Thomas **Stastny**

Aerial-Robotics Researcher

Autonomous Systems Lab, ETH Zürich, LEE J 314, Leonhardstrasse 21, 8092 Zürich, Switzerland

tstastny@ethz.ch | (+41) 79 883 7765 | tstastny.github.io

Summary

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Aerial-robotics researcher with 8+ years experience in aerodynamic modeling, simulation, system identification, state estimation, control,planning, and flight-testing of fixed-wing, multi-copter, and hybrid vertical take-off and landing (VTOL) unmanned aerial vehicles (UAVs).

Grants: Authorship of **successful** research proposals with funding totaling >**EUR 1.5M**.

Publications: As of January 25, 2021, peer-reviewed publication count: **31**, h-index: **12**, citation count: **530** (source: Google Scholar).

Mentorship: **Supervision** of **2** Ph.D. students and **50+** M.Sc. and B.Sc. theses. **Lecturer** for 2 M.Sc. courses. **TA** for 2 B.Sc. courses.

Field experience: Organization/contributions of/to aerial-robotic field-campaigns in the Arctic, Antarctic, Brazilian Amazon, and Swiss/Italian Alps.

Education

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2014 - 2020 **ETH Zürich**, Zürich, Switzerland
Ph.D. in Robotics, supervised by Prof. Roland Siegwart in the *Autonomous Systems Lab*
Dissertation: *Low-Altitude Control and Local Re-Planning Strategies for Small Fixed-wing UAVs*

2012 - 2014 **University of Kansas**, Lawrence, KS, USA
M.Sc. in Aerospace Engineering *(with Honors)*, GPA: 4.0/4.0

2012 **TU Delft**, Delft, Netherlands
Coursework in Systems & Control and Aerospace Engr. M.Sc. Programs

2008 - 2012 **University of Kansas**, Lawrence, KS, USA
B.Sc. in Aerospace Engineering, GPA: 3.7/4.0

Research Experience

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Since 6/2020 **Autonomous Systems Lab (ASL), ETH Zürich** – Post-Doctoral Researcher

- Supervise and coordinate PhD and Masters student research activities related to measurement, aerodynamic modeling, system identification, and control of fixed-wing and hybrid, tilt-wing, VTOL UAVs, results including:
  - automatic tilt-wing control – video: https://youtu.be/pSXEnHUY2_4
  - stabilized deep stalled flight – video: https://drive.google.com/file/d/1JpexWpThE5TOrnXN1Og9uz9aQ5ysgh-m/view?usp=sharing
- Lead a team of PhD and Masters students on an (ongoing) Armasuisse S+T funded project for autonomous, high-speed, aerial, vision-based payload recovery.
- Project lead for an (ongoing) Swiss Polar Institute (SPI) funded project on autonomous, precision sensor placement and recovery on remote glaciers using a long-range tilt-wing UAV.

2014 - 2020 **Autonomous Systems Lab (ASL), ETH Zürich** – PhD Research Assistant

- Core researcher on EU search-and-rescue robotics projects *SHERPA* and *ICARUS*, organizing multiple university and industry partners in collaborative multi-robotic field demonstrations. https://www.euronews.com/2016/05/23/dealing-with-danger-busy-geniuses-and-watchful-robots
- Interfaced with customers and industry partners within the ESA precision-farming project *SOLAR3* to deliver a reliable automatic, multi-hour endurance, surveying drone solution to non-expert end-users in Switzerland and Ukraine.
- Developed and deployed:
  - efficient wind-aware guidance and control algorithms for multiple classes of UAVs in extreme weather conditions
  - Nonlinear Model Predictive Control (NMPC) algorithms for/on fixed-wing UAVs including fault tolerance, stall prevention, and vision-based terrain feedback
  - a semi-automated system identification pipeline for fixed-wing UAVs from flight data to full envelope simulation model
- Conducted performance optimization and developed automatic take-off, landing, and cruise control design for the *AtlantikSolar UAV*, resulting in an **81.5 hour endurance world record** solar-powered flight for aircraft <50kg http://www.atlantiksolar.ethz.ch/index.html%3Fp=670.html and 26 hour, fully autonomous, search-and-rescue payload equipped flight http://www.atlantiksolar.ethz.ch/index.html%3Fp=931.html

2012 - 2014 **Center for Remote Sensing of Ice Sheets (CReSIS), University of Kansas** – Masters Research Assistant

- Conducted research on control and planning for fixed-wing UAVs including multi-agent avoidance and formation strategies.
- Contributed to the design, integration, and **Antarctic deployment** of a polar-conditioned fixed-wing UAV with integrated dual-frequency ground-penetrating radar.

Field Projects

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- **Supervised/Managed** student/engineering work on platform and payload development towards autonomous, beyond visual line-of-sight (BVLOS), drone-based deployment of GNSS monitoring stations on the **Gorner Glacier**, Switzerland. (2019) video: https://youtu.be/1tvYj1aGEUc
- Contributed regulatory documentation and flight-stack verification for the *first* networked (via industry partners Swisscom, INVOLI, and v2sky), BVLOS flight in Switzerland over Lake Neuchâtel. (2019) video: https://youtu.be/ks-TiJP3dxs
- **Organized/Lead** UAV operations in **Northwest Greenland** for a glacier monitoring field campaign, resulting in *first-ever* autonomous, BVLOS, solar-powered flights of a UAV in a polar region. (2017) website: http://sun2ice.ethz.ch, video: https://youtu.be/wyS6W1t_ryQ
- **Organized/Lead** field operations together with Swissnex Brazil and Brazilian Civil Aviation Authorities resulting in *first-ever* solar-powered flights of a UAV over the **Amazon rainforest** and the aerial monitoring/mapping of an oil spill on the Rio Pará.
- **8-week deployment** as mission planner and ground station operator for autonomous, BVLOS flights of a radar-integrated UAV in **Antarctica**, resulting in *first-ever* glacial bed-rock sounding via a UAV. (2014) https://cresis.ku.edu/content/research/field-programs/antarctica#2013

Grants

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Proposals Under Review

2021 — Safe Self-Calibration of Hybrid Aerial Vehicles
Role: **Co-Author**. PI: R. Siegwart. *Amazon Research Awards (ARA).* **USD 100,000 (EUR 82,389)**

Funded Proposals

2021 — Autonomous Deployment of GNSS Stations on Polar Outlet Glaciers Using a Long-Range, Tilt-Wing UAV
PI: T. Stastny. *Swiss Polar Institute (SPI) Technogrants.* **CHF 50,000 (EUR 46,379)**

2021-2023 — AvalMapper: Remote Avalanche Mapping with Long Flight Duration UAVs
Role: **Lead author**. PI: R. Siegwart. *ETH Research Grants.* **CHF 392,900 (EUR 364,450)**

2019-2020 — Drop & Recovery Drones
Role: **Lead author**. PI: R. Siegwart. *Armasuisse S+T.* **CHF 300,000 (EUR 278,262)**

2018 — Sensory Enhanced Perception and Control for Autonomous Operation of Fixed-Wing UAVs in Unstructured Environments
Role: **Lead author**. PI: R. Siegwart. *Armasuisse S+T.* **CHF 150,000 (EUR 139,131)**

2018 — Predicting the Weather: On-board Forecasting of Local 3D Wind Fields for Autonomous and Environment-aware Operation of Unmanned Aerial Vehicles
Role: **Lead author**. PI: R. Siegwart. *Intel University-Industry Research Corporation (UIRC).* **USD 150,000 (EUR 123,564)**

2017-2019 — Sun-to-Ice: Monitoring the Fracturing of Calving Glaciers from Solar-Powered UAVs in Polar Regions
Role: **Co-Lead author**. PI: G. Jouvet. *ETH Research Grants.* **CHF 426,500 (EUR 395,596)**

2014-2016 — Multi-Agent Airborne Laboratory for Cryospheric Remote Sensing
Role: **Co-author**. PI: S. Keshmiri. *Paul G. Allen Family Foundation.* **USD 200,000 (EUR 164,751)**

Awards

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- **O. Hugo Schuck Best Paper Award** (2018) for American Control Conference (ACC) paper: *"Gone with the wind: Nonlinear Guidance for Small Fixed-wing Aircraft in Arbitrarily Strong Windfields"*. http://a2c2.org/awards/o-hugo-schuck-best-paper-award
- **United States Department of Defense Antarctica Service Medal** (2014)
- **University of Kansas Aerospace Undergraduate Researcher Award** (2012)

Skills

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Programming	C++, Python, Matlab/Simulink
Software	GNU Linux, Robotic Operating System (ROS), Embedded Systems, Git, Jenkins CI, Unigraphics NX (CAD)
Hardware	3D Prototyping, Radio controlled (RC) piloting of small fixed-wing aircraft and multi-copters

Mentorship & Teaching (to top)

- **Supervised 4** PhD Students (ongoing), **24** Masters Theses, **18** Masters Semester Theses, and **14** Bachelor Theses at ETH Zürich. (2014 – Present)
- **Coached 3** ETH Zürich Focus Projects – teams of 8-12 B.Sc. students who develop a robotic product from A to Z:
  - *Dipper* – a flying, diving, swimming, and re-emerging, swept-wing UAV. video: https://youtu.be/q_9tSHTW1xE
  - *ftero* – a VTOL UAV for airborne wind energy (year 1 and 2)
  - *VertiGo* – a wall-riding robot. Resulted in a patent. video: https://youtu.be/KRYT2kYbgo4
- **Co-Lecturer** for *ETH Zürich* M.Sc. course "Robot Dynamics" (2015-Present).
- **Guest Lecturer** for *University of Kansas* Aerospace M.Sc. course "Optimal Control" (2013).
- **Teaching assistant** for *University of Kansas* B.Sc. courses "Introductory Topics in Mathematics" and "Elementary Statistics". (2010 – 2012)

Academic Service (to top)

Reviewer	IEEE Transactions on Robotics IEEE Transactions on Aerospace and Electronic Systems Springer Journal of Intelligent and Robotic Systems IEEE Robotics and Automation Letters (RA-L) IEEE Control Systems Letters (L-CSS) IEEE International Conference on Robotics and Automation (ICRA) IEEE/RSJ International Conference on Robots and Intelligent Systems (IROS) IEEE International Conference on Unmanned Aircraft Systems (ICUAS)
Associate Editor	Frontiers in Robotics and AI, Field Robotics (2020)
Organizer	Co-Organizer of ICUAS Tutorial: *Autonomous Navigation for Aerial Robotics in Extreme Environments: From Subterranean Environments to the Arctic* (2018)

Publications (to top)

Organized by type and date. Metrics found on Google Scholar: https://scholar.google.ch/citations?user=R5Fs1A4AAAAJ&hl=en.

Journal Papers

1. D. Malyuta, C. Brommer, D. Hentzen, **T. Stastny**, R. Siegwart, and R. Brockers. "Long-duration Fully Autonomous Operation of Rotorcraft Unmanned Aerial Systems for Remote-sensing Data Acquisition". *Journal of Field Robotics (JFR)*. 2020.
2. D. Rohr, **T. Stastny**, S. Verling, and R. Siegwart. "Attitude and Cruise Control of a VTOL Tiltwing UAV". *IEEE Robotics and Automation Letters*. 2019. https://youtu.be/pSXEnHUY2_4
3. T. Hinzmann, **T. Stastny**, C. Cadena, R. Siegwart, and I. Gilitschenski. "Free LSD: Prior-free Visual Landing Site Detection for Autonomous Planes". *IEEE Robotics and Automation Letters*. 2018. https://youtu.be/SOpYirBwHtQ
4. P. Oettershagen, **T. Stastny**, T. Hinzmann, K. Rudin, T. Mantel, A. Melzer, B. Wawrzacz, G. Hitz, and R. Siegwart. "Robotic Technologies for Solar-powered UAVs: Fully Autonomous Updraft-aware Aerial Sensing for Multiday Search-and-rescue Missions". *Journal of Field Robotics (JFR)*. 2018. https://youtu.be/8m76Mx9m2nM
5. P. Oettershagen, A. Melzer, Mantel, K. Rudin, **T. Stastny**, B. Wawrzacz, T. Hinzmann, S. Leutenegger, K. Alexis, and R. Siegwart. "Design of Small Hand-launched Solar-powered UAVs: From Concept Study to a Multi-day World Endurance Record Flight". *Journal of Field Robotics (JFR)*. 2017. https://youtu.be/8m4_NpTQn0E
6. **T. Stastny**, G. Garcia, S. Keshmiri. "Collision and Obstacle Avoidance in Unmanned Aerial Systems Using Morphing Potential Field Navigation and Nonlinear Model Predictive Control". *Journal of Dynamic Systems, Measurement, and Control*. 2015.
7. G. Garcia, S. Keshmiri, **T. Stastny**. "Nonlinear Model Predictive Controller Robustness Extension for Unmanned Aircraft". *International Journal of Intelligent Unmanned Systems*. 2015.
8. G. Garcia, S. Keshmiri, **T. Stastny**. "Robust and Adaptive Nonlinear Model Predictive Controller for Unsteady and Highly Nonlinear Unmanned Aircraft". *IEEE Transactions on Control Systems Technology*. 2014.

Book Chapters

1. M. Kamel, **T. Stastny**, K. Alexis, R. Siegwart. "Model Predictive Control for Trajectory Tracking of Unmanned Aerial Vehicles Using Robot Operating System". *Robot Operating System (ROS), The Complete Reference (Volume 2)*. 2017.

Peer-Reviewed Conference Papers

1. C. Olsson, S. Verling, **T. Stastny**, and R. Siegwart. "Full Envelope System Identification of a VTOL Tailsitter UAV". *AIAA Guidance, Navigation, and Control (GNC) Conference*. 2021.
2. M. Harms, N. Kaufmann, F. Rockenbauer, N. Lawrance, **T. Stastny**, and R. Siegwart. "Differential Sweep Attitude Control for Swept Wing UAVs". *International Conference on Unmanned Aircraft Systems (ICUAS)*. 2020.
3. **T. Stastny** and R. Siegwart. "On Flying Backwards: Preventing Run-away of Small, Low-speed, Fixed-wing UAVs in Strong Winds". *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2019. https://youtu.be/oM690LO29kM
4. D. Hentzen, **T. Stastny**, R. Siegwart, and R. Brockers. "Disturbance Estimation and Rejection for High-Precision Multirotor Position Control". *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2019. https://youtu.be/-1PvZ5YBIuw
5. **T. Stastny**, E. Ahbe, M. Dangel, and R. Siegwart. "Locally Power-optimal Nonlinear Model Predictive Control for Fixed-wing Airborne Wind Energy". *American Control Conference (ACC)*. 2019.
6. S. Fuhrer, S. Verling, **T. Stastny**, and R. Siegwart. "Fault-tolerant Flight Control of a VTOL Tailsitter UAV". *IEEE International Conference on Robotics and Automation (ICRA)*. 2019. https://youtu.be/tmJQ2r2AOwk
7. J. Lee, T. Muskardin, C. Pacz, P. Oettershagen, **T. Stastny**, I. Sa, R. Siegwart, and K. Kondak. "Towards Autonomous Stratospheric Flight: A Generic Global System Identification Framework for Fixed-Wing Platforms". *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2018.
8. **T. Stastny** and R. Siegwart. "Nonlinear Model Predictive Guidance for Fixed-wing UAVs Using Identified Control Augmented Dynamics". *International Conference on Unmanned Aircraft Systems (ICUAS)*. 2018.
9. L. Furieri, **T. Stastny**, L. Marconi, R. Siegwart, and I. Gilitschenski. "Gone with the Wind: Nonlinear Guidance for Small Fixed-wing Aircraft in Arbitrarily Strong Windfields". *American Control Conference (ACC)*. 2017.
10. S. Verling, **T. Stastny**, G. Bättig, K. Alexis, and R. Siegwart. "Model-based Transition Optimization for a VTOL Tailsitter". *IEEE International Conference on Robotics and Automation (ICRA)*. 2017.
11. Y. Demitri, S. Verling, **T. Stastny**, A. Melzer, and R. Siegwart. "Model-based Wind Estimation for a Hovering VTOL Tailsitter UAV". *IEEE International Conference on Robotics and Automation (ICRA)*. 2017.
12. **T. Stastny**, A. Dash, and R. Siegwart. "Nonlinear MPC for Fixed-wing UAV Trajectory Tracking: Implementation and Flight Experiments". *AIAA Guidance, Navigation, and Control (GNC) Conference*. 2017.
13. P. Oettershagen, A. Melzer, T. Mantel, K. Rudin, **T. Stastny**, B. Wawrzacz, T. Hinzmann, K. Alexis, and R. Siegwart. "Perpetual Flight with a Small Solar-powered UAV: Flight Results, Performance Analysis and Model Validation". *IEEE Aerospace Conference*. 2016.
14. T. Hinzmann, **T. Stastny**, G. Conte, P. Doherty, P. Rudol, M. Wzorek, I. Gilitschenski, E. Galceran, and R. Siegwart. "Collaborative 3D Reconstruction Using Heterogeneous UAVs: System and Experiments". *International Symposium on Experimental Robotics (ISER)*. 2016.
15. P. Doherty, J. Kvarnström, P. Rudol, M. Wzorek, G. Conte, C. Berger, T. Hinzmann, **T. Stastny**. "A Collaborative Framework for 3D Mapping Using Unmanned Aerial Vehicles". *International Conference on Principles and Practice of Multi-Agent Systems*. 2016.
16. Oettershagen, **T. Stastny**, T. Mantel, A. Melzer, K. Rudin, P. Gohl, G. Agamennoni, K. Alexis, and R. Siegwart. "Long-Endurance Sensing and Mapping using a Hand-Launchable Solar-Powered UAV". *Field and Service Robotics (FSR)*. 2015.
17. A. Vempati, G. Agamennoni, **T. Stastny**, and R. Siegwart. "Victim Detection from a Fixed-Wing UAV: Experimental Results". *International Symposium on Visual Computing (ISVC)*. 2015.
18. **T. Stastny**, G. Garcia, S. Keshmiri. "Robust Three-Dimensional Collision Avoidance for Fixed-Wing Unmanned Aerial Systems". *AIAA Guidance, Navigation, and Control (GNC) Conference*. 2015.
19. **T. Stastny**, R. Lykins, S. Keshmiri. "Nonlinear Parameter Estimation of Unmanned Aerial Vehicles in Wind Shear Using Artificial Neural Networks". *AIAA Guidance, Navigation, and Control (GNC) Conference*. 2013.
20. J. Sebes, W. Vanskike, M. Williams, S. McCandless, **T. Stastny**, G. Worden, N. Brunkhorst. "Flight Testing and Evaluation of the Structural Response to Flight Loads of a Small Scale Unmanned Aerial System". *AIAA Infotech@ Aerospace*. 2012.
21. W. Vanskike, M. Williams, **T. Stastny**, A. Ghate, S. McCandless, T. Peckman. "Hawkeye UAV Dynamic Analysis". *AIAA Modeling and Simulation Technologies Conference*. 2011.

Magazine Articles

1. **T. Stastny**. "Mars Exploration? Unleash the Swarms!". *Ruimtevaart*. 2013.

Patents

1. M. Arigoni, R. Simpson, S. Fuhrer, P. Beardsley, D. Mammolo, M. Burri, M. Bischoff, **T. Stastny**, L. Rodgers, D. Krummenacher, and R. Siegwart. "Vehicles Configured For Navigating Surface Transitions". *US Patent 10,464,620*. 2019.

Manuscripts in Preparation

Drafts of papers *in preparation* available on request.

1. **T. Stastny**, T. Hinzmann, D. Rohr, and R. Siegwart. "Vision-Based, Terrain-Aware Local Re-Planning for Low-Flying Fixed-Wing UAVs using Nonlinear MPC". *Journal of Field Robotics (JFR)*.
2. **T. Stastny** and R. Siegwart. "Stability and Robustness Analysis of Efficient, Wind-Aware Nonlinear Guidance for Small Fixed-Wing UAVs". *IEEE Transactions on Control Systems Technology*.
3. G. Heinrich, S. Vogt, **T. Stastny**, N. Lawrance, and R. Siegwart. "Design and Analysis of Span and Chord-Wise Wing-Fitted Pressure Sensors for In-Flight Post-Stall Airflow Characterization of a Fixed-Wing UAV". *AIAA Journal of Guidance, Control, and Dynamics*.

Invited Talks

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2019 Monitoring Glaciers Beyond the Horizon
T. Stastny. Workshop on Informed Scientific Sampling in Large-scale Outdoor Environments. *International Conference on Robots and Intelligent Systems (IROS)*. . https://scientific-sampling-robots.github.io/iros-2019-workshop/

2018 Towards Fully Autonomous Long-range Remote Sensing via Solar-powered Fixed-wing Unmanned Aerial Vehicles
T. Stastny. Application of Unmanned Aerial Systems. *WSL Applied Remote Sensing Lectures.* Davos, Switzerland.

2017 Monitoring Calving Glaciers in the Arctic via Solar-Powered UAVs
T. Stastny. UAVs for Agricultural and Multispectral Remote Sensing. *International Conference on Unmanned Aerial Vehicles in Geomatics (UAV-G).* Bonn, Germany.

2017 From Guidance to Local Planning: Applying NMPC to Small, Fixed-Wing UAVs
T. Stastny. IfA Coffee Talk. *Automatic Control Laboratory (IfA), ETH Zürich.* Zürich, Switzerland.

2017 Monitoring Calving Glaciers in the Arctic via Solar-Powered UAVs
T. Stastny. UAVs for Agricultural and Multispectral Remote Sensing. *International Conference on Unmanned Aerial Vehicles in Geomatics (UAV-G).* Bonn, Germany.

2015 Adventura AtlantikSolar@Brazil
T. Stastny, T. Hinzmann, P. Oettershagen. *Drone Show Latin America.* São Paulo, Brazil.