

# Roderick S. Bayliss III

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## 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

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<sup>st</sup> 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 24rd 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*  
SpaceX, Hawthorne, CA

Summer 2020

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

*Power Electronics Intern*  
Tesla, Palo Alto, CA

Summer 2019

- 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*  
Apple, Cupertino, CA

Summer 2018

- 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