Independent Component Analysis
Principles and Practice

Edited by
Stephen Roberts and Richard Everson

CAMBRIDGE

Independent Component Analysis Principles And Practice

Mike E. Davies,Christopher C. James,Samer A. Abdallah,Mark D. Plumbley

Independent Component Analysis Principles And Practice:

Independent Component Analysis Stephen Roberts,Richard Everson,2001-03 Independent Component Analysis ICA has recently become an important tool for modelling and understanding empirical datasets It is a method of separating out independent sources from linearly mixed data and belongs to the class of general linear models ICA provides a better decomposition than other well known models such as principal component analysis This self contained book contains a structured series of edited papers by leading researchers in the field including an extensive introduction to ICA The major theoretical bases are reviewed from a modern perspective current developments are surveyed and many case studies of applications are described in detail The latter include biomedical examples signal and image denoising and mobile communications ICA is discussed in the framework of general linear models but also in comparison with other paradigms such as neural network and graphical modelling methods The book is ideal for researchers and graduate students in the field

Independent Component Analysis James V. Stone,2004 A tutorial style introduction to a class of methods for extracting independent signals from a mixture of signals originating from different physical sources includes MatLab computer code examples Independent component analysis ICA is becoming an increasingly important tool for analyzing large data sets In essence ICA separates an observed set of signal mixtures into a set of statistically independent component signals or source signals In so doing this powerful method can extract the relatively small amount of useful information typically found in large data sets The applications for ICA range from speech processing brain imaging and electrical brain signals to telecommunications and stock predictions In Independent Component Analysis Jim Stone presents the essentials of ICA and related techniques projection pursuit and complexity pursuit in a tutorial style using intuitive examples described in simple geometric terms The treatment fills the need for a basic primer on ICA that can be used by readers of varying levels of mathematical sophistication including engineers cognitive scientists and neuroscientists who need to know the essentials of this evolving method An overview establishes the strategy implicit in ICA in terms of its essentially physical underpinnings and describes how ICA is based on the key observations that different physical processes generate outputs that are statistically independent of each other The book then describes what Stone calls the mathematical nuts and bolts of how ICA works Presenting only essential mathematical proofs Stone guides the reader through an exploration of the fundamental characteristics of ICA Topics covered include the geometry of mixing and unmixing methods for blind source separation and applications of ICA including voice mixtures EEG fMRI and fetal heart monitoring The appendixes provide a vector matrix tutorial plus basic demonstration computer code that allows the reader to see how each mathematical method described in the text translates into working Matlab computer code **Independent Component Analysis** Aapo Hyvärinen,Juha Karhunen,Erkki Oja,2004-03-22 A comprehensive introduction to ICA for students and practitioners Independent Component Analysis ICA is one of the most exciting new topics in fields such as neural networks advanced statistics and signal

processing This is the first book to provide a comprehensive introduction to this new technique complete with the fundamental mathematical background needed to understand and utilize it It offers a general overview of the basics of ICA important solutions and algorithms and in depth coverage of new applications in image processing telecommunications audio signal processing and more Independent Component Analysis is divided into four sections that cover General mathematical concepts utilized in the book The basic ICA model and its solution Various extensions of the basic ICA model Real world applications for ICA models Authors Hyvarinen Karhunen and Oja are well known for their contributions to the development of ICA and here cover all the relevant theory new algorithms and applications in various fields Researchers students and practitioners from a variety of disciplines will find this accessible volume both helpful and informative **Advances in Independent Component Analysis and Learning Machines** Ella Bingham,Samuel Kaski,Jorma Laaksonen,Jouko Lampinen,2015-05-14 In honour of Professor Erkki Oja one of the pioneers of Independent Component Analysis ICA this book reviews key advances in the theory and application of ICA as well as its influence on signal processing pattern recognition machine learning and data mining Examples of topics which have developed from the advances of ICA which are covered in the book are A unifying probabilistic model for PCA and ICA Optimization methods for matrix decompositions Insights into the FastICA algorithm Unsupervised deep learning Machine vision and image retrieval A review of developments in the theory and applications of independent component analysis and its influence in important areas such as statistical signal processing pattern recognition and deep learning A diverse set of application fields ranging from machine vision to science policy data Contributions from leading researchers in the field *Independent Component Analysis and Blind Signal Separation* Carlos G. Puntonet,2004-09-17 In many situations found both in Nature and in human built systems a set of mixed signalsisobserved frequentlyalsowithnoise anditisofgreatscienti candtech logicalrelevanceto beableto isolateor separatethemso thattheinformationin each ofthesignalscanbeutilized Blind source separation BSS research is one of the more interesting emerging eldsnowadaysinthe eldofsignalprocessing Itdealswiththealgorithmsthatallow therecoveryoftheoriginalsourcesfromasetofmixturesonly Theadjectiveblind is applied becausethe purposeis to estimate the originalsourceswithoutany a priori knowledgeabouteitherthesourcesorthemixingsystem Mostofthemodelsemployed in BSS assume the hypothesisabout the independenceof the original sources Under this hypothesis a BSS problemcan be consideredas a particularcase of independent componentanalysis ICA alineartransformationtechniquethat startingfromam tivariate representation of the data minimizes the statistical dependence between the componentsoftherepresentation Itcan beclaimed thatmostoftheadvancesin ICA havebeenmotivatedbythesearchforsolutionstotheBSSproblemand theotherway around advancesinICAhavebeenimmediatelyappliedtoBSS ICA and BSS algorithms start from a mixture model whose parameters are timated from the observed mixtures Separation is achieved by applying the inverse mixturemodelto theobservedsignals separatingorunmixingmodel Mixturem els usually fall into three broad categories instantaneous linear

models convolutive modelsandnonlinearmodels the rstonebeingthesimplestbut in general notnear realisticapplications Thedevelopmentandtestofthealgorithmscanbeaccomplished throughsyntheticdataorwithreal worlddata Obviously themostimportantaim and mostdif cult istheseparationofreal worldmixtures BSSandICAhavestrongre tionsalso apartfromsignalprocessing withother eldssuchasstatisticsandarti cial neuralnetworks As long as we can nd a system that emits signals propagated through a mean andthosesignalsarereceivedbyasetofsensorsandthereisaninterestinrecovering the originalsources we have a potential eld ofapplication forBSS and ICA Inside thatwiderangeofapplicationswecan nd forinstance noisereductionapplications biomedicalapplications audiosystems telecommunications andmanyothers This volume comes out just 20 years after the rst contributionsin ICA and BSS 1 appeared Thereinafter the numberof research groupsworking in ICA and BSS has been constantly growing so that nowadays we can estimate that far more than 100 groupsareresearchinginthese elds Asproofoftherecognitionamongthescienti ccommunityofICAandBSSdev opmentstherehavebeennumerousspecialsessionsandspecialissuesinseveralwell 1 J Herault B Ans Circuits neuronaux synapses modi ables d codage de messages c posites para apprentissage non supervise C R de l Acad mie des Sciences vol 299 no III 13 pp 525 528 1984   **Independent Component Analysis and Signal Separation** Tulay Adali,Christian Jutten,Joao Marcos Travassos Romano,Allan Kardec Barros,2009-03-16 This book constitutes the refereed proceedings of the 8th International Conference on Independent Component Analysis and Signal Separation ICA 2009 held in Paraty Brazil in March 2009 The 97 revised papers presented were carefully reviewed and selected from 137 submissions The papers are organized in topical sections on theory algorithms and architectures biomedical applications image processing speech and audio processing other applications as well as a special session on evaluation   **On Statistical Pattern Recognition in Independent Component Analysis Mixture Modelling** Addisson Salazar,2012-07-20 A natural evolution of statistical signal processing in connection with the progressive increase in computational power has been exploiting higher order information Thus high order spectral analysis and nonlinear adaptive filtering have received the attention of many researchers One of the most successful techniques for non linear processing of data with complex non Gaussian distributions is the independent component analysis mixture modelling ICAMM This thesis defines a novel formalism for pattern recognition and classification based on ICAMM which unifies a certain number of pattern recognition tasks allowing generalization The versatile and powerful framework developed in this work can deal with data obtained from quite different areas such as image processing impact echo testing cultural heritage hypnograms analysis web mining and might therefore be employed to solve many different real world problems   ,   **Independent Component Analysis and Blind Signal Separation** Justinian Rosca,Deniz Erdogmus,Jose C. Principe,Simon Haykin,2006-02-27 This book constitutes the refereed proceedings of the 6th International Conference on Independent Component Analysis and Blind Source Separation ICA 2006 held in Charleston SC USA in March 2006 The 120 revised papers presented were carefully reviewed and selected from 183

submissions The papers are organized in topical sections on algorithms and architectures applications medical applications speech and signal processing theory and visual and sensory processing **Independent Component Analysis and Signal Separation** Mike E. Davies,Christopher C. James,Samer A. Abdallah,Mark D. Plumbley,2007-12-20 This book constitutes the refereed proceedings of the 7th International Conference on Independent Component Analysis and Blind Source Separation ICA 2007 held in London UK in September 2007 It covers algorithms and architectures applications medical applications speech and signal processing theory and visual and sensory processing Applied Intelligent Systems John Fulcher,2012-10-16 Humans have always been hopeless at predicting the future most people now generally agree that the margin of viability in prophecy appears to be 1 ten years Even sophisticated research endeavours in this arena tend to go 2 off the rails after a decade or so The computer industry has been particularly prone to bold and often way off the mark predictions for example I think there is a world market for maybe five computers Thomas J Watson IBM Chairman 1943 I have traveled the length and breadth of this country and talked with the best people and I can assure you that data processing is a fad that won t last out the year Prentice Hall Editor 1957 There is no reason why anyone would want a computer in their home Ken Olsen founder of DEC 1977 and 640K ought to be enough for anybody Bill Gates CEO Microsoft 1981 3 The field of Artificial Intelligence right from its inception has been particularly plagued by bold prediction syndrome and often by leading practitioners who should know better AI has received a lot of bad press 4 over the decades and a lot of it deservedly so How often have we groaned in despair at the latest by the year 20xx we will all have insert your own particular hobby horse here e g Blind Signal Processing Xizhi Shi,2011-12-28 Blind Signal Processing Theory and Practice not only introduces related fundamental mathematics but also reflects the numerous advances in the field such as probability density estimation based processing algorithms underdetermined models complex value methods uncertainty of order in the separation of convolutive mixtures in frequency domains and feature extraction using Independent Component Analysis ICA At the end of the book results from a study conducted at Shanghai Jiao Tong University in the areas of speech signal processing underwater signals image feature extraction data compression and the like are discussed This book will be of particular interest to advanced undergraduate students graduate students university instructors and research scientists in related disciplines Xizhi Shi is a Professor at Shanghai Jiao Tong University *Intelligent Control and Automation* De-Shuang Huang,George William Irwin,2006-09-08 Results of the International Conference on Intelligent Computing ICIC 2006 Lecture Notes in Computer Science LNCS Lecture Notes in Artificial Intelligence LNAI Lecture Notes in Bioinformatics LNBI Lecture Notes in Control and Information Sciences LNCIS 142 revised full papers are organized in topical sections Blind Source Separation Intelligent Sensor Networks Intelligent Control and Automation and Data Fusion Knowledge Discovery and Data Mining Includes a Special Session on Smart and Intelligent Home Technology **Chemometrics and Numerical Methods in LIBS** Vincenzo Palleschi,2022-10-17 Chemometrics and Numerical Methods in LIBS A practical

guide to the application of chemometric methods to solve qualitative and quantitative problems in LIBS analyses Chemometrics and Numerical Methods in LIBS delivers an authoritative and practical exploration of the use of advanced chemometric methods to laser induced breakdown spectroscopy LIBS cases The book discusses the fundamentals of chemometrics before moving on to solutions that can be applied to data analysis methods It is a concise guide designed to help readers at all levels of knowledge solve commonly encountered problems in the field The book includes three sections LIBS information simplification LIBS classification and quantitative analysis by LIBS Each section of the book is divided into a description of relevant techniques and practical examples of its applications Contributors to this edited volume are the most recognized international experts on the chemometric techniques relevant to LIBS analysis Chemometrics and Numerical Methods in LIBS also includes A thorough introduction to the simplification of LIBS information including principal component analysis independent component analysis and parallel factor analysis Comprehensive explorations of classification by LIBS including spectral angle mapping linear discriminant analysis graph clustering self organizing maps and artifical neural networks Practical discussions of linear methods for quantitative analysis by LIBS including calibration curves partial least squares regression and limit of detection In depth examinations of multivariate analysis and non linear methods including calibration free LIBS the non linear Kalman filter artificial and convolutional neural networks for quantification Relevant for researchers and PhD students seeking practical information on the application of advanced statistical methods to the analysis of LIBS spectra Chemometrics and Numerical Methods in LIBS will also earn a place in the libraries of students taking courses involving LIBS spectro analytical techniques **Optical Imaging for Biomedical and Clinical Applications** Ahmad Fadzil Mohamad Hani,Dileep Kumar,2017-10-30 Optical imaging is a rapidly emerging imaging technique that has been successfjully translated into biomedical applications ranging from clinical diagnosis to molecular biology This book includes an introductory section to explore various optical imaging devices and their functionality and roles for biomedical applications such as dermatology and ophthalmology Recent developments as exemplified with the authors research are explored in detail In depth discussion of other disease conditions and their diagnosis with optical imaging techniques are also covered Advances in Machine Learning I Jacek Koronacki,Zbigniew W Ras,Slawomir T. Wierzchon,2010-02-04 Professor Richard S Michalski passed away on September 20 2007 Once we learned about his untimely death we immediately realized that we would no longer have with us a truly exceptional scholar and researcher who for several decades had been inf encing the work of numerous scientists all over the world not only in his area of expertise notably machine learning but also in the broadly understood areas of data analysis data mining knowledge discovery and many others In fact his influence was even much broader due to his creative vision integrity scientific excellence and exceptionally wide intellectual horizons which extended to history political science and arts Professor Michalski s death was a particularly deep loss to the whole Polish sci tific community and the Polish Academy of Sciences in

particular After graduation he began his research career at the Institute of Automatic Control Polish Academy of Science in Warsaw In 1970 he left his native country and hold various prestigious positions at top US universities His research gained impetus and he soon established himself as a world authority in his areas of interest notably he was widely cons ered a father of machine learning **Information Technology** Yi Wan,Liangshan Shao,Lipo Wang,Jinguang Sun,2015-09-07 These proceedings of the symposium ISIT 2014 aim to be a platform for international exchange of the state of the art research and practice in information technology The contributions cover a wide variety of topics ranging from theoretical and analytical studies to various applications Artificial Neural Networks - ICANN 2001 Georg Dorffner,Horst Bischof,Kurt Hornik,2003-05-15 This book is based on the papers presented at the International Conference on Arti cial Neural Networks ICANN 2001 from August 21 25 2001 at the enna University of Technology Austria The conference is organized by the A trian Research Institute for Arti cal Intelligence in cooperation with the Pattern Recognition and Image Processing Group and the Center for Computational telligence at the Vienna University of Technology The ICANN conferences were initiated in 1991 and have become the major European meeting in the eld of neural networks From about 300 submitted papers the program committee selected 171 for publication Each paper has been reviewed by three program committee m bers reviewers We would like to thank all the members of the program comm tee and the reviewers for their great e ort in the reviewing process and helping us to set up a scienti c program of high quality In addition we have invited eight speakers three of their papers are also included in the proceedings We would like to thank the European Neural Network Society ENNS for their support We acknowledge the nancial support of Austrian Airlines A trian Science Foundation FWF under the contract SFB 010 Austrian Society for Arti cial Intelligence OGAI Bank Austria and the Vienna Convention Bureau We would like to express our sincere thanks to A Flexer W Horn K Hraby F Leisch C Schittenkopf and A Weingessel The conference and the proceedings would not have been possible without their enormous contri tion **Sensor Network Operations** Shashi Phoha,Thomas F. La Porta,Christopher Griffin,2007-01-29 This excellent title introduces the concept of mission oriented sensor networks as distributed dynamic systems of interacting sensing devices that are networked to jointly execute complex real time missions under uncertainity It provides the latest yet unpublished results on the main technical and application challenges of mission oriented sensor networks The authors of each chapter are research leaders from multiple disciplines who are presenting their latest innovations on the issues Together the editors have compiled a comprehensive treatment of the subject that flows smoothly from chapter to chapter This interdisciplinary approach significantly enhances the science and technology knowledge base and influences the military and civilian applications of this field Author Information Dr Shashi Phoha is the Guest Editor of IEEE Transactions in Mobile Computing Special Issue on Mission Oriented Sensor Networks She is the Head of the Information Sciences and Technology Division of ARL and Professor of Electrical and Computer Engineering at Pennsylvania State University She has led major research programs of multimillion dollars for military sensor networks in

industry as well as in academia In addition to more than a hundred journal articles she authored or co authored several books in related areas Dr Thomas La Porta is the Editor of the IEEE Transactions on Mobile Computing He received his B S E E and M S E E degrees from The Cooper Union New York NY and his Ph D degree in Electrical Engineering from Columbia University New York NY He joined the Computer Science and Engineering Department at Penn State in 2002 as a Full Professor He is Director of the Networking Research Center at Penn State Prior to joining Penn State Dr LaPorta was with Bell Laboratories since 1986 He was the Director of the Mobile Networking Research Department Bell Laboratories Lucent Technologies where he led various projects in wireless and mobile networking He is an IEEE Fellow Bell Labs Fellow received the Bell Labs Distinguished Technical Staff Award and an Eta Kappa Nu Outstanding Young Electrical Engineer Award He has published over 50 technical papers and holds over 20 patents Christopher Griffin holds a Masters degree in Mathematics from Penn State and is currently pursuing his Ph D there Mr Griffin has worked as a research engineer at the Penn State Applied Research Laboratory for the last six years on several DARPA and or Army Research Laboratory sponsored programs including the Emergent Surveillance Plexus ESP program as a lead engineer the DARPA sponsored Semantic Information Fusion program under the SensIT initiative where he co developed a distributed target tracking system and managed the development of a target classification algorithm using Level 1 sensor fusion techniques as a co principal software architect for the DARPA Joint Force Component Controller JFACC initiative an adaptive C2 program aimed at improving Air Force response times and he was the principal software architect for the Boeing ARFL Insertion of Embedding Infosphere Technology IEIST program His areas of research expertise are distributed tracking systems mission oriented control and system modeling *Systems Design for Remote Healthcare* Koushik Maharatna,Silvio Bonfiglio,2013-11-13 This book provides a multidisciplinary overview of the design and implementation of systems for remote patient monitoring and healthcare Readers are guided step by step through the components of such a system and shown how they could be integrated in a coherent framework for deployment in practice The authors explain planning from subsystem design to complete integration and deployment given particular application constraints Readers will benefit from descriptions of the clinical requirements underpinning the entire application scenario physiological parameter sensing techniques information processing approaches and overall application dependent system integration Each chapter ends with a discussion of practical design challenges and two case studies are included to provide practical examples and design methods for two remote healthcare systems with different needs

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a four quadrant or multiple quadrant operation is required in industrial as well as commercial applications these applications require both driving and braking i e motoring and generating capability some of these applications include electric traction systems cranes and lifts cable laying winders and engine test loading systems

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the four quadrant chopper block represents a four quadrant controlled chopper for converting a fixed dc input to a variable dc output the block contains two bridge arms each bridge arm each has two switching devices options for the type of

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3 four quadrant operation of dc motor four quadrant operation or mode of any dc motor means that machine operate in four quadrants they are forward breaking mode forward motoring mode reverse breaking or stop mode and reverse motoring mode a motor operates in two modes motoring and breaking a motor drive capable of

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this paper gives a control for three phase brushless dc bldc motor in all four quadrant operation the control system in this paper is capable to detect and identify the rotor position by sensor signal 1 in this paper behaviour of bldc motor is studied in all four quadrant operations through simulation model

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aug 8 2020 1 answer sorted by 1 you can think of the first quadrant operation as being a buck converter down from the supply to the motor you can think of the second quadrant as being a boost converter from the motor s generated low voltage up to the supply voltage

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put simply the four quadrants that the controller can work in are 1 motor going clockwise controller applying clockwise drive

2 motor going anti clockwise controller applying anti clockwise drive 3 motor going clockwise controller applying anti clockwise drive 4 motor going anti clockwise controller applying clockwise drive

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1 to observe the four quadrant operation of a dc motor 2 to control a motor under torque control 3 to couple the speed control motor and torque controlled motor and observe the effect of a stepped torque 6 2 four quadrant operation of a dc motor the four quadrant operation is performed by giving an alternating reference speed command to

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aug 16 2021 the four quadrant operation of the motor can be described as follows quadrant i in the first quadrant the developed power by the motor is positive thus the motor operates in motoring mode and converts electrical energy into mechanical energy therefore the operation of the motor in first quadrant is called forward motoring quadrant ii

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the control of bldc motor in four quadrants is very crucial in this paper bldc motor is controlled in all the four quadrants without any wastage of power during regenerative braking period power generated is being stored in the chargeable battery

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