

# Juntao Yao

EMC Design Engineer at Apple

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## Education

- PhD, Electrical Engineering, University of Florida, 2017-2021, Advisor: Dr. Shuo Wang  
Thesis: Modeling and Reduction of Radiated Electromagnetic Interference in Power Converters
- MS, Electrical Engineering, Wuhan University, 2013-2016, Advisor: Dr. Fei Liu & Dr. Xiaoming Zha  
Thesis: Coordination Control of DC Microgrids with Photovoltaic and Battery
- BS, Electrical Engineering, Wuhan University, 2009-2013, GPA 3.66/4 (89/100), Ranking 22/392  
Thesis: Compound Controller Design for Active Power Filters

## Skills

- **EMC and Power Electronics Solutions** in consumer and automotive electronics, EMC compliance (emissions, BCI, radiated immunity, transient immunity, and ESD) design including semiconductors, transformers, grounding, shielding, filters, and layout
- **Electromagnetic Simulation** in ANSYS Q3D, HFSS, CST, EMCoS, and ADS
- **Circuit Simulation** in LTSpice, MATLAB Simulink, Saber, PSIM, and SIMPLIS
- **Experience** with VNA, impedance analyzer, spectrum analyzer, power analyzer, and oscilloscope
- **Programming** in Python, MATLAB, C, and HTML web

## Experience

### Apple

- **EMC Design Engineer (Full-time)** Jan. 2022 - Present
  - Designed EMC in power converters and compute modules
  - Simulated resonance and power dissipations, and developed mitigation strategies
  - Optimized size and cost in EMC design, and validated in simulations and experiments
  - Designed EMC in high-speed / low-speed interfaces, and validated compliance
  - Worked with SIPI / HW / SW to assure synergy optimization of performance, cost, and EMC
- **PhD Intern** May. 2021 - Sep. 2021
  - Built 3D EM simulation models of filter and PCB, and investigated coupling mitigations
  - Investigated component non-linear characteristics and the impact on EMI
  - Predicted EMI based on noise source and filter modeling and simulations

### University of Florida, Power Electronics and Electrical Power Lab, Research Assistant

- **EMI in Power Converters in Automotive Applications** Aug. 2018 - Apr. 2021  
*Sponsored by Monolithic Power Systems, Inc. San Jose, CA, USA*
  - Developed EMI models of automotive DC-DC power converters including switching noise sources, components, PCB layouts, and antennas
  - Built a virtual lab for EMI predictions. Based on ANSYS Q3D and HFSS simulations, and experiment correlation, extracted the self-parasitics of components and PCB traces, and extracted the mutual coupling parasitics between components, PCB traces, and power cables. Predicted EMI in automotive power converters
  - Created and validated EMI solutions by circuit, component placement, and PCB layout optimizations, and near field coupling mitigations
- **Radiated EMI in GaN IC-based Active Clamp Flyback Power Adapters** Mar. 2018 - Oct. 2019  
*Sponsored by Navitas Semiconductor, Inc. El Segundo, CA, USA*
  - Developed radiated EMI models of GaN IC-based active clamp flyback power adapters
  - Proposed radiated EMI solutions by shielding and grounding, filter, and layout optimizations

- Analyzed and mitigated near field couplings' impact on radiated EMI
- Built an ANSYS HFSS simulation model of a planar transformer

- **EMI in Flyback Power Adapters**

Jan. 2017 - Dec. 2017

- Developed conducted and radiated EMI models for flyback adapters including switching noise sources, transformers, EMI filters, and antennas
- Investigated VNA characterization techniques for transformers, chokes, and antennas
- Investigated transformer winding shielding, layer arrangement, and external component balancing techniques for EMI reduction

## Wuhan University, Center for Grid Power Electronics, Research Assistant

- **Simulation and Experiment Platform of DC Microgrids**

Sep. 2014 - June 2016

- Designed the architecture and simulation model of a DC microgrid including grid-tied power converters, solar panels, batteries, and DC/DC power converters
- Investigated the control strategy of power converters and the coordination strategy of the DC microgrid in grid-tied and standalone operation modes
- Designed the PCB layout of a grid-tied power converter

- **Bidirectional Cascaded Multilevel Converter for Motor Drives**

June 2013 - June 2015

- Designed power cell configurations in a hybrid power converter consisting of unidirectional and bidirectional power cells
- Analyzed the control strategy of cascaded H-bridge multilevel inverters

- **Shunt Active Power Filter**

Nov. 2012 - Aug. 2013

- *Bachelor thesis (Province-wide honor)*

- Proposed a multi-internal-model based controller robust to grid frequency fluctuation
- Built a simulation model of an active power filter

## Publications

### Journal papers

1. **J. Yao**, S. Wang, and Z. Luo, "Modeling, Analysis, and Reduction of Radiated EMI Due to the Voltage across Input and Output Cables in an Automotive Non-isolated Power Converter," *IEEE Transactions on Power Electronics*, vol. 37, no. 5, pp. 5455-5465, 2022.
2. **J. Yao**, Y. Li, S. Wang, X. Huang, and X. Lyu, "Modeling and Reduction of Radiated EMI in a GaN IC-Based Active Clamp Flyback Adapter," *IEEE Transactions on Power Electronics*, vol. 36, no. 5, pp. 5440-5449, May 2021.
3. **J. Yao**, S. Wang, and H. Zhao, "Measurement Techniques of Common Mode Currents, Voltages, and Impedances in a Flyback Converter for Radiated EMI Diagnosis," *IEEE Transactions on Electromagnetic Compatibility*, vol. 61, no. 6, pp. 1997-2005, Dec. 2019.

### Conference papers

1. **J. Yao**, Y. Lai, Z. Ma, and S. Wang, "Advances in Modeling and Reduction of Conducted and Radiated EMI in Non-isolated Power Converters," in 2021 IEEE Applied Power Electronics Conference and Exposition (APEC), 2021.
2. **J. Yao**, Y. Lai, Z. Ma, and S. Wang, "Investigation of Noise Spectrum and Radiated EMI in High Switching Frequency Flyback Converters," in 2021 IEEE Applied Power Electronics Conference and Exposition (APEC), 2021.
3. **J. Yao**, Z. Ma, Y. Lai, and S. Wang, "A Survey of Modeling and Reduction Techniques of Radiated EMI in Power Electronics," in 2021 IEEE Symposium on Electromagnetic Compatibility, Signal Integrity and Power Integrity (EMC, SI & PI), 2021.
4. Z. Ma, Y. Yang, **J. Yao**, S. Wang, H. Sheng, L. Jia, Z. Xu, S. Lakshmikanthan, "Radiated EMI Prediction in Power Converters with Power Cables based on Cable Antenna Voltage Gain Extraction," in 2022 IEEE Symposium on Electromagnetic Compatibility, Signal Integrity and Power Integrity (EMC, SI & PI), 2021.
5. Y. Lai, **J. Yao**, S. Wang, Z. Luo, and Y. Li, "Electric Near Field Emission from a 1MHz Power Converter for Electric Vehicles," in 2021 IEEE Energy Conversion Congress and Exposition (ECCE), 2021.
6. Z. Ma, **J. Yao**, S. Wang, H. Sheng, S. Lakshmikanthan, and D. Osterhout, "Radiated EMI Reduction with Double Shielding Techniques in Active-clamp Flyback Converters," in 2021 IEEE Symposium on Electromagnetic Compatibility, Signal Integrity and Power Integrity (EMC, SI & PI), 2021.
7. Z. Ma, **J. Yao**, Y. Lai, S. Wang, H. Sheng, and S. Lakshmikanthan, "Investigate and Improve the Distorted Waveforms for Core Loss Measurement with Arbitrary Excitations," in 2021 IEEE Applied Power Electronics Conference and Exposition (APEC), 2021.

8. **J. Yao**, Y. Li, Z. Ma, and S. Wang, "Advances of Modeling and Reduction of Conducted and Radiated EMI in Flyback Converters," in 2020 IEEE Energy Conversion Congress and Exposition (ECCE), 2020, pp. 3362-3369.
9. **J. Yao**, S. Wang, and Z. Luo, "Near Field Coupling's Impact on Radiated EMI and Mitigation Techniques for Power Converters in Automotive Applications," in 2020 IEEE Energy Conversion Congress and Exposition (ECCE), 2020, pp. 5882-5889.
10. **J. Yao**, S. Wang, and Z. Luo, "Radiated EMI Reduction by Layout Improvement in Power Converters in Automotive Applications," in 2020 IEEE 9th International Power Electronics and Motion Control Conference (IPEMC2020-ECCE Asia), 2020, pp. 1894-1899.
11. **J. Yao**, Y. Li, S. Wang, X. Huang, and X. Lyu, "Analysis and Reduction of Radiated EMI in High-Frequency GaN IC-based Active Clamp Flyback Converters," in 2020 IEEE Applied Power Electronics Conference and Exposition (APEC), 2020, pp. 664-671.
12. **J. Yao**, S. Wang, and Z. Luo, "Modeling and Reduction of Radiated EMI in Non-isolated Power Converters in Automotive Applications," in 2020 IEEE Applied Power Electronics Conference and Exposition (APEC), 2020, pp. 385-392.
13. **J. Yao**, M. El-Sharkh, Y. Li, Z. Ma, S. Wang, and Z. Luo, "Investigation of Radiated EMI in Non-isolated Power Converters with Power Cables in Automotive Applications," in 2019 IEEE Energy Conversion Congress and Exposition (ECCE), 2019, pp. 6957-6964.
14. Z. Ma, **J. Yao**, Y. Li, and S. Wang, "Comparative Analysis of Magnetic Core Loss Measurement Methods with Arbitrary Excitations," in 2019 IEEE Energy Conversion Congress and Exposition (ECCE), 2019, pp. 4125-4130.
15. Y. Li, **J. Yao**, and S. Wang, "Increase High Frequency Impedance of Ferrite Toroid Inductors Based on Electromagnetic Energy Analysis," in 2019 IEEE Energy Conversion Congress and Exposition (ECCE), 2019, pp. 6184-6191.
16. **J. Yao**, Y. Li, H. Zhao, and S. Wang, "Design of CM Inductor Based on Core Loss for Radiated EMI Reduction in Power Converters," in 2019 IEEE Applied Power Electronics Conference and Exposition (APEC), 2019, pp. 2673-2680.
17. H. Zhao, **J. Yao**, and S. Wang, "A Universal DM/CM Physical Model for Power Transformer EMI Analysis within both Conducted and Radiated Frequency Ranges," in 2018 IEEE Energy Conversion Congress and Exposition (ECCE), 2018, pp. 6592-6599.
18. **J. Yao**, Y. Li, H. Zhao, S. Wang, Q. Wang, Y. Lu, and D. Fu, "Modeling and Reduction of Radiated Common Mode Current in Flyback Converters," in 2018 IEEE Energy Conversion Congress and Exposition (ECCE), 2018, pp. 6613-6620.
19. **J. Yao**, S. Wang, H. Zhao, Y. Zhang, Q. Wang, Y. Lu, and D. Fu, "Measurement Techniques of CM Currents, Impedance and Voltages for Radiated EMI in Isolated Power Converters," in 2018 IEEE Symposium on Electromagnetic Compatibility, Signal Integrity and Power Integrity (EMC, SI & PI), 2018, pp. 438-443.
20. **J. Yao**, F. Liu, J. Gong, and X. Zha. "Power Recovery and Cost Reduction Oriented Optimization of Regenerative Cells Embedded in Cascaded Multilevel Converter", in Energy Conversion Congress and Exposition (ECCE), 2015, pp. 5117 - 5123.
21. **J. Yao**, F. Liu, J. Gong, and S. Li. "A Novel Partial Units Energy Feedback Cascaded Multilevel Inverter with Bypass Control", in International Future Energy Electronics Conference (IFEEEC), 2013, pp. 494-499.

## Patents

1. **J. Yao**, and A. McDowell, "Reconfigurable Battery Pack," U.S. Patent App. US18342065, 2023. (With Apple.)
2. M. Bhattacharya, and **J. Yao**, "Damping Filters for Reduced Electromagnetic Emissions," U.S. Patent App. US18453606, 2023. (With Apple.)
3. M. Bhattacharya, A. Bender, and **J. Yao**, "Electrical Isolation of Motors for Reduction of Electromagnetic Emissions," U.S. Patent App. US63456451, 2023. (With Apple.)
4. S. Wang, **J. Yao**, and Y. Li, "Common Mode (CM) Electromagnetic Interference (EMI) Filters for Reducing Radiated EMI in Power Converters," U.S. Patent 11,356,011, 2022. (U.S. Patent, Issued)
5. Y. Xiong, F. Zhu, **J. Yao**, H. Yang, and F. Liu, "A Rectifier-fed Cascaded Multilevel Converter for Dual Motor Drive," China Patent, CN204859024U, Aug. 24, 2015. (Issued)
6. F. Zhu, Y. Xiong, **J. Yao**, H. Yang, and F. Liu, "A Symmetrical Three Port Cascaded Power Converter for Dual High Power Motor Drive," China Patent, CN204906233U, July 28, 2015. (Issued)
7. F. Liu, **J. Yao**, Y. Wang, K. Feng, C. Huang, and X. Zha, "A Repetitive Controller with Multiple Internal Models Considering the Frequency Deviation of the Power System," China Patent, CN104836233A, May. 25, 2015. (Issued)
8. **J. Yao**, K. Deng, F. Liu, J. Gong, L. Xiong, and X. Zha, "Hybrid Bidirectional Cells based Regenerative Cascaded Multilevel Converter and the Optimized Configuration of the Regenerative Cells," China Patent, CN104104240B, July 25, 2014. (Issued)
9. F. Liu, X. Lai, K. Deng, **J. Yao**, J. Sun, and Y. Li, "A Solid-state Electronic Switch Based Short Circuit Protection Method for DC Microgrids," China Patent, CN103928912B, May. 8, 2014. (Issued)
10. F. Liu, X. Zha, K. Deng, **J. Yao**, and J. Gong, "A Cascaded Multilevel Converter without Active Front for Dual Motor Drives," China Patent, CN103944439A, Apr. 28, 2014. (Issued)

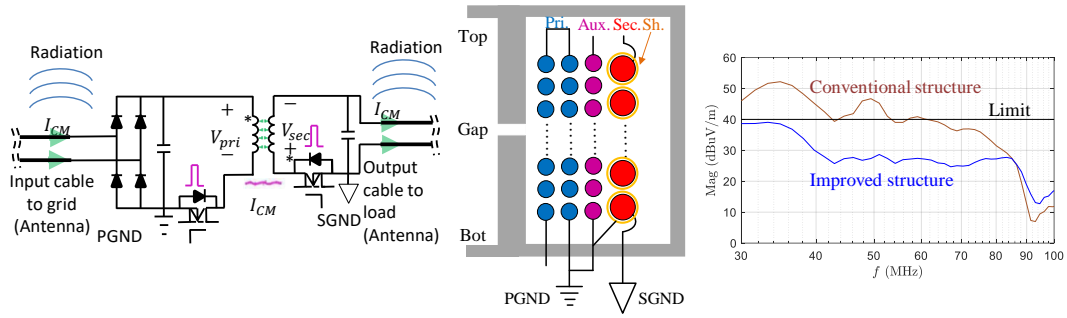
11. **J. Yao**, G. Huang, C. Liu, W. Lyu, Y. Li, F. Liu, and X. Zha, "A DC Microgrid," China Patent, CN202586339U, May. 18, 2012. (Issued)
12. G. Huang, **J. Yao**, C. Liu, W. Lyu, Y. Li, F. Liu, and X. Zha, "Low-voltage Bipolar DC Micro-power Grid," China Patent, CN202586340U, May. 18, 2012. (Issued)
13. J. Sun, X. Zha, Y. Li, W. Lyu, C. Liu, G. Huang, and **J. Yao**, "A Three Wire DC Microgrid System and Control Method for Modern Buildings," China Patent, CN102593832B, Mar. 15, 2012. (Issued)

## Honors and Awards

- Nominee of the Alec Courtelis Award at the University of Florida, for research and academic excellence, supported by Prof. Shuo Wang and Prof. Hitomi Yamaguchi Greenslet, and nominated by the College of Engineering, 2021
- Best Presentation Award, Applied Power Electronics Conference (APEC), 2021
- Outstanding Master Graduate (Top 3%), Wuhan University, 2016
- First-class Scholarship, Wuhan University, 2014
- Exceptional Bachelor Thesis in Hubei Province, China (Top 2%), 2013
- Outstanding Bachelor Graduate (Top 3%), Wuhan University, 2013
- Honorable Mention, USA Mathematical Contest in Modeling/Interdisciplinary Contest in Modeling (USA ICM/MCM), 2012
- All-round Excellent Student (Top 5%), Wuhan University, 2012
- Exemplary Student Leader, Wuhan University, 2012
- National Endeavor Scholarship (Top 5%), 2012
- Third Prize in the National Electrical Mathematical Contest in Modeling, 2011
- National Endeavor Scholarship (Top 5%), 2011
- Award for Creative Researcher, Wuhan University, 2011

## Appendix: Innovation Highlights of Doctoral Research at the University of Florida

### Project I: Transformer Structure Improvement for Radiated EMI Reduction in Flyback Converters



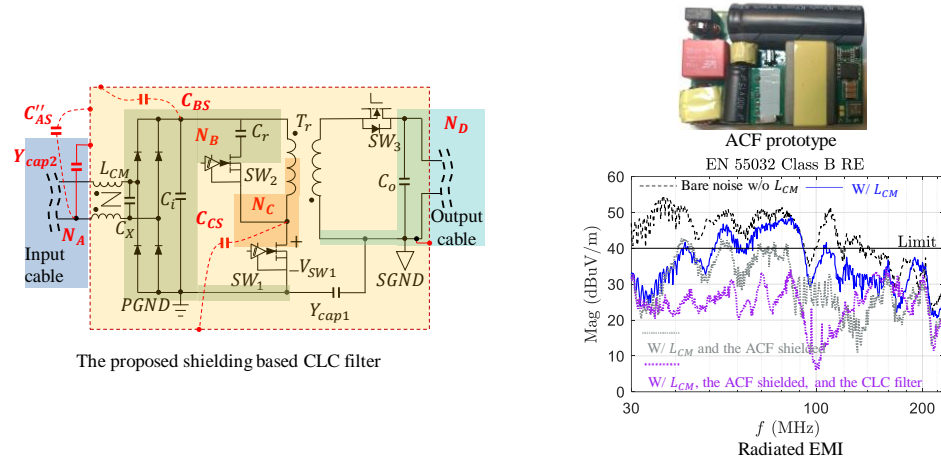
Radiated EMI in the flyback converter with power cables attached

Improved transformer structure with coaxial shielding

Radiated EMI

With the transformer structure improved, the radiated EMI is brought into compliance.

### Project II: Radiated EMI in GaN IC-based Active Clamp Flyback Adapters



The proposed shielding based CLC filter

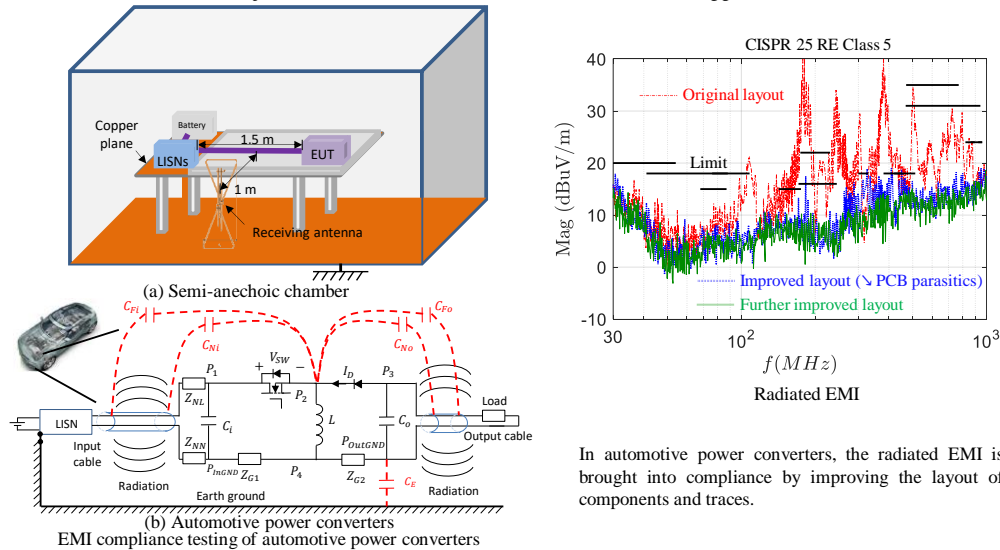
ACF prototype

EN 55032 Class B RE

Radiated EMI

In GaN IC-based ACF power adapters, the radiated EMI is brought into compliance by the proposed shielding based CLC filter.

### Project III: EMI in Power Converters in Automotive Applications



(a) Semi-anechoic chamber

(b) Automotive power converters

EMI compliance testing of automotive power converters

CISPR 25 RE Class 5

Radiated EMI

In automotive power converters, the radiated EMI is brought into compliance by improving the layout of components and traces.