Thomas Stastny

Senior Researcher

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

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

Publications

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

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.

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.

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.

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.

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).

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.

Projects

2021-2024 **AvalMapper**: Remote Avalanche Mapping with Long Flight Duration UAVs
Supported by ETH Grant ETH-10 20-1
- Co-authored project proposal.

2020-2021 **Drill Drone**: Autonomous Retrieval of Ice Samples by Unmanned Aerial Vehicle
Supported by the Swiss Polar Institute, Technogrant
- Co-authored project proposal.

https://swisspolar.ch/spi-technogrants-2019/

2019 **Drop & Recovery Drones**: Automated Remote Sensor Management via Unmanned Aerial Systems
Supported by Armasuisse Science & Technology (Proj. no. 050-45, contract no. 20190201)
- Co-authored project proposal.
- Supervised/managed student/engineering work on platform and payload development and aided field campaign on Gorner Glacier, Switzerland.
- Fully automatic BVLOS dropping of long-term GNSS monitoring stations on Gorner Glacier, Switzerland.

https://youtu.be/1tvYj1aGEUc

2018 **Predicting the Weather**: On-board Forecasting of Local 3D Wind Fields for Autonomous and Environment-aware Operation of Unmanned Aerial Vehicles

Supported by Intel Network on Intelligent Systems (Proj. 3-26-15)

- Co-authored project proposal.

2017 - 2019 **Sun2Ice**: Monitoring calving glaciers from solar-powered UAVs

Supported by ETH Grant ETH-12 16-2

- Co-authored project proposal.
- Organized / lead UAV operations in Qaanaaq, Greenland during glacier monitoring field campaign.
- *First-ever* autonomous, solar-powered flights of a UAV in a polar region, including a flight of more than 12 hours duration, and the survey of the calving front of Bowdoin Glacier, **Northwest Greenland**, which revealed the opening of a crack leading to a major calving event the following week.

http://sun2ice.ethz.ch

2016 **SolAIR**: Solar-powered Automated Aerial Imaging and Reconnaissance using Infrared Cameras

Supported by Armasuisse Science & Technology (Contract #043-12)

- Developed and deployed autonomous take-off and landing algorithms/logic for the AtlantikSolar UAV.
- Demonstrated a fully autonomous, 26 hour, solar-powered flight with the AtlantikSolar UAV while live-streaming onboard infrared camera feed and tracking thermal updrafts.

https://youtu.be/8m76Mx9m2nM

2015 **Adventura AtlantikSolar@Brazil**

Supported by Swissnex Brazil, Swissando, and ETH Global

- Co-organized field campaign, supported field demonstrations, gave public workshops and talks.
- Performed the *first-ever* autonomous solar-powered flight over the **Amazon rain forest**, supporting Brazilian partners at SIPAM (Brazilian Amazon Protection System, part of the Brazilian Ministry of Defense) in the aerial monitoring and mapping of a disaster site on the Rio Pará - a sunken ship involving 4400 dead cattle and 750 tons of spilled oil.

http://www.swissnexbrazil.org/atlantiksolar/

2014 - 2017 **AtlantikSolar**: A UAV for the first-ever autonomous solar-powered crossing of the Atlantic Ocean

Supported by private investors and internal laboratory budget

- System identification & modeling, flight control, guidance, & planning for robust autonmous flight behavior in high winds and uncertain environments.
- Autopilot and onboard software framework development.
- Current world solar-powered endurance record for aircraft below 50kg after 81.5hr flight demonstration in Summer 2015.

http://www.atlantiksolar.ethz.ch/

2014 - 2017 **SHERPA**: **S**mart collaboration between **H**umans and ground-a**E**rial **R**obots for im**P**roving rescuing activities in **A**lpine environments

Supported by the European Commission under the 7th European Framework Programme (#600958)

- Platform specific integration within SHERPA Delegation Framework: C++/ROS based programming for task allocation among the multi-actor SHERPA team.
- Aircraft integration, flight-testing, and autonomy development for senseSoar solar-powered UAV.
- Field demonstration of an autonomous multi-UAV, collaborative aerial mapping and 3-D reconstruction mission with the senseSoar solar-powered UAV and an R-MAX helicopter.

http://www.sherpa-project.eu/

2014 - 2016 **ICARUS**: Robotic Search and Rescue

Supported by the European Commission under the 7th European Framework Programme (#285417)

- Designed and demonstrated a LiDAR-based auto-landing controller for fixed-wing platforms.
- Field demonstration of robotic search and rescue missions including real-time victim detection from fixed-wing aircraft with live-streaming GPS localization.

http://www.fp7-icarus.eu/

2014 **Multi-Agent Airborne Laboratory for Cryospheric Remote Sensing**

Supported by the Paul G. Allen Family Foundation

- Aided writing of full proposal.
- Applied integrated guidance, control, and trajectory generation to the case of UAS formation concepts supporting aerial ice penetrating synthetic aperture radar systems in a relative formation holding approach.

2012 - 2014 **CReSIS**: Center for Remote Sensing of Ice Sheets

Supported by the National Science Foundation (NSF) under grant ANT-0424589

- Designed and manufactured various components for radar integration and Arctic outfitting of the University of Kansas Aerospace Department's G1X UAS.
- Participated in **8-week deployment** as mission planner and ground station operator for autonomous operations of a radar-integrated UAS platform in **Western Antarctica**.
- Conducted the first successful bedrock mapping of Antarctic ice sheets via radar sounding from an autonomous UAV, BVLOS.

https://www.cresis.ku.edu/

Teaching

2015 - Present **Lecturer**: Masters Course – Robot Dynamics (151-0851-00L)

Institute for Robotics and Intelligent Systems, ETH Zürich

- 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.
- Held weekly office hours and bi-weekly exercises.

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

2014 - Present **Student Supervision**

Autonomous Systems Lab, ETH Zürich

- **24** Masters Theses (30 ECTS)
- **18** Masters Semester Theses (8 ECTS)
- **14** Bachelor Theses (24 ECTS)
- Focus Projects (teams of 8-12 Bachelors Students develop and product from A-Z – https://asl.ethz.ch/research/focus-projects.html):
  - Dipper https://dipper.ethz.ch/index.html
  - ftero (year 1 and 2) https://www.ftero.ch/
  - VertiGo https://www.vertigoproject.ch/

2013 **Guest Lecturer**: Masters Course – Optimal Controls (KU-AE750)

Department of Aerospace Engineering, University of Kansas

- Gave two guest lectures on optimal output feedback control.
- Held a session for (related) KU-AE550 Flight Dynamics class on useful tools in MATLAB for dynamic analysis and simulation.

2010 – 2012 **Undergraduate Teaching Assistant**: Bachelors Courses –
Introduction Topics in Mathematics (KU-MA105)
Elementary Statistics (KU-MA365)

Department of Mathematics, University of Kansas

- Conducted tutor sessions three times a week for class section (ca. 20-30 students).
- Held office hours.
- 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)

Technical Skills

Robotics State estimation, system identification/modeling, control theory/design, and path planning for unmanned aerial systems.
Flight instrumentation experience including avionics and sensors.
Practical knowledge of electronic components and circuits, soldering, and crimping techniques.
Practical knowledge of structural design/fabrication.
Radio controlled piloting experience on small fixed-wing platforms.

Software MATLAB/Simulink, MSC Nastran/Patran (Finite Element Analysis), Unigraphics NX (CAD), National Instruments LabVIEW, LaTeX, MS Office, Gimp (open-source graphics editor), Inkscape (open-source graphics editor), Ubuntu(Linux)/Mac/Windows Operating Systems

Programming C/C++, Python, Robotic Operating System (ROS), Open-source software management with version control (Git), microcontroller programming (ARM), HTML

Invited Talks

2019 Monitoring Glaciers Beyond the Horizon
T. Stastny
Workshop on Informed Scientific Sampling in Large-scale Outdoor Environments
IEEE/RSJ 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.

2018 Multi-hour Autonomous Flight and Environmental Monitoring Over the Arctic Region
T. Stastny
Tutorial on Autonomous Navigation for Aerial Robotics in Extreme Environments: From Subterranean Environments to the Arctic
International Conference on Unmanned Aircraft Systems.

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