Tingguang LI (李珽光)

Email: tgli0809@gmail.com | Homepage: https://teaganli.github.io/

RESEARCH INTERESTS	Reinforcement Learning, Embodied AI, Robotics, Multimodal LLM, Manipulation, Locomotion, Robot Learning, Game AI, Deep Learning, Machine Learning

EDUCATION BACKGROUND

The Chinese University of Hong Kong Hong Kong SAR, China
Ph.D. in Electronic Engineering Aug. 2016 – Aug. 2020
- Advisor: Prof. Max Qing-Hu Meng | Hong Kong PhD Fellowship Scheme (HKPFS)

Stanford University Palo Alto, CA, US
Visiting Student Researcher at Stanford AI Lab (SAIL) Feb. 2019 – Aug. 2019
- Advisor: Prof. Jeannette Bohg and Prof. Wenzhen Yuan

Nanjing University Nanjing, China
B.Eng. in Control and System Engineering Sep. 2012 – June 2016
- GPA: 90.8/100 | Ranking: 1/43 | National Undergraduate Scholarship

WORKING EXPERIENCE

Tencent, Robotics X Lab, Senior Research Scientist in RL Team Sep. 2020 – Present
- Research Focus: Embodied AI, Reinforcement Learning and Multimodal LLM

Amazon, Robotics & AI Team, Applied Scientist Intern
Advisor: Onkar Dabeer and Taewan Kim Seattle, WA, US, June 2020 – Aug. 2020
- Research Focus: Self-supervised Reinforcement Learning and Embedding Learning

Tencent, AI Lab, Research Intern June 2018 – Mar. 2019
- Research Focus: Hierarchical Reinforcement Learning on Robot Manipulation

RESEARCH PROJECTS

Navigation: Language-driven Autonomous Navigation via Foundation Models
- Led the project of language-driven autonomous navigation where the robot can understand and execute complex human instructions, explore unknown environments, recognize and navigate to diverse objects while dynamically avoiding obstacles.
- Trained an end-to-end Vision-Language-Action (VLA) model that processes 3D point clouds and their CLIP features to execute trajectories specified by human instructions.
- Built a visual navigation model that takes RGB-D images and human instructions, performs object detection and segmentation, and constructs a scene graph.

Locomotion: Lifelike Agility on Quadruped Robots using RL and Generative Pre-trained Models
- Developed a hierarchical framework for legged robots, which enables the pre-training and reuse of primitive, environmental and strategic-level knowledge.
- The primitive module summarizes knowledge from animal motion data via VQ-VAE and the environmental and strategic levels are trained to traverse complex terrains and executing downstream tasks by reusing the knowledge from previous levels.
- Demonstrated on a physical robot showcasing lifelike agility and strategic behavior.

GameAI: Generative Interactive Agent Locomotion Control with Diverse Style
- Designed agile and responsive agents capable of executing dynamic movements under user control, using a *Mixture of Expert* (MoE) model.
- Established a comprehensive pipeline encompassing Motion Capture script design, data collection, retargeting, model training and runtime deployment.
- Integrated our model into Tencent Games, achieving a 30% reduction in art costs and a 20% acceleration in development time as the pioneering domestic industry case.

TLeague: a Large-scale Distributed Training Framework for Multi-agent RL

- Developed a scalable framework for large-scale RL training, deployable on Kubernates clusters, supporting parallel execution of thousands of environments.
- Enhanced training efficiency by approximately 100-fold through this framework.

Manipulation: Hierarchical Reinforcement Learning for in-hand Manipulation

- **Learning to solve a Rubik's Cube** (video): a hierarchical control scheme with low-level model-free RL policy to learn actions of manipulating a Rubik's cube, and a high-level cube solver to calculate a trajectory to solve a Rubik's cube.
- **Learn to manipulate objects to challenging poses** (video): a hybrid hierarchical control framework combining low-level motion primitive torque controllers to keep stable contacts and high-level model-free reinforcement learning to select controllers.

SELECTED PAPERS

[1] Lei Han*, Qingxu Zhu*, Jiapeng Sheng*, Chong Zhang*, **Tingguang Li***, Yizheng Zhang*, He Zhang*, Yuzhen Liu, Cheng Zhou, Rui Zhao, Jie Li, Yufeng Zhang, Rui Wang, Wanchao Chi, Xiong Li, Yonghui Zhu, Lingzhu Xiang, Xiao Teng, Zhengyou Zhang. Lifelike Agility and Play on Quadrupedal Robots using Reinforcement Learning and Generative Pre-trained Models. *Nature Machine Intelligence*, Vol. 6, No. 7, 2024. (**Cover Article**) [Project][Paper][Code] (* Equal contribution.)

[2] Haojie Shi*, **Tingguang Li***, Qingxu Zhu, Jiapeng Sheng, Lei Han, Max Q.-H. Meng. An Efficient Model-Based Approach on Learning Agile Motor Skills without Reinforcement. *IEEE International Conference on Robotics and Automation (ICRA)*, 2024. [Paper][Video] (* Equal contribution.)

[3] Chong Zhang, Jiapeng Sheng, **Tingguang Li**, He Zhang, Cheng Zhou, Qingxu, Zhu, Rui Zhao, Yizheng Zhang, Lei Han. Learning Highly Dynamic Behaviors for Quadrupedal Robots. *IEEE International Conference on Robotics and Automation (ICRA)*, 2024. [Paper]

[4] **Tingguang Li**, Yizheng Zhang, Chong Zhang, Qingxu Zhu, Jiapeng Sheng, Cheng Zhou, Lei Han. Learning Terrain-Adaptive Locomotion with Agile Behaviors by Imitating Animals. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2023. [Paper][Video]

[5] Zhaoting Li, **Tingguang Li**, Jiankun Wang, Max Q.-H. Meng. Learning Robot Exploration Strategy with 4D Point-Clouds-like Information as Observations. *IEEE Robotics and Automation Letters (RAL)*, 2021. [Paper]

[6] **Tingguang Li**, Danny Ho, Chenming Li, Delong Zhu, Chaoqun Wang, Max Q.-H. Meng. HouseExpo: A Large-scale 2D Indoor Layout Dataset for Learning-based Algorithms on Mobile Robots. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2020. [Paper][Code][Video]

[7] **Tingguang Li**, Krishnan Srinivasan, Max Q.-H. Meng, Wenzhen Yuan, Jeannette Bohg. Learning Hierarchical Control for Robust In-Hand Manipulation. *IEEE International Conference on Robotics and Automation (ICRA)*, 2020. [Paper][Video]

[8] Delong Zhu, Zhe Min, Tong Zhou, **Tingguang Li**, Max Q.-H. Meng. An Autonomous Eye-in-hand Robotic System for Elevator Button Operation Based on Deep Recognition Network. *IEEE Transactions on Instrumentation & Measurement (TIM)*, 2020. [Paper]

[9] **Tingguang Li,** Weitai Xi, Meng Fang, Jia Xu, Max Q.-H. Meng. Learning to Solve a Rubik's Cube Using a Dexterous Hand. *IEEE International Conference on Robotics and Biomimetics (ROBIO)*, 2019. [Paper][Code][Video]

[10] Delong Zhu, **Tingguang Li**, Danny Ho, Tong Zhou, and Max Q.-H. Meng. A Novel OCR-RCNN for Elevator Button Recognition. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2018. [Paper][Code][Video]

[11] Delong Zhu*, **Tingguang Li***, Danny Ho*, Chaoqun Wang, Max Q.-H. Meng. Deep Reinforcement Learning Supervised Autonomous Exploration in Office Environments. *IEEE International Conference on Robotics and Automation (ICRA)*, 2018. [Paper][Video] (* Equal contribution.)

[12] **Tingguang Li**, Jin Pan, Delong Zhu, Max Q.-H. Meng. Learning to Interrupt: A Hierarchical Deep Reinforcement Learning Framework for Efficient Exploration, IEEE International Conference on Robotics and Biomimetics (ROBIO), 2018.

[13] **Tingguang Li**, Delong Zhu, Max Q.-H. Meng. A Hybrid 3DoF Pose Estimation Method Fusing Camera and Lidar Data. *IEEE International Conference on Robotics and Biomimetics (**ROBIO**)*, 2017. **(Best Conference Paper Award Finalist)**

BOOK CHAPTER	[1] **Tingguang Li**, "Learning hierarchical control for robust in-hand manipulation", *Tactile Sensing, Skill Learning and Robotic Dexterous Manipulation*, edited by Qiang Li, Shan Luo, Zhaopeng Chen, Chenguang Yang, Jianwei Zhang, Elsevier, 2022.

SCHOLARSHIPS & AWARDS

腾讯年度专利奖金奖（**公司级奖项，Top 1，专利第一发明人**）	Nov. 2023
腾讯 TEG 技术突破奖（Lifelike Agility on Quadruped Robots）	June. 2022
腾讯 TEG 技术突破奖（Generative Interactive Agent）	June. 2021
Hong Kong Ph.D. Fellowship	Aug. 2016
Best Conference Paper Award Finalist of ROBIO 2017 (**5/558**)	Dec. 2017
ICRA 2017 Mobile Manipulation Challenge Finalists (**5/93**)	May 2017
Outstanding Student Award of CUHK (**1%**)	Oct. 2018
Best Undergraduate Thesis of Jiangsu Province (**Top 1**)	June 2016
National Undergraduate Scholarship (**1%**)	Oct. 2015
Outstanding Undergraduate Award of Nanjing University	May 2016
Outstanding Student of Nanjing University	April 2015

PATENTS

[1] 一种基于室内四旋翼飞行器的激光雷达三维成像方法, CN105334518B
[2] 一种应用于游戏人物动作智能生成的多风格学习技术, 2020110635CN-HK
[3] 一种基于神经网络动作生成的变帧率技术, 2020110631CN-HK
[4] 动作数据的生成方法、装置、电子设备及存储介质, 2020110633CN
[5] 用于神经网络模型的矩阵向量运算方法、设备及存储介质, 2020110644CN
[6] 一种应用于游戏人物躲掩体动作智能生成的技术, 2020110634CN-HK
[7] 一种基于实例正则化的游戏人物动作多风格学习技术, 2021050340CN
[8] 一种基于线性插值的游戏人物动作多风格生成技术, 2021050341CN
[9] 一种多精度动作生成模型压缩技术, 2021110269CN
[10] 一种基于轨迹线感知的四足机器人复杂地形动作生成, 2021110608CN
[11] 一种利用强化学习算法为 UE4 中带有物理仿真的角色计算控制策略的方案, 2021090357CN
[12] 一种基于动作捕捉数据为包含脊柱关节的机械狗的轨迹规划方法, 2021060026CN
[13] 一种基于多帧率同步预测的变帧率动作生成方法, 2021120145CN
[14] 一种基于时序卷积网络的多风格动作在线生成方法, 2021120267CN
[15] 一种通过历史动作矫正来解决四足机器人强化学习 s2r 的方法, 2021120517CN
[16] 一种规范四足动物动捕数据起止落脚点的方法, 2022010181CN
[17] 一种基于特征空间世界模型的视觉语言导航方法, 2024030544CN
[18] 一种基于时间匹配的自动数据集拆分方法, 2023120458CN
[19] 一种基于途径点重采样的室内场景四足机器人路径规划方法, 2023120456CN
[20] 一种基于模型的有效学习敏捷运动技能的四足机器人控制方法, 2023120459CN
[21] 一种实现四足机器人摔倒翻身运动的自我启发式学习方法, 2023120682CN
[22] 一种基于三角面片的离线地图生成方法, 2023040179CN
[23] 一种基于膨胀体检测的四足机器人运动数据自动修正方法, 2023050094CN
[24] 学习模仿动物来实现具有敏捷行为地形自适应能力的四足机器人运动控制方法, 2023060266CN
[25] 基于强化学习并结合地形感知的四足机器人运动控制方法, 2023050311CN
[26] 一种多智能体移动机器人强化学习策略仿真到真机部署方法, 2023050640CN
[27] 基于视觉语言模型引导的轨迹条件机械臂操作扩散方法, 2024090429CN
[28] 基于预训练大模型的机器人视觉语言导航接地策略, 2025020113CN