

# Zhuoren Li

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## Education

<b>Tongji University</b> PhD Student, Vehicle Engineering (Advisor: Prof. Lu Xiong)	Sep 2019 – Present
<b>Tongji University</b> Minor, Department of German	Sep 2017 – Jul 2018
<b>Tongji University</b> Bachelor's, Engineering Mechanics (Advisor: Prof. Hanwen Song)	Sep 2014 - Jul 2019

## Research Experience

<b>LLM-Enhanced Scenario Understanding for RL-based Motion Planning</b> <ul style="list-style-type: none"><li>Scenario understanding for adaptive reward adjustment</li></ul>	Dec 2024 - Present
<b>Control Granularity Improved RL-based Motion Planning</b> <ul style="list-style-type: none"><li>Hybrid action-based RL using parameterized action space</li></ul>	Dec 2023 - Present
<b>Safe Reinforcement Learning for Autonomous Driving</b> <ul style="list-style-type: none"><li>Prior-knowledge designed safety constraint and demonstration experience.</li><li>Multi-Critic mechanism for multi-objective accommodation</li><li>Epistemic uncertainty-based action governor with dynamic control barrier function</li></ul>	Sept 2022 - Present
<b>Optimization-based Motion Planning</b> <ul style="list-style-type: none"><li>POMDP-based integrated decision-making and motion planning considering prediction uncertainty</li><li>MPC-based Trajectory planning and tracking control</li></ul>	Sept 2021 – Jun 2023
<b>Parking Path Planning</b> <ul style="list-style-type: none"><li>Path planning using geometric configuration and hybrid A*</li></ul>	Feb 2021 – Aug 2021

## Publications

### Journal & Conference Publications:

- [1] Bo Leng, Lu Xiong, **Zhuoren Li**\*, et.al. “Multi-Mode Evasion Assistance Control Method considering Human Driver Operation,” *Chin. J. Mech. Eng.*, 2025. (accepted) (Q1)
- [2] 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] [DOI]
- [3] **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] [DOI]
- [4] **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] [DOI]
- [5] Guizhe Jin, **Zhuoren Li**, Bo Leng, et al., “Stability Enhanced Hierarchical Reinforcement Learning for Autonomous Driving with Parameterized Trajectory Action,” in *Proc. IEEE Intell. Transp. Syst. Conf. (ITSC)*, 2024, pp. 3020-3026. [PDF] [DOI]
- [6] **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] [DOI]
- [7] **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] [DOI]
- [8] **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] [DOI]
- [9] **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] [DOI]

### Submitted & In Progress:

- [1] **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]
- [2] 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). [arXiv]
- [3] 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. (under review). [arXiv]
- [4] **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)
- [5] Zhiwen Chen, Bo Leng, **Zhuoren Li**, et.al., “HCRMP: A LLM-Hinted Contextual Reinforcement Learning Framework for Autonomous Driving”. (under review) [arXiv]
- [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). [arXiv]
- [7] Ruolin Yang, **Zhuoren Li**, Bo Leng, et.al., “Convergent Harmonious Decision: Lane Changing in a more Traffic Friendly Way.” *IEEE Trans. Intell. Transp. Syst.* (under review, R2)
- [8] Guizhe Jin, **Zhuoren Li**, Bo Leng, et al., “Hybrid Time-Scale Hierarchical Reinforcement Learning for Motion Planning.” *IEEE Robot. Autom. Let.* (under review)

\* corresponding author

## 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*
- 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*
- 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*
- 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*
- 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*
- 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*
- 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*
- 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*
- 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
- 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

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- 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

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## 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: **Yuqin 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.