

# ZIRUI LIU

State Key Laboratory of Advanced Electromagnetic  
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*Electrical engineering Ph.D candidate focused on power electronics, electrical machines and drives seeking for a postdoc or research assistant position*

## SKILLS

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**Programming:** C, MATLAB, Python, LaTeX

**Tools:** Simulink, Embedded Coder, Altium Designer, JMAG, Pspice

## EDUCATION

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**Ph.D. in Electrical Engineering**, Huazhong University of Sci. and Tech. Sept. 2019 – Exp. Jun. 2025

- 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, Power Electronic, Modern Control & Observe Theory, Artificial Intelligence, Data & Model Fusion, Nonlinear Electrical Machine & Controller Model

**B.Sc. in Electrical Engineering and Automation**, Hunan University Sept. 2015 – Jun. 2019

- GPA: **3.77/4.00** 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

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### 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°C)
- 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

### 12kVA interleave DC/DC & Three Phase DC/AC Controller for SynRm S/G

- Schematic design of the control board and power board
- Testing of the integrated interleave Bidirectional DC/DC & Three Phase DC/AC
- Control strategy design for engine stator & generator integration using synchronous reluctance machine

### All-In-One Thermal Controller for EV Application

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

## 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](#)

## AWARDS

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Two times National Scholarship	2016, 2017
Three times The first prize Scholarship	2018, 2022, 2023
Three times Merit Student	2016, 2017, 2018
Meritorious Winner in The Mathematical Contest in Modeling (MCM)	Mar. 2017
Second Prize of Mid China Area in The National Undergraduate Electronic Design Contest	Nov. 2017
Outstanding Winner in the Huawei Future Smart Car Creative Innovation Competition	Nov. 2021

## PUBLICATIONS

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### 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

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### Reviewer: Journal

- IEEE Transactions on Power Electronics (20)
- IEEE Transactions on Transportation Electrification (5)
- IEEE Journal of Emerging and Selected Topics in Power Electronics (1)
- IEEE Transactions on Industrial Informatics (1)

### Conference

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

## INTERNSHIPS

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

Feb. 2021 – Apr. 2021

Project: All-In-One Integrated Thermal Management Controller Design for EV Application

- Power electronics loss calculation for thermal analysis
- PCB schematic and layout review