

# Lecture Notes in Computer Science

1327

Edited by G. Goos, J. Hartmanis and J. van Leeuwen

Advisory Board: W. Brauer D. Gries J. Stoer

Wulfram Gerstner Alain Germond  
Martin Hasler Jean-Daniel Nicoud (Eds.)

# Artificial Neural Networks – ICANN '97

7th International Conference  
Lausanne, Switzerland, October 8-10, 1997  
Proceedings



Springer

Series Editors

Gerhard Goos, Karlsruhe University, Germany

Juris Hartmanis, Cornell University, NY, USA

Jan van Leeuwen, Utrecht University, The Netherlands

Volume Editors

Wulfram Gerstner

Alain Germond

Martin Hasler

Jean-Daniel Nicoud

Swiss Federal Institute of Technology

École Polytechnique Fédérale de Lausanne

CH-1015 Lausanne, Switzerland

E-mail: wulfram.gerstner@di.epfl.ch

germond@de.epfl.ch

hasler@de.epfl.ch

nicoud@di.epfl.ch

Cataloging-in-Publication data applied for

**Die Deutsche Bibliothek - CIP-Einheitsaufnahme**

**Artificial neural networks : 7th international conference ;  
proceedings / ICANN '97, Lausanne, Switzerland, October 8 - 10,  
1997. Wulfram Gerstner ... (ed.). - Berlin ; Heidelberg ; New York ;  
Barcelona ; Budapest ; Hong Kong ; London ; Milan ; Paris ; Santa  
Clara ; Singapore ; Tokyo : Springer, 1997  
(Lecture notes in computer science ; Vol. 1327)  
ISBN 3-540-63631-5**

CR Subject Classification (1991): F1.1, C.2.1, C.1.3, I.2, G.1.6, I.5.1, B.7.1,  
J.1, J.2

ISSN 0302-9743

ISBN 3-540-63631-5 Springer-Verlag Berlin Heidelberg New York

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, re-use of illustrations, recitation, broadcasting, reproduction on microfilms 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 for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1997  
Printed in Germany

Typesetting: Camera-ready by author  
SPIN 10545612 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

## Preface

This book is based on the papers presented at the *International Conference on Artificial Neural Networks*, ICANN'97, which was hosted by the Swiss Federal Institute of Technology in Lausanne, Switzerland. The ICANN conferences were initiated in 1991 and have since become the major European meetings in the field of neural networks.

From 365 submitted papers 190 were accepted for publication. In addition there were several invited papers. The process of paper selection for ICANN'97 relied heavily upon the work of our referees whom we would like to thank for their great effort. We also owe a warm 'thank you' to the members of the technical program committee, F. Blayo, M. Cottrell, F. de Viron, C. Jutten, E. Mayoraz, and K. Pawelzik who spent two days in Lausanne for the final selection of the papers and the preparation of the conference program.

The conference and the proceedings would not have been possible without the enormous work of M. Dubois and A. Moinat who handled all the organizational aspects of paper submission and registration. M.-J. Pellaud generously helped out whenever it was necessary. Financial support was provided by the Foundation 'Latsis' and the Swiss National Science Foundation.

Lausanne, July 1997

Wulfram Gerstner  
Alain Germond  
Martin Hasler  
Jean-Daniel Nicoud

## Referees and Advisory Board

- Abbott, L., Waltham  
 Abeles, M., Jerusalem  
 Aihara, K., Tokyo  
 Altman, E., Kyoto  
 Amari, S., Saitama  
 Arreguit, X., Neuchâtel  
 Austin, J., York  
 Bauer, H.-U., Göttingen  
 Benveniste, A., Rennes  
 Bernasconi, J., Baden  
 Biehl, M., Würzburg  
 Blayo, F., Lyon  
 Borst, A., Tübingen  
 Bourlard, H., Martigny  
 Breiman, L., Berkeley  
 Burg, T., Zurich  
 Burges, C., Holmdel  
 Cabestany, J., Barcelona  
 Carpenter, G., Boston  
 Changeux, J.P., Paris  
 Chen, P., Dayton  
 Cottrell, M., Paris  
 Cruse, H., Bielefeld  
 Czernichow, T., Madrid  
 de Viron, F., Bruxelles  
 Deco, G., Munich  
 Del Corso, D., Torino  
 Dorizzi, B., Evry Cedex  
 Douglas, R., Zurich  
 Fiesler, E., Torrance  
 Floreano, D., Lausanne  
 Fogelman, F., Clamart  
 Fort, J.-C., Vandoeuvre  
 Fritzsche, B., Bochum  
 Fujii, T., Saitama  
 Garda, P., Paris  
 Gielen, S., Nijmegen  
 Göppert, J., Böblingen  
 Goser, K., Dortmund  
 Gross, H.-M., Ilmenau  
 Hayashi, Y., Kyoto  
 Hemmen, J.L. van, Munich  
 Hepp, K., Zurich  
 Hérault, J., Grenoble  
 Herz, A.V.M., Berlin  
 Horikawa, S.I., Nagoya  
 Hugli, H., Neuchâtel  
 Ienne, P., Munich  
 Jankowski, S., Warsaw  
 Jordan, M., Cambridge  
 Jutten, C., Grenoble  
 Kawakami, H., Tokushima  
 Klar, H., Berlin  
 Koch, C., Pasadena  
 Kohonen, T., Espoo  
 Kosko, B., Los Angeles  
 Landolt, O., Neuchâtel  
 Lansner, A.B., Stockholm  
 Linares, G., Avignon  
 Lister, J., Lausanne  
 Ljung, L., Linköping  
 Lund, H., Edinburgh  
 Malaka, R., Karlsruhe  
 Mallot, H., Tübingen  
 Malsburg, C.v.d., Bochum  
 Mange, D., Lausanne  
 Martinelli, G., Roma  
 Martinetz, T., Bochum  
 Matsuyama, Y., Tokyo  
 Maybank, S., Reading  
 Mayoraz, E., Martigny  
 Morasso, P., Genova  
 Müller, K.-R., Berlin  
 Munoz, A., Madrid  
 Murray, A.F., Edinburgh  
 Niebur, D., Philadelphia  
 Niebur, E., Baltimore  
 Oja, E., Espoo  
 Opper, M., Bayreuth  
 Pagès, G., Vandoeuvre  
 Pawelzik, K., Göttingen  
 Piras, A., Lausanne  
 Piuri, V., Milano  
 Prieto, A., Granada  
 Ramacher, U., Dresden  
 Recce, M., London  
 Reyneri, L., Torino  
 Ritter, H., Bielefeld  
 Ritz, R., La Jolla  
 Rojas, P., Berlin  
 Roska, T., Budapest  
 Rueckert, U., Paderborn  
 Salomon, R., Zurich  
 Sami, M., Milano  
 Schmidhuber, J., Lugano  
 Schoelkopf, B., Tübingen  
 Segev, I., Jerusalem  
 Senn, W., Bern  
 Seelen, W. von, Bochum  
 Sejnowski, T., La Jolla  
 Shibata, T., Tokyo  
 Simard, P., Holmdel  
 Solla, S.A., Holmdel  
 Studer, L., Genova  
 Suykens, J., Heverlee  
 Taylor, J.G., London  
 Thimm, G., Martigny  
 Thiran, P., Lausanne  
 Treves, A., Trieste  
 Tsodyks, M., Rehovot  
 Tuckwell, H., Paris  
 Van Schaik, A., Lausanne  
 Vapnik, V., Holmdel  
 Verleysen, M., Louvain  
 Vesin, J.-M., Lausanne  
 Vetterli, M., Lausanne  
 Villa, A., Lausanne  
 Vittoz, E., Neuchâtel  
 Vorbrüggen, J., Bochum  
 Weinfeld, M., Palaiseaux  
 Wellekens, C., Valbonne  
 Willshaw, D., Edinburgh

# Part I: Coding and Learning in Biology

Reward Responses of Dopamine Neurons: A Biological Reinforcement Signal <i>Schultz W.</i>	3
The Information Content of Action Potential Trains - A Synaptic Basis <i>Markram H., Tsodyks M.</i>	13
Cortical Cell Assemblies, Laminar Interaction, and Thalamocortical Interplay <i>Miller R.</i>	25
Cross-Correlations in Sparsely Connected Recurrent Networks of Spiking Neurons <i>Brunel N.</i>	31
A Comparative Study of Pattern Detection Algorithm and Dynamical System Approach Using Simulated Spike Trains <i>Tetko I.V., Villa A.E.P.</i>	37
Spatio-Temporal Pattern Recognition with Neural Networks: Application to Speech <i>Rouat J.</i>	43
Noise in Integrate-and-Fire Models of Neuronal Dynamics <i>Lánský P., Lánská V.</i>	49
Coarse Coding Accounts for Improvement of Spatial Discrimination after Plastic Reorganization in Rats and Humans <i>Eurich C.W., Dinse H.R., Dicke U., Godde B., and Schwegler H.</i>	55
Analogue Resolution in a Model of the Schaffer Collaterals <i>Schultz S., Panzeri S., Treves A., and Rolls E.T.</i>	61
Modeling Networks with Linear (VLSI) Integrate-and-Fire Neurons <i>Mattia M., Fusi S.</i>	67
An Information-Theoretic Analysis of Temporal Coding Strategies by Spiking Central Neurons <i>Deco G., Schürmann B.</i>	73
Correlation Coding in Stochastic Neural Networks <i>Ritz R., Sejnowski T.J.</i>	79
Two-Dimensional Hodgkin-Huxley Equations for Investigating a Basis of Pulse-Processing Neural Networks <i>Hirose A.</i>	85
Concurrent Parallel-Sequential Processing in Gamma Controlled Cortical-Type Networks of Spiking Neurons <i>Koerner E., Koerner U.</i>	91
A Noise-Robust Auditory Modeling Front End for Voiced Speech <i>Smith L.S.</i>	97
A Novelty Detector Using a Network of Integrate and Fire Neurons <i>Ho T.V., Rouat J.</i>	103

Derivation of Pool Dynamics from Microscopic Neuronal Models <i>Eggert J., van Hemmen J.L.</i>	109
How a Single Purkinje Cell Could Learn the Adaptive Timing of the Classically Conditioned Eye-Blink Response <i>Steuber V., Willshaw D.J.</i>	115
An Algorithm for Synaptic Modification Based on Exact Timing of Pre- and Post-Synaptic Action Potentials <i>Senn W., Tsodyks M., and Markram H.</i>	121
Modeling Plasticity in Rat Barrel Cortex Induced by One Spared Whisker <i>Benušková L.</i>	127
Mathematical Analysis of Competition Between Sensory Ganglion Cells for Nerve Growth Factor in the Skin <i>Kohli R., Clarke P.G.H.</i>	133
Competition Amongst Neurons for Neurotrophins <i>van Ooyen A., Willshaw D.J.</i>	139
Implementing Hebbian Learning in a Rank-Based Neural Network <i>Samuelides M., Thorpe S., and Veneau E.</i>	145
A Model of Clipped Hebbian Learning in a Neocortical Pyramidal Cell <i>Graham B., Willshaw D.J.</i>	151
Hebbian Delay Adaptation in a Network of Integrate-and-Fire Neurons <i>Eurich C.W., Cowan J.D., and Milton J.G.</i>	157
Hippocampal Formation Trains Independent Components via Forcing Input Reconstruction <i>Lörincz A.</i>	163

## Part II: Cortical Maps and Receptive Fields

Nature vs. Nurture in the Development of Tangential Connections and Functional Maps in the Visual Cortex <i>Löwel S., Schmidt K.E., and Singer W.</i>	171
Geometric Relationships Between Feature Maps in Cat Visual Cortex <i>Hübener M., Shoham D., Schulze S., Brändle G., Grinvald A., and Bonhoeffer T.</i>	177
A Linear Hebbian Model for the Development of Spatiotemporal Receptive Fields of Simple Cells <i>Wimbauer S., Wenisch O., van Hemmen J.L.</i>	183
Synapse Clustering Can Drive Simultaneous ON-OFF and Ocular-Dominance Segregation in a Model of Area 17 <i>Stetter M., Lang E.W., and Obermayer K.</i>	189
Must Pinwheels Move During Visual Development? <i>Wolf F., Geisel T.</i>	195

Extending the TRN Model in a Biologically Plausible Way <i>Frisone F., Perico L., and Morasso P.G.</i>	201
SOM-Model for the Development of Oriented Receptive Fields and Orientation Maps from Non-oriented ON-center OFF-center Inputs <i>Brockmann D., Bauer H.U., Riesenhuber M., and Geisel T.</i>	207
On the Anatomical Basis of Field Size, Contrast Sensitivity, and Orientation Selectivity in Macaque Striate Cortex: A Model Study <i>Bauer U., Adorján P., Scholz M., Levitt J.B., Lund J.S., Obermayer K.</i>	213
Statistics of Natural and Urban Images <i>Ziegans C., Lang E.W.</i>	219
A CBL Network Model with Intracortical Plasticity and Natural Image Stimuli <i>Burger T., Lang, E.W.</i>	225
Geometry of Orientation Preference Map Determines Nonclassical Receptive Field Properties <i>Ernst U., Pawelzik K., Wolf F., and Geisel T.</i>	231
A Model for Orientation Tuning and Contextual Effects of Orientation Selective Receptive Fields <i>Bartsch H., Stetter M., and Obermayer K.</i>	237
Objective Functions for Neural Map Formation <i>Wiskott L., Sejnowski T.J.</i>	243
Relative Time Scales in the Self-Organization of Pattern Classification: From One-Shot to Statistical Learning <i>Kopecz K., Mohraz K.</i>	249
Realization of Geometric Illusions and Geometry of Visual Space with Neural Networks <i>Chao J., Miyata Y., Yoshida S.</i>	255

### Part III: Learning: Theory and Algorithms

The Support Vector Method <i>Vapnik V.N.</i>	263
On the Significance of Markov Decision Processes <i>Sutton R.S.</i>	273
Economical Reinforcement Learning for Non Stationary Problems <i>Chatenet N., Bersini H.</i>	283
A Double Gradient Algorithm to Optimize Regularization <i>Czernichow T.</i>	289
Global Least-Squares vs. EM Training for the Gaussian Mixture of Experts <i>Bradshaw N.P., Duchâteau A., and Bersini H.</i>	295
Accelerated Learning in Boltzmann Machines Using Mean Field Theory <i>Kappen H.J., Rodríguez F.B.</i>	301

Adaptive Online Learning for Nonstationary Problems <i>Bös S.</i>	307
Weight Discretization due to Optical Constraints and Its Influence on the Generalization Abilities of a Simple Perceptron <i>Aboukassem M., Schwember S., Noehle S., and Männer R.</i>	313
Wavelet Frames Based Estimator <i>Soltani S., Canu S., Boichu D., and Grandvalet Y.</i>	319
A Spatio-temporal Perceptron for On-Line Handwritten Character Recognition <i>Mozayyani N., Vaucher G.</i>	325
Learning Oscillations Using Adaptive Control <i>Weiss M.G.</i>	331
Creation of Neural Networks Based on Developmental and Evolutionary Principles <i>Eggenberger P.</i>	337
A Boosting Algorithm for Regression <i>Bertoni A., Campadelli P., and Parodi M.</i>	343
Combining Regularized Neural Networks <i>Taniguchi M., Tresp V.</i>	349
Making Stochastic Networks Deterministic <i>Rüger S.M.</i>	355
Unsupervised Learning in Networks of Spiking Neurons Using Temporal Coding <i>Ruf B., Schmitt M.</i>	361
Experiments on Regularizing MLP Models with Background Knowledge <i>Selonen A., Lampinen J.</i>	367
Elliptical Basis Function Networks for Classification Tasks <i>Gutjahr S., Feist J.</i>	373
Probabilistic Neural Networks with Rotated Kernel Functions <i>Galleske I., Castellanos J.</i>	379
Statistical Control of RBF-like Networks for Classification <i>Jankowski N., Kadirkamanathan V.</i>	385
Improving RBF Networks by the Feature Selection Approach EUBAFES <i>Scherf M., Brauer W.</i>	391
Polynomial Classifiers and Support Vector Machines <i>Graf I., Kressel U., and Franke J.</i>	397
Unique Representations of Dynamical Systems Produced by Recurrent Neural Networks <i>Kimura M., Nakano R.</i>	403
Generalization of Elman Networks <i>Hammer B.</i>	409

Designing Neural Networks by a Combination of Structural Learning and Genetic Algorithms <i>Ishikawa M., Nishino K.</i>	415
A Recurrent Self-Organizing Map for Temporal Sequence Processing <i>Varsta M., Millán J. del R., Heikkonen J.</i>	421
An Extended Elman Net for Modeling Time Series <i>Stagge P., Sendhoff B.</i>	427
Recurrent Associative Memory Network of Nonlinear Coupled Oscillators <i>Kuzmina M., Manykin E., and Surina I.</i>	433
A Layered Recurrent Neural Network for Feature Grouping <i>Wersing H., Steil J.J., and Ritter H.</i>	439
A Multilayer Real-Time Recurrent Learning Algorithm for Improved Convergence <i>Meert K., Ludik J.</i>	445
Increasing the Capacity of a Hopfield Network without Sacrificing Functionality <i>Storkey A.</i>	451
A Novel Associative Network Accommodating Pattern Deformation <i>Wang H., Bell D.</i>	457
Adaptive Noise Injection for Input Variables Relevance Determination <i>Grandvalet Y., Canu S.</i>	463
Input Selection with Partial Retraining <i>van de Laar P., Gielen S., and Heskes T.</i>	469
On the Complexity of Recognizing Iterated Differences of Polyhedra <i>Mayoraz E.</i>	475
Optimal Linear Regression on Classifier Outputs <i>Guermeur Y., d'Alché-Buc F., and Gallinari P.</i>	481
Learning Verification in Multilayer Neural Networks <i>Quélavoine R., Nocera P.</i>	487
Design of a Fault Tolerant Multilayer Perceptron with a Desired Level of Robustness <i>Kwon O.J., Bang S.Y.</i>	493
Mixtures of Experts Estimate A Posteriori Probabilities <i>Moerland P.</i>	499
Admissibility and Optimality of the Cascade-Correlation Algorithm <i>Doering A., Galicki M., and Witte H.</i>	505
The Effective VC Dimension of the n-tuple Classifier <i>Bradshaw N.P.</i>	511

## Part IV: Signal Processing: Blind Source Separation, Vector Quantization, and Self-Organization

From Neural Principal Components to Neural Independent Components <i>Oja E., Karhunen J., and Hyvärinen A.</i>	519
Entropy Optimization - Application to Blind Source Separation <i>Taleb A., Jutten C.</i>	529
Improving the Performance of Infomax Using Statistical Signal Processing Techniques <i>Koehler B.-U., Lee T.-W., and Orglmeister R.</i>	535
A Maximum Likelihood Approach to Nonlinear Blind Source Separation <i>Pajunen P., Karhunen J.</i>	541
A Perceptron-Based Approach to Piecewise Linear Modeling with an Application to Time Series <i>Mattavelli M., Amaldi E., and Vesin J.-M.</i>	547
Local Independent Component Analysis by the Self-Organizing Map <i>Oja E., Valkealahti K.</i>	553
Model Breaking Detection Using Independent Component Classifier <i>Linares G., Nocera P., and Meloni H.</i>	559
Neural Network Based Processing for Smart Sensors Arrays <i>Paraschiv-Ionescu A., Jutten C., and Bouvier G.</i>	565
Application of the MEC Network to Principal Component Analysis and Source Separation <i>Fiori S., Uncini A., and Piazza F.</i>	571
Semi-Blind Source Parameter Separation <i>Joutsensalo J.</i>	577
Kernel Principal Component Analysis <i>Schölkopf B., Smola A.J., and Müller K.-R.</i>	583
An Empirical Comparison of Dimensionality Reduction Techniques for Pattern Classification <i>Balachander T., Kothari R., and Cuaing H.</i>	589
Topology Representing Networks for Intrinsic Dimensionality Estimation <i>Bruske J., Sommer G.</i>	595
SOM Based Visualization in Data Analysis <i>Häkkinen E., Koikkalainen P.</i>	601
ARTMAP-DS: Pattern Discrimination by Discounting Similarities <i>Carpenter G.A., Wilson F.D.M.</i>	607
A Self-Organizing Network that Can Follow Non-stationary Distributions <i>Fritzke B.</i>	613
Phase Transitions in Soft Topographic Vector Quantization <i>Burger M., Graepel T., and Obermayer K.</i>	619

Vector Quantization by Optimal Neural Gas <i>Herrmann M., Villmann T.</i>	625
Convergences of the Kohonen Maps: A Dynamical System Approach <i>Fort J.-C., Pagès G.</i>	631
Local Subspace Classifier <i>Laaksonen J.</i>	637
Asymptotic Distributions Associated to Unsupervised Oja's Learning Equation <i>Delmas J.P.</i>	643
The Probabilistic Growing Cell Structures Algorithm <i>Vlassis N.A., Dimopoulos A., and Papanikolaou G.</i>	649
Unsupervised Coding with LOCOCODE <i>Hochreiter S., Schmidhuber J.</i>	655
Wave Propagation in Self-Organizing Feature Maps as a Means for the Representation of Temporal Sequences <i>Dobrzewski B., Ruwisch D., and Bode M.</i>	661
Contextual Kohonen SOM with Orthogonal Weight Estimator Principle <i>Pican N.</i>	667

## Part V: Robotics, Adaptive Autonomous Agents, and Control

Self-Organizing Maps for Robot Control <i>Ritter H.</i>	675
Cognition is Not Computation; Evolution is Not Optimisation <i>Harvey I.</i>	685
Information Theoretic Implications of Embodiment for Neural Network Learning <i>Scheier C., Pfeifer R.</i>	691
Visual Attention and Learning of a Cognitive Robot <i>Tani J.</i>	697
Feature Binding Through Temporally Correlated Neural Activity in a Robot Model of Visual Perception <i>Egner S., Scheier C.</i>	703
Modeling Obstacle Avoidance Behavior of Flies Using an Adaptive Autonomous Agent <i>Huber S.A., Bülthoff H.H.</i>	709
Minimalistic Approach to 3D Obstacle Avoidance Behavior from Simulated Evolution <i>Neumann T.R., Huber S.A., and Bülthoff H.H.</i>	715
Synthesis of Developmental and Evolutionary Modeling of Adaptive Autonomous Agents <i>Vaario J., Shimohara K.</i>	721

Hebbian Multilayer Network in a Wheelchair Robot <i>Bühlmeier A., Steiner P., Rossmann M., Goser K., and Manteuffel G.</i>	727
Neural Networks in an Artificial Life Perspective <i>Nolfi S., Parisi D.</i>	733
Incremental Acquisition of Local Networks for the Control of Autonomous Robots <i>del R. Millán J.</i>	739
Robot-Animal Interaction <i>Lund H.H.</i>	745
The View-Graph Approach to Visual Navigation and Spatial Memory <i>Mallot H.A., Franz M., Schölkopf B., and Bühlhoff H.H.</i>	751
Place Sequence Learning for Navigation <i>Trullier O., Meyer J.-A.</i>	757
Learning to Communicate Through Imitation in Autonomous Robots <i>Billard A., Hayes G.</i>	763
On Learning Soccer Strategies <i>Salustowicz R., Wiering M., and Schmidhuber J.</i>	769
A Model of Logic Like Inference by Memory Model PATON <i>Mizutani K., Omori T.</i>	775
Force Feedback Control of an Assembly Robot by Neural Networks <i>Saadia N., Amirat Y., Pontnau J., and Ramdane-Cherif A.</i>	781
Neural Force Control (NFC) for Complex Manipulator Tasks <i>Dapper M., Maass R., Zahn V., and Eckmiller R.</i>	787
A Hybrid Path Planning System Combining the A*-Method and RBF-Networks* <i>Frontzek T., Goerke N., and Eckmiller R.</i>	793
An ASSOM Neural Network to Represent Actions Performed by an Autonomous Agent <i>Chella A., Gaglio S., Mulia V., and Sajeve G.</i>	799
The Application of Radial Basis Function Networks with Implicit Continuity Constraints <i>Salomon R.</i>	805
Autonomous Vehicle Guidance Using Analog VLSI Neuromorphic Sensors <i>Indiveri G., Verschure P.</i>	811
Neural Network Visual Tracking System <i>Ortmann V., Eckmiller R.</i>	817
Pole-Balancing with Different Evolved Neurocontrollers <i>Pasemann F.</i>	823
Calibration of Parallel Robots by Evolutionary Algorithm <i>Kokcharov I.</i>	831
On Use of ANNs to Model and to Control Robot Manipulators <i>Dulęba I., Muszyński R.</i>	837

Identification of the Electric Arc of a Furnace <i>Ledoux C., Bonnard F.</i>	843
On Using MLPs for Step Size Control in Echo Cancellation for Hands-Free Telephone Sets <i>Breining C., Alt G.</i>	849
Neurocontrol of Nonlinear Dynamic Systems Subject to Unmeasured Disturbance Inputs <i>Habtom R., Litz L.</i>	855
Multiple Multivariate Regression and Global Optimization in a Large Scale Thermodynamical Application <i>Zaragoza H., Gallinari P.</i>	861
A Neural Network for Parameter Estimation of a DC Motor for Feed-Drives <i>Desforges X., Habbadi A.</i>	867

## Part VI: Speech, Vision, and Pattern Recognition

State-of-the-Art and Recent Progress in Hybrid HMM/ANN Speech Recognition <i>Boulevard H.</i>	875
Perceptual Grouping and Attention During Cortical Form and Motion Processing <i>Grossberg S.</i>	885
Development of Shape Primitives from Images of Composite Objects Represented by Complex Cells <i>Shams L., von der Malsburg C.</i>	895
Corner Detection in Color Images by Multiscale Combination of End-Stopped Cortical Cells <i>Würtz R.P., Lourens T.</i>	901
Constructing the Cyclopean View <i>Henkel R.D.</i>	907
SAIM: A Model of Visual Attention and Neglect <i>Heinke D., Humphreys G.W.</i>	913
Object Selection with Dynamic Neural Maps <i>Hamker F.H., Gross H.-M.</i>	919
A Pre-Processing Technique Based on the Wavelet Transform for Linear Autoassociators with Applications to Face Recognition <i>Yang F., Paindavoine M., and Abdi H.</i>	925
Recognition and Segmentation of Components of a Face by a Multi-Resolution Neural Network <i>Fukushima K., Hashimoto H.</i>	931
Sensor Fusion for Mine Detection with the RNN <i>Gelenbe E., Koçak T., and Collins L.</i>	937

Image Segmentation for 3D Object Recognition Using Bidirectional Networks <i>Fujita T., Ando H.</i>	943
A Feature Map Approach to Pose Estimation Based on Quaternions <i>Winkler S., Wunsch P., and Hirzinger G.</i>	949
Facial Feature Detection Using Neural Networks <i>Varchmin A.C., Rae R., and Ritter H.</i>	955
Random Neural Network Recognition of Shaped Objects in Strong Clutter <i>Bakircioğlu H., Gelenbe E., and Carin L.</i>	961
AdaBoosting Neural Networks: Application to on-line Character Recognition <i>Schwenk H., Bengio Y.</i>	967
Cursive Script Recognition with Time Delay Neural Networks Using Learning Hints <i>Marti U.-V., Kaufmann G., and Bunke H.</i>	973

## Part VII: Prediction, Forecasting, and Monitoring

A Powerful Tool for Fitting and Forecasting Deterministic and Stochastic Processes: The Kohonen Classification <i>de Bodt E., Grégoire P., and Cottrell M.</i>	981
Neural Model Selection: How to Determine the Fittest Criterion? <i>Mangeas M.</i>	987
Long Term Forecasting by Combining Kohonen Algorithm and Standard Prevision <i>Cottrell, M., Girard B., and Rousset P.</i>	993
Predicting Time Series with Support Vector Machines <i>Müller K.-R., Smola A.J., Rätsch G., Schölkopf B., Kohlmorgen J., and Vapnik V.N.</i>	999
An Extended Neuron Model for Efficient Time-Series Generation and Prediction <i>Burg T., Tschichold-Gürman N.</i>	1005
Different Model Types for Short-Term Forecasting of Characteristic Load Points <i>Monteyne M., Salomé T., de Viron F., Renders J.-M., Doulliez P., Dongier F., and Claus J.</i>	1011
Assessing Error Bars in Distribution Load Curve Estimation <i>Fidalgo J.N., Matos M.A., and Ponce de Leão M.T.</i>	1017
Building High Performant Classifiers by Integrating Bayesian Learning, Mutual Information and Committee Techniques - A Case Study in Time Series Prediction <i>Ragg T., Gutjahr S.</i>	1023
A Probability Estimation Based Criteria for Model Evaluation <i>Czernichow T., Muñoz A.</i>	1029

Short-Term Load Forecasting Based on Correlation Dimension Estimation and Neural Nets <i>Camastra F., Colla A.M.</i>	1035
Predictive Neural Models in Noisy Environment <i>Lenz T., Dorizzi B.</i>	1041
A Neural-FIR Predictor: Minimum Size Estimation Based on Nonlinearity Analysis of Input Sequence <i>Khalaf A.A.M., Nakayama K., and Hara K.</i>	1047
Modeling Conditional Probabilities with Committees of RVFL Networks <i>Husmeier D., Taylor J.G.</i>	1053
Classifying the Wear of Turning Tools with Neural Networks <i>Sick B.</i>	1059
Detection of Mobile Phone Fraud Using Supervised Neural Networks: A First Prototype <i>Moreau Y., Verrelst H., and Vandewalle J.</i>	1065
Wiener Type SOM- and MLP-classifiers for Recognition of Dynamic Modes <i>Visala A., Pitkänen H., and Halme A.</i>	1071
Analysis of Wake/Sleep EEG with Competing Experts <i>Kohlmorgen J., Müller K.-R., Rittweger J., and Pawelzik K.</i>	1077
Nonlinear Modelling of the Daily Heart Rhythm <i>Silipo R., Deco G., Vergassola R., Schittenkopf C., and Gremigni C.</i>	1083
Linear and Nonlinear Combinations of Connectionist Models for Local Diagnosis in Real-Time Telephone Network Traffic Management <i>Bennani Y., Bossaert F., and Didelet E.</i>	1089
Neural Network Adaptive Modeling of Battery Discharge Behavior <i>Gérard O., Patillon J.-N., and d'Alché-Buc F.</i>	1095
Neural Combustion Control <i>Müller R.</i>	1101
A Neural Network Based Fault Detector for Power Distribution Systems <i>Assef Y., Bastard P., and Meunier M.</i>	1107
Visualization and Analysis of Voltage Stability Using Self-Organizing Neural Networks <i>Handschin E., Kuhlmann D., and Rehtanz C.</i>	1113
Classification of Meteorological Patterns <i>Ambühl J., Cattani D., and Eckert P.</i>	1119
Mapping of Soil Contamination by Using Artificial Neural Networks and Multivariate Geostatistics <i>Kanevski M., Demyanov V., and Maignan M.</i>	1125

## Part VIII: Implementations

Pseudo-Resistive Networks and their Applications to Analog Collective Computation <i>Vittoz E.A.</i>	1133
Implementation of CNN Computing Technology <i>Roska T.</i>	1151
Implementation of a Masking Network for Speech Perception <i>Chiueh T.-D., Bu L.</i>	1157
Real-Time Analog VLSI Sensors for 2-D Direction of Motion <i>Deutschmann R.A., Higgins C.M., and Koch C.</i>	1163
An Improved Multiplexed Resistive Network for Analog Image Preprocessing <i>Yi C.-H., Schlabbach R., Kroth H., and Klar H.</i>	1169
An Analog VLSI Computational Engine for Early Vision Tasks <i>Bisio G.M., Bo G.M., Confalone M., Raffo L., Sabatini S.P., and Zizola M.P.</i>	1175
Spatio-temporal Filter Adjustment from Evaluative Feedback for a Retina Implant <i>Becker M., Eckmüller R.</i>	1181
Simulation of Spiking Neural Networks on Different Hardware Platforms <i>Jahnke A., Schönauer T., Roth U., Mohraz K., and Klar H.</i>	1187
Adaptive On-line Learning Algorithm for Robust Estimation of Parameters of Noisy Sinusoidal Signals <i>Lobos T., Cichocki A., Kostyla P., and Waclawek Z.</i>	1193
Analog Sequential Architecture for Neuro-Fuzzy Models VLSI Implementation <i>Moreno J.M., Madrenas J., Alarcón E., and Cabestany J.</i>	1199
A Mixed-Signal VLSI Circuit for Skeletonization by Grassfire Transformation <i>Oláh M., Masa P., and Lörincz A.</i>	1205
Analysis and Improvement of Neural Network Robustness for On-Board Satellite Image Processing <i>Muller J.-D., Cheynet P., and Velazco R.</i>	1211
On-Line Hebbian Learning for Spiking Neurons: Architecture of the Weight-Unit of NESPINN <i>Roth U., Jahnke A., and Klar H.</i>	1217
Measurement of Finite-Precision Effects in Handwriting- and Speech-Recognition Algorithms <i>Säckinger E.</i>	1223

A Hardware Implementation of Hierarchical Neural Networks for Real-Time Quality Control Systems in Industrial Applications <i>Baratta D., Bo G.M., Caviglia D.D., Valle M., Canepa G., Parenti R., and Penno C.</i>	1229
The SAND Neurochip and Its Embedding in the MiND System <i>Fischer T., Eppler W., Gemmeke H., Kock G., and Becher T.</i>	1235
Short- and Long-Term Dynamics in a Stochastic Pulse Stream Neuron Implemented in FPGA <i>Rossmann M., Bühlmeier A., Manteuffel G., and Goser K.</i>	1241
FPGA Implementation of a Network of Neuronlike Adaptive Elements <i>Pérez-Uribe A., Sanchez E.</i>	1247
Handwritten Digit Recognition with Binary Optical Perceptron <i>Saxena I., Moerland P., Fiesler E., and Pourzand A.</i>	1253
Mapping of Radial Basis Function Networks to Partial Tree Shape Parallel Neurocomputer <i>Kolunummi P., Hämäläinen T., and Saarinen J.</i>	1259
Attractor Dynamics in an Electronic Neural Network <i>Del Giudice P., Fusi S.</i>	1265
Author Index	1271