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# Advances in Computational Intelligence

## 15th International Work-Conference on Artificial Neural Networks, IWANN 2019 Gran Canaria, Spain, June 12–14, 2019 Proceedings, Part I

Springer

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# Preface

We are proud to present the set of final accepted papers for the 13th edition of the IWANN conference—the International Work-Conference on Artificial Neural Networks—held in Gran Canaria, (Spain) during June 12–14, 2019.

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, it also aims to create a friendly environment that could lead to the establishment of scientific collaborations and exchanges among attendees. The proceedings will include all the communications presented at the conference. A publication of an extended version of selected papers in a special issue of several specialized journals (such as *Neural Computing and Applications, PLOS One,* and *Neural Proccesing Letters*) is also foreseen.

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. Evolutionary and genetic algorithms.
2. **Neurocomputational formulations**. Single-neuron modeling. Perceptual modeling. System-level neural modeling. Spiking neurons. Models of biological learning.
3. **Learning and adaptation**. Adaptive systems. Imitation learning. Reconfigurable systems. 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. 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. 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. 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. 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 2.9, Program Committee members or additional reviewers), 150 papers were accepted for oral or poster presentation, according to the reviewers' recommendations and the authors' preferences.

In this edition of IWANN 2019, a workshop entitled "Artificial Intelligence in Nanophotonics" was presented, organized by Dr. Nikolay Zheludev, University of Southampton, UK, and NTU Singapore and Dr. Cesare Soci, NTU, Singapore.

During IWANN 2019, 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: Artificial Neural Network for Biomedical Image Processing**
  Organized by: Dr. Yu-Dong Zhan
- **SS02: Deep Learning Models in Health Care and Biomedicine**
  Organized by: Dr. Leonardo Franco, Dr. Ruxandra Stoean and Dr. Francisco Veredas
- **SS03: Deep Learning Beyond Convolution**
  Organized by: Dr. Miguel Atencia
- **SS04: Machine Learning in Vision and Robotics**
  Organized by: Dr. José García-Rodríguez, Dr. Enrique Domínguez and Dr. Ramón Moreno
- **SS05: Data-Driven Intelligent Transportation Systems**
  Organized by: Dr. Ignacio J. Turías Domínguez, Dr. David Elizondo and Dr. Francisco Ortega Zamorano
- **SS06: Software Testing and Intelligent Systems**
  Organized by: Dr. Juan Boubeta, Dr. Pablo C. Cañizares and Dr. Gregorio Díaz
- **SS07: Deep Learning and Natural Language Processing**
  Organized by: Dr. Leonor Becerra-Bonache, Dr. M. Dolores Jiménez-López and Dr. Benoit Favre
- **SS08: Random-Weights Neural Networks**
  Organized by: Dr. Claudio Gallicchio
- **SS09: New and Future Tendencies in Brain–Computer Interface Systems**
  Organized by: Dr. Ricardo Ron and Dr. Ivan Volosyak
- **SS10: Human Activity Recognition**
  Organized by: Dr.-Ing. habil. Matthias Pätzold
- **SS11: Computational Intelligence Methods for Time Series**
  Organized by: Dr. Héctor Pomares
- **SS12: Advanced Methods for Personalized/Precision Medicine**
  Organized by: Dr. Luis Javier Herrera and Dr. Fernando Rojas

- **SS13: Exploring Document Information to Improve Neural Summarization Models**
  Organized by: Dr. Luigi Di Caro
- **SS15: Machine Learning in Weather Observation and Forecasting**
  Organized by: Dr. Juan Luis Navarro-Mesa, Dr. Antonio Ravelo-García and Dr. Carmen Paz Suárez Araujo

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

1. Dr. Nuria Oliver, Director of Research in Data Science, Vodafone Chief Data Scientist, Data-Pop Alliance
2. Dr. Aureli Soria-Frisch, Director of Neuroscience, Starlab Consulting Division
3. Dr. Jose C. Principe, Distinguished Professor ECE, Eckis Professor of ECE, Director Computational NeuroEngineering Lab, University of Florida
4. Dr. Marin Soljacic, Professor of Physics at MIT

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 2019 sessions, but classified under 22 chapters. The papers are organized in two volumes arranged basically following the topics list included in the call for papers. The first volume (LNCS 11506), entitled *Advances in Computational Intelligence. IWANN 2019. Part I*, is divided into ten main parts and includes contributions on:

1. Machine learning in weather observation and forecasting
2. Computational intelligence methods for time series
3. Human activity recognition
4. New and future tendencies in brain–computer interface systems
5. Random-weights neural networks
6. Pattern recognition
7. Deep learning and natural language processing
8. Software testing and intelligent systems
9. Data-driven intelligent transportation systems
10. Deep learning models in health care and biomedicine

In the second volume (LNCS 11507), entitled *Advances in Computational Intelligence. IWANN 2019. Part II*, is divided into 12 main parts and includes contributions on:

1. Deep learning beyond convolution
2. Artificial neural network for biomedical image processing
3. Machine learning in vision and robotics
4. System identification, process control, and manufacturing
5. Image and signal processing
6. Soft computing
7. Mathematics for neural networks
8. Internet modeling, communication, and networking
9. Expert systems

10. Evolutionary and genetic algorithms
11. Advances in computational intelligence
12. Computational biology and bioinformatics

The 14th edition of the IWANN conference was organized by the University of Granada, University of Malaga, and Polytechnical University of Catalonia. We wish to thank to the University of Gran Canaria for their support and grants.

We would also like to express our gratitude to the members of the different committees for their support, collaboration, and good work. We especially thank our honorary chairs (Prof. Joan Cabestany, Prof. Alberto Prieto and Prof. Francisco Sandoval), the technical program chairs (Prof. Miguel Atencia, Prof. Francisco García-Lagos, Prof. Luis Javier Herrera and Prof. Fernando Rojas), the local Organizing Committee (Prof. Domingo J. Benítez Díaz, Prof. Carmen Paz Suárez Araujo and Prof. Juan Luis Navarro Mesa), the Program Committee, the reviewers, invited speaker, and special session organizers. Finally, we want to thank Springer and especially Alfred Hofmann and Anna Kramer for their continuous support and cooperation.

June 2019

Ignacio Rojas
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Thurnhofer-Hemsi, Karl

# Contents – Part I

**New and Future Tendencies in Brain-Computer Interface Systems**



**Random-Weights Neural Networks**

**Deep Learning Models in Healthcare and Biomedicine**

# Contents – Part II

**Machine Learning in Vision and Robotics**

**Image and Signal Processing**



**Soft Computing**

**Mathematics for Neural Networks**



**Internet Modeling, Communication and Networking**

**Advances in Computational Intelligence**

**Computational Biology and Bioinformatics**