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James Alan Preiss

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Postdoctoral Scholar Computing + Mathematical Sciences California Institute of Technology
Advisors: Yisong Yue, Soon-Jo Chung, Adam Wierman.

Interests: Robotics, machine learning, control theory, optimization, and their intersections – both theoretical and practical.

Goal: Tenure-track professorship beginning in Fall 2024.

Education

Ph.D, Computer Science *2022*

University of Southern California, Los Angeles, CA.
Advisor: Gaurav Sukhatme. GPA: 3.80.
Areas: Robotics, machine learning, control theory, optimization, motion planning.

B.S., Applied Mathematics; B.A, Photography *2010*

The Evergreen State College, Olympia, WA.
Evergreen uses written evaluations instead of numerical grades; evaluations and exam scores consistently showed performance among best in class (furnished upon request).

Skills

Programming Languages: C++, C, Python, Matlab, C#, IDL, LaTeX.

Software/Libraries: Linux, FreeRTOS, NumPy, PyTorch, Jax, TensorFlow, CVXPY, ROS.

Robots: Quadrotor: Bitcraze Crazyflie, Qualcomm Snapdragon Flight. Arm: Franka Emika Panda. Ground: iRobot PackBot.

Miscellaneous: Embedded development, board-level electronics, general DIY fabrication/repair.

Employment

Postdoctoral Scholar, **California Institute of Technology**. Pasadena, CA. *2022 – ongoing*

- Developing algorithms for online policy selection from both continuously-parameterized and finite policy class, with regret guarantees under adversarial time-varying dynamics and costs.
- Validating online policy selection algorithms for robotic applications.
- Studying the structural properties of planning problems that enable Monte Carlo Tree Search to find near-optimal plans without full exploration.
- Combining adaptive control and visual foundation models for navigation on rough terrain.

Research Assistant, **University of Southern California**. Los Angeles, CA. *2015 – 2022*

- Developed the framework of suboptimal coverings to measure continuous spaces of control tasks; bounded covering number for certain families of linear-quadratic regulator (LQR) problems.
- Combined deep learning and traditional control for robotic manipulation of deformable objects.
- Analyzed variance of policy gradient estimators for reinforcement learning in LQR systems.
- Latent-space system identification for generalization of RL policies to unknown test dynamics.
- Trajectory optimization for self-calibration using novel nonlinear observability objective.
- Kinodynamic formation change planning for large quadrotor teams with anytime refinement.
- Co-author and ongoing maintainer of *Crazyswarm* open-source platform for quadrotor multi-robot systems research.

Research Intern, **Google**. New York, NY. *Summer 2019*

- Compared several reductions from neural network architecture search to reinforcement learning.
- Based on experimentally derived insights, designed a novel reduction that outperforms a comparable evolutionary algorithm on benchmark data.

Software Engineer, **SAS Institute**. Cary, NC. *2014 – 2015*

- Developed core routines for interactive text mining, unsupervised typo correction, association rule mining, and mathematics expression layout engine.
- Prototyped VM/compiler for 5x speedup on user data transformations.
- Gave talks on modern C++ and performance optimization to senior staff.

Associate Software Engineer, **Geomagic/3D Systems**. Morrisville, NC. *2011 – 2014*

- Integrated real-time 3D laser and structured light scanners with CAD and metrology programs.
- Designed and implemented scanner engine, wire protocol, and APIs for v1.0 of major new product.
- Collaborated with hardware partners on robotic system for automated part inspection.

Research Technician, **Barlow Scientific**. Olympia, WA. *2010 – 2011*

- Researched and implemented state-of-the-art method for extracting blood vessel network topology and geometry from volumetric images with subpixel precision.
- Assembled electronic and mechanical subsystems of Imaging CryoMicrotome instruments, machined parts on manual and CNC tools, wrote control routines for sensors and actuators.

Refereed Conference Publications

Online Adaptive Controller Selection in Time-Varying Systems: No-Regret via Contractive Perturbations.
Yiheng Lin, James A. Preiss, Emile Anand, Yingying Li, Yisong Yue, and Adam Wierman.
Neural Information Processing Systems (NeurIPS). 2023 (to appear).

Online Switching Control with Stability and Regret Guarantees.
Yingying Li, James A. Preiss, Na Li, Yiheng Lin, Adam Wierman, and Jeff Shamma.
Learning for Dynamics and Control Conference (L4DC). 2023 – **Oral presentation** (10%).

Parameter Estimation for Deformable Objects in Robotic Manipulation Tasks.
David Millard, James A. Preiss, Jernej Barbič, and Gaurav S. Sukhatme.
International Symposium on Robotics Research (ISRR). 2022.

Tracking Fast Trajectories with a Deformable Object using a Learned Model.
James A. Preiss, David Millard, Tao Yao, and Gaurav S. Sukhatme.
IEEE International Conference on Robotics and Automation (ICRA). 2022.

Suboptimal Coverings for Continuous Spaces of Control Tasks.
James A. Preiss and Gaurav S. Sukhatme.
Learning for Dynamics and Control Convference (L4DC). 2021.

Resilient Coverage: Exploring the Local-to-Global Trade-off.
Ragesh K. Ramachandran, Lifeng Zhou, James A. Preiss, and Gaurav S. Sukhatme.
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2020.

Estimating Metric Scale Visual Odometry from Videos using 3D Convolutional Networks.
Alexander S. Koumis, James A. Preiss, and Gaurav S. Sukhatme.
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2019.

Resilience by Reconfiguration: Exploiting Heterogeneity in Robot Teams.
Ragesh K. Ramachandran, James A. Preiss, and Gaurav S. Sukhatme.
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2019.

Sim-to-(Multi)-Real: Transfer of Low-Level Robust Control Policies to Multiple Quadrotors.
Artem Molchanov, T. Chen, W. Hönig, James A. Preiss, N. Ayanian, and G. S. Sukhatme.
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2019.

Downwash-Aware Trajectory Planning for Large Quadrotor Teams.
James A. Preiss, Wolfgang Hönig, Nora Ayanian, and Gaurav S. Sukhatme.
IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). 2017.

Trajectory Optimization for Self-Calibration and Navigation.
James A. Preiss, Karol Hausman, Stephan Weiss, and Gaurav S. Sukhatme.
Robotics: Science and Systems (RSS). 2017.

Crazyswarm: A Large Nano-Quadcopter Swarm.
James A. Preiss, Wolfgang Hönig, Gaurav S. Sukhatme, and Nora Ayanian.
IEEE International Conference on Robotics and Automation (ICRA). 2017.

Journal Publications

Simultaneous Self-Calibration and Navigation using Trajectory Optimization.
James A. Preiss, Karol Hausman, Stephan Weiss, and Gaurav S. Sukhatme.
International Journal of Robotics Research (IJRR). 2018. Invited, RSS 2017 special issue.

Trajectory Planning for Quadrotor Swarms.
Wolfgang Hönig, James A. Preiss, T.K. Satish Kumar, Gaurav S. Sukhatme, and Nora Ayanian.
IEEE Transactions on Robotics (T-RO). 2018.

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Observability-Aware Trajectory Optimization for Self-Calibration with Application to UAVs.
Karol Hausman, James A. Preiss, Stephan Weiss, and Gaurav S. Sukhatme. IEEE Robotics and Automation Letters (RA-L), ICRA.
Optimization framework for designing/modifying trajectories for sensor suite self-calibration.

Reviewed Workshop Papers

A Closer Look at Reinforcement Learning for Neural Network Architecture Search.
James A. Preiss, Eugen Hotaj, and Hanna Mazzawi.
ICLR Workshop on Neural Architecture Search. 2020 – **Selected for contributed talk**.

Analyzing the Variance of Policy Gradient Estimators for the Linear-Quadratic Regulator.
James A. Preiss, Sébastien M. R. Arnold, Chen-Yu Wei and Marius Kloft.
NeurIPS Workshop on Optimization Foundations for Reinforcement Learning. 2019.

Understanding the Variance of Policy Gradient Estimators in Reinforcement Learning.
Sébastien M. R. Arnold, James A. Preiss, Chen-Yu Wei and Marius Kloft.
Southern California Machine Learning Symposium. 2019 – **Awarded best poster**.

Learning a System-ID Embedding Space for Domain Specialization with Deep Reinforcement Learning.
James A. Preiss, Karol Hausman, and Gaurav S. Sukhatme.
NeurIPS Workshop on Reinforcement Learning under Partial Observability. 2018.

Teaching

CSCI 545: Robotics (Master's level). University of Southern California. *2017*
Teaching assistant for Prof. Stefan Schaal. Wrote homework answer keys, supervised graders, held office hours, gave guest lecture on ROS.

CSCI 646: Multi-robot systems (Ph.D. level). University of Southern California. *2016*
Teaching assistant for Prof. Nora Ayanian. Graded homework, held office hours, gave guest lectures on robotics software development and ROS.

Invited Talks

Analyzing the Variance of Policy Gradient Estimators in LQR Systems.
Google NYC Research Intern Talk Series, Summer 2019, New York, NY.

Learning Environment-Aware Acrobatic Flight from Video Demonstrations.
Qualcomm Innovation Fellowship finalist presentation, April 2018. San Diego, CA.

Multi-Sensor Fusion with Seamless Sensor Switching and Trajectory Optimization for Self-Calibration.
Google Tech Talk, Tango team, October 2016. Mountain View, CA.

Student Supervision

Zhenghao Dai ..... *2019 – 2021*
Software development for Crazyswarm platform ↪ *Amazon*

Alexander Koumis ..... *2017 – 2019*
Learning-based SLAM for scale recovery from videos ↪ *Google*

Amlesh Sivanantham ..... *2017 – 2019*
Reinforcement learning for visual quadrotor navigation ↪ *Multiply Labs*

Michael Leahy *2017*
Design and construction of tilted-rotor hexacopter from raw materials ↪ *FluidLogic*

Jiajun Bi ..... *2016 – 2017*
Onboard ROS-based visual-inertial SLAM setup for quadrotor ↪ *Amazon*

Christian Wagner *2016*
Specification and assembly of custom 180mm quadrotor platform ↪ *Google*

Matt Buckley *2016*
Simulation environment for Crazyflie quadrotor firmware testing ↪ *Google*

Peer Review

Served as a reviewer for:

- IEEE Robotics and Automation Letters (RA-L) *2019 – 2023*
- Artificial Intelligence *2022 – 2023*
- IEEE Transactions on Robotics (T-RO) *2019, 2021*
- IEEE International Symposium on Multi-Robot and Multi-Agent Systems (MRS) *2019, 2021*
- Autonomous Robots (AURO) *2018, 2021*
- IEEE International Conference on Robotics and Automation (ICRA) *2017 – 2020*
- IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR) *2019*
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) *2017, 2018*
- Conference on Field and Service Robotics (FSR) *2017*

Scholarships / Awards

Best Poster Award - Southern California Machine Learning Symposium. *2019*

Qualcomm Innovation Fellowship - Finalist (17% acceptance rate). *2018*

University of Southern California Viterbi Graduate School Ph.D. Fellowship. *2015 – 2022*

National Science Foundation Computer Science, Math, and Physics Scholarship. *2009 – 2010*