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# New Challenges on Bioinspired Applications

4th International Work-Conference on the Interplay  
Between Natural and Artificial Computation, IWINAC 2011  
La Palma, Canary Islands, Spain, May 30 - June 3, 2011  
Proceedings, Part II

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ISSN 0302-9743  
ISBN 978-3-642-21325-0  
DOI 10.1007/978-3-642-21326-7  
Springer Heidelberg Dordrecht London New York

e-ISSN 1611-3349  
e-ISBN 978-3-642-21326-7

Library of Congress Control Number: Applied for

CR Subject Classification (1998): F.1, F.2, I.2, G.2, I.4, I.5, J.3-4, J.1

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

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*Typesetting:* Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media ([www.springer.com](http://www.springer.com))

# Preface

## Searching for the Interplay between Natural and Artificial Computation

The general aim of these volumes, continuing with ideas from Professor José Mira and with neurocybernetic concepts from Wiener and W.S. McCulloch, is to present a wider and more comprehensive view of the computational paradigm (CP), proposed by Alan Turing, than usual in computer science and artificial intelligence (AI) and to propose a way of using that which makes it possible: (1) to help neuroscience and cognitive science, by explaining the latter as a result of the former, (2) to establish an interaction framework between natural system computation by posing a series of appropriate questions in both directions of the interaction, from artificial systems to natural systems (in computational neuroscience), and from natural systems to artificial systems (in bioinspired computation). This is the main motivation of the International Work-conference on the Interplay between Natural and Artificial Computation, trying to contribute to both directions of the interplay:

I: From Artificial to Natural Computation. What can computation, artificial intelligence (AI) and knowledge engineering (KE) contribute to the understanding of the nervous system, cognitive processes and social behavior? This is the scope of computational neuroscience and cognition, which uses the computational paradigm to model and improve our understanding of natural science.

II: From Natural Sciences to Computation, AI and KE. How can computation, AI and KE find inspiration in the behavior and internal functioning of physical, biological and social systems to conceive, develop and build up new concepts, materials, mechanisms and algorithms of potential value in real-world applications? This is the scope of the new bionics, known as bioinspired engineering and computation, as well as of natural computing.

To address the two questions exposed in the scope of IWINAC 2011, we will make use of a wide and comprehensive view of the computational paradigm that first considers three levels of description for each calculus (physical mechanisms, symbols and knowledge) and then distinguishes between two domains of description (the level “own” domain and the domain of the external observer).

This wider view of the computational paradigm allows us more elbow room to accommodate the results of the interplay between nature and computation. The IWINAC forum thus becomes a methodological approximation (set of intentions, questions, experiments, models, algorithms, mechanisms, explanation procedures, and engineering and computational methods) to the natural and artificial perspectives of the mind embodiments problem, both in humans and in artifacts. This is the philosophy of the IWINAC meetings, the “interplay” movement between the natural and artificial, facing this same problem every

two years. We want to know how to model biological processes that are associated with measurable physical magnitudes and, consequently, we also want to design and build robots that imitate the corresponding behaviors based on that knowledge. This synergistic approach will permit us not only to build new computational systems based on the natural measurable phenomena, but also to understand many of the observable behaviors inherent to natural systems.

The difficulty of building bridges over natural and artificial computation was one of the main motivations for the organization of IWINAC 2011. In this edition, the conference was simultaneously coorganized with the Joint Workshop and Summer School: Astrostatistics and Data Mining in Large Astronomical Databases 2011, that aims to apply AI techniques to astronomical data. The IWINAC 2011 proceedings volumes include the 108 works selected by the Scientific Committee after a refereeing process. The first volume, entitled *Foundations on Natural and Artificial Computation*, includes all the contributions mainly related to the methodological, conceptual, formal, and experimental developments in the fields of neurophysiology and cognitive science. The second volume entitled *New Challenges on Bioinspired Applications* contains the papers related to bioinspired programming strategies and all the contributions related to the computational solutions to engineering problems in different application domains, especially health applications, including the CYTED “Artificial and Natural Computation for Health” (CANS) research network papers.

An event like IWINAC 2011 cannot be organized without the collaboration of a group of institutions and people, whom we would like to thank now, starting with *UNED* and *Universidad Politécnica de Cartagena*. The collaboration of the *UNED associated center* was crucial, as was the efficient work of the Local Committee, Francisco Javier Neris Paz and Juan Antonio González Arnaez, with the close collaboration of the *Instituto de Astrofísica de Canarias*, and the essential support of Rafael Rebolo and Juan Carlos Pérez. In addition to our universities, we received financial support from the Spanish *Ministerio de Ciencia e Innovación*, *CYTED*, *Red Nacional en Computación Natural y Artificial* and *APLIQUEM S.L.*

We want to express our gratefulness to our invited speakers, Changjiu Zhou from Singapore Polytechnic, Paul Cull, Oregon State University, Rüdiger Dillmann from Karlsruhe Institute of Technology (KIT) and Jon Hall, Open University, for accepting our invitation and for their magnificent plenary talks.

We would also like to thank the authors for their interest in our call and the effort in preparing the papers, condition *sine qua non* for these proceedings, and to all the Scientific and Organizing Committees, in particular, the members of these committees that have acted as effective and efficient referees and as promoters and managers of pre-organized sessions on autonomous and relevant topics under the IWINAC global scope.

Our sincere gratitude also goes to Springer and to Alfred Hofmann and his collaborators, Anna Kramer and Leonie Kunz, for the continuous receptivity, help, and collaboration in all our joint editorial ventures on the interplay between neuroscience and computation.

Finally, we want to express our special thanks to *ESOC S.L.*, our technical secretariat, and to Victoria Ramos, for making this meeting possible, arranging all the details that comprise the organization of this kind of event.

All the authors of papers in this issue, as well as the IWINAC Program and Organizing Committees, would like to pay tribute to the memory of Professor Mira, both as a great scientist and as a good friend. We still greatly miss him.

June 2011

José Manuel Ferrández Vicente  
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## Table of Contents – Part II

Neuromorphic Detection of Vowel Representation Spaces . . . . .	1
<i>Pedro Gómez-Vilda, José Manuel Ferrández-Vicente, Victoria Rodellar-Biarge, Agustín Álvarez-Marquina, Luis Miguel Mazaira-Fernández, Rafael Martínez-Olalla, and Cristina Muñoz-Mulas</i>	
Speaker Recognition Based on a Bio-inspired Auditory Model: Influence of Its Components, Sound Pressure and Noise Level . . . . .	12
<i>Ernesto A. Martínez-Rams and Vicente Garcerán-Hernández</i>	
Inner-Hair Cells Parameterized-Hardware Implementation for Personalized Auditory Nerve Stimulation. . . . .	25
<i>Miguel A. Sacristán-Martínez, José M. Ferrández-Vicente, Vicente Garcerán-Hernández, Victoria Rodellar-Biarge, and Pedro Gómez-Vilda</i>	
Semiautomatic Segmentation of the Medial Temporal Lobe Anatomical Structures . . . . .	33
<i>M. Rincón, E. Díaz-López, F. Alfaro, A. Díez-Peña, T. García-Saiz, M. Bachiller, A. Insausti, and R. Insausti</i>	
Analysis of Spect Brain Images Using Wilcoxon and Relative Entropy Criteria and Quadratic Multivariate Classifiers for the Diagnosis of Alzheimer’s Disease . . . . .	41
<i>F.J. Martínez, D. Salas-González, J.M. Górriz, J. Ramírez, C.G. Puntonet, and M. Gómez-Río</i>	
MRI Brain Image Segmentation with Supervised SOM and Probability-Based Clustering Method . . . . .	49
<i>Andres Ortiz, Juan M. Gorriz, Javier Ramírez, and Diego Salas-González</i>	
Effective Diagnosis of Alzheimer’s Disease by Means of Distance Metric Learning and Random Forest . . . . .	59
<i>R. Chaves, J. Ramírez, J.M. Górriz, I. Illán, F. Segovia, and A. Olivares</i>	
Distance Metric Learning as Feature Reduction Technique for the Alzheimer’s Disease Diagnosis . . . . .	68
<i>R. Chaves, J. Ramírez, J.M. Górriz, D. Salas-Gonzalez, and M. López</i>	

Brain Status Data Analysis by Sliding EMD . . . . .	77
<i>A. Zeiler, R. Faltermeyer, A. Brawanski, A.M. Tomé, C.G. Puntonet, J.M. Górriz, and E.W. Lang</i>	
A Quantitative Study on Acupuncture Effects for Fighting Migraine Using SPECT Images . . . . .	87
<i>M. López, J. Ramírez, J.M. Górriz, R. Chaves, and M. Gómez-Río</i>	
High Resolution Segmentation of CSF on Phase Contrast MRI . . . . .	96
<i>Elsa Fernández, Manuel Graña, and Jorge Villanúa</i>	
Exploration of LICA Detections in Resting State fMRI . . . . .	104
<i>Darya Chyzyhyk, Ann K. Shinn, and Manuel Graña</i>	
FreeSurfer Automatic Brain Segmentation Adaptation to Medial Temporal Lobe Structures: Volumetric Assessment and Diagnosis of Mild Cognitive Impairment . . . . .	112
<i>R. Insausti, M. Rincón, E. Díaz-López, E. Artacho-Pérula, F. Mansilla, J. Florensa, C. González-Moreno, J. Álvarez-Linera, S. García, H. Peraita, E. Pais, and A.M. Insausti</i>	
Alzheimer Disease Classification on Diffusion Weighted Imaging Features . . . . .	120
<i>M. Termenon, A. Besga, J. Echeveste, A. Gonzalez-Pinto, and M. Graña</i>	
Future Applications with Diffusion Tensor Imaging. . . . .	128
<i>T. García-Saiz, M. Rincón, and A. Lundervold</i>	
Monitoring Neurological Disease in Phonation . . . . .	136
<i>Pedro Gómez-Vilda, Roberto Fernández-Baillo, José Manuel Ferrández-Vicente, Victoria Rodellar-Biarge, Agustín Álvarez-Marquina, Luis Miguel Mazaira-Fernández, Rafael Martínez-Olalla, and Cristina Muñoz-Mulas</i>	
Group Formation for Minimizing Bullying Probability. A Proposal Based on Genetic Algorithms . . . . .	148
<i>L. Pedro Salcedo, M. Angélica Punninghoff J., and Ricardo Contreras A.</i>	
A Speaker Recognition System Based on an Auditory Model and Neural Nets: Performance at Different Levels of Sound Pressure and of Gaussian White Noise . . . . .	157
<i>Ernesto A. Martínez-Rams and Vicente Garcerán-Hernández</i>	
Automatic Detection of Hypernasality in Children . . . . .	167
<i>S. Murillo Rendón, J.R. Orozco Arroyave, J.F. Vargas Bonilla, J.D. Arias Londoño, and C.G. Castellanos Domínguez</i>	

Characterization of Focal Seizures in Scalp Electroencephalograms Based on Energy of Signal and Time-Frequency Analysis . . . . .	175
<i>Alexander Cerquera, Laura V. Guío, Elías Buitrago, Rafael M. Gutiérrez, and Carlos Medina</i>	
An Optimized Framework to Model Vertebrate Retinas . . . . .	185
<i>Andrés Olmedo-Payá, Antonio Martínez-Álvarez, Sergio Cuenca-Asensi, Jose M. Ferrández, and Eduardo Fernández</i>	
An Expandable Hardware Platform for Implementation of CNN-Based Applications . . . . .	195
<i>J. Javier Martínez-Álvarez, F. Javier Garrigós-Guerrero, F. Javier Toledo-Moreo, and J. Manuel Ferrández-Vicente</i>	
Classification of Welding Defects in Radiographic Images Using an Adaptive-Network-Based Fuzzy System . . . . .	205
<i>Rafael Vilar, Juan Zapata, and Ramón Ruiz</i>	
Reinforcement Learning Techniques for the Control of WasteWater Treatment Plants . . . . .	215
<i>Felix Hernandez-del-Olmo and Elena Gaudio</i>	
Genetic Programming for Prediction of Water Flow and Transport of Solids in a Basin . . . . .	223
<i>Juan R. Rabuñal, Jerónimo Puertas, Daniel Rivero, Ignacio Fraga, Luis Cea, and Marta Garrido</i>	
Comparing Elastic Alignment Algorithms for the Off-Line Signature Verification Problem . . . . .	233
<i>J.F. Vélez, A. Sánchez, A.B. Moreno, and L. Morillo-Velarde</i>	
A Fuzzy Cognitive Maps Modeling, Learning and Simulation Framework for Studying Complex System . . . . .	243
<i>Maikel León, Gonzalo Nápoles, Ciro Rodriguez, María M. García, Rafael Bello, and Koen Vanhoof</i>	
Study of Strength Tests with Computer Vision Techniques . . . . .	257
<i>Alvaro Rodriguez, Juan R. Rabuñal, Juan L. Perez, and Fernando Martínez-Abella</i>	
Scaling Effects in Crossmodal Improvement of Visual Perception . . . . .	267
<i>Isabel Gonzalo-Fonrodona and Miguel A. Porras</i>	
Pattern Recognition Using a Recurrent Neural Network Inspired on the Olfactory Bulb . . . . .	275
<i>Lucas Baggio Figueira and Antonio Carlos Roque</i>	

Experiments on Lattice Independent Component Analysis for Face Recognition . . . . .	286
<i>Ion Marqués and Manuel Graña</i>	
A Hyperheuristic Approach for Dynamic Enumeration Strategy Selection in Constraint Satisfaction . . . . .	295
<i>Broderick Crawford, Ricardo Soto, Carlos Castro, and Eric Monfroy</i>	
Genetic Algorithm for Job-Shop Scheduling with Operators . . . . .	305
<i>Raúl Mencía, María R. Sierra, Carlos Mencía, and Ramiro Varela</i>	
Bio-inspired System in Automatic Speaker Recognition . . . . .	315
<i>Lina Rosique-López and Vicente Garcerán-Hernández</i>	
Independent Component Analysis: A Low-Complexity Technique . . . . .	324
<i>Rubén Martín-Clemente, Susana Hornillo-Mellado, and José Luis Camargo-Olivares</i>	
AdaBoost Face Detection on the GPU Using Haar-Like Features . . . . .	333
<i>M. Martínez-Zarzuela, F.J. Díaz-Pernas, M. Antón-Rodríguez, F. Perozo-Rondón, and D. González-Ortega</i>	
Fuzzy ARTMAP Based Neural Networks on the GPU for High-Performance Pattern Recognition . . . . .	343
<i>M. Martínez-Zarzuela, F.J. Díaz-Pernas, A. Tejero de Pablos, F. Perozo-Rondón, M. Antón-Rodríguez, and D. González-Ortega</i>	
Bio-inspired Color Image Segmentation on the GPU (BioSPCIS) . . . . .	353
<i>M. Martínez-Zarzuela, F.J. Díaz-Pernas, M. Antón-Rodríguez, F. Perozo-Rondón, and D. González-Ortega</i>	
Simulating a Rock-Scissors-Paper Bacterial Game with a Discrete Cellular Automaton . . . . .	363
<i>Pablo Gómez Esteban and Alfonso Rodríguez-Patón</i>	
Mobile Robot Localization through Identifying Spatial Relations from Detected Corners . . . . .	371
<i>Sergio Almansa-Valverde, José Carlos Castillo, Antonio Fernández-Caballero, José Manuel Cuadra Troncoso, and Javier Acevedo-Rodríguez</i>	
Improving the Accuracy of a Two-Stage Algorithm in Evolutionary Product Unit Neural Networks for Classification by Means of Feature Selection . . . . .	381
<i>Antonio J. Tallón-Ballesteros, César Hervás-Martínez, José C. Riquelme, and Roberto Ruiz</i>	
Knowledge Living on the Web (KLW) . . . . .	391
<i>Miguel A. Fernandez, Juan Miguel Ruiz, Olvido Arraez Jarque, and Margarita Carrion Varela</i>	

Local Context Discrimination in Signature Neural Networks . . . . .	400
<i>Roberto Latorre, Francisco B. Rodríguez, and Pablo Varona</i>	
Spider Recognition by Biometric Web Analysis . . . . .	409
<i>Jaime R. Ticay-Rivas, Marcos del Pozo-Baños, William G. Eberhard, Jesús B. Alonso, and Carlos M. Travieso</i>	
A Prediction Model to Diabetes Using Artificial Metaplasticity . . . . .	418
<i>Alexis Marcano-Cedeño, Joaquín Torres, and Diego Andina</i>	
Band Correction in Random Amplified Polymorphism DNA Images Using Hybrid Genetic Algorithms with Multilevel Thresholding . . . . .	426
<i>Carolina Gárate O., M. Angélica Pinninghoff J., and Ricardo Contreras A.</i>	
Discrimination of Epileptic Events Using EEG Rhythm Decomposition . . . . .	436
<i>L. Duque-Muñoz, L.D. Avendaño-Valencia, and G. Castellanos-Domínguez</i>	
Methodology for Attention Deficit/Hyperactivity Disorder Detection by Means of Event-Related Potentials . . . . .	445
<i>Paola Castro-Cabrera, Jorge Gómez-García, Francia Restrepo, Oscar Moscoso, and German Castellanos-Domínguez</i>	
Methodology for Epileptic Episode Detection Using Complexity-Based Features . . . . .	454
<i>Jorge Andrés Gómez García, Carolina Ospina Aguirre, Edilson Delgado Trejos, and Germán Castellanos Domínguez</i>	
Segmentation of the Carotid Artery in Ultrasound Images Using Neural Networks . . . . .	463
<i>Rosa-María Menchón-Lara, M-Consuelo Bastida-Jumilla, Juan Morales-Sánchez, Rafael Verdú-Monedero, Jorge Larrey-Ruiz, and José Luis Sancho-Gómez</i>	
Tools for Controlled Experiments and Calibration on Living Tissues Cultures . . . . .	472
<i>Daniel de Santos, José Manuel Cuadra, Félix de la Paz, Víctor Lorente, José Ramón Álvarez-Sánchez, and José Manuel Ferrández</i>	
<b>Author Index . . . . .</b>	<b>483</b>



# Table of Contents – Part I

Complex Neuro-Cognitive Systems . . . . .	1
<i>Andreas Schierwagen</i>	
A Markov Model of Conditional Associative Learning in a Cognitive Behavioural Scenario . . . . .	10
<i>Stefan Glüge, Oussama H. Hamid, Jochen Braun, and Andreas Wendemuth</i>	
General Theory of Exobehaviours: A New Proposal to Unify Behaviors . . . . .	20
<i>Sergio Miguel Tomé</i>	
Bio-inspired Decentralized Self-coordination Algorithms for Multi-heterogeneous Specialized Tasks Distribution in Multi-Robot Systems . . . . .	30
<i>Yadira Quiñonez, Javier de Lope, and Darío Maravall</i>	
An Incremental Model of Lexicon Consensus in a Population of Agents by Means of Grammatical Evolution, Reinforcement Learning and Semantic Rules . . . . .	40
<i>Jack Mario Mingo and Ricardo Aler</i>	
Towards an Evolutionary Design of Modular Robots for Industry . . . . .	50
<i>Andrés Faña, Francisco Bellas, Daniel Souto, and Richard J. Duro</i>	
Grammar-Guided Evolutionary Construction of Bayesian Networks . . . . .	60
<i>José M. Font, Daniel Manrique, and Eduardo Pascua</i>	
A Novel Linear Cellular Automata-Based Data Clustering Algorithm . . . . .	70
<i>Javier de Lope and Darío Maravall</i>	
Probabilistic versus Incremental Presynaptic Learning in Biologically Plausible Synapses . . . . .	80
<i>Francisco Javier Ropero Peláez and Diego Andina</i>	
Dynamics of a Three Neurons Network with Excitatory-Inhibitory Interactions . . . . .	90
<i>Carlos Aguirre, Juan I. Cano, and Eloy Anguiano</i>	
The Reversal Potential of Inhibitory Synapses Strongly Impacts the Dynamics of Neural Networks . . . . .	100
<i>Santi Chillemi, Michele Barbi, and Angelo Di Garbo</i>	

Doman's Inclined Floor Method for Early Motor Organization Simulated with a Four Neurons Robot . . . . .	109
<i>Francisco Javier Ropero Peláez and Lucas Galdiano Ribeiro Santana</i>	
On the Biological Plausibility of Artificial Metaplasticity . . . . .	119
<i>Diego Andina and Javier Ropero-Peláez</i>	
Dynamic Model of the dLGN Push-Pull Circuitry . . . . .	129
<i>Rubén Ferreiroa, Eduardo Sánchez, and Luis Martínez</i>	
Task-Driven Species in Evolutionary Robotic Teams . . . . .	138
<i>P. Trueba, A. Prieto, P. Caamaño, F. Bellas, and R.J. Duro</i>	
Concurrent Modular Q-Learning with Local Rewards on Linked Multi-Component Robotic Systems . . . . .	148
<i>Borja Fernandez-Gauna, Jose Manuel Lopez-Guede, and Manuel Graña</i>	
Coordination of Communication in Robot Teams by Reinforcement Learning . . . . .	156
<i>Darío Maravall, Javier de Lope, and Raúl Domínguez</i>	
Self-organized Multi-agent System for Robot Deployment in Unknown Environments . . . . .	165
<i>A. Canedo-Rodríguez, R. Iglesias, C.V. Regueiro, V. Alvarez-Santos, and X.M. Pardo</i>	
Selective Method Based on Auctions for Map Inspection by Robotic Teams . . . . .	175
<i>Manuel Martín-Ortiz, Juan Pereda, Javier de Lope, and Félix de la Paz</i>	
Study of a Multi-Robot Collaborative Task through Reinforcement Learning . . . . .	185
<i>Juan Pereda, Manuel Martín-Ortiz, Javier de Lope, and Félix de la Paz</i>	
Design of Social Agents . . . . .	192
<i>Roman Gorbunov, Emilia Barakova, and Matthias Rauterberg</i>	
Event-Based System for Generation of Traffic Services in Road Congestions . . . . .	202
<i>C. Sotomayor-Martínez and R. Toledo-Moreo</i>	
User-Friendly Robot Environment for Creation of Social Scenarios . . . . .	212
<i>Tino Lourens and Emilia Barakova</i>	

Online Feature Weighting for Human Discrimination in a Person Following Robot .....	222
<i>V. Alvarez-Santos, X.M. Pardo, R. Iglesias, A. Canedo-Rodriguez, and C.V. Regueiro</i>	
Improving Area Center Robot Navigation Using a Novel Range Scan Segmentation Method .....	233
<i>José Manuel Cuadra Troncoso, José Ramón Álvarez-Sánchez, Félix de la Paz López, and Antonio Fernández-Caballero</i>	
Analysis of EEG Mapping Images to Differentiate Mental Tasks in Brain-Computer Interfaces .....	246
<i>Andrés Úbeda, Eduardo Iáñez, José M. Azorín, and Eduardo Fernández</i>	
Design of a Hemispherical Antenna Array Receiver for Medical Applications.....	256
<i>Mohammad Safar and Robert W. Newcomb</i>	
Long Term Modulation and Control of Neuronal Firing in Excitable Tissue Using Optogenetics .....	266
<i>L. Humphreys, J.M. Ferrández, and E. Fernández</i>	
Classification Tree Generation Constrained with Variable Weights .....	274
<i>Pedro Barahona, Gemma Bel-Enguix, Veronica Dahl, M. Dolores Jiménez-López, and Ludwig Krippahl</i>	
Arithmetical Metabolic P Systems .....	284
<i>Rosario Lombardo and Vincenzo Manca</i>	
Simulating Accepting Networks of Evolutionary Processors with Filtered Connections by Accepting Evolutionary P Systems (Extended Abstract) .....	295
<i>Juan Castellanos, Victor Mitrana, Eugenio Santos, and José M. Sempere</i>	
Towards the Automatic Programming of NEPs .....	303
<i>Emilio del Rosal, Marina de la Cruz, and Alfonso Ortega de la Puente</i>	
Bio-inspired Grammatical Inference .....	313
<i>Leonor Becerra-Bonache</i>	
Differential Evolution for Protein Structure Prediction Using the HP Model .....	323
<i>J. Santos and M. Diéguez</i>	
A Preliminary Study on the Prediction of Human Protein Functions....	334
<i>Guido Bologna, Anne-Lise Veuthey, Marco Pagni, Lydie Lane, and Amos Bairoch</i>	

Evaluating Case Selection Algorithms for Analogical Reasoning Systems . . . . .	344
<i>Eduardo Lupiani, Jose M. Juarez, Fernando Jimenez, and Jose Palma</i>	
On the Use of Human-Guided Evolutionary Algorithms for Tackling 2D Packing Problems . . . . .	354
<i>Javier Espinar, Carlos Cotta, and Antonio J. Fernández Leiva</i>	
Particle Swarm Optimisation for Open Shop Problems with Fuzzy Durations . . . . .	362
<i>Juan José Palacios, Inés González-Rodríguez, Camino R. Vela, and Jorge Puente</i>	
Design of Emergent and Adaptive Virtual Players in a War RTS Game . . . . .	372
<i>José A. García Gutiérrez, Carlos Cotta, and Antonio J. Fernández Leiva</i>	
Decision Tree-Based Algorithms for Implementing Bot AI in UT2004 . . . . .	383
<i>Antonio J. Fernández Leiva and Jorge L. O’Valle Barragán</i>	
Neural Networks versus Genetic Algorithms as Medical Classifiers . . . . .	393
<i>Oscar Marín, Irene Pérez, Daniel Ruiz, Antonio Soriano, and Joaquin D. García</i>	
Complexity Changes in Human Wrist Temperature Circadian Rhythms through Ageing . . . . .	401
<i>R. Marin, M. Campos, A. Gomariz, A. Lopez, M.A. Rol, and J.A. Madrid</i>	
Radial Basis Function Neural Network for Classification of Quantitative EEG in Patients with Advanced Chronic Renal Failure . . . . .	411
<i>Juan A. Barios, César Gonzalez, Bettina Benbunan, Victor Fernández-Armayor, José L. Teruel, Milagros Fernández, Antonio Pedrera, and José M. Gaztelu</i>	
Bayesian Network-Based Model for the Diagnosis of Deterioration of Semantic Content Compatible with Alzheimer’s Disease . . . . .	419
<i>José María Guerrero Triviño, Rafael Martínez-Tomás, and Herminia Peraita Adrados</i>	
Localization and Segmentation of the Optic Nerve Head in Eye Fundus Images Using Pyramid Representation and Genetic Algorithms . . . . .	431
<i>José M. Molina and Enrique J. Carmona</i>	

A Multisensory Monitoring and Interpretation Framework Based on the Model–View–Controller Paradigm . . . . .	441
<i>José Carlos Castillo, Angel Rivas-Casado, Antonio Fernández-Caballero, María T. López, and Rafael Martínez-Tomás</i>	
Agent-Based Development of Multisensory Monitoring Systems . . . . .	451
<i>José Manuel Gascueña, Antonio Fernández-Caballero, Elena Navarro, Juan Serrano-Cuerda, and Francisco Alfonso Cano</i>	
Clustering of Trajectories in Video Surveillance Using Growing Neural Gas . . . . .	461
<i>Javier Acevedo-Rodríguez, Saturnino Maldonado-Bascón, Roberto López-Sastre, Pedro Gil-Jiménez, and Antonio Fernández-Caballero</i>	
Human Action Recognition Based on Tracking Features . . . . .	471
<i>Javier Hernández, Antonio S. Montemayor, Juan José Pantrigo, and Ángel Sánchez</i>	
Modeling and Discovering Occupancy Patterns in Sensor Networks Using Latent Dirichlet Allocation . . . . .	481
<i>Federico Castanedo, Hamid Aghajan, and Richard Kleihorst</i>	
Multicamera Action Recognition with Canonical Correlation Analysis and Discriminative Sequence Classification . . . . .	491
<i>Rodrigo Cilla, Miguel A. Patricio, Antonio Berlanga, and José M. Molina</i>	
Low-Power Bed / Seat Occupancy Sensor Based on EMFi . . . . .	501
<i>Francisco Fernandez-Luque, Juan Zapata, and Ramón Ruiz</i>	
Protocol Integration for Intelligent Monitoring Applications in Wireless Sensor Networks . . . . .	511
<i>Antonio M. Ortiz, Fernando Royo, Teresa Olivares, Luis Orozco-Barbosa, José Carlos Castillo, and Antonio Fernández-Caballero</i>	
Event Detection and Fusion Model for Semantic Interpretation of Monitored Scenarios within ASIMS Architecture . . . . .	521
<i>Ángel Rivas-Casado and Rafael Martínez-Tomás</i>	
Proposal for Extending New Linked Data Rules for the Semantic Web . . . . .	531
<i>Rafael Martínez-Tomás and Luis Criado Fernández</i>	

<i>AWARD<sup>prime</sup></i> : An Adaptive Web Based-Tool Prototype for Neurocognitive Individualized Assessment and Training . . . . .	540
<i>Raquel Salmerón, Serafín Crespo, Francisco López, María Teresa Daza, and Francisco Guil</i>	
Automated Mapping of Observation Archetypes to SNOMED CT Concepts . . . . .	550
<i>M. Meizoso, J.L. Allones, M. Taboada, D. Martínez, and S. Tellado</i>	
<b>Author Index</b> . . . . .	563