SANDER TONKENS

Ph.D. student in Mechanical and Aerospace Engineering · Robotics
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EDUCATION

University of California, San Diego March 2026 (Expected)
Doctor of Philosophy (Ph.D.) - Mechanical and Aerospace Engineering *La Jolla, CA*

Thesis Title: Bridging the Gap: Scaling Hamilton-Jacobi Safety Analysis for Real-World Deployment.
Relevant Coursework: Machine Learning for Robotics and Deep Generative Models.
Overall GPA: 4.0

Stanford University December 2020
Master of Science (M.S.) - Mechanical Engineering *Stanford, CA*

Overall GPA: 4.0
Focus in Machine Learning, Robotics, and Mechatronics.
Relevant Coursework includes Optimal and Learning-Based Control, Convex Optimization I & II, Reinforcement Learning, Principles of Robot Autonomy, Mechatronics I & II, State Estimation, and Medical Robotics.

École Polytechnique Fédérale de Lausanne (EPFL) July 2017
Bachelor of Science (B.Sc.) - Mechanical Engineering *Lausanne, Switzerland*

Overall GPA: 5.4 / 6
Focus in Mathematics and Control Theory.
Relevant coursework includes Control Theory, Multivariate Control, Dynamics I & II, and Complex Analysis.

RESEARCH EXPERIENCE

Autonomous Systems Laboratory - Stanford University October 2025 - Present
Visiting Research Scholar - PI: Prof. Marco Pavone *Stanford, CA*

- Deploying automated task failure analysis & red teaming to accelerate robot foundation model data flywheel.
- Built a fully autonomous, safe data collection pipeline for Franka manipulators with VLA model backbone.
- Re-implemented state-of-the-art out-of-distribution detection algorithms for VLA and diffusion models.

Safe Autonomous Systems Laboratory - UC San Diego September 2021 - Present
Graduate Student Researcher - PI: Prof. Sylvia Herbert *La Jolla, CA*

- Thesis work unlocked real-time guaranteed safety for high-dimensional systems in changing environments.
- Founding member: Architected and deployed the lab's hardware, compute, & testing platforms from scratch.
- Directed & managed technical execution of 9 researchers across multiple award-winning technical initiatives.
- Co-wrote 3 successful grant applications & managed the recruitment pipeline for prospective Ph.D. researchers.

Control Systems Tech. Group - Eindhoven University of Technology March 2021 - July 2021
Research Assistant - PI: Dr. Ir. Mauro Salazar *Eindhoven, The Netherlands*

- Architected a predictive control framework to inform government COVID-vaccine distribution policy.
- Performed large-scale system identification for deterministic and stochastic graph-based epidemiology models.
- Work directly resulted in a joint grant with the National Institute for Public Health, securing funding for two post-docs.

Autonomous Systems Laboratory - Stanford University September 2019 - January 2021
Research Assistant - PI: Prof. Marco Pavone *Stanford, CA*

- Engineered state-of-the-art control stack for soft robots, achieving real-time trajectory tracking on hardware.
- Formulated optimal control algorithm that solves high-dimensional dynamics efficiently using reduced order models.
- Laid the technical foundation & hardware testbed for a research stream yielding 11 publications and 2 grants.

CHARM Lab - Stanford University March 2019 - June 2019
Independent Research Project - PI: Prof. Allison Okamura *Stanford, CA*

- Developed & implemented inverse dynamics feed-forward adaptive controller with state prediction, P-MRAC, enabling matching soft actuator performance across different haptic devices with significantly reduced response latency.
- Validated control design with hardware experiments and received the best grade for a related course project.

PROFESSIONAL EXPERIENCE

NVIDIA July 2023 - March 2024
Autonomous Vehicles Research Group — Research Intern *Santa Clara, CA*

- Shipped a transformer-based multi-modal prediction module to the production stack, capturing complex driving behaviors.
- Engineered a robust policy planner that mitigates uncertainty during complex multi-agent interactions.
- Guided production teams on architectural decisions for safety, OOD detection, & fallback planning.

Auris Health June 2019 - September 2019
Controls & Robotics Intern *Redwood City, CA*

- Developed improved nonlinear dynamics model of next-generation teleoperated flexible endoscope for novel treatments leading to 5x improvement in end-effector position control (future iteration in production).
- Designed & implemented automated nonlinear system identification procedure and tuning GUI for endoscopes.
- Conducted controller performance feedback sessions with surgeons & clinical engineers during in-vivo lab sessions.

McKinsey & Company April 2018 - August 2018
Business Analyst Intern *Geneva, Switzerland*

- Developed strategy and modeled ROI of generic drug treatment accessibility incentive in Sub-Saharan Africa.
- Co-created & implemented IoT use cases for packaging machinery manufacturer and a leading PaaS provider.

LM Wind Power September 2017 - April 2018
R&D Engineering Intern *Kolding, Denmark*

- Prototyped a computer vision-enabled mobile robot to inspect the interior of turbine blades; deployed on-site.
- Designed & led field test evaluation of autonomous control system for a novel blade ice mitigation system.

PUBLICATIONS

Ryan Teoh*, **Sander Tonkens***, William A. Sharpless, Anija Yang, Zeyuan Feng, Somil Bansal, and Sylvia Herbert, "MADR: MPC-Guided Adversarial DeepReach", *IEEE Conference on Robotics and Automation*, 2026, `https://arxiv.org/abs/2510.18845`.

Trevor Matthews, Mahesh Kumar, Azra Begzadić*, **Sander Tonkens***, Zhirui Dai, Nikolay A. Atanasov, Jorge Cortés, and Sylvia Herbert, "Expanding Safe Sets with Learning-Based Barrier Functions and HJ Reachability", 2025 (Submitted).

William A. Sharpless*, Dylan Hirsch*, **Sander Tonkens**, Nikhil Uday Shinde, and Sylvia Herbert, "Dual-Objective Reinforcement Learning with Novel Hamilton-Jacobi-Bellman Formulations", *International Conference on Learning Representations*, 2026, `https://arxiv.org/abs/2506.16016`.

Sander Tonkens, Sosuke Kojima, Chenhao Liu, Judy Masri, and Sylvia Herbert, "Refining Almost-Safe Value Functions on the Fly", *IEEE Transactions on Robotics*, 2026.

Matthew Kim, William A. Sharpless, Joe Hyun Jeong, **Sander Tonkens**, Somil Bansal, and Sylvia Herbert, "Reachability Barrier Networks: Learning Hamilton-Jacobi Solutions for Smooth and Flexible Control Barrier Functions", 2025 (Submitted).

Sander Tonkens*, Nikhil Uday Shinde*, Azra Begzadíc*, Michael C. Yip, Jorge Cortés, and Sylvia Herbert, "From Space to Time: Enabling Adaptive Safety with Learned Value Functions via Disturbance Recasting", *Conference on Robot Learning*, 2025, `https://arxiv.org/abs/2509.19597`

Azra Begzadíc*, Nikhil Uday Shinde*, **Sander Tonkens***, Dylan Hirsch, Kaleb Ugalde, Michael C. Yip, Jorge Cortés, and Sylvia Herbert, "Back to Base: Towards Hands-Off Learning via Safe Resets with Reach-Avoid Safety Filters", *Learning for Dynamics and Control Conference*, 2025, `https://arxiv.org/abs/2501.02620`

Yuxiao Chen, **Sander Tonkens**, and Marco Pavone, "Categorical Traffic Transformer: Interpretable and Diverse Behavior Prediction with Tokenized Latent", *IEEE Conference on Robotics and Automation*, 2025, `https://arxiv.org/abs/2311.18307`.

Sander Tonkens, Alex Toofanian, Zhizhen Qin, Sicun Gao, and Sylvia Herbert, "Patching Approximately Safe Value Functions Leveraging Local Hamilton-Jacobi Reachability Analysis", *IEEE Conference on Decision and Control* 2024. `https://arxiv.org/abs/2304.09850`

Sander Tonkens*, Sophia Sun*, Rose Yu, and Sylvia Herbert, "Scalable Safe Long-Horizon Planning in Dynamic Environments Leveraging Conformal Prediction and Temporal Correlations", *Long Term Human Motion Prediction workshop* at *IEEE International Conference on Robotics and Automation*, 2023.

Sander Tonkens and Sylvia Herbert, "Refining Control Barrier Functions using Hamilton-Jacobi Reachability", *IEEE/RSJ International Conference on Intelligent Robots & Systems*, 2022 `https://arxiv.org/abs/2204.12507`.

Sander Tonkens, Paul de Klaver, and Mauro Salazar, "Optimizing Vaccine Allocation Strategies in Pandemic Outbreaks: An Optimal Control Approach", *European Control Conference*, 2022, `https://arxiv.org/abs/2112.11908`.

Sander Tonkens, Joseph Lorenzetti, and Marco Pavone, "Soft Robot Optimal Control Via Reduced Order Finite Element Models", *IEEE International Conference on Robotics and Automation*, 2021, `https://arxiv.org/abs/2011.02092`.

PATENTS

Yuxiao Chen, **Sander Tonkens**, and Marco Pavone, "Scene Modeling using Trajectory Predictions and Tokenized Features", *US20250171017A1*, 2025 (Submitted).

Yuxiao Chen, **Sander Tonkens**, Edward Schmerling, and, and Marco Pavone, "Policy Prediction-based Motion Planner for Autonomous Systems and Applications", *US20250289474A1*, 2025 (Submitted).

TEACHING EXPERIENCE

Graduate Course Assistant - Stanford University March 2020 - July 2020
AA203: Optimal and Learning-Based Control *Stanford, CA*

- Created new assignments on the topics of reachable sets/tubes, sequential convex programming, comparison of classical and learning-based approaches for control, and reinforcement learning using PyTorch.
- Conducted office hours, graded assignments, and mentored custom class projects focused on optimal control.

Undergraduate Course Assistant - EPFL September 2015 - July 2017
Physics I, Analysis II, III & IV, Dynamics I *Lausanne, Switzerland*

- Taught fundamental and advanced undergraduate Mechanical Engineering courses in English and French.
- Responsibilities included leading tutorial sessions, preparing exam questions, and holding office hours.

SKILLS

Programming	Python, Julia, C/C++, Rust, Docker.
Learning & Robotics	ROS, PyTorch, JAX, MuJoCo, Isaac Sim.
Design	CATIA, LabVIEW, Simulink, Solidworks.
Languages	Dutch (mother tongue), English, French (Fluent), German, Spanish, Farsi (Beginner).

AWARDS & FELLOWSHIPS

- ONR Naval Innovation, Science, and Engineering (NISE) Fellow, 2024 (2 years full funding).
- MAE Department Ph.D. Fellowhsip, University of California San Diego, 2021 (1 year).
- First year Ph.D. Fellowship, University of California Berkeley, 2021 (Declined).
- Dean's Fellowship, University of Pennsylvania, 2021 (Declined).
- First year Ph.D. Fellowship, Princeton University, 2021 (Declined).
- Netherlands America Foundation Graduate Fellowship, 2018.
- Fulbright Graduate Scholar, 2018.

INVITED TALKS

- SCALE Seminar, UC Berkeley, November 2025.
- UC San Diego Space Day Forum, November 2025.
- Caltech Computational and Mathematical Sciences Department Seminar, October 2025.
- Southern California Control Workshop, October 2025.
- Seoul National University: Learning-based Control Seminar, September 2025.
- TU Eindhoven Controls Systems Technology Seminar, December 2024.
- 39th Southern California Control Workshop, April 2022.

SERVICE

Workshops	Organizer of 2025 RSS Workshop on Scalable and Resilient Multi-Robot Systems, `https://mrs-workshop.github.io/rss25`,
Reviewing	**ICRA** ('26-'23), **ACC** ('26), **NeurIPS** ('25-'21), **CoRL** ('25-'23), **RA-L** ('25 - '21), **RSS** ('25), **Automatica** ('25), **L4DC** ('25-'22), **OJ-CSYS** ('24), **CDC** ('25-'23), **T-RO** ('24 - '22), **L-CSS** ('23), **IROS** ('23, '22), **ECC** ('22), **IEEE Access** ('21).
Community	IEEE Control Systems Society Hybrid Systems Technical Committee (2024-Present) Vice-President UC San Diego Robograds (June 2022 - May 2023) · Graduate student org. hosting academic and social events for robotics grad students. SafeRL workshop program committee member @ NeurIPS 2021