XIAOXUE ZHANG

Department of Electrical & Computer Engineering, National University of Singapore
4 Engineering Drive 3, Singapore 117583
Mobile: (+65) 8375 7242 Email: xiaoxuezhang@u.nus.edu

PERSONAL PARTICULARS

- Date of Birth: 1st October 1993
- Citizenship: Chinese
- Gender: Female

RESEARCH INTERESTS

- Reinforcement Learning, Control Theory and Optimization, Intelligent Transportation Systems, Mechatronics and Robotics

EDUCATION

- **National University of Singapore,** Singapore 08.2018 - 06.2022 (expected)
  Ph.D. Candidate, Electrical and Computer Engineering
  Advisor: Prof. Tong Heng Lee
- **China Agricultural University,** Beijing, China 08.2015 - 06.2018
  Tsinghua University, (Joint Master Program), Beijing, China 08.2015 - 06.2018
  M.Sc., Vehicle Engineering
  Thesis: *"Periodic Control for Autonomous Vehicle Platoons with Guaranteed Bounded Stability"*
  Advisor: Prof. Shengbo Li, Prof. Zhe Xin
- **China Agricultural University,** Beijing, China 08.2011 - 06.2015
  B.Eng., Vehicle Engineering
- **China Agricultural University,** Beijing, China 08.2011 - 06.2015
  B.B.A., Marketing

RESEARCH EXPERIENCES

- **National University of Singapore,** NUS Graduate School, ISEP 08.2018 - 06.2022 (expected)
  Advisor: Prof. Tong Heng Lee
  ◦ Explored the use of cutting-edge optimization algorithms (e.g., ADMM and ALM) in various domains including autonomous driving. These algorithms alleviate the prohibitively heavy computational burden that arises in large-scale optimization procedures, and they demonstrate a dramatic improvement over the existing solvers.
  ◦ Created several innovative methodologies on motion planning and decision making for human-robot interaction systems, and the effectiveness is successfully demonstrated from the paradigm of automated aerial vehicles.
  ◦ Created a model-free data-driven methodology for controller synthesis with structural constraints, which essentially avoids the necessity of precise modeling required in the classical model-based counterpart.
  ◦ Concentrated on the robotic deployment for inspection and measurement in confined and cluttered 3D environments, in which a path tracking task was completed with learning control.
- **Tsinghua University,** School of Vehicle and Mobility, Beijing, China 08.2015 - 06.2018
  Advisor: Prof. Shengbo Li
  ◦ Designed a series of sectionalized switching maps to minimize overall fuel consumption and proved guarantee bounded stability of heterogeneous vehicle platoons.
  ◦ Designed an interpretative human-like driving model and algorithm based on Reinforcement Learning (RL) and Inverse Reinforcement Learning (IRL).
  ◦ Solved the model predictive control problem for vehicle path tracking at handling limits, and conducted co-simulation with CARSIM and Simulink to verify its path tracking stability.

◦ Solved a fuel-optimal periodic cruising problem of a power-split HEV with the physical limits of power-train components.

- **China Agricultural University,** School of Engineering, Beijing, China 08.2014 - 06.2015
  Advisor: Prof. Zhe Xin
  ◦ Designed and developed an active haptic feedback accelerator pedal to improve driving economy. Built a 3D experimental bench and assembled a physical prototype.
  ◦ Developed a driving behavior analysis algorithm to recognize uneconomic driving behavior, then generated results and corresponding suggestions to drivers to help to reduce fuel consumption.

INDUSTRIAL EXPERIENCES

- **Agency for Science, Technology and Research (A*STAR),** Singapore 10.2018 - present
  Research Student, Singapore Institute of Manufacturing Technology (SIMTech)
  ◦ Designed and controlled a magnetic levitation table widely applied in the industrial field.
  ◦ Developed several model-based and data-driven methodologies for mechatronic and robotic applications, including a magnetically levitated nano-positioning system, an industrial gantry robot for contouring tasks, a flexure-based electromagnetic linear actuator, a timing-belt system for tray-indexing applications, etc.
  ◦ Collaborated with companies to develop key technologies toward precision machines and robotic systems for industrial automation and precision engineering.
- **Temasek Laboratories,University of Singapore,** Singapore 10.2018 - present
  Research Student
  ◦ Developed a novel 3D path planning algorithm, Hierarchical Lazy Theta* (HLT*), to plan the near-optimal path efficiently for real-time operation with application to UAV systems.
  ◦ Developed a variational Bayesian Gaussian mixture model (vBGMM) to predict the future trajectory of moving obstacles. Then, Designed a chance constrained nonlinear MPC to address trajectory generation in the presence of parametric uncertainty and sensor noise with application to UAV systems.
- **Suzhou Automotive Research Institute, Tsinghua University,** Suzhou, China 10.2015 - 01.2016
  Research Intern (Assistant Programmer), Intelligent Vehicle Technology Academy
  ◦ Participated in the pedestrians and cyclist detection project, and focused on salient region detection, object proposals output and designed the target tracking algorithms of EKF and PF.
  ◦ Implemented some path planning algorithms, including environment modeling (Visibility graph, Voronoi diagram, etc.) and path searching (A*, D*, RRT, etc.).

TEACHING EXPERIENCES

- Teaching Assistant for EE5904 Neural Networks 2018 - present
- Teaching Assistant for EE5104/EE6104 Adaptive Control Systems 2018 - present
- Teaching Assistant for EE5111 Selected Topics in Industrial Control and Instrumentation 2018 - present
- Teaching Assistant for EE5103/ME5403 Computer Control System 2018 - present
- Teaching Assistant for EE4302 Advanced Control Systems 2018 - present
- Teaching Assistant for EE4303 Industrial Control System 2018 - present

SKILLS

- **Languages:**
  English, Mandarin
- **Programming Languages:**
  Python, MATLAB/Simulink, C/C++
- **Machine Learning Package:**
  PyTorch, TensorFlow/Keras, ROS, OpenAI Gym, OpenAI Baseline, OpenCV
- **Applications:**
  V-rep Simulation, CARLA Simulator, PreScan, DSpace, LabView, Adobe Suite, CARSIM, Prescan, MultiGen Paradigm Creator, AutoCAD, Solid Works, Eclipse, Qt Creator, Visual Studio, Pro/E (Creo), Arduino, LaTeX, Photoshop, Solidworks, SPSS

AWARDS & HONORS

- Student Best Paper Award (in *Proceedings of the 20th International Conference on Control, Automation and Systems*, Korea) 2020
- NUS Graduate School for Integrative Sciences and Engineering Scholarship 2018
- Outstanding Graduate Students (China Agricultural University) 2018
- Academic Second scholarship of College of Engineering (China Agricultural University) 2017
- Top 100 University-level Outstanding Graduation Thesis (China Agricultural University) 2015
- National Endeavor Scholarship (China Agricultural University) 2014
- University-level Excellent Member (China Agricultural University) 2014
- Model Student of Academic Records (China Agricultural University) 2013

PUBLICATIONS

- **International Refereed Journals**

[1] **X. Zhang**, Z. Cheng, J. Ma, S. Huang, F. L. Lewis, and T. H. Lee, "Semi-Definite Relaxation Based ADMM for Cooperative Planning and Control of Connected Autonomous Vehicles," *submitted to IEEE Transactions on Intelligent Transportation Systems.*

[2] **X. Zhang**, J. Ma, Z. Cheng, F. L. Lewis, and T. H. Lee, "Sequential Convex Programming for Collaboration of Connected and Automated Vehicles," *submitted to IEEE Transactions on Intelligent Vehicles.*

[3] **X. Zhang**, J. Ma, Z. Cheng, S. Huang, C. W. de Silva, and T. H. Lee, "Accelerated Hierarchical ADMM for Nonconvex Optimization in Multi-Agent Decision Making," *submitted to IEEE Transactions on Systems, Man, and Cybernetics: Systems.*

[4] Z. Cheng, J. Ma, **X. Zhang**, F. L. Lewis, and T. H. Lee, "Neural Network iLQR: A New Model-Free Reinforcement Learning Architecture," *submitted to IEEE Transactions on Neural Networks and Learning Systems.*

[5] J. Ma, Z. Cheng, **X. Zhang**, M. Tomizuka, and T. H. Lee, "Alternating Direction Method of Multipliers for Constrained Iterative LQR in Autonomous Driving," *submitted to IEEE Transactions on Intelligent Transportation Systems.*

[6] J. Ma, Z. Cheng, **X. Zhang**, A. Al. Mamun, C. W. de Silva, and T. H. Lee, "Data-Driven Predictive Control for Multi-Agent Decision Making With Chance Constraints," *submitted to IEEE Transactions on Systems, Man, and Cybernetics: Systems.*

[7] Z. Cheng, J. Ma, **X. Zhang**, C. W. de Silva, and T. H. Lee, "ADMM-Based Parallel Model Predictive Formation Control for Multi-Agent Systems," *submitted to IEEE Transactions on Systems, Man, and Cybernetics: Systems.*

[8] Z. Cheng, J. Ma, **X. Zhang**, X. Li, H. Zhu, C. W. de Silva, and T. H. Lee, "Augmented Lagrangian Method for Open-Loop Shaping with Restrictive Frequency Bands," *submitted to Journal of the Franklin Institute.*

[9] J. Ma, Z. Cheng, **X. Zhang**, M. Tomizuka, and T. H. Lee, "On Symmetric Gauss-Seidel ADMM Algorithm for H_∞ Guaranteed Cost Control with Convex Parameterization," *submitted to IEEE Transactions on Systems, Man, and Cybernetics: Systems.*

[10] **X. Zhang**, J. Ma, Z. Cheng, S. Huang, S. S. Ge, and T. H. Lee, "Trajectory Generation by Chance Constrained Nonlinear MPC with Probabilistic Prediction," *IEEE Transactions on Cybernetics,* 2020.

[11] J. Ma, Z. Cheng, **X. Zhang**, M. Tomizuka, and T. H. Lee, "Optimal Decentralized Control for Uncertain Systems by Symmetric Gauss-Seidel Semi-Proximal ALM," *IEEE Transactions on Automatic Control,* 2020.

[12] S. Li, **X. Zhang**, R. Li, Z. Wang, H. Chen, Z. Xin, "Optimal Periodic Control of Connected Multiple Vehicles with Heterogeneous Dynamics and Guaranteed Bounded Stability," IEEE Intelligent Transportation Systems Magazine, 2017.

- **International Refereed Conference Proceedings**

[13] **X. Zhang**, J. Ma, Z. Cheng, S. Huang, and T. H. Lee, "Receding Horizon Motion Planning for Multi-Agent Systems: A Velocity Obstacle Based Probabilistic Method," *submitted to IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2021.

[14] **X. Zhang**, J. Ma, Z. Cheng, and T. H. Lee, "A Collision-Free Framework for Navigation of Nonholonomic Vehicle Systems," in *Proceedings of the 20th International Conference on Control, Automation and Systems,* 2020, pp. 167-172.

[15] Z. Cheng, J. Ma, **X. Zhang**, and T. H. Lee, "Semi-Proximal ADMM for Model Predictive Control Problem with Application to a UAV System," in *Proceedings of the 20th International Conference on Control, Automation and Systems,* 2020, pp. 82-87. **(Student Best Paper Award)**

[16] **X. Zhang**, J. Ma, S. Huang, Z. Cheng, and T. H. Lee, "Integrated Planning and Control for Collision-Free Trajectory Generation in 3D Environment with Obstacles," in *Proceedings of the 19th International Conference on Control, Automation and Systems,* 2019, pp. 974-979.

[17] **X. Zhang**, S. Huang, W. Liang, and T. H. Lee, "HLT*: Real-time and Any-angle Path Planning in 3D environment." in *45th Annual Conference of the IEEE Industrial Electronics Society,* 2019, pp. 5231-5236.

[18] Z. Cheng, J. Ma, X. Li, **X. Zhang**, and T. H. Lee, "Data-Driven Quadratic Optimization for Tracking Problems with Application to a Tray Indexing System," in *Proceedings of the 19th International Conference on Control, Automation and Systems,* 2019, pp. 235-240.

[19] Q. Lin, X. Liu, **X. Zhang**, Z. Wang, S. Xu, and S. Li, "Fuel Economy Analysis of Periodic Cruise Control Strategies for Power-Split HEVs at Medium and Low Speed," SAE Technical Paper, 2018-01-087, 2018.

- **Book Chapters**

[20] S. Li, K. Deng, **X. Zhang,** Q. Zhang, "Pseudospectral Optimal Control of Constrained Nonlinear Systems." Automotive Air Conditioning", in *Precision Motion Systems: Modeling, Control, and Applications.* Oxford: Butterworth-Heinemann, 2019.

PATENTS

[1] S. Li, B. Cheng, **X. Zhang,** et al. "A Partitioned and real-time control method for multi-agent system with discrete control variables." [P], China, CN107628029A.

[2] S. Li, B. Cheng, **X. Zhang,** et al. "A fuel-saving stable motion control method for networked connected vehicle platoons." [P], China, CN108762095A.

[3] S. Li, B. Cheng, H. Chen, **X. Zhang,** et al. "A trajectory tracking control method for intelligent vehicles under extreme working conditions." [P], China, CN108674414A.

[4] S. Li, Q. Lin, X. Du, **X. Zhang,** et al. "An 'Accelerate-uniform-deceleration' -based Economic Driving Method between Two Intersections." [P], China, CN105882658A.