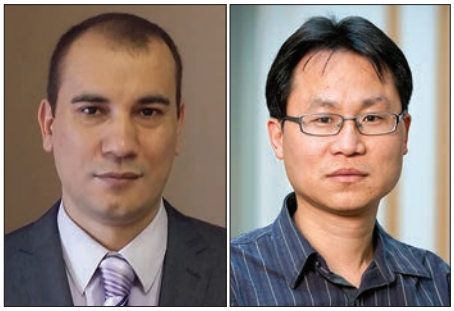
Data Analytics Streamlines Autonomous Driving



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Artificial Intelligence (AI) incorporates the decision-making engine that is responsible for automating vehicle driving without human intervention. However, reliable and accurate decisions can only be concluded when a history of events has been accumulated by the AI engine for an extended set of operations over prolonged periods. The events are associated with status transitions of the vehicle while traveling between different geolocations. Vehicle sensors also generate sets of various information that reports platform status and the visuals of its surrounding domains including nearby objects. The automation system also acquires additional data from vehicle-to-vehicle communications and intelligent transportation systems. This diverse data helps to draw the Augmented Reality (AR) and Virtual Reality (VR) of surrounding domains that can also interact together to produce a new combined Mixed Reality (MR). Correlating all those realities with peripheral data sources leads to new 3D synergy namely eXtended Reality (XR). This aggregation of data is supported by key technology enablers such as cross-layer cyber-physical features and Bigdata storage. Training those families of labeled data improves the accuracy of machine learning predictions and safety of autonomous vehicles. This proves that acquiring more data with smart categorizing will enrich the autonomy of the transportation system.

The growing number of data sources and data consumers within the smart transportation system motivated the adoption of Digital Twin platforms for simulating real world scenarios and events. The digital twin models XR objects and predicted behaviors to determine best actions in real-time. This projection of future events makes it possible to automate self-driving vehicles through network central controllers that prevent accidents or sudden failures. Aside from data, the continued evolution of machine learning would be crucial to deploy an efficient digital twin for managing large numbers of autonomous vehicles. Moreover, it is necessary to integrate traffic scanning and data encryption features into such platforms to maintain data integrity and user trust. This requires a clear standard framework for industries to follow.

This issue of the Vehicular Networking Series includes five articles. The first article, "V2X in 3GPP Standardization: NR Sidelink in Rel-16 and Beyond" by Mehdi Harounabadi *et al.*, provides an interesting tutorial on the most important features of 5G New Radio (NR) for Vehicle-to-Everything (V2X) applications. The article summarizes all the related 3GPP Release 16 specifications and the NR-V2X aspects in the upcoming Release 17. The authors provide a valuable technical study considering physical layer design and related performance indicators.

The next article, "5G Vehicle-to-Everything (V2X) Services in Cross-border Environments: Standardization and Challenges" by Apostolos Kousaridas *et al.*, surveys the standardizations activities of 5G-enabled cross-border connected, cooperative, and automated mobility (CCAM) services. The authors provide an interesting study of the 5G core network components, interfaces, slicing, orchestration, etc. The authors provide a list of current gaps in current standards that could contribute to a standards roadmap and evolution.

The third article, "On the Adequacy of 5G Security for Vehicular Ad-hoc NETworks (VANETs)" by Rasheed Hussain *et al.*, studies the present security solutions in 5G and how they impact vehicular networking standards. The article provides a nice tutorial for security features at all 5G layers as well as related V2X standards. The authors show the integration solutions between secure Vehicular Ad-hoc NETwork (VANET) and 5G networks. Network and vehicular security challenges are well addressed in this article.

The next article, "Digital Twin Analysis to Promote Safety and Security in Autonomous Vehicles" by Sadeq Almeaibed *et al.*, addresses the digital twin design for autonomous vehicles and supported levels of vehicle autonomy. The article shows how the digital twin acquires information from historical data as well as real-time analytics from various sensors. The authors also study the vulnerabilities of autonomous vehicles and how they may impact the accuracy of digital twin decisions. The article includes a case study for an autonomous vehicle with an impaired sensor.

The last article, "5G NR-V2X: Towards Connected and Cooperative Autonomous Driving" by Hamidreza Bagheri *et al.*, studies many of the new technical features and how they evolved from Cellular Vehicle-to-Everything (C-V2X) technology toward NR-V2X. The article provides interesting use cases and the 3GPP standard roadmap. The authors show the end-to-end latency and reliability characteristics for studied technology use cases.

Biographies

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