Infrastructural Vehicles: The TAO From Infrastructural Intelligence to Foundational Mobility and Services

Dear All,

Welcome to the last issue of 2023, a fruitful and successful year for IEEE TIV, thanks to the great effort by each of you! Here, I would like to share the following news with you:

- By November 27, IEEE TIV has received 4228 original manuscripts, far passed our estimated target [1], and our submission per day (SPD) is reaching 12.81, signifying the field's dynamic growth and the editorial team's increased workload.
- As of now, we have accepted a total of 456 manuscripts, indicating a 10.8% acceptance rate that reflects the robust interest in our field and the quality of TIV papers.
- On the day of November 1, 2023, we have received 45 new submissions and 3 revised manuscripts, a total of 48 papers, a milestone in TIV's history, and two more days in November with the total number of submissions over 40, busy but joyful days for EiC and our AEs.
- According to the Web of Science, TIV's current tracking Impact Factor (IF) is **10.12**, another new record for our young publication, doubling our initial IF released last year [2], and increasing our previous IF by more than 20% [3]. Our care and effort to TIV's growth have been well received, and I would like to extend my heartfelt gratitude to all our contributors and associate editors for their support and dedication.

In addition, I'm pleased to highlight the special issues we've organized this year and welcome more submissions for on-going ones. Looking forward, we're committed to delivering more high-quality special issues in our field [4]:

1) Validation & Verification of Intelligent Vehicles
2) Digital Twins and Parallel Intelligence
3) Cyber Physical Social Intelligence
4) Metaverse Intelligence and Scenarios Engineering

For this final issue, I would like to review this year's newly implemented policies with all authors willing to submit their works to IEEE TIV, these policies have greatly improved the speed and quality of our review process [5], [6], [7], [8].

- Authors must fill in "Conflict of Interest" in Step 6 of the Submission: Details & Comments if one of the co-authors is a member of the Editorial Board of IEEE TIV.
- For any individual to be listed as a co-author, it is mandatory that the primary email address is an institutional one.
- ORCIDs enable accurate attribution and improved discoverability of an author's published work. All IEEE journals require an Open Researcher and Contributor ID (ORCID) for all authors, IEEE TIV is no exception.
- We encourage reviewers to recommend proper citations of proper papers to authors, however, reviewers must inform the Associate Editor in charge if any of his/her own publications are suggested for citation in his/her review reports. The AE must also inform the Senior Editor and the Editor-in-Chief about the citation recommendation. Otherwise, the manuscript would be moved to a special committee for special evaluation.
- The number of submissions to IEEE TIV has been increasing greatly, however, a few numbers of fake identities were found in the initial check of the submissions without biographies. Therefore, starting from issue 11, TIV will enforce the inclusion of biographies of all co-authors in IEEE format for TIV submission.

This issue comprises 4 letters and 5 regular papers. After Scanning the Issue, I would like to talk about Infrastructural Vehicles: The TAO from Infrastructural Intelligence to Foundational Mobility and Services.

I. Scanning the Issue

Communication and Letters

Advancing Vehicular Healthcare: The DAO-Based Parallel Maintenance for Intelligent Vehicles

X. Wang, J. Li, L. Fan, Y. Wang, and Y. Li

The Road Ahead: DAO-Secured V2X Infrastructures for Safe and Smart Vehicular Management

X. Dai, M. Vallati, R. Guo, Y. Wang, S. Han and Y. Lin

A Trustworthy Internet of Vehicles: The DAO to Safe, Secure and Collaborative Autonomous Driving

J. Yang, Q. Ni, G. Luo, Q. Cheng, L. Oukhellou and S. Han

A Sustainable Ecology of Mobility: DAO-Based Autonomous Vehicular Services

J. Li et al.

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Regular Papers

A Faster Cooperative Lane Change Controller Enabled by Formulating in Spatial Domain

H. Wang, W. Hao, J. So, X. Xiao, Z. Chen and J. Hu

This research proposes an optimal control based Cooperative Lane-Change controller. It bears a feature of a faster completion of a CLC maneuver by making space and changing lane at the same time. A formulation method in the relative spatial domain is proposed. It enhances computation efficiency by linearizing nonlinear avoidance constraints into a relative longitudinal distance fixed lateral-only avoidance constraint. The results show the effectiveness of the proposed controller.

Counterfactual Evolutionary Reasoning for Virtual Driver Reinforcement Learning in Safe Driving

P. Ye, H. Qi, F. Zhu and Y. Lv

The paper proposes a new method based on counterfactual evolutionary reasoning to build the virtual driver. The method treats safe driving as a sequential decision-making problem with sparse rewards and employs counterfactual evolutionary reasoning to accelerate the model training. An intervention mechanism from outlier distributions is further introduced to enhance the model's ability of exploration. Experiments indicate that the proposed method, compared with other typical reinforcement learning techniques, both achieves a higher safe arrival rate and a faster convergence speed.

ChatGPT as Your Vehicle Co-Pilot: An Initial **Attempt**

S. Wang, Y. Zhu, Z. Li, Y. Wang, L. Li and Z. He

This paper presents a framework that uses Large Language Models (LLMs) as a vehicle "Co-Pilot", which can perform driving tasks based on human intention and natural language input. The framework interacts with humans and vehicles, manages information with memory, and optimizes performance with black-box tuning. The Co-Pilot is tested on two tasks, path tracking and trajectory planning, and achieves promising results. The paper also explores the future of human-machine hybrid intelligence and LLMs in autonomous driving.

SLAPS: Simultaneous Localization and Phase Shift for a RIS-Equipped UAV in 5G/6G Wireless Communication Networks

M. Eskandari and A. V. Savkin

RISs-equipped UAVs (RISeUAVs) reflect wireless signals in the sky and provide aerial line-of-sight (ALoS) links for improving coverage of 5G/6G networks while obviating the complexity of the overhead baseband processor and being energy efficient. RISeUAVs facilitate ALoS vehicle-to-vehicle/everything (V2V) (V2X) communication for autonomous driving of intelligent vehicles in dense urban canyons. Nevertheless, channel estimation is prohibitive in dynamic environments with fragile links. The SLAPS: simultaneous localization and phase shift, a mmWave-based localization, allows geometry-based passive beam-steering and safe RISeUAV navigation.

Intelligent Traction Inverter in Next Generation Electric Vehicles: The Health Monitoring of Silicon-Carbide Power Modules

C. Pino et al.

In the automotive field, driving safety plays a fundamental role. With a view to improving driving safety, the scientific community has recently been investigating the use of AI-based health monitoring systems embedded in the modern vehicles. In this context, the target of this contribution is the design and implementation of a health monitoring system of the traction inverter sub-system embedded in the latest generation electric vehicles. Using a system based on deep learning, the health status of the Silicon-Carbide Power Modules, key-components embedded in the traction inverter of modern electric vehicles, will be monitored. The collected results confirmed the effectiveness of the proposed intelligent approach.

II. Infrastructural Vehicles: The TAO from Infrastructural Intelligence to Foundational Mobility and Services

The four letters we published in this issue are actually part of eigh letters from our new Distributed/Decentralized Hybried Workshop on Founddation/Infrastructure Intelligence (DHW-FII) launched last summer, since we have reached our page budget this year. The first letter [A1] introduces DAO-based parallel maintenance, a novel approach aimed at revolutionizing vehicle maintenance in intelligent transportation systems. It focuses on enhancing vehicular healthcare, securing data with blockchain technology, and offering personalized services. The second letter [A2] presents decentralized autonomous organizations and operations (DAOs) to the coordination of Vehicle-to-Everything (V2X) infrastructures. Through a tripartite functional architecture including organization, coordination, and execution, it can achieve intelligent collaborative management between road infrastructures and vehicles. The third letter [A3] proposes a decentralized Internet of Vehicles (DeIoV) system, using DAOs to address challenges in privacy, data security, and centralized management inefficiencies in autonomous driving, aiming to create a reliable, safe, and collaborative autonomous driving ecosystem . The fourth letter [A4] is intended to study the integration of blockchain-based TRUE DAOs (TAOs) within vehicular services, proposing parallel service systems, i.e., DeVS with decentralized organizations and operations, autonomous cooperation, and intelligent execution.

This editorial and those letters can be viewed as a follow-up for our previous one for foundation vehicles and foundation intelligence [6], as well as our discussion on metavehicles in meteverses [9], [10], [11]. We agree that current foundation models in AI are "neither foundational nor the foundations of AI" [12],

but we hope "Infracture Models" and "Infracture Intelligence" are both "infractural" and "fundamental" operating systems for future intelligent organizations and industries, including the fields of intelligent vehicles, intelligent transportation, as well as smart logistics and mobility.

Simply put, through the creative use of blockchain intelligence, smart contracts, and DAO/TAO, such as lightning networks [13] and many other emerging applications [14], we can move beyond foundation models with foundation intelligence and develop intelligent systems connected through infractural models with infractural intelligence, as the platform, i.e., the underlying foundation or basic framework, of public works for smart organizations to support related activities in a community, region, state, country, or any open/international community [14]. In the coming year's DHW, we will launch our investigation on Infrastructural Vehicles and related Blockchain Intelligence for Infrastructural Intelligence and Foundational Mobility and Services from the perspective of Intelligent Vehicles.

At IEEE ITSS, and IEEE TIV particularly, we will continue to facilitate discussions in those new and emerging directions, as addressed in our vision for Transportation 5.0 [15], [16], [17].

III. Call for Participation: Decentralized Hybrid Workshops

At IEEE TIV we will continue to organize decentralized and hybrid workshops or symposia (DHW or DHS) on various issues in ITS and IVs.

Welcome to participate in our investigations online or off-line. Our discussions will be summarized and reported as perspectives, letters, or regular papers at IEEE TIV. The following DHWs have been organized so far:

1) Verification and Validation for IVs (V&V4IV)
2) Autonomous Mining (AM)
3) Ethics, Responsibility, and Sustainability (ERS)
4) Intelligent Vehicles for Education (IV4E)
5) Data Science for Intelligent Vehicles (DSiV)
6) Vehicle 5.0 (V5)
7) Scenarios Engineering for Smart Mobility (SE4SM)
8) CrowdSensing Intelligence (CSI)
9) Sustainability for Transportation and Logistics (STL)
10) Autonomous Services (AS)
11) Foundation/Infrastruce Intelligence (FII)

Any suggestions or proposals for future topics of DHW/DHS are greatly appreciated. Looking forward to having you in IEEE TIV DHW/DHS.

IV. The "3323" Review Guideline

As reaffirmed in [3], our review guideline for EIC/SE/AE is "3323", specified as below:

- 3 weeks for the first decision
- 3 rounds of revision in maximum
- 2 weeks for minor revisions
- 3 weeks for major revisions

Under this guideline, we expect a maximum total 15-week review process for a submission.

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Appendix
Related Articles

[A1] X. Wang et al., "Advancing vehicular healthcare: The DAO-based parallel maintenance for intelligent vehicles," *IEEE Trans. Intell. Veh.*, vol. 8, no. 12, Dec. 2023, doi: 10.1109/TIV.2023.3341855.

[A2] X. Dai, M. Vallati, R. Guo, Y. Wang, S. Han, and Y. Lin, "The road ahead: DAO-secured V2X infrastructures for safe and smart vehicular management," *IEEE Trans. Intell. Veh.*, vol. 8, no. 12, Dec. 2023, doi: 10.1109/TIV.2023.3337993.

[A3] J. Yang, Q. Ni, G. Luo, Q. Cheng, L. Oukhellou, and S. Han, "A trustworthy internet of vehicles: The DAO to safe, secure and collaborative autonomous driving," *IEEE Trans. Intell. Veh.*, vol. 8, no. 12, Dec. 2023, doi: 10.1109/TIV.2023.3337345.

[A4] J. Li et al., "A sustainable ecology of mobility: DAO-based autonomous vehicular services," *IEEE Trans. Intell. Veh.*, vol. 8, no. 12, Dec. 2023, doi: 10.1109/TIV.2023.3334719.

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[9] F.-Y. Wang, "MetaVehicles in the metaverse: Moving to a new phase for intelligent vehicles and smart mobility," *IEEE Trans. Intell. Veh.*, vol. 7, no. 1, pp. 1–5, Mar. 2022, doi: 10.1109/TIV.2022.3154489.

[10] D. Cao et al., "Future directions of intelligent vehicles: Potentials, possibilities, and perspectives," *IEEE Trans. Intell. Veh.*, vol. 7, no. 1, pp. 7–10, Mar. 2022, doi: 10.1109/TIV.2022.3157049.

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