

A spectrogram showing frequency components over time, with various colored bands (blue, green, yellow, red) representing different frequencies. The background is dark blue.

Jacob Benesty
Jingdong Chen
Yiteng Huang
Israel Cohen

SPRINGER TOPICS IN SIGNAL PROCESSING

Noise Reduction in Speech Processing

 Springer

Noise Reduction In Speech Processing Springer Topics In Signal Processing

**Jacob Benesty, Jingdong Chen, Yiteng
Huang**



Noise Reduction In Speech Processing Springer Topics In Signal Processing:

Noise Reduction in Speech Processing Jacob Benesty, Jingdong Chen, Yiteng Huang, Israel Cohen, 2009-04-28 Noise is everywhere and in most applications that are related to audio and speech such as human machine interfaces hands free communications voice over IP VoIP hearing aids teleconferencing telepresence telecollaboration systems and so many others the signal of interest usually speech that is picked up by a microphone is generally contaminated by noise As a result the microphone signal has to be cleaned up with digital signal processing tools before it is stored analyzed transmitted or played out This cleaning process is often called noise reduction and this topic has attracted a considerable amount of research and engineering attention for several decades One of the objectives of this book is to present in a common framework an overview of the state of the art of noise reduction algorithms in the single channel one microphone case The focus is on the most useful approaches i e filtering techniques in different domains and spectral enhancement methods The other objective of *Noise Reduction in Speech Processing* is to derive all these well known techniques in a rigorous way and prove many fundamental and intuitive results often taken for granted This book is especially written for graduate students and research engineers who work on noise reduction for speech and audio applications and want to understand the subtle mechanisms behind each approach Many new and interesting concepts are presented in this text that we hope the readers will find useful and inspiring

Speech Processing in Modern Communication Israel Cohen, Jacob Benesty, Sharon Gannot, 2009-12-18 Modern communication devices such as mobile phones teleconferencing systems VoIP etc are often used in noisy and reverberant environments Therefore signals picked up by the microphones from telecommunication devices contain not only the desired near end speech signal but also interferences such as the background noise far end echoes produced by the loudspeaker and reverberations of the desired source These interferences degrade the fidelity and intelligibility of the near end speech in human to human telecommunications and decrease the performance of human to machine interfaces i e automatic speech recognition systems The proposed book deals with the fundamental challenges of speech processing in modern communication including speech enhancement interference suppression acoustic echo cancellation relative transfer function identification source localization dereverberation and beamforming in reverberant environments Enhancement of speech signals is necessary whenever the source signal is corrupted by noise In highly non stationary noise environments noise transients and interferences may be extremely annoying Acoustic echo cancellation is used to eliminate the acoustic coupling between the loudspeaker and the microphone of a communication device Identification of the relative transfer function between sensors in response to a desired speech signal enables to derive a reference noise signal for suppressing directional or coherent noise sources Source localization dereverberation and beamforming in reverberant environments further enable to increase the intelligibility of the near end speech signal

Microphone Array Signal Processing Jacob Benesty, Jingdong Chen, Yiteng Huang, 2008-03-11 In the past few years we have written and edited several books in the area

of acoustic and speech signal processing. The reason behind this endeavor is that there were almost no books available in the literature when we first started while there was and still is a real need to publish manuscripts summarizing the most useful ideas, concepts, results, and state of the art algorithms in this important area of research. According to all the feedback we have received so far, we can say that we were right in doing this. Recently, several other researchers have followed us in this journey and have published interesting books with their own visions and perspectives. The idea of writing a book on Microphone Array Signal Processing comes from discussions we have had with many colleagues and friends. As a consequence of these discussions, we came up with the conclusion that again there is an urgent need for a monograph that carefully explains the theory and implementation of microphone arrays. While there are many manuscripts on antenna arrays from a narrowband perspective, narrowband signals, and narrowband processing, the literature is quite scarce when it comes to sensor arrays explained from a truly broadband perspective. Many algorithms for speech applications were simply borrowed from narrowband antenna arrays. However, a direct application of narrowband ideas to broadband speech processing may not be necessarily appropriate and can lead to many misunderstandings.

A Perspective on Single-channel Frequency-domain Speech Enhancement Jacob Benesty, Yiteng Huang, 2011. This book focuses on a class of single channel noise reduction methods that are performed in the frequency domain via the short time Fourier transform (STFT). The simplicity and relative effectiveness of this class of approaches make them the dominant choice in practical systems. Even though many popular algorithms have been proposed through more than four decades of continuous research, there are a number of critical areas where our understanding and capabilities still remain quite rudimentary, especially with respect to the relationship between noise reduction and speech distortion. All existing frequency domain algorithms, no matter how they are developed, have one feature in common: the solution is eventually expressed as a gain function applied to the STFT of the noisy signal only in the current frame. As a result, the narrowband signal-to-noise ratio (SNR) cannot be improved, and any gains achieved in noise reduction on the fullband basis come with a price to pay, which is speech distortion. In this book, we present a new perspective on the problem by exploiting the difference between speech and typical noise in circularity and interframe self-correlation, which were ignored in the past. By gathering the STFT of the microphone signal of the current frame, its complex conjugate, and the STFTs in the previous frames, we construct several new multiple observation signal models similar to a microphone array system: there are multiple noisy speech observations, and their speech components are correlated but not completely coherent, while their noise components are presumably uncorrelated. Therefore, the multichannel Wiener filter and the minimum variance distortionless response (MVDR) filter, that were usually associated with microphone arrays, will be developed for single channel noise reduction in this book. This might instigate a paradigm shift geared toward speech distortionless noise reduction techniques.

[Managerial Perspectives on Intelligent Big Data Analytics](#) Sun, Zhaohao, 2019-02-22. Big data analytics and artificial intelligence are revolutionizing work management and lifestyles and are

becoming disruptive technologies for healthcare e commerce and web services However many fundamental technological and managerial issues for developing and applying intelligent big data analytics in these fields have yet to be addressed Managerial Perspectives on Intelligent Big Data Analytics is a collection of innovative research that discusses the integration and application of artificial intelligence business intelligence digital transformation and intelligent big data analytics from a perspective of computing service and management While highlighting topics including e commerce machine learning and fuzzy logic this book is ideally designed for students government officials data scientists managers consultants analysts IT specialists academicians researchers and industry professionals in fields that include big data artificial intelligence computing and commerce *Artificial Intelligence and Bioinformatics Applications for Omics and Multi-Omics Studies* Angelo Facchiano, Margherita Mutarelli, Dominik Heider, 2024-02-07 Basic Quantitative Research Methods for Urban Planners Reid Ewing, Keunhyun Park, 2020-02-24 In most planning practice and research planners work with quantitative data By summarizing analyzing and presenting data planners create stories and narratives that explain various planning issues Particularly in the era of big data and data mining there is a stronger demand in planning practice and research to increase capacity for data driven storytelling Basic Quantitative Research Methods for Urban Planners provides readers with comprehensive knowledge and hands on techniques for a variety of quantitative research studies from descriptive statistics to commonly used inferential statistics It covers statistical methods from chi square through logistic regression and also quasi experimental studies At the same time the book provides fundamental knowledge about research in general such as planning data sources and uses conceptual frameworks and technical writing The book presents relatively complex material in the simplest and clearest way possible and through the use of real world planning examples makes the theoretical and abstract content of each chapter as tangible as possible It will be invaluable to students and novice researchers from planning programs intermediate researchers who want to branch out methodologically practicing planners who need to conduct basic analyses with planning data and anyone who consumes the research of others and needs to judge its validity and reliability *Handbook on Array Processing and Sensor Networks* Simon Haykin, K. J. Ray Liu, 2010-02-12 A handbook on recent advancements and the state of the art in array processing and sensor Networks Handbook on Array Processing and Sensor Networks provides readers with a collection of tutorial articles contributed by world renowned experts on recent advancements and the state of the art in array processing and sensor networks Focusing on fundamental principles as well as applications the handbook provides exhaustive coverage of wavelets spatial spectrum estimation MIMO radio propagation robustness issues in sensor array processing wireless communications and sensing in multi path environments using multi antenna transceivers implicit training and array processing for digital communications systems unitary design of radar waveform diversity sets acoustic array processing for speech enhancement acoustic beamforming for hearing aid applications undetermined blind source separation using acoustic arrays array processing in astronomy digital 3D 4D

ultrasound imaging technology self localization of sensor networks multi target tracking and classification in collaborative sensor networks via sequential Monte Carlo energy efficient decentralized estimation sensor data fusion with application to multi target tracking distributed algorithms in sensor networks cooperative communications distributed source coding network coding for sensor networks information theoretic studies of wireless networks distributed adaptive learning mechanisms routing for statistical inference in sensor networks spectrum estimation in cognitive radios nonparametric techniques for pedestrian tracking in wireless local area networks signal processing and networking via the theory of global games biochemical transport modeling estimation and detection in realistic environments and security and privacy for sensor networks Handbook on Array Processing and Sensor Networks is the first book of its kind and will appeal to researchers professors and graduate students in array processing sensor networks advanced signal processing and networking

Springer Handbook of Speech Processing Jacob Benesty, M. M. Sondhi, Yiteng Huang, 2007-11-28 This handbook plays a fundamental role in sustainable progress in speech research and development With an accessible format and with accompanying DVD Rom it targets three categories of readers graduate students professors and active researchers in academia and engineers in industry who need to understand or implement some specific algorithms for their speech related products It is a superb source of application oriented authoritative and comprehensive information about these technologies this work combines the established knowledge derived from research in such fast evolving disciplines as Signal Processing and Communications Acoustics Computer Science and Linguistics *Speech Processing in Modern Communication* Israel Cohen, Jacob Benesty, Sharon Gannot, 2010-02-04 Modern communication devices such as mobile phones teleconferencing systems VoIP etc are often used in noisy and reverberant environments Therefore signals picked up by the microphones from telecommunication devices contain not only the desired near end speech signal but also interferences such as the background noise far end echoes produced by the loudspeaker and reverberations of the desired source These interferences degrade the fidelity and intelligibility of the near end speech in human to human telecommunications and decrease the performance of human to machine interfaces i e automatic speech recognition systems The proposed book deals with the fundamental challenges of speech processing in modern communication including speech enhancement interference suppression acoustic echo cancellation relative transfer function identification source localization dereverberation and beamforming in reverberant environments Enhancement of speech signals is necessary whenever the source signal is corrupted by noise In highly non stationary noise environments noise transients and interferences may be extremely annoying Acoustic echo cancellation is used to eliminate the acoustic coupling between the loudspeaker and the microphone of a communication device Identification of the relative transfer function between sensors in response to a desired speech signal enables to derive a reference noise signal for suppressing directional or coherent noise sources Source localization dereverberation and beamforming in reverberant environments further enable to increase the intelligibility of the near end

speech signal **Wiley Encyclopedia of Telecommunications, 5 Volume Set** John G. Proakis,2003-01-06 Online encyclopedia dedicated to telecommunications for electrical engineers Topics Include Optical communications modulation and demodulation coding and decoding communication networks and antennas Regular updates Source Separation in Physical-Chemical Sensing Christian Jutten,Leonardo Tomazeli Duarte,Said Moussaoui,2023-10-23 Source Separation in Physical Chemical Sensing Master advanced signal processing for enhanced physical and chemical sensors with this essential guide In many domains medicine satellite imaging and remote sensing food industry materials science data is obtained from large sets of physical chemical sensors or sensor arrays Such sophisticated measurement techniques require advanced and smart processing for extracting useful information from raw sensing data Usually sensors are not very selective and record a mixture of the useful latent variables An innovative technique called Blind Source Separation BSS can isolate and retrieve the individual latent variables from a mixed source data array allowing for refined analysis that fully exploits these cutting edged imaging and signal sensing technologies Source Separation in Physical Chemical Sensing supplies a thorough introduction to the principles of BSS main methods and algorithms and its potential applications in various domains where data are obtained through physical or chemical sensors Designed to bridge the gap between chemical physical analysis and signal processing it promises to be invaluable in many fields Its alertness to the latest technologies and the full range of potential BSS applications make it an indispensable introduction to this cutting edge method Source Separation in Physical Chemical Sensing readers will also find BSS examples on chemical and physical sensors and devices to enhance processing and analysis Detailed treatment of source separation in potentiometric sensors ion sensitive sensors hyperspectral imaging Raman and fluorescence spectroscopy chromatography and others Thorough discussion of Bayesian source separation nonnegative matrix factorization tensorial methods geometrical methods constrained optimization and more Source Separation in Physical Chemical Sensing is a must have for researchers and engineers working in signal processing and statistical analysis as well as for chemists physicists or engineers looking to apply source separation in various application domains **Subject Guide to Books in Print** ,1993 Advanced Topics in Signal Processing Jae S. Lim,Alan V. Oppenheim,1988 **1997 IEEE International Conference on Acoustics, Speech, and Signal Processing** ,1997

Communication, Control, and Signal Processing Erdal Arıkan,1990 The articles in this two volume set provide a wealth of knowledge on new and emerging trends and topics in three areas of Electrical Engineering Communication Control and Signal Processing Twenty invited speakers and 442 authors from 35 countries contributed to this work resulting in 240 very valuable papers Containing contributions by some of the world s leading scientists the two volumes provide the definitive reference source for anyone interested in the latest advances and results of current fundamental research in these fields

Wiley Encyclopedia of Telecommunications, Volume 1 John G. Proakis,2003 Contains 275 tutorial articles focused on modern telecommunications topics The contents include articles on communication networks source coding and decoding

channel coding and decoding modulation and demodulation optical communications satellite communications underwater acoustic communications radio propagation antennas multiuser communications magnetic storage systems and a variety of standards V 1 p v *Nonlinear Image Processing and Pattern Analysis XII* Edward R. Dougherty, Jaakko Astola, 2001

Speech Enhancement Jacob Benesty, Shoji Makino, Jingdong Chen, 2005-03-17 We live in a noisy world In all applications telecommunications hands free communications recording human machine interfaces etc that require at least one microphone the signal of interest is usually contaminated by noise and reverberation As a result the microphone signal has to be cleaned with digital signal processing tools before it is played out transmitted or stored This book is about speech enhancement Different well known and state of the art methods for noise reduction with one or multiple microphones are discussed By speech enhancement we mean not only noise reduction but also dereverberation and separation of independent signals These topics are also covered in this book However the general emphasis is on noise reduction because of the large number of applications that can benefit from this technology The goal of this book is to provide a strong reference for researchers engineers and graduate students who are interested in the problem of signal and speech enhancement To do so we invited well known experts to contribute chapters covering the state of the art in this focused field *The Journal of the Acoustical Society of America* Acoustical Society of America, 2005

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