Xujie Song

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Bio I am a **Master student** graduated from **Tsinghua University**.
My research focuses on **Neural Network**, **Reinforcement Learning**, **Quantum Computing**, and their applications in **Autonomous Driving** and **Intelligent Transportation System**.

Education

Sep. 2021 – Jun. 2024 **Tsinghua University,** M.Phil *Beijing, China*
- Vehicle Engineering GPA : 4.0/4.0 Rank : 1/35
- Big Data Certificate Program

Sep. 2017 – Jun. 2021 **Delft University of Technology,** Joint B.Eng *Delft, Netherlands*
- Traffic and Transportation

Sep. 2017 – Jun. 2021 **Beijing Jiaotong University,** B.Eng (dual degrees) *Beijing, China*
- Traffic and Transportation GPA : 3.91/4.0 Rank : 1/54
- Computer Science and Technology GPA : 3.98/4.0

Publications

- **X. Song**, J. Duan, W. Wang, et al. "LipsNet : A Smooth and Robust Neural Network with Adaptive Lipschitz Constant for High Accuracy Optimal Control," *International Conference on Machine Learning* (**ICML**), 2023.
  Paper Poster Video GitHub
- **X. Song**, L. Chen, T. Liu, et al. "FlipNet : Fourier Lipschitz Smooth Policy Network for Reinforcement Learning," *Annual Conference on Neural Information Processing Systems* (**NeurIPS**), 2024 (under review).
  Website Video GitHub
- **X. Song**, T. Liu, J. Duan, et al. "Training Multilayer Neural Networks on Ising Machines," **Nature Computational Science**, 2024 (ready to submit).
  Paper
- L. Chen*, **X. Song***, L. Xiao, et al. "Smooth Reinforcement Learning Based Trajectory Tracking for Articulated Vehicles," *Journal of Harbin Institute of Technology* (**Ei Compendex**), 2023.
  Abstract
- L. Chen*, **X. Song***, W. Wang, et al. "A Smooth Reinforcement Learning Method for Trajectory Tracking and Collision Avoidance of Wheeled Vehicle," *IEEE Transactions on Intelligent Transportation Systems* (**TITS**), 2024 (under review).
- W. Wang, J. Duan, **X. Song**, et al. "Smooth Filtering Neural Network for Reinforcement Learning," *IEEE Transactions on Intelligent Vehicles* (**TIV**), 2024.
  Paper
- Y. Wang, W. Wang, **X. Song**, et al. "Smoothing Neural Network with Adaptive Liquid Time-constant for Reinforcement Learning Tasks," *Annual Conference on Neural Information Processing Systems* (**NeurIPS**), 2024 (under review).
  Abstract
- Y. Wang, L. Wang, Y. Jiang, W. Zou, T. Liu, **X. Song**, et al. "Diffusion Actor-Critic with Entropy Regulator," *Annual Conference on Neural Information Processing Systems* (**NeurIPS**), 2024 (under review).
  Paper
- **X. Song** and Z. Lin, "Non-zero-sum Game Control for Multi-vehicle Driving via Reinforcement Learning," *arXiv preprint arXiv :2302.03958*, 2023.
  Paper GitHub
- S. E. Li, **X. Song**, et al. "A Method for Training Feedforward Neural Networks on Ising Machine," *Patent, No. 2023113797497*, 2023.
- S. E. Li, W. Wang, Z. Zheng, C. Zhang, Y. Yang, Y. Zhang, J. Gao, J. Li, **X. Song**, et al. "Offline Simulation System for the General Optimal Control Problem Solver (V2.0)," *Software Copyright, No. 2023SR0225863*, 2023.
  Docs GitHub
- **X. Song**, S. Dai, C. Lin, et al. "LiDAR Data Enhancement via Pseudo-LiDAR Point Cloud Correction," *Journal of image and Graphics* (**JIG**), 2021.
  Paper GitHub
- C. Lin, **X. Song**, S. Dai , et al. "A Method and Device for 3D Point Cloud Densification Based on Stereo RGB Images," *Patent, No. CN111612728B*, 2020.

Experiences

2021.9 – 2025.6 | **Tsinghua University,** Research Assistant — *Beijing, China*

- Research on autonomous driving, reinforcement learning, neural network control, and quantum computing as a research assistant.

Autonomous Driving | Reinforcement Learning | Neural Network

2024.2 – 2024.6 | **QBosoN Ltd.,** Research Intern — *Beijing, China*

- Research on quantum training of neural networks. It provides alternative to gradient-based Back-propagation method.

Quantum Computing | Neural Network

2023.7 – 2023.9 | **Alibaba Group Ltd.,** Research Intern — *Beijing, China*

- Research on aligning LLM (Large Language Model) with safety constraints, by inference based on conditional probability. It provides alternative to Safe-RLHF (RL from Human Feedbacks).

Large Language Model | Align with Human Preference | Safety Constraint

2022.3 – 2023.1 | **MEGVII Technology Ltd.,** Research Intern — *Beijing, China*

- Research on the application of sequential 3D object construction based on the reinforcement learning and computer vision methods.

Reinforcement Learning | 3D Vision | Sequential Construction

2022.1 – 2022.2 | **ProbQuant Ltd.,** Research Intern — *Beijing, China*

- Design a multi-stage quantitative stock position optimization algorithm, then develop the system using CasADi and IPOPT.

Quantitative Investment | Combination Optimization | Optimal Stock Position

2021.6 – 2021.8 | **SenseTime Group Inc.,** Research Intern — *Shanghai, China*

- Research on intelligent signal control. Design a integrative algorithm for green waves coordinating and breakpoints partitioning on arteries, then develop the system using OR-Tool and Coin-or.

Intelligent Transportation | Operational Research | Traffic Signal | Green Wave

Researches & Projects

2022 – 2023 | **Training Quantized Neural Network on Quantum Devices** — *Tsinghua University, Beijing*

- Design an optimization framework in QUBO format for training QNN. Use the Quantum Annealing/Coherent Ising Machine, to complete the training immediately.
- It is the first work that proposes training deep feedforward neural network on Ising Machine.

Quantized Neural Network | Quantum Annealing | Coherent Ising Machine

2021 – 2022 | **Smooth and Robust Neural Network for Reinforcement Learning** — *Tsinghua University, Beijing*

- To address the action fluctuation in RL, we proposed a smooth and robust neural network named LipsNet, proved to be Lipschitz continuous. It can be used as actor network in most RL algorithms.
- Experiments show that it has smooth actions on MuJoCo and autonomous driving tasks.

Reinforcement Learning | Neural Network | Lipschitz Continuity

2021 – 2021 | **Traffic Prediction for Cities with Transfer Learning** — *MIT, Remote*

- Design a traffic state prediction method for different cities with transfer learning. The project has investigated Graph-ResNet, Unet and LSTM, etc.
- Advisor: Zhenliang Mike Ma | Recommendation letter: link。

Transfer Learning | Traffic State Estimation

2020 – 2021 | **Game Control for Autonomous Driving via Reinforcement Learning** — *Tsinghua University, Beijing*

- Propose a game control framework for autonomous driving. The Nash-equilibrium control strategy is obtained by solving coupled HJB euqations through model-based RL.
- Self-play training is used. It has good results in the simulated intersections.

Reinforcement Learning | Game Theory | Autonomous Driving

2019 – 2020 | **LiDAR Enhancement Based on Images** *MePro, Beijing*

- The project aims to densify the LiDAR point cloud in the autonomous driving scenarios. The process flow includes depth estimation, surface reconstruction, pseudo-point cloud correction, etc.
- Experiments show density is improved significantly, and 3D detection accuracy is also increased.

Computer Vision | LiDAR Enhancement | Point Cloud Densification

Competition Awards

2017 – 2020 | **ACM-ICPC / CCPC Competitions** 4 Silver Medals, 3 Bronze Medals

- **Silver medals :** Qinhuangdao site, Harbin site, Xi'an invitation site×2
- **Bronze medals :** Beijing site, Xuzhou site, Hangzhou site

2024 | **Wuyue Cup Quantum Computing Challenge** Gold Award (1st place)

2019 | **Lanqiao Cup National Contest, Beijing (C++, A-level)** First Prize

2019 | **MCM/ICM Mathematical competition in Modeling** Honorable Mention

2018 | **China Mathematical Contest in Modeling, Beijing** Second Prize

Honors & Scholarships

2020	Zhixing Scholarship	(¥20,000, Only 10 Stu.)	2023	RONG Scholarship	(¥6,000, 5th place)
2019	Zhixing Minor Scholarship	(¥10,000, Only 10 Stu.)	2023	General Scholarship, Second-level	(¥5,000)
2020	National Scholarship	(¥8,000, Top 1%)	2022	General Scholarship, Second-level	(¥5,000)
2019	National Scholarship	(¥8,000, Top 1%)	2018	Acad. Scholarship, First-level	(¥3,500, Top 2%)
2018	National Scholarship	(¥8,000, Top 1%)	2020	Acad. Scholarship, Second-level	(¥2,000, Top 2%)
2021	Outstanding Grad., Beijing	(Top 5%)	2019	Acad. Scholarship, Second-level	(¥2,000, Top 2%)
2020	Outstanding Merit Student	(Only 10 Stu.)	2023	Didi Chuxing Scholarship	(¥1,500)
2023	Best Oral Pres., PhD Forum	(Only 3 Stu.)	2022	Didi Chuxing Scholarship	(¥1,500)

Core Courses

Mathematics	Probability & Statistics（100/100）	Discrete Mathematics（100/100）	Geometry & Algebra（98/100）
	General Chemistry（96/100）	Operational Research（96/100）	University Physics（95/100）
	Calculus（92/100）	Numerical Analysis（A-/A+）	Physics Experiment（A-/A）
Computer Science	Machine Learning（98/100）	Database Systems（98/100）	Operating Systems（98/100）
	Data Structures（97/100）	Computer Networks（95/100）	Computing Thinking（A/A）
	Artificial Intelligence（A/A）	Big Data Analytics（A/A）	High-Perf. Computing（A/A）
	Statistical Learning（A/A+）	Deep Learning（A-/A+）	Reinforcement Learning（P/P）
Traffic Engineering	Traffic Engineering（98/100）	Transportation Planning（98/100）	Intell. Trans. Systems（95/100）
	Transportation Network（94/100）	Transportation Facilities（93/100）	Transport. Economics（92/100）
	Railway Operations（90/100）	Road & Railway Design（90/100）	Terminals & Hubs（90/100）
Vehicle Engineering	Self-driving & Intell. Vehicle（P/P）	Vehicle Control Engineering（A/A+）	Modern Optimiz. Method（A/A）
	Modern Control Theories（P/P）		

Skills

Programming : C/C++, Python, MATLAB, PyTorch

Software & Platform : Linux, LaTeX, Git, Simulink, SUMO

Language : Chinese (native), English (TOEFL 101, GRE 323)

Hobby : Hiking, Dizi (Chinese bamboo flute)