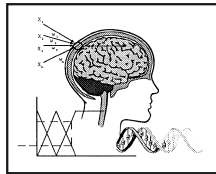


RECENT ADVANCES IN ARTIFICIAL NEURAL NETWORKS Design and Applications



Edited by

Lakhmi Jain, Ph.D.

University of South Australia

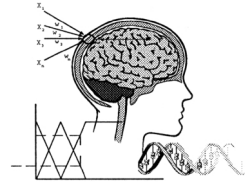
Anna Maria Fanelli, Ph.D.

University of Bari, Italy



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PREFACE

Neural networks are a new generation of information processing paradigms designed to mimic some of the behaviors of the human brain. These networks have gained tremendous popularity due to their ability to learn, recall and generalize from training data. A number of neural network paradigms have been reported in the last four decades, and in the last decade the neural networks have been refined and widely used by researchers and application engineers.

The main purpose of this book is to report recent advances in neural network paradigms and their applications. It is impossible to include all recent advances in this book; hence, only a sample has been included.

This book consists of 10 chapters. Chapter 1, by Ghosh and Taha, presents the architecture of a neuro-symbolic hybrid system. This system embeds initial domain knowledge and/or statistical information into a custom neural network, refines this network using training data, and finally extracts refined knowledge in the form of refined rule base. Two successful applications of this hybrid system are described.

Chapter 2, by Karayiannis and Behnke, presents an axiomatic approach for formulating radial basis function neural networks. The batch and sequential learning algorithms are developed for reformulated radial basis function neural networks. This approach is demonstrated on handwritten digit recognition.

Chapter 3, by Vassilas, is on efficient neural network-based methodology for the design of multiple classifiers. An increase in speed in the neural network training phase as well as in the selection of fuzzy and statistical supervised classifiers is achieved by size reduction and redundancy removal from the data set. The catalog of self-organizing feature maps together with the index table is used as a compressed representation of the original data. This technique is demonstrated on land-cover classification of multi-spectral satellite image showing increased speed.

Versino and Gambardella describe the design of a self-organizing map-like neural network which learns to associate actions with perceptions under the supervision of a planning system in Chapter 4. This novel technique is validated in learning fine motion in robotics.

Chapter 5, by Fernández-Delgado, Presedo, Lama, and Barro, is on a new neural network called MART for adaptive pattern recognition of multichannel input signals. A real application related to the multichannel signal processing is presented to demonstrate the ability of this network to solve complex problems.

Caudell and Healy present their research on a new version of the lateral priming adaptive resonance theory network in Chapter 6. They demonstrate that this architecture not only has one of the highest bounds on learning convergence, but also has strong empirical evidence of excellent generalization performance.

Chapter 7, by Aboulenien and De Wilde, discusses an intelligent agent that employs a machine learning technique in order to provide assistance to users dealing with a particular computer application. The authors present actual results from a prototype agent built using this technique applied on flight reservation domain.

Chapter 8, by Halici, Leblebicioglu, Özgen, and Tuncay, presents some applications of neural networks in process control. The authors show that hybrid methods using neural networks are very promising for the control of nonlinear systems.

Chapter 9, by Howlett, de Zoysa, and Walters, is on monitoring internal combustion engines by neural network based virtual sensing. It is necessary to reduce the quantities of polluting gases emitted by this engine and to decrease the amount of fuel consumed per kilometer. The use of neural networks for monitoring the parameters of this engines is proposed.

Pedrycz presents a novel approach to pattern classification using a concept of fuzzy Petri nets in Chapter 10. The learning scheme is illustrated with the aid of numeric examples.

This book will be useful for application engineers, scientists, and research students who wish to use neural networks for solving real-world problems.

We would like to express our sincere thanks to Berend-Jan van der Zwaag, Irene van der Zwaag-Tong, Ashlesha Jain, Ajita Jain and Sandhya Jain for their help in the preparation of the manuscript. We are grateful to the authors for their contributions, and thanks are due to Dawn Mesa, Lyn Meany, and Suzanne Lassandro for their editorial assistance.

Lakhmi Jain, Australia
Anna Maria Fanelli, Italy

The Editors

Lakhmi Jain is a Director/Founder of the Knowledge-Based Intelligent Engineering Systems (KES) Centre, located in the University of South Australia. He is a fellow of the Institution of Engineers Australia. He has initiated a postgraduate stream by research in the Knowledge-based Intelligent Engineering Systems area. He has presented a number of Keynote addresses in International Conferences on Knowledge-Based Systems, Neural Networks, Fuzzy Systems and Hybrid Systems.

He is the Founding Editor-in-Chief of the International Journal of Knowledge-Based Intelligent Engineering Systems and served as an Associate Editor of the IEEE Transactions on Industrial Electronics. Dr Jain was the Technical chair of the ETD2000 International Conference in 1995, and Publications Chair of the Australian and New Zealand Conference on Intelligent Information Systems in 1996. He also initiated the First International Conference on Knowledge-based Intelligent Electronic Systems in 1997. This is now an annual event. He served as the Vice President of the Electronics Association of South Australia in 1997. He is the Editor-in-Chief of the International Book Series on Computational Intelligence, CRC Press USA. His interests focus on the applications of novel techniques such as knowledge-based systems, artificial neural networks, fuzzy systems and genetic algorithms and the application of these techniques

Anna Maria Fanelli received the "Laurea" degree in Physics from the University of Bari, Italy, in 1974. From 1975 to 1979, she was full time researcher at the Physics Department of the University of Bari, Italy, where she became Assistant Professor in 1980. In 1985 she joined the Department of Computer Science at the University of Bari, Italy, as Professor of Computer Science. Currently, she is responsible for the courses "Computer Systems Architectures" and "Neural Networks" in the computer science discipline. Her research activity has involved issues related to pattern recognition, image processing and computer vision. Her work in these areas has been published in several journals and conference proceedings. Her current research interests include artificial neural networks, genetic algorithms, fuzzy systems, neuro-fuzzy modeling and hybrid systems.

Professor Fanelli is a member of the IEEE Society, the International Neural Network Society and AI*IA (Italian Association for Artificial Intelligence). She is the editorial board member of the *International Journal of Knowledge-Based Intelligent Engineering Systems*.

CONTENTS

Chapter 1.

A neuro-symbolic hybrid intelligent architecture with applications

J. Ghosh and I. Taha

1. Introduction
 2. Knowledge based module for representation of initial domain knowledge
 3. Extraction of supplementary rules via the statistical analysis module
 - 3.1 Extraction of correlation rules
 - 3.2 Reducing the input dimensionality
 4. The mapping module
 5. The discretization module
 6. Refining input characterization
 7. Rule extraction
 - 7.1 First technique (BIO-RE)
 - 7.2 Second technique (Partial-RE)
 - 7.3 Third technique (Full-RE)
 8. Rule evaluation and ordering procedure for the refined expert system
 - 8.1 The rule ordering procedure
 9. The integrated decision maker
 10. Application: controlling water reservoirs
 - 10.1 Implementation results
 - 10.2 Rule extraction
 11. Application of the statistical approach
 12. Discussion
- References

Chapter 2.

New radial basis neural networks and their application in a large-scale handwritten digit recognition problem

N.B. Karayiannis and S. Behnke

1. Introduction
 2. Function approximation models and RBF neural networks
 3. Reformulating radial basis neural networks
 4. Admissible generator functions
 - 4.1 Linear generator functions
 - 4.2 Exponential generator functions
 5. Selecting generator functions
 - 5.1 The blind spot
 - 5.2 Criteria for selecting generator functions
 - 5.3 Evaluation of linear and exponential generator functions
 - 5.3.1 Linear generator functions
 - 5.3.2 Exponential generator functions
 6. Learning algorithms based on gradient descent
 - 6.1 Batch learning algorithms
 - 6.2 Sequential learning algorithms
 - 6.3 Initialization of supervised learning
 7. Generator functions and gradient descent learning
 8. Handwritten digit recognition
 - 8.1 The NIST databases
 - 8.2 Data preprocessing
 - 8.3 Classification tools for NIST digits
 - 8.4 Role of the prototypes in gradient descent learning
 - 8.5 Effect of the number of radial basis functions
 - 8.6 Effect of the initialization of gradient descent learning
 - 8.7 Benchmarking reformulated RBF neural networks
 9. Conclusions
- References

Chapter 3.

Efficient neural network-based methodology for the design of multiple classifiers

N. Vassilas

1. Introduction
 2. Proposed methodology
 - 2.1 Data quantization using self-organizing maps
 - 2.2 Training set reduction and classification of SOFM prototypes for supervised techniques
 - 2.3 Fast clustering and labeling of SOFM prototypes for unsupervised techniques
 - 2.4 Efficient indexed classification
 3. Modifications of supervised algorithms
 - 3.1 Classification using the BP algorithm
 - 3.2 Classification using the LVQ algorithm
 - 3.3 The Pal-Majumder fuzzy classifier
 - 3.4 Classification using the k-NN algorithm
 4. Multimodular classification
 5. Land-cover classification
 - 5.1 Supervised classification
 - 5.2 Multimodular classification
 - 5.3 Unsupervised classification
 6. Summary
- References

Chapter 4.

Learning fine motion in robotics: design and experiments

C. Versino and L.M. Gambardella

1. How to find the path?
 2. The model-based system
 3. The sensor-based system
 4. Perception clustering
 5. Action triggering
 6. All together
 7. Why use a SOM-like network?
 8. Planner vs. HEKM
 9. Conclusions
- References

Chapter 5.

A new neural network for adaptive pattern recognition of multichannel input signals

M. Fernández-Delgado, J. Presedo, M. Lama, and S. Barro

1. Introduction
 2. Architecture and functionality of MART
 - 2.1 Bottom-up propagation in a single-channel block
 - 2.2 Class selection
 - 2.3 Top-down propagation in a single-channel block
 - 2.4 The orientation system
 - 2.5 Class manager
 3. Learning in MART
 - 3.1 Expected values
 - 3.2 Channel credits
 - 3.3 Class radii
 - 3.4 Global vigilances
 - 3.5 Other characteristics
 4. Analysis of the behavior of certain adaptive parameters
 5. A real application example
 6. Discussion
- References

Chapter 6.

Lateral priming adaptive resonance theory (LAPART)-2: innovation in ART

T.P. Caudell and M.J. Healy

1. Introduction
2. ART-1, Stacknet, and LAPART-1
 - 2.1 Binary patterns
 - 2.2 ART-1 architecture
 - 2.3 Stacknet
 - 2.4 LAPART-1
3. The LAPART-2 algorithm
 - 3.1 Forcing learning to occur
 - 3.2 Constraints on the input data
4. The learning theorems
5. Numerical experiments

- 5.1 Method
- 5.2 Results
- 6. Discussion
- 7. Conclusion
- References

Chapter 7.

Neural network learning in a travel reservation domain

H.A. Aboulenien and P. De Wilde

- 1. Introduction
- 2. Agents
- 3. Neural network role
- 4. Agent architecture
 - 4.1 Problem domain
 - 4.2 Data
 - 4.3 Network training
- 5. Operation
- 6. Summary
- References

Chapter 8.

Recent advances in neural network applications in process control

U. Halici, K. Leblebicioglu, C. Özgen, and S. Tuncay

- 1. Introduction
- 2. Process control
- 3. Use of neural networks in control
- 4. Case study I: pH control in neutralization system
 - 4.1 Neutralization system
 - 4.2 Neural network control of the neutralization system
 - 4.3 Results
 - 4.3.1 Conventional PID controller performance
 - 4.3.2 NN controller performance
- 5. Case study II: adaptive nonlinear-model predictive control using neural networks for control of high purity industrial distillation column
 - 5.1 Multicomponent high-purity distillation column

- 5.2 Adaptive nonlinear-model predictive controller using neural networks
 - 5.2.1 Linear-model predictive controller
 - 5.2.2 Nonlinear-model predictive controller
 - 5.2.3 Adaptive nonlinear-model predictive controller via neural networks
 - 5.3 Identification
 - 5.4 Development of the neural network model
 - 5.5 Control application
 - 6. Case study III: PI controller for a batch distillation column with neural network coefficient estimator
 - 6.1 Binary batch distillation column
 - 6.2 PI controller with neural network as a parameter estimator
 - 6.3 Results
 - 7. Case study IV: a rule-based neuro-optimal controller for steam-jacketed kettle
 - 7.1 Analysis of the kettle
 - 7.2 A rule-based neuro-optimal controller for nonlinear MIMO systems
 - 7.2.1 MIMO systems
 - 7.2.2 Rule derivation
 - 7.2.3 Neural network
 - 7.3 Results
 - 8. Remarks and future studies
- References

Chapter 9.

Monitoring internal combustion engines by neural network based virtual sensing

R.J. Howlett, M.M. de Zoysa, and S.D. Walters

- 1. Introduction
- 2. The engine management system
- 3. Virtual sensor systems
- 4. Air-fuel ratio
- 5. Combustion monitoring using the spark plug
- 6. The ignition system of a spark-ignition engine
- 7. Neural-networks for use in virtual sensors

8. AFR estimation using neural network spark voltage characterization
 - 8.1 The spark voltage characterization method
 - 8.2 Neural network training procedure
 - 8.3 The multi-cylinder engine
 - 8.3.1 Equal sample intervals
 - 8.3.2 Unequal sample intervals
 - 8.3.3 Integration of instantaneous values
 - 8.3.4 Radial basis functions
 - 8.3.5 Discussion
 - 8.4 The single-cylinder engine
 - 8.4.1 Single-speed test
 - 8.4.2 Multi-speed tests
 9. Conclusions
- References

Chapter 10.

Neural architectures of fuzzy Petri nets

W. Pedrycz

1. Introduction
 2. The generalization of the Petri net and its underlying architecture
 3. The architecture of the fuzzy Petri net
 4. The learning procedure
 5. Interfacing fuzzy Petri nets with granular information
 6. Experiments
 7. Conclusions
- References

This book is dedicated to all our students