Charles David Brummitt

CONTACT INFORMATION

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CURRENT POSITION

Postdoctoral Research Fellow at Columbia University, funded by a James S. McDonnell Foundation *Postdoctoral Fellowship Award in Studying Complex Systems*

RESEARCH INTERESTS

Understanding complex systems and collective behavior—such as systemic risk, innovation, and economic development—using mathematical modeling, network science, data science, and machine learning

EDUCATION

University of California, Davis   **September 2009 – June 2014**
Ph.D. Applied Mathematics

- Thesis: Models of systemic events: interdependence, contagion, and innovation
- Adviser: Professor Raissa M. D'Souza

University of Wisconsin, Madison   **2005–2009**
B.S. Mathematics, B.S. Physics

- Thesis: A search for the simplest chaotic partial differential equation
- Adviser: Professor Julien Clinton Sprott

POSITIONS

James S. McDonnell Postdoctoral Research Fellow, Columbia University   **2014–2016**

Research Intern, Microsoft Research, New York City   **Summer 2013**

R&D Fellow, Wolfram Research, Inc.   **2009–present**

PUBLICATIONS

Charles D. Brummitt, George Barnett, and Raissa M. D'Souza. Coupled catastrophes: sudden shifts cascade and hop among interdependent systems. *Journal of The Royal Society Interface*, 12(112), 2015.

Charles D. Brummitt and Teruyoshi Kobayashi. Cascades in multiplex financial networks with debts of different seniority. *Physical Review E*, 91:062813, Jun 2015.

Charles D. Brummitt, Shirshendu Chatterjee, Partha S. Dey, and David Sivakoff. Jigsaw percolation: What social networks can collaboratively solve a puzzle? *Ann. Appl. Probab.*, 25(4):2013–2038, August 2015.

Kyu-Min Lee, **Charles D. Brummitt**, and K.-I. Goh. Threshold cascades with response heterogeneity in multiplex networks. *Physical Review E*, 90(6):062816, December 2014.

Charles D. Brummitt, Rajiv Sethi, and Duncan J. Watts. Inside money, procyclical leverage, and banking catastrophes. *PLoS ONE*, 9(8):e104219, August 2014.

Pierre-André Noël, **Charles D. Brummitt**, and Raissa M. D'Souza. Bottom-up model of self-organized criticality on networks. *Physical Review E*, 89:012807, January 2014.

Pierre-André Noël, **Charles D. Brummitt**, and Raissa M. D'Souza. Controlling self-organizing dynamics using models that self-organize. *Physical Review Letters*, 111(7):078701, August 2013.

Charles D. Brummitt, Paul D. H. Hines, Ian Dobson, Cristopher Moore, and Raissa M. D'Souza. Transdisciplinary electric power grid science. *Proc. Natl. Acad. Sci. U.S.A.*, 110(30):12159, July 2013.

Charles D. Brummitt and Eric Rowland. Boundary Growth in One-Dimensional Cellular Automata. *Complex Systems*, 21:85–116, September 2012.

Charles D. Brummitt, Kyu-Min Lee, and K.-I. Goh. Multiplexity-facilitated cascades in networks. *Physical Review E*, 85:045102(R), April 2012.

Charles D. Brummitt, Raissa M. D'Souza, and E. A. Leicht. Suppressing cascades of load in interdependent networks. *Proc. Natl. Acad. Sci. U.S.A.*, 109(12):E680–E689, February 2012.

Charles D. Brummitt and J. C. Sprott. A search for the simplest chaotic partial differential equation. *Physics Letters A*, 373(31):2717–2721, July 2009.

Charles D. Brummitt, Hannah Delventhal, and Michael Retzlaff. Packard snowflakes on the von Neumann neighborhood. *Journal of Cellular Automata*, 3(1):57–79, 2008.

BOOK CHAPTERS

Raissa M. D'Souza, **Charles D. Brummitt**, and E. A. Leicht. *Modeling Interdependent Networks as Random Graphs: Connectivity and Systemic Risk*, chapter 4, pages 73–94. Understanding Complex Systems. Springer, Heidelberg, 2014.

POSTDOCTORAL FELLOWSHIPS

James S. McDonnell Postdoctoral Fellowship in Studying Complex Systems **2014–2016**

GRADUATE FELLOWSHIPS

National Defense Science and Engineering Graduate Fellowship (NDSEG) **2011–2014**

National Science Foundation Graduate Research Fellowship (NSF GRF) **2011–2014**

GAANN Fellowship (Graduate Assistance in Areas of Financial Need) **2010–2011**

UC Davis Graduate Scholars Fellowship **2009–2010**

UC Davis Mathematics Department, NSF VIGRE Fellowship **2009–2010**

VISITING POSITIONS

Research Fellow at the Isaac Newton Institute for Mathematical Sciences, Cambridge University, at the program on Systemic Risk: Mathematical Modeling and Interdisciplinary Approaches (fall 2014)

National Science Foundation (NSF) East Asia & Pacific Summer Institute (EAPSI), a grant for research with Prof. Kwang-Il Goh at Korea University in Seoul, South Korea (summer 2011)

Visiting graduate student researcher at the 2010–11 Complex Networks Program at SAMSI in Research Triangle, NC (spring 2011)

GRADUATE HONORS AND AWARDS

Alice Leung Scholarship (UC Davis Mathematics Department), for excellence in mathematics, including research, scholarship and teaching (2013)

Nominated by the UC Davis Mathematics Department for the Division of Mathematical and Physical Sciences (MPS) Dean's Graduate Student Prize (2013)

Internship at Microsoft Research (New York City Lab), mentored by Dr. Duncan Watts (2013)

Santa Fe Institute's Complex Systems Summer School (2012)

VIGRE Math Department Travel Award, for CompleNet 2012: 3rd Workshop on Complex Networks

(2012)

Graduate Student Association Travel Award, for SAMSI Dynamics on Networks Workshop (2011)

Graduate Student Association Travel Award, for SAMSI Complex Networks Opening Workshop (2010)

VIGRE Math Department Travel Award, for SAMSI Complex Networks Opening Workshop (2010)

Department of Energy Office of Science Graduate Fellowship, Finalist (2010)

UNDERGRADUATE HONORS AND AWARDS

Phi Kappa Phi Award of Excellence (2009, $2,000), a national fellowship for students entering graduate school

Phi Beta Kappa and Phi Kappa Phi (2009), UW-Madison

UW-Madison Book Store Academic Excellence Award (2009, $1,000), for an outstanding senior thesis

Hilldale Scholarship (2008–2009, $5,000), funding for a senior thesis with UW-Madison Physics Professor J. C. Sprott

Frank Cady Scholarship (2009, $1,000), for outstanding UW-Madison mathematics majors

Albert Augustus Radtke Scholarship (2008, $450), for outstanding UW-Madison physics majors

R. Creighton Buck Prize (2007, $450), for unusual creativity in mathematics, the highest honor given to undergraduates in the UW-Madison Mathematics Dept. in acknowledgment of talent

Dean's list, UW-Madison (2005, 2006, 2007, 2008, 2009)

IAP Merit Scholarship (2007, $1,000), to help fund a semester studying abroad in Granada, Spain

Honors Program Summer Apprenticeship (2006, $1,500), funding for research with UW-Madison Physics Professor J. C. Sprott

Wisconsin Academic Excellence Award (2005–2009, $9,000), funding for undergraduate study at UW-Madison

PRESENTATIONS

[Talk] Contagious unreliability and complexity traps in economic development. Seminar at the Network Science Center at West Point. January 27, 2016.

[Talk] Fragility, unreliability, and economic development. Seminar at the Center for International Development, Harvard University, November 9, 2015.

[Poster] Jigsaw percolation: What social networks can collaboratively solve a puzzle?. *Granada Seminar: Physics Meetings Social Sciences*, Granada, Spain, June 15–19, 2015.

[Poster] Coupled catastrophes: Sudden shifts cascade and hop among interdependent systems. *Netsci*, Zaragoza, Spain, June 1–5, 2015.

[Talk] Risk and contagion: Controlling self-organized criticality and contagious sudden changes. Seminar at the Chair of Systems Design (hosted by Frank Schweitzer), ETH Zürich, October 27, 2014

[Talk] Regime shifts in financial crises and in coupled systems
  - Seminar at *University College London, Financial Computing and Analytics group*, December 3, 2014

- Seminar at *INET Oxford*, September 18, 2014

[Talk] Challenges in modeling systemic risk in financial networks, *NetSci*, June 4–6, 2014, Berkeley, CA

[Talk] Inside money and procyclical leverage in a simple model of a banking crisis.
- Invited speaker, *Information and Fragility in Networks Conference*, Boulder, CO, November 15, 2013.
- *Institute for New Economic Thinking (INET) Young Scholars Initiative (YSI) Workshop*, Toronto, Ontario, April 8–9, 2014

[Talk] Controlling risk, the importance of costs, and multitype branching processes for power flow. Invited speaker (with Pierre-Andrè Noël), *Rethinking Network Science and Modeling for Critical Infrastructure Protection, Analysis, and Development*, SFI and MITRE. September 9–12, 2013.

[Talk] Jigsaw percolation. *Statistical Physics group, Korea University*, August 22, 2012.

[Talk] Optimal interdependence among power grids. Invited speaker (with Raissa D'Souza) at the workshop *Power Grids As Complex Networks*, Santa Fe Institute, May 17–19, 2012.

[Talk] Suppressing cascades of load in interdependent networks. *UC Davis Interdisciplinary Graduate and Professional Symposium*, April 27, 2012.

[Talk] Threshold cascades for marketing. *Universal McCann* (marketing agency), San Francisco. March 29, 2012.

[Poster] Multiplexity-facilitated cascades in networks. *CompleNet 2012: 3rd Annual Workshop on Complex Networks* (Melbourne, FL), March 7–9, 2012. *Davis SIAM Student Research Conference* (Davis, CA), May 12, 2012. Joint work with K.-M. Lee and K.-I. Goh (Korea University).

[Talk] Suppressing cascades of load in interdependent networks.
- UC Davis Interdisciplinary Graduate and Professional Symposium, April 27, 2012.
- Korea Advanced Institute of Science and Technology (KAIST), July 19, 2011.
- Korea University, Statistical Physics Group, July 13, 2011.
- Korea Institute for Advanced Studies, Statistical Physics Seminar, June 24, 2011.
- Seoul National University, Dept. of Physics, June 23, 2011.

[Talk] Sandpile cascades on interacting tree-like networks. Invited speaker at *Dynamics on Networks Workshop, SAMSI*, March 21, 2011.

[Talk] Sandpile cascades on interacting tree-like networks. *Dynamics on Networks Working Group, SAMSI*, October 5, 2010.

[Poster] Cascades on interacting networks. *SAMSI Complex Networks Opening Workshop*, August 2010. With Prof. Raissa D'Souza.

[Talk] Inferring network topology from symbolic dynamics. Dynamics of Learning Research Group, Complexity Sciences Center, UC Davis, July 7, 2010.

[Talk] Synchronization, cascades and games in interacting networks. Invited participant in the Workshop on Emergent Properties and Resilience of Interacting Networks, Santa Fe Institute, June 2010.

[Talk] Two computational methods to detect flaws in industrial parts. *Mathematical Problems in Industry Workshop*, RPI, June 2010. (I presented to the workshop the results of a group of six students, two post-docs and a professor on a problem posed by General Electric.)

[Poster] On the evolution of foresight and strategic teaching. *Davis SIAM Conference*, May 8, 2010. With Prof. Burkhard C. Schipper.

[Talk] A search for the simplest chaotic partial differential equation. *Chaos and Complex Systems Seminar*, UW-Madison Dept. of Physics, April 7, 2009.

SELECTED COURSEWORK

Graduate: Network Theory and Applications, Probability Theory, Combinatorics, Graph Theory, Game Theory, Natural Computation and Self-Organization, Nonlinear Physics: Modeling Chaos and Complexity, Mathematical Biology, Dynamical Systems, Applied Asymptotic Analysis, Computational Understanding of Biological Networks, Compressed Sensing, Numerical Methods, Numerical Solutions of PDEs, Analysis

Audited classes post-candidacy: Econophysics (John Rundle, UC Davis), Principles of Economics for Scientists (Antonio Rangel, Caltech, via Coursera), Information and Visualization (Katy Börner, U Indiana, via an IU MOOC), Model Thinking (Scott Page, U Michigan, via Coursera), Money and Banking (Perry Mehrling, Barnard, via Coursera), The Power of Macroeconomics: Economic Principles in the Real World (Peter Navarro, UC Irvine, via Coursera), Convex Optimization (Stephen Boyd, Stanford), Game Theory II: Advanced Applications (Matthew Jackson, Kevin Leyton-Brown, Yoav Shoham, via Coursera), Financial Markets (Robert Shiller, Yale, via Coursera), Machine Learning (Andrew Ng, Stanford, via Coursera), Bitcoin and Cryptocurrency Technologies (Arvind Narayanan, Princeton, via Coursera), Design of Computer Programs (Peter Norvig, Udacity CS 212), Startup Engineering (Balaji Srinivasan, Stanford, via Coursera), Statistical Learning (Trevor Hastie and Rob Tibshirani, Stanford Online), Hadoop Fundamentals I (IBM's Big Data University), Analytics Edge (MIT edX), Deep Learning (Udacity/Google)

Undergraduate: Stochastic Processes, Probability, Combinatorics, Statistical Mechanics, Theoretical Computer Science, Artificial Intelligence, Cellular Automata, Dynamical Systems and Chaos

PROFESSIONAL EXPERIENCE

Wolfram Research, Inc., Champaign, Illinois

R&D Fellow   **2009 – present**
Develop and review mathematics, physics and computer science content for Wolfram Alpha

R&D Intern   **Summer 2009**
Developed content for Wolfram Alpha on nonlinear maps (logistic, Hénon)

ACADEMIC SERVICE

Outreach
Designed and led a two-hour lecture, discussion and problem-solving session with Sacramento-area students ranging from 5th grade to high school at the UC Davis *Math Circle*   **2014**

Student government and representation

Student representative in the Graduate Group in Applied Math (GGAM) Exec. Comte. **2012–2013**

Graduate Student Association Representative for the math grad students 2010–2011

Responsible Conduct of Research

Research Ethics Certification, UC Davis 2011

Tutor

Volunteer tutor at Women's Center *Math Cafe*, which focuses on women and minorities 2010–2011

Academic Coach in TRIO, a federal program supporting disadvantaged students **Fall 2008**

Calculus tutor in the UW-Madison Mathematics Dept. **Spring 2008**

Volunteer tutor of math & physics for UW Greater University Tutor Service 2006–2007

Referee

Referee for Science Advances, Physical Review Letters, Physical Review E, Journal of Complex Networks, PLoS ONE, Scientific Reports, Journal of Statistical Mechanics, Physics Letters A, Mathematical Geosciences

Reviewed a chapter in the book Critical Information Infrastructure Protection and Resilience in the ICT Sector (ISI Global, 2012)

Member of the international program committee for the SESAME satellite workshop (using complex networks to study electrical grids) of CRITIS'12 (critical information infrastructures security)

Reviewed articles for the undergraduate science journal at UW-Madison 2006–2008

Leadership

President of the University of Wisconsin Cycling Club, a nationally-competitive 2008–2009
racing team. Increased membership by 25% to over 100 members, negotiated with sponsors

National Outdoor Leadership School, thirty-day trip in the Wind River Range, WY **2005**

<small>RESEARCH AND STUDY ABROAD</small>

National Science Foundation (NSF) East Asia and Pacific Summer Institutes for Graduate Students (EAPSI)

Collaborated in the statistical physics lab of Dr. Kwang-Il Goh at Korea U., Seoul **Summer 2011**

Published paper in *Physical Review E* with Kyu-Min Lee and Kwang-Il Goh **March 2012**

Returned to continue the collaboration and to finish a second paper **August 2012**

Centro Internacional de Educación Superior (CEGRI), Granada, Spain **Fall 2008**

Lived with a Spanish host family and took college classes in Spanish

Received the UW-Madison International Academic Program (IAP) Merit Scholarship

<small>WORKSHOPS</small>

Ecology of Poverty, Marseille, France **June 2015**

Ecology of Poverty, Paris, France **November 2014**

Defense Threat Reduction Agency (DTRA) Grant Review, Springfield, VA **July 2012**

Presented a poster on jigsaw percolation

Optimization and Control for Smart Grids, Los Alamos National Laboratory, NM **May 2012**

Power grids as complex networks, Santa Fe Institute, Santa Fe, NM **May 2012**

Gave an invited talk on optimal interconnectivity in networks

CompleNet 2012: 3rd Annual Workshop on Complex Networks, Florida Inst. Tech. **March 2012**

Presented a poster on threshold cascades in multiplex networks

Dynamics on Networks Workshop, SAMSI, Research Triangle, NC **March 2011**

Invited speaker

Complex Networks Opening Workshop, SAMSI, Research Triangle, NC   **August 2010**
    Presented a poster with preliminary results on cascades in interacting networks

Interacting Networks Workshop, The Santa Fe Institute, Santa Fe, NM   **June 2010**
    Gave a talk on synchronization, cascades and game theory in networks

Mathematical Problems in Industry Workshop, RPI, Troy, NY   **June 2010**
    Applied 3D curvelet transforms to detect defects in metallic parts for General Electric;
    Presented the group's results in a talk

Graduate Student Mathematical Modeling Camp, RPI, Troy, NY   **June 2010**
    Analyzed bifurcations in the Tero model of the nutrient transport network of the slime
    Physarum polycephalum

NKS Summer School, Pisa, Italy   **July 2009**
    Studied the boundaries of one-dimensional cellular automata (published in Complex Systems, 2012)

Programming

Mathematica and Wolfram Language (expert), Python (proficient), R (proficient), Git (intermediate), SQL (basic), Hadoop (basic), Java and C++ (basic)

Languages

English, Spanish

References

Prof. Raissa M. D'Souza
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University of California
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Dr. Duncan J. Watts
Principal Research Scientist
Microsoft Research
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Prof. Kwang-Il Goh
Dept. of Physics
Korea University
Seoul 136-713, Korea
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Prof. James P. Crutchfield
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University of California
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Prof. Burkhard C. Schipper
Dept. of Economics
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Prof. David Griffeath
Dept. of Mathematics
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Prof. Julien Clinton Sprott
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