

LIAM PAULL

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Citizenship: Canadian
Languages: English (mother tongue) and French (fluent)

Education

2008 - 2013 Ph.D., Electrical and Computer Engineering
University of New Brunswick (UNB)
Advisors: Dr. Mae Seto, Dr. Liuchen Chang, and Dr. Howard Li
Thesis: "Robust Online Adaptive Sensor-Driven Survey Planning for Single and Multiple Autonomous Underwater Vehicles"

2007 - 2008 M.Sc., Electrical and Computer Engineering (Not Completed)
University of New Brunswick (UNB)
Note: Fast-tracked to Ph.D. Results were published in [J10]

2001 - 2004 B.Sc., Computer Engineering
McGill University (Dean's Honour List)

Research Experience

2017 - present Assistant Professor (Université de Montréal) - Département d'Informatique et de Recherche Opérationnelle
2015 - present Chief Operating Officer - Duckietown Engineering Co.
2015 - 2017 Research Scientist (MIT) - Technical Lead CSAIL/Toyota Driverless Car Project
2013 - 2015 Postdoctoral Associate (MIT) - Marine Robotics Group
2010 - 2012 Research Assistant - Defense R&D Canada
2009 Research Assistant - Sustainable Power Research Group, UNB

Teaching Experience

Fall 2017 Lecturer - Autonomous Vehicles (a.k.a. Duckietown) (Université de Montréal)
Spring 2016 Developer and Lecturer - Autonomous Vehicles (a.k.a. Duckietown) (MIT 2.166)
Spring 2014,15 Teaching Assistant - Marine Vehicle Autonomy (MIT 2.680)
Winter 2012 Teaching Assistant - Systems and Control (UNB EE 3312)
Fall 2010 Teaching Assistant - Industrial Control (UNB EE 4323)
Winter 2009 Teaching Assistant - Electrical Machines (UNB EE 3612)
Winter 2008 Teaching Assistant - Safety Critical Systems (UNB CMPE 4433)
Fall 2007 Teaching Assistant - Digital Systems (UNB CMPE 2213)
Winter 2004 Teaching Assistant - Discrete Mathematics (McGill MATH 363)
Fall 2003 Teaching Assistant - Intermediate Calculus (McGill MATH 262)

Advisory and Supervisory Experience

2015 - 2017 Lead of a team of three software/hardware engineers, three postdocs and four graduate students
CSAIL/Toyota autonomous car project [C3][J12].

2015 - 2016 Managing a team of 11 postdocs, five graduate students, and seven undergraduates to develop
Duckietown [C2][C5].

Mentor / Co-advisor for Graduate Students:

2016 - present Teddy Ort - Autonomous vehicle localization based on laser intensity
2017 Veronica Lane - Obstacle Detection and Tracking in an Urban Environment Using 3D LiDAR and a Mobileye 560
2017 Bethany LaPenta - The Ducklingbot - a Self-Driving Robot on a Pi Zero
2014-16 Beipeng Mu - Task-driven Navigation and Mapping with Resource Constraints [J2][C11][C7][C6]

2013-15 Ross Finman - 3D object-based mapping [C14]
 2013-15 Janille Maragh - Cooperative localization of AUVs

Mentor / Advisor Undergraduate Projects:

2016 - present Alexander Amini (MIT) - Distributed end-to-end deep learning for autonomous driving
 2016 - 2017 Tom Yan (MIT) - Road segmentation with deep learning
 2016 Chandon Subedi (MIT) - Autonomous Duckiebot detection
 2014-15 Ernesto Ramirez (MIT) - Multi-robot mapping with turtlebots
 2012 Denise Sweet (UNB) - Fusing RGB and thermal imagery
 2011 Scott Mallais (UNB) - Underwater acoustic communications
 2010 Yao Kok and Shang Yang (UNB) - Hexagon cell decomposition for convex polygons
 2009 Derek McKay (UNB) - Testing of a domestic electric water heater model

Robotics Competition Team Leader:

2013 - 2014 Co-led the MIT RobotX team that won first place at the inaugural RobotX competition in Singapore in Oct. 2014 [C12].
 2011 Student lead of the COBRA Unmanned Systems Canada unmanned ground vehicle competition team (first place).

Selected Awards/Honours

2010 - 2012 NSERC CGS-D award (\$35,000/year grant for 2 years)
 2008 - 2009 Board of governors merit award, UNB (comes with \$3,000 grant)
 2008 - 2009 NSERC PGS-M award (\$17,000/year for 2 years)
 2008 - 2009 Emera Graduate Scholarship (\$6000)

Successful Grant Applications

- “Resource Constrained Cooperative Underwater Localization and Mapping.” Office of Naval Research under Code 32. Co-written with Prof. John J. Leonard.
- “Underwater Mine Counter-Measures and Mapping Surveys with Multiple Autonomous Underwater Vehicles Using MOOS-IvP, MIRO and the Sensor Driven Approach.” Defense R&D Canada Solicitation No. W7707-115128/A. Co-written with Prof. Howard Li.

Selected Publications

For complete list please visit people.csail.mit.edu/lpaull

Journal Articles

- [J1] Liam Paull, Mae Seto, John J. Leonard, Howard Li. “Probabilistic Cooperative Mobile Robot Area Coverage and its Application to Autonomous Seabed Mapping” *International Journal of Robotics Research*. Conditionally Accepted. 2017.
- [J2] Beipeng Mu, Liam Paull, Aliakbar Agha-Mohammadi, John J. Leonard, Jonathan P. How. “Two-Stage Focused Inference for Resource-Constrained Collision-Averse Navigation.” *IEEE Transactions on Robotics*. 33(1). p. 124-140. 2017.
- [J3] Liam Paull, Carl Thibault, Amr Nagaty, Mae Seto, Howard Li. “Sensor-Driven Area Coverage for an Autonomous Fixed-Wing Unmanned Aerial Vehicle.” *IEEE Transactions on Cybernetics*. 44(9). p. 1605-1618. 2014.
- [J4] Liam Paull, Sajad Saeedi, Mae Seto, Howard Li. “AUV Navigation and Localization - A Review.” *IEEE Journal of Oceanic Engineering*. 39(1). p. 131-149. 2014.
- [J5] Sajad Saeedi, Liam Paull, Michael Trentini, and Howard Li. “Group Mapping: A Topological Approach to Map Merging for Multiple Robots.” *IEEE Robotics and Automation Magazine*. 21(2). p. 60-72. 2014.
- [J6] Sajad Saeedi, Liam Paull, Michael Trentini, Mae Seto, and Howard Li. “Map Merging for Multiple Robots using Hough Peak Matching.” *Robotics and Autonomous Systems*. 62(10). p. 1408-1424. 2014.

- [J7] Sajad Saeedi, Liam Paull, Michael Trentini, and Howard Li. “Map Merging for Multiple Robot Simultaneous Localization and Mapping.” *International Journal of Robotics and Automation*. In Press. 2014.
- [J8] Liam Paull, Sajad Saeedi, Mae Seto, Howard Li. “Sensor-Driven Online Coverage Planning for Autonomous Underwater Vehicles.” *IEEE/ASME Transactions on Mechatronics*. 18(6). p. 1827-1838. 2013.
- [J9] Sajad Saeedi, Liam Paull, Mike Trentini, Howard Li. “Neural Network-based Multiple Robot Simultaneous Localization and Mapping”. *IEEE Transactions on Neural Networks*. 22(12), p. 2376-2387. 2012.
- [J10] Liam Paull, Howard Li, Liuchen Chang. “A Novel Domestic Electric Water Heater Model for a Multi-Objective Demand Side Management Program.” *Electric Power Systems Research*. 80(12), p. 1446-1451. 2010.
- [J11] Howard Li, Liam Paull, Yevgen Biletskiy, Simon Yang. “Document Classification Using Information Theory and a fast Back-Propagation Neural Network.” *Intelligent Automation and Soft Computing*. 16(1), p. 25-38. 2010.

Book Chapters

- [B1] Liam Paull, Sajad Saeedi, Howard Li. “Path Planning for Autonomous Underwater Vehicles.” in *Marine Robot Autonomy*. Springer 2012. p. 177-224.
- [B2] M.L. Seto, L. Paull, S. Saeedi. “Introduction to Autonomy for Marine Robots.” in *Marine Robot Autonomy*. Springer 2012. p. 1-46.

Refereed Conference Publications

- [C1] Guy Rosman, Liam Paull, Daniela Rus. “Hybrid Control and Learning with Coresets for Autonomous Vehicles” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. Accepted.
- [C2] Liam Paull, Jacopo Tani, Heejin Ahn, Javier Alonso-Mora, Luca Carlone, Michal Cap, Yu Fan Chen, Changhyun Choi, Jeff Dusek, Daniel Hoehener, Shih-Yuan Liu, Michael Novitzky, Igor Franzoni Okuyama, Jason Papis, Guy Rosman, Valerio Varricchio, Hsueh-Cheng Wang, Dmitry Yershov, Hang Zhao, Michael Benjamin, Christopher Carr, Maria Zuber, Sertac Karaman, Emilio Frazzoli, Domitilla Del Vecchio, Daniela Rus, Jonathan How, John Leonard, Andrea Censi. “Duckietown: an Open, Inexpensive and Flexible Platform for Autonomy Education and Research” *IEEE Conference on Robotics and Automation*. 2017. Accepted.
- [C3] Wilko Schwarting, Javier Alonso-Mora, Liam Paull, Sertac Karaman, Daniela Rus “Parallel Autonomy in Automated Vehicles: Trajectory Generation with Real-time Obstacle Avoidance and Human Input Optimization” *IEEE Conference on Robotics and Automation*. 2017. Accepted.
- [C4] Felix Naser, David Dorhout, Stephen Proulx, Scott Drew Pendleton, Hans Andersen, Wilko Schwarting, Liam Paull, Javier Alonso-Mora, Marcelo H. Ang Jr., Sertac Karaman, Russ Tedrake, John Leonard, Daniela Rus. “A Parallel Autonomy Research Platform” *IEEE Intelligent Vehicles Symposium*. 2017. Accepted.
- [C5] Jacopo Tani, Liam Paull, Andrea Censi, Maria Zuber, Daniela Rus, Jonathan How and John Leonard. “Duckietown: an Innovative Way to Teach Autonomy.” *EduRobotics Conference*. 2016.
- [C6] Beipeng Mu, Matthew Giamou, Liam Paull, Ali-akbar Agha-mohammadi, John J. Leonard, Jonathan P. How. “Information-based Active SLAM via Topological Feature Graphs.” *IEEE Conference on Decision and Control*. 2016.
- [C7] Beipeng Mu, Shih-Yuan Liu, Liam Paull, John Leonard, Jonathan How. “SLAM with Objects using a Nonparametric Pose Graph.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2016.
- [C8] Kevin Ekenhoff, Liam Paull, Guoquan Huang. “Decoupled, Consistent Node Removal and Edge Sparsification for Graph-based SLAM ” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2016.
- [C9] Liam Paull, Guoquan Huang, John Leonard. “A Unified Resource-Constrained Framework for Graph SLAM.” *IEEE International Conference on Robotics and Automation (ICRA)*. 2016.
- [C10] Hsueh-Cheng Wang, Chelsea Finn, Liam Paull, Michael Kaess, Ruth Rosenholtz, Seth Teller, and John Leonard. “Bridging Text Spotting and SLAM with Junction Features.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2015.

- [C11] Beipeng Mu, Ali Agha, Liam Paull, Matt Graham, Jonathan How, John J Leonard. “Two-Stage Focused Inference for Resource-Constrained Collision-Free Navigation.” *Robotics: Science and Systems (RSS)*. 2015.
- [C12] Arthur Anderson, Erin Fischell, Thom Howe, Tom Miller, Arturo Parrales-Salinas, Nick Rypkema, David Barrett, Michael Benjamin, Alex Brennen, Michael DeFillipo, John Leonard, Liam Paull, Henrik Schmidt, Nick Wang, and Alon Yaari. “An Overview of MIT-Olin’s Approach in the AUVSI RobotX Competition.” *Field and Service Robotics (FSR)*. 2015.
- [C13] Liam Paull, Guoquan Huang, Mae Seto, John Leonard. “Communication-Constrained Multi-AUV Cooperative SLAM.” *IEEE International Conference on Robotics and Automation (ICRA)*. 2015.
- [C14] Ross Finman, Liam Paull, John Leonard. “Toward Object-based Place Recognition in Dense RGB-D Maps.” *IEEE International Conference on Robotics and Automation (ICRA) Workshop on Place Recognition in Changing Environments*. 2015.
- [C15] Liam Paull, Mae Seto, John Leonard. “Decentralized Cooperative Trajectory Estimation for Autonomous Underwater Vehicles.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2014.
- [C16] Liam Paull, Mae Seto, Howard Li. “Area Coverage Planning that Accounts for Pose Uncertainty with an AUV Seabed Surveying Application.” *IEEE International Conference on Robotics and Automation (ICRA)*. 2014.
- [C17] Ross Finman, Thomas Whelan, Liam Paull, John Leonard. “Physical Words for Place Recognition in RGB-D Maps.” *International Conference on Robotics and Automation Workshop on Place Recognition in Changing Environments*. 2014.
- [C18] Liam Paull, Sajad Saeedi, Mae Seto, Howard Li. “Sensor Driven Online Coverage Planning for Autonomous Underwater Vehicles.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2012.
- [C19] Liam Paull, Gaetan Severac, Guilherme V. Raffo, Julian M. Angel, Harold Boley, Maki K. Habib, Bao Nguyen, Veera R. S. Kumar, Sajad Saeedi G., Ricardo Sanz, Mae Seto, Aleksandar Stefanovski, Michael Trentini, Howard Li. “Towards An Ontology for Autonomous Robots.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2012.
- [C20] Sajad Saeedi G., Liam Paull, Michael Trentini, Mae Seto, Howard Li. “Map Merging Using Hough Peak Matching.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2012.
- [C21] Sajad Saeedi G., Liam Paull, Michael Trentini, Mae Seto, Howard Li. “Efficient Map Merging Using a Probabilistic Generalized Voronoi Diagram.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2012.
- [C22] Sajad Saeedi G., Liam Paull, Michael Trentini, Howard Li. “Neural Network-based Multiple Robot Simultaneous Localization and Mapping.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2011.
- [C23] Sajad Saeedi G., Liam Paull, Michael Trentini, Howard Li. “Multiple Robot Simultaneous Localization and Mapping.” *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2011.
- [C24] Liam Paull, Sajad Saeedi G., Mae Seto, Howard Li. “A Multi-Agent Framework with MOOS-IvP for Autonomous Underwater Vehicles with Sidescan Sonar Sensors.” *International Conference on Autonomous and Intelligent Systems (ICAIS)*. 2011.
- [C25] Liam Paull, Sajad Saeedi, Howard Li, Vincent Myers. “An Information Gain Based Adaptive Path Planning Method for an Autonomous Underwater Vehicle Using Sidescan Sonar.” *IEEE Conference on Automation Science and Engineering (CASE)*. 2010.
- [C26] Arnaldo Sepulveda, Liam Paull, Walid G. Morsi, Howard Li, Chris P. Diduch, Liuchen Chang. “A Novel Demand Side Management Program Using Water Heaters and Particle Swarm Optimization.” *Electric Power and Energy Conference (EPEC)*. 2010.
- [C27] Liam Paull, Derek MacKay, Howard Li, Liuchen Chang. “A Water Heater Model for Increased Power System Efficiency.” *Canadian Conference on Electrical and Computer Engineering (CCECE)*. 2009.
- [C28] Liam Paull, Howard Li, Liuchen Chang. “The Development of a Fuzzy Neural System for Load Forecasting.” *Canadian Conference on Electrical and Computer Engineering (CCECE)*. 2008.

- [C29] Liam Paull, Carl Thibault, Amr Nagaty, and Howard Li. “MOOS-IvP, a middleware for ... UAVs?” *Unmanned Systems Canada Conference*. November 2012.
- **Best Student Paper Award Finalist**
- [C30] Liam Paull, Sajad Saeedi, Tyler Edwards and Howard Li. “Perception and Navigation of a UGV for Forest Fire Fighting.” *Unmanned Systems Canada Conference*. 2011.
- **Best Student Paper Award Finalist**

Manuscripts Under Review

- [J12] Wilko Schwarting, Javier Alonso-Mora, Liam Paull, Sertac Karaman, Daniela Rus “Parallel Autonomy: Safe Motion Generation with Minimal Intervention for Intelligent Vehicles.” *IEEE Transactions on Intelligent Transportation Systems*. Under Review.
- [C29] Alexander Amini, Liam Paull, Sertac Karaman, Daniela Rus. “Learning Steering Bounds for Parallel Autonomous Systems” *1st Annual Conference on Robot Learning (CoRL 2017)*. Under Review.

Graduate Thesis

- [T1] “Robust Online Adaptive Sensor-Driven Survey Planning for Single and Multiple Autonomous Underwater Vehicles” University of New Brunswick. November 2013.

Academic Services

Conferences / Workshops Organized

- RSS 2016 Workshop organizer: Geometry and Beyond - Representations, Physics, and Scene Understanding for Robotics
- ICRA 2016 Workshop organizer: Marine Robot Navigation and Localization
- Northeastern Robotics Colloquium 2015 co-organizer
- MOOS-DAWG 2015 co-organizer

Conference Program/Editorial Committees

- Associate Editor: IROS 2017
- Associate Editor: Robotics and Automation Letters 2017
- Associate Editor: ICRA 2016
- Program Committee: Robotics: Science and Systems (RSS) 2015-17
- Program Committee: Canadian Conference on Computer and Electrical Engineering (CCECE) 2015

Selected Journals and Conferences Reviewed

- IEEE Transactions on {Robotics, Neural Networks and Learning Systems, Controls Systems Technology, Cybernetics, Aerospace and Electronic Systems}
- International Journal of Robotics Research
- Journal of Field Robotics
- IEEE Control Systems Magazine
- Journal of Guidance, Control, and Dynamics
- IEEE Journal of Oceanic Engineering
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- Robotics: Science and Systems (RSS)

Graduate Thesis Committees

- Beipeng Mu “Task-driven Navigation and Mapping with Resource Constraints” 2016.
- Matthew Graham “Robust Bayesian state estimation and mapping” 2015.
- Theodore Steiner “Utility-based map reduction for ground and flight vehicle navigation” 2015.

Other Committees

- MIT EECS Graduate Admissions Committee 2017

Recent Invited Talks

4/2017	University of Massachusetts Boston MassIntelligence Conference
4/2017	University of Toronto Department of Computer Science
3/2017	Massachusetts Institute of Technology Mechanical Engineering Special Seminar
2/2017	Université de Montréal Département d'Informatique et de Recherche Opérationnelle
2/2017	University of New Hampshire Mechanical Engineering / Ocean Engineering
2/2017	MIT Media Lab MIT Technology Conference Moderator
1/2017	Stanford University Workshop on Human-Centric AI for Intelligent Machines
11/2015	Massachusetts Institute of Technology Campus-wide Robotics Seminar
11/2015	Woods Hole Oceanographic Institute WHOI AOPE Seminar

Affiliations and Certifications

- Diploma in University Teaching from University of New Brunswick
- IEEE member (since 2007)
- Unmanned Systems Canada member (since 2010)
- Association for Unmanned Vehicle Systems International (AUVSI) member (since 2011)