

SHENAO ZHANG

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EDUCATION

Georgia Institute of Technology	<i>May 2020 - Dec. 2021</i>
M.S. in ECE (Electrical and Computer Engineering), GPA: 3.875/4.00	<i>Atlanta, GA</i>
Georgia Institute of Technology	<i>Jan. 2021 - Aug. 2022 (expected)</i>
M.S. in CSE (Computational Science and Engineering), GPA: 4.00/4.00	<i>Atlanta, GA</i>
South China University of Technology	<i>Aug. 2016 - May 2020</i>
B.Eng. in EE (Electronic and Information Engineering, Innovation Class)	<i>Guangzhou, China</i>
University of California, Berkeley	<i>Jan. 2019 - May 2019</i>
Visiting student at Department of EECS, GPA: 3.90/4.00	<i>Berkeley, CA</i>

RESEARCH INTERESTS

My research interests lie in reinforcement learning. I am interested in developing RL algorithms that are theoretically efficient with application to robotic systems.

PUBLICATIONS

- [1] **Shenao Zhang**, Evangelos Theodorou. Dual Conservative Policy Update for Efficient Model-Based Reinforcement Learning. Under review at *Robotics: Science and Systems (RSS)*, 2022. [Paper link: shenao-zhang.github.io/DCPU-2021/DCPU.pdf](https://shenao-zhang.github.io/DCPU-2021/DCPU.pdf)
- [2] **Shenao Zhang**, Li Shen, Lei Han, Li Shen. Learning Meta Representation for Agents in Multi-Agent Reinforcement Learning. Under review at *Machine Learning Journal*. [Paper link: arxiv.org/pdf/2108.12988.pdf](https://arxiv.org/pdf/2108.12988.pdf)
- [3] **Shenao Zhang**, Li Shen, Zhifeng Li, Wei Liu. Structure-Regularized Attention for Deformable Object Representation. Accepted at *Advances in Neural Information Processing Systems (NeurIPS) Workshop*, 2020. [Paper link: shenao-zhang.github.io/StRA-2020/StRA.pdf](https://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](https://ieeexplore.ieee.org/document/8899597)

WORK IN PROGRESS

Global Convergence of Analytic Policy Gradient Through Model Backpropagation. [Report link: shenao-zhang.github.io/MBPG-2021/MBPG.pdf](https://shenao-zhang.github.io/MBPG-2021/MBPG.pdf)

RESEARCH EXPERIENCE

Georgia Tech	<i>Sep. 2020 - Present</i>
<i>Student Researcher. Advisors: Evangelos Theodorou, Tuo Zhao and Zhaoran Wang</i>	<i>Atlanta, GA</i>

- **Analytic policy gradient through model backpropagation**, (co-advised by Tuo Zhao and Zhaoran Wang): For analytic policy gradient algorithms, we derived a unified global convergence rate that depends on the gradient variance and bias. The gradient error is then separately bounded for various algorithms including BPTT, SVG, and MAAC. The results indicate two sources of sample inefficiency: the curse of chaos and the model objective mismatch. We suggest two modifications: learning a non-chaotic version of physics with spectral normalization and leveraging gradient-aware model learning.
- **Over-exploration and sample efficiency of model-based RL**, (advised by Evangelos Theodorou): Previous model-based Bayesian RL algorithms achieve the asymptotic optimality by assuming that model families have a restricted complexity measure. However, it is not polynomially bounded for

nonlinear models, *i.e.*, only an exponentially small portion of uncertainty is eliminated per step. We thus proposed *Dual Conservative Policy Update* (DCPU) which shelves the model sampling process to avoid aggressive policy update. We showed that DCPU not only has a monotonic improvement property, but also is asymptotically optimal with a $\tilde{O}(\sqrt{T})$ Bayes expected regret. Experiments on several MuJoCo tasks also validate the principled over-exploration issue and the superiority of DCPU.

Tencent AI Lab

Research Intern. Advisors: Li Shen, Lei Han and Li Shen

Aug. 2019 - Sep. 2020

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

Research Assistant. Advisors: Huabiao Qin and Mingkui Tan

Sep. 2017 - Jan. 2019

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

[Project paper](#): shenao-zhang.github.io/CFA-2019/CFA.pdf, advised by Bo Wu

May 2019 - Aug. 2019

Columbia University

Cloth Simulation using OpenGL Shader

[Project website](#): ffjmmm.github.io/CS184-final/webpage, advised by Ren Ng

Jan. 2019 - May 2019

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, RSS 2021, ICLR 2022, AISTATS 2022, ICML 2022.

Journal Review: Neurocomputing.

HONORS AND REWARDS

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