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Preface

Neural computation is considered here in the dual perspective of *analysis* (as reverse engineering) and *synthesis* (as direct engineering). As a science of *analysis*, neural computation seeks to help neurology, brain theory, and cognitive psychology in the understanding of the functioning of the nervous system by means of computational models of neurons, neural nets, and subcellular processes, with the possibility of using electronics and computers as a “laboratory” in which cognitive processes can be simulated and hypotheses proven without having to act directly upon living beings.

As a *direct engineering* (how can we build sub-symbolic intelligent machines?), neural computation seeks to complement the symbolic perspective of artificial intelligence (AI), using the biologically inspired models of distributed self-programming and self-organizing networks, to solve those non-algorithmic problems of function approximation and pattern classification having to do with changing and only partially known environments. Fault tolerance and dynamic reconfiguration are other basic advantages of neural nets.

In the sea of meetings, congresses, and workshops on ANNs, IWANN’97, the fourth International Work-Conference on Artificial Neural Networks, that took place in Lanzarote, Canary Islands (Spain), 4 - 6 June, 1997, focused on the three subjects that most worry us:

- (1) The search for biologically inspired new models of local computation architectures and learning along with the organizational principles behind the complexity of intelligent behavior.
- (2) The search for some methodological contributions in the analysis and design of knowledge-based ANNs, instead of “blind nets”, and in the reduction of the knowledge level to the sub-symbolic implementation level.
- (3) The cooperation with symbolic AI, with the integration of connectionist and symbolic processing in hybrid and multi-strategy approaches for perception, decision, and control tasks, as well as for case-based reasoning, concept formation, and learning.

To contribute to the formulation and partial solution of these global topics, IWANN’97 offered a brain-storming interdisciplinary forum in advanced neural computation for scientists and engineers from biology, neuroanatomy, computational neurophysiology, molecular biology, biophysics, mathematics, computer science, artificial intelligence, parallel computing, electronics, cognitive sciences, and all the concerned applied domains (sensory systems and signal processing, monitoring, diagnosis, classification and decision making, intelligent control and supervision, perceptual robotics and communication systems).

The papers presented here correspond to talks delivered at IWANN’97, organized by the Universidad Nacional de Educación a Distancia (UNED), Madrid, Universidad de Las Palmas de Gran Canaria, and Universidad Politécnica de

Catalunya, in cooperation with the Asociación Española de Redes Neuronales (AERN), IFIP Working Group in Neural Computer Systems, WG10.6, Spanish RIG IEEE Neural Networks Council, and the UK&RI Communication Chapter of IEEE.

Sponsorship has been obtained from the Spanish CICYT and DGICYT (MEC) and the organizing universities (UNED, Las Palmas, and Catalunya).

After the evaluation process, 142 papers were accepted for oral presentation or poster, according to the recommendations of reviewers and the author's preferences. The three extended papers corresponding to the invited speakers (DeFelipe, Eckhorn, and Jenne) have been included as introductions to the corresponding topics of neuroscience, neural modeling in perception, and implementation.

We would like to thank all the authors as well as all the members of the international program committee for their labor in the production and evaluation of the papers. Only by proceeding with this severe averaging of the external experts' reviews, could we be sure to maximize the originality, technical quality, and scientific relevance of this event. We also would like to mention the effort of the authors of rejected papers, mainly because they were immature proposals or topics not covered by IWANN.

Last but not least, the editors would like to thank Springer-Verlag, in particular Alfred Hofmann, for the continuous and excellent cooperative collaboration from the first IWANN in Granada (1991, LNCS 540), the successive meetings in Sitges (1993, LNCS 686) and Torremolinos (1995, LNCS 930), and now in Lanzarote.

The papers published in this volume present the current situation in natural and artificial neural nets, with a significant increase in the contributions related to the biological foundations of neural computation and the computational perspective of neuroscience. We have organized the papers in the following sections:

- ❖ *Biological Foundations of Neural Computation*
- ❖ *Formal Tools and Computational Models of Neurons and Neural Nets Architectures*
- ❖ *Plasticity Phenomena (Maturing, Learning and Memory)*
- ❖ *Complex Systems Dynamics*
- ❖ *Cognitive Science and IA*
- ❖ *Neural Nets Simulation, Emulation and Implementation*
- ❖ *Methodology for Data Analysis, Task Selection and Nets Design*
- ❖ *Neural Networks for Communications, Control and Robotics*

This book endeavors to summarize the state of the art in neural computation with a focus on biologically inspired models of the natural nervous system. The complexity of the nervous system is now accepted, and a significant part of the scientific community has returned to anatomy and physiology, rejecting the temptation to use models which are clearly insufficient to cope with this complexity. At the same time there is an increasing interest in the use of computational models of neural networks to improve our understanding of the functional organization of the brain. Finally, there is

also evidence of a lack of formal tools enabling the hybridization of the symbolic and connectionistic perspectives of artificial intelligence in the common goal of making computational the knowledge of human experts in technical domains related with perception, communication, and control. All these developments, as reported in these proceeding, are needed in order to bring neuroscience and computation closer together. To recognize the disparity that exists between the richness and fineness of the nervous system and the crudeness we use in handling it is a good step forward.

Madrid, March 1997

J. Mira Mira

R. Moreno-Díaz

J. Cabestany Moncusi

Contents

1. Biological Foundations of Neural Computation

Microcircuits in the Brain <i>J. De Felipe</i>	1
Some Reflections on the Relationships Between Neuroscience and Computation <i>J. Mira, A.E. Delgado</i>	15
Different Types of Temporal Correlations Obtained in Pairs of Thalamic Visual Neurons Suggest Different Functional Patterns of Connectivity <i>C. Rivadulla, J. Cudeiro</i>	27
Development of <i>On-Off</i> and <i>Off-On</i> Receptive Fields Using a Semistochastic Model <i>E. M. Muro, P. Isasi, M. A. Andrade, F. Morán</i>	35
The Classification of Spatial, Chromatic, and Intensity Features of Simple Visual Stimuli by a Network of Retinal Ganglion Cells <i>S. Shoham, R. Osan, J. Ammermuller, A. Branner, E. Fernández, R. A. Normann</i>	44
Geometric Model of Orientation Tuning Dynamics in Striate Neurons <i>I.A. Shevelev, K.A. Saltykov, G.A. Sharaev</i>	54
Neuronal Circuitry in the Medial Cerebral Cortex of Lizards <i>J.A. Luis de la Iglesia, C. López-García</i>	61
Interactions Between Environmental and Hormonal Oscillations Induce Plastic Changes in a Simple Neuroendocrine Transducer <i>R. Alonso, I. López-Coviella, F. Hernández-Díaz, P. Abreu, E. Salido, L. Tabares</i>	72
Current Source Density Analysis as a Tool to Constrain the Parameter Space in Hippocampal CA1 Neuron Models <i>P. Varona, J. M. Ibarz, J. A. Sigüenza, O. Herrerías</i>	82
Spontaneous Activity of Hippocampal Cells in Various Physiological States <i>N. Stollenwerk, L. Menéndez de la Prida, J.V. Sánchez-Andrés</i>	91

Neural Network Model of Striatal Complex <i>B. Aleksandrovsky, F. Brücher, G. Lynch, R. Granger</i>	103
Symmetry and Self-Organization of the Oculo-Motor Neural Integrator <i>T. J. Anastasio</i>	116
Quantal Neural Mechanisms Underlying Movement Execution and Motor Learning <i>J.M. Delgado-García, A. Gruart, J.A. Domingo, J.A. Trigo</i>	124
A Model of Cerebellar Saccadic Motor Learning Using Qualitative Reasoning <i>J.L. Krichmar, G.A. Ascoli, L. Hunter, J.L. Olds</i>	133
Balance Between Intercellular Coupling and Input Resistance as a Necessary Requirement for Oscillatory Electrical Activity in Pancreatic β -Cells <i>E. Andreu, R. Pomares, B. Soria, J.V. Sánchez-Andrés</i>	146
Mechanisms of Synchronization in the Hippocampus and Its Role Along Development <i>L. Menéndez de la Prida, J.V. Sánchez-Andrés</i>	154
Analysis of Synfire Chains Above Saturation <i>R.M. Reyes, C.J. Pérez Vicente</i>	162
Allometry in the Justo Gonzalo's Model of the Sensorial Cortex <i>I. Gonzalo</i>	169
2. Formal Tools and Computational Models of Neurons and Neural Net Architectures	
Systems Models of Retinal Cells: A Classical Example <i>R. Moreno-Díaz</i>	178
A Generic Formulation of Neural Nets as a Model of Parallel and Self-Programming Computation <i>J. Mira, J.C. Herrero, A.E. Delgado</i>	195
Using an Artificial Neural Network for Studying the Interneuronal Layer of a Leech Neuronal Circuit <i>J.M. Santos, L. Szczupak</i>	207

Capacity and Parasitic Fixed Points Control in a Recursive Neural Network <i>V. Giménez , M. Pérez-Castellanos, J. Rios Carrion, F. de Mingo</i>	217
The Use of Prior Knowledge in Neural Network Configuration and Training <i>M. Hilario, A. Rida</i>	227
A Model for Heterogeneous Neurons and Its Use in Configuring Neural Networks for Classification Problems <i>J.J. Valdés, R. García</i>	237
A Computation Theory for Orientation-Selective Simple Cells Based on the MAP Estimation Principle and Markov Random Fields <i>M. N. Shirazi, Y. Nishikawa</i>	247
Competition Between Feed-Forward and Lateral Information Processing in Layered Neural Networks <i>A.C.C. Coolen, L. Viana</i>	257
Computing Functions with Spiking Neurons in Temporal Coding <i>B. Ruf</i>	265
An Introduction to Fuzzy State Automata <i>L. Reyneri</i>	273
Statistical Analysis of Regularization Constant – From Bayes, MDL and NIC Points of View <i>S.-i. Amari, N.Murata</i>	284
Building Digital Libraries from Paper Documents, Using ART Based Neuro-Fuzzy Systems <i>R. Sanz Guadarrama, Y.A. Dimitriadis , G.I. Sainz Palmero, J.M. Cano Izquierdo, J. López Coronado</i>	294
Parallelization of Connectionist Models Based on a Symbolic Formalism <i>J. Santos, M. Cabarcos, R.P. Otero , J. Mira</i>	304
Generic Neural Network Model and Simulation Toolkit <i>M. García del Valle, C. García-Orellana, F.J. López-Aligué, I. Acevedo-Sotoca</i>	313

A Neural-Fuzzy Technique for Interpolating Spatial Data via the Use of Learning Curve <i>P.M. Wong, K.W. Wong, C.C. Fung, T.D. Gedeon</i>	323
Task Decomposition Based on Class Relations: A Modular Neural Network Architecture for Pattern Classification <i>B.-L. Lu, M. Ito</i>	330
Lower Bounds of Computational Power of a Synaptic Calculus <i>J.P. Neto, J.F. Costa, H. Coelho</i>	340
Feed Forward Neural Network Entities <i>A. Hadjiprocopis, P. Smith</i>	349
3. Plasticity Phenomena (Maturing, Learning and Memory)	
Astrocytes and Slow Learning in the Formation of Distal Cortical Associations <i>J.G. Wallace, K. Bluff</i>	360
Adaptation and Other Dynamic Effects on Neural Signal Transfer <i>L. Orz�, E. L�bos</i>	370
Hebbian Learning in Networks of Spiking Neurons Using Temporal Coding <i>B. Ruf, M. Schmitt</i>	380
An Associative Learning Model for Coupled Neural Oscillators <i>J. Nishii</i>	390
Random Perturbations to Hebbian Synapses of Associative Memory Using a Genetic Algorithm <i>A. Imada, K. Araki</i>	398
Phase Memory in Oscillatory Networks <i>M.G. Kuzmina, I.I. Surina</i>	408
Strategies for Autonomous Adaptation and Learning in Dynamical Networks <i>N. H. Farhat, E. Del Moral Hernandez, G.-H. Lee</i>	417
Modeling the Parallel Development of Multiple Featuremaps and Topography in Visual Cortex <i>W.A. Fellenz</i>	427

Stability and Hebbian Learning in Populations of Probabilistic Neurons	433
<i>F.B. Rodríguez, V. López</i>	
Stochastic Approximation Techniques and Circuits and Systems Associated Tools for Neural Network Optimization	443
<i>H. Dedieu, A. Flanagan, A. Robert</i>	
Recursive Hetero-associative Memories for Translation	453
<i>M.L. Forcada, R. P. Neco</i>	
Universal Binary and Multi-valued Neurons Paradigm: Conception, Learning, Applications	463
<i>N. N. Aizenberg, I. N. Aizenberg</i>	
Learning a Markov Process with a Synchronous Boltzmann Machine	473
<i>U. Iturrarán, A. J. Jones</i>	
The Alpha-EM Algorithm: A Block Connectable Generalized Learning Tool for Neural Networks	483
<i>Y. Matsuyama</i>	
Training Simple Recurrent Networks Through Gradient Descent Algorithms	493
<i>M.A. Castaño, F. Casacuberta, A. Bonet</i>	
On Simultaneous Weight and Architecture Learning	501
<i>S. Rementeria, X. Olabe</i>	
Evolution of Structure and Learning – A GP approach	510
<i>K.G. Char</i>	
4. Complex Systems Dynamics	
Self-Organizing Formation of Receptive Fields and Competitive Systems	518
<i>S. Maekawa, H. Sawai</i>	
Optimizing a Neural Network Architecture with an Adaptive Parameter Genetic Algorithm	527
<i>A. Ribert, E. Stocker, Y. Lecourtier, A. Ennaji</i>	
Self-Organizing Symbolic Learned Rules	536
<i>A. Bahamonde, E.A. de la Cal, J. Ranilla, J. Alonso</i>	

Viewing a Class of Neurodynamics on Parameter Space <i>J. Feng, D. Brown</i>	546
Hopfield Neural Network Applied to Optimization Problems: Some Theoretical and Simulation Results <i>G. Joya, M.A. Atencia, F. Sandoval</i>	556
A Genetic Approach to Computing Independent AND Parallelism in Logic Programs <i>C.R. Vela, C.Alonso, R. Varela, J. Puente</i>	566
Predicting Toxicity of Complex Mixtures by Artificial Neural Networks <i>F. Gagné, C. Blaise</i>	576
Regularisation by Convolution in Symmetric- α -Stable Function Networks <i>C.G. Molina, W.J. Fitzgerald, P.J.W. Rayner</i>	588
Continuation of Chaotic Fields by RBFNN <i>I. Grabec, S. Mandelj</i>	597
Improving the Performance of Piecewise Linear Separation Incremental Algorithms for Practical Hardware Implementations <i>A. Chinea, J.M. Moreno, J. Madrenás, J. Cabestany</i>	607
 5. Cognitive Science and AI	
Accurate Decomposition of Standard MLP Classification Responses into Symbolic Rules <i>G. Bologna, C. Pellegrini</i>	617
A Hybrid Intelligent System for the Preprocessing of Fetal Heart Rate Signals in Antenatal Testing <i>B. Guijarro-Berdiñas, A. Alonso-Betanzos, S. Prados-Méndez, O. Fernández-Chaves, M. Álvarez-Soane, F. Uceda-Pardinas</i>	628
The Pattern Extraction Architecture: A Connectionist Alternative to the Von Neumann Architecture <i>L.A. Coward</i>	634
A Two-level Heterogenous Hybrid Model <i>N.B. Szirbik</i>	644

Interpretation of a Hierarchical Neural Network <i>J. Rahmel, C. Blum, P. Hahn</i>	651
Cognitive Processes in Social Interaction – A Neural Networks Approach <i>J. Barahona da Fonseca, I. Barahona da Fonseca, J. Simões da Fonseca</i>	660
Adding Phase to Recurrent Backpropagation Networks: An Application to Binding Tasks in Vision <i>H. Majewski, J. Wiles</i>	668
Schema-Based Learning: Biologically Inspired Principles of Dynamic Organization <i>F.J. Corbacho, M.A. Arbib</i>	678
6. Neural Nets Simulation, Emulation and Implementation	
Digital Connectionist Hardware: Current Problems and Future Challenges <i>P. Jenne</i>	688
EpsilonNN - A Specification Language for the Efficient Parallel Simulation of Neural Networks <i>A. Strey</i>	714
Forward-Backward Building Blocks for Evolving Neural Networks with Intrinsic Learning Behaviors <i>S.M. Lucas</i>	723
A Cascade Network Algorithm Employing Progressive RPROP <i>N.K. Treadgold, T.D. Gedeon</i>	733
Tight Bounds on the Size of Neural Networks for Classification Problems <i>V. Beiu, T. de Pauw</i>	743
On the Possibilities of the Limited Precision Weights Neural Networks in Classification Problems <i>S. Draghici, I. K. Sethi</i>	753
A Modified Backpropagation Algorithm to Tolerate Weight Errors <i>J.L. Bernier, J. Ortega, A. Prieto</i>	763

A High Performance SOFM Hardware-System <i>S. Rüping, M. Porrman, U. Rückert</i>	772
On Application Incentive and Constraints for Neural Network Hardware Development <i>A. König</i>	782
A Fast Kohonen Net Implementation for Spert-II <i>K. Asanović</i>	792
Synthesis and Optimization of a Bit-Serial Pipeline Kernel Processor <i>J. Madrenás, G. Ruiz, J.M. Moreno, J. Cabestany</i>	801
A Hardware Implementation of CNNs Based on Pulse Stream Techniques <i>F. Colodro, A. Torralba, R. González, L.G. Franquelo</i>	811
Evaluation of the CNAPS Neuro-Computer for the Simulation of MLPs with Receptive Fields <i>B. Granado, P. Garda</i>	817
AFAN, a Tool for the Automatic Design of Fuzzy and Neural Controllers <i>R.G. Carvajal, A. Torralba, F. Colodro, L.G. Franquelo</i>	825
A Fully Stochastic Fuzzy Logic Controller <i>F. Colodro, A. Torralba, R. González, L.G. Franquelo</i>	834
Multi-neural Networks Hardware and Software Architecture: Application of the Divide To Simplify Paradigm DTS <i>A. Chebira, K. Madani, G. Mercier</i>	841
A Fuzzy Controller for Switching Regulators with Programmable Control Surfaces <i>J. Matas, L. García de Vicuña, M. López, J.M. Moreno</i>	851
7. Methodology for Data Analysis, Task Selection and Nets Design	
The Kohonen Algorithm: A Powerful Tool for Analyzing and Representing Multidimensional Quantitative and Qualitative Data <i>M. Cottrell, P. Rousset</i>	861

Constrained Neural Network for Estimating Sensor Reliability in Sensors Fusion <i>A. Guérin-Dugué, P. Teissier, J.-L. Schwartz, J. Héroult</i>	872
Statistical Analysis of the Main Parameters in the Definition of Radial Basis Function Networks <i>I. Rojas, O. Valenzuela, A. Prieto</i>	882
Structural Level Comparison of Two Basic Paradigms in Neural Computation <i>J.R. Álvarez</i>	892
Symmetry: Between Indecision and Equality of Choice <i>E.L. Barakova, I. Spaanenburg</i>	903
A Non-convergent On-Line Training Algorithm for Neural Networks <i>J. Utans</i>	913
Using Classical and Evolutive Neural Models in Industrial Applications: A Case Study for an Automatic Coin Classifier <i>J.M. Moreno, J. Madrenás, J. Cabestany, J.R. Laina</i>	922
A New Type of Unsupervised Growing Neural Network for Biological Sequence Classification That Adopts the Topology of a Phylogenetic Tree <i>J. Dopazo, H. Wang, J.M. Carazo</i>	932
Classification of the Onset of Respiratory Difficulties in Ventilation Assisted Neonates <i>E. Braithwaite, J. Dripps, A. Lyon, A.F. Murray</i>	942
A Neural Network Approach for Symbolic Interpretation in Critical Care <i>V. Moret-Bonillo, J. Díaz Fernández, E. Hernández Pereira</i>	952
ECG Beat Classification with Synaptic Delay Based Artificial Neural Networks <i>R.J. Duro, J. Santos</i>	962
Neural Network-Based Insulin Infusion Control for an Insulin-Pump, Using Discontinuous Blood Glucose Measurements <i>F. Andrianasy, M. Milgram</i>	971

Infraclinic Breast Carcinoma: Application of Neural Networks
Techniques for the Indication of Radioguided Biopsias 978
Ll. Porta, R. Villa, L. Prieto, E. Andia, E. Valderrama

Detection of Glaucoma by Means of ANNs 986
*M. Reyes de los Mozos, E. Valderrama, R. Villa, J. Roig, A. Antón,
J.C. Pastor,*

A Comparative Analysis of the Neonatal Prognosis Problem Using
Artificial Neural Networks, Statistical Techniques and Certainty
Management Techniques 995
A. Alonso-Betanzos, E. Mosquera-Rey, B. Baldonado del Rio

8. Neural Networks for Perception

Models of Visual Processing Derived from Cortical Microelectrode
Recordings 1005
R. Eckhorn

Rotation Invariant IR Object Recognition Using Adaptive Kernel
Subspace Projections with a Neural Network 1028
M.H.W. Smart

Neural Networks Based Projectivity Invariant Recognition of Flat
Patterns 1038
G. Joya, F. Sandoval

The Instant Laboratory: Bringing Intelligence to the Workfloor 1048
L. Spaanenburg, J. deGraaf, J.A.G. Nijhuis, H. Stevens, W. Wichers

A Biological Front-End Processing for Speech Recognition 1058
J. M. Ferrández, D. del Valle, V. Rodellar, P. Gómez

Non Parametric Coding of Speech by Means of a MLP with Hints 1068
G. Hernández Ábrego, E. Monte, J.B. Mariño

Gray-Level Object Segmentation with a Network of FitzHugh-
Nagumo Oscillators 1075
A. Labbi, R. Milanese, H. Bosch

Multidimensional Filtering Inspired by Retino-cortical Projection:
Application to Texture Segmentation 1085
C. Croll, D. Pellerin, J. Héroult

A Competitive Neural Network for Blind Separation of Sources Based on Geometric Properties	1095
<i>A. Prieto, C.G. Puntonet, B. Prieto, M. Rodríguez-Álvarez</i>	
A New Bio-inspired Algorithm for Early Vision Edge Detection and Image Segmentation	1107
<i>C.-H. Yi, R. Schlabbach, H. Kroth, H. Klar</i>	
Function of Biological Asymmetrical Neural Networks	1115
<i>N. Ishii, K.-i. Naka</i>	
Identification of Spectral Features as Sound Localization Cues in the External Ear Acoustics	1126
<i>P. Hofman, J. van Opstal</i>	
Phoneme Recognition by Means of Predictive Neural Networks	1136
<i>F. Freitag, E. Monte</i>	
Shift-Invariant Fuzzy-Morphology Neural Network for Occluded Target Recognition	1144
<i>Y. Won, B.-H. Lee, Y.-C. Baek, J.-S. Lee</i>	
A Comparative Study Between Linear and Nonlinear Speech Prediction	1154
<i>M. Faúndez, E. Monte, F. Vallverdú</i>	
Recognition Model with Extension Fields	1164
<i>P. Kalocsai</i>	
A GA-optimized Neural Network for Classification of Biological Particles from Electron-Microscopy Images	1174
<i>J.J. Merelo, A. Prieto, F. Morán, R. Marabini, J.M. Carazo</i>	
Application of Artificial Neural Networks to the Design and Implementation of Electronic Olfactory Systems	1183
<i>J. Brezmes, N. Canyellas, E. Llobet, X. Vilanova, X. Correig</i>	
Application of a Multilayer Discrete-Time CNN to Deformable Models	1193
<i>D.L. Vilariño, D. Cabello, A. Mosquera, J.M. Pardo</i>	
Spoken-Digit Recognition Using Self-Organizing Maps with Perceptual Pre-processing	1203
<i>F. Díaz, J.M. Ferrández, P. Gómez, V. Rodellar, V. Nieto</i>	

9. Neural Networks for Communications, Control and Robotics

- | | |
|---|------|
| Noise Discrimination and Autoassociative Neural Networks
<i>C. Santa Cruz, J.R. Dorronsoro, J.A. Sigüenza, V. López</i> | 1213 |
| Modified Boltzmann Machine for an Efficient Distributed Implementation
<i>J. Ortega, L. Parrilla, A. Prieto, A. Lloris, C. G. Puntonet</i> | 1221 |
| Simulation of MPEG Video Traffic Using Neural Networks
<i>A. Reyes, E. Casilari, A. Díaz-Estrella, F. Sandoval</i> | 1233 |
| A Continuous Time Structure for Filtering and Prediction Using Hopfield Neural Networks
<i>H.M. Pérez-Meana, M. Nakano-Miyatake</i> | 1241 |
| Structure-Adaptable Neurocontrollers: A Hardware-Friendly Approach
<i>A. Pérez-Uribe, E. Sánchez</i> | 1251 |
| A New QRS Detector Based on Neural Network
<i>C. García-Berdónés, J. Narváez, U. Fernández, F. Sandoval</i> | 1260 |
| Application of Neural Networks for Local Modelization of the Boiler Furnace in Thermal Power Plants
<i>O. Bella, C. Cortés, A. Tomás</i> | 1270 |
| Evolved Neurocontrollers for Pole-Balancing
<i>F. Pasemann, V. Dieckmann</i> | 1279 |
| Artificial Neural Networks for the Computation of Traffic Queues
<i>P. Hernández-Arauzo, S. López-García, A. Bahamonde</i> | 1288 |
| Unsupervised Neural Network for Forecasting Alarms in Hydroelectric Power Plant
<i>P. Isasi-Viñuela, J.M. Molina-López, A. Sanchis de Miguel</i> | 1298 |
| Motor Sequence Processing with an Artificial Learning System
<i>T. Felzer, P. Hartmann, K. Hohm, P. Marenbach</i> | 1307 |
| On-line Continuous Weld Monitoring Using Neural Networks
<i>R.L. Millán, J.M. Quero, L.G. Franquelo</i> | 1315 |

Combining Reinforcement Learning and Differential Inverse Kinematics for Collision-Free Motion of Multilink Manipulators <i>P. Martín, J. del R. Millán</i>	1324
Short-Term Peak Load Forecasting: Statistical Methods Versus Artificial Neural Networks <i>F.J. Marín, F. Sandoval</i>	1334
Integration of Self-Organizing Feature Maps and Reinforcement Learning in Robotics <i>E. Cervera, A.P. del Poblil</i>	1344
Dynamic Path Planning with Spiking Neural Networks <i>U. Roth, M. Walker, A. Hilmann, H. Klar</i>	1355
Implementation of a Basic Reactive Behavior in Mobile Robotics Through Artificial Neural Networks <i>R. Iglesias, C.V. Regueiro, J. Correa, S. Barro</i>	1364
Visual Probe Mark Inspection, Using Hardware Implementation of Artificial Neural Networks, in VLSI Production <i>G. de Trémolles, P. Tannhof, B. Plougonven, C. Demarigny, K. Madani</i>	1374
Teleoreactive Neural Networks <i>J. Ramirez</i>	1384
<i>Author Index</i>	1395