Tingguang LI (李斑光)

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RESEARCH INTERESTS

Reinforcement Learning, Multi-Agent Reinforcement Learning, Robotics, Embodied AI, 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
- Awardee of 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 – Jun. 2016
- GPA: 90.8/100 Ranking: 1/43 National Undergraduate Scholarship

WORKING EXPERIENCE

Tencent, Robotics X, Senior Researcher (T10) — Sept. 2020 – Present
- Focus on MultiModal Large Model, physically simulated RL and Sim2Real transfer
- Built neural network driven humanoid animation and deploy 1st case in game industry
- Built RL-based agile control for quadruped robots and deployed on real robots
- Developed a large-scale distributed training framework for single & multi-agent RL

Amazon, Robotics Strategy & AI Team, Applied Scientist Intern
Advisor: Onkar Dabeer and Taewan Kim — Seattle, WA, US, Jun. 2020 – Sept. 2020
- Internship on self-supervised reinforcement learning and embedding learning

Tencent, AI Lab, Research Intern — Jun. 2018 – Mar. 2019
- Internship on hierarchical reinforcement learning on robot in-hand manipulation

RESEARCH PROJECTS

Multi-Modal Large Language-Vision-Motion Model for Robots — Mar. 2023 – Present
- Create a large model with language, vision and motion for navigation and manipulation
- Combine language (Llama), vision and pretrained motion priors (VQ-VAE)
- Robots can follow human instruction and navigate in indoor environments

Physically Simulated Locomotion Control (Dynamics) — Jan. 2021 – Mar. 2023
- Applied RL to learn low-level control policies for quadruped robots and humanoid robots by imitating motions from animals. Our model can achieve animal-level agility, and robust locomotion behaviors on challenging terrains in reality [video]
- Applied multi-agent RL to learn Chase Tag Game where two robots act as chaser and evader respectively, and demonstrated a high-level intelligence in real world [project]
- Our work has been awarded as Tencent Technology Breakthrough Award (2022)

Network-driven Interactive Humanoid Control (Kinematics) — Dec. 2019-June 2021
- Created agile and responsive humanoid character that can perform highly dynamic movements under user's control, using *Mixture of Expert* model (PFNN, MANN, NSM)
- We build a complete pipeline including Motion Capture data collection, data retargeting, distributed model training and runtime deployment in Unreal engine

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

- Developed a framework for large-scale RL training which can be deployed in Kubernates clusters which supports running thousands of environments in parallel
- The framework increases the training speed for ~100 times for RL training

Embedding Learning for Self-supervised Reinforcement Learning Jun.2020-Sep.2020

- Studied self-supervised exploration that learns policies without a reward function
- Proposed a task-agnostic embedding that can adapt to multiple downstream tasks
- Embedding can significantly speed up the training process for downstream tasks

Hierarchical Reinforcement Learning for Manipulation Jun. 2018 – Aug. 2019

- **Learning to solve a Rubik's Cube** (link): a hierarchical control scheme with low-level model-free reinforcement learning 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** (link): 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

SCHOLARSHIPS & AWARDS

Tencent TEG Technology Breakthrough Award	June. 2022
Tencent TEG Technology Breakthrough Award	June. 2020
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

SELECTED PUBLICATIONS

[1] 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. Submitted to IEEE International Conference on Robotics and Automation (ICRA), 2024.

[2] Chong Zhang, Jiapeng Sheng, **Tingguang Li**, et al. Learning Highly Dynamic Behaviors for Quadrupedal Robots. Submitted to IEEE International Conference on Robotics and Automation (ICRA), 2024.

[3] Lei Han*, Qingxu Zhu*, Jiapeng Sheng*, Chong Zhang*, **Tingguang Li***, et al. Lifelike Agility and Play on Quadrupedal Robots using Reinforcement Learning and Generative Pre-trained Models. Submitted to Nature Machine Intelligence. [Project]

[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] **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]

[6] **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]

[7] **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)** [Paper] [Video]

[8] **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]

[9] 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. (* indicates equal contribution.) [Paper][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] **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. [Paper]

[12] Jiankun Wang, **Tingguang Li**, Baopu Li, Max Q.-H. Meng. GMR-RRT*: Sampling-based Humanlike Path Planning Using Gaussian Mixture Regression, IEEE Transactions on Intelligent Vehicles, 2022.

[13] 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]

[14] 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]

[15] Danny Ho, **Tingguang** Li, Max Q.-H. Meng. Bone Drilling Breakthrough Detection via Energy-based Signal, International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2018. [Paper]

[16] Jiankun Wang, Jianbang Liu, Baopu Li, **Tingguang Li**, Wenzheng Chi, Max Q.-Meng. Learning-based Fast Path Planning in Complex Environments, IEEE International Conference on Robotics and Biomimetics (ROBIO), 2021. [Paper]

[17] Jin Pan, Xiaochun Mai, Chaoqun Wang, Zhe Min, Jiankun Wang, Hu Cheng, **Tingguang Li**, Erli Lyu, Li Liu, Max Q.-H. Meng. A Searching Space Constrained Partial to Full Registration Approach with Applications in Airport Trolley Deployment Robot, IEEE Sensor Journal, 2020. [Paper]

[18] Tang, Yingtian, Jiangtao Liu, Cheng Zhou, **Tingguang Li**. Online Motion Style Transfer for Interactive Character Control. arXiv preprint arXiv:2203.16393 (2022).

[19] Wang, Weiqiang, Xuefei Zhe, Huan Chen, Di Kang, **Tingguang Li**, Ruizhi Chen, and Linchao Bao. "NEURAL MARIONETTE: A Transformer-based Multi-action Human Motion Synthesis System." arXiv preprint arXiv:2209.13204 (2022).

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.

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] 一种基于膨胀体检测的四足机器人运动数据自动修正方法, 2023050094CN