

Agustín Gutiérrez
Santiago Marco (Eds.)

Biologically Inspired Signal Processing for Chemical Sensing



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Biologically Inspired Signal Processing For Chemical Sensing Studies In Computational Intelligence

**Ajith Abraham, Aboul-Ella
Hassanien, Patrick Siarry, Andries
Engelbrecht**



Biologically Inspired Signal Processing For Chemical Sensing Studies In Computational Intelligence:

Biologically Inspired Signal Processing for Chemical Sensing Agustín Gutiérrez,Santiago Marco,2009-05-11

Biologically inspired approaches for artificial sensing have been extensively applied to different sensory modalities over the last decades and chemical senses have been no exception The olfactory system and the gustatory system to a minor extent has been regarded as a model for the development of new artificial chemical sensing systems One of the main contributions to this field was done by Persaud and Dodd in 1982 when they proposed a system based on an array of broad selective chemical sensors coupled with a pattern recognition engine The array aimed at mimicking the sensing strategy followed by the olfactory system where a population of broad selective olfactory receptor neurons encodes for chemical information as patterns of activity across the neuron population The pattern recognition engine proposed was not based on bio inspired but on statistical methods This influential work gave rise to a new line of research where this paradigm has been used to build chemical sensing instruments applied to a wide range of odor detection problems More recently some researchers have proposed to extend the biological inspiration of this system also to the processing of the sensor array signals This has been motivated in part by the increasing body of knowledge available on biological olfaction which has become in the last decade a focus of attention of the experimental neuroscience community

Biologically Inspired Signal Processing for Chemical Sensing Agustín Gutiérrez,Santiago Marco,2009-02-18 Biologically inspired approaches for artificial sensing have been extensively applied to different sensory modalities over the last decades and chemical senses have been no exception The olfactory system and the gustatory system to a minor extent has been regarded as a model for the development of new artificial chemical sensing systems One of the main contributions to this field was done by Persaud and Dodd in 1982 when they proposed a system based on an array of broad selective chemical sensors coupled with a pattern recognition engine The array aimed at mimicking the sensing strategy followed by the olfactory system where a population of broad selective olfactory receptor neurons encodes for chemical information as patterns of activity across the neuron population The pattern recognition engine proposed was not based on bio inspired but on statistical methods This influential work gave rise to a new line of research where this paradigm has been used to build chemical sensing instruments applied to a wide range of odor detection problems More recently some researchers have proposed to extend the biological inspiration of this system also to the processing of the sensor array signals This has been motivated in part by the increasing body of knowledge available on biological olfaction which has become in the last decade a focus of attention of the experimental neuroscience community

Foundations of Computational Intelligence Volume 3 Ajith Abraham,Aboul-Ella Hassanien,Patrick Siarry,Andries Engelbrecht,2009-04-27 Global optimization is a branch of applied mathematics and numerical analysis that deals with the task of finding the absolutely best set of admissible conditions to satisfy certain criteria objective functions formulated in mathematical terms Global optimization includes nonlinear stochastic and combinatorial programming multiobjective

programming control games geometry approximation algorithms for parallel architectures and so on Due to its wide usage and applications it has gained the attention of researchers and practitioners from a plethora of scientific domains Typical practical examples of global optimization applications include Traveling salesman problem and electrical circuit design minimize the path length safety engineering building and mechanical structures mathematical problems Kepler conjecture Protein structure prediction minimize the energy function etc Global Optimization algorithms may be categorized into several types Deterministic example branch and bound methods Stochastic optimization example simulated annealing Heuristics and meta heuristics example evolutionary algorithms etc Recently there has been a growing interest in combining global and local search strategies to solve more complicated optimization problems This edited volume comprises 17 chapters including several overview Chapters which provides an up to date and state of the art research covering the theory and algorithms of global optimization Besides research articles and expository papers on theory and algorithms of global optimization papers on numerical experiments and on real world applications were also encouraged The book is divided into 2 main parts

Foundations of Computational Intelligence Ajith Abraham, Aboul-Ella Hassanien, André Ponce de Leon F. de Carvalho, 2009-04-21 Foundations of Computational Intelligence Volume 4 Bio Inspired Data Mining Theoretical Foundations and Applications Recent advances in the computing and electronics technology particularly in sensor devices databases and distributed systems are leading to an exponential growth in the amount of data stored in databases It has been estimated that this amount doubles every 20 years For some applications this increase is even steeper Databases storing DNA sequence for example are doubling their size every 10 months This growth is occurring in several applications areas besides bioinformatics like financial transactions government data environmental monitoring satellite and medical images security data and web As large organizations recognize the high value of data stored in their databases and the importance of their data collection to support decision making there is a clear demand for sophisticated Data Mining tools Data mining tools play a key role in the extraction of useful knowledge from databases They can be used either to confirm a particular hypothesis or to automatically find patterns In the second case which is related to this book the goal may be either to describe the main patterns present in dataset what is known as descriptive Data Mining or to find patterns able to predict behaviour of specific attributes or features known as predictive Data Mining While the first goal is associated with tasks like clustering summarization and association the second is found in classification and regression problems

New Advances in Intelligent Decision Technologies Gloria Phillips-Wren, 2009-04-28 IDT Intelligent Decision Technologies seeks an interchange of research on intelligent systems and intelligent technologies which enhance or improve decision making in industry government and academia The focus is interdisciplinary in nature and includes research on all aspects of intelligent decision technologies from fundamental development to the applied system It constitutes a great honor and pleasure for us to publish the works and new research results of scholars from the First KES International Symposium on Intelligent Decision

Technologies KES IDT 09 hosted and organized by University of Hyogo in conjunction with KES International Himeji Japan April 2009 The symposium was concerned with theory design development implementation testing and evaluation of intelligent decision systems Its topics included intelligent agents fuzzy logic multi agent systems artificial neural networks genetic algorithms expert systems intelligent decision making support systems information retrieval systems geographic information systems and knowledge management systems These technologies have the potential to support decision making in many areas of management international business finance accounting marketing healthcare military applications production networks traffic management crisis response and human interfaces

The Senses: A Comprehensive Reference, 2020-09-30 The Senses A Comprehensive Reference Second Edition Seven Volume Set is a comprehensive reference work covering the range of topics that constitute current knowledge of the neural mechanisms underlying the different senses This important work provides the most up to date cutting edge comprehensive reference combining volumes on all major sensory modalities in one set Offering 264 chapters from a distinguished team of international experts The Senses lays out current knowledge on the anatomy physiology and molecular biology of sensory organs in a collection of comprehensive chapters spanning 4 volumes Topics covered include the perception psychophysics and higher order processing of sensory information as well as disorders and new diagnostic and treatment methods Written for a wide audience this reference work provides students scholars medical doctors as well as anyone interested in neuroscience a comprehensive overview of the knowledge accumulated on the function of sense organs sensory systems and how the brain processes sensory input As with the first edition contributions from leading scholars from around the world will ensure The Senses offers a truly international portrait of sensory physiology The set is the definitive reference on sensory neuroscience and provides the ultimate entry point into the review and original literature in Sensory Neuroscience enabling students and scientists to delve into the subject and deepen their knowledge All inclusive coverage of topics updated edition offers readers the only current reference available covering neurobiology physiology anatomy and molecular biology of sense organs and the processing of sensory information in the brain Authoritative content world leading contributors provide readers with a reputable dynamic and authoritative account of the topics under discussion Comprehensive style content in depth complex coverage of topics offers students at upper undergraduate level and above full insight into topics under discussion

Foundations of Computational Intelligence Aboul-Ella Hassanien,Ajith Abraham,Athanasios V. Vasilakos,Witold Pedrycz,2009-05-02 Foundations of Computational Intelligence Volume 1 Learning and Approximation Theoretical Foundations and Applications Learning methods and approximation algorithms are fundamental tools that deal with computationally hard problems and problems in which the input is gradually disclosed over time Both kinds of problems have a large number of applications arising from a variety of fields such as algorithmic game theory approximation classes coloring and partitioning competitive analysis computational finance cuts and connectivity inapproximability results

mechanism design network design packing and covering paradigms for design and analysis of approximation and online algorithms randomization techniques real world applications scheduling problems and so on The past years have witnessed a large number of interesting applications using various techniques of Computational Intelligence such as rough sets connectionist learning fuzzy logic evolutionary computing artificial immune systems swarm intelligence reinforcement learning intelligent multimedia processing etc In spite of numerous successful applications of Computational Intelligence in business and industry it is sometimes difficult to explain the performance of these techniques and algorithms from a theoretical perspective Therefore we encouraged authors to present original ideas dealing with the incorporation of different mechanisms of Computational Intelligence dealing with Learning and Approximation algorithms and underlying processes This edited volume comprises 15 chapters including an overview chapter which provides an up to date and state of the art research on the application of Computational Intelligence for learning and approximation

Bioinspired solutions to the challenges of chemical sensing Ramon Huerta, Thomas Nowotny, Chemical sensing is likely the most primordial sensory modality that emerged in the evolution of life Without chemical sensing life on earth would probably not exist It is used for detecting nutrients avoiding threats finding mating partners and various forms of communication and social interaction between animals The advent of artificial sensors has created a myriad of problems in the areas of chemical detection and identification with applications in food quality and pollution control chemical threat detection health monitoring robot control and even odor and taste synthesis Efficient algorithms are needed to address the many challenges of chemical sensing in these areas including but not limited to sensitivity levels sensor drift concentration invariance of analyte identity and complex mixtures Defining and improving analysis methods for artificial chemical sensing remains an active research area in engineering and machine learning alike In the course of evolution animals bacteria and plants have developed sophisticated methods and algorithms for solving difficult problems in chemical sensing very efficiently Complex signalling pathways inside single cells can trigger movement toward the source of a nutrient Complex networks of neurons appear to be able to compute odor types and the distance to a source in turbulent flows These networks of neurons use a combination of temporal coding layered structures simple Hebbian learning rules reinforcement learning and inhibition to quickly learn about chemical stimuli that are critical for their survival Olfaction is a vibrant field of research because recent technological advances allow monitoring and manipulating brain areas inaccessible in the past thus allowing for rapid progress This is particularly relevant because to this date the best solutions to many general chemical sensing problems are still found in animals rather than artificial devices Many lessons may yet have to be learned from biological systems to solve the complex problems of chemical sensing with similar success as animals routinely do This special issue has the ambitious goal of bringing together biologists and engineers to report on biological solutions and engineering approaches to chemical sensing challenges in order to better understand in what aspects both fields can find common ground of discussion and to thus promote novel areas of

interdisciplinary research Foundations of Computational Intelligence Volume 5 Ajith Abraham, Aboul-Ella Hassanien, Vaclav Sná#el, 2009-06-30

Foundations of Computational Intelligence Volume 5

Function Approximation and Classification

Approximation theory is that area of analysis which is concerned with the ability to approximate functions by simpler and more easily calculated functions. It is an area which like many other fields of analysis has its primary roots in the mathematics. The need for function approximation and classification arises in many branches of applied mathematics, computer science, and data mining, in particular. This edited volume comprises of 14 chapters including several overview Chapters which provides an up to date and state of the art research covering the theory and algorithms of function approximation and classification. Besides research articles and expository papers on theory and algorithms of function approximation and classification, papers on numerical experiments and real world applications were also encouraged. The Volume is divided into 2 parts: Part I: Function Approximation and Classification: Theoretical Foundations; Part II: Function Approximation and Classification: Success Stories and Real World Applications.

Part I on Function Approximation and Classification: Theoretical Foundations contains six chapters that describe several approaches: Feature Selection, the use of Decomposition of Correlation Integral, Some Issues on Extensions of Information and Dynamic Information System, and a Probabilistic Approach to the Evaluation and Combination of Preferences.

Chapter 1: Feature Selection for Partial Least Square Based Dimension Reduction by Li and Zeng investigate a systematic feature reduction framework by combining dimension reduction with feature selection. To evaluate the proposed framework, authors used four typical data sets.

Essentials of Machine Olfaction and Taste

Takamichi Nakamoto, 2016-04-18

Essentials of Machine Olfaction and Taste

This book provides a valuable information source for olfaction and taste which includes a comprehensive and timely overview of the current state of knowledge of use for olfaction and taste machines. Presents original latest research in the field with an emphasis on the recent development of human interfacing. Covers the full range of artificial chemical senses including olfaction and taste from basic through to advanced level. Timely project in that mobile robots olfactory displays and odour recorders are currently under research driven by commercial demand.

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