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Andreu Català (Eds.)

Advances in Computational Intelligence

16th International Work-Conference
on Artificial Neural Networks, IWANN 2021
Virtual Event, June 16–18, 2021
Proceedings, Part I

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ISSN 0302-9743

ISSN 1611-3349 (electronic)

Lecture Notes in Computer Science

ISBN 978-3-030-85029-6

ISBN 978-3-030-85030-2 (eBook)

<https://doi.org/10.1007/978-3-030-85030-2>

LNCS Sublibrary: SL1 – Theoretical Computer Science and General Issues

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

We are proud to present the set of final accepted papers for the 16th edition of the IWANN conference - the International Work-Conference on Artificial Neural Networks - held online during June 16–18, 2021. Unfortunately, the 2021 edition of the conference had to be carried out remotely due to the consequences of the COVID-19 pandemic, but interactive digital platforms were used to preserve the participatory climate of previous editions.

IWANN is a biennial conference that seeks to provide a discussion forum for scientists, engineers, educators, and students about the latest ideas and realizations in the foundations, theory, models, and applications of hybrid systems inspired by nature (neural networks, fuzzy logic, and evolutionary systems) as well as in emerging areas related to these topics. As in previous editions of IWANN, this year's conference aimed to create a friendly environment that could lead to the establishment of scientific collaborations and exchanges among attendees. The proceedings include all the communications presented at the conference. Extended versions of selected papers will also be published in special issues of relevant journals (such as *PeerJ Computer Science* and *Neural Processing Letters*).

Since the first edition in Granada (LNCS 540, 1991), the conference has evolved and matured. The list of topics in the successive Call for Papers has also evolved, resulting in the following list for the present edition:

1. **Mathematical and theoretical methods in computational intelligence:** mathematics for neural networks; RBF structures; self-organizing networks and methods; support vector machines and kernel methods; fuzzy logic; and evolutionary and genetic algorithms.
2. **Neurocomputational formulations:** single-neuron modeling; perceptual modeling; system-level neural modeling; spiking neurons; and models of biological learning.
3. **Learning and adaptation:** adaptive systems; imitation learning; reconfigurable systems; and supervised, non-supervised, reinforcement, and statistical algorithms.
4. **Emulation of cognitive functions:** decision-making; multi-agent systems; sensor mesh; natural language; pattern recognition; perceptual and motor functions (visual, auditory, tactile, virtual reality, etc.); robotics; and planning motor control.
5. **Bio-inspired systems and neuro-engineering:** embedded intelligent systems; evolvable computing; evolving hardware; microelectronics for neural, fuzzy, and bioinspired systems; neural prostheses; retinomorphic systems; brain-computer interfaces (BCI) nanosystems; and nanocognitive systems.
6. **Advanced topics in computational intelligence:** intelligent networks; knowledge-intensive problem-solving techniques; multi-sensor data fusion using computational intelligence; search and meta-heuristics; soft computing; neuro-fuzzy systems; neuro-evolutionary systems; neuro-swarm; and hybridization with novel computing paradigms.

7. **Applications:** expert systems; image and signal processing; ambient intelligence; biomimetic applications; system identification, process control, and manufacturing; computational biology and bioinformatics; parallel and distributed computing; human computer interaction, internet modeling, communication and networking; intelligent systems in education; human-robot interaction; multi-agent systems; time series analysis and prediction; and data mining and knowledge discovery.

At the end of the submission process, and after a careful peer review and evaluation process (each submission was reviewed by at least 2, and on average 2.8, Program Committee members or additional reviewers), 85 papers were accepted for oral presentation, according to the reviewers' recommendations.

During IWANN 2021, several special sessions were held. Special sessions are a very useful tool for complementing the regular program with new and emerging topics of particular interest for the participating community. Special sessions that emphasize multi-disciplinary and transversal aspects, as well as cutting-edge topics are especially encouraged and welcome, and in this edition of IWANN 2019 comprised the following:

- SS01: Agent-based Models for Policy Design Towards a More Sustainable World.
Organized by Amparo Alonso-Betanzos, Bertha Guijarro-Berdiñas, Noelia Sánchez-Maróño, and Alejandro Rodríguez-Arias
- SS02: Convolutional Neural Networks: Beyond Traditional Solutions.
Organized by Irina Perfilieva, Jan Platos, and Jan Hula
- SS03: Quality Control Charts Based on Imprecise Information.
Organized by Gholamreza Hesamian
- SS04: Neural Networks for Time Series Forecasting.
Organized by Grzegorz Dudek
- SS05: Randomization in Deep Learning.
Organized by Claudio Gallicchio, Massimo Panella, and Ponnuthurai Nagarathnam Suganthan
- SS06: Intelligent Computing Solutions for SARS-CoV-2 COVID-19 (INClutions COVID-19).
Organized by Carmen Paz Suárez Araujo and Juan Luis Navarro Mesa
- SS07: Multi-valued Cognitive Intelligence.
Organized by Prem Kumar Singh
- SS08: Meta-learning and Other Automatic Learning Approaches in Intelligent Systems.
Organized by Rashedur M Rahman, Ahsanur Rahman, Tanzilur Rahman, Shafin Rahman, Luis Garcia, and Ali Cheraghian
- SS09: New Advances in Artificial Intelligence for Green Computing.
Organized by Antonello Rosato and Massimo Panella
- SS10: Attentive Models and Visual Attention in Computer Vision and AI.
Organized by Lorenzo Baraldi and Marcella Cornia
- SS11: Biosignals Processing.
Organized by Antonio Fernandez-Caballero, Roberto Sánchez-Reolid, and Beatriz García-Martínez

- SS12: Information Fusion in Deep Learning for Biomedicine.
Organized by Miguel Atencia, Francisco Veredas, and Ruxandra Stoean

In this edition of IWANN, we were honored to have the presence of the following invited speakers:

1. Pierre Baldi, University of California, Irvine, USA
2. Jeanna Matthews, Division of Mathematics and Computer Science, Clarkson University, USA
3. Davide Anguita, University of Genova, Italy

It is important to note that, for the sake of consistency and readability of the book, the presented papers are not organized as they were presented in the IWANN 2021 sessions but classified under 13 chapters. The organization of the papers is in two volumes arranged basically following the topics list included in the Call for Papers. The first volume (LNCS 12861), entitled *Advances on Computational Intelligence, IWANN 2021, Part I*, is divided into seven main parts and includes contributions on

1. Information Fusion in Deep Learning for Biomedicine
2. Intelligent Computing Solutions for SARS-CoV-2 COVID-19 (INClusions COVID-19)
3. Advanced Topics in Computational Intelligence
4. Biosignals Processing
5. Deep Learning
6. Meta-learning and Other Automatic Learning Approaches in Intelligent Systems
7. Artificial Intelligence and Biomedicine

The second volume (LNCS 12862), entitled *Advances on Computational Intelligence, IWANN 2021, Part II*, is divided into six main parts and includes contributions on

1. Convolutional Neural Networks: Beyond Traditional Solutions
2. Bio-inspired Systems and Neuro-Engineering
3. Agent-based Models for Policy Design Towards a More Sustainable World
4. Randomization in Deep Learning
5. Neural Networks for Time Series Forecasting
6. Applications in Artificial Intelligence

The 16th edition of the IWANN conference was organized by the University of Granada, the University of Malaga, and the Polytechnical University of Catalonia, Spain.

We would also like to express our gratitude to the members of the different committees for their support, collaboration, and good work. We specially thank our Steering Committee (David Anguita, Andreu Catalá, Marie Cottrell, Gonzalo Joya, Kurosh Madani, Madalina Olteanu, Ignacio Rojas, and Ulrich Rückert), the Technical Assistant Committee (Miguel Atencia, Francisco García-Lagos, Luis Javier Herrera, and Fernando Rojas), the Program Committee, the reviewers, invited speakers, and

special session organizers. Finally, we want to thank Springer and especially Ronan Nugent, Alfred Hofmann, and Anna Kramer for their continuous support and cooperation.

June 2021

Ignacio Rojas
Gonzalo Joya
Andreu Catala

The original version of the book was revised: the affiliations of Gonzalo Joya and Andreu Català as well as the last name of Andreu Català were not correct. This is now corrected. The correction to the book is available at
https://doi.org/10.1007/978-3-030-85030-2_51

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Contents – Part I

Information Fusion in Deep Learning for Biomedicine

Deep Learning for the Detection of Frames of Interest in Fetal Heart Assessment from First Trimester Ultrasound.	3
<i>Ruxandra Stoean, Dominic Iliescu, Catalin Stoean, Vlad Ilie, Ciprian Patru, Mircea Hotoleanu, Rodica Nagy, Dan Ruican, Rares Trocan, Andreea Marcu, Miguel Atencia, and Gonzalo Joya</i>	
Deep Learning Based Neural Network for Six-Class-Classification of Alzheimer’s Disease Stages Based on MRI Images	15
<i>Tim Rörup, I. Rojas, H. Pomares, and P. Glösekötter</i>	
Detection of Tumor Morphology Mentions in Clinical Reports in Spanish Using Transformers.	24
<i>Guillermo López-García, José M. Jerez, Nuria Ribelles, Emilio Alba, and Francisco J. Veredas</i>	
Enforcing Morphological Information in Fully Convolutional Networks to Improve Cell Instance Segmentation in Fluorescence Microscopy Images.	36
<i>Willard Zamora-Cárdenas, Mauro Mendez, Saul Calderon-Ramirez, Martin Vargas, Gerardo Monge, Steve Quiros, David Elizondo, Jordina Torrents-Barrena, and Miguel A. Molina-Cabello</i>	

Intelligent Computing Solutions for SARS-CoV-2 Covid-19 (INClutions COVID-19)

A Bayesian Classifier Combination Methodology for Early Detection of Endotracheal Obstruction of COVID-19 Patients in ICU	49
<i>Francisco J. Suárez-Díaz, Juan L. Navarro-Mesa, Antonio G. Ravelo-García, Pablo Fernández-López, Carmen Paz Suárez-Araujo, Guillermo Pérez-Acosta, and Luciano Santana-Cabrera</i>	
Toward an Intelligent Computing Solution for Endotracheal Obstruction Prediction in COVID-19 Patients in ICU	61
<i>Pablo Fernández-López, Carmen Paz Suárez-Araujo, Patricio García-Báez, Francisco Suárez-Díaz, Juan L. Navarro-Mesa, Guillermo Pérez-Acosta, and José Blanco-López</i>	

Advanced Topics in Computational Intelligence

Features Spaces with Reduced Variables Based on Nearest Neighbor Relations and Their Inheritances	77
<i>Naohiro Ishii, Kazunori Iwata, Naoto Mukai, Kazuya Odagiri, and Tokuro Matsuo</i>	
High-Dimensional Data Clustering with Fuzzy C-Means: Problem, Reason, and Solution.	89
<i>Yinghua Shen, Hanyu E, Tianhua Chen, Zhi Xiao, Bingsheng Liu, and Yuan Chen</i>	
Contrastive Explanations for Explaining Model Adaptations	101
<i>André Artelt, Fabian Hinder, Valerie Vaquet, Robert Feldhans, and Barbara Hammer</i>	
Dimensionality Reduction: Is Feature Selection More Effective Than Random Selection?	113
<i>Laura Morán-Fernández and Verónica Bolón-Canedo</i>	
Classification in Non-stationary Environments Using Coresets over Sliding Windows	126
<i>Moritz Heusinger and Frank-Michael Schleif</i>	
Deep Reinforcement Learning in VizDoom via DQN and Actor-Critic Agents	138
<i>Maria Bakhanova and Ilya Makarov</i>	
Adaptive Ant Colony Optimization for Service Function Chaining in a Dynamic 5G Network	151
<i>Segundo Moreno and Antonio M. Mora</i>	
On the Use of Fuzzy Metrics for Robust Model Estimation: A RANSAC-Based Approach.	165
<i>Alberto Ortiz, Esaú Ortiz, Juan José Miñana, and Óscar Valero</i>	
A New Detector Based on Alpha Integration Decision Fusion	178
<i>Addisson Salazar, Gonzalo Safont, Nancy Vargas, and Luis Vergara</i>	
A Safe and Effective Tuning Technique for Similarity-Based Fuzzy Logic Programs	190
<i>Ginés Moreno and José A. Ríaza</i>	
Predictive Ability of Response Surface Methodology (RSM) and Artificial Neural Network (ANN) to Approximate Biogas Yield in a Modular Biodigester	202
<i>Modestus O. Okwu, Lagouge K. Tartibu, Olusegun D. Samuel, Henry O. Omoregbee, and Anna E. Ivbanikaro</i>	

Biosignals Processing

Analysis of Electroencephalographic Signals from a Brain-Computer Interface for Emotions Detection	219
<i>Beatriz García-Martínez, Antonio Fernández-Caballero, Arturo Martínez-Rodrigo, and Paulo Novais</i>	
A Fine Dry-Electrode Selection to Characterize Event-Related Potentials in the Context of BCI	230
<i>Vinicio Changoluisa, Pablo Varona, and Francisco B. Rodriguez</i>	
Detection of Emotions from Electroencephalographic Recordings by Means of a Nonlinear Functional Connectivity Measure	242
<i>Beatriz García-Martínez, Antonio Fernández-Caballero, Raúl Alcaraz, and Arturo Martínez-Rodrigo</i>	
P300 Characterization Through Granger Causal Connectivity in the Context of Brain-Computer Interface Technologies	253
<i>Vanessa Salazar, Vinicio Changoluisa, and Francisco B. Rodriguez</i>	
Feature and Time Series Extraction in Artificial Neural Networks for Arousal Detection from Electrodermal Activity	265
<i>Roberto Sánchez-Reolid, Francisco López de la Rosa, Daniel Sánchez-Reolid, María T. López, and Antonio Fernández-Caballero</i>	

Deep Learning

Context-Aware Graph Convolutional Autoencoder	279
<i>Asma Sattar and Davide Bacciu</i>	
Development and Implementation of a Neural Network-Based Abnormal State Prediction System for a Piston Pump	291
<i>Mauricio Andrés Gómez Zuluaga, Ahmad Ordikhani, Christoph Bauer, and Peter Glösekötter</i>	
Iterative Adaptation to Quantization Noise	303
<i>Dmitry Chudakov, Sergey Alyamkin, Alexander Goncharenko, and Andrey Denisov</i>	
A BERT Based Approach for Arabic POS Tagging	311
<i>Rakia Saidi, Fethi Jarray, and Mahmud Mansour</i>	
Facial Expression Interpretation in ASD Using Deep Learning	322
<i>Pablo Salgado, Oresti Banos, and Claudia Villalonga</i>	
Voxel-Based Three-Dimensional Neural Style Transfer	334
<i>Timo Friedrich, Barbara Hammer, and Stefan Menzel</i>	

Rendering Scenes for Simulating Adverse Weather Conditions	347
<i>Prithwish Sen, Anindita Das, and Nilkanta Sahu</i>	
Automatic Fall Detection Using Long Short-Term Memory Network	359
<i>Carlos Magalhães, João Ribeiro, Argentina Leite, E. J. Solteiro Pires, and João Pavão</i>	
Deep Convolutional Neural Networks with Residual Blocks for Wafer Map Defect Pattern Recognition	372
<i>Zemenu Endalamaw Amogne, Fu-Kwun Wang, and Jia-Hong Chou</i>	
Enhanced Convolutional Neural Network for Age Estimation	385
<i>Idowu Aruleba and Serestina Viriri</i>	
Deep Interpretation with Sign Separated and Contribution Recognized Decomposition	395
<i>Lucas Y. W. Hui and De Wen Soh</i>	
Deep Learning for Age Estimation Using EfficientNet	407
<i>Idowu Aruleba and Serestina Viriri</i>	
Towards a Deep Reinforcement Approach for Crowd Flow Management	420
<i>Wejden Abdallah, Dalel Kanzari, and Kurosh Madani</i>	
Classification of Images as Photographs or Paintings by Using Convolutional Neural Networks	432
<i>José Miguel López-Rubio, Miguel A. Molina-Cabello, Gonzalo Ramos-Jiménez, and Ezequiel López-Rubio</i>	
Parallel Corpora Preparation for English-Amharic Machine Translation	443
<i>Yohanens Biadgigne and Kamel Smaïli</i>	
Fast Depth Reconstruction Using Deep Convolutional Neural Networks	456
<i>Dmitrii Maslov and Ilya Makarov</i>	
Meta-Learning and Other Automatic Learning Approaches in Intelligent Systems	
A Study of the Correlation of Metafeatures Used for Metalearning	471
<i>Adriano Rivoli, Luís P. F. Garcia, Ana C. Lorena, and André C. P. L. F. de Carvalho</i>	
Learning Without Forgetting for 3D Point Cloud Objects	484
<i>Townim Chowdhury, Mahira Jalisha, Ali Cheraghian, and Shafin Rahman</i>	

Patch-Wise Semantic Segmentation of Sedimentation from High-Resolution Satellite Images Using Deep Learning	498
<i>Tahmid Hasan Pranto, Abdulla All Noman, Asaduzzaman Noor, Ummeh Habiba Deepty, and Rashedur M. Rahman</i>	
Learning Image Segmentation from Few Annotations: A REPTILE Application	510
<i>Héctor F. Satizábal and Andres Perez-Uribe</i>	
Artificial Intelligence and Biomedicine	
Impacted Tooth Detection in Panoramic Radiographs	525
<i>James Faure and Andries Engelbrecht</i>	
Deep Learning for Diabetic Retinopathy Prediction	537
<i>Ciro Rodriguez-Leon, William Arevalo, Oresti Banos, and Claudia Villalonga</i>	
Facial Image Augmentation from Sparse Line Features Using Small Training Data	547
<i>Shih-Kai Hung and John Q. Gan</i>	
Ensemble Models for Covid Prediction in X-Ray Images	559
<i>Juan Carlos Morales Vega, Francisco Carrillo-Perez, Jesús Toledano Pavón, Luis Javier Herrera Maldonado, and Ignacio Rojas Ruiz</i>	
Validation of a Nonintrusive Wearable Device for Distress Estimation During Robotic Roller Assisted Gait	570
<i>Marta Díaz-Boladeras, Xavier Llanas, Marta Musté, Elsa Pérez, Carlos Pérez, Alex Barco, and Andreu Català</i>	
Deep Learning for Heart Sounds Classification Using Scalograms and Automatic Segmentation of PCG Signals	583
<i>John Gelpud, Silvia Castillo, Mario Jojoa, Begonya Garcia-Zapirain, Wilson Achicanoy, and David Rodrigo</i>	
Skin Disease Classification Using Machine Learning Techniques	597
<i>Mohammad Ashraful Haque Abir, Golam Kibria Anik, Shazid Hasan Riam, Mohammed Ariful Karim, Azizul Hakim Tareq, and Rashedur M. Rahman</i>	
Construction of Suitable DNN-HMM for Classification Between Normal and Abnormal Respiration	609
<i>Masaru Yamashita</i>	
Correction to: Advances in Computational Intelligence	C1
<i>Ignacio Rojas, Gonzalo Joya, and Andreu Català</i>	
Author Index	621

Contents – Part II

Convolutional Neural Networks: Beyond Traditional Solutions

Error-Correcting Output Codes in the Framework of Deep Ordinal Classification	3
<i>Javier Barbero-Gómez, Pedro Antonio Gutiérrez, and César Hervás-Martínez</i>	
Features as Keypoints and How Fuzzy Transforms Retrieve Them	14
<i>Irina Perfilieva and David Adamczyk</i>	
Instagram Hashtag Prediction Using Deep Neural Networks	28
<i>Anna Beketova and Ilya Makarov</i>	

Bio-inspired Systems and Neuro-Engineering

Temporal EigenPAC for Dyslexia Diagnosis.	45
<i>Nicolás J. Gallego-Molina, Marco Formoso, Andrés Ortiz, Francisco J. Martínez-Murcia, and Juan L. Luque</i>	
Autonomous Driving of a Rover-Like Robot Using Neuromorphic Computing	57
<i>Enrique Piñero-Fuentes, Salvador Canas-Moreno, Antonio Rios-Navarro, Tobi Delbruck, and Alejandro Linares-Barranco</i>	
Effects of Training on BCI Accuracy in SSMVEP-based BCI.	69
<i>Piotr Stawicki, Aya Rezeika, and Ivan Volosyak</i>	
Effect of Electrical Synapses in the Cycle-by-Cycle Period and Burst Duration of Central Pattern Generators.	81
<i>Blanca Berbel, Alicia Garrido-Peña, Irene Elices, Roberto Latorre, and Pablo Varona</i>	
Operation of Neuronal Membrane Simulator Circuit for Tests with Memristor Based on Graphene and Graphene Oxide.	93
<i>Marina Sparvoli, Jonas S. Marma, Gabriel F. Nunes, and Fábio O. Jorge</i>	

Agent-Based Models for Policy Design Towards a More Sustainable World

Informing Agent-Based Models of Social Innovation Uptake	105
<i>Patrycja Antosz, Wander Jager, Gary Polhill, and Douglas Salt</i>	

Sensitivity Analysis of an Empirical Agent-Based Model of District Heating Network Adoption.	118
<i>Gary Polhill, Doug Salt, Tony Craig, Ruth Wilson, and Kathryn Colley</i>	
Generating a Synthetic Population of Agents Through Decision Trees and Socio Demographic Data	128
<i>Amparo Alonso-Betanzos, Bertha Guijarro-Berdiñas, Alejandro Rodríguez-Arias, and Noelia Sánchez-Marroño</i>	
Randomization in Deep Learning	
Improved Acoustic Modeling for Automatic Piano Music Transcription Using Echo State Networks	143
<i>Peter Steiner, Azarakhsh Jalalvand, and Peter Birkholz</i>	
On Effects of Compression with Hyperdimensional Computing in Distributed Randomized Neural Networks	155
<i>Antonello Rosato, Massimo Panella, Evgeny Osipov, and Denis Kleyko</i>	
Benchmarking Reservoir and Recurrent Neural Networks for Human State and Activity Recognition	168
<i>Davide Bacciu, Daniele Di Sarli, Claudio Gallicchio, Alessio Micheli, and Niccolò Puccinelli</i>	
Neural Networks for Time Series Forecasting	
Learning to Trade from Zero-Knowledge Using Particle Swarm Optimization	183
<i>Stefan van Deventer and Andries Engelbrecht</i>	
Randomized Neural Networks for Forecasting Time Series with Multiple Seasonality.	196
<i>Grzegorz Dudek</i>	
Prediction of Air Pollution Using LSTM	208
<i>Stanislaw Osowski</i>	
Applications in Artificial Intelligence	
Detection of Alzheimer’s Disease Versus Mild Cognitive Impairment Using a New Modular Hybrid Neural Network	223
<i>Alberto Sosa-Marrero, Ylermi Cabrera-León, Pablo Fernández-López, Patricio García-Báez, Juan Luis Navarro-Mesa, Carmen Paz Suárez-Araujo, and for the Alzheimer’s Disease Neuroimaging Initiative</i>	

Fine-Tuning of Patterns Assignment to Subnetworks Increases the Capacity of an Attractor Network Ensemble	236
<i>Mario González, Ángel Sánchez, David Dominguez, and Francisco B. Rodríguez</i>	
A Combined Approach for Enhancing the Stability of the Variable Selection Stage in Binary Classification Tasks	248
<i>Silvia Cateni, Valentina Colla, and Marco Vannucci</i>	
A Convolutional Neural Network as a Proxy for the XRF Approximation of the Chemical Composition of Archaeological Artefacts in the Presence of Inter-microscope Variability	260
<i>Catalin Stoean, Leonard Ionescu, Ruxandra Stoean, Marinela Boicea, Miguel Atencia, and Gonzalo Joya</i>	
Implementation of Data Stream Classification Neural Network Models Over Big Data Platforms	272
<i>Fernando Puentes-Marchal, María Dolores Pérez-Godoy, Pedro González, and María José Del Jesus</i>	
Performance Evaluation of Classical Classifiers and Deep Learning Approaches for Polymers Classification Based on Hyperspectral Images	281
<i>Javier Lorenzo-Navarro, Silvia Serranti, Giuseppe Bonifazi, and Giuseppe Capobianco</i>	
Hotel Recognition via Latent Image Embeddings	293
<i>Boris Tseytlin and Ilya Makarov</i>	
Time Series Prediction with Autoencoding LSTM Networks.	306
<i>Federico Succetti, Andrea Ceschini, Francesco Di Luzio, Antonello Rosato, and Massimo Panella</i>	
Improving Indoor Semantic Segmentation with Boundary-Level Objectives.	318
<i>Roberto Amoroso, Lorenzo Baraldi, and Rita Cucchiara</i>	
EvoMLP: A Framework for Evolving Multilayer Perceptrons	330
<i>Luis Liñán-Villafranca, Mario García-Valdez, J. J. Merelo, and Pedro Castillo-Valdivieso</i>	
Regularized One-Layer Neural Networks for Distributed and Incremental Environments	343
<i>Oscar Fontenla-Romero, Bertha Guijarro-Berdiñas, and Beatriz Pérez-Sánchez</i>	

Frailty Level Prediction in Older Age Using Hand Grip Strength Functions Over Time	356
<i>Elsa Pérez, Jose E. Torres Rangel, Marta Musté, Carlos Pérez, Oscar Macho, Francisco S. del Corral Guijarro, Aris Somoano, Cristina Gianella, Luis Ramírez, and Andreu Català</i>	
Accuracy and Intrusiveness in Data-Driven Violin Players Skill Levels Prediction: MOCAP Against MYO Against KINECT	367
<i>Vincenzo D’Amato, Erica Volta, Luca Oneto, Gualtiero Volpe, Antonio Camurri, and Davide Anguita</i>	
Features Selection for Fall Detection Systems Based on Machine Learning and Accelerometer Signals	380
<i>Carlos A. Silva, Rodolfo García–Bermúdez, and Eduardo Casilari</i>	
Autonomous Docking of Mobile Robots by Reinforcement Learning Tackling the Sparse Reward Problem.	392
<i>A. M. Burgueño-Romero, J. R. Ruiz-Sarmiento, and J. Gonzalez-Jimenez</i>	
Decision Support Systems for Air Traffic Control with Self-enforcing Networks Based on Weather Forecast and Reference Types for the Direction of Operation.	404
<i>Dirk Zinkhan, Sven Eiermann, Christina Klüver, and Jürgen Klüver</i>	
Impact of Minority Class Variability on Anomaly Detection by Means of Random Forests and Support Vector Machines	416
<i>Faisal Saleem Alraddadi, Luis F. Lago-Fernández, and Francisco B. Rodríguez</i>	
Analyzing the Land Cover Change and Degradation in Sundarbans Mangrove Forest Using Machine Learning and Remote Sensing Technique	429
<i>Ashikur Rahman Khan, Anika Khan, Shehzin Masud, and Rashedur M. Rahman</i>	
Correction to: Advances in Computational Intelligence	C1
<i>Ignacio Rojas, Gonzalo Joya, and Andreu Català</i>	
Author Index	439