

ZENGQI PENG

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Robot Motion Planning and Control Lab, Robotics and Autonomous Systems Thrust, SYSTEMS HUB

The Hong Kong University of Science and Technology (Guangzhou), China

RESEARCH INTERETS

Decision-making and motion planning, robotics, autonomous driving, reinforcement learning, optimization

EDUCATION

The Hong Kong University of Science and Technology 2023 - Now

Exchange Ph.D. student in the Department of Electronic and Computer Engineering

Relevant Coursework: Advanced Deep Learning Architectures, etc.

The Hong Kong University of Science and Technology (Guangzhou) 2022 - Now

Ph.D. student of Robotics and Autonomous Systems Thrust

Relevant Coursework: Robot Motion Planning and Control, Convex and Nonconvex Optimization, etc.

Huazhong University of Science and Technology 2019 - 2022

Master of Control Science and Engineering

Relevant Coursework: Matrix Theory, Mathematical Statistics, Robot Principle and Control Technology, Machine Learning and Data Mining, Pattern Recognition Theory, etc.

Huazhong University of Science and Technology 2015 - 2019

Qiming College, Bachelor of Automation

Relevant Coursework: Calculus, Advanced Programming Language C, Physics, Linear Algebra, Complex Function and Integral Transform, Probability Theory and Mathematical Statistics, Control Theory, Numerical Methods, etc.

PUBLICATIONS

- **Zengqi Peng**, Xiao Zhou, Lei Zheng, Yubin Wang, et al. Bilevel Multi-Armed Bandit-Based Hierarchical Reinforcement Learning for Interaction-Aware Self-Driving at Unsignalized Intersections, submitted to IEEE Transactions on Vehicular Technology.
- **Zengqi Peng**, Xiao Zhou, Lei Zheng, Yubin Wang, et al. Reward-Driven Automated Curriculum Learning for Interaction-Aware Self-Driving at Unsignalized Intersections, accepted by IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024.
- **Zengqi Peng**, Xiao Zhou, Yubin Wang, Lei Zheng, et al. Curriculum Proximal Policy Optimization with Stage-Decaying Clipping for Self-Driving at Unsignalized Intersections [C], International Conference on Intelligent Transportation Systems (ITSC). IEEE, 2023.
- Xiao Zhou, **Zengqi Peng**, Jun Ma. Game-Theoretic Driver Modeling and Decision-Making for Autonomous Driving with Temporal-Spatial Attention-Based Deep Q-Learning, submitted to IEEE Transactions on Intelligent Vehicles.
- Yubin Wang, **Zengqi Peng**, Hakim Ghazzai, et al. Learning the References of Online Model Predictive Control for Urban Self-Driving. arXiv preprint arXiv:2308.15808, 2023.
- Yubin Wang, Yulin Li, **Zengqi Peng**, et al. Chance-aware lane change with high-level model predictive control through curriculum reinforcement learning. Accepted by ICRA 2024.
- Lei Zheng, Rui Yang, **Zengqi Peng**, et al. Spatiotemporal Receding Horizon Control with Proactive Interaction Towards Safe and Efficient Autonomous Driving in Dense Traffic [J]. IEEE Transactions on Intelligent Vehicles, 2024.
- Lei Zheng, Rui Yang, **Zengqi Peng**, et al. Real-Time Parallel Trajectory Optimization with Spatiotemporal Safety Constraints for Autonomous Driving in Congested Traffic [J]. arXiv preprint arXiv:2309.05298, 2023.

- Lei Zheng, Rui Yang, **Zengqi Peng**, et al. Incremental Bayesian Learning Towards Real-time Fail-Operational Control in Autonomous Driving under Model Disturbances, Accepted by ECC 2024.
- **Zengqi Peng**, Jian Huang. Soft rehabilitation and nursing-care robots: A review and future outlook [J]. Applied Sciences, 2019, 9(15): 3102.
- **Zengqi Peng**, Jian Huang. Improved Proxy-based Sliding Mode Control Integrated Adaptive Dynamic Programming for Pneumatic Muscle Actuators [C], 2021 6th IEEE International Conference on Advanced Robotics and Mechatronics (ICARM). IEEE, 2021: 424-429.

RESEARCH EXPERIENCE

Bilevel multi-armed bandit-based hierarchical reinforcement learning for autonomous driving (2023 - 2024, HKUST(GZ))

A novel BiM-ACPPO framework is proposed for interaction-aware decision-making and planning at unsignalized intersections, which can proactively handle the uncertainty stemming from the driving intentions of SVs with multi-modal interaction behaviors and traffic density. Particularly, an Exp3.S-based BiMAB algorithm is devised for automated curriculum selection by leveraging the structured nature of the self-driving tasks at unsignalized intersections.

Reward-driven automated curriculum learning for autonomous driving (2022 - 2023, HKUST(GZ))

An interaction-aware RD-ACPPO framework is proposed for self-driving tasks at unsignalized intersections. An adaptive curriculum learning technique is presented to accommodate a progressively increasing difficulty of learning tasks in autonomous driving. In this sense, the proposed approach can proactively account for the uncertainty arising from the intention of SVs and the traffic density while adequately addressing the interaction behaviors of SVs.

Curriculum learning with stage-decaying clipping for autonomous driving (2022 - 2023, HKUST(GZ))

A curriculum proximal policy optimization framework with stage-decaying clipping is proposed for training the RL agent in the unsignalized intersections. The stage-based curriculum learning technology is introduced into the PPO method with a decaying clipping parameter to accelerate the training process and improve the generalization of the trained policy. By learning a series of courses with increasing difficulty levels, the agent can capture the uncertainties of surrounding vehicles implicitly and adapt to situations effectively with varying numbers of surrounding vehicles.

Control of Flexible Bending Pneumatic Muscle for Lower Limb Exoskeleton (2019 - 2022, HUST)

An improved proxy-based sliding mode control strategy based on ADP is proposed and verified on the simulation environment and pneumatic artificial muscle platform.

Lower Limb Rehabilitation Exoskeleton Based on Pneumatic Artificial Muscle (2019 - 2022, HUST)

The exoskeleton is modeled as a four part model, and a new auxiliary control strategy based on reinforcement learning is proposed. The modeling work has been completed, and relevant experiments are in progress.

Basic research on wearable robot for repairing and enhancing human movement ability (2019 - 2020, HUST)

A TRIO MC 405 control board is integrated into an upper limb exoskeleton, and the open-loop control is realized in this robot.

ACADEMIC SERVICES

Reviewer

- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE International Conference on Intelligent Transportation System (ITSC)
- IEEE Transactions on Intelligent Transportation Systems (T-ITS)
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Transactions on Neural Networks and Learning Systems (T-NNLS)

- IEEE Transactions on Industrial Electronics (T-IE)
- IEEE Transactions on Evolutionary Computation (T-EVC)
- IEEE Transactions on Vehicular Technology (T-VT)
- IEEE Transactions on Intelligent Vehicles (T-IV)

AWARDS & SCHOLARSHIPS

- National First Prize of the Third China Graduate Robot Innovation Design Competition of Optics Valley Cup
- First Scholarship for Postgraduate
- Outstanding Graduate

SKILLS

Programming Skills Python, MATLAB, Latex

Language Skills IELTS (6.5), Chinese (native speaker)