Ruiqi Zhang

Tongji University, Shanghai, 201804, P.R.China

Web: http://ruiqizhang99.github.io Email: 1854136@tongji.edu.cn

EDUCATION

B.Eng. in Vehicle Engineering / Automobile Design, Tongji University, Shanghai, China Sep.2018 - Present

- Research Interest: **Reinforcement Learning, Robotics, Autonomous Driving, Computer Vision**
- Major GPA: 91.5/100, Overall GPA: 88.8/100 (ranking 3/62)
- 2 times of University Scholarship (only 10%)
- Core courses: Python Programming (100), Probability Theory (100), Big Data & AI (100), Mechanics of Materials (100), Mechanical Design (95), CAD Mechanical Drawing (95), MATLAB Programming (95)

PUBLICATION AND MANUSCRIPTS

- **Residual Policy Learning Facilitates Efficient Model-Free Autonomous Racing**
  IEEE Robotics and Automation Letters,2022
  Ruiqi Zhang, *Jing Hou, Guang Chen*, Zhijun Li, Jianxiao Chen, Alois Knoll*
- **PIPO: Policy Optimization with Permutation-Invariant Constraint for Distributed Multi-Robot Navigation**
  2022 IEEE International Conference on Multi-Sensor Fusion and Integration, Oral
  Ruiqi Zhang*, Guang Chen*, Jing Hou, Zhijun Li, Changjun Jiang*
- **Reuse Truncated Gradient for Proximal Policy Improvement with Differentiable Simulator**
  (Under Review of *International Conference on Learning Representations 2023*)
  Ruiqi Zhang*, Xiao Ma, Lin Shao, Zhongwen Xu*
- **Spreeze: High-Throughput Parallel Framework for Reinforcement Learning**
  (Under Review of *AAAI Conference on Artificial Intelligence 2023*)
  Jing Hou, Guang Chen,* ***Ruiqi Zhang****, Zhijun Li, Changjun Jiang*
- **Globally-Optimal Inlier Maximization for Relative Pose Estimation under Planar Motion**
  Frontiers in NeuroRobotics, 11, 2022
  Zichen Liang, Haotian Liu, Yinlong Liu, Guang Chen,* ***Ruiqi Zhang****, Alois Knoll*

(The details are available at http://ruiqizhang99.github.io)

RESEARCH EXPERIENCE

Residual Policy Learning Facilitates Efficient Model-Free Autonomous Racing Jun.2021 –Oct.2021
Advisor: **Guang Chen**, Professor @ EECS, Tongji University

- Develop an efficient residual policy learning algorithm with the modified artificial potential field for autonomous racing to solve the inefficient sampling and risk exploration problem of prior RL methods.
- Prove the complementary property of MAPF and model-free policy optimization method and demonstrate the advantage of our method in sample efficiency and real-time performance. Our method can outperform the state-of-the-art model-based RL method by over 40% and reaches the comparable level of professional human players.

Graph-based Policy Optimization for Decentralized Multi-Agent Navigation Nov.2021 –Feb.2022
Advisor: **Guang Chen**, Professor @ EECS, Tongji University

- Propose a decentralized multi-agent reinforcement learning method through constructing the representation constraint via the graph convolutional network. Meanwhile, leverage the permutation-invariant property shuffling observation to enhance the representation and generalization ability of the actor-critic structure.
- Illustrate our method is much safer than centralized MARL baselines and control barrier function-based methods and can be generalized to an arbitrary number of agents in different scenarios.

Reuse Truncated Gradient for RL with Differentiable Simulator | Internship Jul.2022 –Sep.2022
Advisor: **Lin Shao**, Professor of CS Department, National University of Singapore (NUS)

- Propose a novel algorithm to reuse the gradient from the differentiable physics engine to significantly improve the sample efficiency by truncating the gradient flow.
- Provide massive experimental results on the differentiable Flex Engine, including continuous control, high-dimensional and contact-rich tasks. Our method outperforms the SOTA gradient-based methods and prior RL baselines.

High-Throughput Parallel Reinforcement Learning Framework | Research Assistant Aug.2021-Dec.2021
Advisor: **Guang Chen**, professor @ EECS, Tongji University

- Propose a high-throughput RL framework SPREEZE. By asynchronously parallelizing sampling, iteration, and evaluation processes through multiple queues. The framework automatically adjusts the parallelization hyperparameters according to the computing power of the hardware device to achieve efficient large-batch updates.
- Achieve up to 15,000Hz experience sampling and 370,000Hz network update frame rate with only a personal desktop computer, which is an order of magnitude higher than other mainstream parallel RL frameworks.

Globally-Optimal Inlier Maximization for Relative Pose Estimation | Research Assistant Jan.2021 – Apr.2021
Advisor: **Guang Chen**, professor @ EECS, Tongji University

- Develop a globally-optimal Branch-and-Bound (BnB) solver for relative pose estimation under general planar motion, which aims to figure out the globally-optimal solution even under a quite noisy environment.
- Through reasonable modification of the motion equation, we decouple the relative pose into relative rotation and translation to apply the simplified bounding strategy.

EXTRACURRICULAR ACTIVITIES

Autonomous Exploration in Virtual Reality via NVIDIA OMNIVERSE | Internship Apr.2022 –Jun.2022
Advisor: **Ji Zhang**, Research Scientist @ Robotics Institute, Carnegie Mellon University

- Transfer the FAR-Planner and TARE-planner algorithms to NVIDIA Omniverse. Realize autonomous exploration in the unknown complex scenarios and develops a practical toolkit for both Sim-to-Real and Real-to-Sim validation.

(Video: https://www.youtube.com/watch?v=Kpt596Q3FoU)

The Formula Student Team of Tongji University | Chassis-Steering Group Dec.2019 – Dec.2021

- Responsible for the assembly of the chassis system and the design of steering system.
- Won the title of FS China 2019, 3rd of FS Japan 2019, 3rd of FS China 2020, and 2nd of FS China 2021.

Obstacle Detection System for Formula Student Racing | Project Leader Mar.2020 –Mar.2021
Advisor: **Liguang Li**, professor and dean @ School of Automobile, Tongji University

- Design a low-cost cone detection system for Formula and improve SOTA models with increased frame rate and higher accuracy by optimizing the network structure and training hyperparameters.
- Established a large-scale dataset of dynamic racing and labeled hundreds of static pictures.

Active Robotic Lower Limb with Reinforcement Learning | Internship Jan.2021 – May.2021
Advisor: **Zhijun Li**, professor @ EE, University of Science and Technology of China, IEEE Fellow

- Propose an automatic robotic prosthesis framework, which is adaptive to different real-world situations through the multi-expert and curriculum learning method. Our active prosthesis can cooperate with the motion of healthy joints of the disabled to realize walking on different terrains.

SKILLS

- Research Experiences in Reinforcement Learning & Robotic Vision
- Programming Languages and Tools: Python (PyTorch, Tensorflow), PyBullet, LaTeX
- Engineering Software: Unigraphics NX, AutoCAD, Catia
- Natural Language: Chinese, English, German