

Zhuoren Li

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Education

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| Tongji University PhD Student, Vehicle Engineering (Advisor: Prof. Lu Xiong, Co-advisor: Prof. Jia Hu and Nan Li) | Sep 2019 – Dec 2025 |
| Tongji University Minor, Department of German | Sep 2017 – Jul 2018 |
| Tongji University Bachelor's, Engineering Mechanics (Advisor: Prof. Hanwen Song) | Sep 2014 - Jul 2019 |

Research Experience

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| LLM-Enhanced Scenario Understanding for RL-based Motion Planning | Dec 2024 - Present |
| • Scenario understanding for adaptive reward adjustment | |
| Control Granularity Improved RL-based Motion Planning | Dec 2023 - Present |
| • Hybrid action-based RL using parameterized action space | |
| Safe Reinforcement Learning for Autonomous Driving | Sept 2022 - Present |
| • Prior-knowledge based predictive risk constraint and unsafe behavior correction. | |
| • Multi-Critic mechanism for multi-objective accommodation | |
| • Epistemic uncertainty-based action governor with dynamic control barrier function | |
| Optimization-based Motion Planning | Sept 2021 – Jun 2023 |
| • POMDP-based integrated decision-making and motion planning considering prediction uncertainty | |
| • MPC-based Trajectory planning and tracking control | |
| Parking Path Planning | Feb 2021 – Aug 2021 |
| • Path planning using geometric configuration and hybrid A* | |

Publications

Journal & Conference Publications:

- [1] Guizhe Jin, **Zhuoren Li**, Bo Leng, et al., “Multi-Timescale Hierarchical Reinforcement Learning for Unified Behavior and Control of Autonomous Driving,” *IEEE Robot. Autom. Lett.*, vol. 10, no. 12, pp. 12772-12779, 2025. (Q1) [[PDF](#)]
- [2] Bo Leng, Lu Xiong, **Zhuoren Li***, et.al. “Multi-Mode Evasion Assistance Control Method considering Human Driver Operation,” *Chin. J. Mech. Eng.*, 2025, 38: 102. (Q1) [[PDF](#)]
- [3] Lu Xiong*, **Zhuoren Li**, Danyang Zhong, et al. “Rule-Guidance Reinforcement Learning for Lane Change Decision-making: A Risk Assessment Approach,” *Chin. J. Mech. Eng.*, 2025, 38:30. (Q1) [[PDF](#)]
- [4] Ruolin Yang, **Zhuoren Li**, Bo Leng, et.al., “Convergent Harmonious Decision: Lane Changing in a more Traffic Friendly Way,” *IEEE Trans. Intell. Transp. Syst.*, early access. (Q1) [[PDF](#)]
- [5] **Zhuoren Li**, Jia Hu, Bo Leng, et.al. An Integrated of Decision Making and Motion Planning Framework for Enhanced Oscillation-Free Capability. *IEEE Trans. Intell. Transp. Syst.*, vol. 25, no. 6, pp. 5718-5732, June 2024. (Q1) [[PDF](#)]
- [6] **Zhuoren Li**, Guizhe Jin, Ran Yu, Bo Leng and Lu Xiong, “Interaction-Aware Deep Reinforcement Learning Approach Based on Hybrid Parameterized Action Space for Autonomous Driving,” *SAE Intell. Connected Veh. Symposium*, 2024. [[PDF](#)]
- [7] **Zhuoren Li**, Lu Xiong, Bo Leng et.al. Safe Reinforcement Learning of Lane Change Decision Making with Risk-Fused Constraint, in *Proc. IEEE Intell. Transp. Syst. Conf. (ITSC)*, 2023, pp. 1313-1319. [[PDF](#)]
- [8] **Zhuoren Li**, Lu Xiong Bo Leng. A Unified Trajectory Planning and Tracking Control Framework for Autonomous Overtaking Based on Hierarchical MPC. in *Proc. IEEE Intell. Transp. Syst. Conf. (ITSC)*, 2022, pp. 937-944. [[PDF](#)]
- [9] **Zhuoren Li**, Lu Xiong, Bo Leng, et al., “Path Planning Method for Perpendicular Parking Based on Vehicle Kinematics Model Using MPC Optimization,” *SAE Technical Papers*, 2022-01-0085, 2022. [[PDF](#)]
- [10] **Zhuoren Li**, Lu Xiong, Dequan Zeng, et al., “Real-time Local Path Planning for Intelligent Vehicle combining Tentacle Algorithm and B-spline Curve,” *IFAC-PapersOnLine*, 2021, 54(10): 51-58. [[PDF](#)]

Submitted & In Progress:

- [1] Zhiwen Chen, **Zhuoren Li***, Bo Leng, et al., HCRMP: A LLM-Hinted Contextual Reinforcement Learning Framework for Autonomous Driving, *Adv. Neural Inf. Process. Syst.* , 2025. (accept) [[arXiv](#)]
- [2] Ran Yu, **Zhuoren Li***, Lu Xiong, et al., “Uncertainty-Aware Safety-Critical Decision and Control for Autonomous Vehicles at Unsignalized Intersections,” *IEEE Intell. Transp. Syst. Conf. (ITSC)*, 2025. (accept) [[arXiv](#)]
- [3] **Zhuoren Li**, Guizhe Jin, Ran Yu, et al. “A Survey of Reinforcement Learning-Based Motion Planning for Autonomous Driving: Lessons Learned from a Driving Task Perspective.” *IEEE Trans. Neural Netw. Learn. Sys.* (under review). [[arXiv](#)]
- [4] Bo Leng, Ran Yu, **Zhuoren Li*** et al., “Risk-Aware Reinforcement Learning for Autonomous Driving: Improving Safety When Driving through Intersection,” *Eng. Appl. Artif. Intel.* (under review, R1). [[arXiv](#)]
- [5] **Zhuoren Li**, Jia Hu, Bo Leng, Lu Xiong, et.al., “Safety Enhanced Reinforcement Learning for Autonomous Driving: Dare to Make Mistakes to Learn Faster and Better,” *IEEE Trans. Intell. Transp. Syst.* (under review, R1)
- [6] Guizhe Jin, **Zhuoren Li**, Bo Leng, et al. “Hybrid Action Based Reinforcement Learning for Multi-Objective Compatible Autonomous Driving,” *IEEE Trans. Neural Netw. Learn. Sys.* (under review, R1). [[arXiv](#)]

* corresponding author, [†]First author of doctoral supervisor

Project Experience

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| High-Mobility Motion Planning and Control Research for Chassis-by-wire All-terrain Unmanned Vehicle with Hybrid-steering | Jan 2024 - Present |
| National Natural Science Foundation of China, Role: Student Technical Director | |
| <ul style="list-style-type: none">• Comprehensive task management.• Designed an environmental risk characterization algorithm considering negative obstacles.• Led the Development of a motion planning approach combining hybrid A* and optimization-based methods. | |
| Key Technology of Perception and Control in Cooperative Vehicle-Infrastructure System for Urban Public Transportation | Jan 2023 – Mar 2025 |
| National Key Research and Development Program of China, Role: Core Participant | |
| <ul style="list-style-type: none">• Developed the decision-making and motion planning algorithms for cruise driving and lane change functions in vehicle side, based on the recommended speed from the road side. | |
| Development of Evasion Assistance Algorithm for Emergency Collision Avoidance based on Steer-by-Wire System | Jul 2022 – Jul 2024 |
| Shanghai Automotive Industry Science and Technology Development Foundation, Role: Student Technical Director | |
| <ul style="list-style-type: none">• Comprehensive task management.• Led the development of a motion control algorithm for emergency collision avoidance.• Led the simulation validation in Carmaker/Simulink, steer-by-wire system modification on the real vehicle and ground test based on Audesse ECU. | |
| Binary Mixed Traffic Behavior Characteristics and Collaborative Paradigm | Aug 2021 – Jul 2024 |
| Science and Technology Commission of Shanghai, Role: Core Participant, Role: Work Package Leader | |
| <ul style="list-style-type: none">• Motion planning and control of connected automated vehicle according to the road-side guidance. | |
| Research on Vehicle-Road Cooperative Control for Intelligent Public Transportation System | Sep 2021 – Aug 2022 |
| Shanghai Research Institute for Intelligent Autonomous Systems, - Role: Student Technical Director | |
| <ul style="list-style-type: none">• Comprehensive task management.• Led the development of a signal control algorithm and a vehicle speed optimization algorithm. | |
| Autonomous Valet Parking (AVP) System Development | Sept 2021 – Mar 2023 |
| Nanchang Automotive Institute of Intelligence & New Energy, Role: Student Technical Director | |
| <ul style="list-style-type: none">• Comprehensive task management.• Led the development of a parking slot allocation algorithm.• Developed parking path planning and tracking control algorithms. | |
| Development and Application of Automatic Valet Parking System | Feb 2020 – Mar 2021 |
| Nanchang Automotive Institute of Intelligence & New Energy, Role: Student Technical Director | |
| <ul style="list-style-type: none">• Comprehensive task management.• Developed an integrated module for hardware and software communication.• Developed a parking path planning algorithm based on geometric configuration.• Developed a Stanley-based path tracking algorithm and a feedforward PID-based speed tracking algorithm. | |
| China Future Challenge of Intelligent Vehicles | Mar 2020 – Nov 2020 |
| Institute of Intelligent Vehicles, Tongji University, Role: Major developer | |
| <ul style="list-style-type: none">• Developed a system integration framework inspired by the Baidu Apollo.• Developed a search-based path planning algorithm for static obstacle avoidance.• Developed a parking path planning algorithm based on hybrid A*. | |
| Funding/Grant Proposal Writing Experience | Jan 2020 – Mar 2025 |
| <ul style="list-style-type: none">• National Natural Science Foundation of China (NSFC), Excellent Young Scholars Fund, 2025; Key Program, 2024; General Program, 2023; Distinguished Young Scholars Fund, 2022; Young Scholars Grant, 2020.• Shanghai Municipal People's Government (SMPG), Oriental Excellence Program Youth Project, 2024; Shanghai Science and Technology Progress First Award, 2022;• Ministry of Science and Technology, PRC, National Key Research and Development Program of China, 2021;• National Development and Reform Commission, The Breakthrough and Industrialization of Key Technologies for Intelligent Chassis, 2020; | |

Honors and Awards

- SAE International Outstanding Technical Paper Award, SAE ICVS 2024.
- High-Level Academic Poster Award, China SAE Doctoral Student Academic Forum, 2024.
- Outstanding Doctoral Student Scholarship, Tongji University, 2024.
- Vehicle-road-cloud Integrated Autonomous Driving Challenge, Third Prize, 2024.
- Outstanding Individual Award, Institute of Intelligent Vehicles, Tongji University, 2022, 2023, 2024.
- Outstanding Projects Award, Institute of Intelligent Vehicles, Tongji University, 2024.
- World Artificial Intelligence Conference AI Driving Simulation Competition, Third Prize in the University Challenge Competition, 2022

Academic Services

Reviewer

- **Journal Reviewer:** *IEEE Transactions on Intelligent Transportation Systems (TITS)*, *IEEE Transactions on Vehicular Technology (TVT)*, *IEEE Transactions on Intelligent Vehicles (TIV)*, *IEEE Transactions on Transportation Electrification (TTE)*, *IEEE Robotics and Automation Letters (RAL)*, *Journal of Intelligent Transportation Systems (JITS)*, *IET Intelligent Transport Systems*, *Journal of Field Robotics*.
- **Conference Reviewer:** *IV, ITSC, CVCI, SAE WCX*

Mentoring (serving as the Student Director of the Intelligent Decision Research Group at TJU-IIV since 2021, mentored 4 Ph.D.students, 13 master's students, and several undergraduate students.)

Ph.D. Students:

- 2025-present: **Weiqi Zhang**, E2E RL racing.
- 2023-present: **Zhiwen Chen**, LLM-enhanced RL for AD.
- 2022-present: **Peiyuan Fang**, Motion Planning under Off-road Environment; **Xinrui Zhang**, Cloud-Vehicle Cooperative Planning.

Master Students:

- 2024-present: **Ran Yu**, Trajectory Prediction and Safe-RL; **Zhizhao Ni**, LfD-based RL for Merging in Congested Traffic.
- 2023-present: **Guizhe Jin**, Multi-objective Compatible RL; **Zhou Sun**, Motion Planning under Off-road Environment.
- 2022-present: **Yugin Qi**, Learning-based MPC for Motion Control; **Yu Che**, Cloud-Vehicle Cooperative Tracking Control.
- 2021-2024: **Ruolin Yang**, Harmony-enchaned RL; **Encheng Tu**, Hybrid MPC Motion Planning for Autonomous Overtaking; **Yizhuo Guan**, Prediction and Control for Emergency Evasion.
- 2020-2023: **Gesong Shi**, Cooperative Control for Transit Priority.
- 2019-2022: **Puhang Xu**, Safe-RL Decision-Making; **Hongyu Xiao**, POMDP Motion Planning; **Zixuan Qian**, SMPC Motion Planning; **Jie Gao**: Global Planning.