

SULIN LIU

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Research Interests

My research interests are deep learning, probabilistic modeling and robust control. Specifically, I combine these techniques to better model and infer uncertainty that facilitates robust learning in real-world dynamics and environment. I mainly work on methods that utilize the structure of the problems to achieve sample-efficient and scalable learning with guarantees. My current research focuses on speeding up probabilistic model identification and making better use of uncertainty in robust control. Prior to my PhD program at Princeton, I have also worked on federated/distributed learning and multi-task learning.

Education

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| 2017-pres. | Ph.D. in Machine Learning, Electrical and Computer Engineering, Princeton University
- Advisors : Ryan P. Adams (CS), Peter J. Ramadge (ECE), GPA : 3.96/4.0 |
| 2011-2015 | B.Eng. in Electrical Engineering, National University of Singapore
- Major GPA : 4.94/5.0, Minor in Mathematics |
| 2014 | Exchange student, Georgia Institute of Technology
- GPA : 4.0/4.0, only 9 students selected university wide |

Work Experience

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| 2021
May-Aug. | Research Intern, Facebook Research Mentor : Ben Letham
▶ Work on black-box (Bayesian) optimization under the Adaptive Experimentation group in the Core Data Science team |
| 2015-17 | Research Engineer, Nanyang Technological University, Singapore Advisor : Sinno Jialin Pan
▶ Distributed/Federated learning, multi-task learning (MTL) :
- Developed the first distributed/federated learning algorithm for relationship-based MTL with convergence guarantees
- Developed a novel distributed primal-dual optimization algorithm
- Developed a new MTL method that enable adaptive grouping of correlated tasks |

Research Experience

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| 2018-pres. | Research Assistant, Princeton University Advisors : Ryan P. Adams, Peter J. Ramadge
▶ Learning to optimize Gaussian Process hyperparameters :
- Developed an amortized inference framework for GP model selection
- Proposed a novel self-attention based neural network architecture that preserves permutation equivariance/invariance for learning on datasets
- Demonstrated that a single neural model trained on synthetic data is able to perform GP model selection on different unseen real-world benchmarks with comparable quality but ~100 times faster than conventional approaches
▶ Learning probabilistic certificate for safety-critical control
- Introduced GP for modeling the uncertainty in control barrier function dynamics
- Derived a safety-filtering controller that can take advantage of the uncertainty predictions from GP through a novel convex-optimization formulation
▶ Probabilistic modeling for system identification with stability guarantees :
- Identified a general class of stable GPs whose kernel's reproducing kernel Hilbert space corresponds to integrable functions for modeling system impulse responses |
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- 2015 | Undergraduate Thesis, **National University of Singapore** | Advisor : **Loong Fah Cheong**
 ▶ Proposed a new quadratic-programming-based formulation for multi-view planar reconstruction

Publications

- 2020 | **S. Liu**, X. Sun, P. J. Ramadge, R. P. Adams Task-Agnostic Amortized Inference of Gaussian Process Hyperparameters, *Advances in Neural Information Processing Systems (NeurIPS)*, 2020. **Paper**. **Code**.
- 2020 | H. Valavi, **S. Liu**, P. J. Ramadge Revisiting the Landscape of Matrix Factorization, in *International Conference on Artificial Intelligence and Statistics (AISTATS)*, 2020. **Paper**.
- 2018 | M. Zhao, B. An, Y. Yu, **S. Liu**, S. J. Pan Data Poisoning Attacks on Multi-Task Relationship Learning, in *AAAI Conference on Artificial Intelligence (AAAI)*, 2018. **Paper**.
- 2017 | **S. Liu**, S. J. Pan, Q. Ho Distributed Multi-task Relationship Learning, in *Conference on Knowledge Discovery and Data Mining (KDD)*, 2017. **Paper**.
- 2017 | Y. Yu*, **S. Liu*** (Equal Contr.), S. J. Pan Communication-Efficient Distributed Primal-Dual Algorithm for Saddle Point Problems, in *Uncertainty in Artificial Intelligence (UAI)*, 2017. **Paper**.
- 2017 | **S. Liu**, S. J. Pan Adaptive Group Sparse Multi-task Learning via Trace Lasso, in *International Joint Conference on Artificial Intelligence (IJCAI)*, 2017. **Paper**.

Honors and Awards

- 2018 | Anthony Ephremides Fellowship
 - awarded to the top first year Ph.D. student in the information science track
- 2017 | Princeton University Fellowship in Natural Sciences and Engineering
- 2014 | IEEE Eta Kappa Nu Honor Society
- 2014 | Faculty of Engineering Annual General Electric Book Prize
 - awarded to the top student in the concentration of wireless communications
- 2013 | ST Electronics Book Prize
 - awarded to the top second year student in Electrical Engineering
- 2011-15 | Singapore Ministry of Education SM3 Undergraduate Scholarship

Coursework

Machine Learning and Pattern Recognition	Linear and Nonlinear Optimization
New Directions in Theoretical Deep Learning	Large-Scale Optimization
Theoretical Machine Learning	Statistical Theory and Methods
Statistical Optimization and Reinforcement Learning	High-Dimensional Probability
Optimization for Machine Learning	Safety-Critical Robotic Systems

Programming Skills

- Proficient : Python (PyTorch, Numpy), MATLAB, Java, \LaTeX
- Some experience : TensorFlow, C/C++, Bash, Julia, HTML/CSS, VHDL

Academic Service

Reviewer for *JMLR*, *NeurIPS* (2018-, 2019 Top Reviewer), *ICML* (2019-), *ICLR* (2019-), *AAAI* (2020-), *ACML* (2020-), *KDD* (2021-)

Teaching

Teaching assistant/Preceptor for *ELE435/535 Machine Learning and Pattern Recognition* (Head TA), *COS424/524 Fundamentals of Machine Learning*, *COS302 Mathematics for Numerical Computing and Machine Learning*, *SML201 Introduction to Data Science*, *CS1010E Programming Methodology in C*.