Jinshui Zhang

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https://jinshui.me

Research Interests

Innovating modular power electronics for clean energy, green transportation, and neuroscience.

Education

Ph.D. in Electrical and Computer Engineering, Duke University 2026
- Advisor: Stefan M Goetz (stefan.goetz@duke.edu)
- Thesis: Multi-Cell High-Fidelity High-Power Circuits

M.S. in Electrical Engineering, Xi'an Jiaotong University 2021
- Advisor: Yan Zhang (zhangyanjtu@xjtu.edu.cn)
- Thesis: Design of Single-Phase Two-Stage Onboard Charger for Electric Vehicles

B.S. in Electrical Engineering, Tianjin University 2018

Research Experience

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

Funded by NIH (RF1MH124943), Duke University 2022.09 - present
- Launched world's first fully customizable wireless brain stimulation platform
- Engineered a 3 kV&6 kA modular pulse synthesizer circuit for therapeutic pulse delivery
- Programmed a pipeline of signal sampling, processing, and pulse synthesizing
- Collaborated with clinicians to carry out human studies

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

Funded by DARPA (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 neurostimulation

Configurable Battery Based Electric Vehicle Powertrain Development

Funded by Duke Energy Initiative (4411367), Duke University 2022.03 - present
- Invented an equally functional circuit using half amount of transistors as the-state-of-the-art
- Developed a 20 kW electric vehicle based on reconfigurable batteries

Work Experience

Application Engineer

Longteng Semiconductor Co. 2019.05 - 2020.05
- Led a team of five to design a 3 kW 99.1% efficiency onboard charger with unlisted SiC chips

Power Electronic Intern

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

Awards & Recognition

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

Publications

Journal Papers

- **J. Zhang**, A. Peterchev, S. Goetz (2025). Asymmetric Modular Pulse Synthesizer As a High-fidelity Solution for Transcranial Magnetic Stimulation with Practically Any Pulse Shape. Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation Elsevier.
- K. Ma, A. Vlasov, Z. Simsek, **J. Zhang**, Y. Li, B. Wang, D. Murphy, J. Choi, M. Clinton, N. Bukhari-Parlakturk (2025). Optimal Asymmetric Electric Field Pulses for Selective Transcranial Magnetic Stimulation with Minimised Power and Coil Heating. Brain Stimulation Elsevier.
- **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.
- **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.
- 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. Vlasov, Z. Simsek, Y. Li, **J. Zhang**, K. Ma, B. Wang, D. Murphy, M. Clinton, J. Choi, N. Bukhari-Parlakturk (2025). First Experimental Demonstration of Single-and Paired-pulse Stimulation with Different Pulse Shapes Generated by Modular Pulse Synthesizer Tms (mps-tms). Brain Stimulation: Basic, Translational, and Clinical Research in Neuromodulation Vol. 18.0 No. 4.0 pp. 1340-1341 Elsevier.
- 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.

Preprint Papers

• **J. Zhang**, A. Peterchev, S. Goetz (2025). Conditional Nearest Level Modulation for Improved Switching Dynamics in Asymmetric Multilevel Converters. arXiv preprint arXiv:2509.14402.
• **J. Zhang**, S. Goetz (2025). Four-transistor Bipolar Series-parallel Module Structure for Cascaded Bridge and Modular Multilevel Circuits. arXiv preprint arXiv:2509.19516.

Talks

Flexible TMS: A Happier Machine
3 Minute Thesis, Duke University 2025.07
Direction-Selective Parallel Module Structure for Cascaded Bridge and Modular Multilevel Converters with Minimum Transistor Count
Annual Conference of the IEEE Industrial Electronics Society, Chicago 2024.12
A Novel Philosophy for Designing Asymmetrical Multilevel Circuits to Improve Fidelity and Practicality
Annual Conference of the IEEE Industrial Electronics Society, Chicago 2024.12
Current Surging in Parallel Connectivity Enabled Multilevel Converters
IEEE Applied Power Electronics Conference and Exposition, Long Beach 2024.02
Modular Transcranial Magnetic Stimulator – A Cure for Depression May Just Hide Inside Your Tesla
ECE Summer Workshop, Duke University 2022.09

Service

Reviewing Conference & 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)

Volunteering at Conferences & Communities

• Symposium on Power Electronics for Distributed Generation Systems (PEDG) 2019
• Power Electronics and Motion Control Conference (IPEMC2020-ECCE Asia) 2020

Mentoring Students

• Ian Le (Undergrad @ Duke University)
• Zane Mannings (Undergrad @ Duke University, chair of Duke EV club)

- Majed Al Munefi (Undergrad @ Duke University)
- Mingxin Liu (Undergrad @ NYU → Grad @ Duke University)
- Bryan Gonzalez (Duke University → R&D Engineer @ Children's National Hospital)
- Wei Chen (Grad @ Xi'an Jiaotong University → PhD @ Kiel University)
- Nimo Yu (Undergrad @ Duke University)
- Xiaoyang Gao (Grad @ Xi'an Jiaotong University → National Grid Co.)

Teaching Experience

Teaching Assistant & Lab Instructor

ECE 431&531, Duke University — Spring 2022 & Spring 2024

- Designed and instructed a lab session on prototyping a closed-loop DC-DC converter
- Host office hours and graded for a class of 20+ undergrad & grad students

Teaching Assistant

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

- Assisted a class of 100+ grad students

Student Investigator & Demonstrator

Superconductor Tech-Camp, Tianjin University — Summer 2016

- Established and demonstrated superconducting-based prototypes, e.g. mag-lev car
- Recruited a team of 17 volunteers to host 200+ undergraduate visitors