

**2000 International Joint Conference on  
Neural Networks  
(V.3)**

# Proceedings of the IEEE-INNS-ENNS International Joint Conference on Neural Networks

# IJCNN 2000

Como, Italy - 24-27 July 2000

*Neural Computing: New Challenges and Perspectives  
for the New Millennium*

*Sponsored by*

IEEE Neural Network Council  
International Neural Network Society  
European Neural Network Society

*With the technical cooperation of*  
Japanese Neural Network Society

AEI—the Italian Association of Electrical and Electronic Engineers  
SIREN—the Italian Association of Neural Networks  
AI\*IA—the Italian Association for Artificial Intelligence



*Edited by Shun-Ichi Amari, C. Lee Giles, Marco Gori, and Vincenzo Piuri*



Los Alamitos, California

Washington • Brussels • Tokyo

Copyright © 2000 by The Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries may photocopy beyond the limits of US copyright law, for private use of patrons, those articles in this volume that carry a code at the bottom of the first page, provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

Other copying, reprint, or republication requests should be addressed to: IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, P.O. Box 133, Piscataway, NJ 08855-1331.

*The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinions and, in the interests of timely dissemination, are published as presented and without change. Their inclusion in this publication does not necessarily constitute endorsement by the editors, the IEEE Computer Society, or the Institute of Electrical and Electronics Engineers, Inc.*

IEEE CSP Number PR00619  
ISBN: 0-7695-0619-4 (Softbound)  
ISBN: 0-7803-6541-0 (Casebound)  
ISBN: 0-7803-0621-6 (Microfiche)  
Library of Congress: 00-102388  
ISSN: 1098-7576

IEEE Computer Society  
Customer Service Center  
10662 Los Vaqueros Circle  
P.O. Box 3014  
Los Alamitos, CA 90720-1314  
Tel: + 1 714 821 8380  
Fax: + 1 714 821 4641  
<http://computer.org/>  
[csbooks@computer.org](mailto:csbooks@computer.org)

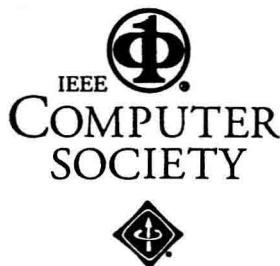
IEEE Service Center  
445 Hoes Lane  
P.O. Box 1331  
Piscataway, NJ 08855-1331  
Tel: + 1 732 981 0060  
Fax: + 1 732 981 9667  
<http://shop.ieee.org/store/>  
[customer-service@ieee.org](mailto:customer-service@ieee.org)

IEEE Computer Society  
Asia/Pacific Office  
Watanabe Bldg., 1-4-2  
Minami-Aoyama  
Minato-ku, Tokyo 107-0062  
JAPAN  
Tel: + 81 3 3408 3118  
Fax: + 81 3 3408 3553  
[tokyo.ofc@computer.org](mailto:tokyo.ofc@computer.org)

Editorial production by Anne Rawlinson  
with assistance from Frances Titsworth and Bob Werner

Cover art production by Alex Torres

Printed in the United States of America by The Printing House



## **Message from the Conference Chairpersons**

The IEEE-INNS-ENNS International Joint Conference on Neural Networks (IJCNN 2000) in Como, Italy, is the year 2000 edition of a long and successful series that gathered the most outstanding scientists and practitioners in all areas of neural network theory and applications from all over the world. This is the first time that the conference is held in Europe, as a worldwide recognition of the European contribution to the field. We are honored by this and grateful to the sponsoring bodies.

The topic of this edition is "*Neural Computing: New Challenges and Perspectives for the New Millennium.*" We recognize in fact a compelling need to compare, update, and share our knowledge and best practice to deal effectively with the evolving challenges coming from research, industry, and daily life in the upcoming millennium. This conference aims therefore to become a milestone, an opportunity for all of us to review our past and to define new challenges and perspectives for the foregoing years.

The research on artificial neural networks comprises a wide spectrum of directions, both theoretical and practical. This conference reflects all these aspects in detail and offers the possibility of discussing and comparing the latest results obtained by researchers all over the world. In particular the conference sessions will cover topics related to aspects of computational intelligence, cognitive neuroscience, neural network architectures, hardware implementations, hybrid systems, and applications. This makes IJCNN 2000 a major international forum for researchers, practitioners, policy makers, industries, and all people who are interested in the latest developments both of research and application of neural networks.

The conference will offer a number of high quality tutorials on basic aspects as well as on recent advancements, a wide technical program with plenty of sessions to present results of worldwide research and application efforts, some interesting plenary talks by outstanding scientists, and interactive panels for open discussion on some hot topics. Organizing a large conference like IJCNN 2000 is a complex task involving many people for a number of different aspects. We want therefore to thank everyone who contributed to the organization: without their valuable efforts the meeting could not have been held.

Although the new telecommunication technologies will allow easy, fast and wide long distance communications and information access, direct human interaction—happily—still remains fundamental to exchange ideas, establish new links, make new friends, and create new opportunities for international cooperation.

We wish all the attendees an enjoyable participation in the conference and a nice stay in Italy!

**General Chairperson**

Prof. Mariagiovanna Sami  
*Politecnico di Milano, Italy*

**Vice General Chairperson**

Prof. Eros Pasero  
*Politecnico di Torino, Italy*

**Technical Program Chairperson**

Prof. Marco Gori  
*Università di Siena, Italy*

**Technical Program Vice Chairpersons**

Prof. Shun-Ichi Amari  
*RIKEN, Japan*

Prof. C. Lee Giles  
*NEC Research Institute, USA*

Prof. Vincenzo Piuri  
*Politecnico di Milano, Italy*

# **Conference Organizers**

## **General Chairperson**

Prof. Mariagiovanna Sami, Politecnico di Milano, Italy

## **Vice General Chairperson**

Prof. Eros Pasero, Politecnico di Torino, Italy

## **Technical Program Committee Chairperson**

Prof. Marco Gori, Università di Siena, Italy

## **Technical Program Committee Vice-Chairperson for Europe and Africa**

Prof. Vincenzo Piuri, Politecnico di Milano, Italy

## **Technical Program Committee Vice-Chairperson for the Americas**

Prof. C. Lee Giles, NEC Research Institute, USA

## **Technical Program Committee Vice-Chairperson for Asia and Oceania**

Prof. Shun-Ichi Amari, RIKEN, Japan

## **Special Sessions Chairperson**

Prof. Robert J. Marks II, University of Washington, USA

## **Special Sessions Committee Members**

Dr. Payman Arabshahi, JPL, USA

Prof. Alexandre P. Alves da Silva, Federal Engineering School at Itajuba, Brazil

Prof. Mohamed El-Sharkawi, University of Washington, USA

Dr. Michael Healy, The Boeing Company, USA

Mr. Jae-Byung Jung, University of Washington, USA

## **Tutorial Chairpersons**

Prof. Erkki Oja, Helsinki University of Technology, Finland

Prof. Carlo Morabito, Università di Reggio Calabria, Italy

Dr. Harold Szu, Office of Naval Research, USA

## **Panel & Plenary Chairperson**

Prof. Jacek Zurada, University of Louisville, USA

## **Steering Committee Chairperson**

Prof. Gianni Orlandi, Università di Roma "La Sapienza", Italy

**Steering Committee Members**

Dr. David Brown, FDA, USA  
Dr. Clifford Lau, Office of Naval Research 363, USA  
Prof. Hanspeter A. Mallot, Max Planck Institut, Germany  
Dr. Enrique H. Ruspini, SRI International, USA  
Dr. Harold Szu, Office of Naval Research, USA  
Prof. Minoru Tsukada, Tamagawa University, Japan  
Dr. Paul Werbos, NSF, USA

**IEEE Liason**

Prof. Evangelia Micheli-Tzanakou, Rutgers University, USA

**INNS Liason**

Prof. Carlo Morabito, Università di Reggio Calabria, Italy

**ENNS Liason**

Prof. Hanspeter A. Mallot, Max Planck Institut, Germany

**International Liason**

Prof. Toshio Fukuda, Nagoya University, Japan

**Financial Chairperson**

Dr. William Fornaciari, Politecnico di Milano, Italy

**Publication Chairperson**

Dr. Marco Maggini, Università di Siena, Italy

**Publicity Chairperson**

Prof. Ron Sun, University of Missouri, USA

**Local Arrangement Chairperson**

Prof. Cesare Alippi, Politecnico di Milano, Italy

**Program Committee Members**

Prof. I. Aleksander, Imperial College, UK  
Prof. Asakura, Fukui University, Japan  
Prof. Y. Bengio, University of Montreal, Canada  
Prof. J. Buhmann, Universität Bonn, Germany  
Dr. D. Brown, FDA, USA  
Prof. P. Campadelli, Università di Milano, Italy  
Prof. A. Chella, Università di Palermo, Italy  
Prof. H. Chi, Peking University, P.R. China  
Dr. A. Colla, Elsag, Italy  
Prof. G. Cybenko, University of Dartmouth, USA  
Prof. W. Dunin-Barkowski, Texas Tech University, USA

Dr. F. Feldkamp, Ford, USA  
Dr. F. Fogelman-Soulie, BusinessDecision, France  
Prof. M. Forcada, Universidad de Alicante, Spain  
Prof. L.-M. Fu, University of Florida, USA  
Prof. T. Fukuda, Nagoya University, Japan  
Prof. K. Fukushima, University of Electro-Communications, Japan  
Dr. P. Gallinari, Université Paris 6, France  
Prof. W. Gerstner, EPFL, Switzerland  
Prof. J. Ghosh, University of Texas, USA  
Prof. S. Gielen, Katholieke Universiteit Nijmegen, The Netherlands  
Prof. K. Goser, Universität Dortmund, Germany  
Prof. Hirasawa, University of Kyushu, Japan  
Prof. M. Ishikawa, Kyushu Institute of Technology, Japan  
Dr. B. Kamgar-Parsi, NRL, USA  
Prof. N. Kasobov, University of Otago, New Zealand  
Prof. N. Kubota, Osaka Institute of Technology, Japan  
Prof. H.A. Mallot, Max Planck Institut, Germany  
Prof. D. Mange, EPFL, Switzerland  
Prof. P. Morasso, Università di Genova, Italy  
Prof. C. Morabito, Università di Reggio Calabria, Italy  
Prof. N. Murshed, Universidade Tuiuti do Paraná, Brazil  
Dr. L. Niklasson, International Relations, Sweden  
Prof. E. Oja, Helsinki University of Technology, Finland  
Prof. S. Omatsu, Osaka Prefecture University, Japan  
Prof. P. Orponen, University of Jyväskylä, Finland  
Prof. G. Palm, University of Ulm, Germany  
Prof. F. Palmieri, Università di Napoli, Italy  
Prof. A. Parlos, Texas A&M University, USA  
Prof. W. Pedrycz, University of Alberta, Canada  
Prof. S. Phatak Dhananjay, University of Binghamton, USA  
Prof. I. Pitas, Aristotle University of Thessaloniki, Greece  
Prof. A. Prieto, University of Granada, Spain  
Prof. T. Roska, University of Berkeley, USA  
Prof. A. Roy, Arizona State University, USA  
Dr. R. Serra, TWX, Italy  
Prof. J. Shawe-Taylor, University of London, UK  
Prof. S. Singh, University of Exeter, UK  
Prof. A. Sperduti, Università di Pisa, Italy  
Prof. R. Sun, University of Missouri, USA  
Dr. R. Tagliaferri, Università di Salerno, Italy  
Prof. J. G. Taylor, King's College London, UK  
Prof. D. Wang, Ohio State University, USA  
Prof. S. Wermeter, University of Sunderland, UK  
Prof. L. Xu, Chinese University of Hong Kong, P.R. China

**Registration Chairperson**

Mrs. Lee Myers, Myers-Smith Inc., USA

# IJCNN 2000

## Table of Contents

Message From the Conference Chairpersons.....	xxiii
Conference Organizers.....	xxxiv

### VOLUME I

Session MB1: Supervised Learning I	
Information Geometrical Methods for Neural Networks .....	I-xxxvii
<i>Shun-ichi Amari</i>	

Session MB1: Supervised Learning I	
Iterative Design of Regularizers Based on Data by Minimizing Generalization Errors .....	I-3
<i>M. Ishikawa, H. Shimada, and S. Amari</i>	
Bias Learning, Knowledge Sharing .....	I-9
<i>J. Ghosh and Y. Bengio</i>	
Incremental Active Learning with Bias Reduction .....	I-15
<i>M. Sugiyama and H. Ogawa</i>	
Development and Convergence Analysis of Training Algorithms with Local Learning Rate Adaptation .....	I-21
<i>G. D. Magoulas, V. P. Plagianakos, and M. N. Vrahatis</i>	
Predicting the Generalization Ability of Neural Networks Resembling the Nearest-Neighbor Algorithm.....	I-27
<i>M. Muselli</i>	

### Session MB2: Special Session on "Global Brain"

A General Framework for the Functions of the Brain .....	I-35
<i>J. G. Taylor</i>	
The Frontal Lobes and Executive Function .....	I-41
<i>J. G. Taylor, N. R. Taylor, R. Bapi, G. Bugmann, and D. Levine</i>	
A Modular Neural System for Machine Cognition .....	I-47
<i>P. O. A. Haikonen</i>	

### Session MB3: System Identification I

Model Structure Selection for Nonlinear System Identification Using Feedforward Neural Networks .....	I-53
<i>I. Petrović, M. Baotić, and N. Perić</i>	
A Neurofuzzy Scheme for On-Line Identification of Non-Linear Dynamical Systems with Variable Transfer Function .....	I-58
<i>M. Pinzolas, J. J. Ibarrola, and J. Lopez</i>	
Approximation of Non-Autonomous Dynamic Systems by Continuous Time Recurrent Neural Networks .....	I-64
<i>C. Kambhampati, F. Garces, and K. Warwick</i>	
Approximation of Hammerstein/Wiener Dynamic Models .....	I-70
<i>A. Balestrino and A. Caiti</i>	
Modelling Unstable Behavior of a Natural Circulation Loop with a Neural Network .....	I-75
<i>A. Fichera, G. Muscato, M. G. Xibilia, and A. Pagano</i>	

### Session MB4: Panel on "Blind Signal Separation and Independent Component Analysis with Neural Networks"

<b>Session MB6: Classification</b>	
Classification of Helical Structures .....	I-85
<i>S. Singh</i>	
Boundary Region Sensitive Classification for the Counterpropagation Neural Network .....	I-90
<i>L. Kovács and G. Terstyánszky</i>	
Focus of Attention in a Neural Network Using Meta Knowledge .....	I-95
<i>D. L. Hudson and M. E. Cohen</i>	
Target Adaptation to Improve the Performance of Least-Squared Classifiers .....	I-100
<i>K. M. Adeney and M. J. Korenberg</i>	
The K-Winner Machine Model .....	I-106
<i>S. Ridella, S. Rovetta, and R. Zunino</i>	
<b>Session MB7: Multilayer Perceptrons</b>	
Overfitting and Neural Networks: Conjugate Gradient and Backpropagation .....	I-114
<i>S. Lawrence and C. L. Giles</i>	
Overlapped Multi-Neural-Network: A Case Study .....	I-120
<i>J. Hu and K. Hirasawa</i>	
Levenberg-Marquardt Algorithm with Adaptive Momentum for the Efficient Training of Feedforward Networks .....	I-126
<i>N. Ampazis and S. Perantonis</i>	
Global Optimization Algorithms for Training Product Unit Neural Networks .....	I-132
<i>A. Ismail and A. P. Engelbrecht</i>	
Training Feedforward Neural Networks with the Dogleg Method and BFGS Hessian Updates .....	I-138
<i>S. J. Perantonis, N. Ampazis, and S. Spirou</i>	
<b>Session MB8: Image Processing</b>	
Proposal of Complex-Valued Region-Based-Coupling Segmentation Neural Networks and the Application to Radar Imaging Systems .....	I-146
<i>A. Hirose and K. Hiramatsu</i>	
Segmentation of Partially Occluded Objects by Local Classification .....	I-152
<i>G. Heidemann, D. Lücke, and H. Ritter</i>	
Segmentation of Virus-Infected Areas in Retinal Angiograms Using a Learning-by-Sample Approach .....	I-158
<i>D. Brahmi, C. Serruys, N. Cassoux, A. Giron, P. Lehoang, and B. Fertil</i>	
Optimizing Ship Length Estimates from ISAR Images .....	I-163
<i>F. E. McFadden and S. A. Musman</i>	
Image-Compression for Wireless World Wide Web Browsing: A Neural Network Approach .....	I-169
<i>N. Vlajic, H. C. Card, and T. Kunz</i>	
<b>Session MD1: Plenary Talk</b>	
Towards Understanding Images of the Mind .....	I-177
<i>John G. Taylor</i>	
<b>Session MD2: Supervised Learning</b>	
A Weight Evolution Algorithm with Deterministic Perturbation .....	I-185
<i>S.-C. Ng, S.-H. Leung, and A. Luk</i>	
On the Combination of Weight-Decay and Input Selection Methods .....	I-191
<i>M. Fernández-Redondo and C. Hernández-Espínosa</i>	
Conditional Information Analysis .....	I-197
<i>R. Kamimura</i>	
Selective Information Acquisition with Application to Pattern Classification .....	I-203
<i>R. Kamimura</i>	

**Session ME2: Neurobiology**

A Three-dimensional Physiologically Realistic Model of the Retina .....	I-211
<i>M. Tadross, C. Whitehouse, M. Hornstein, V. Eng, and E. Micheli-Tzanakou</i>	
A Study on Spatial and Temporal Visual Simulation of Nerve Excitement Propagation .....	I-217
<i>K. Shimokawa and S. Muraki</i>	
Network Capacity for Latent Attractor Computation.....	I-222
<i>S. Doboli and A. A. Minai</i>	
Orientation Map: A Reaction-Diffusion Based Model.....	I-228
<i>B. Bhaumik and C. M. Markan</i>	
A Gustatory Information-Processing Model for the Evaluation of Taste Preference.....	I-234
<i>K. Oguri, T. Sugimoto, and A. Iwata</i>	

Min Max Control of Nonlinear Systems Using Universal Learning Networks .....	I-242
<i>H. Chen, K. Hirasawa, J. Hu, and J. Murata</i>	

Stability and Performance Robustness Issues in Neural Network Feedback Linearization .....	I-248
<i>D. Obradovic</i>	

Methods to Design Robust Controllers against Nonlinear and Multiple Uncertainties by Use of Neural Networks .....	I-254
<i>H. Nakanishi and K. Inoue</i>	

Robust Control in Closed Loops Realised by Fast Signal Transmission of Infinite Gain Neurons .....	I-260
<i>J. J. Steil</i>	

Intelligent Fault Tolerant Control Using Artificial Neural Networks .....	I-266
<i>G. G. Yen and L.-W. Ho</i>	

**Session ME4: Panel on "Does Connectionism Permit Reading of Rules from a Network?"****Session ME5: Special Session on "MLP Networks and Geometry"**

Comparison of Rates of Linear and Neural Network Approximation.....	I-277
<i>V. Kůrková and M. Sanguineti</i>	

On Dimension-Independent Approximation by Neural Networks and Linear Approximators.....	I-283
<i>S. Giulini and M. Sanguineti</i>	

Should Activation Functions Be Affinely Recursive? .....	I-289
<i>A. Vogt</i>	

Genetic Algorithms and Neural Networks: Making Use of Parameter Space Symmetries.....	I-293
<i>R. Neruda</i>	

Convex Geometry and Nonlinear Approximation .....	I-299
<i>P. C. Kainen</i>	

**Session ME6: Multilayer Perceptrons II**

Continuous Optimization of Hyper-Parameters .....	I-305
<i>Y. Bengio</i>	

Gradient Descent in Feed-Forward Networks with Binary Neurons.....	I-311
<i>M. Costa, D. Palmisano, and E. Pasero</i>	

On MCMC Sampling in Bayesian MLP Neural Networks .....	I-317
<i>A. Vehtari, S. Särkkä, and J. Lampinen</i>	

Technique of Learning Rate Estimation for Efficient Training of MLP .....	I-323
<i>V. Golovko, Y. Savitsky, T. Laopoulos, A. Sachenko, and L. Grandinetti</i>	

**Session ME7: Medical Applications I**

Analysis of fMRI Time Series with Mixtures of Gaussians.....	I-331
<i>V. Sanguineti, C. Parodi, S. Perissinotto, F. Frisone, P. Vitali, P. Morasso, and G. Rodriguez</i>	

MR Image Reconstruction from Sparsely Sampled Scans Based on Multilayer Perceptrons and Using Regularization Techniques.....	I-336
<i>D. A. Karras, M. Reczko, B.G. Mertzios, D. Graveron-Demilly, and D. Van Ormondt</i>	
Identification of Masses in Digital Mammograms with MLP and RBF Nets .....	I-342
<i>K. Bovis, S. Singh, J. Fieldsend, and C. Pinder</i>	
Fluorescence Micrograph Segmentation by Gestalt-Based Feature Binding .....	I-348
<i>T. W. Nattkemper, H. Wersing, W. Schubert, and H. Ritter</i>	
A Neuro-Fuzzy System for Automatic Assessment of Myocardial Viability in Positron Emission Tomography.....	I-354
<i>F. Behloul, M. Janier, B. P. F. Lelieveldt, and J. H. C. Reiber</i>	
<b>Author Index .....</b>	<b>I-363</b>

## VOLUME II

<b>Session TB1: Self-Organizing Maps</b>	
Self-Organizing Maps of Massive Document Collections.....	II-3
<i>Teuvo Kohonen</i>	
<b>Session TB2: Statistical Frameworks for Learning</b>	
Stochastic Resonance Neural Network and Its Performance .....	II-13
<i>T. Nobori and N. Matsui</i>	
Bayesian Field Theory: Nonparametric Approaches to Density Estimation.....	II-18
<i>J. C. Lemm</i>	
Large Margin Classifier via Semiparametric Inference .....	II-23
<i>K. Tsuda and S. Akaho</i>	
Parallel Non Linear Dichotomizers .....	II-29
<i>F. Masulli and G. Valentini</i>	
<b>Session TB3: Neurocognition</b>	
Pattern Recognition with Eye Movement: A Neural Network Model .....	II-37
<i>M. Kikuchi and K. Fukushima</i>	
A Hippocampal Model of Visually Guided Navigation as Implemented by a Mobile Agent .....	II-41
<i>J. P. Banquet, P. Gaussier, A. Revel, and Y. Burnod</i>	
<b>Session TB4: Hardware Implementation I</b>	
A Full-Parallel Digital Implementation for Pre-Trained NNs.....	II-49
<i>T. Szabó, L. Antoni, G. Horváth, and B. Fehér</i>	
FPGA Architecture Comparison for Non-Conventional Signal Processing.....	II-55
<i>D. Franco and L. Carro</i>	
Building a 2D-Compatible Multilayer Neural Network.....	II-59
<i>B. Girau</i>	
Hardware Implementation of a PCA Learning Network by an Asynchronous PDM Digital Circuit.....	II-65
<i>Y. Hirai and K. Nishizawa</i>	
Pulse Mode Multilayer Neural Network with Floating Point Operation and On-Chip Learning.....	II-71
<i>H. Hikawa</i>	
<b>Session TB5: What Is the Future of Neural Networks? Intelligent Control and Perspectives?</b>	
<b>Session TB6: From “Society of Mind” to “Symbolic Neural Network Representations to Symbols”</b>	
A Theory of the Brain: There Are Parts of the Brain That Control Other Parts.....	II-81
<i>A. Roy</i>	

A General Framework for Symbol and Rule Extraction in Neural Networks.....	II-87
<i>B. Apolloni, C. Orovas, J. Taylor, W. Fellenz, S. Gielen, and M. Westerdijk</i>	
On Emotion Recognition of Faces and of Speech Using Neural Networks, Fuzzy Logic and the ASSESS System .....	II-93
<i>W. A. Fellenz, J. G. Taylor, R. Cowie, E. Douglas-Cowie, F. Piat, S. Kollias, C. Orovas, and B. Apolloni</i>	
Constructing Symbols as Manipulable Structures by Recurrent Networks.....	II-99
<i>J. G. Taylor, N. R. Taylor, B. Apolloni, and C. Orovas</i>	
Beyond Simple Rule Extraction: The Extraction of Planning Knowledge from Reinforcement Learners .....	II-105
<i>R. Sun</i>	
<b>ARTIFICIAL NEURAL NETWORKS FOR IMAGE PROCESSING AND RECOGNITION III</b>	
The Inefficiency of Batch Training for Large Training Sets.....	II-113
<i>D. R. Wilson and T. R. Martinez</i>	
Tree-Structured Neural Networks: Efficient Evaluation of Higher-Order Derivatives and Integrals .....	II-118
<i>A. P. Heinz</i>	
Backpropagation Algorithm for Logic Oriented Neural Networks.....	II-123
<i>T. Kamio, S. Tanaka, and M. Morisue</i>	
A Hyperbolic Multilayer Perceptron.....	II-129
<i>S. Buchholz and G. Sommer</i>	
<b>ARTIFICIAL NEURAL NETWORKS FOR IMAGE PROCESSING AND RECOGNITION IV</b>	
Spreading Associative Neural Network Recognizes the Shape and Position of an Object Simultaneously .....	II-137
<i>K. Nakamura, N. Kinoshita, H. Kanayama, and T. Minami</i>	
Multiple Kinds of Paper Currency Recognition Using Neural Network and Application for Euro Currency .....	II-143
<i>F. Takeda and T. Nishikage</i>	
A Neural Network Approach to Hyphenating Norwegian .....	II-148
<i>T. Kristensen</i>	
Improved Rotational Invariance for Statistical Inverse in Electrical Impedance Tomography.....	II-154
<i>J. Lahtinen, T. Martinsen, and J. Lampinen</i>	
Pattern Matching in High Energy Physics by Using Neural Network and Genetic Algorithm.....	II-159
<i>M. Castellano, G. Mastronardi, V. Bevilacqua, and E. Nappi</i>	
<b>ARTIFICIAL NEURAL NETWORKS FOR IMAGE PROCESSING AND RECOGNITION V</b>	
Searching the Web: Fundamental Limitations, Artificial Intelligence, and Future Directions .....	II-163
<i>Steve Lawrence</i>	
<b>ARTIFICIAL NEURAL NETWORKS FOR IMAGE PROCESSING AND RECOGNITION VI</b>	
On Derivation of MLP Backpropagation from the Kelley-Bryson Optimal-Control Gradient Formula and Its Application .....	II-167
<i>E. Mizutani, S. E. Dreyfus, and K. Nishio</i>	
Training Feedforward Neural Networks Using Orthogonal Iteration of the Hessian Eigenvectors .....	II-173
<i>A. Hunter</i>	
Effective Learning in Noisy Environment Using Neural Network Ensemble.....	II-179
<i>P. Hartono and S. Hashimoto</i>	
Evaluation of Gradient Descent Learning Algorithms with an Adaptive Local Rate Technique for Hierarchical Feed Forward Architectures.....	II-185
<i>F. Diotalevi, M. Valle, and D. D. Caviglia</i>	
Analyzing Learning Dynamics: How to Average? .....	II-191
<i>C. Goerick</i>	

<b>Session TE2: Neurocognition II</b>	
Unfaithful Population Decoding .....	II-199
<i>S. Wu, D. Chen, and S. Amari</i>	
The Hidden Layer Associative Memory Model of Hippocampus .....	II-205
<i>W. A. Fellenz and J. G. Taylor</i>	
Frequency-Based Error Back-Propagation in a Cortical Network .....	II-211
<i>R. Bogacz, M. W. Brown, and C. Giraud-Carrier</i>	
Is There More to TSSG than Associative Chaining (Chunking and All That)? .....	II-217
<i>N.R. Taylor and J.G. Taylor</i>	
<b>Session TE3: Time Series Prediction</b>	
Time Series Prediction by a Neural Network Model Based on the Bi-directional Computation Style .....	II-225
<i>H. Wakuya and J. M. Zurada</i>	
Predicting Chaotic Time Series by Ensemble Self-Generating Neural Networks.....	II-231
<i>H. Inoue and H. Narihisa</i>	
Input Window Size and Neural Network Predictors .....	II-237
<i>R. J. Frank, N. Davey, and S. P. Hunt</i>	
On the Use of Neural Networks in the Generalized Likelihood Ratio Test for Detecting Abrupt Changes in Signals .....	II-243
<i>C. L. Fancourt and J. C. Principe</i>	
<b>Session TE4: Panel on Neural Network Applications and Implementations</b>	
<b>Session TE6: Symbolic and Sub-Symbolic Computation</b>	
Complex Preferences for the Integration of Neural Codes.....	II-253
<i>C. Panchev and S. Wermter</i>	
Extracting Distributed Representations of Concepts and Relations from Positive and Negative Propositions....	II-259
<i>A. Paccanaro and G. E. Hinton</i>	
Building Predictive Models on Complex Symbolic Sequences with a Second-Order Recurrent BCM Network with Lateral Inhibition.....	II-265
<i>P. Tiňo, M. Stančík, and L. Beňušková</i>	
Refining Hidden Markov Models with Recurrent Neural Networks.....	II-271
<i>T. Wessels and C. W. Omlin</i>	
<b>Session TE8: Pattern Recognition II</b>	
A Comparison of Feature Sets and Neural Network Classifiers on a Bird Removal Approach for Wind Profiler Data .....	II-279
<i>R. Kretzschmar, N. B. Karayannidis, and H. Richner</i>	
On the Performance of the HONG Network for Pattern Classification .....	II-285
<i>A. S. Atukorale, P.N. Suganthan, and T. Downs</i>	
Incorporating <i>a priori</i> Knowledge into Initialized Weights for Neural Classifier .....	II-291
<i>Z. Chen, T.-J. Feng, and Z. Houkes</i>	
Combining Neural Networks, Fuzzy Sets, and Evidence Theory Based Approaches for Analysing Colour Images .....	II-297
<i>A. Verikas, K. Malmqvist, and M. Bacauskiene</i>	
<b>Author Index</b> .....	II-303

## VOLUME III

SESSION V: RECURRENT NETWORKS	
Bi-Causal Recurrent Cascade Correlation..... <i>A. Micheli, D. Sona, and A. Sperduti</i>	III-3
Periodic Motions, Mapping Ordered Sequences, and Training of Dynamic Neural Networks to Generate Continuous and Discontinuous Trajectories..... <i>P. Zegers and M. K. Sundaresan</i>	III-9
Improved Learning of Multiple Continuous Trajectories with Initial Network State .....	III-15
<i>M. Galicki, L. Leistritz, and H. Witte</i>	
Weight Groupings in the Training of Recurrent Networks .....	III-21
<i>L.-W. Chan and C.-C. Szeto</i>	
A Bounded Exploration Approach to Constructive Algorithms for Recurrent Neural Networks .....	III-27
<i>R.. Boné, M. Crucianu, G. Verley, and J.-P. Asselin de Beauville</i>	
SESSION VI: ADAPTIVE CRITIC DESIGN	
Category Theory Applied to Neural Modeling and Graphical Representations..... <i>M. J. Healy</i>	III-35
Realtime Visualization of the Learning Processes in the LAPART Neural Architecture as it Controls a Simulated Autonomous Vehicle..... <i>K. M. Edlund and T. P. Caudell</i>	III-41
The Role of Multiple, Linear-Projection Based Visualization Techniques in RBF-Based Classification of High Dimensional Data .....	III-47
<i>A. Agogino, J. Ghosh, S. J. Perantonis, V. Virvilis, S. Petridis, and P. J. G. Lisboa</i>	
Visualizing Communication between Neurons in the Lamina Ganglionaris of <i>Musca domestica</i> .....	III-53
<i>K. G. Haines, B. A. Pearlmuter, J. A. Moya, K. Edlund, and T. P. Caudell</i>	
SESSION VII: ADAPTIVE LEARNING AND DESIGN	
New Directions in ACDs: Keys to Intelligent Control and Understanding the Brain..... <i>P. J. Werbos</i>	III-61
Robust Adaptive Critic Based Neurocontrollers for Systems with Input Uncertainties..... <i>Z. Huang and S. N. Balakrishnan</i>	III-67
Adaptive Critic Design for Intelligent Steering and Speed Control of a 2-Axle Vehicle..... <i>G. G. Lendaris, L. Schultz, and T. Shannon</i>	III-73
The Cellular Simultaneous Recurrent Network Adaptive Critic Design for the Generalized Maze Problem Has a Simple Closed-Form Solution .....	III-79
<i>D. Wunsch</i>	
SESSION VIII: ADAPTIVE LEARNING AND DESIGN	
Improving the Generalization Capability of the Binary CMAC .....	III-85
<i>T. Szabó and G. Horváth</i>	
A “Recruiting Neural-Gas” for Function Approximation..... <i>M. Aupetit, P. Couturier, and P. Massotte</i>	III-91
Universal Learning Networks with Branch Control..... <i>K. Hirasawa, J. Hu, Q. Xiong, J. Murata, and Y. Shiraishi</i>	III-97
Learning Heterogeneous Functions from Sparse and Non-Uniform Samples .....	III-103
<i>D. Pokrajac and Z. Obradovic</i>	
Fuzzy Set Theoretic Adjustment to Training Set Class Labels Using Robust Location Measures .....	III-109
<i>N. J. Pizzi and W. Pedrycz</i>	

---

**Session W/7: Spiking Neural Networks**

---

Analysis of Fluctuation-Induced Firing in the Presence of Inhibition .....	III-115
<i>C. Christodoulou, T. G. Clarkson, G. Bugmann, and J. G. Taylor</i>	
Neurophysiology of a VLSI Spiking Neural Network: LANN21 .....	III-121
<i>S. Fusi, P. Del Giudice, and D. J. Amit</i>	
On the Effect of the Stimulus on the Synchronization of Coupled Rose-Hindmarsh Neurons .....	III-127
<i>M. Güler and C. Ergün</i>	

---

**Session W/8: Pattern Recognition III**

---

Recognition of Occluded Patterns: A Neural Network Model.....	III-135
<i>K. Fukushima</i>	
Natural Object Classification Using Artificial Neural Networks .....	III-139
<i>S. Singh, M. Markou, and J. Haddon</i>	
Classification of the Italian Liras Using the LVQ Method .....	III-145
<i>T. Kosaka and S. Omatsu</i>	
Image Redundancy Reduction for Neural Network Classification Using Discrete Cosine Transforms .....	III-149
<i>Z. Pan, A. G. Rust, and H. Bolouri</i>	
Unsupervised Learning of Neural Network Ensembles for Image Classification.....	III-155
<i>G. Giacinto, F. Roli, and G. Fumera</i>	

---

**Session W/9: Reinforcement Learning**

---

On-Line EM Reinforcement Learning .....	III-163
<i>J. Yoshimoto, S. Ishii, and M. Sato</i>	
Competing Hidden Markov Models on the Self-Organizing Map .....	III-169
<i>P. Somervuo</i>	
Recognition and Geometrical On-Line Learning Algorithm of Probability Distributions.....	III-175
<i>T. Aida</i>	
An Adaptable Boolean Neural Network Performing Specific Sequence Learning.....	III-181
<i>F. E. Lauria, R. Prevete, and M. Milo</i>	

---

**Session W/10: Learning and Memory**

---

Recurrent Nets That Time and Count .....	III-189
<i>F. A. Gers and J. Schmidhuber</i>	
On the Properties of Time Trajectories Learned by the Cerebellar Cortex .....	III-195
<i>A. Garenne, P. Chauvet, and G. A. Chauvet</i>	
Short Term Memory Phenomena in an Autosynaptic Neuron .....	III-201
<i>A. Herrera, J. L. Pérez, R. Prieto, and A. Padrón</i>	
Storage and Recall of Complex Temporal Sequences through a Contextually Guided Self-Organizing Neural Network.....	III-207
<i>G. de A. Barreto and A. F. R. Araújo</i>	
Trading Off Perception with Internal State: Reinforcement Learning and Analysis of Q-Elman Networks in a Markovian Task.....	III-213
<i>B. Bakker and G. van der Voort van der Kleij</i>	

---

**Session W/11: Special Session on Intelligent Design II**

---

On-Line Learning Control by Association and Reinforcement.....	III-221
<i>J. Si and Y.-T. Wang</i>	
An Estimate of the Number of Samples to Convergence for Critic Algorithms .....	III-227
<i>T. Hrycej</i>	

Comparison of a Heuristic Dynamic Programming and a Dual Heuristic Programming Based Adaptive Critics Neurocontroller for a Turbogenerator .....	III-233
<i>G. K Venayagamoorthy, R. G. Harley, and D. C. Wunsch II</i>	
<hr/>	
<b>SESSION III-6: FUNCTION APPROXIMATION II</b>	
Gaussian Process Regression: Active Data Selection and Test Point Rejection .....	III-241
<i>S. Seo, M. Wallat, T. Graepel, and K. Obermayer</i>	
Neural Network Based on QBP and Its Performance.....	III-247
<i>N. Matsui, N. Kouda, and H. Nishimura</i>	
A Structure Trainable Neural Network with Embedded Gating Units and Its Learning Algorithm .....	III-253
<i>K. Nakayama, A. Hirano, and A. Kanbe</i>	
Piecewise Linear Homeomorphisms: The Scalar Case .....	III-259
<i>R. E. Groff, D. E. Koditschek, and P. P. Khargonekar</i>	
Dynamic Programming with ARMA, Markov, and NARMA Models vs. Q-Learning: Case Study .....	III-265
<i>J. Chrobak, A. Pacut, and A. Karbowski</i>	
<hr/>	
<b>SESSION III-7: NEUROCOMPUTATION</b>	
A Learning Algorithm for Improved Pattern Synchronization in Networks with Biologically Motivated Neurons.....	III-273
<i>J. Teichert and R. Malaka</i>	
Unsupervised Classification of Complex Clusters in Networks of Spiking Neurons .....	III-279
<i>S. M. Bohte, J. N. Kok, and H. La Poutré</i>	
An Unsupervised Learning Rule for the Pulsed Neuron Model: The Vector Quantization of the Auditory Temporal Signals .....	III-285
<i>S. Kuroyanagi and A. Iwata</i>	
Pulse-Coupled Networks of Non-Autonomous Integrate-and-Fire Oscillators and Classification Functions ....	III-291
<i>H. Torikai and T. Saito</i>	
FPGA Implementation of a Pulse Density Neural Network Using Simultaneous Perturbation.....	III-296
<i>Y. Maeda and T. Tada</i>	
<hr/>	
<b>SESSION III-8: FACIAL SIGNAL PROCESSING</b>	
Network Ensembles for Facial Analysis Tasks .....	III-305
<i>S. Gutta and H. Wechsler</i>	
Neural Net with Adaptive Activation Functions for Face Recognition .....	III-311
<i>A. Talukder and D. Casasent</i>	
Neuro-Based Human-Face Recognition with 2-Dimensional Discrete Walsh Transform.....	III-315
<i>M. Yoshida, T. Kamio, and H. Asai</i>	
Fast Modular Neural Nets for Human Face Detection .....	III-320
<i>H. M. El-Bakry, M. A. Abo-Elsoud, and M. S. Kamel</i>	
<hr/>	
<b>SESSION III-9: BLIND SIGNAL SEPARATION</b>	
A Constraint Learning Algorithm for Blind Source Separation .....	III-327
<i>K. Nakayama, A. Hirano, and M. Nitta</i>	
Low Complexity Adaptive Non-Linear Function for Blind Signal Separation.....	III-333
<i>A. Pierani, F. Piazza, M. Solazzi, and A. Uncini</i>	
Blind Source Separation Using a Matrix Pencil .....	III-339
<i>A. M. Tomé</i>	
Stiefel-Grassmann Flow (SGF) Learning: Further Results .....	III-343
<i>S. Fiori</i>	

**Session WC2: Independent Component Analysis I**

$\alpha$ -EM Algorithm and $\alpha$ -ICA Learning Based upon Extended Logarithmic Information Measures .....	III-351
<i>Y. Matsuyama, T. Niimoto, N. Katsumata, Y. Suzuki, and S. Furukawa</i>	
ICA of Complex Valued Signals: A Fast and Robust Deflationary Algorithm.....	III-357
<i>E. Bingham and A. Hyvärinen</i>	
Unsupervised Rank-Deficient Density Estimation via Multi-Class Independent Component Analysis .....	III-363
<i>F. Palmieri and A. Budillon</i>	
Feature Extraction from Colour and Stereo Images Using ICA.....	III-369
<i>P. O. Hoyer and A. Hyvärinen</i>	

**Session WC3: Principal Component Analysis II**

Fuzzy Clustering Algorithm Extracting Principal Components Independent of Subsidiary Variables.....	III-377
<i>C.-H. Oh, H. Komatsu, K. Honda, and H. Ichihashi</i>	
Kernel Factor Analysis with Varimax Rotation.....	III-381
<i>D. Charles and C. Fyfe</i>	
Convergence Analysis of Online Linear Discriminant Analysis.....	III-387
<i>K. Hiraoka, S. Yoshizawa, K. Hidai, M. Hamahira, H. Mizoguchi, and T. Mishima</i>	
Improved $\psi$ -APEX Algorithm for Digital Image Compression.....	III-392
<i>S. Fiori, S. Costa, and P. Burrascano</i>	

A Statistics Based Approach for Extracting Priority Rules from Trained Neural Networks .....	III-401
<i>Z.-H. Zhou, S.-F. Chen, and Z.-Q. Chen</i>	
Applying a Clustering Genetic Algorithm for Extracting Rules from a Supervised Neural Network .....	III-407
<i>E. R. Hruschka and N. F. F. Ebecken</i>	
A New Rule Generation Method from Neural Networks Formed Using a Genetic Algorithm with Virus Infection .....	III-413
<i>M. Fukumi, Y. Mitsukura, and N. Akamatsu</i>	
Rule Extraction from a Multi Layer Perceptron with Staircase Activation Functions .....	III-419
<i>G. Bologna</i>	
Using Graphs to Analyze High-Dimensional Classifiers .....	III-425
<i>O. Melnik and J. Pollack</i>	

Meaning Spotting and Robustness of Recurrent Networks.....	III-433
<i>S. Wermter, C. Panchev, and G. Arevian</i>	
Encoding of Probabilistic Automata into RAM-Based Neural Networks.....	III-439
<i>M. C. P. de Souto, T. B. Ludermir, and M. A. Campos</i>	
What Inductive Bias Gives Good Neural Network Training Performance? .....	III-445
<i>S. Snyders and C. W. Omlin</i>	
On-Line Connectionist Q-Learning Produces Unreliable Performance with a Synonym Finding Task .....	III-451
<i>I. Johnson and M. Plumley</i>	

Exact Representations from Feed-Forward Networks .....	III-459
<i>O. Melnik and J. Pollack</i>	
Justification of a Neuron-Adaptive Activation Function .....	III-465
<i>S. Xu and M. Zhang</i>	
Artificial Neural Networks with Adaptive Multidimensional Spline Activation Functions .....	III-471
<i>M. Solazzi and A. Uncini</i>	