Jiawei Zhang

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EDUCATION & AWARDS

Tsinghua University (THU), China *Sep 2020 - Jun 2025 (Expectation)*
Ph.D, Department of Automation
Advisor: Prof. Li Li
Awards: [1] National scholarship (Ministry of Education of the People's Republic of China, Top 3% at THU); [2] Outstanding graduate student (Beijing Association of Automation); [3] Excellent comprehensive scholarship of Tsinghua University×2; [4]IEEE ITSC 2022 Best student paper award; [5]Academic excellence award (Institute of System Engineering).

Tsinghua University (THU), China *Sep 2016 - Jul 2020*
Department of Automation
B.S. of Engineering (Graduate with honor)
Awards: [1]Outstanding graduates of Dept. Automation; [2] National encouragement scholarship×3; [3]Academic excellence award of Tsinghua University×2; [4] Community contribution award of Tsinghua University; [5] HAGE encouragement scholarship×3; [6] The top scorer of science in Wuwei City (2016).

RESEARCH INTERESTS

Research Areas: Decision, planning, and scheduling of connected and automated vehicles (CAVs); Management and control of mixed traffic; Traffic simulation; Deep reinforcement learning.

RESEARCH PUBLICATION

First Author × 9, Citation 230+, H-index: 9

1. **Jiawei Zhang**, Cheng Chang, Xianlin Zeng, and Li Li. (2022). Multi-agent DRL-based lane change with right-of-way collaboration awareness. *IEEE Transactions on Intelligent Transportation Systems, 24*(1), 854-869.

   (**SCI, IF = 9.551,** Paper)

2. **Jiawei Zhang**, Shen Li, and Li Li. (2023). Coordinating CAV swarms at intersections with a deep learning model. *IEEE Transactions on Intelligent Transportation Systems, 24*(6), 6280-6291.

   (**SCI, IF = 9.551,** Paper)

3. **Jiawei Zhang**, Cheng Chang, Zimin He, Wenqin Zhong, Danya Yao, Shen Li, Li Li. (2023). CAVSim: A microscopic traffic simulator for evaluation of connected and automated vehicles. *IEEE Transactions on Intelligent Transportation Systems, 24*(9), 10038-10054.

   (**SCI, IF = 9.551,** Paper)

4. **Jiawei Zhang**, Qiyuan Liu, Shen Li, and Li Li. (2023). Unleashing the power of connected and automated vehicles: A dedicated link strategy for efficient management of mixed traffic. *IEEE Transactions on Intelligent Transportation Systems*, *Early Access*.

   (**SCI, IF = 8.500,** Paper)

5. **Jiawei Zhang**, Zhiheng Li, Li Li, Yidong Li, and Hairong Dong. (2021). A bi-level cooperative operation approach for AGV based automated valet parking. *Transportation Research Part C: Emerging Technologies, 128*, 103140.

   (**SCI, IF = 9.002,** Paper)

6. **Jiawei Zhang**, Huaxin Pei, Xuegang(Jeff) Ban, and Li Li. (2022). Analysis of cooperative driving strategies at road network level with macroscopic fundamental diagram. *Transportation Research Part C: Emerging Technologies, 135*, 103503.

(**SCI, IF = 9.002,** Paper)

7. **Jiawei Zhang**, Cheng Chang, Shen Li, Xuegang(Jeff) Ban, and Li Li. (2024). Unleashing the two-dimensional benefits of connected and automated vehicles via dedicated intersections in mixed traffic. *Transportation Research Part C: Emerging Technologies, 160*, 104501.

(**SCI, IF = 9.002,** Paper)

8. **Jiawei Zhang**, Jingwei Ge, Shu Li, Shen Li, and Li Li. (2024). A bi-level network-wide cooperative driving approach including deep reinforcement learning-based routing. *IEEE Transactions on Intelligent Vehicles, 9*(1), 1243-1259.

(**SCI, IF = 8.200,** Paper)

9. **Jiawei Zhang**, Cheng Chang, Huaxin Pei, Xinyu Peng, Yuqing Guo, Renzong Lian, Zhenwu Chen, and Li Li. (2022). CAVSim: A microscope traffic simulator for connected and automated vehicles Environment. *IEEE Intelligent Transportation Systems Conference*, 3719-3724.

(**EI,** Paper)

10. Xinyu Peng, **Jiawei Zhang**, Fei-Yue Wang, and Li Li. (2021). Drill the cork of information bottleneck by inputting the most important data. *IEEE Transactions on Neural Networks and Learning Systems, 33*(11), 6360-6372.

(**SCI, IF = 14.255,** Paper)

11. Qiyuan Liu, **Jiawei Zhang**, Wenqin Zhong, Zhiheng Li, Xuegang (Jeff) Ban, Shen Li, and Li Li. (2023). Fault-Tolerant cooperative driving at highway on-ramps considering communication failure. *Transportation Research Part C: Emerging Technologies, 153*, 104227.

(**SCI, IF = 9.002,** Paper)

12. Jingwei Ge, **Jiawei Zhang**, Cheng Chang, Yi Zhang, Danya Yao, and Li Li. (2024). Task-driven controllable scenario generation framework based on AOG. *IEEE Transactions on Intelligent Transportation Systems*, *Early Access*.

(**SCI, IF = 8.500,** Paper)

13. Huaxin Pei, **Jiawei Zhang**, Yi Zhang, Huile Xu, and Li Li. (2024). Self-organized routing for autonomous vehicles via deep reinforcement learning. *IEEE Transactions on Vehicular Technology, 73*(1), 426-437.

(**SCI, IF = 6.800,** Paper)

14. Cheng Chang, **Jiawei Zhang**, Kunpeng Zhang, Wenqin Zhong, Xinyu Peng, Shen Li, and Li Li. (2023). BEV-V2X: cooperative birds-eye-view fusion and grid occupancy prediction via V2X-based data sharing. *IEEE Transactions on Intelligent Vehicles, 8*(11), 4498-4514.

(**SCI, IF = 8.200,** Paper)

15. Jingwei Ge, **Jiawei Zhang**, Cheng Chang, Yi Zhang, Danya Yao, Yonglin Tian, and Li Li. (2024). Dynamic testing for autonomous vehicles using random Quasi Monte Carlo. *IEEE Transactions on Intelligent Vehicles, Early Access*.

(**SCI, IF = 8.200,** Paper)

16. Shen Li, **Jiawei Zhang**, Zhenwu Chen, and Li Li. (2024). Theoretical analysis of cooperative driving at idealized unsignalized intersections. *Tsinghua Science and Technology, 29*(1), 257-270.

(**SCI, IF = 6.600,** Paper)

17. Huaxin Pei, **Jiawei Zhang**, Yi Zhang, Xin Pei, Shuo Feng, and Li Li. (2023). Fault-tolerant cooperative driving at signal-free intersections. *IEEE Transactions on Intelligent Vehicles, 8*(1), 121-134.

(**SCI, IF = 8.200,** Paper)

18. Jingwei Ge, **Jiawei Zhang**, Yi Zhang, Danya Yao, Zuo Zhang, and Rui Zhou. (2023). Autonomous vehicles testing considering utility-based operable tasks. *Tsinghua Science and Technology, 28*(5), 965-975.

(**SCI, IF = 6.600,** Paper)

19. Jingwei Ge, Huile Xu, **Jiawei Zhang**, Yi Zhang, Danya Yao, and Li Li. (2022). Heterogeneous driver modeling and corner scenarios sampling for automated vehicles testing. *Journal of Advanced Transportation*, 8655514.

(**SCI, IF = 2.249,** Paper)

20. Renzong Lian, Zhiheng Li, Boxuan Wen, Junqing Wei, **Jiawei Zhang**, and Li Li. (2024). Predictive information multiagent deep reinforcement learning for automated truck platooning control. *IEEE Intelligent Transportation Systems Magazine, 16*(1), 116-131.

(**SCI, IF = 3.600,** Paper)

21. Cheng Chang, **Jiawei Zhang**, Kunpeng Zhang, Yichen Zheng, Mengkai Shi, Jianming Hu, Shen Li, and Li Li. (2024). CAV driving safety monitoring and warning via V2X-based edge computing system. *Frontiers of Engineering Management, 11*, 107-127.

(**ESCI,** Paper)

22. Cheng Chang, Kunpeng Zhang, **Jiawei Zhang**, Shen Li, and Li Li. (2022). Driving safety monitoring and warning for connected and automated vehicles via edge computing. *IEEE Intelligent Transportation Systems Conference*, 3940-3947.

(**EI, Best Student Paper Award,** Paper)

23. Zimin He, **Jiawei Zhang**, Danya Yao, Yi Zhang, and Huaxin Pei. (2023). Adversarial generation of safety-critical lane-change scenarios for autonomous vehicles. *IEEE Intelligent Transportation Systems Conference*, 6096-6101.

(**EI,** Paper)

PATENTS

1. Li Li, **Jiawei Zhang**, Cheng Chang, and Xinyu Peng. Method and device for training scheduling models, and method and device for achieving collaborative driving. *Authorization Number: CN114566045B* (Link)
2. Li Li, **Jiawei Zhang**, Qiyuan Liu, Shen Li, and Zhiheng Li. A management method and device for intersection in mixed traffic. *Authorization Number: CN116824855A* (Link)
3. Li Li, **Jiawei Zhang**, Cheng Chang, Shen Li, and Yi Zhang. Deep reinforcement learning based route planning method, device and vehicles. *Authorization Number: CN116448135A* (Link)
4. Li Li, Shen Li, **Jiawei Zhang**, Cheng Chang, and Zhiheng Li. Method and roadside equipment for adaptive cooperative driving of vehicles at unsignalized intersections. *Authorization Number: CN116311984A* (Link)
5. Li Li, Cheng Chang, **Jiawei Zhang**, Yuqing Guo, and Zhiheng Li. Data storage device, data processing method, and roadside equipment for cooperative driving. *Authorization Number: CN114461144A* (Link)

MAIN PROJECTS

Cooperative decision-making and planning for CAVs Aug 2020 - Now

Project Leader, First Author, TRC* × *2, IEEE T-ITS* × *1

Connected and automated vehicles (CAVs) have the potential to significantly improve the safety and efficiency of traffic. We propose a cooperative driving algorithm based on the deep learning model and an AGV decision-making and scheduling algorithm based on deep reinforcement learning, which realizes the performance of real-time solving, optimal efficiency, safety and trustworthiness, fault-tolerance and self-healing in large-scale scenarios, and lays a theoretical and methodological foundation for the application of CAVs.

· **[Paper 1]** One revolutionary CAVs impact on transportation system is cooperative driving that turns signalized intersections to be signal-free and boosts traffic efficiency by better organizing the passing order of CAVs. However, how to get the optimal passing order is an *NP*-hard problem. Here, we introduce a novel cooperative driving algorithm (AlphaOrder). AlphaOrder can find a near-optimal passing order for scenarios with an arbitrary number

of CAVs, significantly superior to all existing algorithms, thereby achieving state-of-the-art performance. (*IEEE T-ITS*)

- **[Paper 2]** Automated valet parking (AVP) system based on automated guided vehicles (AGVs) can relieve human from parking and improve efficiency to a certain extent due to their fully automatic control and operation. However, the AGV based AVP system is facing the disadvantage of long-time queue congestion and even deadlock. In this paper, we systematically consider the traffic congestion faced by the AGV based AVP system and introduce a bi-level cooperative operation approach based on deep reinforcement learning (DRL). Experiment results show that operation efficiency of the AGV based AVP system is significantly improved. (*TRC*)
- **[Paper 3]** Cooperative driving, especially the passing order, is the critical link to improve the traffic efficiency of the road network by using automated vehicles (AVs). In this paper, we analysis cooperative driving strategies on the network traffic. We find that the passing order has a dominant impact on the network traffic efficiency, and a better order can significantly raise the curve of the macroscopic fundamental diagram (MFD). The findings in this paper have instructive significance for the rising research on network-wide cooperative driving and provide a systematical perspective for network traffic control. (*TRC*)

Decision-making and planning of autonomous vehicles Jun 2021 - Now

Project Leader, First Author, IEEE T-ITS* × *1*, *IEEE T-IV* × *1

This project studies the issues related to decision-making and planning of autonomous vehicles (AVs). We propose a route planning algorithm based on deep reinforcement learning and a lane-change decision-making algorithm based on multi-agent deep reinforcement learning, which provide theoretical and technical support for realizing safe, efficient, cooperative, and trustworthy autonomous driving.

- **[Paper 1]** Lane change is a common-yet-challenging driving behavior for automated vehicles. However, most of the existing models consider lane-change behavior as a one-player decision-making problem, ignoring the essential multi-agent properties when vehicles are driving in traffic. In this paper, we revisit the lane-change problem and propose a bi-level lane-change behavior planning algorithm based on the multi-agent deep reinforcement learning (DRL). The proposed algorithm can lead to safe, efficient, and harmonious lane-change behaviors, which boosts the collaboration between vehicles and in turn improves the safety and efficiency of the overall traffic. (*IEEE T-ITS*)
- **[Paper 2]** Cooperative driving of CAVs has attracted extensive attention and researchers have proposed various approaches. However, existing approaches are limited to small-scale isolated scenarios and gaps remain in network-wide cooperative driving, especially in routing. In this paper, we decompose the network-level cooperative driving problem into two dominant sub-problems. Accordingly, we propose a multi-agent deep reinforcement learning (DRL) based routing model and an adaptive cooperative driving algorithm. The results show that the upper and lower levels complement each other and work together to significantly improve the network-wide traffic efficiency and reduce the travel time of individual vehicles. (*IEEE T-IV*)

Control and Management of Connected and Automated Vehicles in Mixed Traffic Nov 2022 - Now

Project Leader, First Author, IEEE T-ITS* × *1*, *TRC* × *1

This project focuses on the scheduling and optimization of the mixed traffic system. We propose the CAV-dedicated intersection strategy and the CAV-dedicated link strategy, construct a complete mathematical model and solution algorithm, and provide an efficient control strategy and systematic approach for the control of complex mixed traffic system.

- **[Paper 1]** The management of mixed traffic systems is critical to realize the benefits of CAVs. To fully release the benefits of CAVs, we introduce an innovative approach for managing mixed traffic, known as the dedicated intersection strategy. The dedicated intersection strategy can achieve separation between CAVs and human driven vehicles (HDVs) at the intersection level. We propose a bi-level solving framework, in which the upper level determines the dedicated intersection deployment scheme and the lower level solves the corresponding traffic assignment problem. Results show that the dedicated intersection strategy can significantly improve the overall efficiency of the mixed traffic system, especially when the penetration of CAVs is relatively large (over 40 %). (*TRC*)
- **[Paper 2]** Further, this paper proposes a novel management approach for mixed traffic called the dedicated link strategy. This strategy can unleash both the one-dimensional and two-dimensional benefits of CAVs via: (*i*) dedicated link deployment at the road network level and (*ii*) a novel intersection management approach. At the macroscopic road network level, we introduce a bi-level dedicated link deployment model and design an artificial bee colony based algorithm. At the microscopic intersection level, we develop a novel intersection management approach that integrates traditional traffic signal strategy with the emerging signal-free cooperative driving method. The

results show that macroscopic and microscopic methods complement each other, and the dedicated link strategy yields substantial improvements in the overall efficiency of the mixed traffic system. (*IEEE T-ITS*)

Simulation and testing of connected and automated vehicles Nov 2021 - May 2023

Project Leader, First Author, IEEE TITS* × *1*, *IEEE ITSC* × *1

This project focuses on the simulation, testing, and evaluation of connected and automated vehicles. We develop CAVSim, a novel microscopic traffic simulator for CAVs.

· **[Paper 1&2]** Connected and automated vehicles (CAVs) are expected to play a vital role in the emerging intelligent transportation system. In recent years, researchers have proposed various cooperative driving methods for CAVs, and there is an urgent need for a generic and unified traffic simulator to simulate and evaluate these methods. However, traditional traffic simulators have many critical deficiencies for CAV simulation needs. In this paper, we introduce CAVSim, a novel microscopic traffic simulator for CAVs, to address these deficiencies. CAVSim is developed modularly according to the emerging technology of the CAV environment, emphasizes feed-forward decision and planning for CAVs, and highlights the cooperative decision and planning components in the CAV environment. CAVSim incorporates rich and typical traffic scenarios and provides standardized cooperative driving algorithms and comparable performance metrics for multi-CAV cooperative driving. With CAVSim, researchers can conveniently deploy decision, planning, and control methods for CAVs at different levels, evaluate their performance, compare them with the standardized algorithms incorporated in CAVSim, and even further explore their impact on traffic flow. As a unified platform for CAVs, CAVSim can facilitate the studies on CAVs and promote the advancement of methods and techniques for CAVs.(*IEEE T-ITS*; *IEEE ITSC*)

PROFESSIONAL SERVICE

Reviewer Service	IEEE Transactions on Intelligent Transportation Systems, Transportation Research Part C-Emerging Technologies, IEEE Transactions on Intelligent Vehicles, EEE Transactions on Automation Science and Engineering, IEEE Antennas and Wireless Propagation Letters, International Journal of Human-Computer Interaction, IEEE Transactions on Vehicular Technology, IEEE International Conference on Intelligent Transportation Systems 2022/2023, IEEE Intelligent Vehicles Symposium 2024, China Automation Conference 2022/2023, et al.
Teaching Assistant	Convex Optimization (2020-2021; 2021-2022; 2023-2024)
Blue Book	Annual Report On The Development Of Autonomous Driving Industry In China (2020)