

Roderick S. Bayliss III

145 Cory Hall, Berkeley, CA 94720

rodbay@berkeley.edu • people.eecs.berkeley.edu/~rodbay/ • Updated Dec. 2025

Education

Ph.D. in Electrical Engineering

Expected May 2026

University of California, Berkeley, CA

Research Focus: Power Electronics – *Advisor:* Dr. Robert Pilawa-Podgurski

Thesis: Dynamical Modeling and Control Design for the Flying Capacitor Multilevel Converter in High-Density, High-Efficiency AC/DC and DC/AC Applications

M.Eng. in Electrical Engineering

December 2020

Massachusetts Institute of Technology, Cambridge, MA

Research Focus: Power Electronics – *Advisor:* Dr. David J. Perreault

Thesis: Design, Implementation, and Evaluation of High-Efficiency High-Power Radio-Frequency Inductors

B.S. in Electrical Engineering

December 2019

Massachusetts Institute of Technology, Cambridge, MA

Research Experience

Graduate Research Assistant

January 2021 - Present

University of California, Berkeley – *Advisor:* Dr. Robert Pilawa-Podgurski

- Developed and experimentally evaluated control algorithms for the FCML converter utilizing active flying capacitor voltage balancing to enable buck-type PFC rectifiers.
- Analyzed both the circuit dynamics and relevant parasitics of the FCML converter to characterize and understand underlying dynamic behavior.
- Developed a high-performance FCML converter testbed to validate high bandwidth controls and flying capacitor voltage estimation using a single voltage sensor.
- Integrated multiple high performance FCML converter prototypes and developed motor control algorithms and firmware to enable a dynamometer testbed for high level count FCML converters.

Graduate Research Assistant

January 2020 - December 2020

Massachusetts Institute of Technology, Cambridge, MA – *Advisor:* Dr. David J. Perreault

- Designed and manufactured a high efficiency, radio frequency inductor for high current applications.
- Designed a high accuracy test fixture to characterize RF high quality factor inductors at high currents.

Undergraduate Research Assistant

January 2018 - December 2019

Massachusetts Institute of Technology – *Advisor:* Dr. David J. Perreault

- Characterized core losses of high frequency magnetic materials for power stage components operated at high frequencies.

Selected Academic Honors and Awards

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| 2025 | University of California, Berkeley: Outstanding Graduate Student Instructor Award |
| 2025 | Georgia Institute of Technology: Focus Fellow |
| 2024 | IEEE Workshop on Control and Modeling for Power Electronics (COMPEL): Best Paper Award |
| 2024 | NextProf Nexus: Invited Ph.D. Candidate |
| 2023 | Notre Dame Future Faculty Workshop: Invited Ph.D. Student |
| 2022 | The Hertz Foundation: Hertz Fellow |
| 2021 | Black Alumni of MIT: Research Slam 1 st Place |
| 2021 | University of California, Berkeley: Chancellor's Fellowship |
| 2021 | IEEE Applied Power Electronics Conference: Best Presentation Award |
| 2019 | IEEE Power and Energy Scholarship Plus Initiative: Scholarship Recipient |

Publications

Journal Publications

5. **R. S. Bayliss III**, N. C. Brooks, R. C. N. Pilawa-Podgurski, "A Combined Power Factor Correcting and Active Voltage Balancing Control Technique for Buck-Type AC/DC Grid-Tied Flying Capacitor Multilevel Converters," *IEEE Transactions on Power Electronics*, accepted for publication, 2026
4. M. V. Joisher, J. Wang, **R. S. Bayliss III**, M. K. Ranjram, R. S. Yang, A. Jurkov, D. J. Perreault, "High-Performance High-Power Inductor Design for High-Frequency Applications," *IEEE Open Journal of Power Electronics*, vol. 6, pp. 1991-2004, 2025
3. R. K. Iyer, **R. S. Bayliss III**, I. Z. Petric, S. R. Sanders, R. C. N. Pilawa-Podgurski, "Generalized Averaged Modeling of Capacitor Voltage Balancing Dynamics in Flying Capacitor Multilevel Converters," *IEEE Transactions on Power Electronics*, vol. 40, no. 12, pp. 18097-18112, Dec. 2025
2. **R. S. Bayliss III**, N. C. Brooks, R. C. N. Pilawa-Podgurski, "On the Role of Switch Output Capacitance on Passive Balancing within the Flying Capacitor Multilevel Converter," *IEEE Transactions on Power Electronics*, vol. 40, no. 2, pp. 3275-3285, Feb. 2025
1. R. K. Iyer, I. Z. Petric, **R. S. Bayliss**, N. C. Brooks, R. C. N. Pilawa-Podgurski, "A High-Bandwidth Parallel Active Balancing Controller for Current-Controlled Flying Capacitor Multilevel Converters," *IEEE Transactions on Power Electronics*, vol. 39, no. 10, pp. 12951-12965, Oct. 2024

Conference Publications and Presentations

14. **R. S. Bayliss III**, R. C. N. Pilawa-Podgurski, "Design and Implementation of a Three-Phase Eight-Level Flying Capacitor Multilevel Rectifier for Future Data Center Power Delivery," *2026 IEEE Applied Power Electronics Conference and Exposition (APEC)*, San Antonio, Texas, 2026
13. M. Nerenberg, **R. S. Bayliss III**, R. C. N. Pilawa-Podgurski, "Design and Characterization of a High Slew Rate Electronic Load for Data Center Power Converter Validation," *2026 IEEE Applied Power Electronics Conference and Exposition (APEC)*, San Antonio, Texas, 2026
12. **R. S. Bayliss III**, L. Horowitz, R. C. N. Pilawa-Podgurski, "Design and Analysis of a High Step-Down Ratio Capacitively-Isolated Flying Capacitor Multilevel Resonant Converter," *IEEE 26th Workshop on Control and Modeling for Power Electronics (COMPEL)*, Knoxville, Tennessee, 2025
11. **R. S. Bayliss III**, R. C. N. Pilawa-Podgurski, "A Buck-Type PFC Rectifier Employing the Flying Capacitor Multilevel Converter for Data Center Power Delivery," *2024 Open Compute Project Future Technologies Symposium*, San Jose, California, 2024
10. **R. S. Bayliss III**, R. C. N. Pilawa-Podgurski, "An Input Inductor Flying Capacitor Multilevel Converter Utilizing a Combined Power Factor Correcting and Active Voltage Balancing Control Technique for Buck-Type AC/DC Grid-Tied Applications," *IEEE 25th Workshop on Control and Modeling for Power Electronics (COMPEL)*, Lahore, Pakistan, 2024 [**Best Paper Award**]
9. M. V. Joisher, **R. S. Bayliss**, M. K. Ranjram, R. S. Yang, A. Jurkov and D. J. Perreault, "High-Performance High-Power Inductor Design for High-Frequency Applications," *2024 IEEE Applied Power Electronics Conference and Exposition (APEC)*, Long Beach, CA, USA, 2024
8. **R. S. Bayliss**, N. C. Brooks, R. C. N. Pilawa-Podgurski, "A Combined Power Factor Correcting and Active Voltage Balancing Control Technique for Buck-Type AC/DC Grid-Tied Flying Capacitor Multilevel Converters," *2023 IEEE 24th Workshop on Control and Modeling for Power Electronics (COMPEL)*, Ann Arbor, Michigan, 2023
7. R. K. Iyer, I. Z. Petric, **R. S. Bayliss**, N. C. Brooks, R. C. N. Pilawa-Podgurski, "A High-Bandwidth Parallel Active Balancing Controller for Current-Controlled Flying Capacitor Multilevel Converters," *2023 IEEE Applied Power Electronics Conference and Exposition (APEC)*, Orlando, FL, 2023
6. **R. S. Bayliss**, R. K. Iyer, R. Liou, R. C. N. Pilawa-Podgurski, "A Segmented Electric Aircraft Drivetrain Employing 10-Level Flying Capacitor Multi-Level Dual-Interleaved Power Modules," *2023 IEEE Applied Power Electronics Conference and Exposition (APEC)*, Orlando, FL, 2023
5. **R. S. Bayliss**, N. C. Brooks and R. C. N. Pilawa-Podgurski, "On the Role of Switch Output Capacitance on Passive Balancing within the Flying Capacitor Multilevel Converter," *2022 IEEE 23rd Workshop on Control and Modeling for Power Electronics (COMPEL)*, Tel Aviv, Israel, 2022

4. N. C. Brooks, R. K. Iyer, **R. S. Bayliss** and R. C. N. Pilawa-Podgurski, "Fundamental State-Space Modeling Methodology for the Flying Capacitor Multilevel Converter," *2022 IEEE 23rd Workshop on Control and Modeling for Power Electronics (COMPEL)*, Tel Aviv, Israel, 2022
3. N. Pallo, **R. S. Bayliss** and R. C. N. Pilawa-Podgurski, "A Multi-Phase Segmented Drive Comprising Arrayed Flying Capacitor Multi-Level Modules," *2021 IEEE Applied Power Electronics Conference and Exposition (APEC)*, Phoenix, AZ, USA, 2021
2. **R. S. Bayliss**, R. S. Yang, A. J. Hanson, C. R. Sullivan and D. J. Perreault, "Design, Implementation, and Evaluation of High-Efficiency High-Power Radio-Frequency Inductors," *2021 IEEE Applied Power Electronics Conference and Exposition (APEC)*, Phoenix, AZ, USA, 2021 [**Best Presentation Award**]
1. A. Jackson, N. Pallo, **R. S. Bayliss** and R. C. N. Pilawa-Podgurski, "A Modular Multi-Phase Actively Controlled Resistive Load Bank with Zero-Current Switching Capability and Integrated Snubbers," *2021 IEEE Power and Energy Conference at Illinois (PECI)*, Urbana, IL, USA, 2021

Theses

1. **R. S. Bayliss**, "Design, Implementation, and Evaluation of High-Efficiency High-Power Radio-Frequency Inductors," M.Eng. Thesis, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, 2021 [Online]. Available: <https://dspace.mit.edu/handle/1721.1/130679>

Teaching/Mentoring Experience

Teaching Assistant

January 2024 - May 2024

University of California, Berkeley

Evaluation Score: 6.95/7.0

- EE 113B - Power Electronics Design. Learn-by-design power electronic components, PCB layout, closed-loop control, and experimental validation.

Teaching Assistant

January 2024 - May 2024

University of California, Berkeley

Evaluation Score: 6.98/7.0

- EE 213B - Graduate Level Power Electronics Design. Learn-by-design power electronic components, PCB layout, closed-loop control, and experimental validation.

Research Mentor

August 2021 - Present

University of California, Berkeley

- Supervised and mentored three undergraduate students. Met weekly throughout the semester.
- Students have developed custom electronic load, high voltage motor drive inverter, FCML converter heat sink, and dynamometer data processing.

Graduate Student Advisor

May 2021 - Present

Formula SAE Electric at University of California, Berkeley

- Educated students on engineering fundamentals such as best design and test practices and high voltage safety.
- Held several design reviews evaluating student projects and providing explicit guidance.
- Guided students through project management and team organization to achieve the timeline required for building a competition ready racecar.

Teaching Assistant

August 2020 - December 2020

Massachusetts Institute of Technology

- 6.002 - Circuits and Electronics. Fundamentals of lumped circuit abstraction.

Teaching Assistant

January 2020 - May 2020

Massachusetts Institute of Technology

- 6.302 - Feedback System Design. Learn-by-design introduction to modeling and control of continuous and discrete-time systems.

Industry Experience

Vehicle Performance Modeling Intern

Summer and Fall 2023

Tesla, Palo Alto, CA

- Worked closely with power electronics, drive inverter, and cell engineering teams to understand the vehicle level impact of new onboard charger and high voltage vehicle architectures.

Power Electronics Intern

Summer 2020

SpaceX, Hawthorne, CA

- Reduced both size and cost of valve driver circuit by > 55% and verified performance with prototype design.

Power Electronics Intern

Summer 2019

Tesla, Palo Alto, CA

- Used ANSYS Maxwell to perform design analysis on various transformer designs in high power dc-dc converters, optimizing for power density and efficiency.
- Characterized a vast amount of magnetic core materials across size and temperature to develop a material selection guide for future designs

Hardware Test Engineering Intern

Summer 2018

Apple, Cupertino, CA

- Developed a Linux-based diagnostics system that sped up the development cycle by reducing the data acquisition time.
- Created power diagnostics for the Intel CPU such as verifying P- and C-States

Invited Talks

April 26, 2023 “Next Generation Power Electronics: Overcoming Key Barriers for Electric Aircraft and Ultra Efficient Power Delivery for Data Centers”, Stanford Electrical Engineering Colloquium Series, Palo Alto, CA.

Professional Service

2018 - Present	Reviewer for the <i>IEEE Transactions on Power Electronics</i> , <i>IEEE Journal on Emerging and Selected Topics on Power Electronics</i> , <i>IEEE Applied Power Electronics Conference</i> , <i>IEEE Conference on Control and Modeling of Power Electronics</i> .
2024 - 2025	Hertz Foundation: Summer Workshop Planning Committee Member
2025	Black Alumni of MIT/NSBE Jr.: Research Superday Judge
2025	University of California, Berkeley: Graduate Admissions Student Reviewer for Energy Area
2021	IEEE PES/PELS UC Berkeley Student Chapter: Social Chair