

J. C. Rajapakse, L. Wang (Eds.)

Neural Information Processing: Research and Development

Springer

Berlin

Heidelberg

New York

Hong Kong

London

Milano

Paris

Tokyo

Studies in Fuzziness and Soft Computing, Volume 152

Editor-in-chief

Prof. Janusz Kacprzyk
Systems Research Institute
Polish Academy of Sciences
ul. Newelska 6
01-447 Warsaw
Poland
E-mail: kacprzyk@ibspan.waw.pl

Further volumes of this series
can be found on our homepage:
springeronline.com

Vol. 133. Z.-Q. Liu, J. Cai, R. Buse
Handwriting Recognition, 2003
ISBN 3-540-40177-6

Vol. 134. V.A. Niskanen
Soft Computing Methods in Human Sciences, 2004
ISBN 3-540-00466-1

Vol. 135. J.J. Buckley
Fuzzy Probabilities and Fuzzy Sets for Web Planning, 2004
ISBN 3-540-00473-4

Vol. 136. L. Wang (Ed.)
Soft Computing in Communications, 2004
ISBN 3-540-40575-5

Vol. 137. V. Loia, M. Nikravesh, L.A. Zadeh (Eds.)
Fuzzy Logic and the Internet, 2004
ISBN 3-540-20180-7

Vol. 138. S. Sirmakessis (Ed.)
Text Mining and its Applications, 2004
ISBN 3-540-20238-2

Vol. 139. M. Nikravesh, B. Azvine, I. Yager, L.A. Zadeh (Eds.)
Enhancing the Power of the Internet, 2004
ISBN 3-540-20237-4

Vol. 140. A. Abraham, L.C. Jain, B.J. van der Zwaag (Eds.)
Innovations in Intelligent Systems, 2004
ISBN 3-540-20265-X

Vol. 141. G.C. Onwubolu, B.V. Babu
New Optimization Techniques in Engineering, 2004
ISBN 3-540-20167-X

Vol. 142. M. Nikravesh, L.A. Zadeh, V. Korotkikh (Eds.)
Fuzzy Partial Differential Equations and Relational Equations, 2004
ISBN 3-540-20322-2

Vol. 143. L. Rutkowski
New Soft Computing Techniques for System Modelling, Pattern Classification and Image Processing, 2004
ISBN 3-540-20584-5

Vol. 144. Z. Sun, G.R. Finnie
Intelligent Techniques in E-Commerce, 2004
ISBN 3-540-20518-7

Vol. 145. J. Gil-Aluja
Fuzzy Sets in the Management of Uncertainty, 2004
ISBN 3-540-20341-9

Vol. 146. J.A. Gámez, S. Moral, A. Salmerón (Eds.)
Advances in Bayesian Networks, 2004
ISBN 3-540-20876-3

Vol. 147. K. Watanabe, M.M.A. Hashem
New Algorithms and their Applications to Evolutionary Robots, 2004
ISBN 3-540-20901-8

Vol. 148. C. Martin-Vide, V. Mitrana, G. Păun (Eds.)
Formal Languages and Applications, 2004
ISBN 3-540-20907-7

Vol. 149. J.J. Buckley
Fuzzy Statistics, 2004
ISBN 3-540-21084-9

Vol. 150. L. Bull (Ed.)
Applications of Learning Classifier Systems, 2004
ISBN 3-540-21109-8

Vol. 151. T. Kowalczyk, E. Pleszczyńska, F. Ruland (Eds.)
Grade Models and Methods for Data Analysis, 2004
ISBN 3-540-21120-9

Jagath Chandana Rajapakse
Lipo Wang (Eds.)

Neural Information Processing: Research and Development



Springer

Prof. Dr. Jagath Chandana Rajapakse
Prof. Dr. Lipo Wang
Nanyang Technological University
School of Computer Engineering
Nanyang Avenue
639798 Singapore
Singapore
E-mail: elpwang@ntu.edu.sg

ISSN 1434-9922

ISBN 978-3-642-53564-2

ISBN 978-3-540-39935-3 (eBook)

DOI 10.1007/978-3-540-39935-3

Library of Congress Cataloging-in-Publication-Data

Neural information processing : research and development /

Jagath Chandana Rajapakse, Lipo Wang (eds).

p. cm. -- (Studies in fuzziness and soft computing, ISSN 1434-9922 ; v. 152)

Includes bibliographical references and index.

ISBN 978-3-642-53564-2

I. Neural networks (Computer science) I. Rajapakse, Jagath Chandana. II. Wang, Lipo.

III. Series

QA76.87.N4745 2004

006.3'2--dc22

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitations, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable to prosecution under the German Copyright Law.

Springer-Verlag is a part of Springer Science+Business Media
springeronline.com

© Springer-Verlag Berlin Heidelberg 2004

Softcover reprint of the hardcover 1st edition 2004

The use of general descriptive names, registered names trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Typesetting: camera-ready by editors

Cover design: E. Kirchner, Springer-Verlag, Heidelberg

Printed on acid free paper

62/3020/M - 5 4 3 2 1 0

Preface

The field of neural information processing has two main objects: investigation into the functioning of biological neural networks and use of artificial neural networks to solve real world problems. Even before the reincarnation of the field of artificial neural networks in mid nineteen eighties, researchers have attempted to explore the engineering of human brain function. After the reincarnation, we have seen an emergence of a large number of neural network models and their successful applications to solve real world problems.

This volume presents a collection of recent research and developments in the field of neural information processing. The book is organized in three Parts, i.e., (1) architectures, (2) learning algorithms, and (3) applications.

Artificial neural networks consist of simple processing elements called neurons, which are connected by weights. The number of neurons and how they are connected to each other defines the architecture of a particular neural network. Part 1 of the book has nine chapters, demonstrating some of recent neural network architectures derived either to mimic aspects of human brain function or applied in some real world problems.

Muresan provides a simple neural network model, based on spiking neurons that make use of shunting inhibition, which is capable of resisting small scale changes of stimulus. Hoshino and Zheng simulate a neural network of the auditory cortex to investigate neural basis for encoding and perception of vowel sounds. Masakazu, Mori, and Mitarai propose a convolutional spiking neural network model with population coding for robust object recognition. Kharlamov and Raevsky formulate a class of neural network, using neurobiologically feasible multilevel information processing premises, that realizes the temporal summation of signals. Kitano and Fukai introduce a computational neural model to investigate the underlying mechanism of synchrony of neurons in the primary motor cortex to improve the predictive power.

Huang, King, Lyu, and Yang present a novel approach to construct a kind of tree belief network, which improves the approximation accuracy and recognition rate. Chiewchanwattana, Lursinsap, and Chu present an architecture capable of time-series forecasting by using a selective ensemble neural network. Miyajima, Shigei, and Kiriki propose a higher-order multi-directional associative memory with an energy function, which has an increased memory capacity and higher ability for error correcting. Maire, Bader, and Wathne describe a new indexing tree system for high dimensional codebook vectors, by using a dynamic binary search tree with a fat decision hyperplanes.

Neural networks are large parametric models where parameters are stored as

weights of connections. Part 2 of this book investigates the recent developments in learning algorithms in seven chapters on adapting weights of neural networks.

Roy attempts to define some external characteristics of brain-like learning and investigate some logical flows of connectionism. Geczy and Usui establish a classification framework with superlinear learning algorithm to permit independent specification of functions and optimization techniques. Chaudhari and Tiwari investigate some approaches for adapting binary neural networks for multi-class classification problem. Ozawa and Abe present a memory-based reinforcement learning algorithm to prevent unlearning of weights. Takahama, Sakai, and Isomichi propose a genetic algorithm with degeneration to solve the difficulties by optimizing structures of neural networks. Wanas and Kamel present an algorithm to independently train the members of an ensemble classifier. Verma and Ghosh present a learning algorithm, by using different combination strategies, to find the optimal neural network architecture and weights.

Artificial neural networks and learning algorithms are increasingly being applied today to solve real world problems. Part 3 of this book contains nine chapters, each describing a recent application of artificial neural networks.

Neskovic, Schuster and Cooper use a neural network for the detection of cars from real-time video streams. Yang, King, Chan, and Huang uses non-fixed and asymmetrical margin setting with momentum in support vector regression for financial time-series prediction. Hu and Hirasawa present a neural network for control of non-linear systems. And Ricalde, Sanchez, and Perez provide an application of recurrent neural network for control of a robot manipulator. Ishikawa presents gesture recognition technique based on self-organizing feature maps (SOMs) using multiple sensors. Hussin, Bakus and Kamel present a technique based on SOMs for phase-based document clustering. Kasabov and Dimitrov discover gene regulatory networks from gene expression data with the use of evolving connectionist systems. Harati and Ahmadabadi use neural networks to solve the multi-agent credit assignment problem. Kim, Lee, Shin, and Yang present an implementation of visual tracking system using an artificial retina chip and a shape memory alloy actuator.

We would like to sincerely thank all authors who have spent time and effort to make important contributions to this book. Our gratitude also goes to Professor Janusz Kacprzyk and Dr. Thomas Ditzinger for their most kind support and help for this book.

Jagath C. Rajapakse
Lipo Wang

Contents

Part 1: Architectures

Scale Independence in the Visual System	1
<i>Raul C. Muresan</i>	
Dynamic Neuronal Information Processing of Vowel Sounds in Auditory Cortex	19
<i>Osamu Hoshino and Meihong Zheng</i>	
Convolutional Spiking Neural Network for Robust Object Detection with Population Code using Structured Pulse Packets.....	39
<i>Masakazu Matsugu, Katsuhiko Mori, and Yusuke Mitarai</i>	
Networks Constructed of Neuroid Elements Capable of Temporal Summation of Signals	56
<i>Alexander A. Kharlamov and Vladimir V. Raevsky</i>	
Predictive Synchrony Organized by Spike-Based Hebbian Learning with Time-Representing Synfire Activities	77
<i>Katsunori Kitano and Tomoki Fukai</i>	
Improving Chow-Liu Tree Performance by Mining Association Rules	94
<i>Kaizhu Huang, Irwin King, Michael R. Lyu, and Haiqin Yang</i>	
A Reconstructed Missing Data-Finite Impulse Response Selective Ensemble (RMD-FSE) Network.....	113
<i>Sirapat Chiewchanwattana, Chidchanok Lursinsap, and Chee-Hung Henry Chu</i>	
Higher Order Multidirectional Associative Memory with Decreasing Energy Function.....	128
<i>Hiromi Miyajima, Noritaka Shigei, and Nobuaki Kiriki</i>	
Fast Indexing of Codebook Vectors Using Dynamic Binary Search Trees with Fat Decision Hyperplanes	150
<i>Frederic Maire, Sebastian Bader, and Frank Wathne</i>	

Part 2: Learning Algorithms

On Some External Characteristics of Brain-like Learning and Some Logical Flaws of Connectionism	167
<i>Asim Roy</i>	
Superlinear Learning Algorithm Design.....	180
<i>Peter Geczy and Shiro Usui</i>	
Extension of Binary Neural Networks for Multi-class Output and Finite Automata	211
<i>Narendra S. Chaudhari and Aruna Tiwari</i>	
A Memory-Based Reinforcement Learning Algorithm to Prevent Unlearning in Neural Networks	238
<i>Seiichi Ozawa and Shigeo Abe</i>	
Structural Optimization of Neural Networks by Genetic Algorithm with Degeneration (GA ^d).....	256
<i>Tetsuyuki Takahama, Setsuko Sakai, and Yoshinori Isomichi</i>	
Adaptive Training for Combining Classifier Ensembles.....	278
<i>Nayer M. Wanas and Mohamed S. Kamel</i>	
Combination Strategies for Finding Optimal Neural Network Architecture and Weights	294
<i>Brijesh Verma and Ranadhir Ghosh</i>	

Part 3: Applications

Biologically Inspired Recognition System for Car Detection from Real-Time Video Streams	320
<i>Predrag Neskovic, David Schuster, and Leon N. Cooper</i>	
Financial Time Series Prediction Using Non-Fixed and Asymmetrical Margin Setting with Momentum in Support Vector Regression	334
<i>Haiqin Yang, Irwin King, Laiwan Chan, and Kaizhu Huang</i>	

A Method for Applying Neural Networks to Control of Nonlinear System	351
<i>Jinglu Hu and Kotaro Hirasawa</i>	
Robot Manipulator Control via Recurrent Neural Networks.....	370
<i>Luis J. Ricalde, Edgar N. Sanchez, and Jose P. Perez</i>	
Gesture Recognition Based on SOM Using Multiple Sensors	387
<i>Masumi Ishikawa</i>	
Enhanced Phrase-Based Document Clustering Using Self-Organizing Map (SOM) Architectures.....	405
<i>M. Hussin, J. Bakus, and M. Kamel</i>	
Discovering Gene Regulatory Networks from Gene Expression Data with the Use of Evolving Connectionist Systems	425
<i>Nikola K. Kasabov and Dimiter S. Dimitrov</i>	
Experimental Analysis of Knowledge Based Multiagent Credit Assignment	437
<i>Ahad Harati and Majid Nili Ahmadabadi</i>	
Implementation of Visual Tracking System Using Artificial Retina Chip and Shape Memory Alloy Actuator	460
<i>W. C. Kim, M. Lee, J. K. Shin, and H. S. Yang</i>	