

# IFAC 2020 Open Invited Track Proposal: Control for Next Generation Wireless Networks

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**Abstract:** Next generation wireless networks aim to support critical physical infrastructure, including industrial automation, connected autonomous vehicles and transportation systems, smart grids, and smart cities. As these networking interfaces interact with the physical world, new fundamental research questions arise. In the proposed invited session, we are soliciting contributions showcasing how the control and automation systems community addresses these challenges from various points of view including (i) resource management for next generation wireless architectures, (ii) designs enabling next generation low latency and high reliability applications, and (iii) data-driven designs of wireless autonomous systems.

*Keywords:* Networked Systems, Five to ten keywords, preferably chosen from the IFAC keyword list.

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## 1. IFAC TECHNICAL COMMITTEE (ORGANIZATION OF THE REVIEWING PROCESS)

### 1.5 Networked Systems

#### 2. DESCRIPTION

Next generation wireless networks aim to support a range of critical physical infrastructures, including industrial automation, connected autonomous vehicles and transportation systems, smart grids and smart cities, and connected medical devices. This broad spectrum of applications raises significant new challenges from multiple points of view. The new hardware and software networking installations required to support those applications, which are beyond the traditional high data rate personal communication, are typically referred to as "5G and beyond" in industry. From the point of view of control systems and control engineering, there is both a need to develop novel design methodologies for control in the era of next generation wireless networks, as well as an exciting opportunity for playing a pivotal role in a broad sector of the economy. This invited session aims to address these challenges.

More specifically the control systems community has realized that the characteristics of the next generation wireless networks require novel tools. One of the main challenges is the need for efficient resource management methodologies, particularly in applications operating over low-power sensing devices with long battery lifetimes. Indeed, considerable research effort of the last few years has centered around this problem, developing tools for resource effi-

ciency, including the popular event-triggered control and communication paradigm. A more complex situation arises when multiple systems and physical processes coexist in the environment and need to be supported over shared resources and shared channels.

Beyond the problem of scheduling scarce communication resources, novel applications, such as autonomous transportation systems and wireless industrial robotics, also introduce additional challenge. Safety, tight performance objectives, low communication latency, and high reliability are fundamental for their operation. Both the networking and control communities are beginning to think around these topics. On one hand there are new considerations in networking, how to manage the age/freshness-of-information, and how to guarantee low latency without sacrificing reliability. On the other hand novel control paradigms are emerging explicitly considering the availability (or lack) of communication links among multiple agents, for example, in connected autonomous vehicles.

Finally, next generation wireless networks are inherently data-centric, deployed to efficiently transfer and share data among multiple agents (sensors, actuators, robots, decision makers) at different locations. The recent emergence of machine learning techniques offers a fertile ground to harvest this data-centric view of networks. The aim is to enable novel data-driven design and control methodologies for next generation networks. Examples of this exciting premise include deep learning, reinforcement learning, and safe learning.

Consequently, the topic of our proposal is timely and active in the last years. We believe an Open Invited Session on the proposed topic would help encourage large number of high quality contributions with the goal of showcasing the state of the art and the emerging new challenges. Furthermore, next generation wireless networks are aligned with the theme of *Industry 4.0*, which is central in the IFAC 2020 World Congress call for papers. Moreover, the inclusion of data-driven techniques in the context of next generation wireless networks is aligned with the IFAC 2020 World Congress focus on the *junction of artificial intelligence and control*.

Based on the exciting research opportunities in the area of control for next generation wireless networks, this open invited track session proposal solicits papers in a variety of areas including (but not limited to)

- resource allocation for next generation wireless sensing and control applications
- designs for low-latency high-reliability applications
- age-of-information approaches
- next generation information theoretic approaches for autonomous systems, such as channel coding
- data-driven tools to support wireless autonomous applications, including reinforcement learning and statistical learning
- wireless networks for supporting data-driven and adaptive agents
- next generation wireless control application domains, such as connected vehicles, robotics, industrial automation

## REFERENCES