ZIRUI LIU

State Key Laboratory of Advanced Electromagnetic Engineering and Technology, Huazhong University of Sci & Tech. Hubei, China

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ResearchGate·ORCID·Google Scholar·Github.io

Electrical engineering Ph.D candidate focused on power electronics, electrical machines and drives seeking for a postdoc or research assistant position.

SKILLS

- **Programming:** C, MATLAB, Python, LaTeX
- **Tools:** Simulink, Embedded Coder, Altium Designer, JMAG, Pspice

EDUCATION

Sept.2019 – Jun.2025

Ph.D. in Electrical Engineering, Huazhong University of Sci. and Tech.

- Project: The National Natural Science Foundation of China (Grant 52377050)
- Thesis: "Nonlinear Electro-Thermal Parameters Real-Time Identification of Permanent Magnet Machines"
- Advisor: Professor **Ronghai Qu**
- Main Subjects: PMSM, Nonlinear System, Modern Control & Observe Theory, Artificial Intelligence, Data & Model Fusion, Nonlinear Electrical Machine & Controller Model

Sept.2015 – Jun.2019

B.Sc. in Electrical Engineering and Automation, Hunan University

- GRADE: **87.08/100, RANK: 2/263**
- Thesis: "Design of Modulation Method for High-speed PMSM"
- Advisor: Professor **Keyuan Huang**
- Main Subjects: PMSM, Nonlinear system, Sensorless Control, SiC MOSFET.

PROJECTS

100kW High Temperature Integrated PMSM System

- Power device, capacitor and other controller components early selection and design.
- Design of SiC MOSFET driver for high temperature operation (up to 175℃).
- Self-sensing and auto-tuning algorithm for dual three-phase PMSM with Embedded Coder.
- Prototype testing in different operation condition.

Low Voltage 1kW High-speed Electrical Pump System

- Design of control chip, inverter and EMC in one PCB.
- Low cost resistor-based phase current sampling with full-closed-loop position sensorless control.
- Development of harmonic current injection for low electrolytic capacitance design.
- Prototype testing in different operation condition.

IPMSM Test Platform for EV application

- FEA for nonlinear flux characteristic analysis for IPMSM.
- Up to 20 temperature sensors installed inside different positions
- Development of model & data fusion framework for real-time thermal modelling and temperature estimation
- Open sourced project on thermal modelling: LPTN-informed-LSTM

All-In-One Thermal Controller for EV Application

- Design and testing of IGBT drive and EMC for integrated controller.
- Loss calculation for thermal FEA.
- PCB schematic and layout review.
- Simulation design for PMSM and BLDC sensorless control.

AWARDS

- **Two times** National Scholarship (*2016, 2017*)
- **Three times** The first prize Scholarship (*2018, 2022, 2023*)
- **Three times** Merit Student (*2016, 2017, 2018*)
- *2017.03* **Meritorious Winner** in The Mathematical Contest in Modeling (MCM)
- *2017.11* **Second Prize** of Mid China Area in The National Undergraduate Electronic Design Contest
- *2021.11* **Outstanding Winner** in the Huawei Future Smart Car Creative Innovation Competition (The competition prize is 100,000 Yuan)

PUBLICATIONS

Part I: Nonlinear Parameter Identification & Control

- **Z. Liu,** X. Fan, W. Kong, L. Cao and R. Qu, "Improved Small-Signal Injection-Based Online Multi-parameter Identification Method for IPM Machines Considering Cross-Coupling Magnetic Saturation".
  IEEE Transactions on Power Electronics, vol. 37, no. 12, pp. 14362-14374, Dec. 2022
- **Z. Liu**, W. Kong, X. Fan and R. Qu, "Online Multi-Parameter Observation of IPM Machine with Reconstructed Nonlinear Small-Signal Model Based on Dual EKF".
  IEEE Transactions on Industrial Electronics, vol. 71, no. 2, pp. 1234-1245, Feb. 2024

Part II: AC Machine Position Sensorless Control

- **Z. Liu,** B. Shen, W. Kong, X. Fan, K. Peng and R. Qu, "Analytical Approach for Position Observation Error Correction in IPMSM Sensorless Drives Using Online Multi-Parameter Estimation".
  IEEE Transactions on Power Electronics, 2024, Early Access, doi: 10.1109/TPEL.2024.3390809.
- **Z. Liu,** W. Kong, X. Fan, F. Wang and R. Qu, "Online Multiparameter Estimation with Position Error Correction for Unified Synchronous Machine Sensorless Drives".
  IEEE Energy Conversion Congress and Exposition (ECCE), Nashville, TN, USA, 2023, pp. 4882-4888

Part III: Real-time Thermal Modelling and Temperature Estimation

- **Z. Liu**, W. Kong, X. Fan, Z. Li, P. Kai, R. Qu, "Hybrid Thermal Modeling with LPTN-Informed Neural Network for Multi-Node Temperature Estimation in PMSM"
  IEEE Transactions on Power Electronics, 2024, Early Access
- **Z. Liu**, W. Kong, X. Fan, Z. Li, P. Kai, R. Qu, "Hybrid Thermal Modeling with LPTN-Informed Neural Network for Multi-Node Temperature Estimation in PMSM"
  IEEE Dataport, doi: https://dx.doi.org/10.21227/sbwe-k671.

Others

- **Z. Liu,** W. Yu, H. Guo, W. Kong, C. Gan and R. Qu, "A Capacitor Voltage Sorting Algorithm for Modular Multilevel Converters(MMC) under Low-Frequency Carrier Modulation".
  International Conference on Electrical Machines and Systems (ICEMS), Harbin, China, 2019, pp. 1-4

- L. Li, X. Fan, **Z. Liu**, D. Li, T. Zou, X. Chen, R. Qu, "A Computationally Efficient Semi-Analytical Method for Circulating Current Loss of High Speed Permanent Magnet Machines". IEEE Transactions on Energy Conversion, vol. 39, no. 1, pp. 675-687, March 2024.
- Z. Li, W. Kong, **Z. Liu**, B. Shen and R. Qu, "A Novel Adaptive Nonlinear Reaching Law for DC-link Voltage Control of DC-biased Vernier Reluctance Generator". IEEE Transactions on Transportation Electrification, 2024, doi: 10.1109/TTE.2024.3398082.
- H. Liu, X. Wu, W. Kong, G. Long, H. Lou, **Z. Liu**, D. Li, "Dead-Time Compensation Based on Current Phase Estimation for High-Frequency Cascaded Transformer Multilevel Inverter" IEEE Journal of Emerging and Selected Topics in Power Electronics, doi: 10.1109/JESTPE.2024.3407762
- H. Zheng, J. Hao, M. Zha, **Z. Liu** and W. Kong, "Sensorless Control and Inductance Parameter Identification of PMSM Based on Two-Orientation High-Frequency Square Wave Injection". IEEE 6th International Electrical and Energy Conference (CIEEC), Hefei, China, 2023, pp. 585-590.
- L. Cao, X. Fan, D. Li, W. Kong, R. Qu and **Z. Liu**, "Improved LPTN-Based Online Temperature Prediction of Permanent Magnet Machines by Global Parameter Identification". IEEE Transactions on Industrial Electronics, vol. 70, no. 9, pp. 8830-8841, Sept. 2023.
- R. Wang, X. Fan, D. Li, R. Qu, **Z. Liu** and L. Li, "Comparison of Heat Transfer Characteristics of the Hollow-Shaft Oil Cooling System for High-Speed Permanent Magnet Synchronous Machines". IEEE Transactions on Industry Applications, vol. 58, no. 5, pp. 6081-6092, Sept.-Oct. 2022.
- S. Yang, W. Kong, Z. Li, **Z. Liu**, "Parameter Identification for DC-biased Vernier Reluctance Motor Considering Harmonic Current and Inverter Nonlinearity". International Conference on Smart Energy and Electrical Engineering (SEEE), Wuhan, China, 2022.

SERVICES

Reviewer: Journal

- IEEE Transactions on Power Electronics (18)
- IEEE Transactions on Transportation Electrification (5)
- IEEE Journal of Emerging and Selected Topics in Power Electronics (1)
- IEEE Transactions on Industrial Informatics (1)

Reviewer: Conference

- The 7th International Electrical and Energy Conference 2024 (CIEEC 2024)
- The 26th international Conference on Electrical Machines and Systems 2023 (ICEMS 2023)
- The 6th International Electrical and Energy Conference 2024 (CIEEC 2023)
- Reviewer & Section Chair of the 3rd China International Youth Conference on Electrical Engineering (CIYCEE 2022)

INTERNSHIPS

Feb.2021 – Apr.2021

Hardware Developer, Huawei Intelligent Vehicle Solutions BU, Shanghai, China.

- Project: All-In-One Integrated Thermal Management Controller Design for EV Application
  - Power electronics loss calculation for thermal analysis
  - PCB schematic and layout review