CHENGLIANG LIU

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EDUCATION

University of Chinese Academy of Sciences (US NEWS 112th) **Sept. 2021 - Jun. 2024**

M.Sc. Student of Control Science of Engineering, GPA: 3.57/4.00 *Beijing/Shenzhen, China*

Directed by Yangsheng Xu (Fellow), supervised by Xinyu Wu and Zhengkun Yi.

Graduate Coursework: Deep Learning(82), Pattern Recognition(80), Reinforcement Learning(85), Computational Game Theory and Applications(91), Video Processing and Analysis(92) and etc.

Central South University (Project 985, ARWU 95th) **Sept. 2017 - Jun. 2021**

B.Eng. of Mechanical design, Manufacture & Automation, GPA: 4.00/4.00 (Top 6.53%) *Changsha, China*

Graduate Coursework: Probability And Statistics(95), Advanced Mathematics A2(II)(89), C++ Program Design and Application(90), Scientific Computing And Matlab Language(93), Linear Algebra(86) and etc.

EXPERIENCE

Chinese Academy of Sciences, Shenzhen Institute of Advanced Technology **Mar. 2021 - Sept. 2021**

Research Assistant, Topic: Tactile Ordinal Network for Object Hardness Recognition, Fabric Classification Based on Visual-Tactile Fusion *Shenzhen, China*

Chinese Academy of Sciences, Shenzhen Institute of Advanced Technology **Feb. 2023 - Aug. 2023**

Teaching Assistant, Subject: Introduction to Robotics *Shenzhen, China*

PROJECTS

Tactile Ordinal Network for Object Hardness Recognition **Mar. 2021 - Sept. 2021**

- 1) Used a BarrettHand mounted on a WAM arm to collect a tactile hardness dataset on the silicone samples with three different shapes.
- 2) Proposed to generalize the one-hot encoding using unimodal distributions including the Poisson and Binomial distributions for tactile ordinal classification problems.
- 3) Utilized grid search and introduced two hyperparameters to further optimize the performance of the tactile ordinal networks.

Reinforcement Learning **Jan. 2022 - Jun. 2022**

- *** Pacman Agent**
- 1) Implemented Q-learning and Sarsa algorithms to develop an intelligent agent for the classic game of Pacman.
- 2) Achieved a 100% win rate on small-grid maps, demonstrating the agent's ability to navigate the maze, avoid ghosts, and collect all the pellets efficiently.
- 3) Designed and fine-tuned the reward structure and exploration-exploitation trade-off to optimize the agent's learning process.
- *** Curling Game**
- 1) Developed an intelligent agent using Deep Q-Network (DQN) and Double DQN algorithms for the Curling Game, where the objective was to control a curling stone within a 100x100 square arena.
- 2) Implemented a physics simulation to accurately model the dynamics of the curling stone, considering collisions with the arena boundaries and the impact of air resistance.

- 3) Incorporated an experience replay buffer to improve the agent's learning efficiency, allowing it to learn from past experiences and mitigate the effects of sequential correlations.
- 4) Achieved remarkable performance, with the agent consistently achieving a 100% success rate in reaching randomly generated target points within a 30-second timeframe.

Grasp Outcome Prediction **Jun. 2022 - May. 2023**

- *** With A Limited Dataset**
- 1) Investigate contrastive learning using triplet loss in a supervised manner for grasp outcome prediction in a small Gelsight-based tactile dataset.
- 2) Integrate cross self-attention mechanisms with triplet net to exploit context information from different sensors.
- 3) Found that a self-attention module can work as a non-linear projection head for contrastive learning, which performs better than a simple MLP.
- 4) The experimental results demonstrate significant performance improvements in various metrics when using our framework, compared to the original method.
- *** Through Self-supervised MoCo**
- 1) Explore and verify the transferability of widely-applied data augmentation techniques in the field of Computer Vision to Gelsight-based tactile datasets.
- 2) A grasp outcome prediction network was proposed based on momentum contrast with the maintenance of a large dictionary, which achieves 81.83% predictive accuracy with a single tactile sensor data.
- 3) The experimental results show that the proposed network achieved state-of-the-art performance compared to three other self-supervised methods.

PUBLICATIONS

[1] **C. Liu**, Z. Yi, B. Huang, Z. Zhou, S. Fang, X. Li, Y. Zhang, and X. Wu, "A Deep Learning Method Based on Triplet Network Using Self-Attention for Tactile Grasp Outcomes Prediction", IEEE Transactions on Instrumentation and Measurement (**TIM**), JCR Q1, 2023.

[2] **C. Liu**, B. Huang, Y. Liu, Y. Su, K. Mai, Y. Zhang, Z. Yi, and X. Wu, "A Self-supervised Contrastive Learning Method for Grasp Outcomes Prediction", 2023 IEEE International Conference on Real-time Computing and Robotics (**RCAR**), 2023.

[3] S. Fang, Y. Liu, **C. Liu**, J. Wang, Y. Su, Y. Zhang, H. Kong, Z. Yi, X. Wu, "Probabilistic Spiking Neural Network for Robotic Tactile Continual Learning", 2024 IEEE International Conference on Robotics and Automation (**ICRA**, under review), 2024.

[4] Y. Liu, S. Fang, **C. Liu**, J. Wang, K. Mai, Y. Zhang, Z. Yi, and X. Wu, "Evaluation of Continual Learning Methods for Object Hardness Recognition", 2023 IEEE International Conference on Real-time Computing and Robotics (**RCAR**), 2023.

[5] X. Li, J. Wang, B. Huang, **C. Liu**, Y. Liu, Y. Zhang, Z. Yi, and X. Wu, "TGCN-P: A TCN-GCN Network With Weighted Graph Constructed by Pearson Correlation Coefficient for Human Motion Tracking", 2023 IEEE International Conference on Real-time Computing and Robotics (**RCAR**), 2023.

[6] Y. Su, J. Wang, B. Huang, X. Li, Y. Liu, **C. Liu**, Z. Zhou, Y. Zhang, and X. Wu, "Attention-enhanced BLSTM Network for Liquid Volume Estimation based on Tactile Sensing", 2023 IEEE International Conference on Real-time Computing and Robotics (**RCAR**), 2023.

[7] Z. Zhou, B. Huang, R. Zhang, M. Yin, **C. Liu**, Y. Liu, Z. Yi, and X. Wu, "Methods to Recognize Depth of Hard Inclusions in Soft Tissue Using Ordinal Classification for Robotic Palpation", IEEE Transactions on Instrumentation and Measurement (**TIM**), JCR Q1, 2022.

[8] T. Mi, D. Que, S. Fang, Z. Zhou, C. Ye, **C. Liu**, Z. Yi, and X. Wu, "Tactile Grasp Stability Classification Based on Graph Convolutional Networks", 2021 IEEE International Conference on Real-time Computing and

Robotics (**RCAR**), 2021.
[9] S. Fang, T. Mi, Z. Zhou, C. Ye, **C. Liu**, H. Wu, Z. Yi, and X. Wu, "TactCapsNet: Tactile Capsule Network for Object Hardness Recognition", 2021 IEEE International Conference on Real-time Computing and Robotics (**RCAR**), 2021.

PATENTS

[10] Z. Yi*, **C. Liu**, X. Wu, Y. Cui, X. Xie, Q. Tian, "A Method for Robot Grasping Prediction Based on Triplet Contrastive Networks", Patent ID: PCT/CN2022/137001.
[11] Z. Yi*, X. Li, X. Wu, Y. Liu, **C. Liu**, Y. Su, "A Method for Human Body Motion Pose Tracking Based on Long Short-Term Memory Networks and Graph Convolutional Networks", Patent ID: PCT/CN2022/137068.
[12] Z. Yi*, S. Fang, X. Wu, T. Mi, C. Ye, Z. Zhou, **C. Liu**, "A Method for Object Hardness Recognition Based on Tactile Capsule Neural Networks", Patent ID: CN202110975594.8.

SKILLS

Languages	Chinese: Mother Tongue English: IELTS Level C1 (7.0)
Programming and Software Skills	Python (Pytorch, Pandas, Tensorflow, Pybullet), Matlab, C++, Solidworks, V-rep
Robotic Technologies and Experience	UR5, Gelsight, Digit, Barrett Hand, WAM Arm, ROS

ACADEMIC SERVICE

Paper Reviewer, **ICRA** (IEEE International Conference on Robotics and Automation) **2024**

Paper Reviewer, **RCAR** (IEEE International Conference on Real-time Computing and Robotics) **2023**

SELECTED AWARDS

Scholarships	• National Postgraduate Scholarship (Candidate, 20,000 CNY, Top 1.67%)	**Oct. 2023**
	• UCAS Postgraduate Fellowship (Full Tuition Waiver & 8,000 CNY p.a.)	**2021 - 2024**
	• Shanhe Elite First-class Education Scholarship (10,000 CNY)	**Dec. 2020**
	• CSU Second-Class Excellent Student Scholarship (Top 15%)	**Nov. 2020**
	• Weiqiao Aluminum Electricity Scholarship (5,000 CNY)	**Dec. 2019**
	• CSU First-Class Excellent Student Scholarship (Top 5%)	**Nov. 2019**
	• CSU Second-Class Excellent Student Scholarship (Top 15%)	**Nov. 2018**
Honors	• Outstanding Student Leader of UCAS (Top 5%)	**Jul. 2022**
	• Three Good Student of UCAS (Top 15%)	**Jul. 2022**
	• Outstanding Graduate of CSU (Top 4%)	**May. 2021**
	• Outstanding Graduate of Hunan Province (Top 3.5%)	**May. 2021**
	• Merit Student of Central South University (Top 15%, Three Times)	**2018 - 2020**