Alexander V. Schperberg

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Education and Areas of Expertise

University of California, Los Angeles, Ph.D., MSc, Mechanical and Aerospace Engineering (Robotics) **Los Angeles, USA**
- Committee: Dennis Hong (chair), Stefano Soatto, Khalid Muhammed Jawed, Veronica Santos Sep. 2018 – Jun. 2025
- Thesis Title: *Towards Intelligent Robotic Systems: Unifying Model-based Optimization and Machine Learning for Planning, Control, and Estimation*

University of California, San Diego, BSc, Bioengineering (Bioinstrumentation) **San Diego, USA**
- Provost Honors – Top 10% of Engineering Class Sep. 2013 - 2016

Areas of Expertise: reinforcement learning, Active SLAM, generative models (e.g., diffusion), stochastic model predictive control, force control, large language and visual language models, auto-tuning of control/planning parameters, state estimation, trajectory optimization, manipulation, multi-agent planning

Research and Industry Experience

Mitsubishi Electric Research Laboratories **Cambridge, USA**
Postdoctoral Research Fellow – Control and Autonomy Team Aug. 2024 - Present
Host: Stefano Di Cairano
- Conceptualized and helped implement the architecture for safe whole-body force control for loco-manipulation using a quadruped w/robotic arm for human-robot collaboration tasks.
- Formulated Contextual Active SLAM using VLM/LLMs while leveraging voxel-based maps for in-context reasoning and autonomous navigation for search and exploration tasks.
- Conducting research in dexterous manipulation using a bidirectional VLA and reinforcement learning feedback loop with a diffusion policy, incorporating safety mechanisms through out-of-distribution detection and token probability analysis.
- Contributed to the development of an energy-efficient planner for quadruped locomotion, benchmarked against imitation learning and model-free reinforcement learning approaches.
- Developed the software and conceptual design of a multi-modal biped robot MOBIUS, in collaboration with UCLA.

Mitsubishi Electric Research Laboratories **Cambridge, USA**
Research Intern – Control and Autonomy Team Summers of 2021, 2022
Host: Marcel Menner
- Led the development of simulation and hardware integration for the Unitree A1 quadruped robot, including high-level planning and low-level control architecture.
- Auto-tuning method was demonstrated on feedback controllers and online trajectory planners for robust locomotion of a quadruped robot on uneven terrain using ROS/Gazebo/Python.
- Cost function weights of MPC and feedback gains of swing controller are autonomously calibrated.
- Approach is extended to calibrate parameters of an online trajectory planner, such as swing height, gait timings, and walking speed.

University of California, Los Angeles **Los Angeles, USA**
Graduate Research Assistant – Robotics and Mechanism Laboratory (RoMeLa) Sept. 2018 – Jun. 2024
Advisor: Dennis Hong
- Facilitated the software and conceptual design for the climbing robot SCALER.
- Developed the state estimation for legged robots using gated networks with transformer-based vision and Kalman filtering.
- Modeled residual error with sparse data using auto-tuning techniques for real-to-sim applications.
- Formulated adaptive and robust force controller using admittance control through an unscented Kalman filter.
- Multi-agent planner was developed for safe and autonomous navigation using stochastic MPC, recurrent neural networks and reinforcement learning. Applied to agents such as wheeled, legged, and flying robots.

CureMatch **Sorrento Valley, USA**
Research Scientist Sept. 2016 – Jun. 2018

- Machine learning algorithm was formulated to predict clinical outcome for various cancer drug combinations, using clinical outcome, molecular profile, genomic, transcriptomic, proteomic, and drug-related biomarker information. The model correlated well with clinical outcomes, enhancing the company's software tool for oncologists.

University of California, San Diego **La Jolla, US**
Undergraduate Research Assistant – Swartz Center of Computational Neuroscience (SCCN) Jul. 2016 – Sept. 2016
Advisor: Ying Wu and Tzyy-Ping Jung

- Unity game was programmed to create virtual scenarios that test broad versus narrow creativity
- EEG data was collected from patients and analyzed to evaluate creative ability. Awarded with an NSF grant.

Skills

Programming Languages and Operating Systems: Python, C++, MATLAB, ROS 1/2, Ubuntu/Linux, Microsoft, Mac

Robotic Experience:

- **Machine learning**: reinforcement learning, imitation learning, PyTorch, Jax, transformers, LLM / VLM
- **Optimization**: IPOPT, bonmin, qpOASES, Gurobi, CasADi,
- **Simulators/Software:** MuJoCo, MJX, Gazebo, pyBullet, Isaac Lab, SolidWorks
- **Sensors**: Force Torque Sensors (BOTA), Tactile Sensors (GelSight), Cameras (realsense d435, t265, Hesai LiDAR, ZED X), IMU (MicroStrain), Motion Capture (OptiTrack), Microcontroller (STM-32, Arduino),
- **Hardware Platforms**: Quadrupeds: Unitree A1, Unitree GO2, ALPHRED | Climbing: SCALER | Biped: MOBIUS | Drones: Crazyflie | Wheeled: Turtlebot 3 | Arms: D1, Kuka, AgileX, MELFA ASSISTA

Publications

Journal

1. **A. Schperberg**, S. D. Cairano, M. Menner. *Auto-Tuning of Controller and Online Trajectory Planner for Legged Robots.* IEEE Robotics and Automation Letters (RA-L) with IROS option, June. 2022.

2. **A. Schperberg**, S. Tsuei, S. Soatto, D. Hong. *SABER: Data-Driven Motion Planner for Autonomously Navigating Heterogeneous Robots,* IEEE Robotics and Automation Letters (RA-L), May. 2021.

3. **A. Schperberg**, A. Boichard, I. Tsigelny, S. Richard, R. Kurzrock. *Machine learning model to predict oncologic outcomes for drugs in randomized clinical trials*. International Journal of Cancer (IJC). 2020; 1-13. https://doi.org/10.1002/ijc.33240.

4. J. Queeney, X. Cai, **A. Schperberg**, R. Corcodel, M. Benosman, J. P. How, *GRAM: Generalization in Deep RL with a Robust Adaptation Module*, accepted to Robotics and Automation Letters (RA-L) with ICRA option, 2026.

5. Y. Tanaka, Y. Shirai, **A. Schperberg**, X. Lin, D. Hong. *SCALER: Versatile Multi-Limbed Robot for Free-Climbing in Extreme Terrains*. Under review at IEEE Transactions on Robotics (T-RO), Dec. 2023.

6. Lee, J. S., Lee, N. U., Nair, G., Dinstag, L., Chapman, Y., Chung, K., Wang, S., Sinha, H., Cha, D., Kim, **A. Schperberg**, A., Srinivasan, V., Lazar, E., Rubin, S., Hwang, R., Berger, T., Beker, Z., Ronai, S., Hannenhalli, M. R., … Kurzrock, S.-H. (2021). Synthetic lethality-mediated precision oncology via the tumor transcriptome. Cell., 184(9), 2487-2502.e13. https://doi.org/10.1016/j.cell.2021.03.030

Conference

1. **A. Schperberg**, Y. Wang, S. D. Cairano, *Safe Whole-Body Loco-Manipulation via Combined Model and Learning-based Control*, IEEE International Conference on Robotics and Automation (ICRA), Jun. 2026.

2. **A. Schperberg**, S. D. Cairano. *Energy-Efficient Motion Planner for Legged Robots*. 2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Oct. 2025.

3. **A. Schperberg**, Y. Tanaka, S. Mowlavi, F. Xu, B. Balaji, D. Hong. *OptiState: State Estimation of Legged Robots using Gated Networks with Transformer-based Vision and Kalman Filtering*. IEEE International Conference on Robotics and Automation (ICRA), May. 2024.

4. **A. Schperberg**, Y. Shirai, X. Lin, Y. Tanaka, D. Hong. *Adaptive Force Controller for Contact-Rich Robotic Systems using an Unscented Kalman Filter.* IEEE/RSJ International Conference on Intelligent Robots and Systems (Humanoids), Dec. 2024.

5. **A. Schperberg,** Y. Tanaka, F. Xu, A. Khan, B. Balaji, D. Hong. *Planner for Robotic Free-Climbing using Reinforcement Learning.* Southern California Robotics Symposium (SCR), Sept. 2023.

6. **A. Schperberg**, Y. Tanaka, F. Xu, M. Menner, D. Hong. *Real-to-Sim: Predicting Residual Error of Robotic Systems using a Learning-based Unscented Kalman Filter*. IEEE 20th International Conference on Ubiquitous Robots (UR), Jun. 2023.

7. **A. Schperberg*,** K. Chen*, S. Tsuei, M. Jewett, J. Hooks, S. Soatto, A. Mehta, D. Hong. *Risk-Averse MPC via Visual-Inertial Input and Recurrent Networks for Online Collision Avoidance.* 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Nov. 2020.

8. S. H. Karumanchi, B. Rokaha, **A. Schperberg** and A. P. Vinod, *Energy-constrained multi-robot exploration for autonomous map building*, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Hangzhou, China, 2025, pp. 9154-9161, doi: 10.1109/IROS60139.2025.11247332

9. Y. Tanaka, **A. Schperberg**, A. Zhu, D. Hong. *SCALER-B: A Multi-Modal Versatile Robot for Simultaneous Locomotion and Grasping.* IEEE International Conference on Robotics and Automation (ICRA). Oct. 2024.

10. Y. Shirai, X. Lin, **A. Schperberg**, Y. Tanaka, H. Kato, V. Vichathorn, D. Hong. *Simultaneous Efficient Contact-Rich Grasping and Locomotion Optimization Enabling Free-Climbing for Multi-Limbed Robots.* IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Mar. 2022.

11. Y. Tanaka, Y. Shirai, X. Lin, **A. Schperberg**, H. Kato, A. Swerdlow, N. Kumagai, D. Hong (2022). *SCALER: A Tough Versatile Quadruped Free-Climber Robot*. In 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Mar. 2022.

12. X. Lin, F. Xu, **A. Schperberg**, and D. Hong, *Learning Near-global-optimal Strategies for Hybrid Non-convex Model Predictive Control of Single Rigid Body Locomotion*, Jun. 2022, arXiv preprint arXiv:2207.07846.

13. S. Raj, **A. Schperberg**, B. Tsai, S. Brown, T.P. Jung, Y. Wu. *Resting State and Task-Related Brain Dynamics Supporting Creativity.* Neuroscience 2018 Conference.

14. Y. Wu, J. Wang, A. Tran, **A. Schperberg**, J. Caldwell, T.P. Jung, P.C. Kuo, *MoBI-Box: A next generation Mobile Brain-Body Imaging Platform*, 2016 IEEE International Multi-Disciplinary Conference on Cognitive Methods in Situation Awareness and Decision Support (CogSIMA), San Diego, CA, USA, 2016, pp. 93-96, doi: 10.1109/COGSIMA.2016.7497793.

15. **A. Schperberg**, Y. Shirai, Y. Tanaka, *Reducing Motion Perturbation for a Bipedal Robot using Model Predictive Control*. Research Gate, doi: 10.13140/RG.2.2.27143.55207, Sept. 2019.

Submitted/In-Progress…..……

1. A. Bhaskar, P. Tokekar, S. D. Cairano, **A. Schperberg**, *PRISM: Performer RS-IMLE for Single-Pass Multisensory Imitation Learning*, Submitted to *Robotics: Science and Systems* (RSS), 2026.

2. **A. Schperberg**, Y. Tanaka, S. D. Cairano, D. Hong. *MOBIUS: Multi-Modal Biped Robot that can Walk, Crawl, Climb, and Roll*. Submitted to Robotics Science and Systems (RSS), 2026.

3. **A. Schperberg**, S. Panda**,** Abraham P. Vinod, S. D. Cairano, A. P. Vinod. *RoboAtlas: Contextual Active SLAM*. To be submitted to Transaction on Robotics (T-RO), 2026.

4. C. Wang, D. Romeres, **A. Schperberg**, N. Li, Y. Wang, *Constrained Sampling MPC for Safe Contact-Rich Control: From Exploration to Precision via Hybrid Refinement*, submitted to 2026 International Federation of Automatic Control (IFAC).

Patents

1. M. Menner, S. D. Cairano, **A. Schperberg**. *Method for Online Gait Planning for Legged Robots.*
2. M. Menner, S. D. Cairano, **A. Schperberg**. *Method and System for Calibrating Controller for Legged Robots.*
3. **A. Schperberg**, S. D. Cairano, Y. Wang. *Method on Safe Whole-Body Loco-Manipulation via Hybrid Model and Learning-based Control.*
4. **A. Schperberg**, S. D. Cairano, A. Bhaskar. *Multi-Modal Visuomotor Policy Learning via Performer-based Rejection Sampling for Implicit Maximum Likelihood Estimation.*
5. **A. Schperberg**, A. Vinod, S. D. Cairano, S. Panda. *Method and System on Contextual Active SLAM.* (Patent in-progress)
6. C. Wang, D. Romeres, **A. Schperberg**, N. Li, Y. Wang. *Constrained Sampling MPC for Safe Contact-Rich Control: From Exploration to Precision via Hybrid Refinement*. (Patent in-progress)

Talks

Energy-Efficient Locomotion for Legged Robots.
IROS 2025
OptiState: State Estimation of Legged Robots using Gated Networks with Transformer-based Vision and Kalman Filtering
ICRA 2024, and Amazon Fellowship Poster Session at Luskin Conference Center at UCLA, 2023.
Planning, Control, and Estimation of a Complex and Underactuated Multi-Modal Robot
Unconventional Robot Workshop, ICRA 2024
SCALER-B: A Multi-Modal Versatile Robot for Simultaneous Locomotion and Grasping
Live demo (w/ Y. Tanaka) at the ICRA 2024 Expo
Adaptive Force Controller for Contact-Rich Robotic Systems using an Unscented Kalman Filter
Humanoids 2023
Auto-Tuning of Controller and Online Trajectory Planner for Legged Robots.
IROS 2022
Planner for Robotic Free-Climbing using Reinforcement Learning
Southern California Robotics Symposium (SCR) 2023
Real-to-Sim: Predicting Residual Error of Robotic Systems using a Learning-based Unscented Kalman Filter
Ubiquitous Robots (UR) 2023
Risk-Averse MPC via Visual-Inertial Input and Recurrent Networks for Online Collision Avoidance
IROS, 2020 and at the University of Klagenfurt, Austria, 2020.
Towards Intelligent Robotic Systems: Unifying Model-based Optimization and Machine Learning for Planning, Control, and Estimation (video)
Ph.D. Defense, UCLA, 2024.
Free-Climbing Robotics: Design, Planning, and Control for Multi-Limbed Robots
Space Robotics Laboratory, Tohoku University (w/ Y. Shirai and Y. Tanaka), 2022.
SCALER: A Tough Versatile Quadruped Free-Climber Robot
Live demonstration at the Perceptive Locomotion workshop, IROS 2022
***Machine learning model to predict oncologic outcomes for drugs in randomized clinical trials*.**
Win Symposium 2018

Awards

Amazon Science PhD Fellowship Award, 2023
ICRA 2024 EXPO Travel Award
ONR Grant Award (N00014-15-1-2064)
NSF Grant Award (#1734883)
NIH Grant P30CA023100
Provost Honors – Top 10% of Engineering Class UCSD
Research Scholar Certificate (UCSD)
Humanoid Free Walker 1st place, IEEE RAS Humanoids 2023
Humanoid Static Obstacles 2nd place, IEEE RAS Humanoids 2023

Professional Activities

Academic Reviewer……...

IEEE Transactions on Robotics (T-RO), 2022
IEEE International Conference on Robotics and Automation (ICRA), 2021, 2022, 2023, 2024, 2025, 2026
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2022, 2023, 2024
IEEE Robotics and Automation Letters (RA-L), 2021, 2022, 2025
IEEE-RAS International Conference on Humanoids, 2023
American Control Conference (ACC) 2024

Mentoring……...

Amisha Bhaskar (MERL): 2025
Shivam Panda (MERL): 2025
Yeping Wang (MERL): 2025
Feng Xu (UCLA): 2021-2024
Juan Banchs Rodriguez (UCLA): 2021
Michael Jewett (UCLA): 2020 – 2021

References

Stefano Di Cairano, PhD, Senior Team Leader at Mitsubishi Electric Research Labs (MERL) - dicairano@merl.com
Marcel Menner, PhD, Aurora Flight Sciences – menner@ieee.org
Dennis Hong, PhD, Mechanical Engineering Professor at RoMeLa. University of California, Los Angeles – dennishong@ucla.edu
Stefano Soatto, PhD, Computer Science Professor at UCLA Vision Lab. University of California, Los Angeles. Director of Science for AI Applications at Amazon Web Services - soatto@cs.ucla.edu, soattos@amazon.com
Bharathan Balaji, PhD, Senior Applied Scientist at Amazon Science - bhabalaj@amazon.com
Razelle Kurzrock, MD, Chief Division of Hematology & Oncology, CureMatch co-founder – rkurzrock@ucsd.edu