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Editorial

Vehicular Systems Technologies: Challenges and Trends Across Transportation Means

Jose Santa [1,*] and Ramon Sanchez-Iborra [2,*]

[1] Department of Electronics, Computer Technology, and Projects, School of Telecommunications Engineering, Technical University of Cartagena, Cartagena, 30202 Murcia, Spain

[2] Department of Information and Communication Engineering, Faculty of Computer Science, University of Murcia, 30100 Murcia, Spain

* Correspondence: jose.santa@upct.es (J.S.); ramonsanchez@um.es (R.S.-I.)

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1. Introduction

The Intelligent Transportation Systems (ITS) paradigm embraces a plethora of innovations for different transportation means; hence, several multidisciplinary fields are involved in the extensive research related to this topic. One of the hottest topics today is the design and implementation of efficient vehicular networks that will boost the development of the Internet of Vehicles (IoV) [1] and the improvement of cooperative safe-driving applications [2]. In this line, cybersecurity in vehicular networks is also of relevant importance given the multiple threats which the vehicles are exposed to [3]. The integration of these systems within the novel 5G architecture is another prominent field of study that will be in the first research line during the next years [4].

Besides the networking and communication aspects of vehicles, other fields of study are being widely explored lately. For instance, energy management is another niche of interest in order to enable efficient battery-powered vehicles such as drones, Unmanned Maritime Vehicles (UMV), or electric road-vehicles, among others [5]. Of course, the enhancement of on-board electronic systems for monitoring the status of the vehicles or the transportation infrastructure is also a field in continuous evolution [6,7].

All the aspects mentioned above are addressed in the present special issue from different approaches and perspectives. Therefore, this compilation of works evidences the timeliness of the covered topics and they draw the future research lines that will be tackled in the upcoming times.

2. The Present Issue

This special issue consists of twelve papers presenting state-of-the-art innovations covering several aspects of several transportation means. The contents of these papers are introduced here.

Vehicular networks have been the most addressed topic in the current issue, although it has been explored from different perspectives. The work in [8] presents a cross-layer methodology to coordinate vehicular congestion and awareness control protocols. The coordination methodology, so-called COMPAS, does not require changing the original protocols and solves negative interactions or conflicts that may arise between such protocols when operating independently of each other. Another work focused on traffic management but, in this case, from a centralized approach is presented in [9]. Authors propose a novel traffic management server capable of handling all the traffic in a city, while balancing traffic flows by accounting for present and future traffic congestion conditions. This proposal is evaluated by computer simulations and experimental tests showing substantial improvements in terms of travel times and average travel speed of vehicles, reducing congestion and improving traffic fluidity. In [10], the authors present a precise emergency material scheduling model using vehicular communications. This work provides a comprehensive method to make an emergency material

scheduling plan considering the actual situation of disaster depots. In turn, a warning system to protect pedestrians in urban scenarios using a communication system is studied in [11]. Concretely, authors design four different algorithms to define when to trigger alerts in the warning system with the focus on avoiding the generation of too many unnecessary alerts. This proposal is evaluated via computer simulation. Finally, authors of [12] propose to virtualize vehicle On Board Units (OBUs) and develop a novel Multi-Access Edge Computing (MEC) layer in order to offload processing from the vehicle and serving data-access requests. The obtained results reveal a speed-up of more than 50% in the data request resolution, with consequently great savings of network resources in the wireless segment.

Aligned with vehicular networks, cybersecurity is of prominent importance and it has been also addressed in two contributions. The work in [13] focuses on the security of Communication-Based Train Controls (CBTC) systems, by employing a generalized stochastic Petri net (GSPN) model to capture the dynamic interaction between the attacker and the defender. From this study, a series of security indicators to evaluate the security of CBTC systems under attack–defense confrontation is proposed. From a different perspective, cybersecurity is also addressed in [14]. In this case, the authors evaluate the impact of using certificate-based authentication mechanisms in vehicular networks in terms of the added delay due to communication and processing tasks. Authors found that implicit authentication schemes are better suited than the explicit ones in vehicular scenarios.

Maritime environments have been also explored in different papers but considering different use cases. On the one hand, a novel tracking by detection mechanism is proposed in [15] to detect and track surrounding vessels of Unmanned Surface Vessels (USV) to avoid collision at sea. The authors present a framework that integrates the multimodel and multi0cue pipeline and evaluate it by using two public maritime datasets showing its great performance. On the other hand, the work in [16] proposes the use of LoRa (Long Range) transmission technology for tracking and monitoring boats in port areas. A real experiment is presented and the obtained outcomes confirm the validity of the proposal for monitoring activities and maneuvers inside the port or close to the shore.

Other works have addressed diverse topics related to improve the performance of on-board monitoring systems or optimize the location of electric charging stations. Work in [17] proposes a Raspberry Pi-based system for measuring friction between the types of a vehicle and the road, aiming at improving traffic safety. The presented results show a better performance of the developed prototype in comparison with professional vehicle performance computers. The authors of [18] present a novel framework for estimating the vehicle sideslip angle. This proposal is evaluated through experimental tests, evidencing that it is able to reliably estimate the vehicle sideslip angle during both steady state and transient maneuvers. Finally, a decentralized optimization model for dispatching electric charging stations is presented in [19]. The aim of this solution is to maximize the profit of the charging stations, but it also considers other user-related factors. The results obtained by numerical simulations indicate that the adopted strategy increases the profit of the charging stations as well as maintains a good level of computation efficiency and stability.

3. Future

The continuous evolution of On-Board Units (OBUs) will boost the development of a new wave of both online and off-line services for drivers and passengers. From an online perspective, the fully integration of vehicles within the 5G and the IoV ecosystems will improve their communication capabilities in order to improve autonomous vehicles perception, remote control applications, vehicle monitoring, and safety systems, among many others new-generation services. From an offline point of view, new onboard platforms are being developed to enrich the amount of information handled by the OBUs regarding the perception of the environment. In this line, novel Artificial Intelligence (AI)-based schemes are needed for making quick and smart decisions that will improve the driving experience. It is also of high interest to foster ecological transport means such as bicycles or electric scooters. However, there is still a clear gap related to the safety of these highly vulnerable vehicles.

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