Mr. Juntao YAO

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EMC Design Engineer at Apple

001-6692905629

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: Operational Control for Photovoltaic and Battery based DC Microgrid
- BS, Electrical Engineering, Wuhan University, 2009-2013, GPA 3.66/4 (89/100), Ranking 22/392
  Thesis: Compound Repetitive Control for LCL-filter based Active Power Filter

Skills

- **EMI Solutions for Power Electronics Systems** including conducted and radiated EMI in non-isolated and isolated power converters, in consumer electronics and automotive electronics, by improving component (e.g. switching transformers and EMI filters) design and PCB layout
- **Hardware** including PCB design in Altium Designer, design of switching power supplies and components, and testing using vector network analyzer, impedance analyzer, spectrum analyzer, power analyzer, oscilloscope, signal generator, etc.
- **Electromagnetic Simulation** in ANSYS Q3D, HFSS, and CST
- **Circuit Simulation** in MATLAB Simulink, PSpice, LTSpice, Saber, PSIM, and SIMPLIS
- **Programming** in MATLAB, Code composer studio, LaTex, and GitHub for web development

Experience

Apple

- **EMC Design Engineer (Full-time)** Jan. 2022 - Present
- **PhD Intern** May. 2021 - Sep. 2021
  - EMI characterization of existing GaN based power converters
  - Investigated couplings between filter components and PCB and coupling mitigation techniques
  - Investigated component non-linear characteristics and the impact on EMI
  - Predicted EMI based on filter modeling and noise source modeling
  - Created simulation workflow to capture conducted and radiated emissions and correlated to measurement results
  - Contributed to EMC design of next generation power converters

University of Florida, Power Electronics and Electrical Power Research Lab (PEEPRL)

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 for automotive DC-DC power converters including switching noise sources, components, PCB layouts, and antennas
  - Developed a virtual lab for EMI predictions. Based on ANSYS/Q3D, ANSYS/HFSS, 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. Proposed a characterization technique of cable antenna transfer gain between radiated EMI and noise sources of power converters. Predicted EMI in automotive power converters
  - Proposed EMI solutions by improving PCB layout, improving capacitor applications, and mitigating near field couplings
- **Radiated EMI in GaN IC-based Active Clamp Flyback Adapters** Mar. 2018 - Oct. 2019
  Sponsored by ***Navitas Semiconductor, Inc. El Segundo, CA, USA***

- Developed radiated EMI models for GaN IC-based active clamp flyback adapters
- Proposed radiated EMI solutions by improving shielding and grounding techniques, EMI filters, and PCB layouts
- Analyzed and mitigated near field couplings' impact on radiated EMI
- Built an ANSYS/HFSS simulation model of a planar transformer
- Investigated and improved EMI filter components and PCB layout

- **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 characterization techniques for transformers, chokes, and antennas, using vector network analyzer
  - Improved the transformer winding structure based on the coaxial shielding technique
  - Investigated transformer winding and capacitor balancing techniques for EMI reduction
  - Improved snubbers and EMI filters

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-connected converters, solar cells, batteries, and interface power converters
  - Investigated the control strategy of power converters and the coordination strategy of the DC microgrid in grid-connected and standalone operation modes
  - Designed the PCB layout of a grid connected converter

- **Bidirectional Cascaded Multilevel Converter for Motor Drives** June 2013 - June 2015
  - Designed power cell configurations for a hybrid power converter including unidirectional and bidirectional rectifiers
  - Analyzed the control strategy for cascaded H-bridge multilevel inverters for motor drives

- **Shunt Active Power Filter** Nov. 2012 - Aug. 2013
  Bachelor thesis (Province-wide honor)
  - Proposed a multi-internal-model based repetitive controller robust to frequency fluctuation
  - Built a simulation model of 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.
4. **J. Yao**, Y. Li, Z. Ma, and S. Wang, "A Survey of Modeling and Reduction of Conducted and Radiated EMI in Flyback Converters", IEEE Open Journal of Power Electronics. (Under preparation)

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. 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.
5. 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.
6. 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.
7. **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.
8. **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.
9. **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.
10. **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.
11. **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.
12. **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.
13. 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.
14. 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.
15. **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.
16. 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.
17. **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.
18. **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.
19. **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.
20. **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 (IFEEC), 2013, pp. 494-499.

Patents

1. 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)
2. Y. Xiong, F. Zhu, **J. Yao**, H. Yang, and F. Liu. "A Recitifier-fed Cascaded Multilevel Converter for Dual Motor Drive," China Patent, CN204859024U, Aug. 24, 2015. (Issued)
3. 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)
4. 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)
5. **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)

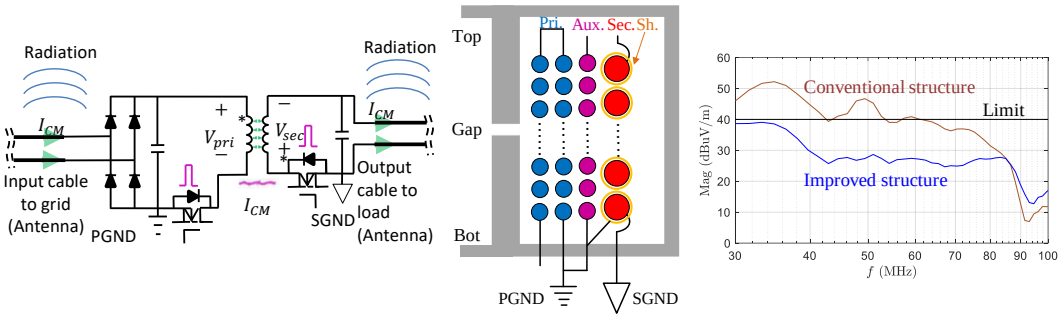
6. F. Liu, X. Lai, K. Deng, **J. Yao**. J. Sun, and Y. Li. "A Solid-state Electronic Switch Based Short Circuit Protection Method for DC Microgrids," China Patent, CN103928912B, May. 8, 2014. (Issued)
7. F. Liu, X. Zha, K. Deng, **J. Yao**, and J. Gong. "A Cascaded Multilevel Converter without Active Front for Dual Motor Drives," China Patent, CN103944439A, Apr. 28, 2014. (Issued)
8. **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)
9. 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)
10. 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

- 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 Encouragement Scholarship (Top 5%), 2012
- Third Prize in the National Electrical Mathematical Contest in Modeling, 2011
- Award for Creative Researcher, Wuhan University, 2011
- National Encouragement Scholarship (Top 5%), 2011

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

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



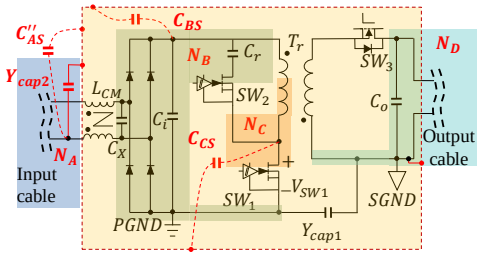
Radiated EMI in the flyback converter with power cables attached

Improved transformer structure with coaxial shielding

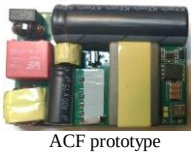
Radiated EMI

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

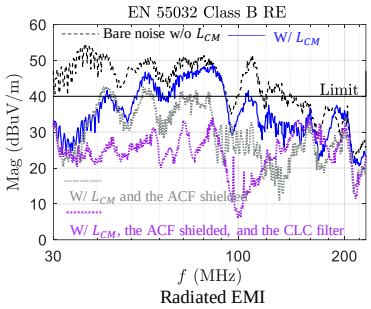
Project II: Radiated EMI in GaN IC-based Active Clamp Flyback Adapters



The proposed shielding based CLC filter



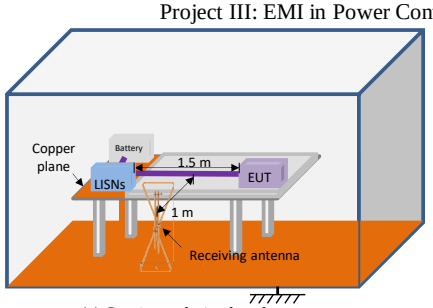
ACF prototype



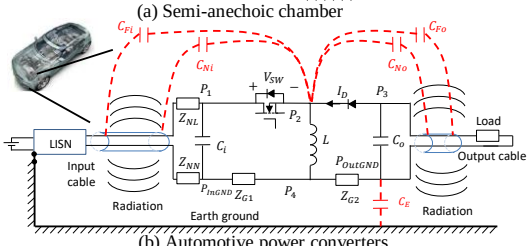
Radiated EMI

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

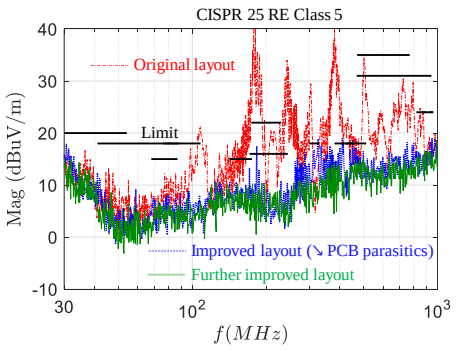


(a) Semi-anechoic chamber



(b) Automotive power converters

EMI compliance testing of automotive power converters



Radiated EMI

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