Bai Cui

Assistant Professor
Department of Electrical and Computer Engineering
Iowa State University
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Research Interests

My general research interest lies in the application of optimization and control techniques in power system studies. Topics of recent interests include:

1. Aggregate flexibility characterization and market integration of distributed energy resources;
2. Stability analysis of modern power system;
3. Topology optimization of bulk power system.

Education

Georgia Institute of Technology

2018 Ph.D. Electrical and Computer Engineering (Electric Power Systems)
- Dissertation: *Distribution System Service Restoration Using Dynamic Programming Considering Switch Characteristics*
- Advisors: Profs. Sakis Meliopoulos and Andy Sun

2014 M.S. Electrical and Computer Engineering

University of Michigan

2011 B.S. Computer Engineering

Shanghai Jiao Tong University

2011 B.S. Electrical Engineering
- Dual bachelor's degree

Experience

2023 – Assistant Professor, Department of Electrical and Computer Engineering, Iowa State University

2019 – 2023 Researcher, National Renewable Energy Laboratory, Power Systems Engineering Center

2018 – 2019 Postdoctoral Appointee, Argonne National Laboratory, Energy Systems Division

2015 – 2018 Research Assistant, Georgia Institute of Technology

2012 – 2014 Teaching Assistant (Electric Power Systems), Georgia Institute of Technology

Publications

Journal Articles

2026 1. Z. Hu, W. Meng, and **B. Cui**, "Unified Sensitivity-Based Heuristic for Optimal Line Switching and Substation Reconfiguration", *Electric Power Systems Research*, to be published.

2025 2. **B. Cui** and X. A. Sun, "Securing Voltage Stability in Power Grids via Holomorphic Dynamics", *Automatica*, vol. 176, Jun. 2025.

3. S. Wang, L. Du, **B. Cui**, Y. Li, "Multi-Factor-Coupled, Ahead-of-Time Aggregation of Power Flexibility Under Forecast Uncertainty", *IEEE Transactions on Sustainable Energy*, vol. 16, no. 2, pp. 892-903, Apr. 2025.

2024 4. Q. Li, J. Liu, **B. Cui**, W. Song, and J. Ye, "Distribution System Flexibility Characterization: A Network-Informed Data-Driven Approach", *IEEE Transactions on Smart Grid*, vol. 15, no. 1, pp. 1188-1191, Jan. 2024.

2023 5. Y. Zhang, C. Chen, T. Hong, **B. Cui**, Z. Xu, B. Chen, and F. Qiu, "Robust Trajectory-Constrained Frequency Control for Microgrids Considering Model Linearization Error", *Applied Energy, 2023 Special Issue on Microgrids*, vol. 333, Mar. 2023.

2022 6. **B. Cui**, A. Zamzam, G. Cavraro, and A. Bernstein, "Efficient Region of Attraction Characterization for Control and Stabilization of Load Tap Changer Dynamics," *IEEE Transactions on Control of Network Systems*, vol. 9, no. 3, pp. 1506–1517, Sep. 2022.

7. J. Huang, X. Zhou, and **B. Cui**, "Online Distribution System State Estimation via Stochastic Gradient Algorithm," *Electric Power Systems Research*, vol. 213, Dec. 2022.

8. J. M. Miller, H. N. Villegas-Pico, I. Dobson, A. Bernstein, and **B. Cui**, "Feedback Control Approaches for Restoration of Power Grids From Blackouts," *Electric Power Systems Research*, vol. 211, Oct. 2022.

9. J. Liu, **B. Cui**, D. K. Molzahn, C. Chen, and X. Lu, "Optimal Power Flow for DC Networks with Robust Feasibility and Stability Guarantees," *IEEE Transactions on Control of Network Systems*, vol. 9, no. 2, pp. 904–916, Jun. 2022.

10. A. Arif, **B. Cui**, and Z. Wang, "Switching Device-Cognizant Sequential Distribution System Restoration," *IEEE Transactions on Power Systems*, vol. 37, no. 1, pp. 317–329, Jan. 2022.

2021 11. Z. Ma, **B. Cui**, Z. Wang, and D. Zhao, "Parameter Reduction of Composite Load Model Using Active Subspace Method," *IEEE Transactions on Power Systems*, vol. 36, no. 6, pp. 5441–5452, Nov. 2021.

12. **B. Cui**, A. Zamzam, and A. Bernstein, "Network-Cognizant Time-Coupled Aggregate Flexibility of Distribution Systems Under Uncertainties," *IEEE Control Systems Letters*, vol. 5, no. 5, pp. 1723–1728, Nov. 2021.

13. B. Li, **B. Cui**, F. Qiu, and D. K. Molzahn, "Balancibility: Existence and Uniqueness of Power Flow Solutions Under Voltage Balance Requirements," *Electric Power Systems Research*, vol. 190, Jan. 2021.

2020 14. **B. Cui**, R. Yao, and F. Qiu, "Certification and Prediction of Post-Disturbance States in Dynamic Security Assessment," *Electric Power Systems Research*, vol. 189, Dec. 2020.

15. Z. Ma, Z. Wang, D. Zhao, and **B. Cui**, "High-Fidelity Large-Signal Order Reduction Approach for Composite Load Model," *IET Generation Transmission & Distribution*, vol. 14, no. 21, pp. 4888–4897, Nov. 2020.

16. T. Hong, D. Zhao, Y. Zhang, **B. Cui**, and Y. Tian, "Optimal Voltage Reference for Droop-Based DERs in Distribution Systems," *IEEE Transactions on Smart Grid*, vol. 11, no. 3, pp. 2357–2366, May 2020.

2019 17. Y. Li, Y. Zhen, D. Zhao, H. Lei, **B. Cui**, and S. Li, "Incorporating Energy Storage and User Experience in Isolated Microgrid Dispatch Using a Multi-objective Model," *IET Generation, Transmission & Distribution, Special Issue on Demand Side Management and Market Design*, vol. 13, no 6, pp. 971–981, Apr. 2019.

18. C. Wang, **B. Cui**, Z. Wang, and C. Gu, "SDP-based Optimal Power Flow with Steady-State Voltage Stability Constraints," *IEEE Transactions on Smart Grid*, vol. 10, no. 4, pp. 4637–4647, Jul. 2019.

2018 19. C. Wang, **B. Cui**, and Z. Wang, "Analysis of Solvability Boundary for Droop-Controlled Microgrids," *IEEE Transactions on Power Systems (Letters)*, vol. 33, no. 5, pp. 5799–5802, September 2018.

20. **B. Cui** and X. A. Sun, "A New Voltage Stability-Constrained Optimal Power Flow Model: Sufficient Condition, SOCP Representation, and Relaxation," *IEEE Transactions on Power Systems*, vol. 33, no. 5, pp. 5092–5102, September 2018.

2017 21. **B. Cui** and Z. Wang, "Voltage Stability Assessment Based on Improved Coupled Single-Port Method," *IET Generation, Transmission & Distribution*, vol. 11, no. 10, pp. 2703–2711, July 2017.

22. Z. Wang, **B. Cui**, and J. Wang, "A Necessary Condition for Power Flow Insolvability in Power Systems with Distributed Generators," *IEEE Transactions on Power Systems*, vol. 32, no. 2, pp. 1440–1450, March 2017.

2016 23. D. Ding, D. Zhao, X. Zhang, X. Lan, C. Li, and **B. Cui**, "Investigation of Vibration Impacts on HVAC Transformer from HVDC System Under Monopole Operation," *IEEE Transactions on Dielectrics and Electrical Insulation*, vol. 23, no. 3, pp. 1386–1392, June 2016.

Conference Proceedings

2024 1. B. Ou, B. Wang, **B. Cui** and D. Wu, "Updated Impedance Power Flow," *56th North American Power Symposium (NAPS 2024)*, El Paso, Texas, 2024.

2. A. Selim, J. Zhao, G.-S. Seo, F. Ding, and **B. Cui**, "Grid-Forming Inverters for Enhancing Stability and Resilience in Distribution Networks Under Transients and Restoration," *2024 Conference on Innovative Smart Grid Technologies, North America (ISGT NA 2024)*, Washington DC, 2024.

3. S. Meliopoulos, G. Cokkinides, Z. Yang, and **B. Cui**, "Optimal Reconfiguration of Distribution Networks via Dynamic Programming," *Hawaii International Conference on System Sciences (HICSS)*, Waikiki, HI, 2024.

2023 4. **B. Cui**, G. Cavraro, and A. Zamzam, "Load Shedding for Voltage Regulation With Probabilistic Agent Compliance," *IEEE Power & Energy Society General Meeting*, Orlando, FL, 2023.

5. S. Taylor, G. Setyawan, **B. Cui**, A. Zamzam, L. A. Roald "Managing Wildfire Risk and Promoting Equity through Optimal Configuration of Networked Microgrids", *14th ACM International Conference on Future Energy Systems (e-Energy '23)*, June 20–23, 2023, Orlando, FL, USA.

2022 6. **B. Cui**, A. Zamzam, and A. Bernstein, "Enabling Grid-Aware Market Participation of Aggregate Flexible Resources," *11th Bulk Power Systems Dynamics and Control Symposium (IREP 2022)*, Banff, Canada, 2022.

7. A. Astudillo, **B. Cui**, and A. Zamzam, "Managing Power Systems-Induced Wildfire Risks Using Optimal Scheduled Shutoffs," *IEEE Power & Energy Society General Meeting*, Denver, CO, 2022.

8. S. Wang, **B. Cui**, L. Du, "An Efficient Power Flexibility Aggregation Framework via Coordinate Transformation and Chebyshev Centering Optimization", *IEEE Power & Energy Society General Meeting*, Denver, CO, 2022.

2021 9. J. Huang, **B. Cui**, X. Zhou, and A. Bernstein, "A Generalized LinDistFlow Model for Power Flow Analysis," *60th IEEE Conference on Decision and Control (CDC)*, Austin, TX, 2021.

2020 10. J. Liu, **B. Cui**, B. Chen, X. Lu, F. Qiu, and S. Mazumder, "DC Microgrids Under Denial of Service Attacks: Feasibility and Stability Issues," *IEEE Energy Conversion Congress and Exposition (ECCE)*, Detroit, MI, 2020.

11. Y. Tian, D. Zhao, T. Hong, and **B. Cui**, "Cost and Efficiency Analysis for Hybrid AC/DC Distribution System Planning with PV and Battery," *IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT)*, Washington, DC, 2020.

2016 12. S. Meliopoulos, G. Cokkinides, R. Fan, L. Sun, and **B. Cui**, "Command Authentication via Faster Than Real Time Simulation," *IEEE PES General Meeting*, Boston, MA, 2016.

2013 13. **B. Cui**, M. Begović, R. Nuqui, D. Sobajić, and Y. Song, "On Voltage Stability Monitoring with Voltage Instability Predictors," *Bulk Power System Dynamics and Control-IX Optimization, Security and Control of the Emerging Power Grid (IREP), 2013 IREP Symposium*, Rethymno, Greece, 2013.

Conference and Workshop Presentations

2025 1. Revenue Adequacy-Constrained Optimal Transmission Switching: A Non-Iterative MILP Formulation , *INFORMS Annual Meeting*, Atlanta, GA, Oct. 2025.

2. Efficient Algorithm Design for Optimal Day-Ahead Bidding Strategy of Aggregated Distributed Energy Resources, *IEEE PES General Meeting Panel: Grid service provision and market integration of distributed energy resource*, Austin, TX, Jul. 2025.

2024 3. Grid Integration of Distributed Energy Resources: Aggregate Flexibility Quantification and Market Participation, *University of Michigan ECE Control Seminar*, Ann Arbor, MI, March 2024.

2022 4. Distribution System Voltage Control with Human-in-the-Loop , *NREL Human Dimensions in Energy Systems Workshop*, Golden, CO, September 2022.

5. Enabling Grid-Aware Market Participation of Aggregate Flexible Resources, *11th Bulk Power Systems Dynamics and Control Symposium (IREP 2022)*, Banff, Canada, July 2022.

2021 6. Network-Cognizant Time-Coupled Aggregate Flexibility of Distribution Systems Under Uncertainties, *INFORMS Annual Meeting*, Anaheim, CA, October 2021.

7. Network-Cognizant Time-Coupled Aggregate Flexibility of Distribution Systems Under Uncertainties, *NREL Workshop on Resilient Autonomous Energy Systems*, Golden, CO, September 2021.

8. Network-Cognizant Time-Coupled Aggregate Flexibility of Distribution Systems Under Uncertainties, *American Control Conference*, virtual conference, May 2021.

2020 9. Distributed Monitoring and Control of Load Tap Changer Dynamics, *NREL Workshop on Autonomous Energy Systems*, Golden, CO, August 2020.

10. Certification and Prediction of Post-Disturbance States in Dynamic Security Assessment, *XXI Power Systems Computation Conference*, virtual conference, June–July 2020.

2019 11. Accelerating Bulk Power System Restoration Using Valid Inequalities, *INFORMS Annual Meeting*, Seattle, WA, October 2019.

12. Solvability of Power Flow Equations Through Existence and Uniqueness of Complex Fixed Point, *INFORMS Annual Meeting*, Seattle, WA, October 2019.

13. Dynamic Load Model Parameter Reduction: Discovering Active Subspace, *WECC Modeling and Validation Work Group Meeting*, Salt Lake City, UT, March 2019.
14. Strong Certificate for Solvability of Power Flow Equations, *LANL Grid Science Winter School and Conference*, Santa Fe, NM, January 2019.

2017 15. Distribution Service Restoration by Dynamic Programming Considering Switch Characteristics, *Georgia Tech Workshop on Electric Energy Systems and Optimization*, poster session, Atlanta, GA, November 2017.

16. Voltage Stability, Power Flow Solvability, and A New Voltage Stability-Constrained Optimal Power Flow (VSC-OPF) Model, *INFORMS Annual Meeting*, Houston, TX, October 2017.
17. Voltage Stability, Power Flow Solvability, and A New Voltage Stability-Constrained Optimal Power Flow (VSC-OPF) Model, *University of Bergamo/Georgia Institute of Technology Optimization Workshop*, Atlanta, GA, September 2017.

2016 18. Robust and Decentralized Operations for Managing Renewable Generation and Demand Response in Large-Scale Distribution Systems, *PSERC IAB Meeting*, poster session, Atlanta, GA, December 2016.

Research Grants

2025 National Science Foundation, Algorithms for Modern Power Systems (AMPS), "Dynamic Grid Optimization under High Renewable Penetration: Multistage Algorithms and Stability Augmentation," PI ($150,000 for 24 months)

2025 Iowa Economic Development and Finance Authority, Iowa Energy Center Grant Program, "Enhancing Iowa's Energy Resilience through Anaerobic Digestion-based Microgrids," co-PI ($250,000 for 24 months, co-PI share: $100,000)

2024 Department of Energy, Solar Energy Technology Office (SETO) OPTIMA Project, "Modernizing Operation and Decision-Making Tools Enabling Resource Management In Stochastic Environment (MODERNISE)," co-PI ($3,102,147 for 42 months, co-PI share: $500,000)

2024 Department of Energy, Office of Electricity, "Data-Driven Automated and Proactive Asset Management to Enhance Reliability and Resilience of Rural Distribution Grids," co-PI ($1,000,000 for 3 years, co-PI share: $100,000)

2024 Midcontinent Independent System Operator, "Transmission Reconfiguration Economic Impacts: Proof of Concept Design," PI ($50,000 for 6 months)

2024 Electric Power Research Institute, "Transmission Reconfiguration White Paper," co-PI ($25,000 for 2 months, co-PI share: $12,500)

2022 Laboratory Directed Research and Development (LDRD) Project, "Harnessing Flexibility to Coordinate Distributed Energy Resources," PI ($100,000 for one year)

2019 Laboratory Directed Research and Development (LDRD) Prime Project, "A Novel Security Analysis Toolbox for National Grid Resilience Modeling," Co-PI ($50,000 for one year)

Professional Service

1. Session Chair for IEEE PES General Meeting Panel on grid service provision and market integration of distributed energy resource, 2025.
2. Secretary for award subcommittee, IEEE Power System Operation, Planning and Economics Committee (PSOPE), 2024–
3. Co-organizer for NREL Workshop on Autonomous Energy Systems, 2022

4. Co-organizer for NREL Workshop on Resilient Autonomous Energy Systems, 2021
5. Session Chair for American Control Conference, 2021
6. Journal reviewer for IEEE Transactions on Control of Network Systems
7. Journal reviewer for IEEE Transactions on Power Systems
8. Journal reviewer for IEEE Transactions on Smart Grid
9. Journal reviewer for IEEE Transactions on Sustainable Energy
10. Journal reviewer for IEEE Power Engineering Letters
11. Journal reviewer for IEEE Access
12. Journal reviewer for IEEE Power and Energy Technology Systems Journal
13. Journal reviewer for IET Generation, Transmission & Distribution
14. Journal reviewer for IET Renewable Power Generation
15. Journal reviewer for IET Smart Grid
16. Journal reviewer for International Transactions on Electrical Energy Systems
17. Reviewer for IEEE PES General Meeting
18. Reviewer for IEEE PES Innovative Smart Grid Technologies Conference
19. Reviewer for IEEE International Conference on Smart Grid Synchronized Measurements and Analytics

Student Supervision

PhD Students

2025 – Puskar Neupane. Research topic: Steady-state stability analysis of modern power system.

2024 – Weiqi Meng. Research topic: Market integration of distributed energy resources.

2024 – Zongqi Hu. Research topic: Bulk power system optimization and stability analysis.

2024 – Ahmed Mesfer S Alkhudaydi. Research topic: Grid strength quantification of inverter-based system.

Master Students

2025 – 2026 Sarah Ebert. Research topic: Coordination and control of distributed energy resources.

2023 – 2024 Haoyu Ma. Current position: PhD Student, Washington State University

2023 – 2024 Maheswari Pothuraju. Current position: Power System Engineer, Concord New Energy Group Limited

Honors and Awards

2021 1. Key Contributor Award at NREL

2016 2. IEEE Transactions on Smart Grid Best Reviewer Award

3. PSERC IAB Meeting Best Poster Award