

# Wentao Zhang

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## Work Experience

### University of Nottingham

Research Assistant

2025/09 - Now

Nottingham, United Kingdom

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## Education

### Southeast University

2021/09 - 2025/09

Ph. D. in Electrical Engineering

Najing, Jiangsu, China

- Dissertation Title: “Multi-physics Analysis and Design of Flat Wire Winding PM machines in Electric Vehicles”

### Southeast University

2018/09 - 2021/06

Master in Electrical Engineering

Najing, Jiangsu, China

- Dissertation Title: “Analysis and Design of High-Performance Wound-Excited Magnetic Field Modulation-based Brushless Machines”

### Southeast University

2014/09 - 2018/06

B.Eng in Electrical Engineering

Najing, Jiangsu, China

- Dissertation Title: “Comparative Study of Control Systems for PM Machine in Electric Vehicles”

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## Research Experience

**My research focuses on the multi-physics design, analysis and control of the high power/torque density electric machine system applied in electric vehicles (EVs)**, including the flat wire PM machines and wound field excited machines. I have wrote 21 journal papers, including fourteen published IEEE Transactions papers and three more are under review. In general, my research can be divided into three parts.

**The first part is the design methods for the high-performance electric machines in EVs**, including the novel n-layer flat wire winding design and performance evaluation, DC winding induced voltage analysis and suppression for the wound excited electric machines and mechanism driven multi-objective optimization methods. **The second part is the advanced cooling system design and analysis for the electric machines in EVs**, both high resolution lumped parameter thermal model and the fluid-solid strong coupled oil cooling system are developed for the EV used electric machines. **The third part is the control and dynamic modeling for the electric machine system in EVs**, in which the control strategy, converter characteristics and the spatial harmonic electric machine model have been applied.

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## Research Publication

### Transaction/Journal Paper

- [J1] **Wentao Zhang**, Wei Hua, Zhongze Wu, Guishu Zhao, Yi Wang and Weiguo Xia, “Analysis of DC Winding Induced Voltage in Wound-Field Flux-Switching Machine With Air-Gap Field Modulation Principle,” **IEEE Trans. Ind. Electron.**, vol. 69, no. 3, pp. 2300-2311, March 2022.
- [J2] **Wentao Zhang** et al., “Reduction of Open-Circuit DC Winding Induced Voltage and Torque Pulsation in the Wound Field Switched Flux Machine by Stator Axial Pairing of Tooth Tips,” **IEEE Trans. Ind Appl.**, vol. 58, no. 2, pp. 1976-1990, March-April 2022.
- [J3] **Wentao Zhang**, Zhongze Wu, Ying Fan, Wei Hua and Ming Cheng, “A Stable and Computationally Efficient Spatial Harmonic Model for Predicting the DC Winding Induced Voltage in WFSF Machine,” **IEEE Trans. Ind Appl.**, vol. 59, no. 4, pp. 3966-3977, July-Aug. 2023.
- [J4] **Wentao Zhang**, Zhongze Wu, Ying Fan, Wei Hua and Ming Cheng, “Analysis and Improvement of DC Winding Current Dynamics in Wound Field Switched Flux Machine,” **IEEE Trans. Ind Appl.**, vol. 60, no. 4, pp. 6023-6032, July-Aug. 2024.
- [J5] **Wentao Zhang**, Zhongze Wu and Wei Hua, “Design of n-Layer Flat Wire Winding in Permanent Magnet Machine for Electric Vehicles,” **IEEE Trans. Transport. Electrific.**, doi: 10.1109/TTE.2025.3532407. (early access)
- [J6] **Wentao Zhang**, Zhongze Wu, Lai Jin, Ying Fan, Wei Hua and Ming Cheng, “Analysis and Multi-Objective Optimization of the Hybrid Excitation Switched Flux Machine,” **IEEE Trans. Ind Appl.**, vol. 61, no. 2, pp. 2996-3006, March-April 2025.

- [J7] **Wentao Zhang**, Zhongze Wu, Lai Jin, Ying Fan, Wei Hua, Zhiyuan Xu and Ming Cheng, “Design Tradeoff between Flux Regulation Capability and DC Winding Induced Voltage in Hybrid Excitation Switched Flux Machine,” **IEEE Trans. Ind Appl.** (accepted).
- [J8] **Wentao Zhang**; Ying Fan.; Ziqiang Zhu; Zhongze Wu; Wei Hua; Ming Cheng. “Analysis of DC Winding Induced Voltage in Wound-Rotor Synchronous Machines by Using the Air-Gap Field Modulation Principle.” **World Electr. Veh. J.** 2022, 13, 215.
- [J9] **Wentao Zhang**, Zhongze Wu and Wei Hua, “Space-Resolved Lumped Parameter Thermal Model for Oil-Cooling Flat Wire Winding PM Machines,” **IEEE Trans. Ind Appl.** (under review)
- [J10] **Wentao Zhang**, Zhongze Wu, Ziyu Cang, Wei Hua, Ying Fan, and Ming Cheng, “Influence of End-Effect in Switched Flux Machines,” **IEEE Trans. Ind Appl.** (under review)
- [J11] Zhongze Wu, **Wentao Zhang**, and Wei Hua, “Performance Evaluation of Flat Wire Windings for Permanent Magnet Machines in Electric Vehicles,” **IEEE Trans. Ind. Electron.** (under review)
- [J12] Zhongze Wu, **Wentao Zhang**, Ying Fan, Wei Hua and Ming Cheng, “A Transient-State Lumped Parameter Thermal Model for Brushless Wound Field Switched Flux Machines,” **IEEE Trans. Transport. Electrific.**, vol. 10, no. 1, pp. 224-238, March 2024.
- [J13] Zhongze Wu, Ziqiang Zhu, Chao Wang, Wei Hua, Kai Wang and **Wentao Zhang**, “Influence of rotor iron bridge position on DC-winding-induced voltage in wound field switched flux machine having partitioned stators,” **Chinese Journal of Electrical Engineering**, vol. 7, no. 3, pp. 20-28, Sept. 2021.
- [J14] Zhongze Wu, Ziqiang Zhu, Shun Cai, Wei Hua and **Wentao Zhang**, “Enhancement of torque density in wound field switched flux machines with partitioned stators using assisted ferrites,” **Chinese Journal of Electrical Engineering**, vol. 7, no. 3, pp. 42-51, Sept. 2021.
- [J15] Zhongze Wu, Lai Jin, Wei Hua, **Wentao Zhang** and Ming Cheng, “Harmonics Orders Modelling of DC Winding Induced Voltage Pulsation in Wound Field Switched Flux Machines under PWM Excitation,” **IEEE Trans. Transport. Electrific.**, vol. 10, no. 3, pp. 7040-7050, Sept. 2024.
- [J16] Zhongze Wu, Lai Jin, **Wentao Zhang**, Ying Fan, Wei Hua and Ming Cheng, “Influence of PWM Excitation on DC Winding Induced Voltage Pulsation in Wound Field Switched Flux Machines,” **IEEE Trans. Ind Appl.**, vol. 60, no. 1, pp. 460-476, Jan.-Feb. 2024.
- [J17] Zhongze Wu, Z. Q. Zhu, Wei Hua, Sam Akehurst, Xiaofeng Zhu, **Wentao Zhang**, Jie Hu, Haoyang Li, Junming Zhu, “Analysis and Suppression of Induced Voltage Pulsation in DC Winding of Five-Phase Wound-Field Switched Flux Machines,” **IEEE Transactions on Energy Conversion**, vol. 34, no. 4, pp. 1890-1905, Dec. 2019.
- [J18] Lai Jin, Wei Hua, Udochukwu B. Akuru, Zhongze Wu, **Wentao Zhang** and Ming Cheng, “Comparative Study on DC Winding Induced Voltage Pulsation of Wound Field Flux Modulation Machines Having Different Iron Core Structures,” **IEEE Trans. Ind Appl.**, doi: 10.1109/TIA.2023.3327033 (early access).
- [J19] Xueyi Yan, Zhongze Wu, Wei Hua, **Wentao Zhang** and Ming Cheng, “A Mathematical Model for Wound Field Switched Flux Machine Considering Inductance Harmonics of Field and Armature Windings,” **IEEE Trans. Ind Appl.**, vol. 60, no. 5, pp. 6811-6822, Sept.-Oct. 2024.
- [J20] Hao Hua, Xinying Chen, Dalin Li, **Wentao Zhang**, Zhongze Wu and Wei Hua, “Investigation of Torque Improvement of Modular Stator Surface-Mounted Permanent Magnet Machines With Flux Gaps,” **IEEE Trans. Ind Appl.**, vol. 60, no. 5, pp. 6787-6798, Sept.-Oct. 2024.
- [J21] Jixuan Chen, Wei Hua, Lingyun Shao, Zhongze Wu, Xueyi Yan, and **Wentao Zhang**, “Modified magnetic equivalent circuit of double-stator single-rotor axial flux permanent magnet machine considering stator radial-end flux-leakage,” **IET Electric Power Applications**, vol. 18, no. 2, pp. 195-207, Feb. 2024.

#### Conference Paper

- [C1] **Wentao Zhang**, Zhongze Wu, Wei Hua, Ying Fan, Zhiyuan Xu and Ming Cheng, “Design Tradeoff between Flux Regulation Capability and DC Winding Induced Voltage in Hybrid Excitation Switched Flux Machine,” in Proc. IEEE Energy Convers. Congr. Expo., Nashville, TN, USA, 2023, pp. 5060-5066.
- [C2] **Wentao Zhang**, Zhongze Wu, Lai Jin, Ying Fan, Wei Hua and Ming Cheng, “Analysis and Multi-Objective Optimization of the Hybrid Excitation Switched Flux Machine,” in Proc. Int. Elect. Energy Conf. , Hefei, China, 2023, pp. 3371-3376. (**Best Paper Award**)
- [C3] **Wentao Zhang**, Zhongze Wu, Wei Hua, Ying Fan and Ming Cheng, “Influence of the End-Effect in Wound Field Switched Flux Machine,” in Proc. Int. Conf. Elect. Mach. Syst., Zhuhai, China, 2023, pp. 1223-1227.

- [C4] **Wentao Zhang**, Zhongze Wu, Ying Fan, Wei Hua and Ming Cheng, “Analysis and Improvement of DC Winding Current Dynamics in Wound Field Switched Flux Machine,” in Proc. Int. Conf. Energy Technol. Future Grids, Wollongong, Australia, 2023, pp. 1-6.
- [C5] **Wentao Zhang**, Zhongze Wu, Ying Fan, Wei Hua and Ming Cheng, “A Stable and Computationally Efficient Spatial Harmonic Model for Predicting the DC Winding Induced Voltage in WFSF Machine,” in Proc. Energy Convers. Congr. Expo., Detroit, MI, USA, 2022, pp. 1-7.
- [C6] **Wentao Zhang**, Zhongze Wu, Wei Hua and Ziqiang Zhu, “Reduction of Open-Circuit DC Winding Induced Voltage and Torque Pulsation in the Wound Field Switched Flux Machine by Stator Axial Pairing of Tooth-Tips,” in Proc. IEEE Int. Elect. Mach. Drives Conf., Gothenburg, Sweden, 2020, pp. 522-528.
- [C7] Lai Jin, Wei Hua, Udochukwu B. Akuru, Zhongze Wu, **Wentao Zhang** and Ming Cheng, “Comparative Study on DC Winding Induced Voltage Pulsation of Wound Field Flux Modulation Machines Having Different Iron Core Structures,” in Proc. Int. Conf. Elect. Mach. Syst., Zhuhai, China, 2023, pp. 442-447.
- [C8] MMartin Philip Koroma, Wei Hua, Zhongze Wu, Lai Jin and **Wentao Zhang**, “Influence of Magnet Layer Numbers on Electromagnetic Performance of Interior Permanent Magnet Machines,” in Proc. Int. Conf. Elect. Mach. Syst., Zhuhai, China, 2023, pp. 696-700.
- [C9] Xueyi Yan, Zhongze Wu, Wei Hua, **Wentao Zhang** and Ming Cheng, “A Mathematical Model for Wound Field Switched Flux Machine Considering Inductance Harmonics of Field and Armature Windings,” in Proc. IEEE Int. Elect. Mach. Drives Conf., San Francisco, CA, USA, 2023, pp. 1-6.
- [C10] Zhongze Wu, Lai Jin, **Wentao Zhang**, Xueyi Yan, Haorui Ge, Hao Hua, “A Lumped Parameter Thermal Model for Variable Flux Reluctance Machine Considering Relative Position of DC and AC Windings,” in Proc. Int. Conf. Elect. Mach., Torino, Italy, 2024, pp. 1-7.

#### Patent

- Zhongze Wu; **Wentao Zhang**; Xixuan Mao; Wei Hua, Method, Device, Storage Medium, and Flat Wire Winding for Generating Windings of Flat Wire Permanent Magnet Motors with Arbitrary Layers, CN119298577A, 2025.01.10.
- Zhongze Wu; **Wentao Zhang**; Wei Hua; Zhixiang Zou, Temperature Calculation Method for Drive Motors Using Temperature-Fluid Weak Coupling Technology, CN119294277A, 2025.01.10.
- Zhongze Wu; **Wentao Zhang**; Erfang Fu; Wei Hua; Kai Liu, General Modeling Method for Magnet Slot to Reduce Stress Concentration in Embedded Permanent Magnet Motor Rotors, CN119004896A, 2024.11.22.
- Zhongze Wu; **Wentao Zhang**; Wei Hua, Mechanism-Driven Optimization Method for Hybrid Excitation Motors with Multiple Operating Modes, CN118886378A, 2024.11.01.
- Zhongze Wu; **Wentao Zhang**; Wei Hua, Optimization Design Method for Embedded Permanent Magnet Motor Rotors with Low Torque Ripple and Low Noise, CN118826334A, 2024.10.22.
- Zhongze Wu; **Wentao Zhang**; Lai Jin; Wei Hua, Disc-Type Brushless Electric Excitation Field Modulation Motor with Double-Row Stator Structure, CN118100572A, 2024.05.28.
- Zhongze Wu; **Wentao Zhang**; Wei Hua; Zhixiang Zou, Establishment Method of General Lumped Parameter Thermal Network Model for Motors, CN117094088A, 2023.11.21.
- Zhongze Wu; **Wentao Zhang**; Junxiang Liao; Ying Fan; Wei Hua; Ming Cheng, Method for Suppressing Pulsating Induced Voltage in Excitation Windings Based on Harmonic Current Injection, CN115208245A, 2022.10.18.
- Zhongze Wu; **Wentao Zhang**; Ying Fan; Wei Hua; Ming Cheng, High-Precision Field-Circuit Coupling Design Method for Brushless Electric Excitation Field Modulation Motors, CN114781227A, 2022.07.22.
- Wei Hua; **Wentao Zhang**; Zhongze Wu; Shichuan Ding, Method for Reducing Torque Ripple and Induced Voltage in Electric Excitation Flux Switching Motors, CN111769697A, 2020.10.13.

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#### Awards

- 2024 2<sup>nd</sup> Prize in 11<sup>th</sup> Energy Equipment Innovative Design Competition for China Postgraduate
- 2023 **Wiscom System Scholarship**
- 2023 1<sup>st</sup> Prize Academic Scholarship
- 2023 CIEEC Best Paper Award
- 2023 **1<sup>st</sup> Prize in IEEE IAS CMD Thesis Contest (non-Ph. D)**
- 2022 Outstanding Master Degree Thesis in Jiangsu Province
- 2017 2<sup>nd</sup> Prize in Southeast University Smart Car Competition