# Michael Fulton, PhD

Robotics software developer with a passion for creating solutions to challenging problems, backed by a decade of research and development experience in perception, autonomy and human-robot interaction. Proficient with a wide variety of languages, libraries, & tools.

## Contact


Currently in Montreal, QC

US Citizen *(Quebec work permit)*

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I entered computer science by developing small applications as a teenager, using textbooks to teach myself Java and HTML. Years later, during my bachelor's degree, I began to explore robotics through undergraduate research opportunities, eventually leading me to graduate school. Over the course of my PhD studies, I published articles in top-tier robotics publications (ICRA, IROS, RSS, THRI, RAL), pioneered methods for HRI in challenging environments, and lead an academic team in the development of a low-cost autonomous marine robot. Since completing my Ph.D, I have been working for the Montreal-based robotics startup Independent Robotics, where I have developed autonomous robotics software and secured $1.15 million CAD in government funding for new projects.

## Skills

**Computer Science** 14 years

*Python* ▪ *C++* ▪ *Javascript* ▪ *bash*
*C* ▪ *Java* ▪ *Ruby* ▪ *Go* ▪ *LaTeX*

**Robotics** 9 years

*ROS 2* ▪ *ROS* ▪ *Gazebo* ▪ *Unity*
*Mobile/Field Robotics*

**Deep Learning / AI** 7 years

*PyTorch* ▪ *Tensorflow* ▪ *TensorRT*
*NVIDIA Jetson deployment*

**Perception** 9 years

*OpenCV* ▪ *SoTA models for object detection/segmentation*

## Education

### Doctor of Philosophy, Computer Science (P.hD.)

**Aug. 2017 - Mar. 2023**
University of Minnesota

**Thesis:** *Robust, Natural, and Multi-Modal Underwater Human-Robot Interaction* **[Read here]**

**Achievements:**

- Received NSF Graduate Research Fellowship (2019-2022).
- Published thirteen articles (3 journals, 10 conference papers).
- Nominated for Best Student Paper on Cognitive Robotics, IROS 2022.

### Master of Science, Computer Science (MS)

**Aug. 2017 - Dec. 2019**
University of Minnesota

### Bachelor of Science, Computer Science (B.S)

**Aug. 2013 - May 2017**
Clarkson University

## Work Experience

### Robotics Software Developer

Independent Robotics

Mar. 2023 - Present
*Montréal, Québec*

In my role at Independent Robotics, I develop novel robotic capabilities, intuitive user interfaces, and deep neural networks for use with the Aqua2 Mk3 AUV, and serve as the project manager for Independent Robotics's OSC projects exploring autonomous robotics for aquaculture.

- Created government funded projects focusing on the development of autonomous capabilities for aquaculture.
- Developed a map-based mission planning interface for the Aqua2 AUV.
- Lead a collaborative redesign process of the control GUI for Aqua2.
- Developed a Dockerized version of our Unity simulator for easier distribution.
- Lead a complete rewrite of Aqua2 user documentation.
- Made major contributions to the modernization of Aqua2 AUV's HRI systems.
- Deployed models such as SegmentAnything Model (SAM) and OWL-ViT on NVIDIA Jetson hardware, designing custom Python and ROS interfaces for each.

**Achievements:**

- Secured CAD $1.15 million funding for project on intelligent aquaculture robotics through Canada's Ocean Supercluster.
- Developed software (map-based planner) critical to the successful completion of a contract with the Royal Canadian Navy.
- Contributed to the production of four Aqua2 Mk3 AUVs.

## Graduate Student Researcher

Aug. 2017 - Mar. 2023

Advisor: Junaed Sattar, University of Minnesota

*Minneapolis, MN*

For six and a half years, I developed cutting-edge human-robot interaction and perception capabilities for underwater robots, built new AUVs, mentored undergraduates, lead teams of graduate students, and published papers at top conferences/journals, earning my PhD in computer science focused on robotics.

- Pioneered the study of multi-modal HRI for AUVs, enabling effective and flexible collaboration between divers and AUVs.
- Developed a system that enables AUVs to autonomously change communication methods based on the context of an interaction.
- Developed a method for autonomous diver approach using only monocular vision and biological priors, with no depth or distance sensors.
- Trained state-of-the-art deep learning methods for underwater diver detection.
- Adapted pedestrian motion prediction methods to predicting diver motion.
- Explored methods for object detection for use in marine trash detection.
- Developed an algorithm for AUV localization using bathymetric maps.
- Created a new method for communicating information from an AUV to a diver using biologically inspire motion, similar to robot "body language".
- Created a new device and method for communicating information and gaze direction from an AUV to a diver using biologically inspired light displays.
- Created a new device and two methods (one verbal, one musical) for communicating information from an AUV to a diver using sound.
- Designed and built a new low-cost, open-source, micro-AUV for general use with a collaborative team of graduate and understand students..
- Designed a buoyancy-controlled AUV for long-term underwater monitoring.
- Created multiple annotated datasets including images of divers and marine trash.
- Coordinated and planned numerous lab experimental trials in pool, lake, and ocean environments.

**Achievements:**

- Published thirteen articles in top-tier venues: ten conference publications and three journal articles.
- Awarded the prestigious National Science Foundation Graduate Research Fellowship in 2018.
- Mentored multiple undergraduate students and lead a team of 5-10 graduate and undergraduate students in the design and development of a new AUV.

## Software Engineering Intern

May 2016 - August 2016

CSpeed, LLC.

*Liverpool, New York*

I interned at CSpeed LLC., a software contracting and radar development company, for one summer. As an intern, I largely helped to cover internal software development tasks that full-time employees were unable to take on, allowing me a high degree of independence.

- Developed a software system for managing terabyte-scale backup data of operating system images.
- Took part in the development of an internal time-logging web application.
- Researched programming interfaces for an RF test device, both their usability and construction.

**Achievements:**

- My contributions of custom backup management software and internal time-logging software are still in use at CSpeed (at time of writing).

# Awards

- NSF Graduate Research Fellowship — September 2019 - August 2022
- UMN Graduate School Excellence Research Grant — September 2019 - August 2022
- Graduate Assistance in Areas of National Need Fellowship — September 2018 - September 2019
- Miller/Davis Service Award for Computer Science, Clarkson University — May 2017

# Publications

### Journal Articles

- **Michael Fulton**, Junaed Sattar and Rafa Absar, *SIREN: Underwater Robot-to-Human Communication Using Audio*, in IEEE Robotics and Automation Letters, vol. 8, no. 10, pp. 6139-6146, Oct. 2023. Presented at ICRA 2024.
- **Michael Fulton**, Chelsey Edge, Junaed Sattar. *Robot Communication Via Motion: A Study on Modalities for Robot-to-Human Communication in the Field*, ACM Transactions on Human-Robot Interaction, 11, 2, Article 15 (June 2022), 40 pages.
- Md Jahidul Islam, **Michael Fulton**, Junaed Sattar. *Towards a Generic Diver-Following Algorithm: Balancing Robustness and Efficiency in Deep Visual Detection.*, Robotics and Automation Letters, in IEEE Robotics and Automation Letters, vol. 4, no. 1, pp. 113-120, Jan. 2019,

### Conference Articles

- **Michael Fulton**. Aditya Prabhu, Junaed Sattar. *HREyes: Design, Development, and Evaluation of a Novel Method for AUVs to Communicate Information and Gaze Direction*, 2023 IEEE International Conference on Robotics and Automation (ICRA), London, United Kingdom, 2023
- Sadman Sakib Enan, **Michael Fulton**, Junaed Sattar. *Robotic Detection of a Human-Comprehensible Gestural Language for Underwater Multi-Human-Robot Collaboration*,IEEE/RSJ International Conference on Robots and Systems (IROS), Kyoto, 2022. Nominated for Best Paper on Cognitive Robotics.
- **Michael Fulton**, Muntaqim Mehtaz, Owen Queeglay, Junaed Sattar. *Underwater Robot-To-Human Communication Via Motion: Implementation and Full-Loop Human Interface Evaluation*. Robotics: Science and Systems (RSS), New York, NY, 2022.
- **Michael Fulton**, Jungseok Hong, Junaed Sattar. *Using Monocular Vision and Human Body Priors for AUVs to Autonomously Approach Divers*. IEEE International Conference on Robotics and Automation (ICRA), Philadelphia, PA, 2022.
- Tanmay Agarwal, **Michael Fulton**, Junaed Sattar. *Predicting the Future Motion of Divers for Enhanced Underwater Human-Robot Collaboration*. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Prague, 2021.
- Karin de Lagnis, **Michael Fulton**, Junaed Sattar. *Towards Robust Visual Diver Detection Onboard Autonomous Underwater Robots: Assessing the Effects of Models and Data*, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Prague, 2021.
- Chelsey Edge, Sadman Sakib Enan, **Michael Fulton**, Jungseok Hong, Jiawei Mo, Kimberly Barthelemy, Hunter Bashaw, Berik Kallevig, Corey Knutson, Kevin Orpen, Junaed Sattar, *Design and Experiments with LoCO AUV: A Low Cost Open-Source Autonomous Underwater Vehicle*, International Conference on Intelligent Robots and Systems (IROS), Las Vegas, NV, 2020. (Authors listed semi-alphabetically)
- Jungseok Hong, **Michael Fulton**, Junaed Sattar. *A Generative Approach Towards Improved Robotic Detection of Marine Litter.* IEEE International Conference on Robotics and Automation (ICRA), Paris, 2020.
- **Michael Fulton**, Chelsey Edge, Junaed Sattar. *Robot Communication Via Motion: Closing the Underwater Human-Robot Interaction Loop.* IEEE International Conference on Robotics and Automation (ICRA), Montreal, 2019.
- **Michael Fulton**, Jungseok Hong, Md Jahidul Islam, Junaed Sattar. *Robotic Detection of Marine Litter Using Deep Visual Detection Models.* IEEE International Conference on Robotics and Automation (ICRA), Montreal, 2019.

## Presentations

- **Michael Fulton**, Muntaqim Mehtaz, Owen Queeglay, Junaed Sattar. *Underwater Robot-To-Human Communication Via Motion: Implementation and Full-Loop Human Interface Evaluation*. Robotics: Science and Systems (RSS), New York, NY, 2022.
- **Michael Fulton**, Jungseok Hong, Junaed Sattar. *Using Monocular Vision and Human Body Priors for AUVs to Autonomously Approach Divers*. IEEE International Conference on Robotics and Automation (ICRA), Philadelphia, PA, 2022.
- **Michael Fulton**, *Predicting the Future Motion of Divers for Enhanced Underwater man-Robot Collaboration*, IEEE/RSJ International Conference on Intelligent Robots and Systems, 2021. (Virtual, due to COVID-19).
- **Michael Fulton**. *LoCO-AUV*, IEEE/RSJ International Conference on Intelligent Robots and Systems, October 2020. (Virtual, due to COVID-19).
- Chelsey Edge, Sadman Sakib Enan, **Michael Fulton**, Jungseok Hong, Junaed Sattar. *Power-On-and-Go Capabilities for a Low-Cost Modular Autonomous Underwater Vehicle*, Robotics: Science and Systems – Power-On-and-Go Workshop, July 2020. (Virtual, due to COVID-19).
- **Michael Fulton**, Chelsey Edge, Junaed Sattar. *Robot Communication Via Motion: Closing the Underwater Human-Robot Interaction Loop.* International Conference on Robotics and Automation, Montreal, May 2019.

- **Michael Fulton**, Jungseok Hong, Md Jahidul Islam, Junaed Sattar. *Robotic Detection of Marine Litter Using Deep Visual Detection Models.* International Conference on Robotics and Automation, Montreal, May 2019.
- **Michael Fulton**. *Robot Communication Via Motion: Closing the Underwater Human-Robot Interaction Loop.* University of Minnesota — Twin Cities, Visual Computing and Artificial Intelligence Seminar, October 2018

# Teaching Experience

## Teaching Assistant

Fall 2020

Introduction To Intelligent Robotic Systems

*University of Minnesota*

- Taught lectures (pre-recorded and live) on core ROS concepts.
- Designed, wrote, and created automated grading for a homework on navigation with ROS.
- Conducted weekly office hours to aide students in understanding course materials.
- Created innovative new course policies, structures, and materials with professor and TA's in order to cope with the online format forced by COVID-19.
- Collaborated with professor and TA's on course material and grading policies.
- Managed LMS software (Canvas) for the entire course.

## Substitute Lecturer

Fall 2017

Introduction to Intelligent Robotic Systems

*University of Minnesota*

- Introduced students to programming for ROS (Robot Operating System).
- Explained core concepts of ROS including nodes, topics, services, messages, and the ROS graph.
- Covered simple ROS command-line tools and ROS build system.

## Substitute Lecturer

Fall 2016

Introduction To Computer Science

*Clarkson University*

- Introduced basic programming concepts such as variables, types, and data representation.
- Reviewed concepts including loops and flow control.
- Provided informal tutoring for a number of students in this course through the semester.

## Workshops and Seminars

Fall 2015-Fall 2016

Clarkson Open Source Institute

*Clarkson University*

- Taught workshops covering topics such as computer vision and Android development basics.
- Taught a series of workshops covering simple robotics concepts and ROS use.
- Gave a number of brief, informative talks on subjects in computer science.

# Service

## Content Creator

Spring 2020-Fall 2020

Minnesota Robotics Institute Outreach (MnRI Gadgets)

*University of Minnesota*

- Created a new outreach program for children stuck at home during COVID-19.
- Designed, built, and programmed multiple Arduino gadgets for children.
- Taught Arduino programming and device design through tutorials on said gadgets.
- Recorded video tutorials available at `https://cse.umn.edu/mnri/mnri-video-hub`.

## Student Officer

Fall 2019-Summer 2020

Computer Science Graduate Student Association

*University of Minnesota*

- Planned and managed social events for the computer science graduate student association.

- Planned and participated in welcome events for new and prospective graduate students.

## Seminar Coordinator

Spring 2019 & 2020

Graduate Research and Discussion Seminar

*University of Minnesota*

- Managed a bi-weekly seminar for graduate students to present their work.
- Coordinated speakers, announced seminars, solicited support from local business, and purchased food for bi-weekly seminars.

## STEM Camp Counselor

Summer 2018

MNDrive Scholars Tech Camps

*University of Minnesota*

- Taught STEM concepts, including circuits, simple Arduino programming, and soldering to children from local middle schools.
- Developed and improved curriculum for future summer tech camps.

## Lab Director and Member

August 2015 - May 2017

Clarkson Open Source Institute

*Clarkson University*

- Director from October 2015 to April 2017, responsible for day-to-day lab operations, meetings, events.
- Mediated discussions and performed conflict resolution when necessary.
- Founded COSI Project For Robotics, Beowulf Cluster interest group.
- Taught basic robotics programming to fifteen students over the years.

## STEM Camp Counselor

Summer 2014 & 2015

IMPETUS Summer Roller Coaster Camp

*Clarkson University*

- Taught STEM concepts, simple mathematics and physics to middle and junior high school children.
- Acted as a general counselor to under-privileged students, teaching encouraging them in the pursuit of higher education and careers in STEM.