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 (USD 55,559)**

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 (USD 436,582)**

2019-2020 Drop & Recovery Drones
Role: **Lead author**. PI: R. Siegwart. *Armasuisse S+T.* **CHF 300,000 (USD 333,354)**

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 166,677)**

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 (USD 166,677)**

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 (USD 473,918)**

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
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
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.