Xinjie Liu

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Education

Delft University of Technology - M.Sc. in Robotics — Sep 2021 - Jul 2023
- GPA: **9.08/10.0** (top **1%**)
- Advisor: Javier Alonso-Mora

Tongji University - B.Eng. in Automotive Engineering — Sep 2016 - Jul 2021
- GPA: 88.9/100
- Major GPA: **97.2/100** (top **5%**)

Graz University of Technology - Exchange Program — Jan 2020 - Jun 2020

Research Experience

Research interests: planning & decision-making under uncertainty, human-robot interaction, dynamic games, optimal control, (reinforcement) learning for control

All projects are available on Xinjie's personal website

Safe Multi-Agent Interaction - Autonomous Multi-Robots Laboratory, TU Delft — Nov 2022 - Present

The second project of Xinjie's master's thesis
- Developing an uncertainty-aware framework for safe multi-agent interaction

Adaptive Game-Theoretic Planning - Autonomous Multi-Robots Laboratory, TU Delft — Jun 2022 - Oct 2022

The first project of Xinjie's master's thesis
- Development of a model-predictive, adaptive game solver that jointly estimates agents' objectives using gradient and solves for generalized Nash equilibrium strategies in non-cooperative dynamic games for safe interaction [1]
- Integration of the proposed differentiable solver with neural networks for computational acceleration
- Simulation evaluation and hardware demonstration

Project Experience

Planning & Control:

High-Precision Robot Assembly Tasks Challenge — Jun 2022 - Jul 2022

Member of the team *Delft University of Technology* (1/6)
- Winner of the Franka Emika challenge in the Hackathon at the European Robotics Forum 2022
- Developed a point cloud based perception module (my part) and interactive imitation learning technique, solved high-precision robot assembly tasks on a randomly positioned task board

Autonomous Robotic Solution for Field Coverage — Apr 2022 - Jun 2022

Course project of *Multidisciplinary Project* (RO47007) with Lely | Main contributor (1/5)
- Developed a robotic system for covering a field with obstacle avoidance and battery constraints on a Husky robot
- Perception: top-view camera with OpenCV; path planning: traveling salesman problem + A*; trajectory planning & control: model predictive control (my part); task scheduling: finite state machine
- The project was graded as 9.7/10 (**top 1** in the class)

Safe MPC Approach for Non-Holonomic Mobile Robots in Dynamic Scenarios — Jan 2022 - Apr 2022

Course project of *Model Predictive Control* (MPC) (SC42125) | Main contributor (1/2)
- Proposed an MPC approach with linearized constraints in velocity space for dynamic obstacle avoidance of mobile robots, proved Lyapunov stability of the system for time-varying regulation problems [2]
- The project was graded as 10/10 on the oral exam (**top 1** in the class)

Model-Free Deep Reinforcement Learning Algorithms Implementation — Jan 2022 - Apr 2022

Course project of *Deep Reinforcement Learning* (Deep RL) (CS4400)
- Implemented the main policy gradient (REINFORCE, Actor-Critic, PPO, DDPG, TD3) and value function (DQN, Double DQN, n-step target, semi-gradients) based methods, implemented the main techniques for exploration and off-policy RL
- Graded as 10/10 on the written exam (**top 1** in the class)

Autonomous Delivery Using Quadrotor Robots — Oct 2021 - Jan 2022

Course project of *Planning & Decision Making* (RO47005) | Main contributor (1/4)
- Developed a pipeline for autonomous navigation of a quadrotor drone in an unknown environment, including global path planning (RRT*), minimum snap optimization, and obstacle avoidance (nonlinear MPC) [3]
- The project was graded as 9.5/10 (**top 1** in the class)

Robot Dynamics & Control — Sep 2021 - Nov 2021

Course project of *Robot Dynamics & Control* (RO47001)
- Implemented force and impedance controllers with singularity-robust control and task-priority control methods for a 2-DOF robot arm, implemented a PID controller for vehicle lateral motion control, employed a PD and a nonlinear geometric controller for multiple quadrotor tracking tasks
- The projects were graded as 10/10 (**top 1** in the class)

Bachelor's Thesis: Interactive Imitation Learning in Robotics Oct 2020 - Jul 2021

- Developed interactive imitation learning algorithms for various simulated robot tasks with reinforcement learning agents as baselines [4]
- The thesis was rated as an *Outstanding Bachelor Thesis* at Tongji University

Perception:

Reproduction of Event Camera Data Processing Project Jan 2022 - Apr 2022

Course project of *Deep Learning* (CS4240) | Main contributor (1/3)

- Reproduced partial results of the project 'High Speed and High Dynamic Range Video with an Event Camera' on a different dataset, reconstructed intensity images from event data using recurrent neural networks

Multisensor Perception of Autonomous Driving Cars Oct 2021 - Jan 2022

Course project of *Machine Perception* (RO47004)

- Developed a perception module for a self-driving car, including visual pedestrian detection (CNN, SVM) with LiDAR point cloud as prior
- Implemented the iterative closest point (ICP) method for vehicle ego-motion compensation
- The project was graded as 9.4/10 (**top 2** in the class)

Autonomous Car Racing by Learning from Pixels Sep 2021 - Nov 2021

Course project of *Machine Learning for Robotics* (RO47002) | Main contributor (1/2)

- Designed a machine learning pipeline for learning driving policy from pixels, including data augmentation, feature extraction, dimensionality reduction, and classification (random forest, SVM, neural network) modules

Publications

[1] **X. Liu***, L. Peters*, and J. Alonso-Mora, "Learning to Play Trajectory Games against Opponents with Unknown Objectives," submitted to *IEEE Robotics and Automation Letters (RA-L)*, 2022. URL: https://arxiv.org/abs/2211.13779.

[2] **X. Liu** and V. Atanassov, "Safe Model Predictive Control Approach for Non-Holonomic Mobile Robots," 2022. URL: https://arxiv.org/abs/2207.12878.

[3] **X. Liu**, R. M. Rodríguez, P. Féry, and Y. Zhang, "Planning Algorithm for a Quadrotor Drone," 2022. URL: https://www.researchgate.net/publication/358573208_Planning_Algorithm_for_a_Quadrotor_Drone.

[4] **X. Liu**, "Interactive Imitation Learning in Robotics Based on Simulations," bachelor's thesis, Tongji University, 2021. URL: https://arxiv.org/abs/2209.03900.

Awards & Scholarships

- First Prize Scholarship for Outstanding Students at Tongji University (3% at TJU, 2019)
- CSC National Scholarship for Outstanding Undergraduate Exchange Programs (1% at School of Automotive Studies, 2020)
- Annual Excellent Student at Tongji University (5% at TJU, 2020)
- Outstanding Student Leader at Tongji University (3 students at School of Automotive Studies, 2019)
- Third Prize Scholarship for Outstanding Students at Tongji University (20% at TJU, 2018)
- Scholarship for Social Activities at Tongji University (2 times, 2017, 2019)
- Winning Prize for Outstanding Innovative Projects at TJU (Autonomous Flight of UAVs Based on UWB Localization, 2019)

Other Experience (TA/ Service/ Management)

Teaching Assistant of Robot Dynamics & Control (RO47001) Sep 2022 - Nov 2022

Consulting Intern at IQVIA (Shanghai) Jul 2020 - Aug 2020

- Marketing project of drugs for rare diseases: conducted policy analysis, interviews with specialists and employees, and business analysis to generate strategies for national negotiation and local breakthrough of orphan drugs

Consulting Intern at Boston Consulting Group (BCG Shanghai) Mar 2020 - May 2020

- Strategic digitalization project for a capital insurance enterprise: conducted qualitative and quantitative analysis of competitors, operation diagnosis, and customer journey survey for effective digitalization of business

Tongji University Basketball Association (TJBA) Oct 2016 - Jun 2019

- Served as president of TJBA, with over 200 club members involved
- Organized referee training sessions and five campus events with an audience of over 500 for each. TJBA is among the most prominent student organizations at TJU and was rated as a five-star club many times

Skills

Programming language: Julia, C++, Python, Matlab

Version control: Git

Optimization toolbox: YALMIP, CasADi, CVX, FORCES Pro, IPOPT, OSQP

Machine learning package: PyTorch, TensorFlow, Keras, Zygote.jl / Flux.jl / ChainRules.jl (Julia auto-differentiation and deep learning tools)

Other software: Robot Operating System (ROS), Linux, LaTeX

Language: Mandarin (native speaker), English (C1, IELTS 7.5), German (B2, DSH 2 at Karlsruhe Institute of Technology)

Hobbies: workout training, basketball (university team member, chief referee at TJU), singing (third place in a singing competition at TJU), writing (part-time editor, reading quantity over 200,000)