

Neuro-fuzzy Systems in Medicine

Andor Sagi, Anita Sabo, Bojan Kuljić, Tibor Szakáll

Subotica Tech, Subotica, Serbia

peva@vts.su.ac.rs, saboanita@vts.su.ac.rs,

bojan.kuljic@gmail.com, szakall.tibor@gmail.com

Abstract— Neuro-fuzzy systems are widely used in both applied and experimental medicine and are one of the most modern subjects of today's Medical Informatics. Despite the initial refuse of their use due to informational, economical, educational and other reasons, these systems are widely accepted in medical institutions operating in all levels of healthcare. The accuracy of some up-to-date neuro-fuzzy systems today matches or even surpasses the diagnostic abilities of physicians, thus holding an important role in risk-assessment and diagnostics in medicine. This work deals with newer applications of these systems in medicine along with the possibility of their implementation in the region of Central Europe.

I. NEURO-FUZZY SYSTEMS IN MEDICAL SCIENCES

Medical diagnostics, despite the wide use of international Latin nomenclature and disease classification systems, is a field of evaluation of vague, human-like categories. Risk assessment requires high degree modeling, but on the same time must provide the necessary environment of interaction with the human factor.

To establish objective quality control the process must be monitored by a multi-level feedback system operated by a team of experts preferably of medical informatics, social medicine, epidemiology and by a committee for verifying the accuracy of the established diagnoses. These factors are important not solely for the purpose of satisfying the principles of Good Clinical Practice (GCP), but also the terms defined by social medicine and the country's main development program.

These systems will need to be changeable as clinical considerations may alter the existing categories. The frequent lowering of tolerance levels for LDL cholesterol provides us with excellent example. These changes are



Figure 1. Neuro-fuzzy information feedback system

often unforeseen in medical sciences so the speed of changing these systems will come to foreground. In the previous example the interaction of business interest of antihyperlipemic drug manufacturers and changing medical aims – among others – resulted in frequent changes of these values.

II. THE ROLE OF NEURO-FUZZY SYSTEMS IN MEDICAL DIAGNOSTICS

Neuro-fuzzy systems, among other requirements, have to meet not only the standards and expectations of physicians, but their patients as well. An ample example for this is the use of neuro-fuzzy systems by a group of prominent scientists of the Annamalai University. Their work, published in 2005 is titled "An investigation of neuro-fuzzy systems in psychosomatic disorders" in which they state the possibility of interpreting the vague, human-like symptoms of the hospitalized as well as appropriately diagnose their psychic condition. I might recollect that this is one of the most ambitious examples of the efficacy of neuro-fuzzy systems, since it was able to validly simulate the understanding of complex pathophysiological laws to the extent of valid diagnoses with its effectiveness approved physicians. It is for the first time that a system that is based on artificial neural networks actually used directly for the evaluation of function of a real neural network.

Mental diseases and psychosomatic disorders are closely determined with the structural architecture and the conductive abilities of this biological network. In the age of examining the human brain the simulation of such a system becomes imperative as medical ethics greatly hinders the possibilities of legal experiments on humans. The electric charge in the neurons is generated by a sodium influx and potassium efflux which depolarizes the cell. Complex, additional biochemical reactions make possible the flow of this current. The speed of current propagation as well as its strength and other properties are now clearly defined, opening the path for making appropriate models. Current conduction by chemical synapses and the properties of the certain neurotransmitters is also a subject of knowledge. The number of possible connections if billion times billion, but the histological and neurological properties of the human brain still provide ample ground for modeling purposes. Many mental disorders are mostly due to abnormal production or lack of certain neurotransmitters or their quantitative proportions. In these examples no higher structural analysis is required. On the other hand in epilepsy the abnormal excitation of pathologic neuron groups provide the clinical picture. Since these phenomena can be measured by EEG the neuro-fuzzy system can be filled up with data intervals necessary to classify vague signals. Epilepsy can be triggered with many external influences which patients can describe only subjectively and therefore not precisely. These effects could be intense or rapidly changing visual or auditive impulses.

Applications Of Neuro Fuzzy Systems In Medicine And Bio Medical Engineering

Sergio Cerutti, Carlo Marchesi



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Revival: Fuzzy and Neuro-Fuzzy Systems in Medicine (1998) Horia-Nicolai L Teodorescu, Abraham Kandel, Lakhmi C. Jain, 2017-11-22 Fuzzy and Neuro Fuzzy Systems in Medicine provides a thorough review of state of the art techniques and practices defines and explains relevant problems as well as provides solutions to these problems After an introduction the book progresses from one topic to another with a linear development from fundamentals to applications

Fuzzy and Neuro-Fuzzy Systems in Medicine Horia-Nicolai L Teodorescu, Abraham Kandel, Lakhmi C. Jain, 2017-11-22 Fuzzy and Neuro Fuzzy Systems in Medicine provides a thorough review of state of the art techniques and practices defines and explains relevant problems as well as provides solutions to these problems After an introduction the book progresses from one topic to another with a linear development from fundamentals to applications

Biomedical Engineering and its Applications in Healthcare Sudip Paul, 2019-11-08 This book illustrates the significance of biomedical engineering in modern healthcare systems Biomedical engineering plays an important role in a range of areas from diagnosis and analysis to treatment and recovery and has entered the public consciousness through the proliferation of implantable medical devices such as pacemakers and artificial hips as well as the more futuristic technologies such as stem cell engineering and 3 D printing of biological organs Starting with an introduction to biomedical engineering the book then discusses various tools and techniques for medical diagnostics and treatment and recent advances It also provides comprehensive and integrated information on rehabilitation engineering including the design of artificial body parts and the underlying principles and standards It also presents a conceptual framework to clarify the relationship between ethical policies in medical practice and philosophical moral reasoning Lastly the book highlights a number of challenges associated with modern healthcare technologies

Intelligent and Adaptive Systems in Medicine Olivier C. L. Haas, Keith J. Burnham, 2008-03-19 Intelligent and adaptive techniques are rapidly being used in all stages of medical treatment from the initial diagnosis to planning delivery and follow up therapy To realize the full potential of these techniques developers and end users must understand both the underlying technology and the specifics of the medical application considered Focus

Bio-Inspired Applications of Connectionism Jose Mira, 2001-06-05 This book constitutes together with its companion LNCS 2084 the refereed proceedings of the 6th International Work Conference on Artificial and Natural Neural Networks IWANN 2001 held in Granada Spain in June 2001 The 200 revised papers presented were carefully reviewed and selected for inclusion in the proceedings The papers are organized in sections on foundations of connectionism biophysical models of neurons structural and functional models of neurons learning and other plasticity phenomena complex systems dynamics artificial intelligence and cognitive processes methodology for nets design nets simulation and implementation bio inspired systems and engineering and other applications in a variety of fields

Application of Biomedical Engineering in Neuroscience Sudip Paul, 2019-11-19 This book focuses on interdisciplinary research in the field of biomedical engineering and

neuroscience Biomedical engineering is a vast field ranging from bioengineering to brain computer interfaces The book explores the system level function and dysfunction of the nervous system from scientific and engineering perspectives The initial sections introduce readers to the physiology of the brain and to the biomedical tools needed for diagnostics and effective therapies for various neurodegenerative and regenerative disorders In turn the book summarizes the biomedical interventions that are used to understand the neural mechanisms underlying empathy disorders and reviews recent advances in biomedical engineering for rehabilitation in connection with neurodevelopmental disorders and brain injuries Lastly the book discusses innovations in machine learning and artificial intelligence for computer aided disease diagnosis and treatment as well as applications of nanotechnology in therapeutic neurology

Control Applications for Biomedical Engineering Systems Ahmad Taher Azar,2020-01-22 Control Applications for Biomedical Engineering Systems presents different control engineering and modeling applications in the biomedical field It is intended for senior undergraduate or graduate students in both control engineering and biomedical engineering programs For control engineering students it presents the application of various techniques already learned in theoretical lectures in the biomedical arena For biomedical engineering students it presents solutions to various problems in the field using methods commonly used by control engineers Points out theoretical and practical issues to biomedical control systems Brings together solutions developed under different settings with specific attention to the validation of these tools in biomedical settings using real life datasets and experiments Presents significant case studies on devices and applications

Biomedical Engineering Tools for Management for Patients with COVID-19 Valentina Emilia Balas,Oana Geman,Guojun Wang,Muhammad Arif,Octavian Adrian Postolache,2021-06-08 Biomedical Engineering Tools for Management of Patients with COVID 19 presents biomedical engineering tools under research and in development that can be used for the management of COVID 19 patients along with BME tools in the global environment that curtail and prevent the spread of the virus BME tools covered in the book include new disinfectants and sterilization equipment testing devices for rapid and accurate COVID 19 diagnosis Internet of Things applications in COVID 19 hospitals analytics Data Science and statistical modeling applied to COVID 19 tracking Smart City instruments and applications and more Later sections discuss smart tools in telemedicine and e health Biomedical engineering tools can provide engineers computer scientists clinicians and other policymakers with solutions for managing patient treatment applying data analysis techniques and applying tools to help the general population curtail spread of the virus Provides leading edge biomedical engineering tools and techniques for the treatment of patients with the COVID 19 virus Integrates a variety of case studies as a resource for COVID 19 researchers and clinicians around the world including both positive and negative research findings Provides insights into innovative Biomedical Engineering techniques and devices from COVID 19 researchers around the world

Fuzzy Systems in Bioinformatics and Computational Biology Yaochu Jin,Lipo Wang,2009-04-15 Biological systems are inherently stochastic and uncertain Thus research in bioinformatics biomedical

engineering and computational biology has to deal with a large amount of uncertainties Fuzzy logic has shown to be a powerful tool in capturing different uncertainties in engineering systems In recent years fuzzy logic based modeling and analysis approaches are also becoming popular in analyzing biological data and modeling biological systems Numerous research and application results have been reported that demonstrated the effectiveness of fuzzy logic in solving a wide range of biological problems found in bioinformatics biomedical engineering and computational biology Contributed by leading experts world wide this edited book contains 16 chapters presenting representative research results on the application of fuzzy systems to genome sequence assembly gene expression analysis promoter analysis cis regulation logic analysis and synthesis reconstruction of genetic and cellular networks as well as biomedical problems such as medical image processing electrocardiogram data classification and anesthesia monitoring and control This volume is a valuable reference for researchers practitioners as well as graduate students working in the field of bioinformatics biomedical engineering and computational biology Computational Intelligence in Biomedical Engineering Rezaul Begg, Daniel T.H. Lai, Marimuthu Palaniswami, 2007-12-04 As in many other fields biomedical engineers benefit from the use of computational intelligence CI tools to solve complex and non linear problems The benefits could be even greater if there were scientific literature that specifically focused on the biomedical applications of computational intelligence techniques The first comprehensive field

Practical Guide for Biomedical Signals Analysis Using Machine Learning Techniques Abdulhamit

Subasi, 2019-03-16 Practical Guide for Biomedical Signals Analysis Using Machine Learning Techniques A MATLAB Based Approach presents how machine learning and biomedical signal processing methods can be used in biomedical signal analysis Different machine learning applications in biomedical signal analysis including those for electrocardiogram electroencephalogram and electromyogram are described in a practical and comprehensive way helping readers with limited knowledge Sections cover biomedical signals and machine learning techniques biomedical signals such as electroencephalogram EEG electromyogram EMG and electrocardiogram ECG different signal processing techniques signal de noising feature extraction and dimension reduction techniques such as PCA ICA KPCA MSPCA entropy measures and other statistical measures and more This book is a valuable source for bioinformaticians medical doctors and other members of the biomedical field who need a cogent resource on the most recent and promising machine learning techniques for biomedical signals analysis Provides comprehensive knowledge in the application of machine learning tools in biomedical signal analysis for medical diagnostics brain computer interface and man machine interaction Explains how to apply machine learning techniques to EEG ECG and EMG signals Gives basic knowledge on predictive modeling in biomedical time series and advanced knowledge in machine learning for biomedical time series **Fuzzy Systems: Concepts, Methodologies, Tools, and Applications** Management Association, Information Resources, 2017-02-22 There are a myriad of mathematical problems that cannot be solved using traditional methods The development of fuzzy expert systems has provided new

opportunities for problem solving amidst uncertainties Fuzzy Systems Concepts Methodologies Tools and Applications is a comprehensive reference source on the latest scholarly research and developments in fuzzy rule based methods and examines both theoretical foundations and real world utilization of these logic sets Featuring a range of extensive coverage across innovative topics such as fuzzy logic rule based systems and fuzzy analysis this is an essential publication for scientists doctors engineers physicians and researchers interested in emerging perspectives and uses of fuzzy systems in various sectors Applied Decision Support with Soft Computing Xinghuo Yu,2012-12-06

Soft computing has provided sophisticated methodologies for the development of intelligent decision support systems Fast advances in soft computing technologies such as fuzzy logic and systems artificial neural networks and evolutionary computation have made available powerful problem representation and modelling paradigms and learning and optimisation mechanisms for addressing modern decision making issues This book provides a comprehensive coverage of up to date conceptual frameworks in broadly perceived decision support systems and successful applications Different from other existing books this volume predominately focuses on applied decision support with soft computing Areas covered include planning management finance and administration in both the private and public sectors **World Congress on Medical Physics and Biomedical Engineering September 7 - 12, 2009 Munich, Germany** Olaf Dössel,Wolfgang C. Schlegel,2010-01-01

Present Your Research to the World The World Congress 2009 on Medical Physics and Biomedical Engineering the triennial scientific meeting of the IUPESM is the world s leading forum for presenting the results of current scientific work in health related physics and technologies to an international audience With more than 2 800 presentations it will be the biggest conference in the fields of Medical Physics and Biomedical Engineering in 2009 Medical physics biomedical engineering and bioengineering have been driving forces of innovation and progress in medicine and healthcare over the past two decades As new key technologies arise with significant potential to open new options in diagnostics and therapeutics it is a multidisciplinary task to evaluate their benefit for medicine and healthcare with respect to the quality of performance and therapeutic output Covering key aspects such as information and communication technologies micro and nanosystems optics and biotechnology the congress will serve as an inter and multidisciplinary platform that brings together people from basic research R D industry and medical application to discuss these issues As a major event for science medicine and technology the congress provides a comprehensive overview and in depth first hand information on new developments advanced technologies and current and future applications With this Final Program we would like to give you an overview of the dimension of the congress and invite you to join us in Munich Olaf Dössel Congress President Wolfgang C Advanced Methods of Biomedical Signal Processing Sergio Cerutti,Carlo Marchesi,2011-06-09 This book grew out of the IEEE EMBS Summer Schools on Biomedical Signal Processing which have been held annually since 2002 to provide the participants state of the art knowledge on emerging areas in biomedical engineering Prominent experts in the areas of biomedical signal processing biomedical data treatment medicine signal

processing system biology and applied physiology introduce novel techniques and algorithms as well as their clinical or physiological applications The book provides an overview of a compelling group of advanced biomedical signal processing techniques such as multisource and multiscale integration of information for physiology and clinical decision the impact of advanced methods of signal processing in cardiology and neurology the integration of signal processing methods with a modelling approach complexity measurement from biomedical signals higher order analysis in biomedical signals advanced methods of signal and data processing in genomics and proteomics and classification and parameter enhancement

Internet of Things enabled Machine Learning for Biomedical Applications Neha Goel,Ravindra Kumar Yadav,2024-11-29 The text begins by highlighting the benefits of the Internet of Things enabled machine learning in the healthcare sector examines the diagnosis of diseases using machine learning algorithms and analyzes security and privacy issues in the healthcare systems using the Internet of Things The text elaborates on image processing implementation for medical images to detect and classify diseases based on magnetic resonance imaging and ultrasound images This book Covers the procedure to recognize emotions using image processing and the Internet of Things enabled machine learning Highlights security and privacy issues in the healthcare system using the Internet of Things Discusses classification and implementation techniques of image segmentation Explains different algorithms of machine learning for image processing in a comprehensive manner Provides computational intelligence on the Internet of Things for future biomedical applications including lung cancer It is primarily written for graduate students and academic researchers in the fields of electrical engineering electronics and communications engineering computer science and engineering and biomedical engineering

4th Kuala Lumpur International Conference on Biomedical Engineering 2008 Noor Azuan Abu Osman,Prof. Ir. Dr Fatimah Ibrahim,Wan Abu Bakar Wan Abas,Herman Shah Abdul Rahman,Hua Nong Ting,2008-07-30 It is with great pleasure that we present to you a collection of over 200 high quality technical papers from more than 10 countries that were presented at the Biomed 2008 The papers cover almost every aspect of Biomedical Engineering from artificial intelligence to biomechanics from medical informatics to tissue engineering They also come from almost all parts of the globe from America to Europe from the Middle East to the Asia Pacific This set of papers presents to you the current research work being carried out in various disciplines of Biomedical Engineering including new and innovative researches in emerging areas As the organizers of Biomed 2008 we are very proud to be able to come up with this publication We owe the success to many individuals who worked very hard to achieve this members of the Technical Committee the Editors and the International Advisory Committee We would like to take this opportunity to record our thanks and appreciation to each and every one of them We are pretty sure that you will find many of the papers illuminating and useful for your own research and study We hope that you will enjoy yourselves going through them as much as we had enjoyed compiling them into the proceedings
Assoc Prof Dr Noor Azuan Abu Osman Chairperson Organising Committee Biomed 2008 *Computational Intelligence And*

Its Applications: Evolutionary Computation, Fuzzy Logic, Neural Network And Support Vector Machine Techniques Hung Tan Nguyen, Steve Sai Ho Ling, Hak-keung Lam, 2012-07-17 This book focuses on computational intelligence techniques and their applications fast growing and promising research topics that have drawn a great deal of attention from researchers over the years It brings together many different aspects of the current research on intelligence technologies such as neural networks support vector machines fuzzy logic and evolutionary computation and covers a wide range of applications from pattern recognition and system modeling to intelligent control problems and biomedical applications Fundamental concepts and essential analysis of various computational techniques are presented to offer a systematic and effective tool for better treatment of different applications and simulation and experimental results are included to illustrate the design procedure and the effectiveness of the approaches a

Fuzzy Logic in Medicine Senen Barro, Roque Marin, 2013-03-20 To say that Fuzzy Logic in Medicine or FLM for short is an important addition to the literature of fuzzy logic and its applications is an understatement Edited by two prominent informaticians Professors S Barro and R Marin it is one of the first books in its field Between its covers FLM presents authoritative expositions of a wide spectrum of medical and biological applications of fuzzy logic ranging from image classification and diagnostics to anaesthesia control and risk assessment of heart diseases As the editors note in the preface recognition of the relevance of fuzzy set theory and fuzzy logic to biological and medical systems has a long history In this context particularly worthy of note is the pioneering work of Professor Klaus Peter Adlassnig of the University of Vienna School of Medicine However it is only within the past decade that we began to see an accelerating growth in the visibility and importance of publications falling under the rubric of fuzzy logic in medicine and biology a leading example of which is the Journal of the Biomedical Fuzzy Systems Association in Japan Why did it take so long for this to happen First a bit of history

Soft Computing in Human-Related Sciences Horia-Nicolai L Teodorescu, Abraham Kandel, Lakhmi C. Jain, 1999-04-29 Hard boundaries have traditionally existed between such fields as fuzzy systems neural networks genetic algorithms chaotic systems and expert systems Gradually those boundaries are tending to vanish and soft computing based systems that mix these different approaches have begun to emerge Soft Computing Techniques in Human Related Sciences focuses on the use of novel techniques such as artificial neural networks fuzzy logic and genetic algorithms to solve practical problems related to humans their activities health and social needs This volume illustrates and presents in an organized manner some of the recent progress in the applications of soft computing to fields related to social science medical science psychology psychiatry management of health and community services and humanoid robots Soft Computing Techniques in Human Related Sciences begins with an introductory chapter to aid newcomers with the basic concepts and progresses to the methodology of the use of soft computing in robotics prosthetics medicine psychology and man machine interaction

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