

# PLAUSIBLE NEURAL NETWORKS FOR BIOLOGICAL MODELLING

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Received 10 October 1997; accepted 10 October 1997

Published online 10 October 1997

© 1998 John Wiley & Sons, Inc.

*J. Neurobiol.* 31: 1–10, 1998. DOI: 10.1002/neuro.4890310101

**Abstract:** The use of artificial neural networks (ANNs) for biological modelling is becoming increasingly popular. However, the use of ANNs in biological modelling is often limited by the lack of biological plausibility. In this paper, we discuss the use of plausible ANNs for biological modelling. We first discuss the concept of biological plausibility and then describe the use of plausible ANNs for biological modelling. Finally, we discuss the advantages and disadvantages of plausible ANNs for biological modelling.

**Keywords:** artificial neural networks; biological modelling; plausible ANNs

**Introduction**

Artificial neural networks (ANNs) have been used for a wide range of biological modelling tasks. However, the use of ANNs in biological modelling is often limited by the lack of biological plausibility. In this paper, we discuss the use of plausible ANNs for biological modelling. We first discuss the concept of biological plausibility and then describe the use of plausible ANNs for biological modelling. Finally, we discuss the advantages and disadvantages of plausible ANNs for biological modelling.

**Keywords:** artificial neural networks; biological modelling; plausible ANNs

# Plausible Neural Networks For Biological Modelling

**Minho Lee,Akira Hirose,Zeng-Guang  
Hou,Rhee Man Kil**



## **Plausible Neural Networks For Biological Modelling:**

Plausible Neural Networks for Biological Modelling H.A. Mastebroek, J.E. Vos, 2012-12-06 The expression Neural Networks refers traditionally to a class of mathematical algorithms that obtain their proper performance while they learn from examples or from experience As a consequence they are suitable for performing straightforward and relatively simple tasks like classification pattern recognition and prediction as well as more sophisticated tasks like the processing of temporal sequences and the context dependent processing of complex problems Also a wide variety of control tasks can be executed by them and the suggestion is relatively obvious that neural networks perform adequately in such cases because they are thought to mimic the biological nervous system which is also devoted to such tasks As we shall see this suggestion is false but does not do any harm as long as it is only the final performance of the algorithm which counts Neural networks are also used in the modelling of the functioning of sub systems in the biological nervous system It will be clear that in such cases it is certainly not irrelevant how similar their algorithm is to what is precisely going on in the nervous system Standard artificial neural networks are constructed from units roughly similar to neurons that transmit their activity similar to membrane potentials or to mean firing rates to other units via weight factors similar to synaptic coupling efficacies **Time-Space,**

**Spiking Neural Networks and Brain-Inspired Artificial Intelligence** Nikola K. Kasabov, 2018-08-29 Spiking neural networks SNN are biologically inspired computational models that represent and process information internally as trains of spikes This monograph book presents the classical theory and applications of SNN including original author's contribution to the area The book introduces for the first time not only deep learning and deep knowledge representation in the human brain and in brain inspired SNN but takes that further to develop new types of AI systems called in the book brain inspired AI BI AI BI AI systems are illustrated on cognitive brain data including EEG fMRI and DTI audio visual data brain computer interfaces personalized modelling in bio neuroinformatics multisensory streaming data modelling in finance environment and ecology data compression neuromorphic hardware implementation Future directions such as the integration of multiple modalities such as quantum molecular and brain information processing is presented in the last chapter The book is a research book for postgraduate students researchers and practitioners across wider areas including computer and information sciences engineering applied mathematics bio and neurosciences The Handbook of Brain Theory and Neural Networks Michael A.

Arbib, 2003 This second edition presents the enormous progress made in recent years in the many subfields related to the two great questions how does the brain work and How can we build intelligent machines This second edition greatly increases the coverage of models of fundamental neurobiology cognitive neuroscience and neural network approaches to language Midwest Advances in Neuro-Information Processing Mario Köppen, Nikola Kasabov, George Coghill, 2009-07-10 The two volume set LNCS 5506 and LNCS 5507 constitutes the thoroughly refereed post conference proceedings of the 15th International Conference on Neural Information Processing ICONIP 2008 held in Auckland New Zealand in November 2008

The 260 revised full papers presented were carefully reviewed and selected from numerous ordinary paper submissions and 15 special organized sessions 116 papers are published in the first volume and 112 in the second volume The contributions deal with topics in the areas of data mining methods for cybersecurity computational models and their applications to machine learning and pattern recognition lifelong incremental learning for intelligent systems application of intelligent methods in ecological informatics pattern recognition from real world information by svm and other sophisticated techniques dynamics of neural networks recent advances in brain inspired technologies for robotics neural information processing in cooperative multi robot systems

Spatiotemporal Models in Biological and Artificial Systems Fernando L. Silva, José C. Príncipe, Luis B. Almeida, 1997 Spatiotemporal models are emerging as a very important topic in several disciplines including neurobiology and artificial neural networks Many hard problems exist in this area Examples include understanding the capabilities of nonlinear dynamical systems on a lattice and of networks of spiking neurons both natural and artificial training such systems implementing them in hardware understanding biological signals like the EEG etc Besides the state of the art in the area of spatiotemporal models the book also covers the neurobiological and the artificial systems communities

Neural Information Processing Minhoo Lee, Akira Hirose, Zeng-Guang Hou, Rhee Man Kil, 2013-10-29 The three volume set LNCS 8226 LNCS 8227 and LNCS 8228 constitutes the proceedings of the 20th International Conference on Neural Information Processing ICONIP 2013 held in Daegu Korea in November 2013 The 180 full and 75 poster papers presented together with 4 extended abstracts were carefully reviewed and selected from numerous submissions These papers cover all major topics of theoretical research empirical study and applications of neural information processing research The specific topics covered are as follows cognitive science and artificial intelligence learning theory algorithms and architectures computational neuroscience and brain imaging vision speech and signal processing control robotics and hardware technologies and novel approaches and applications

*Intelligent Distributed Computing XII* Javier Del Ser, Eneko Osaba, Miren Nekane Bilbao, Javier J. Sanchez-Medina, Massimo Vecchio, Xin-She Yang, 2018-09-14 This book gathers a wealth of research contributions on recent advances in intelligent and distributed computing and which present both architectural and algorithmic findings in these fields A major focus is placed on new techniques and applications for evolutionary computation swarm intelligence multi agent systems multi criteria optimization and Deep Shallow machine learning models all of which are approached as technological drivers to enable autonomous reasoning and decision making in complex distributed environments Part of the book is also devoted to new scheduling and resource allocation methods for distributed computing systems The book represents the peer reviewed proceedings of the 12th International Symposium on Intelligent Distributed Computing IDC 2018 which was held in Bilbao Spain from October 15 to 17 2018

**Neuromorphic Computing Systems for Industry 4.0** Dhanasekar, S., Sagayam, K. Martin, Vijh, Surbhi, Tyagi, Vipin, Norta, Alex, 2023-07-19 As artificial intelligence AI processing moves from the cloud to the edge of the network battery powered and deeply embedded devices

are challenged to perform AI functions such as computer vision and voice recognition Microchip Technology Inc via its Silicon Storage Technology SST subsidiary is addressing this challenge by significantly reducing power with its analog memory technology the memBrain Memory Solution The memBrain solution is being adopted by today's companies looking to advance machine learning capacities in edge devices Due to its ability to significantly reduce power this analog in memory computer solution is ideal for an AI application Neuromorphic Computing Systems for Industry 4.0 covers the available literature in the field of neural computing based microchip technology It provides further research opportunities in this dynamic field Covering topics such as emotion recognition biometric authentication and neural network protection this premier reference source is an essential resource for technology developers computer scientists engineers students and educators of higher education librarians researchers and academicians

**Emergent Neural Computational Architectures Based on Neuroscience** Stefan Wermter, Jim Austin, David Willshaw, 2003-05-15 It is generally understood that the present approaches to computing do not have the performance flexibility and reliability of biological information processing systems Although there is a comprehensive body of knowledge regarding how information processing occurs in the brain and central nervous system this has had little impact on mainstream computing so far This book presents a broad spectrum of current research into biologically inspired computational systems and thus contributes towards developing new computational approaches based on neuroscience The 39 revised full papers by leading researchers were carefully selected and reviewed for inclusion in this anthology Besides an introductory overview by the volume editors the book offers topical parts on modular organization and robustness timing and synchronization and learning and memory storage

**Advances in Machine Learning II** Jacek Koronacki, Zbigniew W. Ras, Slawomir T. Wierzchon, 2009-12-24 This is the second volume of a large two volume editorial project we wish to dedicate to the memory of the late Professor Ryszard S Michalski who passed away in 2007 He was one of the fathers of machine learning an exciting and relevant both from the practical and theoretical points of view area in modern computer science and information technology His research career started in the mid 1960s in Poland in the Institute of Automation Polish Academy of Sciences in Warsaw Poland He left for the USA in 1970 and since then had worked there at various universities notably at the University of Illinois at Urbana Champaign and finally until his untimely death at George Mason University We the editors had been lucky to be able to meet and collaborate with Ryszard for years indeed some of us knew him when he was still in Poland After he started working in the USA he was a frequent visitor to Poland taking part at many conferences until his death We had also witnessed with a great personal pleasure honors and awards he had received over the years notably when some years ago he was elected Foreign Member of the Polish Academy of Sciences among some top scientists and scholars from all over the world including Nobel prize winners Professor Michalski's research results influenced very strongly the development of machine learning data mining and related areas Also he inspired many established and younger scholars and scientists all over the world We feel very happy that so

many top scientists from all over the world agreed to pay the last tribute to Professor Michalski by writing papers in their areas of research. These papers will constitute the most appropriate tribute to Professor Michalski, a devoted scholar and researcher. Moreover, we believe that they will inspire many newcomers and younger researchers in the area of broadly perceived machine learning, data analysis, and data mining. The papers included in the two volumes *Machine Learning I* and *Machine Learning II* cover diverse topics and various aspects of the fields involved. For convenience of the potential readers, we will now briefly summarize the contents of the particular chapters.

***Artificial Neural Networks in Pattern Recognition*** Nadia Mana, Friedhelm Schwenker, Edmondo Trentin, 2012-09-11. This book constitutes the refereed proceedings of the 5th INNS IAPR TC3 GIRPR International Workshop on Artificial Neural Networks in Pattern Recognition ANNPR 2012 held in Trento, Italy, in September 2012. The 21 revised full papers presented were carefully reviewed and selected for inclusion in this volume. They cover a large range of topics in the field of neural network and machine learning based pattern recognition, presenting and discussing the latest research results and ideas in these areas.

***Advances in Computational Intelligence*** Jing Liu, Cesare Alippi, Bernadette Bouchon-Meunier, Garrison W. Greenwood, Hussein A. Abbass, 2012-07-06. This state-of-the-art survey offers a renewed and refreshing focus on the progress in evolutionary computation in neural networks and in fuzzy systems. The book presents the expertise and experiences of leading researchers spanning a diverse spectrum of computational intelligence in these areas. The result is a balanced contribution to the research area of computational intelligence that should serve the community not only as a survey and a reference but also as an inspiration for the future advancement of the state-of-the-art of the field. The 13 selected chapters originate from lectures and presentations given at the IEEE World Congress on Computational Intelligence WCCI 2012 held in Brisbane, Australia, in June 2012.

***Artificial Neural Networks as Models of Neural Information Processing*** Marcel van Gerven, Sander Bohte, 2018-02-01. Modern neural networks gave rise to major breakthroughs in several research areas. In neuroscience, we are witnessing a reappraisal of neural network theory and its relevance for understanding information processing in biological systems. The research presented in this book provides various perspectives on the use of artificial neural networks as models of neural information processing. We consider the biological plausibility of neural networks performance improvements, spiking neural networks, and the use of neural networks for understanding brain function.

***Emergence Of Dynamical Order: Synchronization Phenomena In Complex Systems*** Susanna C Manrubia, Alexander S Mikhailov, Damian H Zanette, 2004-04-14. Synchronization processes bring about dynamical order and lead to spontaneous development of structural organization in complex systems of various origins, from chemical oscillators and biological cells to human societies and the brain. This book provides a review and a detailed theoretical analysis of synchronization phenomena in complex systems with different architectures composed of elements with periodic or chaotic individual dynamics. Special attention is paid to statistical concepts such as nonequilibrium phase transitions, order parameters, and dynamical glasses.

**From**

**Cells to Societies** Alexander S. Mikhailov, Vera Calenbuhr, 2002-08-07 Using simple models this book shows how we can gain insights into the behavior of complex systems It is devoted to the discussion of functional self organization in large populations of interacting active elements The authors have chosen a series of models from physics biochemistry biology sociology and economics and systematically discuss their general properties The book addresses researchers and graduate students in a variety of disciplines

**Neuro-inspired Computing for Next-gen AI: Computing Model, Architectures and Learning Algorithms** Angeliki Pantazi, Emre O. Neftci, Bipin Rajendran, Osvaldo Simeone, 2022-08-29 Artificial Intelligence and Soft Computing Leszek Rutkowski, Marcin Korytkowski, Rafal Scherer, Ryszard Tadeusiewicz, Lotfi A. Zadeh, Jacek M. Zurada, 2013-06-04 The two volume set LNAI 7894 and LNCS 7895 constitutes the refereed proceedings of the 12th International Conference on Artificial Intelligence and Soft Computing ICAISC 2013 held in Zakopane Poland in June 2013 The 112 revised full papers presented together with one invited paper were carefully reviewed and selected from 274 submissions The 57 papers included in the first volume are organized in the following topical sections neural networks and their applications fuzzy systems and their applications pattern classification and computer vision image and speech analysis

Paul Churchland Brian L. Keeley, 2006 Offers an introduction to Churchland's work alongside a critique of his most famous philosophical positions

**Transcranial Magnetic and Electrical Brain Stimulation for Neurological Disorders** Bahman Zohuri, Patrick J. McDaniel, 2022-08-20 Transcranial Magnetic and Electrical Brain Stimulation for Neurological Disorders examines the non invasive application of electrical stimulation of the brain to treat neurological disorders and to enhance individual group performance This volume discusses emerging electro technologies such as transcranial direct current alternating current electric fields and pulsed magnetic fields to treat many of these common medical problems Chapters begin by examining foundations of electromagnetic theory and wave equations that underly these technologies before discussing methods to treat disorders the impact of technology and mental health and artificial intelligence Discussing over 40 neurological diseases this book presents coverage of techniques to treat stroke epilepsy Alzheimer's Disease Parkinson's Disease Huntington's Disease depression schizophrenia and many other diseases of the nervous system Compares techniques so users can select ideal methods for their experiment Provides a focused tutorial introduction to core diseases of the nervous system including stroke epilepsy Alzheimer's Parkinson's head and spinal cord trauma schizophrenia and more Covers more than 40 diseases from foundational science to the best treatment protocols Includes discussions of translational research drug discovery personalized medicine ethics and neuroscience Provides walk through boxes that guide students step by step through the experiment

**The Future of the Artificial Mind** Alessio Plebe, Pietro Perconti, 2022-06-08 The Future of the Artificial Mind is about the social and technological challenges posed by the new wave of artificial intelligence both from a technical and a cognitive perspective Deep neural networks have brought about tremendous technological improvements This renaissance in artificial intelligence after decades of stagnation has

enabled new technologies capable of surpassing human performance as in the case of visual recognition The book reviews the key ideas that have enabled these goals to be achieved and their historical origins The book also considers some of the ethical and social challenges that the future development of artificial intelligence will face Will humans fall in love with future android dolls What will artificial sex be like And what will it be like to travel in cars that will treat us as passengers instead of drivers But predicting the future appears more magic than science But when it comes to artificial intelligence it is a constant temptation Since it is well known that the only way to get rid of a temptation is to enjoy it the hypothesis considered in the last chapter is that emerging trends point to a near future in which intelligence will be ubiquitous but it will be difficult to identify its bearer We may be heading towards an era of widespread intelligence but an intelligence without accountability



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