

# Artificial Intelligence in beyond 5G and 6G Wireless Networks - Preface

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## Abstract

The workshop *Artificial Intelligence in beyond 5G and 6G Wireless Networks (AI6G 2022)* was organized in Padua on July 21, 2022, co-located with the *IEEE World Congress on Computational Intelligence (WCCI 2022)* which is the world's largest technical event on computational intelligence, featuring the three flagship conferences of the *IEEE Computational Intelligence Society (CIS)* under one roof: the *2022 International Joint Conference on Neural Networks (IJCNN 2022)*, the *2022 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2022)*, and the *2022 IEEE Congress on Evolutionary Computation (IEEE CEC 2022)*. These workshop proceedings reflect the objective of the workshop, conceived as a markedly multidisciplinary event, to foster cross-fertilization of ideas among the areas of Artificial Intelligence and Wireless Networks. Researchers and professionals working at the interface between these two fields have contributed to these proceeding by presenting results of their ongoing research.

Artificial Intelligence and Machine Learning will play an increasing role in designing and optimizing Next Generation Wireless Networks (NGWN). The fourth (4G), fifth (5G) and subsequent generations, including those Beyond 5G (B5G), of cellular networks not only allow billions of people to communicate with each other but also have the potential to support the digitisation of industries and public administrations, machine-to-machine communication, distributed wireless computing and several advanced services tailored for a wide range of customers. Even though 5G is still in its infancy, academia and industry started to look at B5G and to conceive the sixth generation (6G) of cellular networks, which is expected to start being deployed from 2030. Future 6G networks are envisioned to be much more complex and dynamic than 4G and 5G networks. Heterogeneous end-user applications, such as high-precision manufacturing and smart transportation will lead to stringent requirements in terms of reliability and latency. Moreover, an increasing volume of devices will join the network and new coordination and orchestration schemes will be necessary to support all operations and services.

Indeed, tools and techniques from the three big areas of Computational Intelligence will underpin the NGWN and will be crucial to fulfill the requirements of performance, sustainability and trustworthiness, to offer innovative services and to handle the increasing complexity of the network. At the same time, the future 6G network architecture will foster novel applications of

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AI, featuring an ever-increasing number of intelligent edge devices connected over a flexible platform.

The first edition of this workshop was aimed at bringing together researchers, professionals and technologists working in Computational Intelligence and Wireless Communication fields, providing an international and multidisciplinary forum to share information on their latest investigation related to the adoption of AI techniques in NGWN. To stimulate discussion, we considered two types of submissions: *regular communications*, describing unpublished work that is being presented for the first time, and *ideas* describing new research directions, work in progress and doctoral work.

The topics of interest for the first edition revolved around the following areas, relevant to the field of Computational Intelligence:

- Concepts and applications of neural networks in B5G/6G networks;
- Concepts and applications of evolutionary computation in B5G/6G networks;
- Concepts and applications of fuzzy logic in B5G/6G networks;
- AI/CI-native B5G/6G networks: air interface design, communications mechanisms, semantic and goal-oriented communications;
- Distributed learning architectures: edge AI, federated learning;
- Big data mining for 6G;
- Computational Intelligence towards trustworthy AI: technical robustness and safety, privacy and data governance, transparency and explainability;
- Governing AI mechanisms;
- Resource allocation for AI mechanisms;
- Sustainable AI;
- Performance evaluation and experimentation of AI-based solutions for B5G/6G networks.

The papers presented at AI6G2022 offer exciting contributions in many of these areas. There were 13 short papers submitted for this workshop; out of these, 11 high-quality papers (9 *regular communications* and 2 *ideas*) were accepted for presentation and are published in this volume. The quality of the contributions is assured by a rigorous peer-review process: each submission has been assessed by at least two reviewers of a high-caliber Technical Program Committee, whose members come from academia or IT companies. They are listed below, in alphabetical order.

- Andras Benczur, Institute for Computer Science and Control, Hungary
- Tamas Borsos, Ericsson, Hungary
- Panagiotis Demestichas, University of Piraeus, WINGS ICT Solutions, Greece

- Pietro Ducange, University of Pisa, Italy
- Michela Fazzolari, IIT, CNR, Italy
- Miltiadis Filippou, Intel, Germany
- Hannu Flinck, Nokia, Finland
- Alberto Gotta, ISTI, CNR, Italy
- Ignacio Labrador, ATOS, Spain
- Giada Landi, Nextworks, Italy
- Luc Le Magoarou, BCOM, France
- Francesco Marcelloni, University of Pisa, Italy
- Jafar Mohammadi, Nokia, Germany
- Giovanni Nardini, University of Pisa, Italy
- Riccardo Pecori, University of Sannio, Italy
- Premanand Rajatheva, University of OULU, Finland
- Alessandro Renda, University of Pisa, Italy
- Merve Saimler, Ericsson
- Elif Ustundag Soykan, Ericsson, Turkey
- Massimo Vecchio, FBK, Italy

In addition to the presentation of peer-reviewed papers, the workshop has hosted two keynote talks, focused on crucial aspects of the current trends of AI and WN, provided by well-respected invited speakers:

- “Federated Learning and Explainable Artificial Intelligence: a Favourable Synergy”, by Prof. Francesco Marcelloni (University of Pisa).
- “The role of AI and edge computing toward 6G systems: how simplifying a bigger complexity with MEC and network automation”, by Dr. Dario Sabella (Intel).

To the two keynote speakers, members of the program committee, authors of the papers, those who helped in the organization and those who attended the event, we extend our heartfelt thanks for contributing to the success of the First International Workshop on Artificial Intelligence in beyond 5G and 6G Wireless Networks (AI6G).