

# Florian Shkurti

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## CURRENT POSITIONS

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| <b>Assistant Professor (tenure-track)</b><br>Mathematical & Computational Sciences, University of Toronto Mississauga<br>Department of Computer Science, University of Toronto | Dec 2018-  |
| <b>Scientific Advisory Board</b><br>Propagator Ventures                                                                                                                        | Sept 2018- |
| <b>Faculty Member</b><br>University of Toronto Robotics Institute                                                                                                              | May 2019-  |

## EDUCATION

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| Ph.D. Computer Science & Robotics, McGill University<br>Thesis: <i>Algorithms and Systems for Robot Videography with Human Specifications</i><br>Supervisor: Gregory Dudek, GPA 4.0/4.0<br>Committee: Joelle Pineau, Doina Precup, Michael Langer | 2012-2019 |
| M.Sc. Computer Science & Robotics, McGill University<br>Thesis: <i>3D Simultaneous Localization and Mapping (SLAM) using Visual and Inertial Measurements</i> , GPA 4.0/4.0<br>Supervisors: Gregory Dudek & Ioannis Rekleitis                     | 2009-2011 |
| H. B.Sc. Computer Science & Mathematics, University of Toronto                                                                                                                                                                                    | 2005-2009 |

## AWARDS

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|----------------------------------------------------------------------|------------|
| Alexander Graham Bell CGS Doctoral Award, NSERC, National            | 2014-2016  |
| Graduate Student Excellence Award, McGill, Institutional             | 2013-2016  |
| AAAI Robotics Fellowship, International                              | 2015       |
| FQRNT Doctoral Award, McGill, Provincial                             | 2013-2014  |
| Lorne Trottier Science Accelerator Fellowship, McGill, Institutional | 2014       |
| GREAT Award, McGill, Institutional                                   | 2015, 2017 |
| Walter Sumner Foundation Award, McGill, National                     | 2011-2013  |
| Provost's Graduate Fellowship, McGill, Institutional                 | 2009       |
| Dean's Honor List, UofT, Institutional                               | 2006-2009  |
| Woodsworth College Student Association Award, UofT, Institutional    | 2008       |
| Trenwith Award in Computer Science, UofT, Institutional              | 2007       |
| Coxeter Scholarship in Mathematics, UofT, Institutional              | 2007       |

## RESEARCH STATEMENT

My research is at the intersection of mobile robotics, computer vision, machine learning, planning and control. My goal is to develop learning methods and algorithms that will enable robots to efficiently learn how to perform reliably in outdoor environments and alongside humans. When human supervision and human-robot interaction are necessary, I want to enable people to effectively specify the desired behavior of their robots through as few interactive demonstrations as possible, without requiring them to write code. I am particularly interested in:

- Robust imitation learning from visual data
- Bayesian inverse reinforcement learning of cost functions
- Planning and control under uncertainty in cost functions, models, as well as partial observability
- Learning visual attention operators for robot exploration, navigation, and search
- Shared autonomy and safe control for human-robot collaboration
- Active semi-supervised learning for visual data
- Perception and semantic video understanding
- Field robotics and deployment in outdoor environments, particularly for environmental monitoring

## PUBLICATIONS

### Peer-Reviewed Conference Papers

- ICRA '19 Yasasa Abeyirigoonawardena, Florian Shkurti and Gregory Dudek. "Generating Adversarial Self-Driving Scenarios in High-Fidelity Simulators". *IEEE International Conference on Robotics and Automation*.
- ICRA'18 Florian Shkurti, Nikhil Kakodkar, Gregory Dudek. "Model-Based Probabilistic Pursuit via Inverse Reinforcement Learning". *IEEE International Conference on Robotics and Automation*.
- ICML'17 Peter Henderson, Wei-Di Chang, Florian Shkurti, Johanna Hansen, David Meger, Gregory Dudek. "Benchmark Environments for Multitask Learning in Continuous Domains". *Lifelong Learning Workshop at the International Conference on Machine Learning*.
- IROS '17 Florian Shkurti, Wei-Di Chang, Peter Henderson, Jahidul Islam, Juan Camilo Gamboa Higuera, Jimmy Li, Travis Manderson, Anqi Xu, Gregory Dudek, and Junaed Sattar. "Underwater Multi-Robot Convoying using Visual Tracking by Detection". *IEEE International Conference on Intelligent Robots and Systems*.
- IROS '17 Florian Shkurti and Gregory Dudek. "Topologically distinct trajectory predictions for probabilistic pursuit". *IEEE International Conference on Intelligent Robots and Systems*.
- CRV '16 Travis Manderson, Florian Shkurti, Gregory Dudek. "Texture-Aware SLAM Using Stereo Imagery And Inertial Information". *Conference on Computer and Robot Vision*.
- IROS '14 David Meger, Florian Shkurti, David Cortes, Philippe Giguere, Gregory Dudek. "3D Trajectory Synthesis and Control for a Legged Swimming Robot". *IEEE International Conference on Intelligent Robots and Systems*.

- IROS '14 Qiwen Zhang, David Whitney, Florian Shkurti, Ioannis Rekleitis. "Ear-Based Exploration on Hybrid Metric/Topological Maps". *IEEE International Conference on Intelligent Robots And Systems*.
- CRV '14 Malika Meghjani, Florian Shkurti, Juan Camilo Gamboa Higuera, Arnold Kalmbach, David Whitney, Gregory Dudek. "Asymmetric Rendezvous Search at Sea". *Conference on Computer and Robot Vision*.
- ICRA '14 Florian Shkurti and Gregory Dudek. "Maximizing visibility in collaborative trajectory planning". *IEEE International Conference on Robotics and Automation*.
- ICRA '13 Florian Shkurti and Gregory Dudek. "On the complexity of searching for an evader with a faster pursuer". *IEEE International Conference on Robotics and Automation*.
- IROS '12 Florian Shkurti, Anqi Xu, Malika Meghjani, Juan Gamboa, Yogesh Girdhar, Philippe Giguere, Bikram Dey, Jimmy Li, Arnold Kalmbach, Chris Prahacs, Katrine Turgeon, Ioannis Rekleitis, Gregory Dudek. "Multi-Domain Monitoring of Marine Environments Using a Heterogeneous Robot Team". *IEEE International Conference on Intelligent Robots and Systems*.
- CRV '12 Juan Camilo Gamboa Higuera, Anqi Xu, Florian Shkurti, Gregory Dudek. "Socially-Driven Collective Path Planning for Robot Missions". *Conference on Computer and Robot Vision*.
- IROS '11 Florian Shkurti, Ioannis Rekleitis, Milena Scaccia, Gregory Dudek. "State estimation of an underwater robot using visual and inertial information". *IEEE International Conference on Intelligent Robots and Systems*.
- IROS '11 Yogesh Girdhar, Anqi Xu, Bikram Dey, Malika Meghjani, Florian Shkurti, Ioannis Rekleitis, Gregory Dudek. "MARE: Marine Autonomous Robotic Explorer". *IEEE International Conference on Intelligent Robots and Systems*.
- CRV '11 Florian Shkurti, Ioannis Rekleitis, Gregory Dudek. "Feature Tracker Evaluation For Pose Estimation In Underwater Environments." *Conference on Computer and Robot Vision*.

### **Journal Papers In Preparation**

- 2018 Florian Shkurti and Gregory Dudek. "Imitation Learning for Robotics: a Review".
- 2018 Florian Shkurti and Gregory Dudek. "Active Semi-Supervised Learning of Reward Functions over Visual Content".

### **Conference Papers In Preparation**

- 2018 Florian Shkurti, Travis Manderson, Gregory Dudek. "MORESLAM: Multisensor ORB Enhanced SLAM Using Stereo + IMU".
- 2018 Florian Shkurti and Gregory Dudek. "Sampling topologically distinct paths via Hamiltonian dynamics".

### **PROFESSIONAL EXPERIENCE**

- 2010-18 *Robotics Researcher, Mobile Robotics Lab, McGill University.*  
Designed, implemented, and analyzed algorithms for control and motion planning under uncertainty. Extensive experience with robust estimation algorithms and probabilistic

modeling. Extensive experience with vision-based 3D reconstruction, coupled with inertial measurements. Designed and deployed robotics systems in challenging outdoor environments (underwater, air, deserts). Experience with machine learning techniques for representation learning, reinforcement learning, variational inference, sampling, inverse reinforcement learning etc. Supervised by Prof. Gregory Dudek.

- 2016-17 *Robotics Consultant, Independent Robotics Inc. Montreal, QC.*  
Provided integration and debugging services for software and hardware systems.
- 2015-16 *Co-Inventor of a hardware and software 3D mapping system. Montreal, QC.*  
Integrated machine-vision cameras with an IMU and a mobile GPU. Created a stereo vision and IMU SLAM system. Won \$20,000 in startup funding.
- 2015 *Software Engineering Consultant, Lemay-Yates Associates Inc, Montreal, QC.*  
Supervised by Robert Yates and Johanne Lemay. Provided systems review services for simulators of electromagnetic spectrum auctions.
- 2009 *Undergraduate Software Engineer, University of Toronto, ON.*  
NSERC USRA, advised by Prof. Gregory Wilson. Implemented parts of Basie, a project management portal for classroom use that includes wiki pages, mailing lists, code reviews, and source code browsers.
- 2008 *Software Engineering Intern, Google Inc. Mountain View, CA.*  
Ads Quality Team, supervised by Simon Favreau-Lessard and Michelle Levesque. Developed software infrastructure for statistical experiments.
- 2007 *Undergraduate Software Engineer, University of Toronto, ON.*  
Google Summer of Code award. Advised by Prof. Karen Reid and Jason Montojo (IBM).
- 2006 *Undergraduate Research Assistant. A.U.G. Signals, Toronto, ON.*  
NSERC Industrial USRA, supervised by Dr. George Lampropoulos. Designed signal-processing filters for the classification of spectral signatures of different types of terrains and plants.

## TEACHING EXPERIENCE

### University of Toronto

CSC2621: Imitation Learning for Robotics, graduate course. 30 students. Rated 4.7/5.0 2019  
TA for Capstone course in AI for robot soccer, supervised by Prof. Steve Engels<sup>1</sup> 2009

### McGill

Instructor for undergraduate robotics course, COMP417. 45 students. Rated 4.8/5.0 2017  
TA for undergraduate algorithms course, COMP360, supervised by Prof. Yang Cai 2016  
TA for graduate robotics course, COMP765, supervised by Prof. Gregory Dudek 2012  
TA for graduate computer vision course, COMP558, supervised by Prof. Michael Langer 2011

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<sup>1</sup>While an undergraduate student, I proposed the concept of the creation of this new AI course to the Computer Science department, and recruited students to enroll. The course was so popular that it was offered for two more semesters after I had graduated.

## SUPERVISION

### M.Sc.

Homanga Bharadhwaj, University of Toronto, Computer Science.	Sept 2019-
Kevin (Cheng) Xie, University of Toronto, Computer Science. Co-supervised with Sanja Fidler.	Sept 2019-
Dhruv Sharma, University of Toronto, Computer Science.	Sept 2019-
Ke Dong, University of Toronto, UTIAS. Co-supervised with Angela Schoellig.	2019-

### Visiting Students

Melissa Mozifian, Ph.D. student, MILA/McGill University, Computer Science. <i>Combining imitation and reinforcement learning</i>	Summer 2019
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### Undergraduates

Yuchen Wu, University of Toronto, Engineering Science. UTEA summer research award. <i>Curriculum learning via imitation and reinforcement</i>	2018-
Zihan Wang, University of Toronto, Engineering Science <i>Reading course on imitation learning</i>	2019-
Zidong Weng, University of Toronto, Computer Engineering <i>Deep predictive models for imitation learning</i>	2019-
Julia Chae, University of Toronto, Engineering Science, USROP summer research award. <i>Adversarial attacks on combined vision and LiDAR classifiers</i>	2019-
Siyun Li, University of Toronto, Engineering Science. USRA summer research award. <i>Generating adversarial driving scenarios in differentiable LiDAR simulators.</i>	2019-
Philip (Yizhou) Huang, University of Toronto, Engineering Science <i>TBD</i>	2019-
Shichen Lu, University of Toronto, Engineering Science <i>POMDP planning as variational inference</i>	2019-
Zichu Liu, University of Toronto, Engineering Science <i>Thesis: Query-efficient imitation learning via bootstrapping</i>	2018-2019

Haozhe Sheng, University of Toronto, Engineering Science <i>Thesis: Action-conditional video prediction via vector quantization</i>	2018-2019
Yasasa Abeysirigoonawardena, McGill University, ECE <i>Active learning for generating challenging driving scenarios.</i>	2018-2019
Peter Park, McGill University, CS <i>Multi-agent Bayesian inverse reinforcement learning.</i>	2018
Gabe Cemaj Hochstein, McGill University, CS <i>Imitation learning for Partially Observable Markov Decision Processes (POMDPs).</i>	2017
Daniele Bercovici, McGill University, CS <i>Human-aware autonomous social robot navigation.</i>	2016

## FUNDING

### Approved

NSERC Discovery, \$127,500 CAD <i>New Directions in Robotic Environmental Monitoring via Machine Learning.</i> Primary applicant.	2019-2024
University of Toronto XSeed Award, \$120,000 CAD <i>Active and Sample-Efficient Robot Learning with Human Guidance.</i> Co-applicant with Angela Schoellig and Tovi Grossman.	2019-2021

## INVITED TALKS

<i>Collaborative Human-Robot Environmental Monitoring</i> Symposium Speaker, Conference on Computer and Robot Vision.	2019
<i>Enabling robot videographers to record the visual footage that human experts want.</i> University of Toronto, McGill University.	2018

## CONFERENCE ACTIVITY

### Sessions Organized

<i>Motion Planning for Robotics</i> IEEE International Conference on Robotics and Intelligent Systems. Vancouver, Canada.	2017
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## **Panels**

*Deep Learning for Robotics* 2017  
Panel member with Joelle Pineau, John Tsotsos, Jon Kelly, and Martin Gerdzhev; chaired by Richard Vaughan. NSERC Canadian Field Robotics Network, Annual General Meeting, Ottawa, Canada.

## **SERVICE**

Associate Editor, *IEEE International Conference on Intelligent Robots and Systems, IROS*  
Reviewer, *IEEE International Conference on Robotics and Automation, ICRA*  
Reviewer, *IEEE International Conference on Robotics and Intelligent Systems, IROS*  
Reviewer, *Conference on Robot Learning, CoRL*  
Reviewer, *Robotics: Science and Systems, RSS*  
Reviewer, *International Symposium on Experimental Robotics, ISER*  
Reviewer, *Conference on Computer and Robot Vision, CRV*  
Reviewer, *Robotics and Automation Letters, RA-L*  
Reviewer, *Transactions on Robotics and Automation, TRO*

## **SELECTED MEDIA COVERAGE**

IEEE Spectrum. *Robotic Airplane, Boat, and Submarine Team Up to Monitor Coral Reefs.* 2012

## **OUTREACH**

Taught at McGill's Computer Science Summer Camp for high school students. 2013, 2015  
Helped conduct lab tours for high school students. 2012-2017  
Represented McGill's School of Computer Science at Vanier College for Science Week. 2010  
Ambassador of the Department of Computer Science at the University of Toronto. 2009

## **LANGUAGES**

English, fluent  
Greek, fluent  
Albanian, fluent  
French, basic

Updated June 2019