Shiqi Zhang

Postdoctoral Research Fellow in AI-Enabled Power Electronics and Energy Systems
KTH Royal Institute of Technology, Stockholm, Sweden
Email: shizha@kth.se | Mobile: +86 188 3388 4449
Homepage: https://s-q-z.github.io/
Google Scholar: https://scholar.google.com/citations?user=f6Bvb1UAAAAJ&hl=zh-CN

Research Identity

I am a Postdoctoral Research Fellow in Electrical Engineering with research expertise in AI-enabled control, deep reinforcement learning, fault diagnosis, and stability analysis of converter-dominated energy systems. My research focuses on integrating physics-based modeling, optimization, and machine learning to enhance the resilient operation of renewable-rich power systems, distributed energy resources, and microgrid-like energy infrastructures under uncertainty, disturbances, and abnormal operating conditions.

My previous work has been applied to renewable-powered hydrogen production systems, multi-port power converters, and weak-grid-connected energy systems. These systems share key cyber-physical characteristics with DER-rich distribution networks, including inverter-dominated interfaces, uncertain renewable inputs, multi-timescale control interactions, and the need for reliable operation under disturbances. I aim to develop interpretable, physics-informed, and hardware-validated AI methods for adaptive control, anomaly detection, and resilient decision-making in modern power and energy systems.

EDUCATION

Yanshan University, PhD in Electrical Engineering **Qinhuangdao, China | Dec 2025**

- **GPA**: 90.4/100 (Ranked **1/54**)
- **Research Interests**: Power electronics for renewable-integrated energy systems; fault diagnosis and fault-tolerant control of converter systems; reliability-oriented operation and energy management

Curtin University, M.Eng. in Emerging Power Systems **Perth, Australia | Aug 2022**

- **GPA**: 4.26 out of 5.0 (Ranked **1/35**)
- **Relevant Coursework**: Distributed Generation, Smart Grid Technologies, Power System Protection and Control

Selected Research Experience

Innovation Project of Hebei Province, Principal Investigator **Qinhuangdao | Oct 2023 – Mar 2025**

- Developed a dynamic modeling framework for converter-interfaced renewable energy systems under uncertain and intermittent operating conditions, with emphasis on multi-timescale interactions among renewable generation, power converters, energy storage, and controllable loads.
- Designed deep reinforcement learning-based energy management and operation strategies to improve scheduling robustness, reduce frequent operating-state transitions, and enhance system resilience under fluctuating renewable inputs.
- Integrated physics-based constraints into learning-based control policies to improve interpretability, feasibility, and engineering applicability of AI-enabled decision-making methods.
- Validated the proposed models and control strategies through MATLAB/Simulink-based simulations and experimental studies, supporting journal publications and patent outputs in intelligent energy management and converter control.

National Key R&D Program – Major Energy Project, Participant **Beijing/Qinhuangdao | Jan. 2021–Jan. 2026**

- Contributed to coordinated control, ripple suppression, reliability enhancement, and fault-tolerant operation of

converter-based renewable energy systems.

- Developed and evaluated fault diagnosis and fault-tolerant control strategies for multi-port power converter systems, providing a foundation for anomaly detection and resilient operation of inverter-based energy systems.
- Investigated impedance-based stability and control interactions in weak-grid and converter-dominated environments, with relevance to DER-rich distribution networks and microgrid operation.
- Conducted model-to-hardware validation using real-time simulation, DSP/FPGA-based control implementation, and hardware-in-the-loop experimental platforms.
- Supported prototype development, system testing, and practical engineering implementation for renewable-integrated energy systems.

Technical Expertise

- **AI/ML for Energy Systems**: deep reinforcement learning, fault diagnosis, anomaly detection, data-driven modeling, physics-informed learning, intelligent optimization, decision-making under uncertainty
- **Power and Energy Systems**: converter-dominated power systems, distributed energy resources, microgrids, renewable energy integration, power quality, weak-grid stability, inverter-based resources
- **Control and Optimization**: adaptive control, fault-tolerant control, robust operation, model-based control, impedance-based stability analysis, multi-objective optimization
- **Cyber-Physical Energy Systems**: resilient operation, disturbance-aware control, fault/attack-tolerant operation, sensor-data-driven condition monitoring, operational recovery strategies
- **Tools and Platforms**: Python, MATLAB/Simulink, PSCAD, PLECS, RT-LAB, DSP, FPGA, hardware-in-the-loop validation
- **Machine Learning Frameworks**: PyTorch / TensorFlow
- **Experimental Validation**: converter prototyping, real-time control implementation, HIL validation, hardware testing, data acquisition and analysis

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Selected Publications

- **S. Zhang**, Y. Teng, Y. Sun, F. Ding, N. Wang, X. Guo, and C. Hua, "Fault diagnosis and fault-tolerant operation strategy for triple-port hydrogen production system," **IEEE Trans. Power Electron.**, vol. 40, no. 8, pp. 11526–11536, 2025.
- X. Guo, **S. Zhang** (Corresponding Author), F. Ding, J. Zhu, and H. Bai, "A novel DC–DC converter for electrolyzer with low ripple and high step down," **IEEE Trans. Ind. Electron.**, vol. 71, no. 10, pp. 12476–12486, 2024.
- **S. Zhang**, Z. Jiao, J. Su, N. Wang, Z. Li, X. Guo, and C. Hua, "Low-ripple modulation strategy for a photovoltaic-based triple-port hydrogen production system," **IEEE Trans. Ind. Electron.**, Early Access, 2025.
- **S. Zhang**, Y. Teng, H. Kong, N. Wang, Y. Liu, X. Guo, and C. Hua, "An industrial overview of variable-frequency drives for hydrogen compressors in hydrogen transportation," **Renew. Sustain. Energy Rev.**, vol. 223, 116009, 2025.
- **S. Zhang**, Y. Wei, X. Guo, Z. Li, X. Song, and F. Blaabjerg, "Overview of US patents for energy management of renewable energy systems with hydrogen," **Int. J. Hydrogen Energy**, vol. 48, no. 26, pp. 9574–9591, 2023.
- X. Guo, **S. Zhang** (Corresponding Author), Z. Yan, Y. Wei, and X. Hu, "A novel phase-locked loop structure to enhance converter stability in weak grids," **IEEE Trans. Power Electron.**, vol. 38, no. 11, pp. 13855–13865, 2023.
- X. Guo, **S. Zhang** (Corresponding Author), Y. Gao, Y. Teng, N. Diao, C. Hua, and V. Terzija, "Advancements in photovoltaic electrolysis for green hydrogen production: A comprehensive review and comparative analysis of modeling approaches," **IEEE Trans. Power Electron.**, vol. 40, no. 7, pp. 10000–10026, 2025.
- Fang, W., Teng, Y., **Zhang, S.** (Corresponding Author); Kong, H., Wang, H., Guo, X. Impedance Modeling and Stability Analysis of Electrolysis System for Hydrogen Production Under Weak Grid. **Fuel**, Vol. 374, 132403.
- Guo, X., Ding, F., **Zhang, S.** (Corresponding Author); Teng, Y., Diao, N., Terzija, V. Enhanced Green Hydrogen Production Using a Novel Converter with Extremely Low Current Ripple and High Step-Down Ratio. **Fuel**, Vol. 398, 135424, 2025.

- Guo, X., Zhu, H., **Zhang, S.** (Corresponding Author) Overview of Electrolyser and Hydrogen Production Power Supply from Industrial Perspective. **Int. J. Hydrogen Energy**, Vol. 49, pp. 1048–1059.
- X. Guo, X. Hu, and **S. Zhang** (Corresponding Author), "Application status of variable-frequency drive in hydrogen fuel cell air compressors from an industrial viewpoint: A review," **Sustain. Energy Technol. Assess.**, vol. 64, 103716, 2024.
- X. Guo, **S. Zhang** (Corresponding Author), Z. Liu, L. Sun, Z. Lu, C. Hua, and J. M. Guerrero, "A new multi-mode fault-tolerant operation control strategy of multiphase stacked interleaved Buck converter for green hydrogen production," **Int. J. Hydrogen Energy**, vol. 47, no. 71, pp. 30359–30370, 2022.

Selected Awards & Honors

- **Top 100 Outstanding Graduate Students Nationwide,** China, 2024
- **China Telecom Tianyi Scholarship,** one of 98 awardees nationwide, 2025
- **Youth Medal of Hebei Province,** 2025
- **Gold Award,** China International College Students' Innovation Competition, 2021, 2022
- **Silver Medal / International Award,** 49th Geneva International Exhibition of Inventions, 2024

Patents (Granted, Selected)

- **Zhang, S.**, Guo, X., Liu, Z., et al. Control and fault-tolerant method for multiphase interleaved parallel converters. CN115347774B, Granted May 23, 2023.
- **Zhang, S.**, Zhang, L., Guo, X., et al. Fault diagnosis and recovery control for interleaved Buck circuits. CN115065243B, Granted Dec. 30, 2022.
- **Zhang, S.**, Guo, X., Hu, X., et al. Improved transformerless three-phase multilevel inverter and control method. CN115987127A, Granted Apr. 18, 2023.
- **Zhang, S.**, Guo, X., Ding, F., et al. Hydrogen production power converter. CN117040267B, Granted Nov. 10, 2023.
- **Zhang, S.**, Guo, X., Kong, H., et al. Electrolysis hydrogen production system model. CN117037928B, Granted Nov. 10, 2023.
- **Zhang, S.,** Guo, X., Kong, H., Song, X., Zhang, Z., Blaabjerg, F. Energy management method for renewable energy systems. CN115411770B, Granted Nov. 29, 2022.
- **Zhang, S.**, Li, Z., Guo, X., et al. Intelligent optimization control for satellite power fault reconstruction based on wild goat algorithm. CN115079571B, Granted Dec. 30, 2022.
- **Zhang, S.,** Guo, X., Li, Z., Lu, Z., Hua, C., Guerrero, J. Energy management method for microgrids with hydrogen energy storage. CN115085229B, Granted Dec. 30, 2022.
- **Zhang, S.**, Guo, X., Wei, Y., Yang, Y., Song, L. Multi-mode dual-layer fault diagnosis method for fuel cell systems. CN113962259B, Granted Jun. 3, 2022.
- **Zhang, S.**, Guo, X., Wang, Z., Wei, Y., Yang, Y. Multi-objective optimization method for distributed generation considering power constraints. CN113890094B, Granted Jun. 3, 2022.

Conference Publications (Selected)

- **Zhang, S.**, Teng, Y., Diao, N., Guo, X., Terzija, V., Wang, L. Fault Diagnosis and Tolerant Strategy for Triple-Port Hydrogen Converter Using SSA-Optimized Random Forest Algorithm. 2025 **IEEE Applied Power Electronics Conference and Exposition (APEC)**, pp. 757–760, **Atlanta, GA, USA**, 2025. (**Oral presentation**)
- Guo, X., **Zhang, S.** (Corresponding Author), Yuwen, B., Zhang, Q., Wang, T., Padmanaban, S. A Novel DC–DC Converter for Electrolyzer with Low Ripple and High Step-Down Ratio. **2023 IEEE PEDS**, **Montréal, Canada**, pp. 1-5, 2023. (**Oral presentation**)
- **Zhang, S.**, Guo, X. Optimal Configuration of Integrated Target Distributed Power Generation Based on Improved JAYA Algorithm and AHP. 2022 IEEE PEAC, Guangzhou, China, pp. 684–687, 2022. (**Oral presentation**)
- **Zhang, S.**, Wei, Y., Hu, X., Guo, X., Wang, L., Guerrero, J.M. A Novel Three-Phase Multilevel Converter for Medium-Voltage Application. 2022 SPIES, Shanghai, China, pp. 294–297, 2022. (**Oral presentation**)