

Igor Aizenberg

**Complex-Valued
Neural Networks with
Multi-Valued Neurons**

Complex Valued Neural Networks With Multi Valued Neurons

Akira Hirose



Complex Valued Neural Networks With Multi Valued Neurons:

Complex-Valued Neural Networks with Multi-Valued Neurons Igor Aizenberg,2011-07-20 *Complex-Valued Neural Networks with Multi-Valued Neurons* Igor Aizenberg,2011-06-24 Complex Valued Neural Networks have higher functionality learn faster and generalize better than their real valued counterparts This book is devoted to the Multi Valued Neuron MVN and MVN based neural networks It contains a comprehensive observation of MVN theory its learning and applications MVN is a complex valued neuron whose inputs and output are located on the unit circle Its activation function is a function only of argument phase of the weighted sum MVN derivative free learning is based on the error correction rule A single MVN can learn those input output mappings that are non linearly separable in the real domain Such classical non linearly separable problems as XOR and Parity n are the simplest that can be learned by a single MVN Another important advantage of MVN is a proper treatment of the phase information These properties of MVN become even more remarkable when this neuron is used as a basic one in neural networks The Multilayer Neural Network based on Multi Valued Neurons MLMVN is an MVN based feedforward neural network Its backpropagation learning algorithm is derivative free and based on the error correction rule It does not suffer from the local minima phenomenon MLMVN outperforms many other machine learning techniques in terms of learning speed network complexity and generalization capability when solving both benchmark and real world classification and prediction problems Another interesting application of MVN is its use as a basic neuron in multi state associative memories The book is addressed to those readers who develop theoretical fundamentals of neural networks and use neural networks for solving various real world problems It should also be very suitable for Ph D and graduate students pursuing their degrees in computational intelligence [Claudio Moraga: A Passion for Multi-Valued Logic and Soft Computing](#) Rudolf Seising,Héctor Allende-Cid,2016-10-20 The book is an authoritative collection of contributions by leading experts on the topics of fuzzy logic multi valued logic and neural network Originally written as an homage to Claudio Moraga seen by his colleagues as an example of concentration discipline and passion for science the book also represents a timely reference guide for advance students and researchers in the field of soft computing and multiple valued logic *Artificial Intelligence and Soft Computing, Part II* Leszek Rutkowski,Rafał Scherer,Ryszard Tadeusiewicz,Lotfi A. Zadeh,Jacek M. Zurada,2010-06 This volume constitutes the proceedings of the 10th International Conference on Artificial Intelligence and Soft Computing ICAISC 2010 held in Zakopane Poland in June 13 17 2010 The articles are organized in topical sections on Fuzzy Systems and Their Applications Data Mining Classification and Forecasting Image and Speech Analysis Bioinformatics and Medical Applications Volume 6113 together with Neural Networks and Their Applications Evolutionary Algorithms and Their Applications Agent System Robotics and Control Various Problems aof Artificial Intelligence Volume 6114 **Advances in Knowledge Discovery and Data Mining** Hisashi Kashima,Tsuyoshi Ide,Wen-Chih Peng,2023-05-26 The 4 volume set LNAI 13935 13938 constitutes the proceedings of the 27th Pacific Asia

Conference on Knowledge Discovery and Data Mining PAKDD 2023 which took place in Osaka Japan during May 25 28 2023 The 143 papers presented in these proceedings were carefully reviewed and selected from 813 submissions They deal with new ideas original research results and practical development experiences from all KDD related areas including data mining data warehousing machine learning artificial intelligence databases statistics knowledge engineering big data technologies and foundations

Advances in Intelligent and Distributed Computing Costin Badica, Marcin Paprzycki, 2010-04-25 This book presents the proceedings of the 1st International Symposium on Intelligent and Distributed Computing IDC 2007 held in Craiova Romania October 2007 Coverage includes autonomous and adaptive computing data mining and knowledge discovery distributed problem solving and decision making e business e health and e learning genetic algorithms image processing information retrieval intelligence in mobile and ubiquitous computing

Complex-Valued Neural Networks Akira Hirose, 2013-05-08 Presents the latest advances in complex valued neural networks by demonstrating the theory in a wide range of applications Complex valued neural networks is a rapidly developing neural network framework that utilizes complex arithmetic exhibiting specific characteristics in its learning self organizing and processing dynamics They are highly suitable for processing complex amplitude composed of amplitude and phase which is one of the core concepts in physical systems to deal with electromagnetic light sonic ultrasonic waves as well as quantum waves namely electron and superconducting waves This fact is a critical advantage in practical applications in diverse fields of engineering where signals are routinely analyzed and processed in time space frequency and phase domains *Complex Valued Neural Networks Advances and Applications* covers cutting edge topics and applications surrounding this timely subject Demonstrating advanced theories with a wide range of applications including communication systems image processing systems and brain computer interfaces this text offers comprehensive coverage of Conventional complex valued neural networks Quaternionic neural networks Clifford algebraic neural networks Presented by international experts in the field *Complex Valued Neural Networks Advances and Applications* is ideal for advanced level computational intelligence theorists electromagnetic theorists and mathematicians interested in computational intelligence artificial intelligence machine learning theories and algorithms

Complex-valued Neural Networks Akira Hirose, 2003 In recent years complex valued neural networks have widened the scope of application in optoelectronics imaging remote sensing quantum neural devices and systems spatiotemporal analysis of physiological neural systems and artificial neural information processing In this first ever book on complex valued neural networks the most active scientists at the forefront of the field describe theories and applications from various points of view to provide academic and industrial researchers with a comprehensive understanding of the fundamentals features and prospects of the powerful complex valued networks

Complex-Valued Neural Networks Akira Hirose, 2012-03-22 This book is the second enlarged and revised edition of the first successful monograph on complex valued neural networks CVNNs published in 2006 which lends itself to graduate and undergraduate courses in electrical

engineering informatics control engineering mechanics robotics bioengineering and other relevant fields In the second edition the recent trends in CVNNs research are included resulting in e g almost a doubled number of references The parametron invented in 1954 is also referred to with discussion on analogy and disparity Also various additional arguments on the advantages of the complex valued neural networks enhancing the difference to real valued neural networks are given in various sections The book is useful for those beginning their studies for instance in adaptive signal processing for highly functional sensing and imaging control in unknown and changing environment robotics inspired by human neural systems and brain like information processing as well as interdisciplinary studies to realize comfortable society It is also helpful to those who carry out research and development regarding new products and services at companies The author wrote this book hoping in particular that it provides the readers with meaningful hints to make good use of neural networks in fully practical applications The book emphasizes basic ideas and ways of thinking Why do we need to consider neural networks that deal with complex numbers What advantages do the complex valued neural networks have What is the origin of the advantages In what areas do they develop principal applications This book answers these questions by describing details and examples which will inspire the readers with new ideas The book is useful for those beginning their studies for instance in adaptive signal processing for highly functional sensing and imaging control in unknown and changing environment robotics inspired by human neural systems and brain like information processing as well as interdisciplinary studies to realize comfortable society It is also helpful to those who carry out research and development regarding new products and services at companies The author wrote this book hoping in particular that it provides the readers with meaningful hints to make good use of neural networks in fully practical applications The book emphasizes basic ideas and ways of thinking Why do we need to consider neural networks that deal with complex numbers What advantages do the complex valued neural networks have What is the origin of the advantages In what areas do they develop principal applications This book answers these questions by describing details and examples which will inspire the readers with new ideas

MELECON '98, 9th Mediterranean Electrotechnical Conference ,1998 Proceedings of MELECON ,1998 **Computational Intelligence** ,2001

Applications of Artificial Neural Networks in Image Processing ,2001 **Encyclopedia of Artificial Intelligence** ,2009-01-01 This book is a comprehensive and in depth reference to the most recent developments in the field covering theoretical developments techniques technologies among others Provided by publisher Second International Workshop on Cellular Neural Networks and Their Applications ,1992 ,1992 *Knowledge-based Intelligent Information Engineering Systems and Allied Technologies* Ernesto Damiani,2002 Annotation The book contains the Proceedings of KES 2002 the Sixth Edition of the Knowledge Based Intelligent Information Engineering Systems International Conference The conference papers presented new research results focusing on three main areas of interest Generic Intelligent Techniques This area includes results on basic disciplines underlying knowledge based and intelligent systems such as artificial neural networks

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Proceedings ,1996 **Neural Networks in Multidimensional Domains** Paolo Arena,1998-04-28 In this monograph new structures of neural networks in multidimensional domains are introduced These architectures are a generalization of the Multi layer Perceptron MLP in Complex Vectorial and Hypercomplex algebra The approximation capabilities of these networks and their learning algorithms are discussed in a multidimensional context The work includes the theoretical basis to address the properties of such structures and the advantages introduced in system modelling function approximation and control Some applications referring to attractive themes in system engineering and a MATLAB software tool are also reported The appropriate background for this text is a knowledge of neural networks fundamentals The manuscript is intended as a research report but a great effort has been performed to make the subject comprehensible to graduate students in computer engineering control engineering computer sciences and related disciplines

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