# Thomas Stastny

## SENIOR RESEARCHER

*Autonomous Systems Lab, ETH Zürich*
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*Date of Birth: 22, May, 1990*

**Grants**: Authorship of **successful** research proposals with funding totaling >**1.7M USD**
**Publications**: As of November 6, 2020, publication count: **31**, h-index: **11**, i10-index: **14**, citation count: **488** (source: 🎓 Google Scholar)
**Teaching**: **Supervision** of **2** PhD students and **50+** Masters and Bachelors theses. **Lecturer** for 2 Masters courses. **TA** for 2 Bachelors courses.
**Field experience**: Organization/participation of/in aerial-robotic field-campaigns to the Arctic, Antarctic, Amazon, and Swiss/Italian Alps

*Research interests*:  Environment-aware control and planning, autonomous aerial-robotic payload transport, novel airflow sensing and perception techniques, system identification of the post-stall regime, safe experiment-based reinforcement learning for modeling and/or control of complex aerodynamic effects on hybrid aerial robots.

## EDUCATION

2014 - 2020 **ETH Zürich, Switzerland** | DOCTOR OF SCIENCE 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, USA** | MASTER OF SCIENCE IN AEROSPACE ENGINEERING *(with Honors)*

Thesis: *Collision and Obstacle Avoidance for Fixed-wing UAVs using Morphing Potential Field Navigation with Robust and Predictive Control*
GPA: 4.0/4.0

2012 **TU Delft, Netherlands** | STUDY ABROAD

Coursework in Systems & Control and Aerospace Engr. M.Sc. Programs.

2008 - 2012 **University of Kansas, USA** | BACHELOR OF SCIENCE IN AEROSPACE ENGINEERING

GPA: 3.7/4.0

## RESEARCH EXPERIENCE

Since 10/2020 **Autonomous Systems Lab (ASL), ETH Zürich** | SENIOR RESEARCHER

- **Team lead** for research activities related to control of fixed-wing and hybrid, tilt-wing UAVs. Additional research related to: measurement, modeling, system identification, and control of partially and fully stalled fixed-wing and hybrid VTOL UAVs; autonomous vision-based, environment-aware operation of UAVs beyond visual line-of-sight (BVLOS).

2014 - 2020 **Autonomous Systems Lab (ASL), ETH Zürich** | RESEARCH ASSISTANT

- Research on control, modeling, system identification, state estimation, and planning for UAVs operating in extreme environments. Core researcher on EU FP7 search-and-rescue (SaR) robotics projects *SHERPA* and *ICARUS*, the *AtlantikSolar* solar-powered UAV, the ESA precision-farming project *SOLAR3*, and several Armasuisse S+T contracts.
*Research / Project Milestones:*
- Developed and deployed Nonlinear Model Predictive Control (NMPC) algorithms for/on fixed-wing UAVs considering actuator faults, stall prevention, wind, and vision-based terrain measurements.
- Developed and deployed efficient wind-aware guidance logic for small, fixed-wing UAVs. ☐ https://youtu.be/oM690LO29kM
- **Drop & Recovery Drones**: Supervised/Managed student/engineering work on platform and payload development towards a fully automatic BVLOS dropping of GNSS monitoring stations on the **Gorner Glacier**, Switzerland, from a multi-rotor UAV. (2019) ☐ https://youtu.be/1tvYj1aGEUc
- Contributed to the *first* networked (via Swisscom), BVLOS flight in Switzerland over Lake Neuchatel. (2019) ☐ https://youtu.be/ks-TiJP3dxs
- **Sun2Ice**: Organized/Lead UAV operations in Qaanaaq, **Northwest Greenland** for a 2017 glacier monitoring field campaign, resulting in *first-ever* autonomous, BVLOS, solar-powered flights of a UAV in a polar region. website: ☐ http://sun2ice.ethz.ch, video: ☐ https://youtu.be/wyS6W1t_ryQ
- **Adventura AtlantikSolar@Brazil**: Co-Organized/Lead (with Swissnex Brazil) field operations 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. (2015) ☐ http://www.swissnexbrazil.org/atlantiksolar/
- **AtlantikSolar**: Contributed performance optimization and automatic take-off, landing, and cruise control design to the AtlantikSolar UAV, resulting in an **81.5 hour endurance world record** perpetual, solar-powered flight for aircraft <50kg (2015) ☐ http://www.atlantiksolar.ethz.ch/index.html%3Fp=670.html and 26 hour, fully autonomous, payload equipped SaR flight (2016) ☐ http://www.atlantiksolar.ethz.ch/index.html%3Fp=931.html

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

- Conducted research on control and planning for fixed-wing UAVs including multi-agent avoidance and formation strategies and contributed to the design, integration, and deployment of a UAV outfitted with a dual-frequency ground-penetrating radar.
*Research / Project Milestones:*
- Participated in **8-week deployment** as mission planner and ground station operator for autonomous operations of a radar- integrated UAV in **Western Antarctica**, resulting in *first-ever* bed-rock sounding via a UAV. ⬀
https://cresis.ku.edu/content/research/field-programs/antarctica#2013

## GRANTS

### Proposals Under Review

| 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** |

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

### Funded Proposals

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

| 2019-2020 | Drop & Recovery Drones |
| | Role: **Lead author**. PI: R. Siegwart. *Armasuisse S+T.* **CHF 300,000** |

| 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** |

| 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: R. Siegwart. *ETH Research Grants.* **CHF 426,500** |

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

## PUBLICATIONS

🎓 https://scholar.google.ch/citations?user=R5Fs1A4AAAAJ&hl=en

Drafts of papers *in preparation* available on request. Topics including stability and robustness analysis of wind-aware guidance logic, vision-based, high-speed local re-planning using nonlinear MPC, and in-flight, post-stall characterization of fixed-wing UAVs using span and chord -wise in-wing pressure sensing.

### Journal Papers

| 2020 | Long-duration Fully Autonomous Operation of Rotorcraft Unmanned Aerial Systems for Remote-sensing Data Acquisition |
| | D. Malyuta, C. Brommer, D. Hentzen, **T. Stastny**, R. Siegwart, and R. Brockers |
| | *Journal of Field Robotics (JFR). Vol. 37(1). pp. 137–157.* |

| 2019 | Attitude and Cruise Control of a VTOL Tiltwing UAV |
| | D. Rohr, **T. Stastny**, S. Verling, and R. Siegwart |
| | *IEEE Robotics and Automation Letters. Vol. 4(3). pp. 2683–2690.* |
| | ⬀ https://drive.google.com/file/d/17KuRJ5tZ2-2HdHv2_iPJ2gaeiFHlKkkH/view?usp=sharing |

| 2018 | Free LSD: Prior-free Visual Landing Site Detection for Autonomous Planes |
| | T. Hinzmann, **T. Stastny**, C. Cadena, R. Siegwart, and I. Gilitschenski |
| | *IEEE Robotics and Automation Letters. Vol. 3(3). pp. 2545–2552.* |
| | ⬀ https://youtu.be/SOpYirBwHtQ |

| 2018 | Robotic Technologies for Solar-powered UAVs: Fully Autonomous Updraft-aware Aerial Sensing for Multiday Search-and-rescue Missions |
|------|---|

2018     **Robotic Technologies for Solar-powered UAVs: Fully Autonomous Updraft-aware Aerial Sensing for Multiday Search-and-rescue Missions**

P. Oettershagen, **T. Stastny**, T. Hinzmann, K. Rudin, T. Mantel, A. Melzer, B. Wawrzacz, G. Hitz, and R. Siegwart

*Journal of Field Robotics (JFR). Vol. 35(4). pp. 612–640.*

 https://youtu.be/8m76Mx9m2nM

2017     **Design of Small Hand-launched Solar-powered UAVs: From Concept Study to a Multi-day World Endurance Record Flight**

P. Oettershagen, A. Melzer, Mantel, K. Rudin, **T. Stastny**, B. Wawrzacz, T. Hinzmann, S. Leutenegger, K. Alexis, and R. Siegwart

*Journal of Field Robotics (JFR). Vol. 34(7). pp. 1352–1377.*

 https://youtu.be/8m4_NpTQn0E

2015     **Collision and Obstacle Avoidance in Unmanned Aerial Systems Using Morphing Potential Field Navigation and Nonlinear Model Predictive Control**

**T. Stastny**, G. Garcia, S. Keshmiri

*Journal of Dynamic Systems, Measurement, and Control. Vol. 137(1).*

2015     **Nonlinear Model Predictive Controller Robustness Extension for Unmanned Aircraft**

G. Garcia, S. Keshmiri, **T. Stastny**

*International Journal of Intelligent Unmanned Systems. Vol. 3(2/3). pp. 93–121.*

2014     **Robust and Adaptive Nonlinear Model Predictive Controller for Unsteady and Highly Nonlinear Unmanned Aircraft**

G. Garcia, S. Keshmiri, **T. Stastny**

*IEEE Transactions on Control Systems Technology. Vol. 23(4). pp 1620–1627.*

## Book Chapters

2017     **Model Predictive Control for Trajectory Tracking of Unmanned Aerial Vehicles Using Robot Operating System**

M. Kamel, **T. Stastny**, K. Alexis, R. Siegwart

*Robot Operating System (ROS), The Complete Reference (Volume 2). pp. 3–39.*

## Conference Papers

2021     **Full Envelope System Identification of a VTOL Tailsitter UAV**

C. Olsson, S. Verling, **T. Stastny**, and R. Siegwart

*AIAA Guidance, Navigation, and Control (GNC) Conference. Accepted for publication*

2020     **Differential Sweep Attitude Control for Swept Wing UAVs**

M. Harms, N. Kaufmann, F. Rockenbauer, N. Lawrance, **T. Stastny**, and R. Siegwart

*International Conference on Unmanned Aircraft Systems (ICUAS).*

2019     **On Flying Backwards: Preventing Run-away of Small, Low-speed, Fixed-wing UAVs in Strong Winds**

**T. Stastny** and R. Siegwart

*IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*

 https://youtu.be/oM690LO29kM

2019     **Disturbance Estimation and Rejection for High-Precision Multirotor Position Control**

D. Hentzen, **T. Stastny**, R. Siegwart, and R. Brockers

*IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*

2019     **Locally Power-optimal Nonlinear Model Predictive Control for Fixed-wing Airborne Wind Energy**

**T. Stastny**, E. Ahbe, M. Dangel, and R. Siegwart

*American Control Conference (ACC).*

2019     **Fault-tolerant Flight Control of a VTOL Tailsitter UAV**

S. Fuhrer, S. Verling, **T. Stastny**, and R. Siegwart

*IEEE International Conference on Robotics and Automation (ICRA).*

2018     **Towards Autonomous Stratospheric Flight: A Generic Global System Identification Framework for Fixed-Wing Platforms**

J. Lee, T. Muskardin, C. Pacz, P. Oettershagen, **T. Stastny**, I. Sa, R. Siegwart, and K. Kondak

*IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*

| 2018 | **Nonlinear Model Predictive Guidance for Fixed-wing UAVs Using Identified Control Augmented Dynamics** |
|---|---|

2018  **Nonlinear Model Predictive Guidance for Fixed-wing UAVs Using Identified Control Augmented Dynamics**
**T. Stastny** and R. Siegwart
*International Conference on Unmanned Aircraft Systems (ICUAS).*

2017  **Gone with the Wind: Nonlinear Guidance for Small Fixed-wing Aircraft in Arbitrarily Strong Windfields**
L. Furieri, **T. Stastny**, L. Marconi, R. Siegwart, and I. Gilitschenski
*American Control Conference (ACC).* ***Best Paper Award***

2017  **Model-based Transition Optimization for a VTOL Tailsitter**
S. Verling, **T. Stastny**, G. Bättig, K. Alexis, and R. Siegwart
*IEEE International Conference on Robotics and Automation (ICRA).*

2017  **Model-based Wind Estimation for a Hovering VTOL Tailsitter UAV**
Y. Demitri, S. Verling, **T. Stastny**, A. Melzer, and R. Siegwart
*IEEE International Conference on Robotics and Automation (ICRA).*

2017  **Nonlinear MPC for Fixed-wing UAV Trajectory Tracking: Implementation and Flight Experiments**
**T. Stastny**, A. Dash, and R. Siegwart
*AIAA Guidance, Navigation, and Control (GNC) Conference.*

2016  **Perpetual Flight with a Small Solar-powered UAV: Flight Results, Performance Analysis and Model Validation**
P. Oettershagen, A. Melzer, T. Mantel, K. Rudin, **T. Stastny**, B. Wawrzacz, T. Hinzmann, K. Alexis, and R. Siegwart
*IEEE Aerospace Conference.*

2016  **Collaborative 3D Reconstruction Using Heterogeneous UAVs: System and Experiments**
T. Hinzmann, **T. Stastny**, G. Conte, P. Doherty, P. Rudol, M. Wzorek, I. Gilitschenski, E. Galceran, and R. Siegwart
*International Symposium on Experimental Robotics (ISER).*

2016  **A Collaborative Framework for 3D Mapping Using Unmanned Aerial Vehicles**
P. Doherty, J. Kvarnström, P. Rudol, M. Wzorek, G. Conte, C. Berger, T. Hinzmann, **T. Stastny**
*International Conference on Principles and Practice of Multi-Agent Systems.*

2015  **Long-Endurance Sensing and Mapping using a Hand-Launchable Solar-Powered UAV**
Oettershagen, **T. Stastny**, T. Mantel, A. Melzer, K. Rudin, P. Gohl, G. Agamennoni, K. Alexis, and R. Siegwart
*Field and Service Robotics (FSR).*

2015  **Victim Detection from a Fixed-Wing UAV: Experimental Results**
A. Vempati, G. Agamennoni, **T. Stastny**, and R. Siegwart
*International Symposium on Visual Computing (ISVC).*

2015  **Robust Three-Dimensional Collision Avoidance for Fixed-Wing Unmanned Aerial Systems**
**T. Stastny**, G. Garcia, S. Keshmiri
*AIAA Guidance, Navigation, and Control (GNC) Conference.*

2013  **Nonlinear Parameter Estimation of Unmanned Aerial Vehicles in Wind Shear Using Artificial Neural Networks**
**T. Stastny**, R. Lykins, S. Keshmiri
*AIAA Guidance, Navigation, and Control (GNC) Conference.*

2012  **Flight Testing and Evaluation of the Structural Response to Flight Loads of a Small Scale Unmanned Aerial System**
J. Sebes, W. Vanskike, M. Williams, S. McCandless, **T. Stastny**, G. Worden, N. Brunkhorst
*AIAA Infotech@ Aerospace.*

2011  **Hawkeye UAV Dynamic Analysis**
W. Vanskike, M. Williams, **T. Stastny**, A. Ghate, S. McCandless, T. Peckman
*AIAA Modeling and Simulation Technologies Conference.*

## Magazine Articles

2013  **Mars Exploration? Unleash the Swarms!**
**T. Stastny**
*Ruimtevaart. Vol. 2013(1), pp. 8–11. Netherlands Space Society (NVR).*

**Patents**

2019      Vehicles Configured For Navigating Surface Transitions

M. Arigoni, R. Simpson, S. Fuhrer, P. Beardsley, D. Mammolo, M. Burri, M. Bischoff, **T. Stastny**, L. Rodgers, D. Krummenacher, and R. Siegwart

*US Patent 10,464,620.*

# TEACHING

2015 - Present    **Institute for Robotics and Intelligent Systems, ETH Zürich** | LECTURER

Masters Course – Robot Dynamics (151-0851-00L)

- Developed lecture notes, exercises, and presentation material and gave lectures related to fundamentals of aerodynamics, performance, aircraft design, flight mechanics, and flight control. Designed and graded final examinations.

  ⊡ https://rsl.ethz.ch/education-students/lectures/robotdynamics.html

2014 - Present    **Autonomous Systems Lab, ETH Zürich** | STUDENT SUPERVISION

- Supervised **2** PhD Students (ongoing), **24** Masters Theses (30 ECTS), **18** Masters Semester Theses (8 ECTS), and **14** Bachelor Theses (24 ECTS)
- Coached Focus Projects (teams of 8-12 Bachelors Students develop and product from A-Z – ⊡ https://asl.ethz.ch/research/focus-projects.html:
  - *Dipper* – a flying, diving, swimming, and re-emerging, swept-wing robot.
    webpage: ⊡ https://dipper.ethz.ch/index.html video: ⊡ https://youtu.be/q_9tSHTW1xE
  - *ftero* – a VTOL UAV for airborne wind energy (year 1 and 2). ⊡ https://www.ftero.ch/
  - *VertiGo* – a wall-riding robot. video: ⊡ https://youtu.be/KRYT2kYbgo4

2013      **Department of Aerospace Engineering, University of Kansas** | GUEST LECTURER

Masters Course – Optimal Controls (KU-AE750)

- Gave two guest lectures on optimal output feedback control.

2010 – 2012    **Department of Mathematics, University of Kansas** | UNDERGRADUATE TEACHING ASSISTANT

Bachelors Courses – Introduction Topics in Mathematics (KU-MA105), Elementary Statistics (KU-MA365)

- Conducted tutor sessions three times a week for class section (ca. 20-30 students), held office hours, and graded tests, quizzes, and homework.

# AWARDS

2018      O. Hugo Schuck Best Paper Award    ⊡ http://a2c2.org/awards/o-hugo-schuck-best-paper-award

Paper title: "Gone with the wind: Nonlinear Guidance for Small Fixed-wing Aircraft in Arbitrarily Strong Windfields"

2014      Awarded United States Department of Defense Antarctica Service Medal

2012 - 2013    C&C Chaffee Engineering School Scholarship

2012      University of Kansas Aerospace Undergraduate Researcher Award

# 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)

# Invited Talks

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.*