Thomas **Stastny**

Aerial-Robotics Researcher

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Summary (to top)

I am a field roboticist with a specialization on autonomy for flying systems. I have a particular passion for (remote) field work, developing practical algorithms for the purpose of deploying fixed-wing, multirotor, and hybrid vertical-take-off-and-landing (VTOL) unmanned aerial vehicles (UAVs) in challenging conditions or for complex tasks. My primary research motivations are geared towards enabling safe, reliable, and useful(!) autonomous vehicle operations in environments where humans can or should not go.

Grants: Authorship of **successful** research proposals with funding totaling >**USD 1.7M**.

Publications: As of March 8, 2021, peer-reviewed publication count: **31**, h-index: **12**, citation count: **548** (source: 🎓 Google Scholar).

Mentorship: **Supervision** of **4** 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 (to top)

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 (to top)

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

- Supervise and coordinate PhD and Masters student research activities related to aerodynamic modeling, system identification, estimation, control, and planning for fixed-wing and hybrid, tilt-wing, VTOL UAVs, some recent results including:
    - automatic tilt-wing UAV control, stabilized deep stalled flight, and development and analysis of span and chord-wise wing-fitted pressure sensors for in-flight airflow characterization
- Project lead for an Armasuisse S+T funded project on autonomous, high-speed, aerial, vision-based payload recovery using fixed-wing UAVs.
- Project lead for a Swiss Polar Institute (SPI) funded project on autonomous, precision sensor placement and recovery on remote glaciers using a long-range tilt-wing UAV.
- Project lead for ETH Foundation project "AvalMapper", on developing an autonomous aerial detection and mapping system for high-alpine avalanches utilizing machine learned classification methods and informative path planning for reliably reconstructable snow-depth maps.

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, solar-powered surveying drone solution to non-expert end-users in Switzerland and Ukraine.
- Developed and deployed robust, wind-aware estimation, guidance, and control algorithms for multiple classes of UAVs in extreme wind conditions.
- Designed and deployed Nonlinear Model Predictive Control (NMPC) schemes for/on fixed-wing UAVs including objectives for aggressive 3D path following, actuator fault tolerance, stall prevention, and vision-based terrain feedback.
- Developed and utilized a semi-automated system identification pipeline for fixed-wing and hybrid UAVs using iterated ekf based flight path reconstruction and nonlinear grey-box optimization for identifying full envelope parameterized aircraft models from flight data.
- 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 (to top)

- **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 (to top)

Proposals Under Review

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

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 (USD 53,529)**
2021-2023	AvalMapper: Remote Avalanche Mapping with Long Flight Duration UAVs
	Role: **Lead author**. PI: R. Siegwart. *ETH Research Grants*. **CHF 392,900 (USD 420,634)**
2019-2020	Drop & Recovery Drones
	Role: **Lead author**. PI: R. Siegwart. *Armasuisse S+T*. **CHF 300,000 (USD 321,176)**
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 (USD 160,588)**
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**
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 (USD 456,606)**
2014-2016	Multi-Agent Airborne Laboratory for Cryospheric Remote Sensing
	Role: **Co-author**. PI: S. Keshmiri. *Paul G. Allen Family Foundation*. **USD 200,000**

Awards (to top)

- **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 (to top)

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

- **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

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

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 (to top)

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.