SHENAO ZHANG

shenao@gatech.edu | shenao-zhang.github.io

EDUCATION

Georgia Institute of Technology *May 2020 - Feb. 2022*
M.S. in ECE (Electrical and Computer Engineering), GPA: 3.875/4.00 *Atlanta, GA*

South China University of Technology *Aug. 2016 - May 2020*
B.Eng. in EE (Electronic and Information Engineering, Innovation Class) *Guangzhou, China*

University of California, Berkeley *Jan. 2019 - May 2019*
Visiting student at Department of EECS, GPA: 3.90/4.00 *Berkeley, CA*

RESEARCH INTERESTS

My research interests lie in reinforcement learning (RL), especially model-based RL. I'm interested in developing and analyzing efficient RL algorithms with application to robotic systems.

PUBLICATIONS

[1] **Shenao Zhang**. Conservative Dual Policy Optimization for Efficient Model-Based Reinforcement Learning. Accepted at *Neural Information Processing Systems (NeurIPS)*, 2022. Paper link: shenao-zhang.github.io/CDPO-2021/CDPO.pdf

[2] **Shenao Zhang**, Li Shen, Lei Han, Li Shen. Learning Meta Representation for Agents in Multi-Agent Reinforcement Learning. Accepted at *ICLR Workshop on Gamification and Multiagent Solutions*, 2022. Under review at *Machine Learning Journal*. Paper link: arxiv.org/pdf/2108.12988.pdf

[3] **Shenao Zhang**, Li Shen, Zhifeng Li, Wei Liu. Structure-Regularized Attention for Deformable Object Representation. Accepted at *NeurIPS Workshop on Object Representations for Learning and Reasoning*, 2020. Paper link: shenao-zhang.github.io/StRA-2020/StRA.pdf

[4] Dazheng Hu, Huabiao Qin, **Shenao Zhang**, Hongmei Liu. Gaze Tracking Algorithm Based on Projective Mapping Correction and Gaze Point Compensation in Natural Light. Accepted at *International Conference on Control and Automation (ICCA)*, 2019. Paper link: ieeexplore.ieee.org/document/8899597

WORK IN PROGRESS

[5] **Shenao Zhang**, Boyi Liu, Yan Li, Tuo Zhao, Zhaoran Wang. Model-Based Reparameterization Policy Gradient Methods. Paper link: https://shenao-zhang.github.io/RPgradRL/RPgrad.pdf

RESEARCH EXPERIENCE

Georgia Tech *Sep. 2020 - Present*
Student Researcher. Advisors: Tuo Zhao and Zhaoran Wang *Atlanta, GA*

- **Reparameterization Policy Gradient**: We propose a unified framework that can be instantiated to multiple RP policy gradient algorithms and prove the non-asymptotic global convergence of this general RP-based PGM framework. We also establish its explicit dependency on the variance and bias of the gradient estimator and characterize how the gradient variance and bias are controlled by several key factors of the algorithm. Our result also suggests potential algorithmic designs. In particular, for complex contact-rich systems, one can significantly reduce the variance and bias of RP gradients by learning a smooth transition kernel and policy. The tradeoff between gradient variance and bias further identifies the optimal model expansion step that depends on the gradient error of model and critic.
- **Over-exploration and sample efficiency of provable model-based RL**: Previous provable model-based RL algorithms achieve the global optimality by assuming that model families have a restricted complexity measure, which rarely holds for nonlinear models. We thus proposed *Conservative*

Dual Policy Optimization (CDPO) which shelves the model sampling process with Referential Update and Constrained Conservative Update. We showed that CDPO not only has a monotonic improvement property, but also is asymptotically optimal with a $\widetilde{\mathcal{O}}(\sqrt{T})$ Bayes expected regret. Experiments on several MuJoCo tasks also validate the principled over-exploration issue and the superiority of CDPO.

Tencent AI Lab *Aug. 2019 - Sep. 2020*
Research Intern. Advisors: Li Shen, Lei Han and Li Shen *Shenzhen, China*

- **Generalizability of multi-agent RL algorithms**: To make RL algorithms generalizable in population-varying multi-agent systems, we proposed *Meta Representations for Agents* (MRA) that adopts multi-modal latent policies and a constrained mutual information maximization objective to discover the common strategic knowledge and diverse strategic modes. We proved that the learned policies can reach the Nash Equilibrium in every evaluation Markov game if with a sufficiently large latent space.
- **Visual tasks with structured data**: For structured visual tasks including person re-id and face recognition, we proposed to formulate feature interactions in a structured manner. Our *Structure-Regularized Attention* first captures informative patterns between neighbor nodes. Higher-level contextual information can then be accessed to enhance the desired features.

South China University of Technology *Sep. 2017 - Jan. 2019*
Research Assistant. Advisors: Huabiao Qin and Mingkui Tan *Guangzhou, China*

- **Gaze tracking algorithms**: We proposed a gaze tracking algorithm based on projective mapping correction and gaze point compensation in natural light.
- **Perception for mobile robot navigation**

TEACHING EXPERIENCE

Head TA of CS 7648: Interactive Robot Learning (Fall 2021) at Georgia Tech.

SELECTED PROJECTS

Object Detection *May 2019 - Aug. 2019*
Project paper: shenao-zhang.github.io/CFA-2019/CFA.pdf, advised by Bo Wu *Columbia University*

Cloth Simulation using OpenGL Shader *Jan. 2019 - May 2019*
Project website: ffjmmm.github.io/CS184-final/webpage, advised by Ren Ng *UC Berkeley*

RELEVANT COURSES

Undergraduate courses: Computer Graphics (CS 184 at UC Berkeley), Intro to AI (CS 188 at UC Berkeley), Algorithms (CS 170 at UC Berkeley), Machine Perception, Information Theory, Deep Learning.

Graduate courses at Georgia Tech:

- Control courses: Linear Systems and Controls (ECE 6550), Nonlinear Systems and Control (ECE 6552), Optimal Control and Optimization (ECE 6553), Autonomous Control of Robotic Systems (ECE 6562).
- ML courses: Statistical Machine Learning (ECE 6254), Mathematical Foundations of Machine Learning (ISyE 7750), Machine Learning Theory (CS 7545), Computational Data Analysis (CSE 6740).

PROFESSIONAL ACTIVITIES

Conference Review: NeurIPS 2020, NeurIPS 2021, NeurIPS 2022, RSS 2021, ICLR 2022, AISTATS 2022, ICML 2022.
Journal Review: Neurocomputing.

HONORS AND REWARDS

Georgia Tech's Level A Premier Merit-Based Scholarship	*2020*
Second Prize in 2018 Undergraduate Electronics Design Contest	*2018*
Third Prize in 2018 Intel Undergraduate Embedded System Contest	*2018*
Outstanding Freshman Scholarship (Awarded to 30 among 6,500 students)	*2016*