# HAOYU WANG

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## EDUCATION

**Columbia University** New York, USA
Ph.D. in Electrical Engineering Sept. 2023 – Present
- Teaching Assistant: Power Electronics

**Tsinghua University** Beijing, China
M.S. in Electrical Engineering Sept. 2020 − Jun. 2023
- Selected Courses: Power Electronic Devices, Modern Control Theory, Deep Learning

**Shanghai Jiao Tong University** Shanghai, China
B.S. in Electrical Engineering Sept. 2016 − Jun. 2020
- Selected Courses: Power Electronics, Computer Networks

## SELECTED PUBLICATIONS

- **H. Wang**, D. Mou*, S. Ji *et al*., " Universal Phase-Shift Modulation Scheme and Efficiency Optimization for Modular Multiactive Bridge Converter," in ***IEEE Transactions on Industrial Electronics*. Accepted.**
- **H. Wang**, S. Ji*, D. Mou *et al*., "Switching Characterization and Power Loss Optimization for Modular Multiactive Bridge Converter Under Common Phase Shift Control," in ***IEEE Journal of Emerging and Selected Topics in Power Electronics***, vol. 11, no. 4, pp. 3924-3936, Aug. 2023.
- **H. Wang**, Y. Zeng, S. Ji* *et al*., "ZVS Soft Switching Operation Region Analysis of Modular Multi Active Bridge Converter Under Single Phase Shift Control," in ***IEEE Transactions on Industrial Electronics***, vol. 70, no. 7, pp. 6865-6875, July 2023.
- **H. Wang**, S. Ji*, Y. Zhang *et al*., " High-Frequency-Link-based Reactive-Power Optimal Control for Modular Multi Active Bridge Converter," in ***IEEE Journal of Emerging and Selected Topics in Industrial Electronics***. **Minor Revision**.
- **H. Wang**, D. Mou, S. Ji *et al*., "Comparison and Improvement of ZVS Operation Under Different Modulation Strategies for Modular Multi Active Bridge Converters," ***2023 IEEE Energy Conversion Congress and Exposition (ECCE)****, Nashville, USA.* **Accepted.**
- D. Mou, **H. Wang**, L. Yuan* *et al*., "High-Efficiency Time-Division Multiplexing Modulation Technology for Modular Multiactive Bridge Converters," in ***IEEE Transactions on Industrial Electronics*. Accepted.**
- D. Mou, L. Yuan, **H. Wang** *et al*., "A Hybrid Modulation Strategy for the Modular Quad-Active Bridge Converters with the Aid of DC Blocking Capacitors, " ***2023 IEEE Energy Conversion Congress and Exposition (ECCE), Nashville, USA.*** **Accepted.**
- M. Xiang, Y. Liu, **H. Wang** *et al*., "Design and Analysis of a 75 kVA High-Frequency-Link Based Three-Port Power Electronic Transformer," ***2021 IEEE 1st International Power Electronics and Application Symposium (PEAS)***, 2021, pp. 1-7.
- D. Mou, Y. Dai, L. Yuan*, Q. Luo, **H. Wang** *et al*., "Reactive Power Minimization for Modular Multi-Active-Bridge Converter With Whole Operating Range," in ***IEEE Transactions on Power Electronics***, vol. 38, no. 7, pp. 8011-8015, July 2023.

## SELECTED RESEARCH EXPERIENCE

**Tsinghua University (Department of Electrical Engineering)** Beijing, China
Project Lead at High Power Electronics and Advanced Power Transmission Lab Advisor: Prof. Shiqi Ji

**Reactive-Power Optimal Control for Modular Multi Active Bridge Converters** May 2022 – May 2023
- Derived a comprehensive frequency-domain mathematical model of multi-port modular multi-active bridge (MMAB) DC-DC converters under multi-phase-shift modulation, and designed conditioning circuits controlling boards including DSP and FPGA to extract power-related information
- Developed decoupling designs of active and reactive powers with the power-related information and proposed dual-loop-based reactive-power optimal control (RPOC) to fully eliminate the overall fundamental reactive power in MMAB converters for optimization effects
- Constructed RTLAB-based hardware-in-the-loop platforms and verified the effectiveness of RPOC on a virtual four-port MMAB converter with real circuits and controllers
- Revised a journal paper to *IEEE Journal of Emerging and Selected Topics in Industrial Electronics*

**Universal Modulation and Global Optimization for MMAB Converters** Sept. 2022 – Jan. 2023
- Proposed a universal multi-phase-shift modulation scheme for MMAB converters and derived an overall mathematical model under multiple degrees of freedom (DOFs) in time domain

- Chose full zero-voltage switching (ZVS) and minimized root-mean-square currents as optimization objectives, then simplified a multi-DOF problem into a single-DOF one by proper formats
- Developed a global optimization strategy to have significantly improved the system efficiency of a four-port laboratory prototype with a maximum increment of 20.49% under extreme load conditions
- A journal paper has been accepted by *IEEE Transactions on Industrial Electronics*, and a conference paper has been accepted by *2023 IEEE Energy Conversion Congress and Exposition (ECCE)*

**Common Phase-Shift Control for MMAB Converters** May 2022 – Aug. 2022

- Implemented a common DOF into MMAB converters and derived its mathematical performance
- Derived overall power loss models of MMAB converters, including turn-on, turn-off and conducting losses of power semiconductors and high-frequency transformer losses
- Developed an optimization strategy and common phase-shift control to locally minimize the overall power losses and largely improved the efficiency with a maximum increment of 16.55%
- Published a journal paper in *IEEE Journal of Emerging and Selected Topics in Power Electronics*

**Zero-Voltage Switching Operation Analysis for MMAB Converters** Nov. 2021 – Jan. 2022

- Analyzed the operation and switching characterization of MMAB converters under phase-shift control
- Established the switching-on inductance current model and defined full ZVS and constrained regions
- Generated an overall flow chart of discriminating ZVS operation and verified the feasibility of the chart on both MATLAB/Simulink and a three-port laboratory prototype
- Published a journal paper in *IEEE Transactions on Industrial Electronics*

**Time-Division Multiplexing Techniques for MMAB converters** Oct. 2022 – Jan. 2023

- Adopted time-division full-or-half-bridge hybrid modulation techniques in MMAB converters
- Chose root-mean-square currents as the objective that determines multiplexing methods of each port
- Verified the technique on a 4-port prototype and improved the system efficiency up to 19.09%
- A journal paper has been accepted by *IEEE Transactions on Industrial Electronics*, and a conference paper has been accepted by *2023 IEEE Energy Conversion Congress and Exposition (ECCE)*

**Design, Analysis and Control of a Three-port Power Electronic Transformer** Jan. 2021 – Jul. 2021

- Designed a 75 kVA three-port high-frequency-link based power electronic transformer (PET)
- Developed control strategies of a rectifier as static var generator and dc ports under phase-shift control
- Verified the PET operation under hardware-in-the-loop simulation and practical experimental tests
- Published a conference paper in *2021 IEEE Power Electronics and Application Symposium (PEAS)*

**Online Monitoring of Junction Temperature for Power IGBTs** Apr. 2021 – Mar. 2022

- Chose turn-off delay time as the electrical parameter to manifest the junction temperature of IGBTs
- Evaluated its sensitivity and linearity and designed processing circuits to interpret the delay time
- Carried out dual-pulse experiments to form an offline look-up table further real-time monitoring

**Shanghai Jiao Tong University (Department of Electrical Engineering)** Shanghai, China

Research Assistant at Wind Power Research Center Advisor: Prof. Jianwen Zhang

**Synergetic Modulation and Control for Power Electronic Transformer** Oct. 2019 – Jun. 2020

- Developed a flexible modulation scheme for hybrid modular multilevel converters and a synergetic control strategy for dual active bridge converters to ensure uninterrupted operation under DC fault

## SELECTED HONOR

- Wei Family Private Foundation Fellowship at Columbia University 2023
- Best Master Thesis at Tsinghua University (Top 1%) 2023
- Outstanding Graduate of Beijing at Tsinghua University (Top 1%) 2023
- East Cable Scholarship at Tsinghua University (Top 5%) 2022
- Siyuan Electric Scholarship at Tsinghua University (Top 5%) 2021
- Excellent Graduation Design at Shanghai Jiao Tong University (Top 2%) 2020

## SELECTED LEADERSHIP

**Tsinghua Mountaineering Club** Sept. 2020 – Dec. 2021

Director of Training Department

- Organized daily workouts of dozens of people, including endurance training and muscle building
- Led a team of 20 members to hike off-trial more than 5 times and performed as route leader

## MISCELLANEOUS

- **Programming:** Python, C/C++ and Verilog HDL
- **Proficient Software:** MATLAB, Anaconda, Altium Designer, Code Composer Studio, Quartus II
- **Language:** Mandarin (native), English, Japanese
- **Interest:** Street Workout, Mountaineering, Powerlifting, Running, Boxing