Parker C. Lusk

robotic perception, estimation, and controls

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Education

2023	**Ph.D. Aeronautical & Astronautical Engineering**, *MIT*, Cambridge, MA
	Thesis: Algorithms and Representations for Data Association in Geometric Robotic Perception
	Advisor: Jonathan P. How
2018	**M.S. Electrical & Computer Engineering**, *Brigham Young University*, Provo, UT
	Thesis: Vision-Based Emergency Landing of Small Unmanned Aircraft Systems
	Advisor: Randal W. Beard
2016	**B.S. Electrical Engineering**, *Brigham Young University*, Provo, UT

Research Experience

Massachusetts Institute of Technology, Cambridge, MA

2018–2023 **Doctoral Candidate**, *Aerospace Controls Laboratory*
Research in robust geometric perception and data association techniques for robotics. Developing algorithms (C++/Python) with applications to extrinsic sensor calibration, localization, mapping, loop closure and place recognition, and multiple object tracking. Algorithms demonstrated on heterogeneous teams of robots (multirotor and ground robot). Significant flight control development for multirotor and ground robot teams via on-board control and estimation. Open source contributor.

Brigham Young University, Provo, UT

2016–2018 **Graduate Research Assistant**, *Multiple Agent Intelligent Coordination and Control Laboratory*
Developed vision-based multiple object tracking algorithms (C++/Python) to detect moving objects in potential landing sites for emergency-landing of multirotors. Provided extensive hardware demonstrations and field tests of the complete system. Contributed to design and implementation of in-house research autopilot.

Work Experience

LGS Innovations, Westminster, CO

2015 **Embedded Engineering Intern**, *Embedded Software Group*
Designed PCBs and configured device drivers, kernel modules to enable ethernet connectivity on Intel Edison embedded Linux device. Created NodeJS web applications to control input/output of embedded hardware.

Verisage, Provo, UT

2013–2015 **Software Developer**, *Verisage*
Worked directly with clients to develop web applications using Python, JavaScript, HTML/CSS, and SQL.

2014–2015 **Course Instructor**, *Coding Campus*
Created and taught curriculum for introductory and intermediary programming classes, mentored students.

Teaching Experience

Spring 2021 **Teaching Assistant**, *16.32 Optimal Control and Estimation*, Massachusetts Institute of Technology
Taught by Prof. Jonathan How. Created new problem sets and transitioned course from MATLAB to a Python implementation focus. Designed estimation labs based on custom microcontroller and IMU hardware.

Spring 2017 **Teaching Assistant**, *Senior Capstone: Robot Soccer*, Brigham Young University
Taught by Prof. Randal Beard. Mentored students on the design and implementation of planning, control, and estimation algorithms for custom-built, soccer-playing robots. Gave tutorials on OpenCV and ROS.

Publications

Journal articles

[1] K. Kondo, R. Figueroa, J. Rached, J. Tordesillas, P. C. Lusk, and J. P. How, "Robust MADER: Decentralized Multiagent Trajectory Planner Robust to Communication Delay in Dynamic Environments," *IEEE Robots and Automation Letters (submitted)*, 2023.

[2] P. C. Lusk, K. Fathian, and J. P. How, "MIXER: Multiattribute, Multiway Fusion of Uncertain Pairwise Affinities," *IEEE Robotics and Automation Letters*, pp. 1–8, 2023.

[3] P. C. Lusk, D. Parikh, and J. P. How, "GraffMatch: Global Matching of 3D Lines and Planes for Wide Baseline LiDAR Registration," *IEEE Robotics and Automation Letters*, vol. 8, no. 2, pp. 632–639, 2022.

[4] P. C. Lusk, X. Cai, S. Wadhwania, A. Paris, K. Fathian, and J. P. How, "A distributed pipeline for scalable, deconflicted formation flying," *IEEE Robotics and Automation Letters*, vol. 5, no. 4, pp. 5213–5220, 2020.

[5] K. Fathian, K. Khosoussi, Y. Tian, P. Lusk, and J. P. How, "Clear: A consistent lifting, embedding, and alignment rectification algorithm for multiview data association," *IEEE Transactions on Robotics*, vol. 36, no. 6, pp. 1686–1703, 2020.

[6] P. C. Lusk, P. C. Glaab, L. J. Glaab, and R. W. Beard, "Safe2Ditch: Emergency landing for small unmanned aircraft systems," *Journal of Aerospace Information Systems*, vol. 16, no. 8, pp. 327–339, 2019.

Peer-reviewed conference proceedings

[7] J. Ankenbauer, P. C. Lusk, and J. P. How, "Global Relocalization in Unstructured Environments using Semantic Object Maps Built from Various Viewpoints," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (submitted)*, 2023.

[8] M. B. Peterson, P. C. Lusk, and J. P. How, "MOTLEE: Distributed Mobile Multi-Object Tracking with Localization Error Elimination," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) (submitted)*, 2023.

[9] K. Kondo, J. Tordesillas, R. Figueroa, J. Rached, J. Merkel, P. C. Lusk, and J. P. How, "Robust MADER: Decentralized and Asynchronous Multiagent Trajectory Planner Robust to Communication Delay," in *IEEE International Conference on Robotics and Automation (ICRA) (to appear)*, 2023.

[10] P. C. Lusk and J. P. How, "Global Data Association for SLAM with 3D Grassmannian Manifold Objects," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2022.

[11] S. Morozov, P. C. Lusk, B. Lopez, and J. P. How, "Performance Analysis of Adaptive Dynamic Tube MPC," in *AIAA Scitech 2021 Forum*, 2021, p. 0785.

[12] P. C. Lusk, K. Fathian, and J. P. How, "CLIPPER: A Graph-Theoretic Framework for Robust Data Association," in *IEEE International Conference on Robotics and Automation (ICRA)*, 2021.

[13] P. C. Lusk and R. W. Beard, "Visual multiple target tracking from a descending aerial platform," in *2018 Annual American Control Conference (ACC)*, 2018, pp. 5088–5093.

[14] J. H. Lee, J. D. Millard, P. C. Lusk, and R. W. Beard, "Autonomous target following with monocular camera on UAS using recursive-RANSAC tracker," in *2018 International Conference on Unmanned Aircraft Systems (ICUAS)*, 2018, pp. 1070–1074.

Workshop papers

[15] P. C. Lusk, R. Roy, K. Fathian, and J. P. How, "MIXER: A Principled Framework for Multimodal, Multiway Data Association," in *ICRA 2021 Workshop on Robust Perception For Autonomous Field Robots in Challenging Environments*, 2021. [Online]. Available: https://arxiv.org/pdf/2111.14990.pdf

Professional Service

Journal Reviewer

T-RO: IEEE Transactions on Robotics (2022–2023)
RA-L: IEEE Robotics and Automation Letters (2020–2023)
CSM: IEEE Control Systems Magazine (2022)
JGCD: AIAA Journal of Guidance, Control, and Dynamics (2021)
JAIS: AIAA Journal of Aerospace Information Systems (2018–2019, 2021)
JINT: Springer Journal of Intelligent & Robotic Systems (2019–2021)

Conference Reviewer

ICRA: IEEE International Conference on Robotics and Automation (2021–2023)
IROS: IEEE/RSJ International Conference on Intelligent Robots and Systems (2020–2021)
CDC: IEEE Conference on Decision and Control (2021)
ICUAS: IEEE International Conference on Unmanned Aircraft Systems (2019–2021)
MFI: IEEE international Conference on Multisensor Fusion and Integration (2021)

Selected Honors

2022	**AIAA Excellence in Research Mentoring**
2017–2018	**Utah NASA Space Grant**
2014–2016	**BYU Mechatronics Club**, Founder, President
2013–2016	**Heritage Scholarship** (Full scholarship)

Mentoring

2019–2020	**Jacqueline Pedlow** (MIT Undergraduate) Explored human–swarm interfacing, enabling vision-based gesture control of multirotor swarm [4].
2019–2020	**Dominique Maggio** (MIT Undergraduate) Benchmark comparison of visual-inertial odometry and SLAM algorithms in resource-constrained settings.
2019–2020	**Savva Morozov** (MIT Undergraduate) Demonstration of advanced planning and controls algorithm [11] on hardware testbed.
2019	**Yonatan Delelegn** (MIT Undergraduate) Autopilot design for vertical takeoff and landing (VTOL) transitioning vehicle.
2021	**Ronak Roy** (MIT Undergraduate) Experimentation design and implementation of novel robotic data association algorithm [15] applied to LiDAR–camera sensing.
2021	**Bill Kuhl** (MIT Undergraduate) Embedded software development for multirotor motor control feedback (DSHOT).
2021	**Ray Tsou** (MIT Undergraduate) Embedded software development enabling flight control of multirotors with new autopilot hardware.
2021–2022	**Jared Boyer** (MIT Undergraduate) Implementation and testing of path planning and LiDAR-based navigation algorithms for ground robots.
2022–2023	**Kota Kondo** (MIT Master's Student) Communication-robust, decentralized, multi-agent trajectory optimization in dynamic environments [9, 1].
2022–2023	**Jacqueline Ankenbauer** (MIT Master's Student) Global localization and ego-motion tracking of vehicles from cross-view maps [7].
2022–2023	**Mason Peterson** (MIT Master's Student) Distributed multi-object tracking on a team of moving robots [8]; multi-robot data association and estimation.
2023	**Lili Sun** (MIT Undergraduate) Developing flight control strategies for transitioning eVTOL using model predictive control.