

IAN DOBSON

Sandbulte Professor
Electrical and Computer Engineering Department
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- Education**
- PhD in Electrical Engineering 1989, Cornell University, Ithaca, NY.
 - Bachelor of Arts in Mathematics 1978, Cambridge University, England.
- Work**
- Sandbulte Professor
Electrical and Computer Engineering Department,
Iowa State University.
 - Faculty (Assistant Prof. 1989, Associate Prof. 1994, Professor 1999)
Electrical and Computer Engineering Department,
University of Wisconsin-Madison 1989-2011.
 - Graduate Research Assistant, Cornell University, 1984-1989.
PhD thesis: Describing fractal basin boundaries in a forced oscillator.
 - Consultant to Transonic Systems Inc., Ithaca NY, 1987-1988.
Advised on theory of a laser doppler blood flow meter.
 - Systems analyst EASAMS Ltd., Frimley, Surrey, England, 1978-1983.
Simulation and modeling of airborne weapon systems.
Devised and implemented an original and general switching circuit simulation to analyse transients in transformer-rectifier and other high voltage switching power supplies. This work was done at Culham Laboratory on contract to the United Kingdom Atomic Energy Authority. Planning, technical control and marketing of contracts.
Promoted to Intermediate and Senior 2 positions.
- Awards**
- NSF Initiation Grant
 - NSF Presidential Young Investigator
 - Fellow IEEE

Some research highlights

- Explaining how voltages fall in voltage collapse blackouts using nonlinear dynamics.
- Inventing algorithms to find the closest voltage collapse blackout, and select controls to avoid blackouts. These algorithms appear in textbooks and commercial software used to operate power grids. More generally in nonlinear science, the same algorithms apply to closeness to bifurcation instabilities, and have been applied by others to a variety of problems in chemical engineering, mechanical engineering and biology.
- Data shows heavy tails in the probability of large blackouts. I worked with physicists to explain this as the power grid self-organizing itself to near a critical point. Our simulations of power grid upgrade and failure can reproduce the observed data. This is an advance in complex systems science and engineering.
- I devised high-level probabilistic models of cascading failure that can help explain complicated series of failures in large blackouts. So far, the models match observed data. This is an advance in a challenging unsolved problem in risk analysis.
- New instrumentation called synchrophasors is being deployed to monitor power grids. I had a recent breakthrough in circuit theory that allows synchrophasor measurements to be easily combined to monitor events in specific regions of the power grid.
- Co-inventing a modulator for a soft switching power electronic convertor. This is a patented, licensed, and manufactured invention that generalizes to power electronics work in communication systems on one dimensional sigma-delta modulators. We analyzed the spectrum (noise performance) using ergodic theory from nonlinear dynamics. (I was happy to apply this theory to engineering since it is a fun fact that my academic great-great-grandfather is the mathematician G.D. Birkhoff who invented ergodic theory!)
- Analyzing resonances and jumps of switching times in high power switching devices using nonlinear dynamics.
- Citations: h index of 24 (ISI Web of Science) and 38 (Google Scholar).

most papers downloadable from
<http://home.engineering.iastate.edu/~dobson>
or simply google ian dobson papers

Journal publications: Complex Systems and Risk of Blackouts

- [1] B.A. Carreras, V.E. Lynch, I. Dobson, D.E. Newman, Critical points and transitions in an electric power transmission model for cascading failure blackouts, *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 12, no. 4, December 2002, pp. 985-994.
Discovery of critical loading phenomena in which blackout risk sharply increases in a power system model of cascading line overloads.
- [2] B.A. Carreras, D.E. Newman, I. Dobson, A.B. Poole, Evidence for self-organized criticality in a time series of electric power system blackouts, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 51, no. 9, September 2004, pp. 1733-1740.
Analyzes historical North American blackout distribution and suggests complex system explanation for this observed data.
- [3] B.A. Carreras, V.E. Lynch, I. Dobson, D.E. Newman, Complex dynamics of blackouts in power transmission systems, *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 14, no. 3, September 2004, pp. 643-652.
Opposing forces of increasing load and the engineering upgrades in response to blackouts can self-organize the network to near a critical point. Uses a power system model of cascading line overloads on a slowly evolving network.
- [4] D.P. Nedic, I. Dobson, D.S. Kirschen, B.A. Carreras, V.E. Lynch, Criticality in a cascading failure blackout model, *International Journal of Electrical Power and Energy Systems*, vol 28, 2006, pp 627-633.
- [5] I. Dobson, B.A. Carreras, V.E. Lynch, D.E. Newman, Complex systems analysis of series of blackouts: cascading failure, critical points, and self-organization, *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 17, 026103, June 2007 (13 pages).
- [6] H. Ren, I. Dobson, B.A. Carreras, Long-term effect of the n-1 criterion on cascading line outages in an evolving power transmission grid, *IEEE Transactions on Power Systems*, vol. 23, no. 3, August 2008, pp. 1217 - 1225.
- [7] B. A. Carreras, D. E. Newman, I. Dobson, M. Zeidenberg, The impact of risk-averse operation on the likelihood of extreme events in a simple model of infrastructure, *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 19, no. 4, 043107, October 2009 (8 pages).
- [8] D.E. Newman, B.A. Carreras, V.E. Lynch, I. Dobson, Exploring complex systems aspects of blackout risk and mitigation, *IEEE Transactions on Reliability*, vol. 60, no. 1, March 2011, pp. 134-143.

Journal publications: Cascading Failure and Risk of Blackouts

- [9] I. Dobson, B.A. Carreras, D.E. Newman, A loading-dependent model of probabilistic cascading failure, *Probability in the Engineering and Informational Sciences*, vol. 19, no. 1, January 2005, pp. 15-32.
An analytically solvable model for cascading failure.
- [10] J. Chen, J.S. Thorp, I. Dobson, Cascading dynamics and mitigation assessment in power system disturbances via a hidden failure model, *International Journal of Electrical Power and Energy Systems*, vol. 27, no. 4, May 2005, pp. 318-326.
- [11] I. Dobson, B.A. Carreras, V.E. Lynch, B. Nkei, D.E. Newman, Estimating failure propagation in models of cascading blackouts, *Probability in the Engineering and Informational Sciences*, vol 19, no 4, October 2005, pp 475-488.
- [12] M. Begovic, J-M. Gagnon, P. Gomes, W. Lachs, C-C. Liu, V. Madani, D. Novosel, G. Trudel, M. Amin, H. Clark, I. Dobson, P. Donalek, P. Grondin, L. Wehenkel, Defense Plan Against Extreme Contingencies - CIGRE Task Force C2.02.24, Summary of Technical Brochure No. 316, *Electra*, vol. 231, April 2007.
- [13] H. Ren, I. Dobson, Using transmission line outage data to estimate cascading failure propagation in an electric power system, *IEEE Transactions on Circuits and Systems Part II*, vol. 55, no. 9, Sept. 2008, pp. 927-931.
- [14] D.L. Turcotte, S.G. Abaimov, I. Dobson, J.B. Rundle, Implications of an inverse branching aftershock sequence model, *Physical Review E*, vol. 79, no. 1, 016101, 2009 (8 pages).
- [15] I. Dobson, J. Kim, K.R. Wierzbicki, Testing branching process estimators of cascading failure with data from a simulation of transmission line outages, *Risk Analysis*, vol. 30, no. 4, 2010, pp. 650-662.
- [16] J. Kim, I. Dobson, Approximating a loading-dependent cascading failure model with a branching process, *IEEE Transactions on Reliability*, vol. 59, no. 4, December 2010, pp. 691-699.
- [17] N. Romero, N. Xu, L. K. Nozick, I. Dobson, D. Jones, Investment planning for electric power systems under terrorist threat, *IEEE Transactions on Power Systems*, vol. 27, no. 1, February 2012, pp. 108-116.
- [18] M. Vaiman, K. Bell, Y. Chen, B. Chowdhury, I. Dobson, P. Hines, M. Papic, S. Miller, P. Zhang, Risk assessment of cascading outages: methodologies and challenges, to appear in *IEEE Transactions on Power Systems*.
- [19] J. Kim, K.R. Wierzbicki, I. Dobson, R.C. Hardiman, Estimating propagation and distribution of load shed in simulations of cascading blackouts, to appear in *IEEE Systems Journal*, special issue on complex systems.
- [20] H. Wu, I. Dobson, Cascading stall of many induction motors in a simple system, to appear in *IEEE Transactions on Power Systems*.

Journal publications: Phasor measurements for smart grid

- [21] I. Dobson, Voltages across an area of a network, to appear in *IEEE Transactions on Power Systems*.

Journal publications: Electric Power System Stability

- [22] I. Dobson, H.-D. Chiang, Towards a Theory of Voltage Collapse in Electric Power Systems, *Systems and Control Letters*, Vol. 13, 1989, pp. 253-262.
Explains using nonlinear dynamics how voltages fall along a center manifold in a voltage collapse blackout when an operating equilibrium disappears in a saddle-node bifurcation. Introduces popular voltage collapse model with load dynamics.
135 citations in ISI Web of Science
- [23] H.-D. Chiang, I. Dobson, R.J. Thomas, J.S. Thorp, L. Fekih-Ahmed, On voltage collapse in electric power systems, *IEEE Transactions on Power Systems*, Vol. 5, No. 2, May 1990, pp. 601-611.
- [24] I. Dobson, Observations on the geometry of saddle node bifurcation and voltage collapse in electric power systems, *IEEE Transactions on Circuits and Systems, Part 1: Fundamental Theory and Applications*, Vol. 39, No. 3, March 1992, pp. 240-243.
- [25] C.A. Canizares, F.L. Alvarado, C.L. DeMarco, I. Dobson, W.F. Long, Point of collapse methods applied to AC/DC power systems, *IEEE Transactions on Power Systems*, Vol. 7., No. 2, May 1992, pp. 673-683.
- [26] I. Dobson, H. Glavitsch, C.C. Liu, Y. Tamura, K. Vu, Voltage collapse in power systems, *IEEE Circuits and Devices Magazine*, vol. 8, no. 3, May 1992, pp. 40-45.
- [27] I. Dobson, L. Lu, Computing an optimum direction in control space to avoid saddle node bifurcation and voltage collapse in electric power systems, *IEEE Transactions on Automatic Control*, vol 37, no. 10, October 1992, pp. 1616-1620.
- [28] I. Dobson, L. Lu, Voltage collapse precipitated by the immediate change in stability when generator reactive power limits are encountered, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 39, no. 9, Sept. 1992, pp. 762-766.
- [29] I. Dobson, L. Lu, New methods for computing a closest saddle node bifurcation and worst case load power margin for voltage collapse, *IEEE Transactions on Power Systems*, vol. 8, no. 3, August 1993, pp. 905-913.
- [30] T.J. Overbye, I. Dobson, C.L. DeMarco, Q-V Curve interpretations of energy measures for voltage security, *IEEE Transactions on Power Systems*, vol. 9, no. 1, Feb. 1994, pp. 331-340.
- [31] F.L. Alvarado, I. Dobson, Y. Hu, Computation of closest bifurcations in power systems, *IEEE Transactions Power Systems*, vol. 9, no. 2, May 1994, pp. 918-928.
- [32] S. Greene, I. Dobson, F.L. Alvarado, Sensitivity of the loading margin to voltage collapse with respect to arbitrary parameters, *IEEE Transactions on Power Systems*, vol. 12, no. 1, February 1997, pp. 262-272.
110 citations in ISI Web of Science.
- [33] S. Greene, I. Dobson, F.L. Alvarado, Contingency ranking for voltage collapse via sensitivities from a single nose curve, *IEEE Transactions on Power Systems*, vol. 14, no. 1, February 1999, pp. 232-240.
- [34] I. Dobson, J. Zhang, S. Greene, H. Engdahl, P.W. Sauer, Is strong modal resonance a precursor to power system oscillations?, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 48, no. 3, March 2001, pp. 340-349.

- [35] S. Greene, I. Dobson, F.L. Alvarado, Sensitivity of transfer capability margins with a fast formula, *IEEE Transactions on Power Systems*, vol. 17, no. 1, February 2002, pp. 34-40.
- [36] I. Dobson, E. Barocio, Scaling of normal form analysis coefficients under coordinate change, *IEEE Transactions on Power Systems*, vol. 19, no. 3, August 2004, pp. 1438-1444.
- [37] J. Zhang, I. Dobson, F.L. Alvarado, Quantifying transmission reliability margin, *International Journal of Electric Energy and Power Systems*, vol. 26, no. 9, 2004, pp. 697-702.
- [38] I. Dobson, E. Barocio, Perturbations of weakly resonant power system electromechanical modes, *IEEE Transactions on Power Systems*, vol. 20, no. 1, Feb. 2005, pp. 330-337.
- [39] J. Arroyo, I. Dobson, Counterexamples to a method for identifying Hopf bifurcations without eigenvalue calculation, *IEEE Transactions on Circuits and Systems-II*, vol. 54, no. 5, May 2007, pp. 432-434.
- [40] I. Dobson, The irrelevance of electric power system dynamics for the loading margin to voltage collapse and its sensitivities, *Nonlinear Theory and Its Applications*, IEICE, vol. 2, no. 3, July 2011, pp. 263-280.

Journal publications: Nonlinear Dynamics

- [41] I. Dobson, Formation of a fractal basin boundary in a forced oscillator, *IEEE Transactions on Circuits and Systems*, Vol. 36, No. 6, pp. 866-872, June 1989.
- [42] J.H. Booske, R.F. Cooper, I. Dobson, Mechanisms for nonthermal effects on ionic mobility during microwave processing of crystalline solids, *Journal of Materials Research*, vol. 7, no. 2, February 1992, pp. 495-501.
- [43] I. Dobson, Computing a closest bifurcation instability in multidimensional parameter space, *Journal of Nonlinear Science*, vol. 3, no. 3, 1993, pp. 307-327.
Finds smallest pattern of parameter changes that destabilize an engineering system with many parameters
- [44] I. Dobson, D.F. Delchamps, Truncated fractal basin boundaries in the pendulum with nonperiodic forcing, *Journal of Nonlinear Science*, vol. 4, 1994, pp. 315-328.
- [45] A. Mazzoleni, I. Dobson, Closest bifurcation analysis and robust stability design of flexible satellites, *Journal of Guidance, Control and Dynamics*, vol. 18, no. 2, March-April 1995, pp. 333-339.
- [46] A. Mazzoleni, I. Dobson, Instability tests, Liapunov's direct method and exact stability boundaries for flexible satellites, *Journal of Guidance, Control and Dynamics*, vol. 18, no. 3, May-June 1995, pp. 426-432.
- [47] G. Gray, I. Dobson, D.C. Kammer, Chaos in a spacecraft passive attitude maneuver due to time-periodic perturbations, *ASME Journal of Applied Mechanics*, vol. 63, no. 2, June 1996, pp. 501-508.
- [48] G. Gray, D.C. Kammer, I. Dobson, A.J. Miller, Heteroclinic bifurcations in rigid bodies containing internally moving parts and a viscous damper, *ASME Journal of Applied Mechanics*, vol. 66, no. 3, September 1999, pp. 720-728.

- [49] J.G. Wohlbier, J.H. Booske, I. Dobson, The multifrequency spectral Eulerian (MUSE) model of a traveling wave tube, *IEEE Transactions on Plasma Science*, vol. 30, no. 3, June 2002, pp. 1063-1075.
- [50] J.G. Wohlbier, I. Dobson, J.H. Booske, Generation and growth rates of nonlinear distortions in a traveling wave tube, *Physical Review E*, vol. 66, article 056504, November 2002.
- [51] J.G. Wohlbier, J.H. Booske, I. Dobson, On the physics of harmonic injection in a traveling wave tube, *IEEE Transactions on Plasma Science*, vol. 32, no. 3, June 2004, pp. 1073-1085.

Journal publications: Power Electronics (mainly high power)

- [52] I. Dobson, Representation and simulation of AC/DC convertor systems using fixed and varying electrical axes, *IEE Proceedings, Part A*, Vol. 134, No. 1, pp. 67-83, January 1987.
- [53] I. Dobson, Geometric description of bridge rectifier operational modes using regular polygons, *IEE Proceedings, Part A*, Vol. 134, No. 1, pp. 85-88, January 1987.
- [54] S.G. Jalali, R.H. Lasseter, I. Dobson, Dynamic response of a thyristor controlled switched capacitor, *IEEE Transactions on Power Delivery*, vol. 9, no. 3, July 1994, pp.1609-1615.
- [55] I. Dobson, Stability of ideal thyristor and diode switching circuits, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 42, no. 9, September 1995, pp. 517-529.
- [56] S.G. Jalali, I. Dobson, R.H. Lasseter, G. Venkataramanan, Switching time bifurcations in a thyristor controlled reactor, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 43, no. 3, March 1996, pp. 209-218.
- [57] R. Rajaraman, I. Dobson, R.H. Lasseter, Y. Shern, Computing the damping of subsynchronous oscillations due to a thyristor controlled series capacitor, *IEEE Transactions on Power Delivery*, vol. 11, no. 2, April 1996, pp. 1120-1127.
- [58] R. Rajaraman, I. Dobson, Damping estimates of subsynchronous and power swing oscillations in power systems with thyristor switching devices, *IEEE Transactions on Power Systems*, vol. 11, no. 4, November 1996, pp. 1926-1930.
- [59] R. Rajaraman, I. Dobson, S. Jalali, Nonlinear dynamics and switching time bifurcations of a thyristor controlled reactor circuit, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 43, no. 12, December 1996, pp. 1001-1006.
- [60] R. Rajaraman, I. Dobson, Justification of torque per unit velocity methods of analyzing subsynchronous resonance and a swing mode in power systems, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 45, no. 10, October 1998, pp. 1109-1113.
- [61] G.A. Luckjiff, I. Dobson, Hexagonal sigma-delta modulation, *IEEE Transactions on Circuits and Systems, Part 1*, vol. 50, no. 8, August 2003, pp. 991-1005.
Analytic derivation of device spectrum and switching rate using ergodic theory and Fourier theory on lattices.

- [62] G.A. Luckjiff, I. Dobson, Hexagonal sigma delta modulators in power electronics, *IEEE Transactions on Power Electronics*, vol. 20, no. 5, September 2005, pp. 1075-1083.

Journal publications: Climate change

- [63] L.M. Beard, J.B. Cardell, I. Dobson, F. Galvan, D. Hawkins, W. Jewell, M. Kezunovic, T.J. Overbye, P.K. Sen, D.J. Tylavsky, Key technical challenges for the electric power industry and climate change, *IEEE Transactions on Energy Conversion*, vol. 25, no. 2, June 2010, pp. 465-473.

Patent

- [64] D.M. Divan, I. Dobson, G.A. Luckjiff, Modulator for resonant link converters, US patent 5,619,406, April 1997.
Generalization of one-dimensional sigma-delta modulator principle to hexagonal quantizer. Licensed and manufactured invention.

Book chapters

- [65] I. Dobson, S.G. Jalali, R. Rajaraman, Damping and resonance in a high power switching circuit, chapter in *Systems and Control Theory for Power Systems* (eds. J.H. Chow, P.V. Kokotovic, R.J. Thomas), IMA volume 64 in mathematics and its applications, Springer Verlag, pp. 137-156, 1995.
- [66] I. Dobson, Stability and nonlinear dynamics in thyristor and diode circuits, chapter in *Nonlinear Phenomena in Power Electronics: Attractors, Bifurcations, Chaos, and Nonlinear Control* (eds. S. Banerjee, G.C. Verghese), IEEE Press 2001, ISBN 0780353838.
- [67] I. Dobson, T. Van Cutsem, C. Vournas, C. DeMarco, M. Venkatasubramanian, T. Overbye, C. Canizares, Chapter 2: Basic Theoretical Concepts in *Voltage Stability Assessment: Concepts, Practices and Tools*, IEEE Power Engineering Society Power System Stability Subcommittee Special Publication, IEEE product number SP101PSS, ISBN 0780378695, 2002.
- [68] I. Dobson, Distance to bifurcation in multidimensional parameter space: margin sensitivity and closest bifurcations, chapter 3, pp. 49-66 in *Bifurcation Control, Theory and Applications*, editors G. Chen, D.J. Hill, X. Yu, Lecture Notes in Control and Information Sciences. Vol. 293, ISBN 3-540-40341-8, Springer Verlag 2003
- [69] I. Dobson, Analysis of cascading infrastructure failures, chapter for *Wiley Handbook of Science and Technology for Homeland Security*, edited by J. G. Voeller, Wiley-Interscience, April 2010.

Web site

- [70] I. Dobson, S. Greene, R. Rajaraman, F.L. Alvarado, C.L. DeMarco, M. Glavic, A. DeSouza, R. Zimmerman, R.J. Thomas et al., *Transfer capability calculator and tutorial*, web site at <http://www.pserc.cornell.edu/tcc/>, 2001.

Selected Conference Papers

particularly those not reworked or republished as journal papers

- I. Dobson, A first analysis of stability when a constraint on the system state is encountered, *International Symposium on Circuits and Systems*, Singapore, June 1991, pp. 1224-1227.
- I. Dobson, F.L. Alvarado, C.L. DeMarco, Sensitivity of Hopf bifurcations to power system parameters, *invited paper, 31st IEEE Conference on Decision and Control* Tucson, AZ, December 1992, pp. 2928-2933.
- R. Rajaraman, I. Dobson, Damping and incremental energy in thyristor switching circuits, *invited paper, IEEE International Symposium on Circuits and Systems*, Seattle, Washington, May 1995, pp. 291-294.
- I. Dobson, Strong resonance effects in normal form analysis and subsynchronous resonance, *Bulk Power System Dynamics and Control V*, August 2001, Onomichi, Japan.
- I. Dobson, B.A. Carreras, D.E. Newman, A branching process approximation to cascading load-dependent system failure, *Thirty-seventh Hawaii International Conference on System Sciences*, Hawaii, January 2004.
- B.A. Carreras, V.E. Lynch, D.E. Newman, I. Dobson, Dynamical and probabilistic approaches to the study of blackout vulnerability of the power transmission grid, *Thirty-seventh Hawaii International Conference on System Sciences*, Hawaii, Jan. 2004.
- V. Auvray, I. Dobson, L. Wehenkel, Modifying eigenvalue interactions near weak resonance, *IEEE International Symposium on Circuits and Systems*, Vancouver Canada, May 2004.
- I. Dobson, B.A. Carreras, D.E. Newman, Probabilistic load-dependent cascading failure with limited component interactions, *IEEE International Symposium on Circuits and System*, Vancouver Canada, May 2004.
- I. Dobson, B.A. Carreras, D.E. Newman, A criticality approach to monitoring cascading failure risk and failure propagation in transmission systems, *Electricity Transmission in Deregulated Markets: Challenges, Opportunities and Necessary R&D Agenda*, Carnegie-Mellon University, Pittsburgh PA, December 2004.
- D.E. Newman, B.A. Carreras, V.E Lynch, I. Dobson, The impact of various upgrade strategies on the long-term dynamics and robustness of the transmission grid, *Electricity Transmission in Deregulated Markets: Challenges, Opportunities and Necessary R&D Agenda*, Carnegie-Mellon University, Pittsburgh PA, December 2004.
- I. Dobson, B.A. Carreras, D.E. Newman, Branching process models for the exponentially increasing portions of cascading failure blackouts, *Thirty-eighth Hawaii International Conference on System Sciences*, Hawaii, January 2005.

- D.E. Newman, B. Nkei, B.A. Carreras, I. Dobson, V.E. Lynch, P. Gradney, Risk assessment in complex interacting infrastructure systems, Thirty-eighth Hawaii International Conference on System Sciences, Hawaii, January 2005.
- U. Bhatt, D.E. Newman, B.A. Carreras, I. Dobson, Understanding the effect of risk aversion on risk, Thirty-eighth Hawaii International Conference on System Sciences, Hawaii, January 2005.
- I. Dobson, K.R. Wierzbicki, B.A. Carreras, V.E. Lynch, D.E. Newman, An estimator of propagation of cascading failure, Thirty-ninth Hawaii International Conference on System Sciences, Kauai, Hawaii, January 2006.
- K.R. Wierzbicki, I. Dobson, An approach to statistical estimation of cascading failure propagation in blackouts, CRIS, Third International Conference on Critical Infrastructures, Alexandria VA, Sept. 2006.
- B.A. Carreras, D.E. Newman, P. Gradney, V.E. Lynch, I. Dobson, Interdependent risk in interacting infrastructure systems, Fortieth Hawaii International Conference on System Sciences, Hawaii, January 2007.
- I. Dobson, Where is the edge for cascading failure?: challenges and opportunities for quantifying blackout risk, IEEE Power Engineering Society General Meeting, Tampa FL USA, June 2007.
- I. Dobson, K.R. Wierzbicki, J. Kim, H. Ren, Towards quantifying cascading blackout risk, Bulk Power System Dynamics and Control-VII, Charleston SC, August 2007.
- D.E. Newman, B.A. Carreras, V.E. Lynch, I. Dobson, Evaluating the effect of upgrade, control and development strategies on robustness and failure risk of the power transmission grid, Forty-first Hawaii International Conference on System Sciences, Hawaii, January 2008
- IEEE PES CAMS Task Force on Cascading Failure, Initial review of methods for cascading failure analysis in electric power transmission systems, IEEE Power and Energy Society General Meeting, Pittsburgh PA USA, July 2008 (Dobson was task lead for this paper).
- B. A. Carreras, D. E. Newman, I. Dobson, M. Zeidenberg, A simple model for the reliability of an infrastructure system controlled by agents, Forty-second Hawaii International Conference on System Sciences, Hawaii, January 2009.
- IEEE PES CAMS Task Force on Cascading Failure, Vulnerability assessment for cascading failures in electric power systems, IEEE PES Power Systems Conference and Exposition, Seattle WA USA, March 2009.
- B. A. Carreras, D. E. Newman, M. Zeidenberg, I. Dobson, Dynamics of an economics model for generation coupled to the OPA power transmission model, Forty-third Hawaii International Conference on System Sciences, Kauai, Hawaii, January 2010.
- I. Dobson, M. Parashar, C. Carter, Combining phasor measurements to monitor cutset angles, Forty-third Hawaii International Conference on System Sciences, Kauai, Hawaii, January 2010. Best Paper Award.
- J. Kim, I. Dobson, Propagation of load shed in cascading line outages simulated by OPA, COMPENG 2010: Complexity in Engineering, Rome Italy, February 2010.

- I. Dobson, M. Parashar, A cutset area concept for phasor monitoring, IEEE Power and Energy Society General Meeting, Minneapolis, MN USA, July 2010.
- I. Dobson, New angles for monitoring areas, IREP Symposium, Bulk Power System Dynamics and Control - VIII, Buzios, Rio de Janeiro, Brazil, August 2010.
- I. Dobson, B.A. Carreras, Number and propagation of line outages in cascading events in electric power transmission systems, 48th Annual Allerton Conference on Communication, Control and Computing, Monticello IL USA, September 2010.
- D.E. Newman, B.A. Carreras, M. Kirchner, I. Dobson, The impact of distributed generation on power transmission grid dynamics, Forty-fourth Hawaii International Conference on System Sciences, Kauai, Hawaii, January 2011.
- I. Dobson, Estimating the extent of cascading transmission line outages using standard utility data and a branching process, summary for panel session at IEEE Power and Energy Society General Meeting, Detroit MI USA, July 2011.
- B.A. Carreras, D.E. Newman, I. Dobson, Determining the vulnerabilities of the power transmission system, Forty-fifth Hawaii International Conference on System Sciences, Maui, Hawaii, January 2012.
- D.E. Newman, B.A. Carreras, N.S. Degala, I. Dobson, Risk metrics for dynamic complex infrastructure systems such as the power transmission grid, Forty-fifth Hawaii International Conference on System Sciences, Maui, Hawaii, January 2012.

Courses taught at Iowa State University

EE653 Phasor measurements in power system networks 2012

Courses taught at University of Wisconsin

ECE220 Electrodynamics I	1995
ECE330 Signals and systems	1990,1994,1999
ECE331 Probability & random processes	2002,2003,2004,2006,2009
ECE332 Feedback control systems	1996,2002,2002,2003,2004
ECE342 Electronic Circuits II	1998,1999
ECE355 Electromech. energy conversion	1999,2000
ECE334 State space systems analysis	1992,1993,1995,1998,2007,2010
ECE427 Electric power systems	1989,1991,1992,1996
ECE730 Probability & stochastic processes	2006
ECE731 Advanced power system analysis	1993
ECE717 Linear Systems	1991,1997,2001,2003,2005,2008
ECE/ChE/Math 777 Chaos & bifurcations	1997,2001,2005,2010
ECE817 Nonlinear systems	1991,2011
ECE903 Special topics in control	1990,1994
ECE905 Special topics in power	2004

Conference Proceedings Edited

- [71] A.B. Kumar, A. Ipakchi, F.L. Alvarado, I. Dobson, S. Mukherjee, W.H. Esselman (eds.), Proceedings: EPRI/NSF Workshop on Application of advanced mathematics to power systems, Electric Power Research Institute, TR101795, April 1993.

Reports

- [72] I. Dobson, 6 Culham Laboratory (United Kingdom Atomic Energy Authority) reports on the CONNIE switching circuit simulation, including Technical Description (CLM-PDN2/88), Users Guide (CLM-PDN1/88), and modelling of transformer rectifier systems using CONNIE (EDD/ESG/83/N10, N11, N12, N13), Culham Laboratory, Abingdon, Oxon OX14 3DB, England, Nov. 1983.
- [73] R.H. Lasseter, I. Dobson, S.G. Jalali, *Harmonics and instabilities in switching circuits*, (Electric Power Research Institute Report), EPRI TR-102317, May 1993.
- [74] I. Dobson, *Loading margin methods for avoiding voltage collapse*, (Electric Power Research Institute Report), EPRI, Palo Alto CA and National Science Foundation, Arlington VA, EPRI TR-111275, September 1998.
- [75] I. Dobson, *Stability, damping, nonlinear dynamics and SSR in thyristor switching circuits*, (Electric Power Research Institute Report), EPRI, Palo Alto CA and National Science Foundation, Arlington VA, EPRI TR-111276, September 1998.
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- [79] Task Force on Blackout Experience, Mitigation, and Role of New Technologies, of the IEEE PES Power System Dynamic Performance Committee, Blackout experiences and lessons, best practices for system dynamic performance, and the role of new technologies, IEEE Special Publication 07TP190, July 2007.
- [80] M. Parashar, A. Agarwal, Y. Makarov, I. Dobson, Real-time voltage security assessment (RTVSA) Functional specifications for commercial grade application, Consortium for Electric Reliability Technology Solutions (CERTS) report for California Independent System Operator (CAISO), April 2007. Available from <http://certs.lbl.gov/>
- [81] M. Parashar, A. Agarwal, Y. Makarov, I. Dobson, Real-time voltage security assessment (RTVSA) Report on algorithms and framework, Consortium for Electric Reliability Technology Solutions (CERTS) report for California Independent System Operator (CAISO), December 2007. Available from <http://certs.lbl.gov/>
- [82] J. McCalley, S. Khaitan, I. Dobson, K.R. Wierzbicki, J. Kim, H. Ren, Risk of cascading outages (final project report), PSERC publication 08-04, February 2008. Available from <http://www.pserc.wisc.edu/>.

- [83] J. Guckenheimer, J. Ottino, A. Bertozzi, I. Couzin, I. Dobson, S. Glotzer, M. Golubitsky, J. Hudson, C. Jacobson, I. Kevrekidis, E. Klavins, J. Lega, I. Mezic, M. Newman, J. Sethna, M. Shelley, A. Vespignani, L.S. Young, Foundations for Complex Systems Research in the Physical Sciences and Engineering, Report from an NSF Workshop in September 2008.

Grants

- I. Dobson, *NSF Initiation Grant*. The main causes of voltage collapse in electric power systems, \$60,750, 1990-1992.
- I. Dobson, *NSF Presidential Young Investigators Award*. \$125,000, 1991-1998.
- I. Dobson, Avoiding bifurcation instabilities in electric power systems, \$188,800 PYI Industrial matching funds from Electric Power Research Institute plus \$187,500 NSF matching funds, 1992-1998.
- R.H. Lasseter, I. Dobson, Harmonic interactions between FACTS systems, \$287,620 over 3 years from Electric Power Research Institute 1992 -1995.
- P. Sauer, I. Dobson, R.J. Thomas, M.A. Pai, F.L. Alvarado, H.-D. Chiang, Real time control of oscillations of electric power systems, Empire State Electric Energy Research Corporation and New York State Electric and Gas, \$75,000, Wisconsin share is \$24,000, 1996.
- R.H. Lasseter, F.L. Alvarado, C.L. DeMarco, I. Dobson, D. Ray, NSF Industry-University Cooperative Research Center PSerc (Power Systems engineering research center), \$237,500, 1996-01.
- I. Dobson, Modulator for a soft switching power supply, Industrial and Economic Development Research Program, Wisconsin \$15,000 for one year, 1998-99.
- I. Dobson, F.L. Alvarado, C.L. DeMarco, P. Sauer, Avoiding and suppressing oscillations in electric power systems, PSerc project. \$60,000 1997-1999,
- H.-D. Chiang, P. Sauer, I. Dobson, Voltage collapse monitor. PSerc Industry project. \$10,000 Dobson share. 1997-2000.
- I. Dobson, F.L. Alvarado, C.L. DeMarco, Limitations and interactions of bulk power transfers in large scale electric power systems, NSF funding for Research Centers and Small Firm Collaborative Research and Development, \$190,000, 1998-2000. \$73,000 of the \$190,000 is subcontracted to Christensen Associates, Madison, WI.
- C.L. DeMarco, M.A. Pai, I.A. Hiskens, I. Dobson, New System Control Methodologies. PSerc Industry project. \$10,000 Dobson share. 1999-2002.
- I. Dobson, Towards real time control of oscillations in electric power systems, NSF \$220,000 for 4 years starting 7/1/00.
- I. Dobson, Self-organized criticality, blackouts and disruptions in power, and communication systems, NSF grant ECS0085711 \$64,800 for one year starting 9/1/00.
- I. Dobson, B.A. Carreras, B. Kirby, J.S. Thorp, Self-organized criticality, blackouts and disruptions in power and communication systems, DOE CERTS grant, \$80,000 Dobson share. 2001-2002.
- I. Dobson, Collaborative research: Complex dynamics, criticality and cascading events in power system blackouts and communication networks, NSF grant ECS02143691, \$60,000 for 3 years starting 9/1/02.
- C.L. DeMarco, I. Dobson, I.A. Hiskens, D.J. Ray, F.L. Alvarado, NSF IUCRC PSerc site award, 2004-2006, \$75,000 plus supplements exceeding 300K.

- I. Dobson, B.A. Carreras, Risk, Criticality and Self-Organization in Large Blackouts involving Cascading Failure, DOE/CERTS, \$250,000 for 2003-2004. Dobson share is \$125,000.
- S. Talukdar, J.D. McCalley, I Dobson, Risk analysis of critical loading and blackouts with cascading events, PSerc, \$160,000 for 2 years starting summer 2005. Dobson share is \$53,334.
- I. Dobson, Support for CAISO Voltage Security Assessment and Oscillation Monitoring Projects, **DOE CERTS**, \$30,000. 2005-2006.
- I. Dobson, Support for CAISO Voltage Security Assessment and Oscillation Monitoring Projects, **DOE CERTS**, \$21,000. 2006-2007.
- J. Cardell, I. Dobson, and many others, PSerc, The Electric Power Industry and Climate Change Discussion Paper, PSerc, \$21,000 for 6 months in 2007. Dobson share is \$3,000.
- I. Dobson, Cyber Systems: collaborative research: Complex Systems Dynamics of Blackouts and Transmission System Upgrades **NSF**, \$73,000 for 3 years starting in June 2006. This is the Wisconsin portion of collaborative research with University of Alaska and Oak Ridge National Lab/BACV solutions.
- I. Dobson, M. Zeidenberg, HSD Collaborative research: Human decision making and its effect on infrastructure system dynamics, **NSF**, \$210,000 for 4 years starting in November 2006. This is the Wisconsin portion of collaborative research with University of Alaska and Oak Ridge National Lab/BACV solutions.
- I. Dobson, J.D. McCalley, C-C. Liu, Risk analysis of critical loading and blackouts with cascading events, PSerc, \$190,000 for 3 years starting summer 2007. Dobson share is \$56,000.
- I. Dobson, M. Morgan, M. Kumbale, D.E. Newman, B.A. Carreras, Y. Makarov, B.C. Lesieutre, S. Varadan, R. Adapa, Extreme Event Research, **California Energy Commission CIEE/PIER** program, \$1,140,000 for about 2.25 years starting in March 2009. This is a collaboration between University of Wisconsin, EPRI, PNNL, BACV solutions, Southern Company, KEMA consulting, and University of Alaska. Dobson is the technical lead in this proposal and UW share is \$215,000.
- I. Dobson, Exploring approaches to suppressing oscillations, **California Energy Commission/PIER via DOE CERTS**, \$123,000. 2009-2010.
- D. Bienstock, S.J. Wright, I. Dobson, I. Hiskens, J. Linderth, Reconfiguring power systems to minimize cascading failures– models and algorithms, **DOE ASCR**, 1.5 M\$ for 3 years starting in September 2009. Collaborative grant with Columbia U. and U. Michigan.
- I. Dobson, New angles for monitoring areas of electric power systems, University of Wisconsin graduate school, \$38,400 for one year starting July 2011.
- V. Vittal, C.L. Demarco, B.C. Lesieutre, I. Dobson, and many others, PSERC Collaborative Proposal for a Phase III Industry University Cooperative Research Center Program, **NSF**, \$135K for 1 year starting March 2010.

- V. Vittal, T. Overbye, I. Dobson, J.D. McCalley, V. Ajjarapu, C.L. Demarco, and many others, The future grid to enable sustainable energy systems, an initiative of PSEERC, funds from **DOE** via supplement to preceding NSF grant. Dobson share of funding is \$210,000 for 3 years starting in 2011.
- I. Dobson, F. Bullo, B. Sinopoli, CPS Collaborative Research: The Cyberphysical challenges of transient stability and security in power grids, **NSF**, 1.125M\$ for 3 years starting in 2011. Collaborative grant with University of California Santa Barbara and Carnegie-Mellon University. Dobson share of funding is \$375,000.

Media reporting about our blackout research

- Why the lights went out. Jonathan Kay, National Post, August 16 2003
- How a butterfly's wing can bring down Goliath. Chaos theories calculate the vulnerability of megasystems. Keay Davidson, San Francisco Chronicle, August 15 2003
- L'energia ha un punto critico. Donata Allegri, Ecplanet
- Black-out: cause e mezzi per prevenirli. Carlo Alberto Nucci e Alberto Borghetti, Rivista ENERGIA, n. 3, pp. 20-29, 2003
- This was a first world blackout. Chris Suellentrop, Slate magazine, August 15 2003
- Energy scientist studies blackout triggers. Pat Daukantas, Government Computer News, August 22 2003
- The Power Grid as Complex System. Sara Robinson, **SIAM News**, Volume 36, Number 10, December 2003
Headline story with extensive coverage of our work.
- The unruly power grid, Peter Fairley, **IEEE Spectrum** August 2004.
This lead article quoted Dobson and Carreras and summarized our complex systems research on blackouts.
- The items above discussed our research results. Our team was also widely quoted for general background on the August 2003 blackout, including appearances on ABC Nightline, NPR radio and quotes in about a dozen newspapers.

Professional Society Activities

- **Fellow IEEE** “for contributions to understanding and analysis of voltage collapse”, 2006.
- Paper reviewer, including IEEE Power Engineering Society and IEEE Circuit and Systems Society Transactions and Conferences and a large variety of other journals in power systems and complex and nonlinear systems.
- Member of Technical Committee on Power Systems and Power Electronics Circuits, IEEE Circuits and Systems Society, 1990-present.
- Member of IEEE Power Engineering Society Power System Stability Subcommittee, 1995-2002. Coordinator, editor and coauthor of a 96 page chapter of a working group publication on voltage collapse. This publication received an IEEE Power engineering Society Working Group Recognition Award for an outstanding technical report in 2005.
- Member of IEEE Power Engineering Society Power System Dynamic Performance Committee, 1998-present
- Member of IEEE Power Engineering Society Power System Analysis, Computing, and Economics Committee, 2009-present
- **Chair** of Technical Committee on Power Systems and Power Electronic Circuits, IEEE Circuits and Systems Society, 1998-99.
- Member of IEEE Circuits and Systems Society review committee for ISCAS, 2000-04, 2008, and 2010.
- Member of IEEE Power Engineering Society Task Force on the Need to Assess Higher Order Terms for Small Signal (Modal) Analysis, 2001-2005.
- Member of IEEE Power Engineering Society Task Force on Blackout Experience, Mitigation, and Role of New Technologies, 2005-2007.
- Member (also Task 1 leader) of IEEE Power Engineering Society Task Force on Understanding, Prediction, Prevention and Restoration of Cascading Failures. 2007-present
- External Member, a project review committee, Center for Nonlinear Sciences, Los Alamos National Lab, August 2010.
- Member of SIAM Mathematics Awareness Month 2011 Advisory Committee.

Selected talks presented by Dobson that are not in list of conference papers

- Cascading failure, Talk at the University of Liege, Belgium March 2003
- Cascading failure and catastrophic risk in complex systems, Invited talk at Institute for Asset Management Workshop, Birmingham, England, September 2003
- Cascading failure analysis, Lecture at EEI Market Design & Transmission Pricing School Madison, Wisconsin, July 2004
- Avoiding bifurcations in high-dimensional parameter spaces, invited talk in Minisymposium on Theory and Numerical Analysis of Bifurcations in Piecewise Smooth Dynamical Systems, SIAM Conference on Applications of Dynamical Systems, Snowbird UT, May 2005.
- Monitoring risk of cascading failure blackouts, Presentation at Oak Ridge National Lab to representatives from Nuclear Regulatory Commission, Federal Energy Regulatory Commission, and North American Electric Reliability Council, July 2005
- Monitoring risk of cascading failure blackouts, Invited presentation at NSF/EPRI workshop, Denver CO October 2005.
- **Plenary speaker**, Cascading Failure and Complex Dynamics in Large Blackouts, at SIAM Conference on Applications of Dynamical Systems, Snowbird UT, May 2005.
- Plenary Speaker, Criticality, Self-organization and Cascading Failure in Blackouts of Evolving Electric Power Networks, 6th Understanding Complex Networks Symposium, University of Illinois at Urbana-Champaign, May 2006.
- Plenary Speaker, Cascading Failure and Complex Dynamics in Large Blackouts, Los Alamos National Laboratory Center for Nonlinear Studies Workshop on Optimization in Complex Networks, June 2006.
- Panelist, PIER TRP Policy Advisory Committee Meeting, San Ramon, CA June 2006.
- Criticality, Self-organization and Cascading Failure in Electric Power System Blackouts, University of California-Davis, June 2006, Rice University, October 2006, and Princeton Plasma Physics National Lab, September 2007.
- Risk of Large Cascading Blackouts, EUCI Transmission Reliability Conference, Washington DC, October 2006.
- Understanding Cascading failure, EPRI Workshop, Palo Alto CA December 2007.
- Cascading failure analysis, Lecture at EEI Transmission & Wholesale Markets School Madison, Wisconsin, August 2008.
- Modeling cascading failure, Presentation at workshop: Vulnerability assessment of critical infrastructure, with case studies on power transmission networks and dams, Madison WI, January 2009
- Can we quantify the risk of cascading failure blackouts with branching processes? Center for Nonlinear Studies seminar, Los Alamos National Lab, April 2009.
- How can complex system feedbacks shape cascading failure blackout risk towards criticality?, Center for Control, Dynamical Systems, and Computation seminar, University of California at Santa Barbara, April 2009.

- Modeling engineered and sustainable systems with complex system feedbacks, First international conference on computational sustainability CompSust09, Cornell University, Ithaca NY, June 2009.
- Extreme event research, California Energy Commission Transmission Research Program Colloquium, Costa Mesa CA, September 2009.
- Models of cascading failure in blackouts of electric power transmission systems, Electronic Power Grid Resilience Workshop. Organized by the Naval Postgraduate School. Monterey CA May 2010.
- Monitoring stress and reliability for a smarter grid, University of Washington-Seattle, May 2010.
- Modeling cascading failure with branching processes, Mini-Workshop on Optimization and Control Theory for Smart Grids, Center for Nonlinear Sciences, Los Alamos National Lab, August 2010.
- New angles for monitoring power system area stress with synchrophasors, Webinar, Power systems engineering research center, September 2010.
- New angles across power system areas to monitor stress, North American SynchroPhasor Initiative NASPI meeting, Arlington VA, October 2010.
- Propagation of cascading line outages as a reliability metric, talk at Federal Energy Regulatory Commission FERC, Washington DC, October 2010.
- Cascading failure and complex systems dynamics in large blackouts, invited talk at Energy and Emergence, public workshop sponsored by Institute for Complex Adaptive Matter and Center for the Study of Complex Systems, University of Michigan, Ann Arbor MI, November 2010.
- Cascading failure in widespread blackouts, invited talk at session on Mathematics and Our Energy Future, AAAS (American Association for the Advancement of Science) Annual Meeting, Washington DC, February 2011.
- Estimating propagation and the statistics of blackout extent from electric power grid cascading failure data, keynote speaker, Network Frontier Workshop, Northwestern University, Evanston IL, December 2011.

Conference Sessions since 2003

- Chair and organizer, Self-Organizing Criticality Minitrack, Thirty-Sixth Hawaii International Conference on Systems Sciences, January 2003.
- CoChair, Session on Systems Theory for Power, International Symposium on Circuits and Systems, Vancouver, May 2004.
- Chair and organizer, Special session on Probabilistic assessment of cascading events and blackouts, Eighth International Conference on Probability Methods Applied to Power Systems, Ames Iowa, Sept. 2004.
- CoChair, Session on Analysis and control of power system oscillations, Power Systems Computation Conference, Liege, Belgium, August 2005.
- Minitrack chair and Organizer, session on Complex interacting infrastructure systems, 40th Hawaii International Conference on Systems Sciences, Hawaii, January 2007.
- Chair, session on Blackouts and Restoration, IEEE Power Engineering Society General Meeting, Tampa FL USA, June 2007.
- Discussor, session on Intelligent Control, IREP Symposium Bulk Power System Dynamics and Control-VII, Charleston, SC, USA, August 2007.
- Chair, session on Modeling Energy Systems Risk at the INFORMS Annual Meeting, Seattle WA, November 2007.
- Organizer, session on Advanced control for reliability, Hawaii International Conference on Systems Sciences, January 2008.
- Conference co-organizer: Vulnerability assessment of critical infrastructure, with case studies on power transmission networks and dams, an international workshop; Madison WI, January 2009.
- Organizer and chair, session on Large-scale system control, Hawaii International Conference on Systems Sciences, January 2010.
- Chair, session on Power grids and systems, COMPENG: Complexity in Engineering, Rome Italy, February 2010.
- Chair, session on Transient Stability and Time Simulation, IREP Symposium, Bulk Power System Dynamics and Control - VIII, Buzios, Rio de Janeiro, Brazil, August 2010.
- Co-organizer, session on System protection and control, Hawaii International Conference on Systems Sciences, January 2011.

Summary of university service at Wisconsin

- Chair and member, tenure and promotion committee
- Chair and member, awards committee
- Chair and member, MS exam committee
- Member, promotion and recruiting committee
- Member, salary committee
- Member, graduate award committee
- Member, graduate recruiting and fellowship committee
- Member, graduate committee
- Member, budget committee
- Member, undergraduate curriculum committee
- Member, undergraduate advising and scholarships (in charge of scholarships)
- Member, teaching peer review committee
- Member, undergraduate scholarship committee
- Member, ad hoc committees on workload
- Member, steering committee for UW-Madison Chaos and Complex Systems Seminar
- Faculty senator

Conference Papers (complete list)

- [84] Mace, T.A., J.W. Gray, R.C. McLachlan, I. Dobson, CONNIE— A general AC-DC convertor and transient circuit analysis program, *Proceedings of the 18th IEEE Power Modulator Symposium*, June 1988.
- [85] I. Dobson, H.-D. Chiang, J.S. Thorp, L. Fekih-Ahmed, A model of voltage collapse in electric power systems, *invited paper, Proceedings of the 27th IEEE Conference on Decision and Control*, Austin, Texas, pp. 2104-2109, December 1988.
- [86] I. Dobson, D.F. Delchamps, Basin boundaries in the pendulum with nonperiodic forcing, *Proceedings of the 1989 Conference on Information Sciences and Systems*, The Johns Hopkins University, Baltimore, MD, pp. 374-379, March 1989.
- [87] H.-D. Chiang, I. Dobson, R.J. Thomas, J.S. Thorp, L. Fekih-Ahmed, On voltage collapse in electric power systems, *IEEE Power Industry Computer Application Conference*, Seattle, WA, May 1989.
- [88] I. Dobson, Approximate decoupling of a condition for voltage collapse, *Proceedings of the 28th IEEE Conference on Decision and Control*, invited paper, Tampa, Florida, vol. 1, December, 1989, pp. 336-337.
- [89] I. Dobson, A first analysis of stability when a constraint on the system state is encountered, *International Symposium on Circuits and Systems*, Singapore, June 1991, pp. 1224-1227.
- [90] I. Dobson, L. Lu, Y. Hu, A direct method for computing a closest saddle node bifurcation in the load power parameter space of an electric power system, *International Symposium on Circuits and Systems*, Singapore, June 1991, pp. 3019-3022.
- [91] C.A. Canizares, F.L. Alvarado, C.L. DeMarco, I. Dobson, W.F. Long, Point of collapse methods applied to AC/DC power systems, paper 91 SM 491-1-PWRS, IEEE Power Engineering Society 1991 Summer Meeting, San Diego, CA, July 1991.
- [92] I. Dobson, L. Lu, Computing an optimum direction in control space to avoid saddle node bifurcation and voltage collapse in electric power systems, L.H. Fink ed., *Proceedings: Bulk power system voltage phenomena, voltage stability and security ECC/NSF workshop*, Deep Creek Lake, MD, August 1991, pp. 163-168.
- [93] J.H. Booske, R.F. Cooper, I. Dobson, L. McCaughan, Models of nonthermal effects on ionic mobility during microwave processing of crystalline solids, *Ceramic Transactions*, vol. 21, *Microwaves: Theory and applications in materials processing*, ISBN 0-944904-43-2 (American Ceramic Society, Westerville, OH, 1991), pp. 185-192.
- [94] I. Dobson, L. Lu, Immediate change in stability and voltage collapse when generator reactive power limits are encountered, L.H. Fink ed., *Proceedings: Bulk power system voltage phenomena, voltage stability and security ECC/NSF workshop*, Deep Creek Lake, MD, August 1991, pp. 65-73.
- [95] I. Dobson, L. Lu, Using an iterative method to compute a closest saddle node bifurcation in the load power parameter space of an electric power system, L.H. Fink ed., *Proceedings: Bulk power system voltage phenomena, voltage stability and security ECC/NSF workshop*, Deep Creek Lake, MD, August 1991, pp. 157-161.

- [96] I. Dobson, Power system instabilities, bifurcations and parameter space geometry, *EPRI/NSF Workshop on application of advanced mathematics to power systems, invited paper*, Redwood City, CA, Sept. 1991; appears in EPRI proceedings TR-101795, April 1993, pp 3-20–3-29.
- [97] G. Gray, D.C. Kammer, I. Dobson, Chaos in an attitude maneuver of a damped satellite due to time-periodic perturbations, AAS 92-171, AAS/AIAA Space Flight Mechanics Meeting, Colorado Springs, CO, February 1992.
- [98] I. Dobson, An iterative method to compute the closest saddle node or Hopf bifurcation instability in multidimensional parameter space, *invited paper, International Symposium on Circuits and Systems*, San Diego, CA, May 1992, pp. 2513-2516.
- [99] S.G. Jalali, I. Dobson, R.H. Lasseter, Instabilities due to bifurcation of switching times in a thyristor controlled reactor, *Power Electronics Specialists Conference*, Toledo, Spain, July 1992, pp. 546-552.
- [100] I. Dobson, L. Lu, New methods for computing a closest saddle node bifurcation and worst case load power margin for voltage collapse, 92 SM 587-6 PWRs, *IEEE PES Summer meeting*, Seattle, WA, July 1992.
- [101] I. Dobson, F.L. Alvarado, C.L. DeMarco, Sensitivity of Hopf bifurcations to power system parameters, *invited paper, 31st IEEE Conference on Decision and Control* Tucson, AZ, December 1992, pp. 2928-2933.
- [102] I. Dobson, S.G. Jalali, R. Rajaraman, Damping and resonance in a high power switching circuit, Institute for Math and its Applications workshop paper, Univ. of Minnesota, Minneapolis MN, March 1993.
- [103] T.J. Overbye, I. Dobson, C.L. DeMarco, Q-V Curve interpretations of energy measures for voltage security, 93 WM 184-2 PWRs, *IEEE PES Winter meeting*, Columbus OH, February 1993.
- [104] A. Mazzoleni, I. Dobson, Analytic methods for determining exact stability boundaries for flexible structures, *34th Structures, Structural Dynamics and Materials Conference*, La Jolla, CA, April 1993.
- [105] A. Mazzoleni, I. Dobson, Closest bifurcation analysis applied to design of flexible satellites, AAS/AIAA Space Flight Mechanics Conference, Pasadena, CA, Feb. 1993 (Paper AAS 93-123).
- [106] A. Mazzoleni, I. Dobson, A method for determining exact stability boundaries for flexible satellites with arbitrary position independent damping, AAS/AIAA Space Flight Mechanics Conference Pasadena, CA, Feb. 1993.
- [107] G. Gray, I. Dobson, D.C. Kammer, Detection of chaotic saddles in an attitude maneuver of a spacecraft containing a viscous damper, AAS/AIAA Space Flight Mechanics Conference Feb. 1993, Pasadena, CA.
- [108] R. Rajaraman, I. Dobson, S.G. Jalali, Nonlinear dynamics and switching time bifurcations of a thyristor controlled reactor, *IEEE International Symposium on Circuits and Systems*, Chicago, IL, May 1993, pp. 2180-2183.
- [109] I. Dobson, S.G. Jalali, Surprising simplification of the Jacobian of a switching circuit, *IEEE International Symposium on Circuits and Systems*, Chicago, IL, May 1993, pp. 2652-2655.

- [110] F.L. Alvarado, I. Dobson, Y. Hu, Computation of closest bifurcations in power systems, *IEEE PES Summer meeting*, Vancouver, Canada, July 1993.
- [111] S.G. Jalali, R.H. Lasseter, I. Dobson, Dynamic response of a thyristor controlled switched capacitor, *IEEE PES Winter meeting*, New York, February 1994.
- [112] I. Dobson, The irrelevance of load dynamics for the loading margin to voltage collapse and its sensitivities, Bulk power system voltage phenomena III, Voltage stability, security & control, ECC/NSF workshop, Davos, Switzerland, August 1994, pp. 509-518.
- [113] R. Rajaraman, I. Dobson, Damping and incremental energy in thyristor switching circuits, *invited paper, IEEE International Symposium on Circuits and Systems*, Seattle, Washington, May 1995, pp. 291-294.
- [114] G.A. Luckjiff, I. Dobson, D. Divan, Interpolative sigma delta modulators for high frequency power electronic applications, *Power Electronics Specialists Conference*, Atlanta, Georgia, June 1995, pp. 444-449.
- [115] R. Rajaraman, I. Dobson, R.H. Lasseter, Y. Shern, Computing the damping of subsynchronous oscillations due to a thyristor controlled series capacitor, paper 95SM403-6PWRD, *IEEE PES Summer meeting*, Portland, Oregon, July 1995.
- [116] R. Rajaraman, I. Dobson, Damping estimates of subsynchronous and power swing oscillations in power systems with thyristor switching devices, paper 96WM255-0-PWRS, *IEEE PES Winter meeting*, Baltimore, MD, January 1996.
- [117] S. Greene, I. Dobson, F.L. Alvarado, Sensitivity of the loading margin to voltage collapse with respect to arbitrary parameters, paper 96WM278-2-PWRS, *IEEE PES Winter meeting*, Baltimore, MD, January 1996.
- [118] S. Greene, I. Dobson, F.L. Alvarado, P.W. Sauer, Initial concepts for applying sensitivity to transfer capability, NSF Workshop on Available Transfer Capability, Urbana IL USA, June 1997.
- [119] S. Greene, I. Dobson, F.L. Alvarado, Contingency ranking for voltage collapse via sensitivities from a single nose curve, paper PE-707-PWRS-2-06-1997, *IEEE PES Summer meeting*, Berlin, Germany, July 1997.
- [120] I. Dobson, J. Zhang, S. Greene, H. Engdahl, P.W. Sauer, Is modal resonance a precursor to power system oscillations?, International symposium on Bulk power System Dynamics and Control-IV Restructuring, Santorini, Greece, August 1998, , pp. 659-673.
- [121] G.A. Luckjiff, I. Dobson, Power spectrum of a sigma-delta modulator with hexagonal vector quantization and constant input, *invited paper, IEEE International Symposium on Circuits and Systems*, Orlando, Florida, May 1999, vol. V, pp. 270-273.
- [122] B.A. Carreras, D.E. Newman, I. Dobson, A.B. Poole, Evidence for self organized criticality in electric power system blackouts, *Thirty-fourth Hawaii International Conference on System Sciences, Maui, Hawaii, January 2001*
- [123] I. Dobson, B.A. Carreras, V. Lynch, D.E. Newman, An initial model for complex dynamics in electric power system blackouts, *Thirty-fourth Hawaii International Conference on System Sciences, Maui, Hawaii, January 2001*

- [124] B.A. Carreras, V.E. Lynch, M.L. Sachtjen, I. Dobson, D.E. Newman, Modeling black-out dynamics in power transmission networks with simple structure, *Thirty-fourth Hawaii International Conference on System Sciences*, Maui, Hawaii, January 2001
- [125] J.G. Wohlbier, J.H. Booske, I. Dobson, New nonlinear multifrequency TWT model, 2nd IEEE International Vacuum Electronics Conference, Huis ter Duin, Noordwijk, Netherlands, April 2001.
- [126] I. Dobson, Strong resonance effects in normal form analysis and subsynchronous resonance, *Bulk Power System Dynamics and Control V*, August 2001, Onomichi, Japan.
- [127] I. Dobson, J. Chen, J.S. Thorp, B.A. Carreras, D.E. Newman, Examining criticality of blackouts in power system models with cascading events, *Thirty-fifth Hawaii International Conference on System Sciences*, Hawaii, January 2002.
- [128] B.A. Carreras, V.E. Lynch, I. Dobson, D.E. Newman, Dynamics, criticality and self-organization in a model for blackouts in power transmission systems, *Thirty-fifth Hawaii International Conference on System Sciences*, Hawaii, January 2002.
- [129] I. Dobson, D.E. Newman, B.A. Carreras, V. Lynch, An initial complex systems analysis of the risks of blackouts in power transmission systems, *Power Systems and Communications Infrastructures for the future*, Beijing, September 2002.
- [130] I. Dobson, B.A. Carreras, D.E. Newman, A probabilistic loading-dependent model of cascading failure and possible implications for blackouts, *Thirty-sixth Hawaii International Conference on System Sciences*, Hawaii, January 2003.
- [131] B.A. Carreras, V.E. Lynch, D.E. Newman, I. Dobson, Blackout mitigation assessment in power transmission systems, *Thirty-sixth Hawaii International Conference on System Sciences*, Hawaii, January 2003.
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