Antonio Loquercio

Assistant Professor
University of Pennsylvania
Departments of Electrical and Systems Engineering

Email: aloque@seas.upenn.edu
URL: https://antonilo.github.io/
Google Scholar: https://scholar.google.com/citations?user=pbmjtZsAAAAJ&hl=en

Last Update: October 19, 2024

Education

Feb 17–July 21 **Ph.D.** at the *University of Zurich*. Honors: *Summa cum laude*
Dissertation title: *Learning Agile Robot Navigation.*
Dissertation Committee: Prof. Peter Abbeel (UC Berkeley), Prof. Angela Schoellig (U. of Toronto), Prof. Roland Siegwart (ETH)
Advisor: Prof. Davide Scaramuzza

Sep 14–Jan 17 **M.Sc.** in Robotics, System and Control at *ETH Zurich*. Honors: *Summa cum laude*
Overall Grade Point Average: 5.92 (out of 6)
Master Thesis: *Efficient Descriptor Learning for Large Scale Localization*
Advisor: Prof. Roland Siegwart

Sep 11–July 14 **B.Sc.** in Advanced Control and Informatics, *Università Tor Vergata, Rome*
Bachelor Thesis: The Unscented and Extended Kalman Filter in Mobile Robotics
Advisor: Prof. Francesco Martinelli

Awards

2023 **Article featured on the cover of *Nature***
(Paper: Champion-level Drone Racing with Deep Reinforcement Learning)
2023 **Frontiers of Science Award**
(Paper: Learning High-Speed Flight in the Wild, Science Robotics)
2022 **Georges Giralt Ph.D. Award**, the most prestigious recognition
for a PhD dissertation in robotics in Europe.
2022 **Outstanding Reviewer Award**, Robotics and Automation Letters (RA-L).
2020 **Best Paper Award** Honorable Mention, IEEE Transactions on Robotics (T-RO)
(paper: Deep Drone Racing: From Simulation to Reality with Domain Randomization)
(paper: Agile Autonomy: High-Speed Flight with On-Board Sensing and Computing)
2020 **Best Paper Award** Finalist, Robotics, Science and Systems (RSS)
(paper: Deep Drone Acrobatics)

2018 **Best System Paper Award**, Conference on Robotics Learning (CORL)
(paper: Deep Drone Racing: Learning Agile Flight in Dynamic Environments)
2017 **ETH Medal** for outstanding master thesis
(awarded to each department's best master theses at ETH Zurich)

Experience

Nov 21–Jun 24 **Postdoctoral scholar** at *University of California at Berkeley*, advised by Jitendra Malik

Feb 17–Sep 21 **Graduate Student Researcher** at *University of Zurich* and *ETH Zurich*
at *Robotics and Perception Group*, advised by Davide Scaramuzza

Feb 18–Sept 18 **Graduate Student Researcher** at *University of California Los Angeles*
at *UCLA Vision Lab*, advised by Stefano Soatto

Oct 16–Jan 17 **Machine Learning Research Intern** at *Semeion Research Center, Italy*,
advised by Massimo Buscema

Sep 15–Feb 16 **Student Research Assistant** at *ETH Zurich*,
at *Autonomous Systems Lab*, advised by Roland Siegwart and Marcin Dymczyk

Fellowships

2015 Excellence Scholarship and Opportunity Program, ETH Zurich
(ETH most prestigious scholarship award for master students)
2012–2013 Merit Scholarship Faculty of Engineering, Università Roma Tor Vergata
(awarded annually to the best student of the faculty of Engineering)
2012–2013 Top Ten Students in Engineering Sciences, Università Roma Tor Vergata
(awarded annually to the top 10 students of the Engineering Sciences study program)
2011–2013 Collegio Universitario Lamaro Pozzani Scholarship
(national scholarship covering all living and study costs for university students)
2011 Rotary Club Merit Scholarship
(awarded to the top five high-school graduates in Viterbo, Italy)

Educational Activities

2022 **Lecturer** at *Materials+, The AI PowerBoat Project*, ETH Zurich
2021 Guest Lecturer at *Aerial robotics*, EPFL Lausanne
2021 **Lecturer** at *Materials+, The AI PowerBoat Project*, ETH Zurich
2020 Guest Lecturer at *Vision Algorithms for Mobile Robotics*, ETH Zurich
2020 Guest Lecturer at *DSI Studium Digitale*, University of Zurich
2019 Guest Lecturer at *Vision Algorithms for Mobile Robotics*, ETH Zurich
2017-2018 Teaching Assistant at *Vision Algorithms for Mobile Robotics*, ETH Zurich

2016 Teaching Assistant at *Advanced Machine Learning*, ETH Zurich

Funding

2024 **PI**, DARPA Transfer from Imprecise and Abstract Models to Autonomous Technologies (TIAMAT). 2.4M USD.

Media Coverage

31.09.2023 My Nature paper on beating the best human pilots in drone racing has received great media attention: [IEEE Spectrum, SRF, TeleZürich, The Guardian, The Daily Mail, Spiegel, Heise, National Public Radio, The New Scientiest, El Diario, NZZ, Forbes]

26.10.2021 **Forbes**, This hotshot AI drone can speed through complex environments thanks to new kind of virtual training [Link]

07.10.2021 **IEEE Spectrum**, Autonomous Racing Drones Dodge Through Forests at 40 kph [Link]

07.10.2021 **Robohub**, Flying high-speed drones into the unknown with AI [Link]

29.06.2020 **Der Spiegel**, Akrobatische Drohnen [PDF]

25.06.2020 **Drones Crunch**, Must Watch! Programming Precision Aerobatics [Link]

24.06.2020 **NCYT**, Acrobacias para drones [Link]

24.06.2020 **ZDNet**, An autonomous daredevil pushes the limits of flight [Link]

24.06.2020 **DailyMail**, Drones all in a spin! AI algorithm enables quadcopters to perform acrobatic manoeuvres like power loops and barrel rolls autonomously [Link]

23.06.2020 **Blick**, Navigationsalgorithmus der Uni Zurich lehrt Drohnen Kunststuecklein [Link]

24.06.2020 **Robohub**, Drones learn acrobatics by themselves [Link]

24.06.2020 **New Atlas**, AI algorithm enables autonomous drones to do barrel rolls and flips [Link]

24.06.2020 **InceptiveMind**, A navigation algorithm enables drones to learn challenging acrobatic maneuvers [Link]

17.06.2020 **DroneDj**, Drones trained to do acrobatics thanks to artificial intelligence [Link]

27.03.2019 **The New York Times** A.I. Is Flying Drones (Very, Very Slowly) [Link]

27.06.2018 **WIRED**, Drones Just Learned to Fly Solo, Racers May Soon Meet Their Match [Link]

14.02.2018 **La Repubblica**, Tra alberi e palazzi ora il drone fa lo slalom [Link]

26.01.2018 Drone Life, DroNet Algorithm Learns From Traffic to Navigate City Streets [Link]

26.01.2018 **The Robot Report**, DroNet Teaches Drones to Autonomously Navigate Cities [Link]

26.01.2018 **ZDNet**, Autonomous high flying drones learn to navigate by watching traffic below [Link]

26.01.2018 **Blick**, Zürcher Algorithmus lenkt Drohnen sicher durch die Stadt [Link]

26.01.2018 **MIT Tech Review**, This drone learned to fly through streets by studying driverless-car data [Link]

25.01.2018 **IEEE Spectrum**, AI-Powered Drone Mimics Cars and Bikes to Navigate Through City Streets [Link]

24.01.2018 **Tages Anzeiger**, Diese Drohne lernt durch Imitation [Link]

24.01.2018 **NZZ**, So kommen Drohnen sicher durch die Stadt [Link]

24.01.2018 **Digital Trends**, The DroNet algorithm teaches drones to navigate city streets like cars [Link]

23.01.2018 **Phys.org**, Drones learn to navigate autonomously by imitating cars and bicycles [Link]

23.01.2018 **Science Daily**, Drones learn to navigate autonomously by imitating cars and bicycles [Link]

23.01.2018 **Alpha Galileo**, Drones learn to navigate autonomously by imitating cars and bicycles [Link]

23.01.2018 **ORF Science**, So kommen Drohnen sicher durch die Stadt [Link]
23.01.2018 **Spektrum.de**, Drohne lernt von Fahrradfahrern [Link]
23.01.2018 **Blick am Abend**, Sicher durch die Stadt [Link]
23.01.2018 **20 Minuten**, Uni macht Drohnenflüge sicherer [Link]

Advising

The parentheses indicate the student's current occupation.

PhD Students

2024- Chunwei Xing

Master Students

2022 March Rauch (Daedalean AI)
2021 Nina Wiedermann (PhD, ETH Zurich)
2021 Simone Arreghini (PhD, IDSIA USI-SUPSI)
2021 Mario Bonsembiante (Amazon)
2021 Lorenzo Ferrini (Seervision AI)
2020 Alessandro Saviolo (PhD, New York University)
2020 Francesco Milano (PhD, ETH Zurich)
2019 Mattia Segu (PhD, ETH Zurich)
2019 Daniel Mouritzen (Torso Electronics)
2018 Simon Muntwiler (PhD, ETH Zurich)
2018 Moritz Zimmermann (Scandit)
2018 Bojana Nenezic (Danfoss)
2017 Yawei Ye (Waymo Research)

Visiting Students

2019 Bianca Sangiovanni (Capgemini Engineering)
2019 Yuto Suebe (Astroscale)
2017 Ana Maqueda

Professional Service

Organizer/Co-Organizer

2023 ICRA Workshop *Pre-training for Robotics*, London, UK.[Link]
2022 IROS Competition *Safe Robot Learning*, Tokyo, Japan.[Link]
2022 ICRA Competition *DodgeDrone: Vision-Based Agile Flight*, Philadelphia, USA.[Link]
2021 ICRA Workshop *Perception and Action in Dynamic Environments*, Online, [Link]
2020 AAAI Spring Symposium *ML for Mobile Robot Navigation in the Wild*, Palo Alto, California

Technical Reviewer

I reviewed each year for the following conferences and journals since 2018:

Journals — IEEE Transactions on Robotics (T-RO) ● IEEE Robotics and Automation Letters (RA-L) ● Science Robotics ● IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI) ● The International Journal of Robotics Research (IJRR) ● Computer Graphics Forum

Conferences — *Robotics:* Robotics: Science and Systems (RSS) ● Conference on Robotics Learning (CORL) ● International Conference on Robotics and Automation (ICRA) ● International Conference on Intelligent Robots and Systems (IROS)
Computer Vision: Computer Vision and Pattern Recognition (CVPR) ● International Conference on Computer Vision (ICCV)
Machine Learning: Conference on Neural Information Processing Systems (NeurIPS) ● International Conference on Machine Learning (ICML) ● International Conference on Learning Representations (ICLR)

Books — Foundations and Trends in Robotics (Now Publishers)

Service

I have taken the role of associate editor for:

2025 International Conference on Robotics and Automation (ICRA)
2024 Intelligent Robots and Systems (IROS)

Invited Speaker

Oct 24 **keynote:** Simulation: What made us intelligent will make our robots intelligent, GRASP for Robotics Seminar, University of Pennsylvania.
June 24 **keynote:** Towards Multi-Sensory World Models, Workshop on Understanding Higher-Level Intelligence from AI, Psychology, and Neuroscience Perspectives, The Simons Insitute.
May 24 **keynote:** Towards Multi-Sensory World Models, First International Conference on Neuro-symbolic Systems (NeuS).
April 24 **keynote:** Lessons learned from superhuman autonomous drone racing, DREAM Seminar, UC Berkeley.
Jan 24 **keynote:** Lessons learned from superhuman autonomous drone racing, PRISMA Seminar, University of Naples Federico II.
Dec 23 **keynote:** Learning vision-based pursuit-evasion policies, Multi-Agent Reinforcement Learning Seminar.
July 23 **keynote:** Agile Robot Autonomy, International Congress on Basic Science, Beijing.
April 23 **keynote:** Agile Robot Autonomy, ETH Zurich.
Mar 23 **keynote:** Agile Robot Autonomy, UPenn.
Feb 23 **keynote:** Agile Robot Autonomy, UC Berkeley.
Oct 22 **keynote:** Safe Robotics and the value of competitions for robotics, IROS Workshop.
Sep 22 **seminar:** Learning Agile Robot Navigation: From Drones to Legged Robots, KIT.
Sep 22 **seminar:** What shall we learn in simulation and what in the real world?, MIT.
May 22 **keynote:** Workshop on Releasing Robots into the Wild, ICRA.
May 22 **keynote:** Aerial Robotics Workshop, ICRA.
May 22 **keynote:** Aerial Robotics Workshop, ICRA.
May 22 **keynote:** the SeasonDepth Prediction Challenge, ICRA.
Mar 22 **keynote:** AI in Robotics Seminar, University of Toronto [Youtube]
Feb 22 **keynote:** Computer vision and robotics at an ELLIS Seminar in Turin
May 21 **keynote:** Computer Vision Seminar, UC Berkeley

Nov 20 **keynote:** Autonomy Talks, ETH Zurich, [Youtube]
Nov 20 **keynote:** UZH Machine Learning Workshop , [Link]
May 20 **keynote:** Workshop on Perception, Action, and Learning, ICRA (with Davide Scaramuzza) [Youtube]
Apr 20 Workshop Bridging AI and Cognitive Science (BAICS), ICLR
Apr 20 **keynote:** UZH Deep Learning Symposium, Zurich
Nov 19 **keynote:** Zurich Machine Learning Meetup
June 18 Presentation at University of California Los Angeles (UCLA)
May 18 Workshop on Perception, Inference, and Learning, ICRA
Feb 18 Presentation at National University of Singapore (NUS)
Nov 17 **keynote:** Swiss Machine Learning Day, EPFL, Lausanne

Publications

Preprints

1. D. Zhang, A. **Loquercio**, J. Tang, T.-H. Wang, J. Malik, and M. W. Mueller, "A learning-based quadcopter controller with extreme adaptation," *arXiv preprint arXiv:2409.12949*, 2024

2. H. G. Singh, A. **Loquercio**, C. Sferrazza, J. Wu, H. Qi, P. Abbeel, and J. Malik, "Hand-object interaction pretraining from videos," *arXiv preprint arXiv:2409.08273*, 2024

Books

1. A. **Loquercio**, "Agile autonomy: Learning high-speed vision-based flight," *Springer Tracts in Advanced Robotics*, 2023. DOI: 10.1007/978-3-031-27288-2

Journal Articles

1. D. Hanover, A. **Loquercio**, L. Bauersfeld, A. Romero, R. Penicka, Y. Song, G. Cioffi, E. Kaufmann, and D. Scaramuzza, "Autonomous drone racing: A survey," *IEEE Transactions on Robotics*, 2024

2. E. Kaufmann, L. Bauersfeld, A. **Loquercio**, M. Müller, V. Koltun, and D. Scaramuzza, "Champion-level drone racing using deep reinforcement learning," *Nature*, vol. 620, no. 7976, pp. 982–987, 2023

3. P. Foehn, E. Kaufmann, A. Romero, R. Penicka, S. Sun, L. Bauersfeld, T. Laengle, G. Cioffi, Y. Song, A. **Loquercio**, *et al.*, "Agilicious: Open-source and open-hardware agile quadrotor for vision-based flight," *Science Robotics*, vol. 7, no. 67, 2022

4. C. Pfeiffer, S. Wengeler, A. **Loquercio**, and D. Scaramuzza, "Visual attention prediction improves performance of autonomous drone racing agents," *Plos one*, vol. 17, no. 3, 2022

5. A. **Loquercio**, A. Saviolo, and D. Scaramuzza, "Autotune: Controller tuning for high-speed flight," *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 4432–4439, 2022

6. A. **Loquercio**, E. Kaufmann, R. Ranftl, M. Müller, V. Koltun, and D. Scaramuzza, "Learning high-speed flight in the wild," *Science Robotics*, vol. 6, no. 59, 2021

7. A. **Loquercio**, A. Dosovitskiy, and D. Scaramuzza, "Learning depth with very sparse supervision," *IEEE Robotics and Automation Letters*, vol. 5, no. 4, pp. 5542–5549, 2020

8. A. **Loquercio**, M. Segu, and D. Scaramuzza, "A general framework for uncertainty estimation in deep learning," *IEEE Robotics and Automation Letters*, vol. 5, no. 2, pp. 3153–3160, 2020

9. A. **Loquercio**, E. Kaufmann, R. Ranftl, A. Dosovitskiy, V. Koltun, and D. Scaramuzza, "Deep drone racing: From simulation to reality with domain randomization," *IEEE Transactions on Robotics*, vol. 36, no. 1, pp. 1–14, 2019

10. D. Palossi, A. **Loquercio**, F. Conti, E. Flamand, D. Scaramuzza, and L. Benini, "A 64-mw dnn-based visual navigation engine for autonomous nano-drones," *IEEE Internet of Things Journal*, vol. 6, no. 5, pp. 8357–8371, 2019

11. A. **Loquercio**, A. I. Maqueda, C. R. Del-Blanco, and D. Scaramuzza, "Dronet: Learning to fly by driving," *IEEE Robotics and Automation Letters*, vol. 3, no. 2, pp. 1088–1095, 2018

Conference Articles

1. A. Bar, A. Bakhtiar, D. Tran, A. **Loquercio**, J. Rajasegaran, Y. LeCun, A. Globerson, and T. Darrell, "Egopet: Egomotion and interaction data from an animal's perspective," in *European Conference on Computer Vision (ECCV)*, 2024

2. Y. Dou, F. Yang, Y. Liu, A. **Loquercio**, and A. Owens, "Tactile-augmented radiance fields," in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2024, pp. 26 529–26 539

3. A. Bajcsy, A. **Loquercio**, A. Kumar, and J. Malik, "Learning vision-based pursuit-evasion robot policies," *2024 IEEE International Conference on Robotics and Automation (ICRA)*, 2024

4. H. Huang, A. **Loquercio**, A. Kumar, N. Thakkar, K. Goldberg, and J. Malik, "More than an arm: Using a manipulator as a tail for enhanced stability in legged locomotion," *2024 IEEE International Conference on Robotics and Automation (ICRA)*, 2024

5. H. Huang, S. Sharma, A. **Loquercio**, A. Angelopoulos, K. Goldberg, and J. Malik, "Conformal policy learning for sensorimotor control under distribution shifts," *2024 IEEE International Conference on Robotics and Automation (ICRA)*, 2024

6. A. **Loquercio**, A. Kumar, and J. Malik, "Learning visual locomotion with cross-modal supervision," in *2023 IEEE International Conference on Robotics and Automation (ICRA)*, IEEE, 2023, pp. 7295–7302

7. N. Wiedemann, V. Wüest, A. **Loquercio**, M. Müller, D. Floreano, and D. Scaramuzza, "Training efficient controllers via analytic policy gradient," in *2023 IEEE International Conference on Robotics and Automation (ICRA)*, IEEE, 2023, pp. 1349–1356

8. D. Zhang, A. **Loquercio**, X. Wu, A. Kumar, J. Malik, and M. W. Mueller, "Learning a single near-hover position controller for vastly different quadcopters," in *2023 IEEE International Conference on Robotics and Automation (ICRA)*, IEEE, 2023, pp. 1263–1269

9. A. **Loquercio** and D. Scaramuzza, "Agile autonomy: High-speed flight with on-board sensing and computation," in *Conference on Robotics and Intelligent Machines (I-RIM)*, 2020

10. F. Milano, A. **Loquercio**, A. Rosinol, D. Scaramuzza, and L. Carlone, "Primal-dual mesh convolutional neural networks," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2020

11. Y. Song, S. Naji, E. Kaufmann, A. **Loquercio**, and D. Scaramuzza, "Flightmare: A flexible quadrotor simulator," in *Conference on Robot Learning*, 2020

12. N. Messikommer, D. Gehrig, A. **Loquercio**, and D. Scaramuzza, "Event-based asynchronous sparse convolutional networks," in *European Conference on Computer Vision (ECCV)*, 2020

13. E. Kaufmann*, A. **Loquercio***, R. Ranftl, M. Müller, V. Koltun, and D. Scaramuzza, "Deep drone acrobatics," in *Robotics, Science, and Systems (RSS)*, 2020

14. D. Gehrig, A. **Loquercio**, K. G. Derpanis, and D. Scaramuzza, "End-to-end learning of representations for asynchronous event-based data," in *Proceedings of the IEEE/CVF International Conference on Computer Vision (ICCV)*, Oct. 2019

15. Y. Yang*, A. **Loquercio***, D. Scaramuzza, and S. Soatto, "Unsupervised moving object detection via contextual information separation," in *2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, IEEE, 2019, pp. 879–888

16. E. Kaufmann*, A. **Loquercio***, R. Ranftl, A. Dosovitskiy, V. Koltun, and D. Scaramuzza, "Deep drone racing: Learning agile flight in dynamic environments," in *Conference on Robotic Learning (CoRL)*, 2018

17. A. I. Maqueda, A. **Loquercio**, G. Gallego, N. García, and D. Scaramuzza, "Event-based vision meets deep learning on steering prediction for self-driving cars," in *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, Jun. 2018

18. Y. Ye, T. Cieslewski, A. **Loquercio**, and D. Scaramuzza, "Place recognition in semi-dense maps: Geometric and learning-based approaches.," in *British Machine Vision Conference (BMVC)*, 2017

19. A. **Loquercio**, M. Dymczyk, B. Zeisl, S. Lynen, I. Gilitschenski, and R. Siegwart, "Efficient descriptor learning for large scale localization," in *2017 IEEE International Conference on Robotics and Automation (ICRA)*, 2017, pp. 3170–3177