Jinshui Zhang

529 Hillsborough St, Chapel Hill, NC, USA
jinshui.zhang@duke.edu | https://jinshui.me

Research Interests

Topology, design, and control of multi-cell power electronics, and their cutting-edge applications – clean energy, green transportation, and neuroscience.

Education

Ph.D. in Electrical and Computer Engineering, Duke University 2026
M.S. in Electrical Engineering, Xi'an Jiaotong University 2021
B.S. in Electrical Engineering, Tianjin University 2018

Selected Research Projects

MPS-TMS: Modular Pulse Synthesizer for Transcranial Magnetic Stimulation with Fully Adjustable Pulse Shape and Sequence

NIH fund (RF1MH124943), Duke University 2022.09 - present

- Launched world's first fully pulse-adjustable, closed-loop wireless brain stimulation platform
- Co-developed a 3 kV&6 kA modular pulse synthesizer circuit
- Developed a pipeline integrating signal sampling and processing, and pulse generation
- Colaborated with clinicians to carry out human studies

MOANA: Magnetic, Optical, and Acoustic Neural Access Device, for High-Bandwidth, Non-Surgical Brain Computer Interfaces

DARPA fund (HR001118S0029-N3-FP), Duke University 2021.09 - 2023.03

- Constructed a Python-interfaced embedded control system for pulse optimization
- Prototyped a dc-to-5 MHz bandwidth 5 kW power amplifier for magnetogenetics stimulation

Configurable Battery Based Electric Vehicle Powertrain Development

Duke Energy Initiative fund (4411367), Duke University 2022.03 - present

- Developed a 20 kW electric vehicle based on reconfigurable batteries
- Invented a circuit using half transistors yet performing the same functionalities as present art

Teaching Experience

Teaching Assistant & Lab Instructor

ECE 431&531, Duke University Spring 2022, 2024

- Designed and led a lab session guiding students to prototype a closed-loop dc-dc converter

Teaching Assistant

Modeling & Control of Power Electronic Circuits, Xi'an Jiaotong University Spring, 2020

Student Investigator of Superconductor Technology

Tech-Camp, Tianjin University Summer, 2016

- Established and demonstrated superconducting-based prototypes, e.g. mag-levitation car
- In charge of recruiting volunteers and organizing social events

Industrial Experience

Application Engineer

Longteng Semiconductor Co. 2019.05 - 2020.05

- Developed a 3 kW Totem-Pole rectifier with unlisted SiC MOSFET chips

Power Electronic Intern
Vertiv Co. 2018.05 - 2018.08
• Performed noise & mechanical test of uninterrupted power supply for data center

Honors

Best Presentation Award at 50th IECON conference 2024
Excellent Graduate of Xi'an Jiaotong University 2019
Meritorious Winner of Mathematical Contest in Modeling 2017
Ultra High Voltage (UHV) Scholarship of State Grid Corporation of China 2016
Merit Student of Tianjin University 2015-2018

Services

Reviewing Conference and Journal Papers

IEEE Transactions on Power Electronics, IEEE Transactions on Industrial Electronics, IEEE Journal of Emerging and Selective Topics in Power Electronics, ACM Transactions on Computing for Healthcare, Applied Power Electronics Conference APEC, Conference of the IEEE Industrial Electronics Society IECON

Mentoring Students

• Ian Le (Undergraduate @ Duke University)
• Zane Mannings (Undergraduate @ Duke University)
• Majed Al Munefi (Undergraduate @ Duke University)
• Bryan Gonzalez (Undergraduate @ Duke University)
• Nimo Yu (Undergraduate @ Duke University)
• Xiaoyang Gao (Graduate @ Xi'an Jiaotong University)

Publications

Journal Papers

• **J. Zhang**, B. Wang, X. Tian, A. Peterchev, S. Goetz (2024). DC-to-5-MHZ Wide-output-bandwidth High-power High-fidelity Converter. IEEE Transactions on Industrial Electronics.
• X. Tian, **J. Zhang**, H. Wang, S. Goetz (2024). Design and Analysis of Automatic Modulation and Demodulation Strategy in Wireless Power and Drive Transfer System. IEEE Transactions on Industrial Electronics IEEE.
• **J. Zhang**, B. Wang, X. Tian, A. Peterchev, S. Goetz (2024). Analytical Model and Planar Magnetic Solution for Parallelization Surges in Switched-capacitor and Series/parallel Multilevel Circuits. IEEE Transactions on Industrial Electronics 10.1109/TIE.2024.3472297.
• B. Wang, **J. Zhang**, Z. Li, W. Grill, A. Peterchev, S. Goetz (2023). Optimized Monophasic Pulses with Equivalent Electric Field for Rapid-rate Transcranial Magnetic Stimulation. Journal of neural engineering Vol. 20.0 No. 3.0 pp. 036027 IOP Publishing.
• **J. Zhang**, X. Tian, B. Wang, A. Peterchev, S. Goetz (2023). Modulation-enhanced Nearest-level Quantization for a Wide Output Bandwidth. IEEE Transactions on Power Electronics Vol. 39.0 No. 3.0 pp. 3289-3299 IEEE.
• Z. Li, **J. Zhang**, A. Peterchev, S. Goetz (2022). Modular Pulse Synthesizer for Transcranial Magnetic Stimulation with Fully Adjustable Pulse Shape and Sequence. Journal of neural engineering Vol. 19.0 No. 6.0 pp. 066015 IOP Publishing.
• **J. Zhang**, Y. Zhang, J. Liu, Y. Gao, X. Gao (2021). Variable Switching Frequency Scheme Minimizing Inductor Saturation Margin for Totem-pole Rectifier Based on Frequency-domain Ripple Analysis. IEEE Transactions on Industrial Electronics Vol. 69.0 No. 12.0 pp. 12632-12640 IEEE.

Conference Papers

- A. Peterchev, **J. Zhang**, K. Ma, Y. Li, B. Wang, Z. Simsek, A. Vlasov, D. Murphy, M. Clinton, J. Choi (2025). Experimental Platform Utilizing Tms Waveform and Direction in Probing and Neuromodulation. Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation Vol. 18.0 No. 1.0 pp. 312-313 Elsevier.
- **J. Zhang**, S. Goetz (2024). Direction-selective Parallel Module Structure for Cascaded Bridge and Modular Multilevel Converters with Minimum Transistor Count. IECON 2024-50th Annual Conference of the IEEE Industrial Electronics Society pp. 1-6 IEEE. *Best Presentation Award*
- **J. Zhang**, S. Goetz (2024). A Novel Framework for Designing Asymmetrical Multilevel Circuits to Improve Fidelity and Practicality. IECON 2024-50th Annual Conference of the IEEE Industrial Electronics Society pp. 1-6 IEEE.
- **J. Zhang**, A. Peterchev, S. Goetz (2024). Frequency-dependent Impedance Variation in Multilevel Converters with Parallel Connectivity. 2024 IEEE Applied Power Electronics Conference and Exposition (APEC) pp. 2337-2341 IEEE.
- **J. Zhang**, M. Al Munefi, A. Peterchev, S. Goetz (2024). Overshoot Dynamics in Parallel Connectivity Enabled Multilevel Converters: Generalized Analytic Expression and Impact Analysis. 2024 IEEE Applied Power Electronics Conference and Exposition (APEC) pp. 581-586 IEEE.
- **J. Zhang**, Z. Li, B. Wang, A. Peterchev, S. Goetz (2023). Highly Flexible Electronics for Selective Noninvasive Stimulation Through Free Pulse Shaping in Transcranial Magnetic Stimulation and Magnetogenetics. Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation Vol. 16.0 No. 1.0 pp. 219 Elsevier.
- **J. Zhang**, S. Goetz, B. Wang (2023). Gallium-nitride (gan) Transistor Design for Transient-overload Power Applications. 2023 IEEE Applied Power Electronics Conference and Exposition (APEC) pp. 2441-2445 IEEE.
- B. Wang, **J. Zhang**, Z. Li, W. Grill, A. Peterchev, S. Goetz (2023). Optimized Monophasic-equivalent Transcranial Magnetic Stimulation Pulses with Reduced Coil Heating. Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation Vol. 16.0 No. 1.0 pp. 186-187 Elsevier.
- **J. Zhang**, Y. Zhang, S. Zaman, R. Cao, X. Gao, M. Cao (2020). Precise Correction of Current Zero-crossing Distortion of Totem Pole Pfc Converter. 2020 IEEE 9th International Power Electronics and Motion Control Conference (IPEMC2020-ECCE Asia) pp. 2414-2419 IEEE.
- **J. Zhang**, Y. Zhang, J. Liu (2020). Downsizing Design of Powdered Iron Core Inductor Based on Variable-frequency Modulation Targeted at Harmonics Suppression. 2020 IEEE 21st Workshop on Control and Modeling for Power Electronics (COMPEL) pp. 1-8 IEEE.
- R. Cao, Y. Li, Y. Zhang, X. Liu, C. Lv, **J. Zhang** (2020). Thermal Modeling of Power Semiconductor Devices with Heat Sink Considering Ambient Temperature Dynamics. 2020 IEEE 9th International Power Electronics and Motion Control Conference (IPEMC2020-ECCE Asia) pp. 290-295 IEEE.
- X. Li, Y. Zhang, P. Zeng, **J. Zhang**, J. Liu (2019). A Novel Interleaved Non-isolated Switched-capacitor Network High Step-up Dc/dc Converter. 2019 10th International Conference on Power Electronics and ECCE Asia (ICPE 2019-ECCE Asia) pp. 2395-2401 IEEE.
- K. Ding, Y. Zhang, J. Liu, P. Zeng, **J. Zhang** (2018). Dynamic Performance Improvement of Bidirectional Switched-capacitor Dc/dc Converter by Right-half-plane Zero Elimination. 2018 international power electronics conference (ipec-niigata 2018-ecce Asia) pp. 4181-4185 IEEE.

Preprints

- **J. Zhang**, A. Peterchev, S. Goetz (2025). Asymmetric Modular Pulse Synthesizer: a High-power High-granularity Electronics Solution for Transcranial Magnetic Stimulation with Practically Any Pulse Shape for Neural Activation Selectivity. arXiv preprint arXiv:2503.06172.