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;
2. Modeling and analysis of inverter-based resources;
3. Real-time control and resilience.

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

2023 1. Y. Zhang, C. Chen, T. Hong, **B. Cui**, Z. Xu, B. Chen, F. Qiu, "Robust Trajectory-Constrained Frequency Control for Microgrids Considering Model Linearization Error", *Applied Energy, Special Issue on Microgrids 2023*, vol. 333, Mar. 2023.

2022 2. **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.

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

4. 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.

5. 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 Power Systems*, vol. 9, no. 2, pp. 904–916, Jun. 2022.

6. 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 7. 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.

8. **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.

9. 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 10. **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.

11. 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.

12. 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 13. 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.

14. 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 15. 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.

16. **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 17. **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.

18. 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 19. 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

2023 1. **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.

2. 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 3. **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.

4. 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.

5. 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 6. 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 7. 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.

8. 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 9. 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 10. **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

2022 1. Distribution System Voltage Control with Human-in-the-Loop , *NREL Human Dimensions in Energy Systems Workshop*, Golden, CO, September 2022.

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

2021 3. Network-Cognizant Time-Coupled Aggregate Flexibility of Distribution Systems Under Uncertainties, *INFORMS Annual Meeting*, Anaheim, CA, October 2021.

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

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

2020 6. Distributed Monitoring and Control of Load Tap Changer Dynamics, *NREL Workshop on Autonomous Energy Systems*, Golden, CO, August 2020.

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

2019 8. Accelerating Bulk Power System Restoration Using Valid Inequalities, *INFORMS Annual Meeting*, Seattle, WA, October 2019.

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

10. Dynamic Load Model Parameter Reduction: Discovering Active Subspace, *WECC Modeling and Validation Work Group Meeting*, Salt Lake City, UT, March 2019.

11. Strong Certificate for Solvability of Power Flow Equations, *LANL Grid Science Winter School and Conference*, Santa Fe, NM, January 2019.

2017 12. Distribution Service Restoration by Dynamic Programming Considering Switch Characteristics, *Georgia Tech Workshop on Electric Energy Systems and Optimization*, poster session, Atlanta, GA, November 2017.

13. Voltage Stability, Power Flow Solvability, and A New Voltage Stability-Constrained Optimal Power Flow (VSC-OPF) Model, *INFORMS Annual Meeting*, Houston, TX, October 2017.

14. 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 15. 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

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. Co-organizer for NREL Workshop on Autonomous Energy Systems, 2022
2. Co-organizer for NREL Workshop on Resilient Autonomous Energy Systems, 2021

3. Session Chair for American Control Conference, 2021
4. Journal reviewer for IEEE Transactions on Control of Network Systems
5. Journal reviewer for IEEE Transactions on Power Systems
6. Journal reviewer for IEEE Transactions on Smart Grid
7. Journal reviewer for IEEE Transactions on Sustainable Energy
8. Journal reviewer for IEEE Access
9. Journal reviewer for IEEE Power and Energy Technology Systems Journal
10. Journal reviewer for IET Generation, Transmission & Distribution
11. Journal reviewer for IET Renewable Power Generation
12. Journal reviewer for IET Smart Grid
13. Journal reviewer for International Transactions on Electrical Energy Systems
14. Reviewer for IEEE PES Innovative Smart Grid Technologies Conference
15. Reviewer for IEEE International Conference on Smart Grid Synchronized Measurements and Analytics

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