Turcan **Tuna**

Senior PhD Candidate · ETH Zurich · Robotics & Spatial 3D Perception

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Research Interest

Main Areas   Spatial 3D Perception, Embodied AI, State-estimation & Mapping in the wild

Education

Ph.D. in Mechanical and Process Engineering (Robotics)   *ETH Zurich*

Research topic: Robust Spatial 3D Perception in Degenerate Environments to Enable Robot Autonomy.

Supervisors: Prof. Marco Hutter, Dr. Cesar Cadena   *Feb. 2023 – Present*

M.Sc. in Robotics, Systems & Control   *ETH Zurich*

Thesis: X-ICP: Localizability-Aware LiDAR Registration for Robust Localization in Extreme Environments.   *Sep. 2019 – May. 2022*

B.Sc. in Control & Automation Engineering (Rank: 1st/105)   *Istanbul Technical University*

Thesis: Deep learning frameworks to learn prediction and simulation focused control system models.   *Sep. 2015 - Jun. 2019*

B.Sc. in Mechanical Engineering(Rank: 1st/81)   *Istanbul Technical University*

Thesis: Design and development of FOLLY: A self-foldable and self-deployable quadcopter   *Sep. 2013 - Jun. 2018*

Publications

Journal Articles

GrandTour: A Legged Robotics Dataset in the Wild for Multi-Modal Perception and State Estimation
Turcan Tuna*, Jonas Frey*, Frank Fu, Katharine Patterson, Tianao Xu, Maurice Fallon, Cesar Cadena, Marco Hutter
under review, 2026

Large-Scale Autonomous Gas Monitoring for Volcanic Environments: A Legged Robot on Mount Etna
Julia Richter, **Tuna, Turcan**, Manthan Patel, Takahiro Miki, Devon Higgins, James Fox, Cesar Cadena, Andres Diaz, Marco Hutter
under review, 2026

Informed, Constrained, Aligned: A Field Analysis on Degeneracy-aware Point Cloud Registration in the Wild
Tuna, Turcan, Julian Nubert, Patrick Pfreundschuh, Cesar Cadena, Shehryar Khattak, Marco Hutter
IEEE Transactions on Field Robotics 2 (2025) pp. 485–515

Holistic Fusion: Task- and Setup-Agnostic Robot Localization and State Estimation with Factor Graphs
Julian Nubert, **Turcan Tuna**, Jonas Frey, Cesar Cadena, Katherine J. Kuchenbecker, Shehryar Khattak, Marco Hutter
arXiv preprint, 2025

Continuous-Time State Estimation Methods in Robotics: A Survey
William Talbot, Julian Nubert, **Tuna, Turcan**, Cesar Cadena, Frederike Dümbgen, Jesus Tordesillas, Timothy D. Barfoot, Marco Hutter
IEEE Transactions on Robotics 41 (2025) pp. 4975–4999

X-ICP: Localizability-Aware LiDAR Registration for Robust Localization in Extreme Environments
Tuna, Turcan, Julian Nubert, Yoshua Nava, Shehryar Khattak, Marco Hutter
IEEE Transactions on Robotics 40 (2024) pp. 452–471

Scientific exploration of challenging planetary analog environments with a team of legged robots
Philip Arm, Gabriel Waibel, Jan Preisig, **Turcan Tuna**, Ruyi Zhou, Valentin Bickel, Gabriela Ligeza, Takahiro Miki, Florian Kehl, Hendrik Kolvenbach, Marco Hutter
Science Robotics 8.80 (2023) eade9548

Deep learning frameworks to learn prediction and simulation focused control system models
Tuna, Turcan, Aykut Beke, Tufan Kumbasar
Applied Intelligence 52.1 (2022) pp. 662–679

Design and development of FOLLY: A self-foldable and self-deployable autonomous quadcopter
Tuna, Turcan, Salih Ertug Ovur, Etka Gokbel, Tufan Kumbasar
Aerospace Science and Technology 100 (2020) p. 105807

Conference Proceedings

BIEVR-LIO: Robust LiDAR-Inertial Odometry through Bump-Image-Enhanced Voxel Maps
Patrick Pfreundschuh, **Turcan Tuna**, Cédric Le Gentil, Roland Siegwart, Cesar Cadena, Helen Oleynikova
under review for RSS, 2026

One-Shot Badminton Shuttle Detection for Mobile Robots
Florentin Dipner, William Talbot, **Turcan Tuna**, Andrei Cramariuc, Marco Hutter
under review for R-AP, 2026

CaRLi-V: Camera–RADAR–LiDAR Point-Wise 3D Velocity Estimation
Landson Guo, Andres M. Diaz Aguilar, William Talbot, **Tuna, Turcan**, Marco Hutter, Cesar Cadena
under review, 2025

Boxi: Design Decisions in the Context of Algorithmic Performance for Robotics
Tuna, Turcan*, Frey, Jonas*, Lanke Frank Tarimo Fu, Cedric Weibel, Katharine Patterson, Benjamin Krummenacher, Matthias Müller, Julian Nubert, Maurice F. Fallon, Cesar Cadena, Marco Hutter
Proceedings of Robotics: Science and Systems, 2025

ForestLPR: LiDAR Place Recognition in Forests Attentioning Multiple BEV Density Images
Yanqing Shen, **Tuna, Turcan**, Marco Hutter, Cesar Cadena, Nanning Zheng
Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2025

Diffusion Based Robust LiDAR Place Recognition
Benjamin Krummenacher, **Tuna, Turcan*** andFrey, Jonas*, Olga Vysotska, Marco Hutter
2025 IEEE International Conference on Robotics and Automation (ICRA), 2025

Global Path Planning for Autonomous Vehicles in Orchards and Vineyards
Timo Schönegg, **Tuna, Turcan**, Fan Yang, Gabriel Waibel, Matias Mattamala, Marco Hutter
2024 13th International Workshop on Robot Motion and Control (RoMoCo), 2024

Autonomous Forest Inventory with Legged Robots: System Design and Field Deployment
Matías Mattamala, Nived Chebrolu, Benoit Casseau, Leonard Freißmuth, Jonas Frey, **Turcan Tuna**, Marco Hutter, Maurice Fallon
2024

FOLLY: A Self Foldable and Self Deployable Autonomous Quadcopter
Tuna, Turcan, Salih Ertug Ovur, Etka Gokbel, Tufan Kumbasar
2018 6th International Conference on Control Engineering & Information Technology (CEIT), 2018

Work and Research Experience

Research Exchange
MIT – Spark Lab

MA, USA
Sep. 2024 – Dec. 2024

- Research on spatial 3D mapping with Gaussian Splatting methods for a generizable robotic mapping pipeline.

Ph.D. Candidate (4th Year)
ETH Zurich – Robotic Systems Lab

Zurich, Switzerland
Feb. 2023 – Present

- Research on Spatial 3D Perception in geometrically degenerate environments using multi-modal sensors.
- Develop degeneracy-aware point cloud registration methods and analyze mitigation strategies for SLAM.

Scientific Researcher
ETH Zurich – Robotic Systems Lab

Zurich, Switzerland
May 2022 – Feb. 2023

- Independent research on robust localization and mapping for legged robots.
- Developed the X-ICP framework for localizability-aware LiDAR registration and conducted large-scale evaluation.

Teaching Assistant (Robot Dynamics)
ETH Zurich, Department of Mechanical and Process Engineering

Zurich, Switzerland
Sep. 2022 – Jan. 2023

- Assisted with lectures and exercises for the Robot Dynamics course (4 ECTS).
- Prepared and graded assignments and examinations; supported students during lab sessions.

Perception Engineering Intern
ANYbotics AG

Zurich, Switzerland
Mar. 2021 – Oct. 2021

- Implemented global initialization and robust localization/mapping for ANYmal quadrupedal robots.
- Integrated LiDAR, camera and inertial sensors for a sensor-fusion odometry system.
- Conducted real-world experiments and field trials on multi-floor facilities and rough terrain.

Student Mechanical Designer
Autonomous Systems Lab, ETH Zurich

Zurich, Switzerland
Sep. 2019 – Mar. 2021

- Redesigned the Super Mega Bot mobile robot for the DARPA Subterranean Challenge, focusing on robustness and maintainability.
- Performed mechanical design, optimization and finite element analysis of robot components; oversaw manufacturing and assembly.

Research Assistant   *Istanbul, Turkey*

Istanbul Technical University   *Sep. 2018 – Jun. 2019*

- Worked on deep learning frameworks for non-linear system identification and time-series prediction.
- Co-authored the journal article on prediction- and simulation-focused deep learning models for control systems.

Research Intern   *London, United Kingdom*

Imperial College London   *Jun. 2018 – Sep. 2018*

- Developed algorithms to infer mental states using visual and biosignal data for human–robot interaction.
- Implemented machine-learning pipelines combining EEG, EMG and video data to estimate human stress levels.

Teaching

ETH Zurich	**Lecturer in Robotics Summer School**, Teaching Assistant	*2022 – Present*
ETH Zurich	**Student Supervision**, Master Thesis and Semester Project Supervision	*2023–Present*
ETH Zurich	**Teaching Assistant**, Robot Dynamics, assisted lectures, exercises	*2022 – 2023*

Others

Awards

2025	**Paper Highlight in CVPR**, *ForestLPR: LiDAR Place Recognition in Forests Attentioning Multiple BEV Density Images*, IEEE/CVF Conference on Computer Vision and Pattern Recognition	*Nashville , USA*
2018	**Best Paper Award**, *FOLLY: A Self-Foldable and Self-Deployable Autonomous Quadcopter*, Conference on Control Engineering and Information Technology (CEIT)	*Istanbul, Turkey*
2019	**Top Graduate, Control & Automation Engineering**, First in class (1/105) at Istanbul Technical University	*Istanbul, Turkey*
2018	**Top Graduate, Mechanical Engineering**, First in class (1/81) at Istanbul Technical University	*Istanbul, Turkey*