Juan Augusto Paredes Salazar

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Education

2019 - 2023 **Ph.D., Aerospace Engineering (Adaptive Control for Aerospace Applications)**, ***University of Michigan***, Ann Arbor, Michigan, GPA: 4.0/4.0
Dissertation title: Adaptive Control of Self-Excited Systems with Application to a Gas Turbine Combustor

2017 - 2019 **M.S.E., Aerospace Engineering (Controls and Dynamics)**, ***University of Michigan***, Ann Arbor, Michigan, GPA: 4.0/4.0

2010 - 2015 **B.S.E., Mechatronics Engineering**, ***Pontifical Catholic University of Peru***, Lima, Peru, GPA: 3.58/4.0

Teaching Experience

2025 **Instructor**, ***Course: Dynamics***, University of Maryland, Baltimore County, Spring 2025
Prepared and presented class lectures, held office hours, and administered and graded exams.

2020 - 2022 **Graduate Student Instructor**, University of Michigan
Assisted students with course inquiries and designed tutorials, homework and exam problems.
Courses:
- AEROSP 540: Intermediate Dynamics (Fall 2021, Fall 2022)
- AEROSP 584: Navigation and Guidance of Aerospace Vehicles (Fall 2020)

2015 - 2017 **Teacher's Assistant**, Pontifical Catholic University of Peru
Prepared and supervised laboratory activities, and graded examinations.
Courses:
- Autonomous Control
- Computer Integrated Manufacturing
- Introduction to Aeronautical Engineering

Employment History

2024 - 2025 **Postdoctoral Research Fellow**, *Estimation, Control, and Learning Laboratory, University of Maryland, Baltimore County*, Baltimore, Maryland

2023 - 2024 **Postdoctoral Research Fellow**, *Adaptive Control Laboratory, University of Michigan*, Ann Arbor, Michigan

2018 - 2023 **Research Assistant and Ph.D. Candidate**, *Adaptive Control Laboratory, University of Michigan*, Ann Arbor, Michigan

2016 - 2017 **Laboratory Assistant**, *Unmanned Aerial Systems Laboratory, Pontifical Catholic University of Peru*, Lima, Peru

2015 - 2017 **Project Assistant**, *Biomechanics and Applied Robotics Laboratory, Pontifical Catholic University of Peru*, Lima, Peru

Research Projects

2025 - 2025 **Control barrier functions for discrete-time systems with applications to robotics and aerospace systems**

Control barrier functions (CBFs) have emerged as a powerful framework for enforcing safety in control systems by guaranteeing the forward invariance of a prescribed safe set. Most CBF formulations are developed in continuous-time, which requires discretization for practical implementation, which implies that the guarantees provided by the continuous-time theorems do not necessarily hold. This motivates the implementation of CBFs based on discrete-time systems, which take the discretization and sampling effects into account. The aim of the project is to develop discrete-time CBFs that can be easily implemented in robotics and aerospace systems for safe operation. In particular, the multicopter lateral flight system is considered. The main tasks performed in this project so far are the following:

- Developed a discrete-time, predictive CBF formulation for systems with unmodeled delays and input dynamics. This setup simplifies the implementation of CBFs on outer-loop controllers within an inner-loop, outer-loop architecture, which is adopted in several robotics and aerospace systems.
- Developed a simulation environment to test a projection-based CBF formulation to address the feasibility and computational issues that nonconvex constraints cause in discrete-time CBF formulations; a comparison against nonconvex CBFs was established to highlight the advantages of the proposed method.

2024 - 2025 **Adaptive, Active Vibration Control with Applications to Disturbance Rejection and Self-Induced Vibration Suppression**

The aim of the project is to apply adaptive control algorithms to minimize the vibrations in systems under the effect of a vibrational mechanism, such as an oscillatory disturbance or self-induced vibrations. Such vibrations are often undesirable and suppressing them leads to improved system performance. However, the characteristics of the vibrational mechanism may change depending on several factors, which implies that the effectiveness of static and model-based techniques may be decreased. Hence, adaptive control techniques are chosen for their capability of adapting to changing system characteristics. The main tasks performed in this project so far are the following:

- Developed a lumped-mass simulation model of a cantilever system to test the effectiveness of retrospective cost adaptive control (RCAC) at minimizing displacement vibrations due to an oscillatory disturbance in numerical simulations.
- Modified RCAC algorithm to increase robustness to the spillover effect of vibratory systems and increase the vibration suppression performance of a disturbance with known frequency.
- Developed a cantilever experimental testbed to test the effectiveness of RCAC at minimizing displacement vibrations due to an oscillatory disturbance in physical experiments.
- Implemented RCAC in MicroLabBox II embedded system and tested the suppression performance of the modified RCAC algorithm to corroborate simulation results.

2024 - 2025 **Controller Learning and Synthesis based on Control and Trajectory Optimization**

The aim of the project is the development of a technique to learn and synthesize controllers based on training data obtained from solving control and trajectory optimization problems. The main idea is to train computationally inexpensive controllers using data from closed-loop simulations which either implement optimal control feedback or a complex controller to follow an optimal trajectory, with the objective of obtaining a controller that emulates an optimal behavior without requiring a computationally expensive controller. For this purpose, multiple linear controllers are trained such that each controller emulates a desired behavior; fuzzy logic is then used to interpolate the outputs of all linear controllers to better emulate the optimal behavior. The main tasks performed in this project were the following:

- Set up the optimization problems and numerical solvers using CasADi to implement optimization-based controllers, such as Model Predictive Control (MPC), and obtain optimal trajectories via nonlinear optimization.
- Apply least-squares optimization to train linear controllers from data obtain from the optimization procedures described above; the data sets were chosen based on desired behaviors observed in the optimization results.
- Implement Takagi-Sugeno-based fuzzy logic to interpolate the outputs of the trained linear controllers to better emulate the optimal behaviors displayed by the optimization results.

2023 - 2024 **Adaptive Model Predictive Control for Aerospace Applications and Performance Diagnostics**

Source of Funding: Office of Naval Research (ONR) under grant N00014-18-1-2211 and Air Force Office of Scientific Research (AFOSR) under grant FA9550-20-1-0028.

The aim of the project is to develop an adaptive model predictive control (MPC) algorithm, in which the model is identified online by performing closed-loop linear model identification, for aerospace applications and develop diagnostics to determine the effect of hyperparameters on stabilization performance. In particular, Predictive Cost Adaptive Control (PCAC) is developed, implemented and evaluated as part of this project. The main tasks performed in this project were the following:

- Evaluated absolute stability properties of PCAC applied to Lur'e systems (systems with nonlinear feedback).
- Applied PCAC to a Rijke-tube experiment to test stabilization performance over a range of operating conditions.
- Applied PCAC to nonlinear longitudinal aircraft dynamics in a simulation environment to test trajectory-following performance.

2020 - 2023 **Adaptive Digital Autopilot Development for Unmanned Aerial Vehicles (UAVs)**

Source of Funding: Office of Naval Research (ONR) under grant N00014-19-1-2273.

The aim of the project is to develop an adaptive digital autopilot for UAVs to address unknown or unanticipated changes in flight conditions and prevent nominal flight performance degradation. For this purpose, the PX4 autopilot firmware is modified to enable the implementation of the adaptive autopilot solution. Tests were performed using multicopter, fixed-wing and vertical take-off and landing (VTOL) aircraft. The main tasks performed in this project were the following:

- Implemented an adaptive control algorithm in the PX4 autopilot firmware for simulation and physical testing.
- Designed and developed a wireless communication setup to allow the transmission of Motion Capture (MOCAP) measurements for state estimation.

2019 - 2023 **Adaptive Control of Self-Excited Systems with Application to a Gas Turbine Combustor**

Source of Funding: National Science Foundation (NSF) under grant CMMI 1634709.

The aim of the project is to apply adaptive control algorithms to minimize the oscillatory response of self-excited systems (SES), in particular, gas-turbine combustors, in which the interaction between combustion and acoustics causes thermoacoustic oscillations and may result in flameout, structural fatigue, thermal cycling, failure of combustor components, and poor combustion performance. For this purpose, retrospective cost adaptive control (RCAC) is applied to thermoacoustic systems under extremely limited modelling information and actuator limitations. The main tasks performed in this project were the following:

- Developed a methodology to choose RCAC hyperparameters and applied RCAC to a Rijke-tube experiment to test stabilization performance over a range of operating conditions.
- Developed an extension of RCAC called quasi-static RCAC (QSRCAC) for online optimization applications, and applied it to a physical combustor to obtain operating conditions under which thermoacoustic oscillations are reduced while reaching a specified exit temperature corresponding to a desired flame length.

2019-2021 **Development and Evaluation of Multicopter Controllers for Computationally Limited Embedded Systems**

The aim of the project is the evaluation of digital controllers for multicopter systems, suitable for real-time implementation in low power embedded systems. For this purpose, PID, LQR and explicit MPC (EMPC) techniques are implemented in a quadcopter system, which is flown in an outdoor testing facility and made to track an inclined, circular path at different tangential velocities under ambient wind conditions. The main tasks performed in this project were the following:

- Developed simulation environment that implemented continuous-time quadcopter nonlinear dynamics and discrete-time controller capabilities for preliminary testing.
- Performed closed-loop simulation tests to tune the hyperparameters of PID, LQR and EMPC for suitable position tracking performance.
- Implemented the control and trajectory generation algorithms in C code for compilation and execution in the target embedded system.
- Performed closed-loop physical tests to determine trajectory following performance of the tuned digital controllers.

2016 - 2018 **Obstacle Avoidance Device for Multirotor UAVs**

Source of Funding: 2017 Research Project Annual Contest (CAP 2017).

The aim of the project is the development of a device that can be attached to a multicopter running the PX4 flight controller firmware to allow avoidance of obstacles in flight missions. The main tasks performed in this project were the following:

- Designed and fabricated prototype structure to mount LIDAR sensor and companion computer to multicopter frame.
- Developed multirotor guidance algorithm for concurrent goal seeking and obstacle avoidance using GPS and LIDAR measurements.
- Verified system operation and embedded controller performance through Software-in-the-Loop (SITL) simulations.

2016 - 2017 **Design of Decision Support System through UAVs for Management, Optimization and Control of High Andean Agriculture Systems in response to Climate Change**

Source of Funding: National Program of Agrarian Innovation (PNIA).

The aim of the project is the development of a decision support system based on multispectral aerial imaging obtained through UAVs to help farmers in High Andean locations determine soil fertility, irrigation efficiency and estimate crop yield, among other benefits to reduce the impact of climate change. The main tasks performed in this project were the following:

- Development of a low-cost image acquisition system consisting of an embedded board and two multispectral cameras.
- Design and fabrication of a prototype structure to attach image acquisition system to UAV systems.
- Acquisition system evaluation in flight missions carried out over high-altitude crops.

Journal Peer Review Activities

IEEE Transactions on Automation Science and Engineering, 3 articles
IEEE Transactions on Automatic Control, 2 articles
IEEE Transactions on Control Systems Technology, 2 articles
International Journal of Control, 2 articles
Annual Reviews in Control, 1 article
Engineering Applications of Artificial Intelligence, 1 article
International Journal of Robust and Nonlinear Control, 1 article
International Journal of Power Electronics and Drive Systems, 1 article

Honors & Awards

Academic Excellence Stimulus Scholarship (BEA), awarded by Pontifical Catholic University of Peru for outstanding undergraduate academic performance (2014).

Professional Associations

IEEE, Member, ID Number: 93821833

Tau Beta Pi, Member

Grants

2017 Research Project Annual Contest (CAP 2017), internal grant offered by the Pontifical Catholic University of Peru for the **Obstacle detection and avoidance device for multirotor UAVs through interface with Pixhawk flight controller** project.

Certificates

Remote Pilot Certificate for Small Unmanned Aircraft Systems.
Certificate number: 4673355. Date of issue: 05/31/2022.

Computer Skills

Languages	C, C++, C#, Python, Matlab, Fortran 90, LaTeX
Software	PX4 Firmware for UAS, Simulink Real-Time, dSpace Simulink Interface, CasADi for Optimization, ROS, Arduino, AutoCAD Inventor, SolidWorks, Eagle, LTspice, AutoCAD Mechanical, LabView, ANSYS Workbench
Operating Systems	Windows, Ubuntu, Red Hat, CentOS, Linux for Embedded Systems
Manufacturing Technologies	3D Printing, Laser Cutting, CNC Machining, PCB Milling

Publications

[1] J. A. Paredes Salazar, J. Usevitch, and A. Goel, "Predictive control barrier functions for discrete-time linear systems with unmodeled delays," submitted to Amer. Contr. Conf. (ACC), New Orleans, Louisiana, May 2026.

[2] S. Verma, J. A. Paredes Salazar, J. M. Portella Delgado, A. Goel, and D. S. Bernstein, "Sensor-noise mitigation in extremum seeking control using adaptive numerical differentiation," submitted to Amer. Contr. Conf. (ACC), New Orleans, Louisiana, May 2026.

[3] A. Phelps, J. A. Paredes Salazar, and A. Goel, "Data-driven fuzzy control for time-optimal, aggressive trajectory tracking," to be presented at Model. Est. Contr. Conf. (MECC), Pittsburgh, Pensylvania, October 2025.

[4] M. Mirtaba, P. Oveissi, J. A. Paredes Salazar, and A. Goel, "Single-shot learning of multirotor controller gains: A data-driven approach with experimental validation," in *Proc. IEEE Conf. Contr. Tech. Appl. (CCTA)*. IEEE, 2025, pp. 946–951.

[5] J. A. Paredes Salazar and D. S. Bernstein, "Experimental application of predictive cost adaptive control to thermoacoustic oscillations in a Rijke tube with unknown input delay," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2025, pp. 1864–1869.

[6] J. A. Paredes Salazar and A. Goel, "MPC-guided, data-driven fuzzy controller synthesis," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2025, pp. 46–51.

[7] R. A. Alhazmi, J. A. Paredes Salazar, S. A. U. Islam, and D. S. Bernstein, "Application of root-finding methods to iterative model predictive control of pseudo-linear systems," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2025, pp. 3385–3390.

[8] J. A. Paredes Salazar and D. S. Bernstein, "Absolute-stability-based closed-loop stability analysis of adaptive model predictive control for self-excited Lur'e systems," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2025, pp. 2477–2482.

[9] S. A. U. Islam, J. A. Paredes Salazar, and D. S. Bernstein, "Multirate model predictive control of inner-outer loops," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2025, pp. 3335–3340.

[10] R. Richards, J. Paredes, and D. Bernstein, "Predictive cost adaptive control of fixed-wing aircraft without prior modeling," in *Proc. AIAA SciTech Forum*, 2025, p. 2081.

[11] Y. Y. Chee, P. Oveissi, S. Shao, J. Lee, J. A. Paredes, D. S. Bernstein, and A. Goel, "A Hammerstein-Weiner modification of adaptive autopilot for parameter drift mitigation with experimental results," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2024, pp. 1556–1561.

[12] R. J. Richards, Y. Yang, J. A. Paredes, and D. S. Bernstein, "Output-only identification of Lur'e systems with hysteretic feedback nonlinearities," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2024, pp. 2891–2896.

[13] Y. Y. Chee, J. A. Paredes, and D. S. Bernstein, "Data-driven retrospective-cost-based adaptive digital PID control," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2024, pp. 5163–5168.

[14] J. A. Paredes, J. M. Portella Delgado, D. S. Bernstein, and A. Goel, "Retrospective cost-based extremum seeking control with vanishing perturbation for online output minimization," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2024, pp. 2344–2349.

[15] J. A. Paredes, O. Kouba, and D. S. Bernstein, "Self-excited dynamics of discrete-time Lur'e systems with affinely constrained, piecewise-C1 feedback nonlinearities," *IEEE Open J. Contr. Sys.*, vol. 3, pp. 214–224, 2024.

[16] J. A. Paredes, R. Ramesh, M. Gamba, and D. S. Bernstein, "Experimental application of a quasi-static adaptive controller to a Dual Independent Swirl combustor," *Comb. Sci. Tech.*, vol. 197, no. 9, pp. 2116–2149, 2024.

[17] J. A. Paredes, Y. Yang, and D. S. Bernstein, "Output-only identification of self-excited systems using discrete-time Lur'e models with application to a gas-turbine combustor," *Int. J. Contr.*, vol. 97, no. 2, pp. 187–212, 2024.

[18] K. F. Aljanaideh, M. Al Janaideh, R. J. Richards, J. A. Paredes, and D. S. Bernstein, "Output-only identification of lur'e systems with prandtl-ishlinskii hysteresis nonlinearities," *IFAC-PapersOnLine*, vol. 58, no. 15, pp. 366–371, 2024.

[19] Y. Y. Chee, P. Oveissi, J. Paredes, D. S. Bernstein, and A. Goel, "Performance comparison of adaptive autopilot architectures for multicopter stabilization and trajectory tracking," in *Proc. AIAA SciTech Forum*, 2024, p. 1391.

[20] J. A. Paredes and D. S. Bernstein, "Experimental implementation of retrospective cost adaptive control for suppressing thermoacoustic oscillations in a Rijke tube," *IEEE Trans. Contr. Sys. Tech*, vol. 31, no. 6, pp. 2484–2498, 2023, DOI: 10.1109/TCST.2023.3262223.

[21] J. Lee, J. Spencer, S. Shao, J. A. Paredes, D. S. Bernstein, and A. Goel, "Experimental flight testing of a fault-tolerant adaptive autopilot for fixed-wing aircraft," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2023, pp. 2981–2986.

[22] J. A. Paredes, S. A. U. Islam, and D. S. Bernstein, "Adaptive stabilization of thermoacoustic oscillations in a Rijke tube," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2022, pp. 28–33.

[23] J. Spencer, J. Lee, J. A. Paredes, A. Goel, and D. Bernstein, "An adaptive PID autotuner for multicopters with experimental results," in *Proc. Int. Conf. Robot. Autom. (ICRA)*. IEEE, 2022, pp. 7846–7853.

[24] J. A. Paredes, R. Ramesh, S. Obidov, M. Gamba, and D. Bernstein, "Experimental investigation of adaptive feedback control on a Dual-Swirl-Stabilized gas turbine model combustor," in *Proc. AIAA SciTech Forum*, 2022, p. 2058.

[25] A. Goel, J. A. Paredes, H. Dadhaniya, S. A. U. Islam, A. M. Salim, S. Ravela, and D. S. Bernstein, "Experimental implementation of an adaptive digital autopilot," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2021, pp. 3737–3742.

[26] J. A. Paredes and D. S. Bernstein, "Identification of self-excited systems using discrete-time, time-delayed Lur'e models," in *Proc. Amer. Contr. Conf. (ACC)*. IEEE, 2021, pp. 3939–3944.

[27] R. Ramesh, J. A. Paredes, D. Bernstein, and M. Gamba, "Design and characterization of the Dual Independent Swirl Combustor facility (DISCo)," in *Proc. AIAA Prop. Energy Forum*, 2021, p. 3479.

[28] J. A. Paredes, P. Sharma, B. Ha, M. Lanchares, E. Atkins, P. Gaskell, and I. Kolmanovsky, "Development, implementation, and experimental outdoor evaluation of quadcopter controllers for computationally limited embedded systems," *Annu. Rev. Contr.*, vol. 52, pp. 372–389, 2021.

[29] J. A. Paredes, S. A. U. Islam, and D. S. Bernstein, "A time-delayed Lur'e model with biased self-excited oscillations," in *Proc. Amer. Contr. Conf. (ACC)*, Denver, July 2020.

[30] J. Gonzalez, A. Chavez, J. A. Paredes, and C. Saito, "Obstacle detection and avoidance device for multirotor UAVs through interface with Pixhawk flight controller," in *Proc. Conf. Autom. Sci. Eng. (CASE)*, Aug 2018, pp. 110–115.

[31] M. Abarca, C. Saito, A. Angulo, J. A. Paredes, and F. Cuellar, "Design and development of an hexacopter for air quality monitoring at high altitudes," in *Proc. Conf. Autom. Sci. Eng. (CASE)*. IEEE, 2017, pp. 1457–1462.

[32] J. A. Paredes, C. Saito, M. Abarca, and F. Cuellar, "Study of effects of high-altitude environments on multicopter and fixed-wing UAVs' energy consumption and flight time," in *Proc. Conf. Autom. Sci. Eng. (CASE)*. IEEE, 2017, pp. 1645–1650.

[33] L. C. Caballero, C. Saito, R. B. Micheline, and J. A. Paredes, "On the design of an UAV-based store and forward transport network for wildlife inventory in the western Amazon rainforest," in *Proc. Int. Congr. Electron. Elect. Eng. Comput. (INTERCON)*. IEEE, 2017, pp. 1–4.

[34] J. A. Paredes, J. González, C. Saito, and A. Flores, "Multispectral imaging system with UAV integration capabilities for crop analysis," in *Proc. Int. Symp. Geosci. Remote Sens. (GRSS-CHILE)*. IEEE, 2017, pp. 1–4.

[35] D. A. Flores, C. Saito, J. A. Paredes, and F. Trujillano, "Multispectral imaging of crops in the Peruvian Highlands through a fixed-wing UAV system," in *Proc. Int. Conf. Mechatron. (ICM)*. IEEE, 2017, pp. 399–403.

[36] ——, "Aerial photography for 3D reconstruction in the Peruvian Highlands through a fixed-wing UAV system," in *Proc. Int. Conf. Mechatron. (ICM)*. IEEE, 2017, pp. 388–392.

[37] J. A. Paredes, C. Jacinto, R. Ramirez, I. Vargas, and L. Trujillano, "Fuzzy-PD controller for behavior mixing and improved performance in quadcopter attitude control systems," in *Proc. Latin Amer. Conf. Comput. Intell. (LA-CCI)*. IEEE, 2016, pp. 1–6.

[38] ——, "Simplified fuzzy-PD controller for behavior mixing and improved performance in quadcopter attitude control systems," in *Proc. Tech. Sci. Conf. Andean Council (ANDESCON)*. IEEE, 2016, pp. 1–4.

[39] J. A. Paredes, J. Acevedo, H. Mogrovejo, J. Villalta, and R. Furukawa, "Quadcopter design for medicine transportation in the Peruvian Amazon Rainforest," in *Proc. Int. Congr. Electron. Elect. Eng. Comput. (INTERCON)*. IEEE, 2016, pp. 1–6.