

# Melissa Greeff

Curriculum Vitae

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Robotics researcher passionate about integrating machine learning and control algorithms with practical robotic applications. Final year PhD student and engineering science graduate with programming experience in several languages. Current projects include the development of vision-based control for GPS-denied flight and integrating machine learning for safe robot decision-making.

## ACHIEVEMENTS

### Woman Grandmaster | Chess

Chess career highlights:

- Women's World Cup 2010, 2012
- Represented South Africa at the Chess Olympiad 2008, 2010, 2012

### W.S. Wilson Medal | Highest Academic Standing Award

06 2016

"awarded to the student in each engineering discipline who has achieved the highest academic standing in the final year of their program"

## EDUCATION

### PhD Candidate | Dynamic Systems Lab

09 2016-Present

Fast Vision-Based Flight in Real-World Environments

- Fields: Aerial & Mobile Robotics, Control Systems, Machine Learning

### Bachelor of Applied Science | Engineering Science

09 2012-04 2016

High Honors & Dean's List:

- Major: Aerospace Engineering
- Minors: Business & Robotics and Mechatronics

## TEACHING EXPERIENCE

### University Course Instructor | Linear Algebra

2019, 2020, 2021

Lecturer for first year Linear Algebra (MAT188) at the University of Toronto. This course teaches fundamentals such as solving a linear systems of equations, linear independence, eigenvalues and eigenvectors, invertibility, e.t.c. My objectives have been 1) to highlight the connections between different topics in linear algebra and 2) to demonstrate relevant engineering applications.

### Lecturer | Autonomy of UAVs

2021

Lecture on multirotor dynamics and control for a graduate robotic course, AER 1217 Autonomy of UAVs, at the University of Toronto.

### Teaching Assistant | Robotics Modelling and Control

2019

Taught weekly robotic labs on mobile manipulation for ECE470 at the University of Toronto

### Teaching Assistant | Learning for Robotics

2019

Graded various assignments and tests for ROB313 at University of Toronto

### Teaching Assistant | Engineering Mathematics

2017,2018,2020

Taught weekly tutorials and MATLAB labs for ESC103 at the University of Toronto

### Teaching Assistant | Vector Calculus and Fluid Mechanics

2016, 2017, 2018

Taught weekly tutorials on multivariable calculus and fluid mechanics for AER210 at the University of Toronto

### Teaching Assistant | Engineering Ethics

2016

Taught weekly tutorials on critical reading and engineering ethics for ESC203 at the University of Toronto

### Chess Instructor | Chess Institute of Canada

06 2012-06 2016

Taught chess at junior schools in Toronto with the aim to develop essential life skills, such as sportsmanship and confidence, in children.

## PUBLICATIONS

- Fly Out The Window: Exploiting Discrete-Time Flatness for Fast Vision-Based Multirotor Flight** |  
Submitted IEEE Robotics and Automation Letters 2021  
M. Greeff, S. Zhou and A. P. Schoellig
- Safe Learning in Robotics: From Learning-Based Control to Safe Reinforcement Learning** |  
Annual Review of Control, Robotics, and Autonomous Systems 2021  
L. Brunke, M. Greeff, A. W. Hall, Z. Yuan, S. Zhou, J. Panerati and A. P. Schoellig
- Learning a Stability Filter for Uncertain Differentially Flat Systems using Gaussian Processes** |  
Conference on Decision and Control (CDC) 2021  
M. Greeff, A. W. Hall and A. P. Schoellig
- Exploiting differential flatness for robust learning-based tracking control using Gaussian Processes**  
| IEEE Control Systems Letters 2020  
M. Greeff and A. P. Schoellig
- A perception-aware flatness-based model predictive controller for fast vision-based multirotor flight**  
| International Federation of Automatic Control (IFAC) World Congress 2020  
M. Greeff, T. D. Barfoot and A. P. Schoellig
- There's no place like home: visual teach and repeat for emergency return of multirotor UAVs during GPS failure** | IEEE Robotics and Automation Letters 2019  
M. Warren, M. Greeff, B. Patel, J. Collier, A. P. Schoellig and T. D. Barfoot
- Flatness-based model predictive control for quadrotor trajectory tracking** |  
International Conference on Intelligent Robots and Systems (IROS) 2018  
M. Greeff and A. P. Schoellig

## KEY ENGINEERING PROJECTS

- Vision-Based GPS-Denied Flight** | University of Toronto 04 2017-Present  
Development of vision-based control for multirotor drones for GPS-denied flight. Demonstrated successful autonomous flight relying exclusively on vision in field trials at Defense Research Canada, Alberta and downtown Montreal.
- Machine Learning Competition** | University of Toronto 09 2016-12 2016  
Classification of images in 1 of 8 categories, training on 7000 images. Tested nearest neighbour, SVM with GIST feature extraction and CNN. Proposed CNN, with transfer learning from Tensorflow, lead to 82.99% accuracy on test set.
- Multirotor Aircraft Design** | University of Toronto 09 2016-12 2016  
Detailed design of a multirotor UAV for crop inspection. Responsible for motor selection analysis and control design.
- RC Aircraft Design & Build** | University of Toronto 01 2016-04 2016  
Design and build of remote controlled canard pusher aircraft. Demonstrated successful flight. Responsible for stability and control analysis.

## INTERNSHIPS

- Engineering Intern** | Bombardier 04 2015-09 2015  
Automated damage tolerance analysis and developed a program, with user interface, to calculate the threshold and repeat inspection times for fuselage repairs.
- Engineering Intern** | De Beers Canada 04 2013-08 2014  
Performed open pit optimization analysis, collected mining fleet data, compiled an underground mine revenue and cost estimation and assisted with micro-diamond statistical analysis. Involved in outreach to first nations students promoting engineering and science careers.

## TECHNICAL SKILLS

**Coding Languages** | Python, Visual Basic, C++

**Software Tools** | ROS (Robot Operating System), MATLAB, Solidworks

**Machining** | Basic Machining Course

## AWARDS

**Nelson Mandela Award** | University of Toronto 2015  
Undergraduate students at the end of their 3rd year on the basis on academic excellence, demonstrated leadership and community involvement.

**Undergraduate Academic Scholarships** | University of Toronto 2012-2016

## CERTIFICATIONS

**Advance Drone Pilot Certificate** | Transport Canada 2019-Present  
Required legally for outdoor drone flight in restricted airspace

## FIELD EXPERIMENTS

**Autonomous Vision-based Flight** | Suffield 2018  
Demonstrated successful vision-based autonomous aerial vehicle flight at field trials at Defense Research and Development Canada (DRDC) in Suffield, Alberta, Canada.

**Autonomous Vision-based Flight** | Montreal 2018  
Demonstrated successful vision-based autonomous aerial vehicle flight for inspection in downtown Montreal, Canada.

## WORKSHOP ORGANIZATION

**Safe Real-World Robot Autonomy** |  
International Conference on Intelligent Robots and Systems (IROS) 2021  
This workshop facilitated interdisciplinary discussions and initiated collaboration on the topic of safe autonomy for real-world applications. The workshop had four components: a tutorial on Safe Robot Autonomy and three moderated discussions addressing: 1) Safety Definitions and Requirements, 2) Open Challenges and Opportunities for Integrating Theoretic and Data-driven Approaches and 3) Evaluation of Safety-Aware and Safety-Assured Algorithms.

**Deployable Decision Making in Embodied Systems** |  
Neural Information Processing Systems (NeurIPS) 2021  
This workshop will bring together researchers from machine learning, computer vision, robotics, and control to facilitate interdisciplinary discussions on the topic of deployable decision making in embodied systems. Two discussion themes: 1) Deployable Learning Algorithms for Embodied Systems and 2) Safe Learning and Decision Making in Uncertain and Unstructured Environments.

## EXTRACURRICULARS

**PASS** | 1st Year Engineering Math Mentor 2016

**ILEAD** | Engineering Leadership Organization 2013-2016

**WISE** | Campus Ambassador Women in Science and Engineering 2015

**Habitat for Humanity** | Building in Cape Town, South Africa 2011

**Hart House Chess Club** | Pan-American Team & Simultaneous Exhibitions 2013-2014

**FIDE Chess Instructor** | International Chess Instructor 2011

## INTERESTS

Integrating machine learning and control algorithms; Practical robotic applications; Reading; Technology; Systems approach to design; Community development; Teaching and facilitating learning; Economics and current events.