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(Last updated: August 16, 2017.)

## RESEARCH INTERESTS

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Machine Learning for Robotics and Control. Combining models and data for safe, high-performance robot control. Algorithms that enable robots to safely and effectively operate in increasingly unstructured, uncertain and changing environments, and over long periods of time. Algorithms that enable a seamless interaction between technical systems and the physical world.

## APPOINTMENTS

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**Associate Director**, Centre for Aerial Robotics Research and Education, Canada. since 08/2015  
Interdisciplinary centre at the University of Toronto bringing together researchers from three Canadian universities, six European and US schools, and a dozen of Canadian startups. [[web page](#)]

**Assistant Professor (Tenure Track)**, University of Toronto, Canada. since 01/2013  
Institute for Aerospace Studies, Faculty of Applied Science and Engineering. Also affiliated with the Institute for Robotics and Mechatronics, and the Lassonde Institute for Mining.

**Postdoctoral Researcher and Lecturer**, ETH Zurich, Switzerland. 2012  
Institute for Dynamic Systems and Control, with Prof. Raffaello D'Andrea. Five-month appointment.

**Research Assistant**, ETH Zurich, Switzerland. 2008–2012  
Institute for Dynamic Systems and Control, with Prof. Raffaello D'Andrea.

## EDUCATION

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**Dr. sc. (Ph.D.)**, ETH Zurich, Switzerland. 2013  
Institute for Dynamic Systems and Control, Dept. of Mechanical and Process Engineering.  
Advisor: Prof. Raffaello D'Andrea. Referee: Prof. Andrew Alleyne.

**Dipl.-Ing. (M.Sc.), Engineering Cybernetics**, University of Stuttgart, Germany. 2008  
Advisor: Prof. Frank Allgöwer. With highest honors, GPA<sup>1</sup>: 1.0.

**M.Sc., Engineering Science & Mechanics**, Georgia Institute of Technology, USA. 2007  
Advisor: Prof. Magnus Egerstedt. GPA: 4.0/4.0.

**Abitur**, Max-Born Gymnasium Backnang, Germany. 2002  
High school diploma. Valedictorian, GPA<sup>1</sup>: 1.0.

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<sup>1</sup>The German grading scale ranges from 1.0 (excellent, equals A+) to 5.0 (insufficient, equals F). Grades are given out in 0.1 increments. The minimum score required to pass is 4.0.

## AWARDS AND HONORS

- 2017 Sloan Research Fellowship (USD \$60K).** 2017  
This award for early-career researchers in the U.S. and Canada is “in recognition of distinguished performance and a unique potential to make substantial contributions to their field.” I have been awarded one of 16 Sloan Research Fellowships in the category ‘Computer Science’. Out of the 16, two are in the broad area of robotics. [[Sloan Press Release](#)] [[University of Toronto Press Release](#)]
- Ministry of Research, Innovation & Science Early Researcher Award (\$150K).** 2017  
This is one of the premier early researcher awards in Canada, administered by the Ministry of Research, Innovation and Science, Ontario. [[web page](#)]
- Nominated for a Canada Research Chair (Tier 2, \$500K).** 2017  
Canada Research Chairs were established to “attract and retain some of the world’s most accomplished and promising minds.” Tier 2 Chairs are intended for exceptional emerging scholars (i.e., candidates must have less than ten years of experience as an active researcher in their field at the time of nomination). Decision pending. [[web page](#)]
- NSERC Canadian Robotics Network Principal Investigator (Letter of Intent Stage).** 2017  
I was selected as the youngest of 11 robotics researchers in Canada to participate in this Canada-wide research network led by Prof. G. Dudek. The scope of the intended project includes \$6M in funding (over five years) from NSERC, the federal funding agency, and \$4M from a total of 11 partner companies.
- Connaught New Researcher Award (\$35K).** 2015  
I received this early researcher award from the University of Toronto for the application entitled “Safety and performance for next-generation robots through continuous online learning.” Success rate for this funding level was 32%.
- MIT Enabling Society Tech Competition First Prize (\$3K).** 2015  
We received this prize for the project *Waterfly*, a fully automated “swarm” of drones that can talk to each other and help with data retrieval for environmental monitoring. A collaboration with the MIT SENSEable City Lab. [[project page](#)]
- \$1M Drones For Good Competition Finalist.** 2015  
We were one of 19 international finalists among over 800 entries (2.4% success rate) at this Dubai competition with the project *Waterfly*, a “swarm” of drones for environmental monitoring. A collaboration with the MIT SENSEable City Lab. [[project page](#)]
- IEEE Control Systems Society (CSS) Video Clip Contest Finalist.** 2014  
Our video was among the top seven videos out of 53 submissions. [[video](#)]
- Best Robotics Paper Award, International Conference on Computer and Robot Vision (CRV).** 2014  
Paper: “Speed daemon: experience-based mobile robot speed scheduling”, Ostafew, Schoellig, Barfoot, Collier. [[video](#)]
- Science Leadership Program Fellow.** 2014  
I was the youngest of 21 science faculty members in Canada selected for the 2014 program. Selection is based, among others, on “excellence in research and teaching” and “passion and capacity to exercise leadership and enthusiasm for communicating science.” [[program details](#)], [[news article](#)]
- Dimitris N. Chorafas Foundation Prize (\$5K).** 2013  
The award honors innovative Ph.D. research in a wide range of fields, from life sciences and biotechnology to physics, computer technology, and engineering. I am one of 35 recipients worldwide.
- ETH Medal (\$2K).** 2013  
The ETH Medal is awarded to the top 8% of Ph.D. dissertations at ETH Zurich.

**Named one of “25 women in robotics you need to know about (2013)”.** 2013

A list compiled by Robohub.org, a leading professional robotics online platform. The 2013 list includes robotics researchers such as Daniela Rus (MIT), Manuela Veloso (CMU), and Maja Matarić (USC). [[web page](#)]

**NSERC Canadian Field Robotics Network (NCFRN) Distal Fellow.** since 2013

A program that supports promising, young robotics researchers in Canada. The NCFRN is a Canada-wide initiative in Field Robotics that brings together academic researchers, and industrial and government partners. Selected based on academic achievements and vote of the NCFRN Scientific Steering Committee.

**IEEE Fellowship in Robotics and Automation Finalist.** 2008

The award supports prospective leaders in this field.

**Professor-Peter-Sagirow Award.** 2005

For outstanding performance in the undergraduate program Engineering Cybernetics. Awarded to the top two students out of 70.

**Three Graduate Scholarships (total value: \$90K).** 2005–2008

From the *German National Academic Foundation* (2005–2008, \$33K, awarded to the top 3% of students from all disciplines), from the *Cusanuswerk* (2005–2008, \$35K), and from the *German Academic Exchange Service* (2006–2007, \$22K, included full tuition for my studies at Georgia Tech).

**Two High School Graduation Awards.** 2002

For outstanding achievements in mathematics and the natural sciences. Awarded to the top student out of 90 graduates.

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**RESEARCH FUNDING**


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I have obtained funding from the *Natural Sciences and Engineering Research Council of Canada (NSERC)*, the *Canada Foundation for Innovation (CFI)*, the *Ontario Research Fund (ORF)*, and the *Ontario Centres of Excellence (OCE)*. I have also contributed to grant applications to the *Swiss National Science Foundation (SNSF)*. All grants awarded and under review are listed below with their total grant amounts in the corresponding national currency. For joint, non-equipment grants, the amount of my share is provided as well.

**Funding Summary**

- Research funding to date exceeds \$2.68M from 18 successful grants, 10 as Principal Investigator.
- This includes \$1.4M of secured operational funding for my research group (for comparison, we budget \$20-25K/student year) and over \$1.28M in secured infrastructure funding (including shared equipment).

**Complete List**

□ *Principal Investigator*

**Ministry of Research, Innovation & Science Early Career Research Award (\$150K).** 2017–2022  
“Efficient and safe learning algorithms for enhanced robot capabilities in human-centered environments.”

**DND/NSERC Research Partnership Program (\$227K, total: \$454K).** 2017–2022  
“Visual breadcrumbs for emergency return of unmanned aerial vehicles.” Co-applicants/Collaborators: T. Barfoot, Drone Delivery Canada Corp, Defence R&D Canada.

- Sloan Research Fellowship (USD \$60K).** 2017–2019  
 “Safe and efficient learning for enhanced robot capabilities in human-centered environments.” Awarded based on nomination by the department and three reference letters.
- Havelaar Electric Vehicle Research Centre Fund (\$100K).** 2017–2019  
 “Incorporating human feedback into self-driving algorithms.” Collaborator: The Havelaar Group.
- University of Toronto Dean’s Strategic Fund (\$72K, total: \$216K).** 2017–2019  
 “Where the rubber meets the road: Seed funding for collaborative self-driving car research between FASE (Robotics) and CS (Artificial Intelligence).” With T. Barfoot and others.
- SOSCIP–TalentEdge Postdoctoral Fellowship (\$115K).** 2017–2019  
 “Safe learning-based control for high-precision assembly robots in advanced aerospace manufacturing.” Collaborator: MDA (MacDonald, Dettwiler and Associates Ltd).
- NSERC Engage Grant (\$25K).** 2016–2017  
 “Automatic on-the-ground wind stabilization system for hybrid aerial vehicle.” Collaborator: Solar Ship Inc.
- Connaught New Researcher Award (\$35K).** 2015–2017  
 “Safety and performance for next-generation robots through continuous online learning.” Success rate: 32%.
- NSERC Research Tools and Instruments Grant (\$150K).** 2015–2017  
 “Aerial vehicle platforms and sensor payloads to support research on autonomous, long-term monitoring of natural and agricultural resources.” Co-applicants: T. Barfoot, J. Kelly. Success rate: 33%.
- CFI John R. Evans Leaders Fund (JELF) (\$135K).** 2015–2017  
 “Indoor/outdoor testbed for aerial and ground multi-robot research.” Collaborators: T. Barfoot, J. Kelly.
- ORF Provincial Matching Component for CFI-JELF (\$135K).** 2015–2017  
 “Indoor/outdoor testbed for aerial and ground multi-robot research.” Collaborators: T. Barfoot, J. Kelly.
- NSERC Discovery Grant (\$155K).** 2014–2019  
 “Learning and adaptation for long-term autonomous robotics applications.”
- *Co-Principal Investigator*
- NSERC Strategic Partnership Grants for Networks (\$6M, applied).** 2018–2022  
 “NSERC Canadian Robotics Network.” With G. Dudek (PI) and 9 others.
- NSERC Strategic Partnership Grants for Projects (\$597K, applied).** 2017–2020  
 “Human-centered interfaces for flying through 3D real and virtual environments: seamless blending of real and virtual world navigation.” With W. Stuerzlinger (PI), B. Riecke, R. Allison. Collaborators: GeoSim, Wavesin, The Sky Guys, National Research Council Canada’s Flight Research Laboratory.
- NSERC Collaborative Research and Development Grant (\$320K, applied).** 2017–2020  
 “Development of unmanned aerial vehicle systems for real-time mining data acquisition and decision making.” With K. Esmaeili (PI). Collaborator: McEwen Mining.
- NSERC Research Tools and Instruments Grant (\$150K).** 2017–2019  
 “Self-driving car perception platform.” With T. Barfoot (PI), J. Kelly.
- SAE/GM AutoDrive Challenge (\$167K, total: \$333K; plus \$366 for equipment).** 2017–2020  
 The University of Toronto got selected as one of 8 teams to compete in this international, undergraduate-focused self-driving car competition. Monetary support from both SAE/GM and the Faculty for Applied Science & Engineering. With T. Barfoot (PI).

- NSERC Collaborative Research and Training Experience (\$149K, total: \$1.65M).** 2015–2021  
 “Research and training program in unmanned aerial vehicles.” With H.H.T. Liu (PI) and 9 others. Success rate: 14%.
- University of Toronto Dean’s Strategic Fund (\$52K, total: \$367K).** 2015–2018  
 “Centre for Aerial Robotics Research and Education.” With H.H.T. Liu (PI) and 5 others.
- NSERC Research Tools and Instruments Grant (\$147K).** 2014–2016  
 “Infrastructure to support research on long-term visual navigation of multiple autonomous robots.” With J. Kelly (PI), T. Barfoot. Success rate: 38%.
- CFI John R. Evans Leaders Fund (JELF) (\$127K).** 2014–2016  
 “Mobile mapping and manipulation.” With J. Kelly (PI), T. Barfoot.
- ORF Provincial Matching Component for CFI-JELF (\$127K).** 2014–2016  
 “Mobile mapping and manipulation.” With J. Kelly (PI), T. Barfoot.
- NSERC Research Tools and Instruments Grant (\$145K).** 2013–2015  
 “Field robot to support research on long-term autonomous navigation.” With T. Barfoot (PI), J. Kelly. Success rate: 23%.

□ *Contributor*

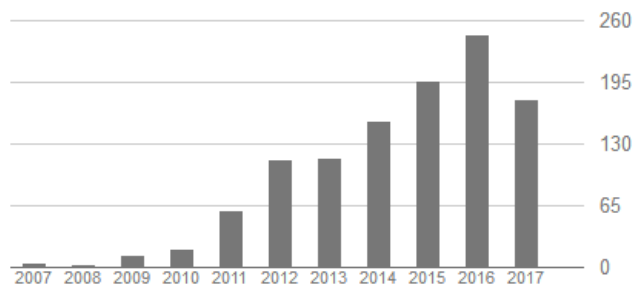
- SNSF Project Funding (CHF 529K).** 2012–2014  
 “High-performance maneuvers and trajectory generation for quadrotor flying vehicles.” With R. D’Andrea (PI).
- SNSF Research Equipment (CHF 96K).** 2011–2012  
 “Optical motion capture system for robot experiments in real world environments.” With R. D’Andrea (PI).

## PUBLICATIONS

### Publication Summary

- Citation Indices (according to [Google Scholar](#), 16 August 2017):

Citations: 1104  
 h-index: 19  
 i10-index: 22



- Supplementary material including videos, code, and slides can be found [\[here\]](#).
- Please note that conference papers are full-paper-refereed with *typical acceptance rates of 20% to 40%*.
- Below, students supervised by me<sup>2</sup> are in **bold** and former advisors are underlined.

<sup>2</sup>Note that at Swiss universities B.Sc. and M.Sc. students are directly supervised by Ph.D. students, with the professor acting as a consultant and last resort. It was my task to define student projects of appropriate scope (typically sub-problems of my own Ph.D. work), recruit students, discuss research progress during weekly meetings, introduce them to the robotic testbed, and support them in writing papers and preparing presentations.

**Journal Articles (appeared or accepted)**

- [1] T. **Bamford**, K. Esmaeili, and A. P. Schoellig, “A real-time analysis of post-blast rock fragmentation using UAV technology,” *International Journal of Mining, Reclamation and Environment*, 2017, accepted. [\[pdf\]](#)
- [2] J. J. Boutilier, S. C. Brooks, A. Janmohamed, A. Byers, J. E. Buick, C. Zhan, A. P. Schoellig, S. Cheskes, L. J. Morrison, and T. C. Y. Chan, “Optimizing a drone network to deliver automated external defibrillators,” *Circulation*, doi: 10.1161/CIRCULATIONAHA.116.026318, 2017, in press. [\[pdf\]](#)
- [3] C. J. **Ostafew**, A. P. Schoellig, and T. D. Barfoot, “Robust constrained learning-based NMPC enabling reliable mobile robot path tracking,” *International Journal of Robotics Research*, vol. 35, no. 13, pp. 1547–1563, 2016. [\[pdf\]](#)
- [4] C. J. **Ostafew**, A. P. Schoellig, T. D. Barfoot, and J. Collier, “Learning-based nonlinear model predictive control to improve vision-based mobile robot path tracking,” *Journal of Field Robotics*, vol. 33, no. 1, pp. 133–152, 2016. [\[pdf\]](#)
- [5] T. Andre<sup>△</sup>, K. A. Hummel<sup>△</sup>, A. P. Schoellig<sup>△</sup>, E. Yanmaz<sup>△</sup>, M. Asadpour, C. Bettstetter, P. Grippa, H. Hellwagner, S. Sand, and S. Zhang, “Application-driven design of aerial communication networks,” *IEEE Communications Magazine*, vol. 52, no. 5, pp. 129–137, 2014. <sup>△</sup>Contributed equally, in alphabetic order. [\[pdf\]](#)
- [6] S. Lupashin, M. Hehn, M. Mueller, A. P. Schoellig, and R. D’Andrea, “A platform for aerial robotics research and demonstration: the Flying Machine Arena,” *Mechatronics*, vol. 24, no. 1, pp. 41–54, 2014. [\[pdf\]](#)
- [7] F. **Augugliaro**, A. P. Schoellig, and R. D’Andrea, “Dance of the flying machines: methods for designing and executing an aerial dance choreography,” *IEEE Robotics and Automation Magazine*, vol. 20, no. 4, pp. 96–104, 2013. [\[pdf\]](#)
- [8] A. P. Schoellig, J. **Alonso-Mora**, and R. D’Andrea, “Limited benefit of joint estimation in multi-agent iterative learning,” *Asian Journal of Control*, vol. 14, no. 3, pp. 613–623, 2012. [\[pdf\]](#)
- [9] A. P. Schoellig, F. L. **Mueller**, and R. D’Andrea, “Optimization-based iterative learning for precise quadcopter trajectory tracking,” *Autonomous Robots*, vol. 33, pp. 103–127, 2012. [\[pdf\]](#)

**Journal Articles (under review)**

- [1] K. **Pereida**, D. **Kooijman**, R. R. P. R. **Duivendoorn**, and A. P. Schoellig, “Transfer learning for high-accuracy trajectory tracking through L1 adaptive feedback and iterative learning,” *International Journal of Adaptive Control and Signal Processing*, submitted May 2017, submission #17-0163. [\[pdf\]](#)
- [2] M. K. **Helwa** and A. P. Schoellig, “On the construction of safe controllable regions for affine systems with applications to robotics,” *Automatica*, submitted September 2016, submission #16-1078.
- [3] A. **Hock** and A. P. Schoellig, “Distributed iterative learning control for multi-agent systems,” *Autonomous Robots*, submitted August 2016, submission #AURO-D-16-00130.

**Conference Proceedings (full-paper-refereed, appeared or accepted)**

- [1] S. **Zhou**, M. K. **Helwa**, and A. P. Schoellig, “Design of deep neural networks as add-on blocks for improving impromptu trajectory tracking,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2017, accepted. [\[pdf\]](#)
- [2] M. K. **Helwa** and A. P. Schoellig, “Multi-robot transfer learning: a dynamical system perspective,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2017, accepted. [\[pdf\]](#)

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- [3] M. **Vukosavljev**, Z. Kroeze, M. E. Broucke, and A. P. Schoellig, “A framework for multi-vehicle navigation using feedback-based motion primitives,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2017, accepted. [[pdf](#)]
- [4] M. Warren, M. Paton, K. MacTavish, A. P. Schoellig, and T. D. Barfoot “Towards visual teach & repeat for emergency return of a fixed-wing UAV,” in *Proc. of the Conference on Field and Service Robotics (FSR)*, 2017, accepted. [[pdf](#)]
- [5] T. **Bamford**, K. Esmaili, and A. P. Schoellig, “Aerial rock fragmentation analysis in low-light condition using UAV technology,” in *Proc. of the Conference on Application of Computers and Operations Research in the Mineral Industry (APCOM)*, 2017, pp. 4-1–4-8. [[pdf](#)]
- [6] R. R. P. R. **Duivenvoorden**, F. **Berkenkamp**, N. Carion, A. Krause, and A. P. Schoellig, “Constrained Bayesian optimization with particle swarms for safe adaptive controller tuning,” in *Proc. of the IFAC (International Federation of Automatic Control) World Congress*, 2017. [[pdf](#)]
- [7] C. D. **McKinnon** and A. P. Schoellig, “Learning multimodal models for robot dynamics online with a mixture of Gaussian process experts,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2017, pp. 322–328. [[pdf](#)]
- [8] K. **Pereida**, R. R. P. R. **Duivenvoorden**, and A. P. Schoellig, “High-precision trajectory tracking in changing environments through  $\mathcal{L}_1$  adaptive feedback and iterative learning,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2017, pp. 344–350. [[pdf](#)]
- [9] Q. **Li**, J. **Qian**, Z. **Zhu**, X. **Bao**, M. K. **Helwa**, and A. P. Schoellig, “Deep neural networks for improved, impromptu trajectory tracking of quadrotors,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2017, pp. 5183–5189. [[pdf](#)]
- [10] A. Marco, F. **Berkenkamp**, P. Hennig, A. P. Schoellig, A. Krause, S. Schaal, and S. Trimpe, “Virtual vs. real: trading off simulations and physical experiments in reinforcement learning with Bayesian optimization,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2017, pp. 1557–1563. [[pdf](#)]
- [11] A. **Hock** and A. P. Schoellig, “Distributed iterative learning control for a team of quadrotors,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2016, pp. 4640–4646. [[pdf](#)]
- [12] M. K. **Helwa** and A. P. Schoellig, “On the construction of safe controllable regions for affine systems with applications to robotics,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2016, pp. 3000–3005. [[pdf](#)]
- [13] F. **Berkenkamp**, R. Moriconi, A. P. Schoellig, and A. Krause, “Safe learning of regions of attraction for uncertain, nonlinear systems with Gaussian processes,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2016, pp. 4661–4666. [[pdf](#)]
- [14] T. **Bamford**, K. Esmaili, and A. P. Schoellig, “A real-time analysis of rock fragmentation using UAV technology,” in *Proc. of the International Conference on Computer Applications in the Minerals Industries (CAMI)*, 2016. [[pdf](#)]
- [15] C. **McKinnon** and A. P. Schoellig, “Unscented external force estimation for quadrotors and experiments,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2016, pp. 5651–5657. [[pdf](#)]
- [16] M. **Vukosavljev**, I. Jansen, M. E. Broucke, and A. P. Schoellig, “Safe and robust robot maneuvers based on reach control,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2016, pp. 5677–5682. [[pdf](#)]

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- [17] F. **Berkenkamp**, A. P. Schoellig, and A. Krause, “Safe controller optimization for quadrotors with Gaussian processes,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2016, pp. 491–496. [\[pdf\]](#)
- [18] K. V. **Raimalwala**, B. A. Francis, and A. P. Schoellig, “A preliminary study of transfer learning between unicycle robots,” in *Proc. of the AAAI Spring Symposium Series*, 2016, pp. 53–59. [\[pdf\]](#)
- [19] K. V. **Raimalwala**, B. A. Francis, and A. P. Schoellig, “An upper bound on the error of alignment-based transfer learning between two linear, time-invariant, scalar systems,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2015, pp. 5253–5258. [\[pdf\]](#)
- [20] F. **Berkenkamp** and A. P. Schoellig, “Safe and robust learning control with Gaussian processes,” in *Proc. of the European Control Conference (ECC)*, 2015, pp. 2501–2506. [\[pdf\]](#)
- [21] C. J. **Ostafew**, A. P. Schoellig, and T. D. Barfoot, “Conservative to confident: treating uncertainty robustly within learning-based control,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2015, pp. 421–427. [\[pdf\]](#)
- [22] F. **Berkenkamp** and A. P. Schoellig, “Learning-based robust control: guaranteeing stability while improving performance,” in *Proc. of the Machine Learning in Planning and Control of Robot Motion Workshop at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2014. [\[pdf\]](#)
- [23] N. **Degen** and A. P. Schoellig, “Design of norm-optimal iterative learning controllers: the effect of an iteration-domain Kalman filter for disturbance estimation,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2014, pp. 3590–3596. [\[pdf\]](#)
- [24] C. J. **Ostafew**, A. P. Schoellig, and T. D. Barfoot, “Learning-based nonlinear model predictive control to improve vision-based mobile robot path-tracking in challenging outdoor environments,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2014, pp. 4029–4036. [\[pdf\]](#)
- [25] C. J. **Ostafew**, A. P. Schoellig, T. D. Barfoot, and J. Collier, “Speed daemon: experience-based mobile robot speed scheduling,” in *Proc. of the International Conference on Computer and Robot Vision (CRV)*, 2014, pp. 56–62. **Best Robotics Paper Award.** [\[pdf\]](#)
- [26] A. **Pfrunder**, A. P. Schoellig, and T. D. Barfoot, “A proof-of-concept demonstration of visual teach and repeat on a quadcopter using an altitude sensor and a monocular camera,” in *Proc. of the International Conference on Computer and Robot Vision (CRV)*, 2014, pp. 238–245. [\[pdf\]](#)
- [27] C. J. **Ostafew**, A. P. Schoellig, and T. D. Barfoot, “Visual teach and repeat, repeat, repeat: Iterative learning control to improve mobile robot path tracking in challenging outdoor environments,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2013, pp. 176–181. [\[pdf\]](#)
- [28] F. **Augugliaro**, A. P. Schoellig, and R. D’Andrea, “Generation of collision-free trajectories for a quadcopter fleet: A sequential convex programming approach,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2012, pp. 1917–1922. [\[pdf\]](#)
- [29] F. L. **Mueller**, A. P. Schoellig, and R. D’Andrea, “Iterative learning of feed-forward corrections for high-performance tracking,” in *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2012, pp. 3276–3281. [\[pdf\]](#)
- [30] A. P. Schoellig, C. **Wiltzsche**, and R. D’Andrea, “Feed-forward parameter identification for precise periodic quadcopter motions,” in *Proc. of the American Control Conference (ACC)*, 2012, pp. 4313–4318. [\[pdf\]](#)



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- [31] A. P. Schoellig and R. D'Andrea, “Sensitivity of joint estimation in multi-agent iterative learning control,” in *Proc. of the IFAC (International Federation of Automatic Control) World Congress*, 2011, pp. 1204–1212. [[pdf](#)]
- [32] A. P. Schoellig, M. Hehn, S. Lupashin, and R. D'Andrea, “Feasibility of motion primitives for choreographed quadcopter flight,” in *Proc. of the American Control Conference (ACC)*, 2011, pp. 3843–3849. [[pdf](#)]
- [33] S. Lupashin, A. P. Schoellig, M. Sherback, and R. D'Andrea, “A simple learning strategy for high-speed quadcopter multi-flips,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2010, pp. 1642–1648. [[pdf](#)]
- [34] A. P. Schoellig, J. **Alonso-Mora**, and R. D'Andrea, “Independent vs. joint estimation in multi-agent iterative learning control,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2010, pp. 6949–6954. [[pdf](#)]
- [35] A. P. Schoellig, F. **Augugliaro**, and R. D'Andrea, “A platform for dance performances with multiple quadcopters,” in *Proc. of the Workshop on Robots and Musical Expressions at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2010, pp. 1–8. [[pdf](#)]
- [36] A. P. Schoellig, F. **Augugliaro**, and R. D'Andrea, “Synchronizing the motion of a quadcopter to music,” in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2010, pp. 3355–3360. [[pdf](#)]
- [37] A. P. Schoellig and R. D'Andrea, “Optimization-based iterative learning control for trajectory tracking,” in *Proc. of the European Control Conference (ECC)*, 2009, pp. 1505–1510. [[pdf](#)]
- [38] P. F. Gath, D. Weise, T. Heinrich, A. P. Schoellig, and S. Otte (EADS Astrium GmbH Satellites, Friedrichshafen, Germany), “Verification of the performance of selected subsystems for the LISA mission,” in *Proc. of the German Aerospace Congress*, German Society for Aeronautics and Astronautics (DGLR), 2008. [[pdf](#)]
- [39] A. P. Schoellig, P. E. Caines, M. Egerstedt, and R. P. Malhamé, “A hybrid Bellman equation for systems with regional dynamics,” in *Proc. of the IEEE Conference on Decision and Control (CDC)*, 2007, pp. 3393–3398. [[pdf](#)]
- [40] A. P. Schoellig, U. Münz, and F. Allgöwer, “Topology-dependent stability of a network of dynamical systems with communication delays,” in *Proc. of the European Control Conference (ECC)*, 2007, pp. 1197–1202. [[pdf](#)]

### Conference Papers (under review)

- [1] F. **Berkenkamp**, M. Turchetta, A. P. Schoellig, and A. Krause, “Safe model-based reinforcement learning with stability guarantees,” in *Proc. of the Conference on Neural Information Processing Systems (NIPS)*, 2017, submitted. [[pdf](#)]

### Abstracts and Videos (refereed, appeared or accepted)

- [1] J. J. Boutilier, S. C. Brooks, A. Janmohamed, A. Byers, C. Zhan, J. E. Buick, A. P. Schoellig, L. J. Morrison, S. Cheskes, T. C. Y. Chan, “Quantifying the value of drone-delivered AEDs in cardiac arrest response,” Abstract and Oral Presentation, in *American Heart Association (AHA) Resuscitation Science Symposium*, 2016.
- [2] F. **Berkenkamp**, A. Krause, and A. P. Schoellig, “Safe automatic controller tuning for quadrotors,” Video Submission, *Assn. of the Advancement of Artificial Intelligence (AAAI) AI Video Competition*, 2016. [[video](#)]

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- [3] C. **McKinnon** and A. P. Schoellig, “Data-driven interaction for quadrotors based on external forces,” Video Submission, *Assn. of the Advancement of Artificial Intelligence (AAAI) AI Video Competition*, 2016. [[video](#)]
  - [4] F. **Berkenkamp**, A. P. Schoellig, and A. Krause, “Safe controller optimization for quadrotors with Gaussian processes,” Abstract and Presentation, in *Proc. of the Second Machine Learning in Planning and Control of Robot Motion Workshop at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2015. [[pdf](#)]
  - [5] A. P. Schoellig, F. L. **Mueller**, and R. D’Andrea, “Quadrocopter slalom learning,” Video Submission, *AI and Robotics Multimedia Fair, Conf. on Artificial Intelligence (AI), Assn. of the Advancement of Artificial Intelligence (AAAI)*, 2012. [[video](#)]
  - [6] S. Lupashin, A. P. Schoellig, M. Hehn, and R. D’Andrea, “The Flying Machine Arena as of 2010,” Video Submission, in *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, 2011, pp. 2970–2971. [[pdf](#)] [[video](#)]
  - [7] A. P. Schoellig and R. D’Andrea, “Learning through experience – Optimizing performance by repetition,” Abstract and Poster, in *Proc. of the Robotics Challenges for Machine Learning Workshop at the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2008. [[pdf](#)] [[poster](#)]

### Book Chapters

- [1] A. P. Schoellig, H. Siegel, F. **Augugliaro**, and R. D’Andrea, “So you think you can dance? Rhythmic flight performances with quadrocopters,” in *Controls and Art*, A. LaViers and M. Egerstedt, Eds. Springer, pp. 73–105, 2014. [[pdf](#)]
- [2] P. E. Caines, M. Egerstedt, R. P. Malhamé, and A. P. Schoellig, “A hybrid Bellman equation for bimodal systems,” in *Hybrid Systems: Computation and Control*, ser. Lecture Notes in Computer Science. A. Bemporad, A. Bicchi, and G. Buttazzo, Eds. Springer Berlin Heidelberg, 2007, vol. 4416, pp. 656–659. [[pdf](#)]

### Professional Magazine Articles (invited)

- [1] T. **Bamford**, K. Esmaili, and A. P. Schoellig, “Rock fragmentation analysis using UAV technology,” *Ontario Professional Surveyor (OPS) Magazine*, Assn. of Ontario Land Surveyors, 2016. [[pdf](#)]
- [2] R. Ritz, M. W. Müller, F. **Augugliaro**, M. Hehn, S. Lupashin, A. P. Schoellig, R. D’Andrea, “An aerial robotics demonstration for controls research at the ETH Flying Machine Arena,” *Swiss Society for Automatic Control Bulletin*, no. 63, p. 2–15, 2012. [[pdf](#)]

### Theses

- [1] A. P. Schoellig, “Improving tracking performance by learning from past data,” Doctoral Thesis, Diss. ETH No. 20593, ETH Zurich, Switzerland, 2013. **ETH Medal, Dimitris N. Chorafas Foundation Prize.** [[pdf](#)]
- [2] A. P. Schoellig, “Optimal control of hybrid systems with regional dynamics,” Master Thesis, Georgia Institute for Technology, USA, 2007. [[pdf](#)]
- [3] A. P. Schoellig, “Stability of a network of dynamical systems with communication delays (in German),” Master Thesis, University of Stuttgart, Germany, 2006. [[pdf](#)]

## SELECT INVITED TALKS

I gave a total of *40 invited talks for a scientific/professional audience* in 9 different countries and a total of *18 invited talks for the general public* in 4 different countries. In addition, we have hosted visits for representatives from government and industry (most recently, DARPA, the Canadian Space Agency, General Motors, Magna, and Ontario Power Generation), which also included research talks from me.

□ *Scientific Audience*

**Robotics: Science and Systems Conference (RSS) Workshop, Boston, USA.** 07/2017

Invited Speaker at the workshop ‘Learning Perception and Control for Autonomous Flight: Safety, Memory, and Efficiency’ (Organizers: Karydis, Atanasov, Levine, Roy, Tomlin, Kumar), “Machine learning for safe, high-performance control of mobile robots.”

**Conference on Computer and Robot Vision, Edmonton, Canada.** 05/2017

Invited Symposium Speaker (Dr. S. Waslander and J. Elder), “Machine learning for safe, high-performance control of mobile robots.”

**Duke University, Durham, USA.** 05/2017

Invited Speaker for internal colloquium (Dr. M. Cummings), “Machine learning for safe, high-performance control of mobile robots.”

**University of California, Santa Barbara, USA.** 05/2017

Invited Speaker for internal colloquium (Mechanical Engineering Department), “Machine learning for safe, high-performance control of mobile robots.”

**University of Washington, Seattle, USA.** 04/2017

Distinguished Speaker for Aerospace Engineering Colloquium (Dr. Anthony M. Waas), “Machine learning for robotics: high-performance flight control in unknown and changing conditions.”

**Engineering Science Education Conference, Toronto, Canada.** 01/2017

Invited speaker for the Robotics Major, “Machine learning for mobile robots.”

**Technical University Darmstadt, Germany.** 01/2017

Invited speaker at internal colloquium (Dr. J. Peters), “Safe learning control for mobile robots.”

**Max Planck Institute for Intelligent Systems, Tuebingen, Germany.** 04/2016

Invited speaker at the Intelligent Systems Colloquium (Dr. S. Trimpe), “Safe learning control for mobile robots.” [\[web page\]](#)

**Oberwolfach Workshop on Control Theory for Cyber-Physical Systems, Germany.** 02/2015

Invited speaker at the Workshop on ‘Control Theory: A Mathematical Perspective on Cyber-Physical Systems’, “Control of aerial and ground multi-robot systems.”

**University of California, Berkeley, USA.** 12/2014

Invited speaker at the DREAM (Design of Robotics and Embedded Systems, Analysis, and Modeling) Seminar Series (Prof. P. Abbeel), “Improving the performance and autonomy of mobile robots by enabling them to learn from experience.”

**Intelligent Transportation Systems Research Day, University of Toronto, Canada.** 12/2014

Invited speaker at the industry-university symposium (Prof. E. J. Miller), “The role of unmanned aerial vehicles in future urban environments.”

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- FLYNET Workshop, ETH Zurich, Switzerland.** 11/2014  
Invited speaker and panelist at this workshop on ‘Micro and Nano Aerial Vehicle Networks for Civilian Use’, “High-performance flight control in unknown and changing conditions.” [[web page](#)]
- University of Illinois at Urbana-Champaign, USA.** 10/2014  
Invited speaker at the Coordinated Science Lab Lecture Series (Prof. N. Hovakimyan), “Improving the performance and autonomy of robots by enabling them to learn from experience.”
- Lassonde Institute of Mining Research Day, University of Toronto, Canada.** 10/2014  
Invited speaker at this industry-university symposium, “Applications of unmanned aerial vehicles in mining.”
- International Workshop on Multi Unmanned Vehicles Systems, Compiègne, France.** 06/2014  
Invited speaker at this workshop (Prof. I. Fantoni-Coichot), “Challenges for robotic (outdoor) air and ground applications.”
- Workshop on Open Problems in Multi-Agent Systems, Portland, USA.** 06/2014  
Invited speaker at this workshop held at the American Control Conference (Prof. M. Egerstedt), “Open problems in multi-agent learning: is information sharing between agents beneficial?” [[web page](#)]
- Concordia University, Montréal, Canada.** 05/2014  
Invited speaker at the Engineering Research Seminar (Prof. L. Rodrigues), “Slalom races, flight dances, rover speeding? Planning, control and learning for high-performance robot operations.”
- McGill University, Montréal, Canada.** 12/2013  
Invited speaker at the Centre for Intelligent Machines (Prof. G. Dudek), “Enabling high-performance maneuvers of ground and aerial vehicles by incorporating data into mobile robot control.”
- University of Michigan, Ann Arbor, USA.** 11/2013  
Invited speaker at the Mechanical Engineering Department Seminar Series (Prof. K. Barton), “Enhanced performance and autonomy for mobile robots through learning from past data.”
- Drones and Aerial Robotics Conference, New York, USA.** 10/2013  
Session/interactive speaker, “Are we there yet? Robots that learn from experience, and enhance their performance and autonomy over time.” [[web page](#)]
- Université de Technologie de Compiègne, France.** 10/2013  
Invited speaker at the Labex MS2T Seminar (Laboratories of Excellence in Control of Systems of Systems), (Prof. I. Fantoni-Coichot), “Are we there yet? Robots that learn from experience, and enhance their performance and autonomy over time.” [[announcement](#), [slides](#)]
- Lakeside Labs and Alpen-Adria-University Klagenfurt, Austria.** 07/2013  
Keynote speaker at the 2013 Research Days on Multi-UAV Systems (Prof. C. Bettstetter), “Slalom racing and flight dances – motion planning, control and learning for high-performance quadcopter flight.” [[video of presentation](#)]
- NSERC Canadian Field Robotics Network (NCFRN), Toronto, Canada.** 04/2013  
Invited speaker at the 2013 Robot Field Trials (Prof. G. Dudek), “Enhanced performance and autonomy through learning from data: an aerial robotics example.”
- Ontario Society of Professional Engineers (OSPE), Toronto, Canada.** 03/2013  
Invited speaker at the Aerospace and Automotive Night, “Extended performance and autonomy through learning from data.”

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- Center for Advanced Aerospace Technologies (CATEC), Sevilla, Spain.** 12/2012  
Invited speaker at the CATEC Research Seminar (Dr. A. Viguria), “Accomplishing high-performance quadcopter maneuvers through learning from experience.”
- Bio-Robotics Network in Zurich (BiRoNZ), Switzerland.** 11/2012  
Invited speaker at the BiRoNZ Talks, “Accomplishing high-performance quadcopter maneuvers through learning from experience.”
- University Stuttgart, Germany.** 11/2012  
Invited speaker at the Colloquium Engineering Cybernetics (Prof. F. Allgöwer), “Improving performance of automated systems through learning from past data.”
- Swiss Association of Aeronautical Sciences (SVFW), Zurich, Switzerland.** 09/2011  
Invited speaker at the Annual Meeting, “Enabling quadcopters to learn from repetition.”
- Session on Controls Education, American Control Conference, San Francisco, USA.** 06/2011  
Invited speaker at the Special Session on ‘Emerging Control Education Issues, Systems & Control for a Wide Range of the Public’ (Prof. B. Pasik-Duncan), “Flying robots on stage – control and learning for aerial acrobatics.”
- Stanford University, USA.** 06/2011  
Invited speaker at the Information Systems Laboratory (Prof. S. Boyd), “Control and learning for aerial vehicles – where optimization is required.”
- Lund University, Sweden.** 04/2010  
Invited speaker at the Lund Center for Control of Complex Engineering Systems (LCCC) (Prof. A. Rantzer), “Optimization-based learning.”
- Workshop on Adaptation and Learning in Autonomous Systems, Lund, Sweden.** 04/2010  
Invited speaker at this 3-day workshop organized by Prof. A. Rantzer at Lund University, “Synchronizing motion to music – a rhythmic flight performance.”
- Queensland University of Technology (QUT), Brisbane, Australia.** 01/2010  
Invited speaker at the Smart Systems Seminar (Prof. G. Wyeth), “Learning through experience – improving performance by repetition.”
- ETH Zurich, Switzerland.** 01/2008  
Invited speaker at the Automatic Control Laboratory (Prof. M. Morari), “Optimal control of hybrid systems with regional dynamics.”
- *Industry Audience*
- MDA Robotics and Automation Corp, Toronto, Canada.** 03/2016  
Invited speaker for an internal research seminar (Dr. P. Jasiobedzki), “Dynamic Systems Lab: Research in robotics, controls and machine learning.”
- Clearpath Robotics Inc, Kitchener, Canada.** 08/2015  
Invited speaker at the Guest Lecture Series (R. Garipey, CTO), “Excellence and safety in robotics.”
- Bombardier Aerospace, Toronto, Canada.** 05/2015  
Invited speaker at the Lunch & Learn talk series (H. Khimji), “The possibilities of aerial robotics.”
- Defence Research & Development Canada, Suffield, Canada.** 04/2014  
Invited talk (J. Collier), “Enabling High-Performance Maneuvers of Ground and Aerial Vehicles by Incorporating Data into Mobile Robot Control.”

**Festo AG & Co. KG, Esslingen, Germany.** 07/2013  
Invited visit and presentation (E. Knubben, Dr. Alexander Hildebrandt), “Research at the Dynamic Systems Lab: Learning and adaptation for ubiquitous long-term robotics applications.”

□ *General Public*

**Workshop on Automatic Control for High School Students, Las Vegas, USA.** 12/2016  
Invited speaker at this workshop on ‘The Power and Beauty of Control, a Field that Spans Science, Technology, Engineering & Mathematics’ held in conjunction with the IEEE Control and Decision Conference, “How flying robots learn to fly.”

**Drone Fair, University of Ontario Institute of Technology, Canada.** 11/2016  
Invited speaker, “Robots and drones that learn to empower us.” [[event page](#)]

**Spring Reunion, University of Toronto, Canada.** 05/2016  
Invited speaker at this alumni event, “Making robots safer by enabling them to learn.”

**Girls’ Leadership in Engineering Experience event, University of Toronto, Canada.** 05/2016  
Keynote speaker at this recruitment event, “Three lessons from my work in engineering.”

**TEDxUofT, Toronto, Canada.** 03/2016  
Invited speaker, “Robots and drones that learn to empower us.” [[video](#)]

**German Consulate, Toronto, Canada.** 01/2016  
Invited speaker at the Science Slam, “Why should you care about robotics?”

**Royal Canadian Institute (RCI) For the Advancement of Science, Toronto, Canada.** 11/2015  
Invited speaker at the Fall Lecture Series, “Revolution in robotics: will the next robot be for you?” [[video](#)]

**Lift China Conference, Shanghai, China.** 06/2015  
Keynote speaker at this Swiss-China event aiming to connect academia and business to facilitate cooperation and innovation, “Expand your abilities with drones.” [[event summary video](#)] [[event page](#)]

**Girls’ Leadership in Engineering Experience event, University of Toronto, Canada.** 05/2015  
Keynote speaker at this recruitment event, “How flying robots learn to fly: Controls for autonomous aerial vehicles.”

**University of Toronto in Your Neighbourhood, Toronto, Canada.** 01/2015  
Invited speaker at this talk series for University of Toronto alumni, “The possibilities of aerial robotics.” [[web page](#)]

**Workshop on Automatic Control for High School Students, Los Angeles, USA.** 12/2014  
Invited speaker at this workshop on ‘The Power and Beauty of Control, a Field that Spans Science, Technology, Engineering & Mathematics’ held in conjunction with the IEEE Control and Decision Conference, “Robots that learn from their mistakes.” [[web page](#)]

**Fall Campus Day, University of Toronto, Canada.** 10/2014  
Invited speaker at this university open-house day, “How flying robots learn to fly.”

**Canadian Science Writers’ Association (CSWA), Toronto, Canada.** 06/2014  
Invited speaker and panellist at the CSWA Annual Conference, “Teaching robots to fly.” [[news article](#)]

**Girls’ Leadership in Engineering Experience event, University of Toronto, Canada.** 05/2014  
Keynote speaker at this recruitment event, “How flying robots learn to fly: Controls for autonomous aerial vehicles.” [[news article](#)]

**Toronto Students for the Advancement of Aerospace (TSAA), Toronto, Canada.** 10/2013  
Invited speaker at “The DIY Innovator” Conference, “Unmanned aerial vehicles: research challenges and business opportunities.”

**Girls’ Leadership in Engineering Experience event, University of Toronto, Canada.** 05/2013  
Keynote speaker at this recruitment event, “How flying robots learn to fly: Controls for autonomous aerial vehicles.”  
[[news article](#)]

**Tech Days at High School Rämibühl, Zurich, Switzerland.** 02/2012  
Interactive talk and demonstration for 50 high school students, “Flying robots on stage.”

**Workshop on Automatic Control for Middle & High School Students, Atlanta, USA.** 12/2010  
Invited speaker at this workshop on ‘Ideas and Technology of Control Systems’ held in conjunction with the IEEE Control and Decision Conference, “Flying robots on stage – control and learning for aerial acrobatics.”

## COLLABORATORS

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A list of current research collaborators is found here: [[web page](#)].

## STUDENT ADVISING

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□ *Current Students*

### Postdoctoral Fellows

- [1] Mohammad Nahangi (coadvised with Prof. B. McCabe, CIV, University of Toronto). since 09/2016  
NSERC Postdoctoral Fellow. Before Ph.D. student at the University of Waterloo, Civil and Environmental Engineering Department, with Prof. C. Haas.
- [2] Mohamed Helwa. since 01/2016  
Before Postdoc at McGill University with Prof. P. Caines.

### Ph.D. Students (four-year research and training, including 4 courses)

- [1] Melissa Greeff. since 09/2016  
Topic: “Vision-based flight control and motion planning.”
- [2] SiQi Zhou. since 09/2016  
Topic: “Deep learning for robot control.”
- [3] Thomas Bamford (coadvised with Prof. K. Esmaili, CIV, University of Toronto). since 01/2016  
Topic: “Applications of unmanned aerial vehicle technology in mining.” Direct transfer to Ph.D. program. Partially supported by an NSERC CGS-M (Canada Graduate Scholarships–Master’s Program).
- [4] Chris McKinnon. since 09/2015  
Topic: “Reliable robot operation in partially unknown or changing conditions.”
- [5] Felix Berkenkamp (coadvised with Prof. A. Krause, Computer Science, ETH Zurich). since 03/2015  
Topic: “Safe robot learning and exploration.”
- [6] Karime Pereida Pérez. since 09/2014  
Topic: “Adaptive robot-robot and human-robot interaction.” Partially supported by CONACYT, a Mexican government scholarship.

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- [7] Mario Vukosavljev (coadvised with Prof. M. Broucke, ECE, University of Toronto). since 07/2014  
Topic: “Reach control for provably safe robot maneuvers.”

**M.A.Sc. Students** (two-year research and training, including 4 courses)

- [1] Adam Heins. since 09/2017  
Topic: “Reinforcement learning.”
- [2] Bhavit Patel. since 09/2017  
Topic: “Vision-based flight with a gimbaled camera.”
- [3] Carlos Luis. since 09/2017  
Topic: “Robot group learning.”
- [4] Keenan Burnett. since 05/2017  
Topic: “Self-driving cars.”
- [5] Julian Förster (exchange student from ETH Zurich). since 05/2017  
Topic: “Advanced control methods for stabilization of a hybrid aircraft against crosswinds.”
- [6] Dave Kooijman (exchange student from Eindhoven University of Technology). since 01/2017  
Topic: “High-accuracy tracking in changing environments through adaptive feedback and iterative learning.”
- [7] Yassine Nemmour (exchange student from ETH Zurich). since 10/2016  
Topic: “Safe exploration in robotics using Gaussian process models.”

**B.A.Sc. Thesis Students** (year-long research project, approx. 3 months full time equivalent)

- [1] Aakash Goel, Engineering Science. since 09/2016

**Undergraduate Summer Students** (four-month summer research)

- [1] Qiyang Li, Engineering Science. 2017  
Partially supported by Kenneth Carless Smith Engineering Science Research Fellowship.
- [2] Yizhou Huang, Engineering Science. 2017  
Partially supported by an Engineering Science Research Opportunities Program (ESROP) Award.
- [3] Quinlan Sykora, Engineering Science. 2017  
Partially supported by an Engineering Science Research Opportunities Program (ESROP) Award.
- [4] Xintong Du, Engineering Science. 2017  
Supported by a University of Toronto Excellence Award.

□ *Former Students*

**Ph.D. Students** (four-year research and training, including 4 courses)

- [1] Chris Ostafew, Aerospace, University of Toronto. 2013–2016  
Topic: “Learning control for vision-based mobile robot path tracking in outdoor environments.” Partially supported by an Ontario Graduate Scholarship. Coadvised with Prof. T. Barfoot, Aerospace, University of Toronto. Now System Engineer Autonomous Driving at Nissan, San Francisco.



**M.A.Sc. Students** (two-year research and training, including 4 courses)

- [1] Rikky Duivenvoorden, Aerospace, University of Toronto. 2014–2016  
Topic: “Quadrotor control in the presence of unknown mass properties.” Now starting his own start-up.
- [2] Kaizad Raimalwala, Aerospace, University of Toronto. 2013–2015  
Topic: “Transfer learning for robotics: can a robot learn from another robot’s data?” Coadvised with Prof. B. Francis, ECE, University of Toronto. Now Junior Robotics Engineer at Mission Control Space Services.
- [3] Chris McKinnon, Aerospace, University of Toronto. 2013–2015  
Topic: “Data-driven, force-based interaction for quadrotors.” Now Ph.D. student at the University of Toronto, Aerospace, in my group.

**M.Sc. Thesis** (6-month, full-time research project)

- [1] Andreas Hock, Engineering Cybernetics, University of Stuttgart. Spring 2016  
Topic: “Distributed iterative learning control for multi-agent systems.”
- [2] Felix Berkenkamp, Mechanical Engineering, ETH Zurich. Fall 2014  
Topic: “Learning-based robust control: robustness guarantees for learning systems.” Now Ph.D. student at ETH Zurich, Computer Science, with Prof. Andreas Krause and me.
- [3] Fabian L. Mueller, Robotics, ETH Zurich. Spring 2011  
Topic: “Implementation and evaluation of iterative learning algorithms for precise quadcopter trajectory tracking.” Now Ph.D. student at IBM Research and ETH Zurich, Electrical Engineering.
- [4] Federico Augugliaro, Robotics, ETH Zurich. Spring 2011  
Topic: “Dancing quadcopters: trajectory generation, feasibility, and user interface.” **2012 Willi Studer Prize** for best ETH master degree in Robotics. **2012 Hans-Eggenberger Award** for outstanding Master thesis research (CHF 5K prize and CHF 100K for follow-up research project). Continued as Ph.D. student at ETH Zurich, Mechanical Engineering, with Prof. Raffaello D’Andrea. Now R&D Engineer at Verity Studios AG.
- [5] Philippe Goffin, Robotics, ETH Zurich. Spring 2009  
Topic: “Can we do better than humans do? Learning aerobatic maneuvers from observation.” Continued as Ph.D. student at ETH Zurich, Building Systems, graduated 2014.

**Master Semester Project** (semester-long research project, approx. 7 weeks full-time equivalent)

- [1] Nicolas Degen, Robotics, ETH Zurich. Fall 2013  
Topic: “Analytic comparison of norm-optimal iterative learning schemes.” Continued as M.Sc. student at ETH Zurich, Robotics.
- [2] Clemens Wiltsche, Electrical Engineering, ETH Zurich. Spring 2011  
Topic: “Precise synchronized periodic quadcopter motion in three dimensions based on feed-forward parameter identification.” Continued as Ph.D. student at the University of Oxford, Computer Science, with Prof. Marta Kwiatkowska. Now Deployment Strategist at Palantir Technologies.
- [3] Raphael Wüest, Robotics, ETH Zurich. Fall 2010  
Topic: “New synchronized quadcopter motions: bounce motions in 2D.” Now Development Engineer at Trumpf Maschinen AG, Baar, Switzerland.
- [4] Federico Augugliaro, Robotics, ETH Zurich. Spring 2010  
Topic: “A platform for dance performances with multiple quadcopters: graphical user interface and demonstration.” Continued as Ph.D. student at ETH Zurich, Mechanical Engineering, with Prof. Raffaello D’Andrea. Now R&D Engineer at Verity Studios AG.

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- [5] Javier Alonso-Mora, Robotics, ETH Zurich. Spring 2009  
Topic: “Extending iterative learning control to multi-agent systems.” **2010 Willi Studer Prize** for best ETH master degree in Robotics. Now Postdoc at MIT with Prof. Daniela Rus.
- [6] Sonja Stüdl, Electrical Engineering, ETH Zurich. Spring 2009  
Topic: “Fly! Iterative learning control for quadcopters.” Now Research Associate at the University of Newcastle, Australia.

**B.A.Sc. Thesis** (3-month to year-long research project, approx. 3 months full time equivalent)

- [1] SiQi Zhou, Engineering Science, University of Toronto. Fall 2015–Spring 2016  
Topic: “Transformation between kinematic point and unicycle model for leader-follower formation problems.”  
Now M.A.Sc. student at the University of Toronto in my group.
- [2] Rakibur Rahman, Engineering Science, University of Toronto. Fall 2015–Spring 2016  
Topic: “Analysis of the Capabilities of the Intel RealSense Camera.” Now Infrastructure Analyst at Accenture.
- [3] Masha Itkina, Engineering Science, University of Toronto. Fall 2015–Spring 2016  
Topic: “Towards multi-agent learning.” Now M.A.Sc. student at Stanford University, Aerospace.
- [4] Spencer Richards, Engineering Science, University of Toronto. Fall 2015–Spring 2016  
Topic: “Sensor fusion and state estimation for indoor-outdoor Flight of an octocopter.” Now M.Sc. student at ETH Zurich, Robotics, Systems and Control.
- [5] YihTang Yeo, Engineering Science, University of Toronto. Fall 2015–Spring 2016  
Topic: “Controller design for quadrotors with cable-suspended payload for fire-fighting missions.” Now M.A.Sc. student at the University of Toronto with Prof. Hugh Liu.
- [6] Adrian Esser, Engineering Science, University of Toronto. Fall 2015–Spring 2016  
Topic: “Development of a programmable unmanned aerial vehicle for nuclear reactor face surveying.” Now B.A.Sc. student at the University of Toronto.
- [7] Tristan Laidlow, Engineering Science, University of Toronto. Fall 2014–Spring 2015  
Topic: “A framework for real-time motion generation for aerial vehicles in response to musical signals.” Now Ph.D. student at Imperial College London with Prof. Andrew Davison.
- [8] Xingbo Wang, Engineering Science, University of Toronto. Fall 2013–Spring 2014  
Topic: “Physically interactive flying robots.” Now M.A.Sc. student at the University of Toronto with Prof. Manfredi Maggiore.
- [9] Andreas Pfrunder, Mechanical Engineering, ETH Zurich. Spring 2013  
Topic: “Visual teach and repeat for autonomous quadrotor flight.” Coadvised with Profs. Tim Barfoot and Roland Siegwart. Now Intern at Commonwealth Scientific and Industrial Research Organisation (CSIRO), Brisbane.
- [10] Raphael Schottenhaml, Mechanical Engineering, ETH Zurich. Spring 2011  
Topic: “Extensions to the rhythmic side-to-side motion.” Now M.Sc. student at ETH Zurich, Mechanical Engineering.
- [11] Benjamin Troxler, Mechanical Engineering, ETH Zurich. Spring 2009  
Topic: “Generation of acrobatic trajectories for quadcopters.” Now Software Engineer at Helbling Technik AG Aarau, Switzerland.
- [12] Fabian L. Mueller, Mechanical Engineering, ETH Zurich. Spring 2009  
Topic: “An automated testing platform for learning algorithms.” Now Ph.D. student at IBM Research and ETH Zurich, Electrical Engineering.

- [13] Federico Augugliaro, Mechanical Engineering, ETH Zurich. Spring 2009  
 Topic: “Synchronizing motion and music beat – a dancing quadrocopter.” Continued as Ph.D. student at ETH Zurich, Mechanical Engineering, with Prof. Raffaello D’Andrea. Now R&D Engineer at Verity Studios AG.

### Studies on Mechatronics (semester-long literature study)

- [1] Timon Heinis, Mechanical Engineering, ETH Zurich. Spring 2011  
 Topic: “Exploring software tools for music analysis.” Now Research Associate at ETH Zurich, Product Development Group.
- [2] Robert Stettler, Mechanical Engineering, ETH Zurich. Spring 2010  
 Topic: “Interaction and information sharing between multiple systems.” Now Commissioning and Software Engineer at MECOS AG.
- [3] Benjamin Troxler, Mechanical Engineering, ETH Zurich. Spring 2009  
 Topic: “A quadrocopter learns acrobatic maneuvers – trajectory generation and control methods.” Now Software Engineer at Helbling Technik AG Aarau, Switzerland.
- [4] Fabian L. Mueller, Mechanical Engineering, ETH Zurich. Spring 2009  
 Topic: “Swing-up of a pendulum: a benchmark problem.” Now Ph.D. student at IBM Research and ETH Zurich, Electrical Engineering.
- [5] Federico Augugliaro, Mechanical Engineering, ETH Zurich. Spring 2009  
 Topic: “Synchronizing motion and music beat.” Continued as Ph.D. student at ETH Zurich, Mechanical Engineering, with Prof. Raffaello D’Andrea. Now R&D Engineer at Verity Studios AG.

### Undergraduate Summer Internship (four-month summer research)

- [1] Qiyang Li, Engineering Science, University of Toronto. 2016  
 Supported by First Year Summer Research Fellowship from the Faculty of Applied Science & Engineering.
- [2] Zining Zhu, Engineering Science, University of Toronto. 2016  
 Partially supported by an Engineering Science Research Opportunities Program (ESROP) Award.
- [3] Xuchan Bao, Engineering Science, University of Toronto. 2016  
 Partially supported by a Kenneth Carless Smith Engineering Science Research Fellowship.
- [4] Jingxing Qian, Engineering Science, University of Toronto. 2016  
 Partially supported by a UTIAS Summer Research Fellowship.
- [5] Adrian Esser, Engineering Science, University of Toronto. 2015  
 Supported by a University of Toronto Excellence Award.
- [6] Yilun Wu, Engineering Science, University of Toronto. 2015  
 Supported by an Undergraduate Summer Research Fellowship from the Faculty of Applied Science & Engineering.
- [7] Yuqing Tang, Engineering Science, University of Toronto. 2014  
 Partially supported by an NSERC Undergraduate Student Research Award.
- [8] SiQi Zhou, Engineering Science, University of Toronto. 2014  
 Partially supported by an NSERC Undergraduate Student Research Award. Coadvised with Prof. Bruce Francis, University of Toronto, ECE.
- [9] Natasha Dalal, Computer Science, University of Toronto. 2014
- [10] Rikky Duivenvoorden, Engineering Science, University of Toronto. 2014
- [11] Tristan Laidlow, Engineering Science, University of Toronto. 2014

- [12] Xingbo Wang, Engineering Science, University of Toronto. 2014  
Partially supported by an NSERC Undergraduate Student Research Award.
- [13] Jai Bansal, Engineering Science, University of Toronto. 2013
- [14] Ahmed Khan, Engineering Science, University of Toronto. 2013  
Partially supported by an NSERC Undergraduate Student Research Award.
- [15] Behzad Abghari, Engineering Science, University of Toronto. 2013  
Supported by an Undergraduate Summer Research Fellowship from the Faculty of Applied Science & Engineering.
- [16] Tristan Laidlow, Engineering Science, University of Toronto. 2013  
Partially supported by an NSERC Undergraduate Student Research Award.

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## TEACHING EXPERIENCE

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### *Lecturer*

**Design of Autonomous UAVs**, University of Toronto. Spring 2017  
Graduate course, co-lecturer for section on Quadrotor Dynamics & Control, approx. 30 students, English. *Newly developed course.* [[course information](#)]

**Fundamentals of UAVs**, University of Toronto. Spring 2016, Fall 2016  
Graduate course, co-lecturer for section on Quadrotor Dynamics & Control, approx. 30 students, English. *Newly developed course.* [[course information](#)]

**Mathematics for Robotics**, Engineering Science, University of Toronto. Fall 2015, 2016, 2017  
Undergraduate course, approx. 80 students, English. *Newly developed course.* [[Syllabus](#)]

**Control Systems**, Engineering Science, University of Toronto. Spring 2014, 2015, 2016  
Undergraduate course, approx. 60 students, English. Course includes four labs, 3 hours each. *Newly developed labs.*

**Dynamic Programming and Optimal Control**, ETH Zurich. Fall 2012  
Graduate course, approx. 150 students, English. Course includes programming exercises.

### *Faculty Advisor for Student Competition Teams*

**SAE/GM AutoDrive Challenge.** since 04/2017  
A team of 50 undergraduate and graduate students from the University of Toronto compete in this 3-year self-driving car competition. I am the Principal Faculty Advisor of the team. [[team web page](#)]

**University of Toronto Aerospace Team (UTAT).** since 2015  
The Aerospace Team is a student club participating in 6 national and international aerospace competitions each year, and engaging nearly 100 active undergraduate and graduate students. UTAT has won more than 35 awards in the past five years alone, including recognition from NASA, the UN, and six annual domestic and international competitions. I am a Faculty Advisor for the Unmanned Aerial Vehicles (multirotor and fixed-wing drones) division. [[team web page](#)]

### *Invited Teaching Activities*

**Summer School on Decision Making and Uncertainty, Magdeburg, Germany.** 08/2017  
Invited speaker at the 5th Summer School of the International Max Planck Research School (IMPRS) for Advanced Methods in Process and Systems Engineering.

**Summer School on Autonomous Micro Aerial Vehicles, Sankt Augustin, Germany.** 08/2015

Invited speaker at this summer school, an activity of the European Project TRADR, held at the Fraunhofer Institute for Intelligent Analysis and Information Systems, “Controls for multi-rotor vehicles: from model-based to learning-enabled approaches.”

**Digital Dramaturgy in Performance Course, University of Toronto, Canada.** 03/2015

Invited speaker at this course offered by the Centre for Drama, Theatre and Performance Studies, “Robots on stage?!”

**Engineering Science Praxis, University of Toronto, Canada.** 03/2013, 02/2015, 10/2016

Invited speaker at this lecture series for undergraduate students, “How flying robots learn to fly: Controls for autonomous aerial vehicles.”

**Summer School on Autonomous Micro Aerial Vehicles, Zurich, Switzerland.** 07/2011

Invited speaker at the robotics summer school organized by Prof. R. Siegwart and team at ETH Zurich, “Coordination and synchronization for a rhythmic flight performance.”

□ *Teaching Assistant***Recursive Estimation, ETH Zurich.** Spring 2010, 2011

Graduate course, approx. 80 students, English. My responsibilities included teaching weekly recitation classes, developing problem sets and exams, grading, offering student office hours, maintaining the class web page, and overall class administration. I helped develop this new course taught first time in Spring 2010. Lecturer: Prof. Raffaello D’Andrea.

**Dynamic Programming and Optimal Control, ETH Zurich.** Spring 2008, 2009

Graduate course, approx. 80 students, English. My responsibilities included teaching weekly recitation classes, developing problem sets and exams, grading, offering student office hours, maintaining the class web page, and overall class administration. I helped develop this new course taught first time in Spring 2008. Lecturer: Prof. Raffaello D’Andrea.

**Control Theory I, University of Stuttgart.** Spring 2006

Graduate course, approx. 30 students, German. I supervised students during their practical laboratory work. Lecturer: Prof. Frank Allgöwer.

**Thermodynamics I, University of Stuttgart.** Spring 2005

Undergraduate course, approx. 10 students, German. Guided undergraduate students in their project work focusing on a practical problem in the field of thermodynamics: the generation of energy through warm water heated by the sun. Lecturer: Prof. Hans Hasse.

**Advanced Mathematics I, University of Stuttgart.** Fall 2004

Undergraduate course, approx. 25 students, German. Taught weekly student exercise classes. Lecturer: Prof. Klaus Höllig.

**Engineering Mechanics I, University of Stuttgart.** Fall 2003, Spring 2004

Undergraduate course, approx. 50 students, German. Taught weekly student exercise classes. Lecturer: Prof. Peter Eberhard.

□ *Teaching Innovation***Pilot Project: Integrating Feedback into Your Teaching, University of Toronto.** Fall 2016

With my course ‘Mathematics for Robotics’, I am participating in this pilot project initiated by the Centre for Teaching Support & Innovation (CTSI) at the University of Toronto.

**Gradescope for Online Marking**, University of Toronto. 01/2016  
 I introduced Gradescope at the University of Toronto for faster, fairer and collaborative marking online. I used it for the course ‘Control Systems’ in Spring 2016 for the first time. [[web page](#)]

**EduApp for Real-Time Classroom Feedback**, ETH Zurich. 09/2012  
 I used ETH’s EduApp in the graduate course ‘Dynamic Programming and Optimal Control’ to ask 2-3 questions related to the key learning objectives. Those questions are answered by the students using their internet-capable devices and the results can be displayed during the class or in the next class. [[web page](#)]

□ *Instructional Development Activities*

**Workshop: Best Practices in Graduate Supervision**, University of Toronto. 11/2014  
 I attended this one-day workshop offered by the Centre for Teaching Support and Innovation (CTSI) focusing on setting up your students for success.

**Workshop: Building Your Portal Course**, University of Toronto. 01/2014  
 I attended this half-day workshop on the university’s online course management system offered by the Centre for Teaching Support and Innovation (CTSI).

**Several Teaching Workshops**, ETH Zurich. 2009–2012  
 I participated in various several-day workshops focusing on didactic skills including ‘Didactic Workshop for Newcomers’, ‘Implementation of Computerized Exercises and Exams’, and ‘Alignment of Learning Objectives, Performance Assessment and Teaching Methods’.

PROFESSIONAL ACTIVITIES

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□ *Editor Positions*

**International Journal of Robotics Research (IJRR)**, Associate Editor. since 2017  
**IEEE Control Systems Society Video Clip Contest**, Chair of Jury. 2017  
**Robotics: Science and Systems Conference (RSS)**, Area Chair. 2016–2017  
**IEEE/RSJ Int. Conf. on Intelligent Robots & Systems (IROS)**, Associate Editor. 2015  
**Frontiers in Robotics and AI, Specialty: Robotic Control Systems**, Review Editor. since 2015  
**Mechatronics Journal**, Associate Editor. 2013–2016

□ *Workshop Organization*

**Invited Session on Learning-Based Control.** 2017  
 Organizer of this session together with Prof. M. Zeilinger (ETH Zurich) and Dr. S. Trimpe (Max Planck Institute for Intelligent Systems, Tuebingen) to be held at the 2017 IEEE Conference on Decision and Control (CDC). Session proposal submitted.

**Invited Session on Learning-Based Control.** 2016  
 Organizer of this session together with Prof. M. Zeilinger (ETH Zurich) and Dr. S. Trimpe (Max Planck Institute for Intelligent Systems, Tuebingen) to be held at the 2016 IEEE Conference on Decision and Control (CDC).

**Second Workshop on Machine Learning in Planning and Control of Robot Motion.** 2015  
 Held at the 2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). [[web page](#)]

**International Workshop on Multi Unmanned Vehicles Systems (MUVS).** 2014  
Held in Compiègne, France. Second workshop after a first successful one held in [Austria](#) in 2013. [[web page](#)]

**Workshop on Machine Learning in Planning and Control of Robot Motion.** 2014  
Held at the 2014 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). Biggest workshop at IROS 2014. [[web page](#)]

□ *Technical/Program Committees*

**Conference on Field and Service Robotics (FSR).** 2017  
I am serving on the International Program Committee.

**IFAC World Congress Invited Track for Live Robotic Demonstrations.** 2016–2017  
My responsibilities include reviewing submitted proposals for robotics demonstrations to be exhibited during the IFAC World Congress.

**Conference on Field and Service Robotics (FSR).** 2015  
I was the Technical Tour Chair for the 2015 conference in Toronto, Canada. My responsibilities included organizing the technical tour and robot demonstrations as well as giving a short talk about the activities at our institute.

**IEEE Control Systems Society Video Clip Contest.** 2015  
I was a jury member of this yearly competition featuring videos that promote the field of automatic control. [[web page](#)]

**DroNet Workshop at MobiSys.** 2015  
Workshop on ‘Micro Aerial Vehicle Networks, Systems, and Applications for Civilian Use’ held at the International Conference on Mobile Systems, Applications, and Services (MobiSys). My responsibilities included reviewing submitted papers. [[web page](#)]

**International Conference on Computer and Robot Vision (CRV).** 2015  
My responsibilities included reviewing submitted papers. [[web page](#)]

**Internat. Workshop on Wireless Sensor, Actuator & Robot Networks (WiSARN).** since 2014  
My responsibilities included reviewing submitted papers. [[web page](#)]

**AAAI (Assoc. for the Advancement of Artificial Intelligence) Video Competition.** since 2014  
I was a judge of this yearly competition showing the latest results in AI and robotics in video. [[web page](#)]

**Techn. Committee on Control Education, Int. Fed. of Automatic Control (IFAC).** since 2014  
My responsibilities include organizing outreach workshops and special sessions on controls education, and engaging the other technical committees in controls education issues and activities. [[web page](#)]

**International Conference of Control, Dynamic Systems, and Robotics (CDSR).** since 2014  
My responsibilities include reviewing submitted papers.

**Techn. Committee on Control Education, IEEE Control Systems Society (CSS).** since 2011  
My responsibilities include organizing workshops for school teachers and students. [[web page](#)]

**Techn. Committee on Control Education, American Automatic Control Council.** since 2011  
My responsibilities include organizing outreach workshops and special sessions on controls education, and engaging the other technical committees in controls education issues and activities. [[web page](#)]

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□ *Internal University Committees and Service*

I served on committees both at the departmental level (University of Toronto Institute for Aerospace Studies; short: UTIAS) as well as at the Faculty level (Faculty of Applied Science & Engineering, University of Toronto; short: FASE).

**Aerial Robotics International Research Symposium, UTIAS.** 2017

I am one of the co-organizers for this two-day symposium featuring high-profile speakers such as Prof. Siegwart (ETH Zurich), Prof. Floreano (EPF Lausanne), Prof. How (MIT) and Prof. Singh (CMU) as well as a panel with industry representatives moderated by Hallie Siegel. [[web page](#)]

**Robotics Strategic Planning Committee, FASE.** 2017

The mandate is to evaluate existing robotics activities and initiatives at the University of Toronto and offer a unified plan for the future.

**Robotics Talk for Advancement Staff, FASE.** 02/2017

I gave a presentation on the field of robotics and robotics research efforts at the University to staff from University Advancement, to help them understand the field and approach potential donors.

**Aerial Robotics Seminar Series, UTIAS.** since Fall 2016

I am a co-organizer of the CARRE (Centre for Aerial Robotics Research and Education) Aerial Robotics Seminar Series, which invites one speaker per month on average.

**Faculty Search Committee, UTIAS.** 2015, 2017

I am part of the search committee for a new faculty position at the Institute for Aerospace Studies.

**CARRE Research Symposium, UTIAS.** 2016

I helped organizing this annual event of the Centre for Aerial Robotics Research and Education (CARRE), which includes student and industry talks, and networking activities.

**UTIAS Director Advisory Committee, FASE.** 2016

I was part of the committee advising on UTIAS' new director.

**Undergraduate Lab Review Committee, UTIAS.** 2015

I am part of a team conducting a broad review of the laboratory components of our undergraduate courses and making recommendations for improving both the quality and the efficiency of the labs offered by UTIAS.

**Curriculum Design for Robotics Option, FASE.** 2014–2015

I helped to design the curriculum for the new undergraduate major in Robotics offered to students in the Engineering Science undergraduate program.

**Student Recruitment, FASE.** since 2013

I am supporting the Faculty in recruiting top high-school students for our undergraduate programs; in particular, top female students. For details, please refer to Outreach Activities and Public Lectures above. As a result of these and many other efforts of the Faculty, we have a record number of 30.6% female first-year students in our engineering programs in Fall 2015 compared to an average of about 20% in North America.

**Planning & Fundraising Committees, UTIAS.** since 2013

I am helping to define the long-term strategy of the institute and to raise funds from industry and private donors.



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□ *Grant Proposal Reviewing*

<b>Canada Foundation for Innovation (CFI)</b> , John R. Evans Leaders Fund.	2016
<b>European Robotics Challenges</b> , short proposals for admission to Stage II. [ <a href="#">web page</a> ]	2015
<b>European Research Council</b> , Consolidator Grant.	2014
<b>Mitacs Accelerate, Canada.</b> [ <a href="#">web page</a> ]	2014

□ *Journal and Conference Reviewing*

**Journal Papers** since 2008

Automatica (2011), Autonomous Robots (2013), Control Engineering Practice (2012, 2014), IEEE Transactions on Aerospace and Electronic Systems (2014), IEEE Transactions on Automatic Control (2008, 2009), IEEE Transactions on Robotics (2013), International Journal of Robotics Research (2017), Mechanical Systems and Signal Processing (2012), Mechatronics (2013), SIAM Journal on Control and Optimization (2008).

**Conference Papers** since 2008

American Control Conference (ACC), Conference on Neural Information Processing Systems (NIPS), Conference on Robot Learning (CoRL), European Control Conference (ECC), IEEE Conference on Decision and Control (CDC), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE International Conference on Rehabilitation Robotics (ICORR), IEEE International Conference on Robotics and Automation (ICRA), IEEE Multi-Conference on Systems and Control (MSC), IFAC World Congress, Robotics: Science and Systems (RSS).

□ *Ph.D. Examination Committees*

**Current**

Adam Sniderman (supervisor: G. D'Eleuterio), Patrick McGarey (T. Barfoot), Michael Paton (T. Barfoot), Valentin Peretroukhin (J. Kelly), Lee Clement (J. Kelly), Tianhang Teng (P. Grant), Lingzhu Xiang (J. Kelly), Peter Berzi (T. Barfoot), Qingrui Zhang (H. Liu), Kirk MacTavish (T. Barfoot), Mona Gridseth (T. Barfoot).

**Past**

Milan Erdelj (T. Razafindralambo, INRIA, Lille, France; graduated 2014), Jing Yang (M. Jenkin, York University, Canada; graduated 2014).

□ *Professional Memberships*

**Institute of Electrical and Electronics Engineers (IEEE)**, Member.

**IEEE Robotics and Automation Society**, Member.

**IEEE Control Systems Society**, Member.

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OUTREACH

In addition to our participation in major science exhibitions and outreach events, we have published more than 45 research videos on our Youtube channel [[link](#)].

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□ *Exhibitions (Flying Machine Arena)*<sup>3</sup>

**TED Global**, Edinburgh, UK. 06/2013

Demonstration of the Flying Machine Arena during Raffaello D'Andrea's TED talk followed by a five-day live demonstration during the remaining days of the TED conference.

**Zurich Minds**, Zurich, Switzerland. 12/2012

Zurich Minds is a flagship conference in Switzerland with a similar concept as the TED conferences. Raffaello D'Andrea used the Flying Machine Arena research in his talk to demonstrate the principles of feedback control. More than 500 invited guests attended.

**Google I/O**, San Francisco, USA. 06/2012

The Flying Machine Arena team was invited to showcase its research at Google's yearly developers conference. The event was attended by more than 1K people.

**Hannover Messe**, Hannover, Germany. 04/2012

The Hannover Messe is a leading, annual showcase for industrial technology. Over five days, we provided 25 flight shows reaching more than 5K visitors.

□ *Science Promotion Events*<sup>4</sup>

**NSERC International Day of Women and Girls in Science Panel**, Toronto, Canada. 02/2017

I was on the panel with The Honourable Kirsty Duncan, Canada's Minister of Science, The Honourable Maryam Monsef, Canada's Minister of Status of Women, the CEO of Actua and a representative of Facebook's Oculus team. [[news article](#)]

**Doors Open**, Toronto, Canada. 05/2016

Around 400 visitors came to the institute for a tour during this two-day event and saw a demonstration of our flying robots. [[event page](#)]

**Science Rendezvous**, Toronto, Canada. 05/2016

Annual science festival attracting 200,000 visitors Canada-wide. My team gave a science talk and showcased our robots during the festival. [[event page](#)]

**Engineering Showcase**, Toronto, Canada. 06/2015

Robot demonstration as part of festivities around the ground-breaking of the new engineering building at the University of Toronto, the Centre for Engineering Innovation & Entrepreneurship (CEIE).

**Summer STEM Camp**, Toronto, Canada. 07/2014

Question-and-answer session with around 50 attendees.

**Google[x] Fiesta**, Palo Alto, USA. 05/2013

One-day live demo on "Aerial Robotics for Photo and Videography" with Z. Marom, S. Lupashin and D. Kaneshige.

**Numerous demonstrations of our robotics research**, University of Toronto, Canada. since 01/2013

We regularly demonstrate our outdoor autonomous driving research and indoor flight research to visitors. We had 1,000 visitors in the past year alone. Visitors included *politicians and government officials* (including the Canadian Minister of State for Science and Technology, various Members of Parliament, representatives from Industry Canada, and delegations from Brazil, China and Singapore), *journalists and science writers* (from Canada, USA, Austria, Japan, UK, Italy, and Belgium), *technology experts* (for example, 80 attendees of the Tenth Conference on Field and

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<sup>3</sup>My Ph.D. research was conducted in the Flying Machine Arena and led to demonstrations shown during the exhibitions mentioned above. For more details about the Flying Machine Arena aerial robotics testbed, visit <http://flyingmachinearena.org/>.

<sup>4</sup>These events are in addition to numerous invited talks for a general audience listed in the 'Invited Talks' section above and in addition to various media coverage, see section 'Select Media Coverage' below.

Service Robotics and representatives from NASA Ames), *industry representatives, donors*, and many *high-school, undergraduate and graduate student groups* from Canada and abroad.

**Week on Science and Technology**, Zurich, Switzerland. 02/2012

Day-long interactive presentation of our research at this high school event at the Literargymnasium Rämibühl. Attended by around 100 students.

**Numerous demonstrations in the Flying Machine Arena**, Zurich, Switzerland. 2009–2012

We demonstrated our aerial robotics research at ETH Zurich to numerous visitors ranging from academic guests, groups of students to prominent engineers, businessmen and government officials. Attracted nearly 1K visitors (around 30 demonstrations and 300 visitors per year).

**Maturandentage**, ETH Zurich, Switzerland. 2009–2011

Annual open house day at ETH Zurich for high school seniors with information sessions presenting study programs and research projects.

**National Daughter's Day (later: National Future Day)**, Zurich, Switzerland. 2008–2011

Swiss nation-wide initiative showing 10-13 year-old boys and girls gender-untypical fields of work with the goal of fostering equal career opportunities for men and women. Around 40 visitors each year.

**TecNight@Kanti**, Zurich, Switzerland. 11/2011

An initiative of the Swiss Academy of Engineering Sciences (SATW) to bring innovative projects, people, and companies to Swiss high schools during a science night; participated in the science talk “Switzerland needs engineers.”

**Researchers' Night**, Zurich, Switzerland. 2008–2009

Yearly, city-wide exhibition in Zurich presenting innovative projects and latest research results to the public; attracted more than 25K visitors each year.

**Promotional Video**, ETH Zurich, Switzerland. 07/2008

I managed the group's activities for a promotional video aimed at incoming ETH engineering students.

## SELECT MEDIA COVERAGE

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### □ Television

**CBC News**, Interview and Demonstration, “Defibrillator-equipped drones.” 11/2016

Canadian crown corporation that serves as the national public radio and television broadcaster. Aired 15/11/2016. This story was featured later in *more than 40 newspapers and radio shows* reaching more than 6M people (according to typical media analyses). Outlets included CBC Radio 1, CBC News [\[article\]](#), Toronto Star [\[article\]](#), The Globe and Mail [\[article\]](#), and several German newspapers. [\[media summary\]](#)

**TVO**, Interview, “Here come the robots.” 03/2016

Canadian publicly funded educational television station founded 1970. [\[video\]](#)

**BBC Click**, Video, “The swarming drones that can float on water.” 04/2015

UK's public-service broadcaster BBC covered our drone project *Waterfly*, a joint project with the MIT SENSEable City Lab. [\[video\]](#)

**CP24 Live**, Interview, “Amazon Drone Testing in Canada.” 03/2015

The Canadian news channel interviewed me about the opportunities for drone research in Canada. Aired 31/03/2015.

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- City TV**, Interview and Demonstration, “Live at the University of Toronto.” 09/2014  
We gave a brief demonstration of our aerial robotics research as part of the Breakfast Television show. Aired 03/09/2014. [[video](#)]
- n-tv**, Interview and Flight Demonstration, “What do drones get to do?” 12/2012  
German news channel. As part of the show *n-tv Ratgeber*. Aired 06/08/2013. [[video and online article](#)]
- ZDF**, Flight Demonstration, “The World of Robots: Eric Controls Flying Robots.” 04/2012  
German, public-service television. As part of the show *pur+*. Aired 28/04/2012.
- Discovery Channel Canada**, Flight Demonstration. 01/2012  
As part of the show *Daily Planet*. Aired 30/01/2012.
- PRO7**, Flight Demonstration. 08/2011  
As part of the show *Galileo*. Aired 29/08/2011 in Germany, Austria and Switzerland.
- 3sat**, Flight Demonstration, “Quadrokopter extrem.” 02/2011  
As part of the show *neues*. Aired 25/02/2011 in Germany, Austria and Switzerland.
- SF Swiss Television**, Flight Demonstration. 02/2011  
As part of the show *Einstein*. Aired 10/02/2011.
- Discovery Channel Canada**, Flight Demonstration and Interview, “Robots Today.” 01/2011  
As part of the show *Daily Planet*. Aired 20/01/2011.
- NZZ Format**, Flight Demonstration, “Die Intelligenz der Roboter – The intelligence of robots.” 08/2010  
TV show in German-speaking public TV. Aired 04/08/2010 in Germany, Austria and Switzerland.
- SF Swiss Television**, Flight Demonstration, “Roboterballet im Warenlager.” 03/2009  
As part of the show *Einstein*. Aired 05/03/2009.
- *Radio*
- CBC Radio One**, Interview, “Pilotless planes.” 06/2017  
Canadian crown corporation that serves as the national public radio and television broadcaster. A total of 15 interviews with local radio stations on Boeing’s announcement of pilotless planes. Aired 08/06/2017.
- Deutschlandradio Kultur**, Interview, “Autonomous flying vehicles.” 08/2015  
National German public broadcasting radio. Aired 25/08/2015. [[link to audio](#)]
- WDR 5 Radio**, Interview, “Drone Swarms.” 06/2015  
German public-broadcasting institution, as part of the science show ‘Leonardo’. Aired 11/06/2015. [[link to audio](#)]
- *Print*
- Swissquote Magazine**, Article/Interview, “How drones are changing the world.” 07/2016  
Switzerland’s largest business publication. [[article](#)]
- Technology Review Germany**, Article/Interview, “Daring more autonomy.” 05/2016  
Technology magazine. [[article](#)]
- Skulematters**, Article/Interview, “Eight women shaping the future of engineering.” 02/2016  
Alumni magazine of U of T Engineering. [[online article](#)]

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- The Globe and Mail**, Article/Interview, “A drone maker flies high.” 06/2015  
Nationally distributed Canadian newspaper. [article]
- The Boston Globe**, Article, “MIT’s entry in Dubai’s ‘Drones For Good’ contest is...” 02/2015  
American newspaper. Article about the collaborative project *Waterfly* with the MIT SENSEable City Lab. [article]
- University of Toronto Engineering**, Article, “Year in Review 2012–2013.” 07/2013  
University-internal producer. [article]
- SonntagsZeitung**, Article, “Die Dressur der Drohnen.” 11/2012  
Swiss weekly newspaper. [article]
- c’t**, Article, “Flugzirkus.” 07/2012  
German computer magazine. [article]
- Le Matin**, Article, “Ici. On Dompte Les Robots Volants.” 04/2011  
Swiss daily newspaper (in French). [article]
- *Online Video*
- Research2Reality**, Interview. 07/2016  
Social media initiative promoting Canadian scientists who are engaged in innovative and leading-edge research. [video]
- University of Toronto Engineering**, Interview, “A Professor’s Perspective.” 10/2013  
University-internal producer. [video]
- University of Toronto**, Interview, “Academic Appointment Interview.” 05/2013  
University-internal producer. [video]
- *Online Articles*
- The Varsity**, Article/Interview, “Promoting women in STEM from an early age.” 02/2017  
The University of Toronto’s student newspaper (since 1880). [article]
- Research2Reality**, Interview. 07/2016  
Social media initiative promoting Canadian scientists who are engaged in innovative and leading-edge research. [article]
- NSERC Canada Chair for Women in Science and Engineering**, Online Feature. 06/2015  
Online article “Special Feature: Women in Aerospace.” [web page]
- CBC**, Interview, “Amazon tests delivery drones at a secret site in Canada – here’s why.” 03/2015  
Canadian national public radio, television and online content broadcaster. [article]
- NBC News**, Article, “Eco-Drones Aid Researchers in Fight to Save the Environment.” 02/2015  
American commercial broadcast television and radio network. Article about the collaborative project *Waterfly* with the MIT SENSEable City Lab. [article]
- CNN**, Article, “These drones have a higher calling.” 02/2015  
American TV channel. Article about the collaborative project *Waterfly* with the MIT SENSEable City Lab. [article]
- U of T Engineering News**, Article, “Teaching flying robots to learn.” 05/2015  
University-internal producer. [article]

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- Popular Science**, Article, “Project Breadcrumb Helps Lost Drones Find Their Way Home.” 03/2015  
Article about our research collaboration with the UAV startup *PrecisionHawk*. [[article](#)]
- Wired Germany**, Article, “Zukunft der Musik / Diese Drohne ist ein fliegendes Schlagzeug.” 02/2015  
Article about the collaborative project *Flying Drum Machine* with WaveDNA Inc. [[article](#)]
- Daily Commercial News**, Interview, “Drones could keep watchful eye on construction sites.” 01/2015  
Article about potential applications of UAVs in the construction industry. [[article](#)]
- Market Wired**, Article, “Intelligent Drones, the Evolution of Depression and ...” 01/2015  
Article about an equipment grant I won. [[article](#)]
- Fast Company**, Article, “Drone Plus Drum Machine Equals This Flying Musical Instrument.” 12/2014  
Article about the collaborative project *Flying Drum Machine* with WaveDNA Inc. [[article](#)]
- Next City**, Article, “The Technology That Everyone Thinks Is Evil Can Do Good in Cities” 11/2014  
Article about the collaborative project *Waterfly* with the MIT SENSEable City Lab. [[article](#)]
- U of T Engineering News**, Article, “Teaching flying robots to learn.” 05/2014  
University-internal producer. [[article](#)]
- New Scientist**, Article and Video, “Slaloming robot minicopter learns from its mistakes.” 12/2012  
Article about our robot learning results. [[article](#)]
- Robohub**, Article, “Quadrocopter learns from its mistakes, perfects air racing.” 11/2012  
Professional robotics news web page. [[article](#)]
- BotJunkie**, Article, “Quadrotors Learn New Dance.” 09/2010  
Robotics news web page. [[article](#)]
- BotJunkie**, Article, “Autonomous Quadrotors Dance Together.” 06/2010  
Robotics news web page. [[article](#)]

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## EXTENDED RESEARCH VISITS

- NCFRN Robot Field Trials**, Ottawa, Canada. 05/2017  
Yearly, week-long event of the NSERC Canadian Field Robotics Network. The event includes talks from researchers, and industry and government representatives as well as robot demonstrations in realistic, outdoor environments.
- Interdisciplinary Workshop on Autonomous Systems**, Austin, USA. 04/2016  
Two-day, by-invitation-only workshop on “the integration of control theory, formal methods, learning and human factors for autonomous systems”. [[web page](#)]
- NCFRN Robot Field Trials**, Kelowna, Canada. 06/2015  
Yearly, week-long event of the NSERC Canadian Field Robotics Network. The event includes talks from researchers, and industry and government representatives as well as robot field testing in realistic, outdoor environments.
- NCFRN Robot Field Trials**, Montréal, Canada. 05/2014  
During the 2014 field trials, we tested our learning-based navigation algorithms on a ground robot in diverse and challenging outdoor environments.

**MIT SENSEable City Lab, Boston, USA.**

03–04/2014

First milestone demonstration of our collaborative project *Waterfly* to external stakeholders (representatives of the US Environmental Protection Agency, and of the city of Boston and Cambridge). My team was responsible for the algorithms enabling autonomous multi-vehicle flight. We demonstrated an aerial-imaging drone and a drone landing on water. Main collaborators: Yaniv Turgeman and Chris Green.

**Focus Period on Learning and Adaptation, Lund University, Sweden.**

04/2010

I attended this 3-week focus period on ‘Adaptation and Learning in Autonomous Systems’ at the Lund Center for Control of Complex Engineering Systems. Main organizer: Prof. Anders Rantzer. [[web page](#)]

**Graduate School on Networked Control Systems, Paris, France.**

03/2009

I attended the week-long HYCON-EECI (Hybrid Control – European Embedded Control Institute) Graduate School on ‘Networked Control Systems’. Main organizers: Profs. Richard Murray (California Institute of Technology) and Vijay Gupta (University of Notre Dame).

**IDEAL Research Summer School, Imperial College, London, UK.**

07/2008

This week-long summer school included workshops on international researcher development and was organized by the IDEA League, a network of leading European universities of science and technology including ParisTech, Imperial College London, TU Delft, RWTH Aachen, and ETH Zurich.

**Summer Course on Aspects of Cognitive Robotics, South Tyrol, Italy.**

09/2004

This 2-week summer school included talks by experts and participants, and robot experimentation. It was organized by the universities of Munich, Stuttgart, and Erlangen, Germany.

## PAST RESEARCH PROJECTS AND INTERNSHIPS

**Iterative Trajectory Learning, ETH Zurich, Switzerland.**

2008–2012

I developed algorithms that enable autonomous systems to improve through practice. I performed research into computationally efficient learning algorithms and applied them to state-of-the-art experimental platforms such as highly agile flying vehicles. Work was demonstrated in the Flying Machine Arena<sup>5</sup>. Videos featuring select research results are found here: [[videos](#)]. Advisor: Prof. Raffaello D’Andrea. Outcome: 2 journal papers, 6 conference papers, doctoral thesis, 12 invited talks.

**Rhythmic Multi-Vehicle Flight Performances, ETH Zurich, Switzerland.**

2008–2012

I created rhythmic flight performances of multiple quadcopters to music, and performed research in multi-vehicle coordination, control and synchronization. Work was demonstrated in the Flying Machine Arena. Videos featuring select research results are found here: [[videos](#)]. Advisor: Prof. Raffaello D’Andrea. Outcome: 1 journal paper, 1 book chapter, 5 conference papers, doctoral thesis, 3 invited talks, 4 public exhibitions.

**Distributed Control and Estimation, EADS Astrium GmbH, Friedrichshafen, Germany.**

Fall 2007

At the European Aeronautic Defense and Space Company (EADS), I was part of the group ‘Future Programmes & Missions, Science Missions & Systems’. I worked on the LISA (Laser Interferometer Space Antenna) project. I analyzed and further developed a distributed control and estimation method reducing the signal-to-noise ratio when aiming to measure gravitational waves. Advisor: Dr. Peter Gath. Outcome: 1 conference paper.

**Optimal Control of Hybrid Systems, Georgia Institute of Technology, Atlanta, USA.**

2007

I studied systems with regional dynamics and derived a hybrid Bellman equation for solving the optimal control problem for such systems. Advisor: Prof. Magnus Egerstedt. Outcome: Master thesis, 1 book chapter, 1 conference paper, 1 invited talk.

<sup>5</sup>Aerial robotics testbed: [www.FlyingMachineArena.org](http://www.FlyingMachineArena.org).

**Stability of Networked Systems**, University of Stuttgart, Germany. Summer 2006  
I explored stability analysis methods for time-delay systems and their applicability for analyzing the dynamic behavior of networked systems with communication delays. Advisors: Dr. Ulrich Münz, Prof. Frank Allgöwer. Outcome: semester project thesis, 1 conference paper.

**Robot Painting Applications**, Dürr Systems GmbH, Bietigheim-Bissingen, Germany. Summer 2002  
I helped to optimize the performance of robots used for serial painting of car and airplane bodies.

## ADDITIONAL COURSES

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**Leadership Workshops**, ETH Zurich, Switzerland. 2009–2012  
I participated in various several-day workshops focusing on presentation and management skills:

- *Presentation skills*: Presentation Skills Course for Scientists; Speaking to Large Audiences; The Success Factor Voice; Strengthen your Voice; Developing a Comprehensive Skills' Profile.
- *Management skills*: Work Methodology and Time Management; Giving Feedback as a Management Tool.

**Venture Challenge**, ETH Zurich, Switzerland. Spring 2009  
This semester-long course of tailored educational modules aimed at promoting start-up companies and raising awareness for entrepreneurship at ETH Zurich. It was offered by *VentureLab* in cooperation with Swiss universities. Modules included: Business Opportunity, Business Strategy, New Product Development, Marketing, Communications, Sales and Negotiation, Accounting and Finance, Writing the Business Plan, Intellectual Property, and Legal Issues and Taxes.

**Science Communication Workshops**, ETH Zurich, Switzerland. 11/2008  
I participated in two courses related to presenting research to the general public: 'Science and its Public – Understanding your Audience' (discussing ways to improve the dialog between scientists and the public), and 'Writing Clear Messages' (discussing ways to improve writing techniques for non-specialist audiences).

**Interdisciplinary and Societal Workshops**, Cusanuswerk. 10/2007, 09/2005  
I participated in a week-long workshop on 'Public Appearance – Ways to Improve your Personal Presentation' and in the 2-week summer school on 'Sociology of the Family'. The Cusanuswerk is the scholarship body of the Catholic Church in Germany and awards government scholarships to exceptionally gifted students in all branches of academic study. [[web page](#)]

**Mathematics Seminar**, Max-Born Gymnasium Backnang, Germany. 1999–2000  
I participated in a mathematics seminar on 'Strategies for Solving Mathematical Problems' limited to particularly talented students, offered by my high school.

## VOLUNTEER EXPERIENCE

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**Teaching flute.** 2000–2006

**Orchestra musician**, Musikverein Burgstetten, Germany. 2000–2006

**Managing youth group**, Roman Catholic Church St. Michael Burgstetten, Germany. 1999–2006

**Trainer of gymnastics group**, SKG Erbstetten, Germany. 1995–2002

**Musician at the high school's orchestra**, Max-Born Gymnasium Backnang, Germany. 2000–2002

**Vocalist in Parents-Teachers-Students-Choir**, Max-Born Gymn. Backnang, Germany. 2000–2002



SKILLS AND INTERESTS

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**Languages.**

German (native), English (fluent), French (good knowledge), Italian (basic knowledge).

**Sport.**

Sailing (sailing license for inland waters), Yoga, Running, Skiing.

**Culture.**

Reading and Listening, Exploring and Travelling, Friends and Family.