Jingzehua (MiMi) Xu

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Education

Massachusetts Institute of Technology 5/2024 – present
MicroM.S. in Statistic and Data Science *Massachusetts, USA*
Tsinghua University 9/2023 – present
M.S. in Electronic and Information Engineering *Beijing, China*
Zhejiang University 9/2019 – 6/2023
B.S. in Marine Science *Hangzhou, China*
Zhejiang University 9/2019 – 6/2023
B.E. in Electronic Science and Technology (Double Degree) *Hangzhou, China*

- GPA: 3.91/4.00; Ranking: $1^{st}/20$
- Courses: Linear Algebra, Complex Function, Partial Differential Equation, Probability Theory and Statistics, Stochastic Process, Object-Oriented programming, Data Analysis and Algorithm Design, Fundamentals of Numerical Simulation and Machine Learning, Calculation Method, Signals and Systems, Digital Signal Processing, Digital Image Processing, Automatic Control Theory, Underwater Robot Design.

Research

Reinforcement Learning (RL), Large Language Model (LLM), Marine Robotics, Path Planning

Publications

[1] Guanwen Xie*, **Jingzehua Xu***, Zekai Zhang, Ziqi Zhang, Xiangwang Hou, Dongfang Ma, Shuai Zhang, Yong Ren and Dusit Niyato, *Is FISHER All You Need in The Multi-AUV Underwater Target Tracking Task?*, IEEE Transactions on Mobile Computing, early access, 2024.

[2] **Jingzehua Xu**, Zekai Zhang, Jingjing Wang, Zhu Han and Yong Ren, *Multi-AUV Pursuit-Evasion Game in The Internet of Underwater Things: An Efficient Training Framework via Offline Reinforcement Learning*, IEEE Internet of Things Journal, 2024.

[3] **Jingzehua Xu***, Guanwen Xie*, Zekai Zhang, Xiangwang Hou, Shuai Zhang, Yong Ren and Dusit Niyato, *UPEGSim: An RL-Enabled Simulator for Unmanned Underwater Vehicles Dedicated in the Underwater Pursuit-Evasion Game*, IEEE Internet of Things Journal, 2024.

[4] **Jingzehua Xu***, Yimian Ding*, Zekai Zhang, Guanwen Xie, Ziyuan Wang, Yongming Zeng and Gang Li, *Multi-AUV Assisted Seamless Underwater Target Tracking Relying on Deep Learning and Reinforcement Learning*, IEEE World Congress on Computational Intelligence (WCCI), 2024.

[5] **Jingzehua Xu**, Zekai Zhang, Ziyuan Wang, Jingjing Wang and Yong Ren, *VoI and Energy-Aware AUV-Assisted Data Collection for Internet of Underwater Things*, IEEE Wireless Communications and Networking Conference (WCNC), 2024.

[6] **Jingzehua Xu***, Yongming Zeng*, Jintao Zhang, Xuanchen Li, Lingru Meng, Haocai Huang, Jingjing Wang and Yong Ren, *AUV Efficient Navigation Relying on Adaptive Proximal Policy Optimization*, International Conference on Neural Information Processing (ICONIP), 2024.

[7] **Jingzehua Xu**, Zekai Zhang, Ziqi Jia, Tianyu Xing, Jingjing Wang and Yong Ren, *Robust Navigation for Unmanned Surface Vehicle Utilizing Improved Distributional Soft Actor-Critic*, International Conference on Artificial Neural Network (ICANN), 2024.

[8] Zekai Zhang*, **Jingzehua Xu***, Guanwen Xie, Jingjing Wang, Zhu Han and Yong Ren, *Environment-Energy-Aware AUV-Assisted Data Collection for IoUT Relying on Reinforcement Learning*, IEEE Internet of Things Journal, 2024.

[9] Zekai Zhang*, **Jingzehua Xu***, Jun Du, Weishi Mi, Ziyuan Wang, Zonglin Li and Yong Ren, *UUVSim: Intelligent Modular Simulation Platform for Unmanned Underwater Vehicle Learning*, IEEE World Congress on Computational Intelligence (WCCI), 2024.

[10] Baihui Xiao*, **Jingzehua Xu***, Zekai Zhang, Tianyu Xing, Jingjing Wang and Yong Ren, *Multimodal Monocular Dense Depth Estimation with Event-Frame Fusion using Transformer*, International Conference on Artificial Neural Networks (ICANN), 2024.

[11] Ziyuan Wang, **Jingzehua Xu**, Yuanzhe Feng, Yijing Wang, Guanwen Xie, Xiangwang Hou, Wei Men and Yong Ren, *Fisher-Information-Matrix-Based USBL Cooperative Location in USV-AUV Networks*, Sensors, 2023.

[12] Yi Xia, Zekai Zhang, **Jingzehua Xu**, Pengfei Ren, Jingjing Wang and Zhu Han, *Eye in the Sky: Energy Efficient Model-Based Reinforcement Learning Aided Target Tracking Using UAVs*, IEEE Transactions on Vehicular Technology, 2024.

[13] Zekai Zhang, Shaoyang Song, **Jingzehua Xu**, Ziyuan Wang, Xiangwang Hou, Ming Zeng, Wei Men and Yong Ren, *Comprehensive Simulation Framework for Space–Air–Ground Integrated Network Propagation Channel Research*, Sensors, 2023.

[14] Yi Xia, Jun Du, Ziyuan Wang, Zekai Zhang, **Jingzehua Xu** and Weishi Mi, *Standoff Target Tracking for Networked UAVs With Specified Performance Via Deep Reinforcement Learning*, IEEE Journal of Selected Topics in Signal Processing, 2024.

Preprints

[1] **Jingzehua Xu***, Yimian Ding*, Yiyuan Yang, Guanwen Xie and Shuai Zhang, *Enhancing Information Freshness: An AoI Optimized Markov Decision Process Dedicated In the Underwater Task*, arXiv preprint arXiv:2409.02424, 2024.

[2] **Jingzehua Xu***, Guanwen Xie*, Xinqi Wang, Yimian Ding and Shuai Zhang, *USV-AUV Collaboration Framework for Underwater Tasks under Extreme Sea Conditions*, arXiv preprint arXiv:2409.02444, 2024.

[3] Guanwen Xie*, **Jingzehua Xu***, Yiyuan Yang, Yimian Ding and Shuai Zhang, *Large Language Models as Efficient Reward Function Searchers for Custom-Environment Multi-Objective Reinforcement Learning*, arXiv preprint arXiv:2409.02428, 2024.

[4] Yimian Ding*, **Jingzehua Xu***, Guanwen Xie, Haoyu Wang, Weiyi Liu and Yi Li, *EFILN: The Electric Field Inversion-Localization Network for High-Precision Underwater Positioning*, arXiv preprint arXiv:2410.11223, 2024.

[5] Ziqi Zhang*, **Jingzehua Xu***, Jinxin Liu, Zifeng Zhuang and Donglin Wang, *Context-Former: Stitching via Latent Conditional Sequence Modeling*, arXiv preprint arXiv:2401.16452, 2024.

Experiences

New Jersey Institute of Technology, Department of Data Science 3/2024 – present

Research Assistant *Advisor: Prof. Shuai Zhang*

- **Large Language Model-driven Multi-task Reinforcement Learning:** Utilized the large language model to produce interpretable and free-form dense reward functions while realizing iterative refinement with human feedback. Finally, we applied generated reward functions in the multi-AUV underwater data collection task to realize policy improvement, which can be modeled as a multi-task reinforcement learning problem.
- **AoI Optimized Markov Decision Process:** Proposed an AoI optimized Markov decision process (AoI-MDP) to improve the performance of underwater tasks. Specifically, AoI-MDP models observation delay as signal delay through statistical signal processing, and includes this delay as a new component in the state space. Additionally, AoI-MDP introduced wait time in the action space, and integrated AoI with reward functions to achieve joint optimization of information freshness and decision-making for AUVs leveraging RL for training.

Tsinghua University, Department of Electronic Engineering 12/2022 – present

Graduate Researcher *Advisor: Prof. Yong Ren*

- **Environment-Aware RL via LLM, Diffusion Model, and PINN:** Proposed environment-aware RL, a new paradigm for RL utilizing LLM, diffusion model, and PINN. Specifically, I introduced the flow field information around the agent into the state space. an efficient multi-AUV training framework. The framework consists of two stages: policy improvement and offline training. Then I utilized imitation learning

and offline reinforcement learning algorithms as the optimization method for multiple objectives. Finally this framework achieved superior performance in the multi-AUV target tracking task.

- **Multi-AUV Collaboration via Reinforcement Learning:** Designed an efficient multi-AUV training framework to improve the collaboration between each AUV, taking the factors of ocean turbulence into consideration. The framework consists of two stages: policy improvement and offline training. Utilized imitation learning and offline reinforcement learning algorithms as the optimization method for multiple objectives. Finally achieved superior performance in the multi-AUV collaboration data collection task, and target tracking task.

Westlake University, Machine Intelligence Laboratory 5/2023 – 9/2023

Undergraduate Researcher *Advisor: Prof. Donglin Wang*

- **Representation Learning in Imitation Learning:** Proposed ContextFormer to provide Decision Transformer (DT) with stitching by matching trajectory contexts, combining context-aware imitation learning (IL) with sequence modeling to emulate expert trajectory representations. Experiments on D4RL benchmarks and comparisons with DT variants show superior performance in emulating expert decision making.
- **Adaptive Proximal Policy Optimization:** Utilized the multi-armed bandit and Upper Confidence Bound algorithm to improve the adaptivity and performance of Proximal Policy Optimization (PPO) algorithm.

Professional Activities

Conference Session Chair 2024

- IEEE Wireless Communications and Networking Conference (WCNC)
- OCEANS

Conference Reviewer 2025

- International Conference on Learning Representations (ICLR)
- IEEE / CVF Computer Vision and Pattern Recognition Conference (CVPR)

Conference Reviewer 2024

- IEEE International Conference on Robotics and Automation (ICRA)
- International Conference on Artificial Neural Network (ICANN)
- International Joint Conference on Neural Networks (IJCNN)

Selected Honors

First-Class Scholarship *(awarded to top graduate students at Tsinghua University)* 2024
Outstanding Graduate *(awarded to top undergraduates at Zhejiang University)* 2023
National Encouragement Scholarship *(3% at Zhejiang University)* 2022
Zhejiang Province Robot Competition *(the second prize)* 2022
Zhejiang University Underwater Robot Design Competition *(the first prize)* 2022
Top Ten College Student *(0.6% in LanTian Community of Zhejiang University)* 2021
Nandu First-Class Scholarship *(0.2% at Zhejiang University)* 2021
Zhejiang Provincial Government Scholarship *(3% at Zhejiang University)* 2021

Skills

Languages Chinese (native), English (IELTS: 7.0)
Programming Python (Pytorch), MATLAB/Simulink, ROS, C/C++, Ansys Fluent