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EDITORIAL

Special issue on recent advances in autonomous vehicle solutions in the digital continuum

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1 Editorial

Autonomous vehicle computing systems is a rapidly changing landscape under the pressure of an intense competition, the continuous emergence of new markets and players, and the recent proliferation of computing technologies such as sensors, computer vision, machine learning, and hardware acceleration. Automating the decision and control of vehicles by leveraging the perception results poses many challenges and opportunities both in hardware and software across the Digital Continuum: from sensors at the Edge to High Performance Computing (HPC) resources in the Cloud.

Hardware requirements range from specific processor architectures, efficient single instruction multiple data (SIMD) processing on graphics processors, and efficient memory hierarchy. Similarly, software requirements range from operating system support and specialized image processing kernels, to efficient deep learning algorithms for scene and object detection. Power limitations and energy efficiencies becomes of paramount importance and need to be accounted for early on in the design of autonomous vehicles. Other concerns include cost for mass production, and safety.

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We have received several manuscript submissions; of these, four papers have been accepted after several rounds of very thoughtful constructive and deep reviews. This special issue includes the following papers:

1. "Cloud-Backed Mobile Cognition: Power-Efficient Deep Learning in the Autonomous Vehicle Era," by Vega et al.
2. "ADBench: Benchmarking Autonomous Driving Systems," by Tabani et al.
3. "A Hybrid Machine Learning Model for Intrusion Detection in VANET for Computing," by Bangui et al.
4. "Ultra-Safe and Reliable Enhanced Train-centric Communications-Based Train Control System," by Zamouche et al.

In the first paper, A. Vega et al. propose a new method for increasing power efficiency in autonomous vehicles applications. Their approach is based on a smart cooperation between edge and cloud platforms for executing machine learning (ML) inference. In addition to increasing speed and autonomy, their cloud-backed mobile cognition system architecture allows a dynamic adaptation of the deep learning (DL) models. Their initial system has been extended by incorporating "flying clouds". In this case, vehicles may connect to flying drones that provide services while in flight. Flying clouds offer interesting features such as a shorter processing latency and a reliable support of critical tasks.

The next paper proposes ADBench, a benchmarking technique along with a benchmark suite for the state-of-the-art autonomous driving platforms. Specific benchmark setup includes applications that incorporate key modules, structural designs, and functions of autonomous driving systems that can be found on industry-level autonomous driving systems. Authors provide such a system for setting standards and using them for verification and validation of autonomous driving systems.

The third paper titled "A Hybrid Machine Learning Model for Intrusion Detection in VANET for Computing," by Bangui et al. proposes a new machine learning model to improve the performance of intrusion detection systems used in Vehicular Ad-hoc Network (VANET). These networks enable effective vehicle communication and traffic information exchange which makes them vulnerable to different security attacks, such as DOS attacks. The authors use a Random Forest based machine learning method to improve the detection accuracy and increase the detection efficiency.

The paper of Zamouche et al. addresses the issue of automatic train control and proposes an Enhanced Train-centric Communications-Based Train Control (ETcCBTC) approach based on process algebra. ETcCBTC enables to efficiently and safely control rail traffic. The train position is determined using the information from balises and GPS. Authors use Matlab simulations for evaluating the performance of ETcCBTC. Operational safety is assessed via a process algebra method. Experimental results indicate that ETcCBTC outperforms related approaches with respect to the operation rate, transmission load and response time.

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