



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 [Prof. Yangsheng Xu \(FIEEE\)](#), supervised by [Prof. Xinyu Wu](#) and [Prof. 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

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- [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