

Editorial: The Era of Quality and Metaverse

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First of all, I would like to take this opportunity to express my sincere thanks to Professor Fei-Yue Wang, the founding Editor-in-Chief, and Professor MengChu Zhou, the former Editor-in-Chief, for their trust in me to take over the role of Editor-in-Chief, IEEE/CAA Journal of Automatica Sinica (JAS) [1], [2]. One can see clearly that under their wonderful leadership, IEEE/CAA JAS has become a young and high-impact publication in the world. They do expect me to lead IEEE/CAA JAS to reach a new high for its service and quality. In fact, IEEE/CAA JAS has set itself an ambitious target of becoming one of the top journals in the world. How to make this happen is a very challenging task. The short path is that IEEE/CAA JAS does its best to attract influential world-class researchers to publish their high quality papers with great impact. However, these world-class researchers have their own favourite journals and they are loyal to these journals. It is very difficult to let these researchers submit their high quality papers to IEEE/CAA JAS. Notice that many early- and mid-career researchers who are ambitious have a strong desire to become world-class researchers. Professor Fei-Yue Wang, Professor MengChu Zhou, and I have an assertion of attracting these ambitious researchers to make their contributions to IEEE/CAA JAS. How can we make this happen? The best approach is that we do our best to provide these researchers the platform in their career developments. In return, these researchers are loyal to IEEE/CAA JAS and submit their high-quality papers to IEEE/CAA JAS. Thus, we established an Early Career Advisory Board (ECAB). The responsibilities of an ECAB member include 1) submitting high-quality papers and inviting for submissions of high-quality work to IEEE/CAA JAS; 2) conducting reviews actively for IEEE/CAA JAS submissions at the request of an Associate Editor, and recommending qualified scholars to serve as reviewers; 3) serving as an ambassador for IEEE/CAA JAS and promoting IEEE/CAA JAS via conferences, academic activities, social media and other channels to audiences around the world; and 4) helping IEEE/CAA JAS organize academic conferences and training. On 22 July 2021, IEEE/CAA JAS issued an Open Call for ECAB Members. We received over 350 applications by the deadline of 20 September 2022. After rigorous evaluation of all the applications, we selected 62 outstanding young researchers to join the first ECAB. On 30 October 2021, we officially launched the inaugural ceremony of the ECAB. In November 2021, I had online individual meetings with most of the ECAB members. During

the meetings, the ECAB members and I discussed about how to promote IEEE/CAA JAS and solicit high quality papers to IEEE/CAA JAS. As one of the outcomes of the discussions, we officially launched IEEE/CAA JAS Symposium Series on 15 January 2022. The Symposium Series technically sponsored by IEEE/CAA JAS aims at providing a research venue for researchers, students and control engineers to exchange ideas and discuss the technical trends and challenges in the area of automation science and engineering. The Symposium Series brings together a set of one day or half day symposia at a common site, currently being planned as an online event given the pandemic situation, but IEEE/CAA JAS will be monitoring the pandemic situation and updating this plan soon. The Symposium Series will run multiple times yearly and different symposium topics will be solicited from the current ECAB members. In 2022, the Symposium Series ran 10 times with different topics by over 20 ECAB members. The Symposium Series attracted about 40 outstanding researchers to deliver keynote speeches. There were 315 submissions to the Symposium Series. After rigorous review of all the submissions, 117 submissions were selected to be presented at the Symposium Series by authors. Furthermore, these 117 submissions were also published in the form of *Letter* in IEEE/CAA JAS.

IEEE/CAA JAS created a new category, i.e., *Perspective*, in November 2022. The *Perspective* allows the brand new ideas and sometimes controversial ideas to be published in a timely fashion, that could revolutionize an existing area or establish a completely new area [2]. The launching topic in *Perspective* is Metaverse. Professor Fei-Yue Wang is a world-class leader in Metaverse. In his *Perspective* [3], he investigated and outlined MetaControl and DeControl in Metaverse for control intelligence and knowledge automation. In order to further promote the topic of Metaverse, we invited his team to contribute an invited special section on intelligent control for industrial metaverses [4]–[8]. Furthermore, I would like to take this opportunity to discuss about MetaVehicles [9]. MetaVehicles can be deemed as a technological expression of intelligent vehicles, robotics, AI, blockchain, knowledge automation, networking and communication [10]. Generally speaking, MetaVehicles aim to improve vehicle stability and performance, driving safety, security and privacy, traffic efficiency, and cooperation intelligence for connected automated vehicles (CAVs) as well as for future intelligent transportation and smart mobility. MetaVehicles rely heavily on suitable wireless communication networks to guarantee reliable, efficient, secure and private vehicle-to-everything (e.g., vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-pedestrian, vehicle-to-grid) data communications across the cyber and physical spaces.

The advent of pervasive wireless communication technolo-

Citation: Q.-L. Han, “Editorial: The era of quality and metaverse,” *IEEE/CAA J. Autom. Sinica*, vol. 10, no. 1, pp. 1–2, Jan. 2023.

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Digital Object Identifier 10.1109/JAS.2023.123003

gies for MetaVehicles greatly facilitates vehicle-to-everything communication and cooperation. However, the digital, broadcasting and sharing nature of wireless networks poses several challenging issues that need to be carefully addressed for distributed cooperative sensing, control and optimization of MetaVehicles. For example, when the sensing and networking resources are constrained, novel resource-efficient data sensing and dissemination paradigms are demanded to achieve both satisfactory communication efficiency and control and optimization performance for CAVs. Event-triggered control and optimization provide a truly viable pathway, where certain *human intelligence* is added to the sensing, control and optimization processes in such a way to intelligently orchestrate the desired sensing and control tasks or the information exchanges during the optimization procedure whenever truly *needed*. For example, the problem of dynamic event-triggered platooning control of automated vehicles is achieved with expected gap references and harmonious speeds, while simultaneously attaining significant vehicle-to-vehicle communication efficiency [11]. Apart from event-triggered mechanisms, suitable communication scheduling protocols that preserve reliable and efficient data communications could be also explored and promoted for MetaVehicles.

Security and privacy are recognized as another two major concerns that hinder the further development of the Metaverse due to the possibility of a wide variety of security breaches and privacy invasions, e.g., the untrustworthy dissemination and management of massive data streams, the sensitive user profiling activities under network eavesdroppers, and the malicious external destruction and disruption of physical infrastructures and several pieces of equipment. To defend security threats on MetaVehicles, on one hand, advanced control strategies can be developed to safeguard the vehicular dynamical systems with guaranteed resilience and security performance. For example, the problem of resilient and safe platooning control is addressed for CAVs subject to intermittent denial-of-service attacks that disrupt vehicle-to-vehicle communications [12]. When the actually computed control input commands of each physical vehicle are first recorded and then replayed, a PI-observer-based secure platooning control method is developed to guarantee the desired platoon stability and performance [13]. On the other hand, opportunities brought by machine learning (ML), in particular deep learning (DL), can be skillfully exploited to deal with cyber attacks and cyber criminals against the Metaverse applications. For example, a holistic review of the existing DL solutions to cyber attack detection is provided in the cyber-physical system context [14]. The existing relevant literature is classified and discussed based on a six-step DL driven methodology, i.e., system scenario analysis, attack identification, ML problem formulation, DL model customization, data acquisition for training, and performance evaluation.

Due to the open nature of wireless communication networks, the transmitted vehicular data packets are widely exposed to the public and concomitant data leakage may lead to unintended consequences to vehicle stability and driving safety. For this issue, the privacy-preserving platooning control issue of a class of vehicular cyber-physical systems subject to control input saturations is investigated [15]. An inter-

esting topic here is how emerging AI/ML/IoT/blockchain technologies can be effectively and efficiently adopted to achieve distributed privacy-preserving control for CAVs and MetaVehicles.

In this first issue of 2023, we invited Professor Qing-Guo Wang to contribute a perspective entitled “Control design for transient performance” [16]. Transient performance control is significant as it yields incredible benefits to the end users. We do hope you will join us to provide us your own perspective.

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