

Guest Editorial

Special Issue on Intelligent Autonomous Transportation Systems With 6G—Part IV

WE ARE delighted to introduce the fourth part of the Special Issue on Intelligent Autonomous Transportation Systems With 6G, which aims to provide the scientific community with a comprehensive overview of innovative technologies, advanced architectures, and potential challenges for the 6G-supported Intelligent Autonomous Transport Systems. Forty-three papers were selected for publication in this issue. All the papers were rigorously evaluated according to the standard reviewing process of the IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS. The evaluation process considered originality, technical quality, presentational quality, and overall contribution. We will introduce these articles and highlight their main contributions in the following.

In [A1], Sun et al. discuss a Parking Assistance Alliance (PAA) scheme based on a double auction for vehicular blockchain. Through truthful incentives, the PAA encourages vehicles in the alliance to provide parking information for nearby vehicle users. Furthermore, the vehicle user's preference is fully considered when assigning the parking space. The matching priority is introduced by incorporating the parking space supply and demand, as a reference to provide prioritized service.

In [A2], Pan et al. present and discuss an Asynchronous federated deep Q-learning (DQN)-based and URLLC-aware computation offloading algorithm (ASTEROID) used to achieve throughput maximization considering the long-term URLLC constraints. Specifically, an extreme value theory-based URLLC constraint model is established and the task offloading and computation resource allocation are decomposed by employing Lyapunov optimization. Finally, an asynchronous federated DQN-based (AF-DQN) algorithm is presented to address the UV-side task offloading problem.

In [A3], Gao et al. present and discuss a novel deep-learning framework for joint optimization of depth and ego-motion estimation. In [A4], Huq et al. present a study on the energy-efficiency (EE) analysis for UAV-aided terahertz-enabled 6G networks. In [A5], Abyaneh et al. present a discussion on blockchain as a support technology for a new Medium Access Control (MAC) protocol for IEEE 802.11ax designed for future IoT wireless local area networks (WLANs).

In [A6], Lin et al. discuss a hard-cored-based caching strategy to avoid simultaneous caching for a particular file

in vehicular networks. Furthermore, a joint caching and scheduling scheme is investigated in the article. In [A7], Qureshi et al. present a discussion on a Blockchain-based Privacy-Preserving Authentication (BPPAU) model for ITS networks to ensure users' privacy and security. The proposed model provides data storage, data accessing, and processing management by using a blockchain smart contract system. In [A8], Ugwuanyi et al. present a deadlock-aware, and collaborative edge decision algorithm for facilitating the seamless communication of autonomous vehicles over Multi-Access Edge Computing (MEC).

In [A9], Otoum et al. present and discuss a Split Learning-based IDS (SplitLearn) for Intelligent Transportation System (ITS) infrastructures to address the potential security concerns. In [A10], Zhuo et al. present and discuss a new cooperative relaying system based on partial non-orthogonal multiple access (P-NOMA), where two relays help the communications between the source and destination nodes in the presence of an eavesdropper. In [A11], Schiliro et al. present a novel deep-learning-based human cognitive privacy framework, named DeepCog, that ensures users' privacy through the application of feature-transforming normalization. In [A12], Lin et al. present a discussion on the utilization of the Software-Defined Networking (SDN) technique to update the controllability of the AUV-based network, leading to the paradigm of SDN-enabled multi-AUVs network Intelligent Transportation Systems (SDNA-ITS). In [A13], Raja et al. present and discuss a Drones Trajectory Generation employing an improved Genetic Algorithm (GA) and Non-Uniform Rational P-Splines (NURPS)-based optimizer (DTG-GN). The improved GA utilizes a novel dual-fitness-function parameter to select an optimal path to map the weed-infested regions.

In [A14], Su et al. present a discussion on task offloading in an aerial edge network assisted by a UAV, where the sum energy consumption of all users is minimized by jointly optimizing the offloading decisions of ground UEs and the flight position of UAV under the constraints of the latency and the total energy. In [A15], Sun et al. present and discuss a privacy-preserving data share mechanism with flexible cross-domain authorization over distinctive platoons. In [A16], Zhang et al. present a novel user experience prediction scheme where causal structure learning was used to analyze a large number of performance indicators (KPIs) and key quality indicators (KQI) collected from the base station. In [A17], Xu et al. present and discuss a distributed reinforcement

learning motivated traffic signal control with pedestrian access.

In [A18], Azad et al. discuss the Vehicle Routing Problem (VRP) and present an investigation on the possible use of near-term quantum devices for solving it. In [A19], Hong et al. discuss an integrated green transportation system based on 6G Internet of Things (IoT) and big data technology, aiming at integrating state grid, electric vehicles, and renewable energy to address these concerns. In [A20], de Ree et al. present a design of a decentralized and efficient key management scheme, abbreviated as the DECENT scheme. This scheme provides secure multi-hop communication in dense and dynamic network environments while functioning in a self-organized manner. In [A21], Gao et al. present and discuss a privacy-oriented task-offloading method that can resist attacks from privacy attackers with prior knowledge of ITS. In [A22], Yang presents a discussion on the long-term effect of new transit projects on transit ridership and traffic congestion at the regional level, and the causal relationship between transit and its effect on traffic congestion and transit ridership.

In [A23], Wen et al. discuss a Pseudo-inverse-based Hard Thresholding sparse signal recovery algorithm called PHT for short. Unlike the Iterative Hard Thresholding algorithm which uses the gradient of the objective function to iteratively update the solution, the proposed algorithm utilizes the pseudo-inverse of the sensing matrix to iteratively update the solution. In [A24], Zhang et al. propose a new federated learning framework for unsupervised multidomain face recognition of postexercise. The approach uses adversarial learning to improve the recognition effect of the federated framework in each domain. In [A25], Li et al. propose a malware family classification approach based on multimodal fusion and weight self-learning in ITS.

In [A26], Dalgkitis et al. present a study on the problem of zero-touch SFC orchestration for multi-domain networks, targeting the latency reduction of URLLC services while improving energy efficiency for beyond-5G networks. In [A27], Yu et al. present a novel method of energy-efficient deployment of coverage-aimed UAV-BSs and capacity-aimed UAV-BSs for the coverage and capacity enhancement of ground communication under disaster areas or burst data traffic. In [A28], Chai et al. present a novel space-time predicting model called the deep multi-view spatial-temporal network to predict the changing behaviors of sharing-bikes and provide valuable scientific methods for solving predicting problems of sharing-bikes. In [A29], Li et al. present a new joint image compression and encryption scheme to ensure the security of JPEG images. The scheme is realized by introducing encryption operations into JPEG's compression process. In [A30], Cao et al. present a discussion on a pavement crack detection method based on 3-D edge representation and data communication with digital twins.

In [A31], Guo et al. present a lightweight U-shaped segmentation model URS to segment multi-line laser stripe image defects with high accuracy. In [A32], Yang et al. present an object detection model based on a multi-attention residual network (MA-ResNet). In [A33], Hijji et al. present an intelligent

hierarchical framework for road infrastructure maintenance that exploits the latest developments in 6G communication technologies, deep learning techniques, and mobile edge AI training approaches. At the core of the proposed framework is a novel Convolution Neural Networks (CNN) model which fuses imagery and sensory data to perform pothole detection. In [A34], the authors present a study on the impact and elimination of aggregate interference in intelligent transportation systems, and propose an anti-fragile communication algorithm to improve the reliability of signal transmission.

In [A35], He et al. present and discuss channel measurements and ray-tracing (RT) simulations for FMCW automotive mmWave radar. A measurement-based electromagnetic (EM) parameter estimation method is proposed to find the optimal parameter set. As a result, the issue of lacking reliable EM material parameters for RT simulation is tackled. In [A36], Zhang et al. present a virtual DLO model described by wave PDE equations with velocity feedback for replacing external metamorphic constraints of underground multi-robot transportation systems. In [A37], Sun et al. present and discuss the existence condition of static perception-based stochastic user equilibrium with a homogeneous traveller community in a two-route road network based on a nonlinear perception model. In [A38], Zhou et al. present a low-cost lane information extraction method to help HD maps update lane information. The data sources are road images and trajectory data collected by crowdsourcing vehicles equipped with driving recorder cameras and low-precision positioning equipment.

In [A39], Chen et al. present and discuss an adaptive hybrid attention-based convolutional neural network framework for Intelligent Transportation Object Recognition. First, fuzzy c-means and maximum entropy algorithms are utilized for image feature pre-extraction. A heuristic search-based adaptive attention mechanism is then presented, which adaptively combines the previously extracted features and generates fused images. In [A40], Li et al. present and discuss a safe and eco-friendly consensus speed advisory system, Eco-CSAS. The authors also formulate an optimization problem subject to the minimum following distance and maximum road speed limit that can minimize the energy consumption of an automated platoon. In [A41], Wang et al. discuss an autonomous obstacle avoidance control strategy that can effectively guarantee vehicle stability based on an attention-long short-term memory (Attention-LSTM) deep learning model with the idea of humanoid driving. In [A42], Liu et al. propose a Direction Decide as a Service (DDaaS) scheme to alleviate traffic congestion. First, it contains a novel three-layer service architecture based on Swarm Learning (SL), which enables orderly transmission of traffic data and control instructions and protects user privacy. Second, an improved local model and aggregation method is incorporated into DDaaS, which enables to make accurate predictions when the road resources at a single intersection are insufficient. Third, a dynamic traffic control algorithm is used to provide signal light switching decisions for rapidly changing ITS. In [A43], Yu et al. discuss uncertainty quantification method as a guide to the optimization design of Wireless Power Transfer (WPT) structure and to improve the efficiency.

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APPENDIX: RELATED ARTICLES

- [A1] L. Sun, S. Sun, and X. Yu, "PAA: A blockchain-based parking assistance alliance with user preference," *IEEE Trans. Intell. Transp. Syst.*, early access, Aug. 17, 2022, doi: [10.1109/TITS.2022.3197433](https://doi.org/10.1109/TITS.2022.3197433).
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