Mengdi Xu

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Education

Carnegie Mellon University

Ph.D. in SafeAI Lab, GPA: 4.0/4.0   *2019–present*
Advisor: Ding Zhao

Graduate Courses: 10703 Deep RL and Control, 10-725 Convex Optimization, 10-708 Probabilistic Graphical Models, 36700 Probability and Mathematical Statistics, 10715 Advanced Introduction to Machine Learning, 15780 Graduate Artificial Intelligence

Johns Hopkins University

Robotics MSE, Laboratory of Computational Sensing and Robotics   *2017–2019*
Advisor: Gregory Chirikjian

Tsinghua University

Excellent Graduate Award   *2013–2017*
BS, Automotive Engineering, School of Vehicle and Mobility
BS, Management, School of Economics and Management

Research Interests

Applications: Robotics, Human-Robot Interaction
Theories: Reinforcement Learning, Probabilistic Graphical Model, Game Theory, Lie Group Theory

Publication and Preprints

- **Xu, Mengdi**, Wenhao Ding, Jiacheng Zhu, Zuxin Liu, Baiming Chen, and Ding Zhao. "Task-Agnostic Online Reinforcement Learning with an Infinite Mixture of Gaussian Processes." Thirty-fourth Conference on Neural Information Processing Systems (NeurIPS), 2020.

- Ding, Wenhao, **Mengdi Xu**, and Ding Zhao. "CMTS: A Conditional Multiple Trajectory Synthesizer for Generating Safety-Critical Driving Scenarios." In 2020 IEEE International Conference on Robotics and Automation (ICRA), pp. 4314-4321. IEEE, 2020.

- Chen, Baiming, **Mengdi Xu**, Zuxin Liu, Liang Li, and Ding Zhao. "Delay-Aware Multi-Agent Reinforcement Learning." In submission to Elsevier Neurocomputing, 2020.

- Chen, Baiming, **Mengdi Xu**, Liang Li, and Ding Zhao. "Delay-Aware Model-Based Reinforcement Learning for Continuous Control." In submission to Elsevier Neurocomputing, 2020.

- Chen, Baiming, Zuxin Liu, Jiacheng Zhu, **Mengdi Xu**, Wenhao Ding, Liang Li, Ding Zhao. Context-Aware Safe Reinforcement Learning for Non-Stationary Environments. In submission to IEEE Robotics and Automation Letters, 2020.

- **Xu, Mengdi**, Shengnan Lyu, Yingtian Xu, Can Kocabalkanli, Brian K. Chirikjian et al. "Mosquito staging apparatus for producing PfSPZ malaria vaccines." In 2019 IEEE 15th International Conference on Automation Science and Engineering (CASE), pp. 443-449. IEEE, 2019.

- Wu, Hongtao, Jiteng Mu, Ting Da, **Mengdi Xu**, Russell H. Taylor, Iulian Iordachita, and Gregory S. Chirikjian. "Multi-mosquito object detection and 2D pose estimation for automation of PfSPZ malaria vaccine production." In 2019 IEEE 15th International Conference on Automation Science and Engineering (CASE), pp. 411-417. IEEE, 2019.

- **Xu, Mengdi**, and Gregory S. Chirikjian. "Recovering a Rotation Matrix From Three Direction Cosines." ASME 2018 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference. American Society of Mechanical Engineers, 2018.

- Zhao, Jieliang*, **Mengdi Xu***, Youjian Liang, Shaoze Yan, and Wendong Niu. "Influence of hydrodynamic pressure and vein strength on the super-elasticity of honeybee wings." Journal of insect physiology 109 (2018): 100-106. (*equal contribution)

Research Experience

Task-agnostic online reinforcement learning

Research Assistant, Carnegie Mellon University 2020.01–2020.06
Advisor: Ding Zhao
- We proposed a continual online model-based reinforcement learning approach for real-world task-agnostic problems. Our method does not require pre-training by using a mixture of Gaussian Processes and automatically detects task boundaries by sequential variational inference. Our approach can handle streaming data and outperforms alternative meta-learning methods in various non-stationary tasks.

System design to automate the production of Malaria vaccine

Team Leader, Johns Hopkins University. With the collaboration of Sanaria, Inc. 2018.02–2019.05
Advisor: Gregory Chirikjian, Russell Taylor, Iulian Iordachita
- We designed a fully-automated apparatus to dispense mosquitoes into isolate units using vortex and reorient the mosquito proboscis aided by multi-mosquito keypoint detection. We hope our efficient automation system help enhance the mass production of vaccine and thus prevent the propagation of Malaria.

Recovering a rotation matrix from three direction cosines

Independent Research, Johns Hopkins University 2017.10–2018.02
Advisor: Gregory Chirikjian
- We proposed a new parameterization for SO(3) rotation group based on the three direction cosine coordinates. We introduced bi-invariant and left-invariant distance metrics in configuration space for path planning. We further analyzed the Jacobian matrix and singularities to better understand the manipulability.

An object risk calibration method based on drivers' psychological perception

Independent Research, Tsinghua University 2017.02–2017.07
Advisor: Jianqiang Wang
- We proposed a novel risk level calibration method based on experienced drivers' risk perceptions including bio-signals and active risk reactions. We classified the data using SVM with driver reported discrete risk labels. We showed that the resulting importance enhanced the anthropomorphic characteristic of collision warning algorithms by designing experiments in both a driving simulator and real vehicles.

Design and control of a Snake-on-Wheel robot

Research Scholar Intern, Carnegie Mellon University 2016.07-2016.09
Advisor: Howie Choset
- We built a modular Snake-on-Wheel robot using HEBI's smart actuators aiming to reduce the cost of leaking detection machines. We controlled the robot climbing in a vertical tube with a force and position feedback controller in MATLAB.

Super-elastic phenomenon of honeybee Wings

Team Leader, Tsinghua University 2015.12-2016.08
Advisor: Shaoze Yan, Jieliang Zhao
- We discovered the quick recovery phenomena of honeybee wings when bumping into obstacles like the flowers. We found the relationship between the time and chord-wise bending angles. We built and validated a new structure-based flexible model of wings, predicting a new deployable material for the solar system.

Teaching and Professional Services

Teaching Assistant, Johns Hopkins University

EN.530.646 Robot Devices, Kinematics, Dynamics, and Control (Robotics MSE Core) *Spring 2019*
EN.530.645 Kinematics *Fall 2018*

Assistant to Associate Chief Editor, the Journal of Robotica *2018.09-2019.05*

Honors and Awards

Department Fellowship of Mechanical Engineering, Johns Hopkins University *2017–2018*
Excellent Bachelor Thesis, Tsinghua University *2017*
National Motivational Scholarship, Tsinghua University *2014, 2015, 2016*
Qualcomm Scholarship for excellent student researchers, 0.3%, Tsinghua University *2016*
Cummins Dr. Lin Scholarship for excellent female students, Tsinghua University *2014, 2015*
Sports Excellence Award, Tsinghua University *2015*

Projects

Autonomous Quality Inspection System *2018.04–2018.05*
- We achieved a simulated industrial quality inspection system built on ROS consisting of three stages: human inspection, EduMiP transition, and UR5 classification. [Link]

UR5 Maze Solver *2017.11–2017.12*
- We built a UR5 Maze Solver based on ROS and MATLAB, subtasks of which including calibrating maze board, recognizing maze, path planning using A*, and controlling the UR5 to draw the path. [Link]

Extracurriculars

3rd Summer School on Cognitive Robotics, University of South California *2019.07*
Vice-Chairman of Student Union, Department of Automotive Engineering, Tsinghua University *2016*
Member of Red Cross Society helping organize blood donation, Tsinghua University *2014.09–2015.06*
Volunteer of APEC Summit Meeting, Beijing, China *2014.11*
Tutoring high school students in Tsinghua Summer School *2015.08*
Tutoring freshman in English, Tsinghua University *2014.07*

Skills

Programming Languages: Python, C/C++, MATLAB, Mathmatica
Technologies: Pytorch, Tensorflow, OpenCV, ROS, Arduino, Gazebo, EAG, Gym, Mujoco, SolidWorks, Altium DXP