Yulun Tian

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Research Interests

I am an Assistant Professor of Robotics at the University of Michigan. I am passionate about developing **scalable and trustworthy multi-agent systems** that operate robustly over long periods of time without human intervention. My current research applies tools from nonlinear and distributed optimization, graph theory, and machine learning to develop principled **algorithms with theoretical guarantees** and **real-world systems** for multi-agent state estimation, perception, and navigation.

Education

2019 – 2023 **Ph.D. Aeronautics and Astronautics**, *Massachusetts Institute of Technology*.
- Thesis: *Algorithms and Systems for Scalable Multi-Agent Geometric Estimation.*
- Minor concentration: Optimization Methods.
- Cumulative GPA: 5.0/5.0.

2017 – 2019 **S.M. Aeronautics and Astronautics**, *Massachusetts Institute of Technology*.
- Cumulative GPA: 5.0/5.0.

2013 – 2017 **B.A. Computer Science**, *University of California, Berkeley*.
- Cumulative GPA: 3.94/4.0 (*High Distinction*).

Selected Awards and Recognitions

2024 **Best Dissertation Award**, *IEEE RAS TC for Multi-Robot Systems*

2023 **Outstanding Reviewer**, *IEEE Robotics and Automation Letter (RA-L)*

2022 **Best Paper Award**, *IEEE Transactions on Robotics (T-RO)*

2021 **Honorable Mention for Best Paper**, *IEEE Transactions on Robotics (T-RO)*

2020 **Honorable Mention for Best Paper**, *IEEE Robotics and Automation Letter (RA-L)*

2019 **AUVSI XCELLENCE Humanitarian Award**, *Association for Uncrewed Vehicle Systems International (AUVSI)*

Experience

2025– **Assistant Professor**, *University of Michigan*.

2024–2025 **Postdoctoral Scholar**, *University of California, San Diego*.

2023–2024 **Postdoctoral Scholar**, *Massachusetts Institute of Technology*.

2017–2023 **Graduate Research Assistant**, *Massachusetts Institute of Technology*.

2020 **Research Intern**, *Meta Reality Labs*.

Teaching

Fall 2025 **ROB 320: Robot Operating Systems**, *University of Michigan*.
General computational paradigm for robot operating systems that model, simulate, and control mobile manipulation robots. Composition of full-stack software systems for forward and inverse kinematics, planar path planning, high-dimensional motion planning, maximal coordinate robot simulation, and front-end visualization that work through interprocess communication.

Fall 2023 **16.485: Visual Navigation for Autonomous Vehicles**, *MIT*.
As a guest lecturer and teaching assistant, I taught a cohort of about 50 graduate and undergraduate students on the mathematical foundations, state-of-the-art algorithms, and software packages for visual navigation. My duties included giving selected lectures on nonlinear optimization for state estimation, leading labs and recitations, and holding office hours. **Overall rating as instructor: 6.8/7.0**.

Fall 2023 **Kaufman Teaching Certification**, *MIT*.
As a participant of MIT's Kaufman Teaching Certificate Program (KTCP), I received systematic training on effective evidence-based teaching. Through a series of interactive workshops, I practiced skills that include course development, lesson planning, designing learning and assessment activities, and creating an effective and welcoming classroom climate.

Spring 2017 **EE 122: Communication Networks**, *UC Berkeley*.
As an undergraduate teaching assistant, I helped teach the undergraduate-level course on communication networks with about 30 students. My main duties included holding regular office hours and helping with the design and grading of exams.

Selected Talks

Mar 2025 **"Signed Distance Function and 3D Dense SLAM"**, *Guest lecture at UCSD ECE 276A: Sensing and Estimation in Robotics.*

Nov 2024 **"Toward Resilient and Scalable Distributed Perception: Algorithms and Systems"**, *Guest lecture at MIT 16.485: Visual Navigation for Autonomous Vehicles.*

Feb 2024 **"Toward Resilient and Scalable Distributed Perception: Algorithms and Systems"**, *Invited talk at Robotics Institute, University of Technology Sydney*.

July 2023 **"Rotation Averaging via Fast Laplacian Solvers"**, *Spectral Graph Theoretic Methods (SGTM) Workshop, RSS 2023, Video*.

July 2022 **"Kimera-Multi: Robust, Distributed, Dense Metric-Semantic SLAM for Multi-Robot Systems"**, *UC Berkeley Semiautonomous Seminar*.

Publications

Journal Articles

[1] Yulun Tian and Jonathan P. How. "Spectral Sparsification for Communication-Efficient Collaborative Rotation and Translation Estimation". In: *IEEE Transactions on Robotics (T-RO)* (2023).

[2] Yulun Tian, Yun Chang, Fernando Herrera Arias, Carlos Nieto-Granda, Jonathan P How, and Luca Carlone. "Kimera-Multi: Robust, Distributed, Dense Metric-Semantic SLAM for Multi-Robot Systems". In: *IEEE Transactions on Robotics (T-RO)* (2022). **King-Sun Fu Memorial Best Paper Award.**

[3] Yulun Tian, Kasra Khosoussi, David M Rosen, and Jonathan P How. "Distributed Certifiably Correct Pose-Graph Optimization". In: *IEEE Transactions on Robotics (T-RO)* (2021). **Honorable Mention for King-Sun Fu Memorial Best Paper Award.**

[4] Yulun Tian, Kasra Khosoussi, and Jonathan P How. "A Resource-Aware Approach to Collaborative Loop-Closure Detection with Provable Performance Guarantees". In: *International Journal of Robotics Research (IJRR)* (2021). **Invited Paper.**

[5] Yulun Tian, Alec Koppel, Amrit Singh Bedi, and Jonathan P How. "Asynchronous and Parallel Distributed Pose Graph Optimization". In: *IEEE Robotics and Automation Letters (RA-L)* (2020). **Honorable Mention for Best Paper Award.**

[6] Yulun Tian, Katherine Liu, Kyel Ok, Loc Tran, Danette Allen, Nicholas Roy, and Jonathan P. How. "Search and Rescue under the Forest Canopy using Multiple UAVs". In: *International Journal of Robotics Research (IJRR)* (2020). **Invited Paper.**

[7] Kaveh Fathian, Kasra Khosoussi, Yulun Tian, Parker Lusk, and Jonathan P How. "CLEAR: A Consistent Lifting, Embedding, and Alignment Rectification Algorithm for Multiview Data Association". In: *IEEE Transactions on Robotics (T-RO)* (2020).

Conference Proceedings

[8] Yulun Tian, Hanwen Cao, Sunghwan Kim, and Nikolay Atanasov. "MISO: Multiresolution Submap Optimization for Efficient Globally Consistent Neural Implicit Reconstruction". In: *Robotics: Science and Systems (RSS)*. 2025.

[9] Mason B Peterson, Yixuan Jia, Yulun Tian, Annika Thomas, and Jonathan P How. "ROMAN: Open-set object map alignment for robust view-invariant global localization". In: *Robotics: Science and Systems (RSS)*. 2025.

[10] Yulun Tian, Yun Chang, Long Quang, Arthur Schang, Carlos Nieto-Granda, Jonathan P How, and Luca Carlone. "Resilient and Distributed Multi-Robot Visual SLAM: Datasets, Experiments, and Lessons Learned". In: *IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*. **Honorable Mention for MIT Open Data Prize.** 2023.

[11] Yulun Tian, Amrit Singh Bedi, Alec Koppel, Miguel Calvo-Fullana, David M Rosen, and Jonathan P How. "Distributed Riemannian Optimization with Lazy Communication for Collaborative Geometric Estimation". In: *IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*. 2022.

[12] Yun Chang, Yulun Tian, Jonathan P. How, and Luca Carlone. "Kimera-Multi: a System for Distributed Multi-Robot Metric-Semantic Simultaneous Localization and Mapping". In: *IEEE Intl. Conf. on Robotics and Automation (ICRA)*. 2021.

[13] Yulun Tian, Katherine Liu, Kyel Ok, Loc Tran, Danette Allen, Nicholas Roy, and Jonathan P. How. "Search and Rescue Under the Forest Canopy Using Multiple UAS". In: *Intl. Sym. on Experimental Robotics (ISER)*. 2018.

[14] Yulun Tian, Kasra Khosoussi, and Jonathan P How. "Resource-Aware Algorithms for Distributed Loop Closure Detection with Provable Performance Guarantees". In: *Intl. Workshop on the Algorithmic Foundations of Robotics (WAFR)*. 2018.

[15] Yulun Tian, Kasra Khosoussi, Matthew Giamou, Jonathan P How, and Jonathan Kelly. "Near-Optimal Budgeted Data Exchange for Distributed Loop Closure Detection". In: *Robotics: Science and Systems (RSS)*. 2018.

[16] Ming Jin, Shichao Liu, Yulun Tian, Mingjian Lu, Stefano Schiavon, and Costas Spanos. "Indoor Environmental Quality Monitoring by Autonomous Mobile Sensing". In: *4th ACM International Conference on Systems for Energy-Efficient Built Environments*. 2017.

Preprints and Workshop Papers

[17] Zhirui Dai, Hojoon Shin, Yulun Tian, Ki Myung Brian Lee, and Nikolay Atanasov. *Learning Scene-Level Signed Directional Distance Function with Ellipsoidal Priors and Neural Residuals*. **Best Paper at RSS 2025 Workshop on Leveraging Implicit Methods for Aerial Autonomy.** 2025.

[18] Sunghwan Kim, Woojeh Chung, Yulun Tian, Zhirui Dai, Arth Shukla, Hao Su, and Nikolay Atanasov. "Seeing the Bigger Picture: 3D Latent Mapping for Mobile Manipulation Policy Learning". In: *RSS 2025 Workshop on Mobile Manipulation: Emerging Opportunities and Contemporary Challenges*. 2025.

[19] Alan Papalia, Yulun Tian, David M Rosen, Jonathan P How, and John J Leonard. *An Overview of the Burer-Monteiro Method for Certifiable Robot Perception*. 2024.

[20] Mason B Peterson, Yi Xuan Jia, Yulun Tian, and Jonathan P How. "Outdoor Global Localization via Robust Registration of 3D Open-Set Segments". In: *RSS 2024 Workshop on Navigation and Mobile Manipulation in Challenging and Cluttered Natural Environments*. 2024.

[21] Yulun Tian, Kasra Khosoussi, and Jonathan P. How. *Block-Coordinate Minimization for Large SDPs with Block-Diagonal Constraints*. 2019.

Theses

[22] Yulun Tian. "Algorithms and Systems for Scalable Multi-Agent Geometric Estimation". PhD thesis. Massachusetts Institute of Technology, 2023.

[23] Yulun Tian. "Reliable and resource-aware collaborative slam for multi-robot search and rescue". S.M. thesis. Massachusetts Institute of Technology, 2019.

Professional Activities

Associate Editor
IJRR: International Journal of Robotics Research (2024-2025)
IROS: IEEE/RSJ International Conf. on Intelligent Robots and Systems (2025)

Journal Reviewer
T-RO: IEEE Transactions on Robotics (2020–2025)
IJRR: International Journal of Robotics Research (2024)
RA-L: IEEE Robotics and Automation Letters (2018–2025)
Field Robotics (2021–2022)
AIJ: Artificial Intelligence Journal (2022)
AURO: Autonomous Robots (2022)

Conference Reviewer
ICRA: IEEE International Conf. on Robotics and Automation (2020–2024)
IROS: IEEE/RSJ International Conf. on Intelligent Robots and Systems (2020–2024)
RSS: Robotics: Science and Systems (2024-2025)
ACC: American Control Conference (2024)
ISER: International Symposium on Experimental Robotics (2025)

Membership
IEEE: Institute of Electrical and Electronics Engineers

Software

Kimera-Multi
A complete system for *distributed* and *robust* multi-robot metric-semantic SLAM, featuring distributed loop closure, pose graph optimization, and onboard metric-semantic mapping. Implemented in C++ and ROS (code).

dpgo
A suite of distributed pose graph optimization (PGO) algorithms based on Riemannian optimization. Additional features include asynchronous communication and outlier-robust optimization. Implemented in C++ with ROS wrapper (code).

References available upon request.