Siyu(Sylvia) Dai

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Education

M.S., PhD Candidate, Massachusetts Institute of Technology (MIT) *Sep. 2016 - Present*
Major: *Robotics* Minor: *Machine Learning* **Cumulative GPA: 5.0/5.0**
Research Assistant in MIT Computer Science and Artificial Intelligence Laboratory (CSAIL)
Master Thesis: *Probabilistic Motion Planning and Optimization Incorporating Chance Constraints*
Interests: Robot Manipulation Planning, Integrated Task and Motion Planning, Optimization, Controls

B.S. & **BBA, Shanghai Jiao Tong University (SJTU)** *Sep. 2012 - Jun. 2016*
Major: *Naval Architecture and Ocean Engineering* — **Overall Ranking: 1/73**
Overall GPA: 3.89/4.00 (90.6/100) Major GPA: 3.92/4.00 (91.1/100)
Bachelor Thesis: *Numerical Reconstruction and Mechanism Analysis on Vortex-Induced-Vibration of Steel Catenary Riser Caused by Platform Movement* (Awarded 2016 Excellent Bachelor Thesis (**Top 1%**) of SJTU)
Second Major: *Business Administration* GPA: 3.74/4.00 (88.4/100)
Bachelor Thesis: *Study of Strategy for Precision Marketing based on the WeChat Platform*

Experience

Research Scientist Intern, General AI Lab, Horizon Robotics *May - Aug. 2019*
- Applied mutual information maximization approaches to encourage robotic manipulators learn skills through intrinsic motivation in reinforcement learning.

Selected Publications

Siyu Dai, Andreas Hofmann, and Brian Williams. "Fast-Reactive Probabilistic Motion Planning for High-Dimensional Robots," *The International Journal of Robotics Research (IJRR)*. Under Review.

Siyu Dai, Shawn Schaffert, Ashkan Jasour, Andreas Hofmann, and Brian Williams. "Chance Constrained Motion Planning for High-Dimensional Robots," *2019 International Conference on Robotics and Automation (IRCA)*.

Matthew Orton, **Siyu Dai**, Shawn Schaffert, Andreas Hofmann, and Brian Williams. "Improving Incremental Planning Performance through Overlapping Replanning and Execution, *2019 International Conference on Robotics and Automation (ICRA)*.

Siyu Dai, Matthew Orton, Shawn Schaffert, Andreas Hofmann, and Brian Williams. "Improving Trajectory Optimization using a Roadmap Framework," *Proceedings of 2018 International Conference on Intelligent Robots and Systems (IROS)*.

Siyu Dai, Yadong Zeng, Feier Chen, 2016. "The Scaling Behavior of Bulk Freight Rate Volatility," *International Journal of Transport Economics*. XLIII(1-2): 85-104

Siyu Dai, Yadong Zeng, Feier Chen, Xin Zhang, Jihong Chen, Cungen Liu. "Long Memory Analysis of Bulk Freight Rate under Structural Breaks," *Proceedings of International Forum on Shipping, Ports and Airports*, 2015: 204-212.

Siyu Dai, Yadong Zeng, Feier Chen, Jihong Chen, Han Xu, Cungen Liu. "The Effect of Noise Reduction on Long Memory Test of Bulk Freight Rate Index," *Proceedings of International Forum on Shipping, Ports and Airports*, 2015: 213-219.

Siyu Dai, Yadong Zeng, Feier Chen. "Scaling Behavior of Bulk Freight Rate Volatility before and after Noise Reduction," *Journal of Shanghai Jiao Tong University (Science)*, 2016, 21(6): 655-661

Xiaoxu Ding, **Siyu Dai**, Feier Chen, Yuqi Miao, Kang Tian, Yadong Zeng, Han Xu, Cao Qin. "Long Memory and Scaling Behavior Study of Bulk Freight Rate Volatility with Structural Breaks," *Transportation Letters*, 2017. (published online: http://www.tandfonline.com/doi/full/10.1080/19427867.2016.1270718)

Leijian Song, Shixiao Fu, **Siyu Dai**, Mengmeng Zhang, Yifan Chen. "Distribution of Drag Force Coefficient along a Flexible Riser undergoing VIV in Sheared Flow," *Ocean Engineering*, 2016, 126: 1-11.

Scholarships and Main Awards

CC Tung Fellowship of MIT Mechanical Engineering Department	*Sep. 2016*
National Scholarship of China (**1st** out of 73, for academic and extracurricular excellence)	*Nov. 2015*
Changshi Scholarship (**Top 2** out of 73, for academic and extracurricular excellence)	*Nov. 2014*
City Scholarship of Shanghai (**Top 4** out of 245, for academic and extracurricular excellence)	*Nov. 2013*
Outstanding Graduates of Shanghai City	*May 2016*
Second Prize, National Physics Contest for College Students (Chinese Physics Society)	*Dec. 2014*

Selected Research Projects

Improving Chance-Constrained Motion Planning using Machine Learning Methods
Advisor: Brian C. Williams, *Model-based Embedded and Robotic Systems Group*, MIT *Feb. 2019 - Present*

- Goal: To develop an offline learning scheme that can provide faster online reaction time and more accurate collision risk estimation for chance-constrained manipulator motion planning
- Use kernel-based regression and random forest methods to improve the accuracy and efficiency of collision risk estimation given a probability distribution of robot states
- Apply active learning approach to improve data collecting efficiency and sample representativeness during the offline learning phase

Fast-reactive Risk-aware Robotic Motion Planning and Execution System Design
Advisor: Brian C. Williams, *Model-based Embedded and Robotic Systems Group*, MIT *Oct. 2017 - Jan. 2019*

- Goal: To develop a risk-aware robotic motion planning system that accounts for system process noises and observation noises, and can quickly provide safe plans for robots with complicated dynamics but work under uncertainty, for instance underwater vehicles and human support robots
- Improved and tested an implementation of LQR-RRT* algorithm, and explored approaches of building probabilistic roadmaps accounting for complicated system dynamics
- Implemented the Linear Quadratic Gaussian Motion Planning (LQG-MP) algorithm on the 7-DOF Baxter arm
- Developed a quadrature-based collision risk estimation approach and a risk reallocation method to facilitate chance constraints satisfaction for high-dimensional robotic planning tasks
- Conducted 1000 simulation tests and showed significant collision reduction compared to deterministic solutions
- Designed a risk-aware planning and execution system that can iteratively improve plans during execution time by incorporating the Iterative Risk Allocation (IRA) algorithm

Trajectory Optimization in Robot Manipulation Motion Planning
Advisor: Brian C. Williams, *Model-based Embedded and Robotic Systems Group*, MIT *Sep. 2016 - Sep. 2017*

- Goal: To analyze the strengths and weaknesses of the TrajOpt algorithm in robot motion planning, and to improve its performance by providing initial trajectories through sparse roadmaps
- Created 4 representative environments and randomly sampled 5000 pairs of kinematically feasible and collision-free start and target poses for each test environment
- Evaluated the performance of 4 sampling-based planners and the TrajOpt planner in those test cases; showed that sampling-based planners are not fast-reactive and TrajOpt alone has low success rate
- Compared and analylzed TrajOpt's performance under different costs and constraints
- Combined TrajOpt with a sparse multi-query roadmap approach, and the performance of this combined planner shows superiority over current planner in terms of speed and success rate

Selected Extracurricular Activities

Co-Chair, *Graduate Student Council Academic, Research and Career Committee*, MIT *May. 2019 - Present*

- Initiated a subcommittee that works with MIT senior administration to improve advisor-advisee relationship.
- Host academic related events, including panels and workshops on academia and industry job hunting.

President & **Officer**, *Graduate Association of Mechanical Engineers (GAME)*, MIT *Feb. 2017 - Feb. 2019*

- Arrange GAME meetings with department faculty and express students' concerns
- Host the sixth GAME annual gala, including venue reservation, funding application, publicity, etc.

Chair of Executive Committee, Former Floor Officer, *Ashdown House*, MIT *Jun. 2017 - May 2019*

- Lead housing-related initiatives in MIT, including changes to housing allocation policies and resident food source problem after the closure of the nearby supermarket
- Initiated a volunteer appreciation system to improve the community engagement in Ashdown
- Won Ashdown House Outstanding Officer Award of the year 2017

Representative of Graduates, *2016 Bachelor Degree Conferring Ceremony*, SJTU *Jun. 2016*

- Delivered a speech on behalf of 2016 graduates to express gratitude for SJTU and confidence for our new future

Representative, *SJTU Student Congress* *May 2013 - Jun. 2016*

- Collected students' opinion on academic system and campus life, and presented on the Student Congress

Skills and Interests

***Computer Skills*:** Python, Matlab, TensorFlow, OpenRAVE, ROS, AutoCad, Abaqus, Vba, Sql

***Interests*:** Piano player (16 years), swimmer (16 years, front crawl and breaststroke), amateur yoga instructor (5 years), Chinese Kung fu (Northern style), dancer (5 performances for Dance Club with average audience of 1000+)