Audio Signal Processing and Associated Standards provides thorough coverage of the basic foundations of speech audio image and video processing and associated applications to broadcast storage search and retrieval and communications

Musicality of Human Brain through Fractal Analytics Dipak Ghosh,Ranjan Sengupta,Shankha Sanyal,Archi Banerjee,2017-09-26 This book provides a comprehensive overview of how fractal analytics can lead to the extraction of interesting features from the complex electroencephalograph EEG signals generated by Hindustani classical music It particularly focuses on how the brain responses to the emotional attributes of Hindustani classical music that have been long been a source of discussion for

musicologists and psychologists Using robust scientific techniques that are capable of looking into the most intricate dynamics of the complex EEG signals it deciphers the human brain's response to different ragas of Hindustani classical music shedding new light on what happens inside the performer's brain when they are mentally composing the imagery of a particular raga It also explores the much debated issue in the musical fraternity of whether there are any universal cues in music that make it identifiable for people throughout the world and if so what are the neural correlates associated with the universal cues This book is of interest to researchers and scholars of music and the brain nonlinear science music cognition music signal processing and music information retrieval In addition researchers in the field of nonlinear biomedical signal processing and music signal analysis benefit from this book

Image and Signal Processing Abderrahim Elmoataz, Olivier Lezoray, Fathallah Nouboud, Driss Mammass, Jean Meunier, 2010-06-09 This book constitutes the refereed proceedings of the 4th International Conference on Image and Signal Processing ICISP 2010 held in Quebec Canada June 30 July 2 2010 The 69 revised full papers were carefully selected from 165 submissions The papers presented are organized in topical sections on Image Filtering and Coding Pattern Recognition Biometry Signal Processing Video Coding and Processing Watermarking and Document Processing Computer Vision and Biomedical Applications

Chaos and Fractals in Engineering Masao Nakagawa, 1999 This book is written for all engineers graduate students and beginners working in the application fields and for experimental scientists in general It is not presented as a purely theoretical treatise but shows mathematics at a workshop so to speak through important applications originating in a deep pure mathematical theory Widely spread subjects which the author has encountered hitherto are briefly addressed in the book as chaos and fractal science is a frontier of new research fields nowadays

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