

DANIEL K. MOLZAHN

Computational Engineer

Argonne National Laboratory
Energy Systems Division

Office Address: Argonne National Laboratory
Building 362, Room C381
9700 South Cass Avenue
Lemont, IL 60439, USA

Email Address: dan.molzahn@gmail.com

Webpage: <https://molzahn.github.io/>

Education

University of Michigan

2013 Dow Sustainability Fellow, Department of Electrical Engineering and Computer Science
• Supervisor: Dr. Ian Hiskens

University of Wisconsin–Madison

2013 Ph.D. Electrical Engineering (Electric Power Systems)
• Dissertation: *Application of Semidefinite Optimization Techniques to Problems in Electric Power Systems*
• 2014 Harold A. Peterson Best Dissertation Award, Second Place
• Advisor: Dr. Bernard Lesieutre

2012 M.P.A. La Follette School of Public Affairs

2010 M.S. Electrical Engineering
• Thesis: *Power System Models Formulated as Eigenvalue Problems and Properties of Their Solutions*
• Certificate in Energy Analysis and Policy

2008 B.S. Electrical Engineering, Mathematics
• Graduated with Highest Distinction Honors

Experience

2015 – Computational Engineer, Argonne National Laboratory, Energy Systems Division

2013 – 2015 Dow Sustainability Fellow, University of Michigan

2009 – 2013 Research Assistant, University of Wisconsin–Madison

2012 Teaching Assistant (Electric Power Systems), University of Wisconsin–Madison

2008 – 2012 Graduate Fellow, University of Wisconsin–Madison

2008 Ford Motor Company, Sustainable Mobility Technology (Internship)
• Created MATLAB/Simulink models of permanent magnet synchronous motors and control systems for hybrid electric vehicles.

- 2007 Wisconsin Public Service Corporation, Electric Distribution Engineering (Internship)
- Modeled distributed generators.
 - Analyzed distribution systems using SynerGEE load flow software.
 - Conducted stray voltage investigations.
- 2005 – 2007 Wisconsin Public Service Corporation, Information Technology (Internship)
- Developed code in VB.NET for engineering and business applications.
 - Designed websites in Dreamweaver.
 - Created, modified, and tested reports in Crystal XI and Business Objects XI.

Honors & Awards

- 2010, 2008 Grainger Power Engineering Award
- 2009 National Science Foundation Graduate Research Fellowship
- 2008 Electrical and Computer Engineering Distinguished Fellowship, UW–Madison

Publications

In Review

1. **D.K. Molzahn**, “Identifying Redundant Flow Limits on Parallel Lines,” Submitted.
2. **D.K. Molzahn** and L.A. Roald, “Towards an AC Optimal Power Flow Algorithm with Robust Feasibility Guarantees,” Submitted.
3. M.R. Narimani, **D.K. Molzahn**, and M.L. Crow, “Improving QC Relaxations of OPF Problems via Voltage Magnitude Difference Constraints and Envelopes for Trilinear Monomials,” Submitted.
4. S. Misra, **D.K. Molzahn**, and K. Dvijotham, “Optimal Adaptive Approximations of the AC Power Flow Equations,” Submitted.
5. J.A. Kersulis, I.A. Hiskens, C. Coffrin, and **D.K. Molzahn**, “Topological Graph Metrics for Detecting Grid Anomalies and Improving Algorithms,” Submitted.
6. M.R. Narimani, **D.K. Molzahn**, D. Wu, and M.L. Crow, “Empirical Investigation of Non-Convexities in Optimal Power Flow Problems,” Submitted.
7. **D.K. Molzahn** and I.A. Hiskens, “A Survey of Relaxations and Approximations of the Power Flow Equations,” Submitted.
8. **D.K. Molzahn** and J. Wang, “Detection and Characterization of Intrusions to Network Parameter Data in Electric Power System Operations,” Submitted.
9. C. Jozs and **D.K. Molzahn**, “Multi-Ordered Lasserre Hierarchy for Large Scale Polynomial Optimization in Real and Complex Variables,” Submitted, technical report available: <http://arxiv.org/abs/1508.02068>

Journal Articles

- 2017 1. O. Coss, J.D. Hauenstein, H. Hong, and **D.K. Molzahn**, “Locating and Counting Equilibria of the Kuramoto Model with Rank One Coupling,” to appear in *SIAM Journal on Applied Algebra and Geometry*, 2017.

2. D. Wu, **D.K. Molzahn**, B.C. Lesieutre, and K. Dvijotham, “A Deterministic Method to Identify Multiple Local Extrema for the AC Optimal Power Flow Problem,” to appear in *IEEE Transactions on Power Systems*, 2017.
3. J. Lavaei, S.H. Low, R. Baldick, B. Zhang, **D.K. Molzahn**, F. Dörfler, H. Sandberg, “Guest Editorial: Distributed Control and Efficient Optimization Methods for Smart Grid,” *IEEE Transactions on Smart Grid, Special issue on Distributed Control and Efficient Optimization Methods for Smart Grid*, vol. 8, no. 6, pp. 2939-2940, November 2017.
4. **D.K. Molzahn**, F. Dörfler, H. Sandberg, S.H. Low, S. Chakrabarti, R. Baldick, and J. Lavaei, “A Survey of Distributed Optimization and Control Algorithms for Electric Power Systems,” to appear in *IEEE Transactions on Smart Grid, Special issue on Distributed Control and Efficient Optimization Methods for Smart Grid*, vol. 8, no. 6, pp. 2941-2962, November 2017.
5. **D.K. Molzahn**, “Computing the Feasible Spaces of OPF Problems,” *IEEE Transactions on Power Systems*, vol. 32, no. 6, pp. 4752-4763, November 2017.
6. **D.K. Molzahn**, “Incorporating Squirrel-Cage Induction Machine Models in Convex Relaxations of OPF Problems,” *IEEE Transactions on Power Systems (Letters)*, vol. 32, no. 6, pp. 4972-4974, November 2017.
7. J.F. Marley, **D.K. Molzahn**, and I.A. Hiskens, “Solving Multiperiod OPF Problems using an AC-QP Algorithm Initialized with an SOCP Relaxation,” *IEEE Transactions on Power Systems*, vol. 32, no. 5, pp. 3538-3548, September 2017.
8. **D.K. Molzahn**, C. Josz, I.A. Hiskens, and P. Panciatici, “A Laplacian-Based Approach for Finding Near Globally Optimal Solutions to OPF Problems,” *IEEE Transactions on Power Systems*, vol. 32, no. 1, pp. 305-315, January 2017.
- 2016 9. **D.K. Molzahn** and I.A. Hiskens, “Convex Relaxations of Optimal Power Flow Problems: An Illustrative Example,” *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 63, no. 5, pp. 650-660, May 2016.
- 2015 10. **D.K. Molzahn** and I.A. Hiskens, “Sparsity-Exploiting Moment-Based Relaxations of the Optimal Power Flow Problem,” *IEEE Transactions on Power Systems*, vol. 30, no. 6, pp. 3168-3180, November 2015.
- 2014 11. **D.K. Molzahn**, B.C. Lesieutre, and C.L. DeMarco, “Approximate Representation of ZIP Loads in a Semidefinite Relaxation of the OPF Problem,” *IEEE Transactions on Power Systems, Letters*, vol. 29, no. 4, pp. 1864-1865, July 2014.
12. **D.K. Molzahn**, B.C. Lesieutre, and C.L. DeMarco, “A Sufficient Condition for Global Optimality of Solutions to the Optimal Power Flow Problem,” *IEEE Transactions on Power Systems, Letters*, vol. 29, no. 2, pp. 978-979, March 2014.
- 2013 13. **D.K. Molzahn**, J.T. Holzer, B.C. Lesieutre, and C.L. DeMarco, “Implementation of a Large-Scale Optimal Power Flow Solver Based on Semidefinite Programming,” *IEEE Transactions on Power Systems*, vol. 28, no. 4, pp. 3987-3998, November 2013.
14. **D.K. Molzahn**, B.C. Lesieutre, and C.L. DeMarco, “A Sufficient Condition for Power Flow Insolvability with Applications to Voltage Stability Margins,” *IEEE Transactions on Power Systems*, vol. 28, no. 3, pp. 2592-2601, August 2013.
15. **D.K. Molzahn** and B.C. Lesieutre, “Initializing Dynamic Power System Simulations Using Eigenvalue Formulations of the Induction Machine and Power Flow Models,” *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 60, no. 3, pp. 690-702, March 2013.

16. **D.K. Molzahn**, B.C. Lesieutre, and H. Chen, “Counterexample to a Continuation-Based Algorithm for Finding All Power Flow Solutions,” *IEEE Transactions on Power Systems, Letters*, vol. 28, no. 1, pp. 564–565, February 2013.
- 2011 17. **D.K. Molzahn** and C. Singletary, “An Empirical Investigation of Speculation in the MISO Financial Transmission Rights Auction Market,” *The Electricity Journal*, vol. 24, issue 5, pp. 57–68, June 2011.

Conference Proceedings

- 2017 1. M. Yao, **D.K. Molzahn**, and J.L. Mathieu, “The Impact of Load Models in an Algorithm for Improving Power System Voltage Stability via Demand Response,” *55th Annual Allerton Conference on Communication, Control, and Computing*, October 4-6, 2017.
2. L.A. Roald, **D.K. Molzahn**, and A.F. Tobler, “Power System Optimization with Uncertainty and AC Power Flow: Analysis of an Iterative Algorithm,” *IREP Symposium on Bulk Power System Dynamics and Control – X. The Power System of the Future: Global Dynamics arising from Distributed Actions*, August 27–September 1, 2017.
3. M. Yao, J.L. Mathieu, and **D.K. Molzahn**, “Using Demand Response to Improve Power System Voltage Stability Margins,” *IEEE PowerTech Manchester*, 18-22 June 2017.
High-quality paper award.
- 2016 4. K. Dvijotham and **D.K. Molzahn**, “Error Bounds on the DC Power Flow Approximation: A Convex Relaxation Approach,” *IEEE 55th Annual Conference on Decision and Control (CDC)*, 12-14 December 2016.
5. **D.K. Molzahn**, C. Jozs, and I.A. Hiskens, “Moment Relaxations of Optimal Power Flow Problems: Beyond the Convex Hull,” *IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, 7-9 December 2016.
6. **D.K. Molzahn**, D. Mehta, and M. Niemerg, “Toward Topologically Based Upper Bounds on the Number of Power Flow Solutions,” *American Control Conference (ACC)*, 6-8 July 2016.
Best presentation in session award.
7. D. Mehta, **D.K. Molzahn**, K. Turitsyn, “Recent Advances in Computational Methods for the Power Flow Equations,” *American Control Conference (ACC)*, 6-8 July 2016.
8. **D.K. Molzahn**, C. Jozs, I.A. Hiskens, and P. Panciatici, “Computational Advances for Sparsity-Exploiting Moment Relaxations of the OPF Problem,” *19th Power Systems Computation Conference (PSCC)*, 20-24 June 2016.
9. **D.K. Molzahn**, I.A. Hiskens, and B.C. Lesieutre, “Calculation of Voltage Stability Margins and Certification of Power Flow Insolvability using Second-Order Cone Programming,” *49th Hawaii International Conference on System Sciences (HICSS)*, 5-8 January 2016.
- 2015 10. **D.K. Molzahn**, C. Jozs, I.A. Hiskens, and P. Panciatici, “Solution of Optimal Power Flow Problems using Moment Relaxations Augmented with Objective Function Penalization,” *IEEE 54th Annual Conference on Decision and Control (CDC)*, 15-18 December 2015.
11. **D.K. Molzahn**, Z.B. Friedman, B.C. Lesieutre, C.L. DeMarco, and M.C. Ferris, “Estimation of Constraint Parameters in Optimal Power Flow Data Sets,” *47th North American Power Symposium (NAPS)*, 4-6 October 2015.
12. **D.K. Molzahn** and I.A. Hiskens, “Mixed SDP/SOCP Moment Relaxations of the Optimal Power Flow Problem,” *IEEE PowerTech Eindhoven*, 29 June–2 July, 2015.

13. **D.K. Molzahn**, S.S. Baghsorkhi, and I.A. Hiskens, “Semidefinite Relaxations of Equivalent Optimal Power Flow Problems: An Illustrative Example,” *2015 IEEE International Symposium on Circuits and Systems (ISCAS)*, 24-27 May 2015.
- 2014 14. P. Panciatici, M.C. Campi, S. Garatti, S.H. Low, **D.K. Molzahn**, A.X. Sun, L. Wehenkel, “Advanced optimization methods for power systems,” *18th Power Systems Computation Conference (PSCC)*, 18-22 August 2014.
15. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxation of the Optimal Power Flow Problem,” *18th Power Systems Computation Conference (PSCC)*, 18-22 August 2014.
16. **D.K. Molzahn**, B.C. Lesieutre, and C.L. DeMarco, “Investigation of Non-Zero Duality Gap Solutions to a Semidefinite Relaxation of the Optimal Power Flow Problem,” *47th Hawaii International Conference on System Sciences (HICSS)*, 2014, 6-9 January 2014.
- 2013 17. A.R. Borden, **D.K. Molzahn**, B.C. Lesieutre, and P. Ramanathan, “Power System Structure and Confidentiality Preserving Transformation of Optimal Power Flow Model,” *51st Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, 2013, 2-4 October 2013.
18. **D.K. Molzahn**, V. Dawar, B.C. Lesieutre, and C.L. DeMarco, “Sufficient Conditions for Power Flow Insolvability Considering Reactive Power Limited Generators with Applications to Voltage Stability Margins,” *IREP Symposium on Bulk Power System Dynamics and Control – IX. Optimization, Security, and Control of the Emerging Power Grid*, 25-30 August 2013.
- 2012 19. A.R. Borden, **D.K. Molzahn**, P. Ramanathan, and B.C. Lesieutre, “Confidentiality-Preserving Optimal Power Flow for Cloud Computing,” *50th Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, 2012, pp. 1300-1307, 1-5 October 2012.
- 2011 20. B.C. Lesieutre, **D.K. Molzahn**, A.R. Borden, and C.L. DeMarco, “Examining the Limits of the Application of Semidefinite Programming to Power Flow Problems,” in *49th Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, 2011, pp. 1492-1499, 28-30 September 2011.
21. D.R. Schwarting, **D.K. Molzahn**, C.L. DeMarco, and B.C. Lesieutre, “Topological and Impedance Element Ranking (TIER) of the Bulk-Power System,” *44th Hawaii International Conference on System Sciences (HICSS)*, 2011, pp. 1-10, 4-7 January 2011.
- 2010 22. **D.K. Molzahn** and B.C. Lesieutre, “An Eigenvalue Formulation for Determining Initial Conditions of Induction Machines in Dynamic Power System Simulations,” *2010 IEEE International Symposium on Circuits and Systems (ISCAS)*, pp. 2311-2313, 30 May–2 June 2010.

Other Conference and Workshop Presentations

- 2018 1. **D.K. Molzahn**, H. Hijazi, and C. Josz, “Quickly Certifying Global Optimality of a Candidate Optimal Power Flow Solution using a Moment Relaxation Hierarchy,” *Power Systems: Semi-Algebraic Techniques for Optimal Power Flow and Stability Assessment*, Paris, France, 16-17 January 2018.
- 2017 2. **D.K. Molzahn** and L.A. Roald, “AC Optimal Power Flow with Robust Feasibility Guarantees,” *Georgia Tech Workshop on Electric Energy Systems and Operations Research*, Atlanta, GA, 9-10 November 2017.
3. **D.K. Molzahn** and K. Dvijotham, “Error Bounds on Power Flow Linearizations: A Convex Relaxation Approach,” *INFORMS Annual Meeting 2017*, Houston, TX, 22-25 October 2017.

4. **D.K. Molzahn**, M. Yao, and J.L. Mathieu, “A Multi-Period OPF Approach to Improve Voltage Stability using Demand Response,” *INFORMS Annual Meeting 2017*, Houston, TX, 22-25 October 2017.
5. **D.K. Molzahn**, “Characterizing Non-Convexities in the Feasible Spaces of AC OPF Problems,” *INFORMS Annual Meeting 2017*, Houston, TX, 22-25 October 2017.
6. O. Coss, J.D. Hauenstein, H. Hong, and **D.K. Molzahn**, “Finding & Counting Equilibria of the Kuramoto Model for Coupled Oscillators,” *SIAM Conference on Applied Algebraic Geometry*, Atlanta, GA, 31 July–4 August, 2017.
7. **D.K. Molzahn**, C. Jozs, I.A. Hiskens, and P. Panciatici, “A Laplacian-Based Approach for Finding Near Globally Optimal Solutions to OPF Problems,” *IEEE Power and Energy Society General Meeting, Transactions Paper Session*, Chicago, IL, 19 July 2017.
8. **D.K. Molzahn**, J.L. Mathieu, and M. Yao, “Power System Voltage Stability using Demand Response,” *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software (Docket No. AD10-12-008)*, Federal Energy Regulatory Commission, Washington, DC, 26-28 June 2017.
9. **D.K. Molzahn** and K. Dvijotham, “Error Bounds on Power Flow Linearizations: A Convex Relaxation Approach,” *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software (Docket No. AD10-12-007)*, Federal Energy Regulatory Commission, Washington, DC, 26-28 June 2017.
10. **D.K. Molzahn**, “A Tutorial on Convex Relaxations of the Power Flow Equations,” *Modern Challenges in Power System Operation and Electricity Market: An Optimization Perspective*, DTU Summer School, Copenhagen, Denmark, 12-16 June, 2017.
11. **D.K. Molzahn** and K. Dvijotham, “Error Bounds on Power Flow Linearizations: A Convex Relaxation Approach,” *Banff International Research Station, Workshop on Optimization and Inference for Physical Flows on Networks (17w5165)*, 7 March 2017.
12. **D.K. Molzahn**, D. Wu, B.C. Lesieutre, and K. Dvijotham, “Computing Multiple Local Optima for OPF Problems using an Elliptical Tracing Algorithm,” *INFORMS Computing Society Conference (ICS)*, Austin, TX, 15-17 January 2017.
13. **D.K. Molzahn** and K. Dvijotham, “Error Bounds on Power Flow Linearizations: A Convex Relaxation Approach,” *Los Alamos National Laboratory Center for Nonlinear Studies, Grid Science Winter School and Conference*, Santa Fe, NM, 12-13 January 2017.
- 2016 14. **D.K. Molzahn**, “Visualizing The Feasible Spaces of Optimal Power Flow Problems and Their Convex Relaxations,” *INFORMS Annual Meeting 2016*, Nashville, TN, 13-16 November 2016.
15. J.-C. Gilbert, C. Jozs, and **D.K. Molzahn**, “Plea for a Semidefinite Optimization Solver in Complex Numbers,” *14th EUROPT Workshop on Advances in Continuous Optimization*, Warsaw, Poland, 1-2 July 2016.
16. **D.K. Molzahn**, “Visualizing the Feasible Spaces of Challenging OPF Problems,” *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software (Docket No. AD10-12-007)*, Federal Energy Regulatory Commission, Washington, DC, 27-29 June 2016.
17. C. Jozs and **D.K. Molzahn**, “Moment/Sum-of-Squares Hierarchy for Complex Polynomial Optimization,” *INFORMS International*, Waikoloa Village, HI, 12-15 June 2016.

18. **D.K. Molzahn**, F. Qiu, and J. Wang, “Optimization of Electric Power Systems: Considering Uncertainty and Non-Convexity,” Poster presentation at *Argonne National Laboratory Grid Day*, Lemont, IL, 18 April 2016.
- 2015 19. **D.K. Molzahn** and I.A. Hiskens, “Computational Advances for Moment Relaxations of Optimal Power Flow Problems,” *INFORMS Annual Meeting 2015*, Philadelphia, PA, 1-4 November 2015.
20. **D.K. Molzahn**, I.A. Hiskens, and B.C. Lesieutre, “Calculation of Voltage Stability Margins and Certification of Power Flow Insolvability using Convex Relaxations,” *INFORMS Annual Meeting 2015*, Philadelphia, PA, 1-4 November 2015.
21. **D.K. Molzahn** and I.A. Hiskens, “Sparsity-Exploiting Moment Relaxations of Optimal Power Flow Problems,” *22nd International Symposium on Mathematical Programming*, Pittsburgh, PA, 12-17 July 2015.
22. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of the Optimal Power Flow Problem,” *SIAM Conference on Computational Science and Engineering*, Salt Lake City, UT, 14-18 March 2015.
- 2014 23. **D.K. Molzahn** and I.A. Hiskens, “Convex Optimization of Electric Power Systems,” *Dow Sustainability Fellows Symposium*, poster session, Ann Arbor, MI, 15 November 2014.
24. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of Optimal Power Flow Problems,” *INFORMS Annual Meeting 2014*, San Francisco, CA, 9-12 November 2014.
25. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of Optimal Power Flow Problems,” *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software (Docket No. AD10-12-005)*, Federal Energy Regulatory Commission, Washington, DC, 23-25 June 2014.
26. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxation of the Optimal Power Flow Problem,” *IBM and RTE Workshop on Convexification of the AC Optimal Power Flow Problem*, Dublin, Ireland, 23 April 2014.
- 2013 27. **D.K. Molzahn**, B.C. Lesieutre, C.L. DeMarco, and M.C. Ferris, “Application of Semidefinite Programming to Large-Scale Optimal Power Flow Problems,” *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software (Docket No. AD10-12-004)*, Federal Energy Regulatory Commission, Washington, DC, 24-26 June 2013.
28. M.C. Ferris, Z.B. Friedman, **D.K. Molzahn**, C.L. DeMarco, and B.C. Lesieutre, “ACOPF Models: Extending Data, Formulations, and Solution Methodology,” *Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software (Docket No. AD10-12-004)*, Federal Energy Regulatory Commission, Washington, DC, 24-26 June 2013.
29. B.C. Lesieutre, **D.K. Molzahn**, and C.L. DeMarco, “Advanced Optimization Tools for OPF Formulations in Power Markets,” *Power Systems Engineering Research Center (PSERC) Industry-University Meeting, 2013*, Madison, WI, 29-31 May 2013.

Technical Reports

- 2016 1. **D.K. Molzahn**, “A Survey of Distributed Optimization Algorithms for Optimal Power Flow Problems,” Grid Modernization Initiative, Grid Architecture Project, November 2016.
2. S. Backhaus, K. Kalsi, S. Misra, **D.K. Molzahn**, J. Lian, E. Dall’Anese, M. Vuffray, S. Kundu, and K. Baker, “Grid Modernization Initiative Project 1.4.10 Control Theory Project Road Map,” October 2016.

3. **D.K. Molzahn**, M. Niemerg, D. Mehta, and J.D. Hauenstein, “Investigating the Maximum Number of Real Solutions to the Power Flow Equations: Analysis of Lossless Four-Bus Systems,” *arXiv:1603.05908*, March 2016.
- 2014 4. B.C. Lesieutre and **D.K. Molzahn**, “Optimization and Control of Electric Power Systems,” *Final Technical Report, DOE Grant #DE-SC0002319*, 17 October 2014.
- 2012 5. B.C. Lesieutre, C.L. DeMarco, and **D.K. Molzahn**, “Power System Deliverability Ranking of Critical Elements to Support Select Facilities,” *Report to the Federal Energy Regulatory Commission (not publicly available)*, January 2012.
6. B.C. Lesieutre, C.L. DeMarco, and **D.K. Molzahn**, “Power System Ranking of Nodal Locations,” *Report to the Federal Energy Regulatory Commission (not publicly available)*, January 2012.
- 2010 7. **D.K. Molzahn**, S.P. Williams, and R. Srinivasan, “Plug-In Vehicles in Madison, WI: Consumer Preferences, Charging Stations, and Distribution System Impacts,” *Energy Analysis and Policy Capstone Project Report to Madison Gas and Electric (not publicly available)*, 2010.

Invited Seminars

- 2017 1. **D.K. Molzahn**, “Recent Research in Power System Optimization: Approximation Error Quantification, Feasible Space Computation, and Convex Relaxations,” *Northwestern University*, 30 November 2017.
2. **D.K. Molzahn** and L.A. Roald, “Recent Progress in Optimal Power Flow: A Survey of Convex Relaxations and an Algorithm for Robust Feasibility,” *Argonne National Laboratory, Mathematics and Computer Science Division*, 16 November 2017.
3. **D.K. Molzahn**, “Recent Research in Power System Optimization: Approximation Error Quantification, Feasible Space Computation, and Convex Relaxations,” *Purdue University*, 19 October 2017.
4. **D.K. Molzahn**, “Recent Research in Power System Optimization: Approximation Error Quantification, Feasible Space Computation, and Convex Relaxations,” *University of Aalborg*, 16 June 2017.
5. **D.K. Molzahn**, “Recent Research in Power System Optimization: Approximation Error Quantification, Feasible Space Computation, and Convex Relaxations,” *University of California, Berkeley*, 3 May 2017.
6. **D.K. Molzahn**, “Recent Research in Optimization of Electric Power Systems and Implications for Electricity Markets,” *Energy Policy Institute at the University of Chicago (EPIC)*, 21 February 2017.
- 2016 7. **D.K. Molzahn**, “Moment Relaxations of Optimal Power Flow Problems,” *Seminar at the Missouri University of Science and Technology*, 4 October 2016.
8. **D.K. Molzahn**, “Recent Developments in Moment Relaxations of Optimal Power Flow Problems,” *Seminar at Columbia University*, 9 May 2016.
9. **D.K. Molzahn**, “Moment Relaxations of Optimal Power Flow Problems,” *Seminar at Argonne National Laboratory*, 22 January 2016.
- 2015 10. **D.K. Molzahn**, “Computational Advances for Moment Relaxations of Optimal Power Flow Problems,” *Seminar at the University of Wisconsin–Madison*, 18 September 2015.
11. **D.K. Molzahn** and I.A. Hiskens, “Computational Advances for Moment Relaxations of Optimal Power Flow Problems,” *Seminar at Réseau de transport d’électricité (RTE)*, 23 June 2015.

12. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of the Optimal Power Flow Problem,” *Seminar at ETH Zürich*, 8 June 2015.
13. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of the Optimal Power Flow Problem,” *Seminar at the University of Notre Dame*, 16 April 2015.
14. **D.K. Molzahn** and I.A. Hiskens, “Optimization of Electric Power Systems,” *University of Michigan Dow Sustainability Seminar*, 26 February 2015.
15. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of the Optimal Power Flow Problem,” *Seminar at the University of Illinois at Urbana-Champaign*, 2 February 2015.
- 2014 16. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxations of the Optimal Power Flow Problem,” *Seminar at the University of California, Berkeley*, 6 November 2014.
17. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxation of the Optimal Power Flow Problem,” *Seminar at Argonne National Laboratory*, 12 May 2014.
18. **D.K. Molzahn** and I.A. Hiskens, “Moment-Based Relaxation of the Optimal Power Flow Problem,” *Seminar at the University of Wisconsin–Madison*, 10 April 2014.
19. **D.K. Molzahn**, I.A. Hiskens, B.C. Lesieutre, and C.L. DeMarco, “Optimization and Other Research Topics in Electric Power Systems,” *University of Michigan Dow Sustainability Seminar*, 17 February 2014.
20. **D.K. Molzahn**, I.A. Hiskens, B.C. Lesieutre, and C.L. DeMarco, “Application of Semidefinite Optimization Techniques to the Optimal Power Flow Problem,” *Seminar at Texas A&M*, 20 January 2014.
- 2013 21. **D.K. Molzahn**, I.A. Hiskens, B.C. Lesieutre, and C.L. DeMarco, “Application of Semidefinite Optimization Techniques to the Optimal Power Flow Problem,” *Seminar at Los Alamos National Laboratory*, 30 October 2013.
22. B.C. Lesieutre and **D.K. Molzahn**, “A New Method for Estimating Maximum Power Transfer and Voltage Stability Margins to Mitigate the Risk of Voltage Collapse,” *PSEERC Webinar*, 15 October 2013.
23. **D.K. Molzahn**, “Research Topics in Electric Power Systems Engineering,” *University of Michigan Undergraduate Research Opportunity Program (UROP) Seminar*, 8 October 2013.
24. **D.K. Molzahn**, B.C. Lesieutre, and C.L. DeMarco, “Training on the TIER Methods for Ranking Transmission System Facilities,” *Federal Energy Regulatory Commission Training Session*, 18–20 June 2013.

Software Packages

- 2013 1. **D.K. Molzahn**, “SDP.PF: Implementation of Applications for a Semidefinite Programming Relaxation of the Power Flow Equations.”

A package of MATLAB code integrated with MATPOWER that implements the semidefinite programming relaxation of the optimal power flow problem for large-scale systems, a sufficient condition for global optimality of an optimal power flow solution, a power flow insolvability condition (including the possibility of generator reactive power limits), and voltage stability margins. *Available in the current version of the MATPOWER distribution:*

<http://www.pserc.cornell.edu/matpower/>

Research Grants

- 2016
1. Department of Energy, Grid Modernization Laboratory Consortium (GMLC), “Control Theory Enabling the Deployment of Huge Numbers of Distributed Energy Resources,” Co-I and Argonne Lead (Argonne portion: \$585,000 over three years)
 2. Department of Energy, Advanced Research Projects Agency–Energy (ARPA-E), “EPIGRIDS: Electric Power Infrastructure & Grid Representation in Interoperable Data Sets,” Co-I and Argonne Lead (Argonne portion: \$324,900 over two years)
 3. Laboratory Directed Research and Development (LDRD) SEED Project, “Enhancing Computational Tools for Polynomial Optimization Problems Relevant to Networked Systems,” PI (\$25,000 for one year)

Professional Service

1. Panel member for review of National Science Foundation grant proposals
2. Member of *IEEE Task Force on Benchmarks for Emerging Power System Algorithms*
3. Guest associate editor (special issue on distributed control and optimization) and reviewer for *IEEE Transactions on Smart Grid*
4. Technical Program Committee member, reviewer, and session chair for *Power Systems Computation Conference*
5. Technical Program Committee member for *IEEE Global Conference on Signal and Information Processing*
6. Technical Program Committee member for *Intelligent Systems Application to Power Systems*
7. Tutorial session co-organizer and reviewer for *American Control Conference*
8. Session chair and reviewer for *IEEE PowerTech Conference*
9. Session chair for *North American Power Symposium*
10. Poster judge for *Postdoctoral Research and Career Symposium, Argonne National Laboratory*
11. Journal reviewer for *IEEE Transactions on Power Systems*
12. Journal reviewer for *IEEE Transactions on Automatic Control*
13. Journal reviewer for *IEEE Transactions on Control of Network Systems*
14. Journal reviewer for *IEEE Transactions on Network Science and Engineering*
15. Journal reviewer for *International Journal of Electrical Power and Energy Systems*
16. Journal reviewer for *IET Generation, Transmission & Distribution*
17. Journal reviewer for *Journal of Modern Power Systems and Clean Energy*
18. Journal reviewer for *Sustainable Energy, Grids and Networks*
19. Journal reviewer for *Electric Power Systems Research*
20. Journal reviewer for *Electric Power Components and Systems*
21. Journal reviewer for *Mathematical Programming*
22. Journal reviewer for *Optimization Methods and Software*
23. Journal reviewer for *Automatica*
24. Journal reviewer for *IEEE Journal on Emerging and Selected Topics in Circuits and Systems*
25. Journal reviewer for *EURASIP Journal on Advances in Signal Processing*

- 26. Reviewer for *IEEE Conference on Decision and Control*
- 27. Reviewer for *IEEE Multiconference on Systems and Control*
- 28. Reviewer for *IEEE Power and Energy Society General Meeting*
- 29. Reviewer for *IEEE International Symposium on Circuits and Systems*
- 30. Reviewer for *Mediterranean Conference on Control and Automation*
- 31. Reviewer for *Intelligent System Applications to Power Systems Conference*
- 32. Reviewer for *Mediterranean Conference on Control and Automation*

Advised / Co-Advised Students

- 2017 1. Wesley Chan, Northwestern University, undergraduate student
- 2016 2. Alireza Barzegar, Nanyang Technological University, doctoral student with Prof. Su Rong
- 3. Mohammad Rasoul Narimani, Missouri University of Science and Technology, doctoral student with Prof. Mariesa Crow
- 4. Aldo Tobler, ETH Zürich, masters student with Dr. Line Roald

Joint Appointments

- 1. Adjunct Professor, Missouri University of Science and Technology, Electrical and Computer Engineering Department

Memberships in Professional Organizations

- 1. Institute of Electrical and Electronics Engineers
- 2. INFORMS (Optimization Society)
- 3. Tau Beta Pi Engineering Honor Society
- 4. Eta Kappa Nu Electrical and Computer Engineering Honor Society