

KYLE BRADBURY

CONTACT INFORMATION

Duke University Energy Initiative
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CITIZENSHIP

United States of America

RESEARCH INTERESTS

I develop, apply, and communicate the science of machine learning and data mining techniques to better manage scarce energy resources. Using data science tools, I work to solve energy systems problems that lead to a more efficient, reliable, and clean energy system. My current research projects include estimating energy resources, infrastructure, and access in developed and developing countries using remote sensing data; increasing building energy consumption efficiency and automation in buildings using smart meter data; and integrating intermittent wind and solar power into the grid through geospatial diversity and energy storage technologies.

EDUCATION

PhD | Duke University, Durham, NC | May 2013

Area of Study: Energy Systems Modeling, Division of Earth and Ocean Sciences

Advisor: Lincoln F. Pratson

Research: Generation adequacy in grid-connected sustainable energy systems, and the statistical modeling and comparison of enabling technologies including energy storage systems and conventional generation.

M.S. | Duke University, Durham, NC | December 2008

Area of Study: Electrical & Computer Engineering: Signal Processing & Machine Learning

Advisor: Leslie M. Collins

Research: Machine learning algorithm development for landmine detection using ground penetrating radar systems

B.S.E.E. | Tufts University, Medford, MA | May 2007, *Summa cum laude*

Area of Study: Electrical & Computer Engineering

Advisor: Joseph P. Noonan

Research: Image-based anomaly detection and secure communication systems

EXPERIENCE

Managing Director, Energy Data Analytics Lab

January 2015 – present

Lecturing Fellow in the Duke University Energy Initiative

July 2016 – present

Lecturing Fellow in Electrical and Computer Engineering

September 2016 – present

Duke University Energy Initiative, Duke University

- Develop and apply data science techniques to solve diverse energy systems problems using datasets including remotely sensed earth observations and smart meter data
- Teach and mentor students across disciplines in energy data science tools and research best practices through the Bass Connections, Data+ programs
- Co-develop and manage a new interdisciplinary research lab and research team

Postdoctoral Energy Fellow

February 2013 – December 2014

Duke University Energy Initiative, Duke University

- Developed and administered, with the guidance of senior faculty and administration, the interdisciplinary, team-based educational program, Bass Connections in Energy
- Designed and led student-based research teams analyzing smart electric utility meter data using energy disaggregation algorithms to obtaining device-level energy insight

Business Architecture & Technology Intern

Summer 2011

ISO New England, Holyoke, MA

- Conducted a reliability assessment of power outage events for the United States
- Created a framework for jointly evaluating power system reliability and survivability

Electrical Engineering Intern

Summer 2006

MIT Lincoln Laboratory, Lexington, MA

Implemented a custom timing generator circuit for the Radar Open System Architecture on a field-programmable gate array (FPGA).

Electrical and Mechanical Intern

Summers 2004 & 2005

Dominion Energy New England, Summer 2005

National Energy and Gas Transmission, Summer 2004

Brayton Point Station, Somerset, MA (1600 MW coal, oil, and natural gas-fired plant)

- Implemented a preventive maintenance program for the coal pulverization system
- Assessed startup processes of plant generation units, plant safety, and oil analyses

PUBLICATIONS

Bradbury, K., R. Saboo, T. Johnson, J. Malof, W. Zhang, A. Devarajan, L. Collins, and R. Newell (2016). "Distributed Solar Photovoltaic Array Location and Extent Dataset for Remote Sensing Object Identification." *Scientific Data*, 3. doi:10.1038/sdata.2016.106.

Malof, J., K. Bradbury, L. Collins, and R. Newell (2016). "Automatic detection of solar photovoltaic arrays in high resolution aerial imagery," *Applied Energy*, 183, 229-240.

Bradbury, K., L. Pratson, and D. Patiño-Echeverri (2014). "Economic viability of energy storage systems based on price arbitrage potential in real-time US electricity markets," *Applied Energy*, vol. 114, pp. 512–519.

Bradbury, K. (2013). "The Potential of Energy Storage Systems with Respect to Generation Adequacy and Economic Viability". Duke University, Dissertation.

CONFERENCE PUBLICATIONS

Qian, S., S. Chelikani, P. Wang, L. Collins, K. Bradbury, and J. Malof. "Trading spatial resolution for improved accuracy when using detection algorithms on remote sensing imagery." In 2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS). Fort Worth, TX, 2017. *To be presented*.

Malof, J., L. Collins, and K. Bradbury. "A deep convolutional neural network, with pre-training, for solar photovoltaic array detection in aerial imagery." In 2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS). Fort Worth, TX, 2017. *To be presented*.

So, B., C. Nezin, V. Kaimal, S. Keene, L. Collins, [K. Bradbury](#), and J. Malof. "Estimating the electricity generation capacity of solar photovoltaic arrays using only color aerial imagery." In 2017 IEEE International Geoscience and Remote Sensing Symposium (IGARSS). Fort Worth, TX, July 2017. *To be presented*.

Malof, J., L. Collins, [K. Bradbury](#), and R. Newell. "A Deep Convolutional Neural Network and a Random Forest Classifier for Solar Photovoltaic Array Detection in Aerial Imagery." In 2016 IEEE International Conference on Renewable Energy Research and Applications (ICRERA), 2016, pp. 650–54. doi:10.1109/ICRERA.2016.7884415.

Malof, J., [K. Bradbury](#), L. Collins, R. Newell, A. Serrano, H. Wu, and S. Keene. "Image Features for Pixel-Wise Detection of Solar Photovoltaic Arrays in Aerial Imagery Using a Random Forest Classifier." In 2016 IEEE International Conference on Renewable Energy Research and Applications (ICRERA), 2016, pp. 799–803. doi:10.1109/ICRERA.2016.7884446.

Malof, J., R. Hou, L. Collins, [K. Bradbury](#), and R. Newell. "Automatic solar photovoltaic panel detection in satellite imagery." In 2015 International Conference on Renewable Energy Research and Applications (ICRERA), 2015, pp. 1428–1431.

Czarnek, N., K. Morton, L. Collins, R. Newell, and [K. Bradbury](#). "Performance Comparison Framework for Energy Disaggregation Systems." In 2015 IEEE International Conference on Smart Grid Communications (SmartGridComm), 2015, pp. 446–452.

[Bradbury, K.](#), P. Torrione, and L. Collins. "Real-time Gaussian Markov random-field-based ground tracking for ground penetrating radar data." In Proceedings of SPIE, Orlando, FL, USA, 2009, Vol. 7303, pp. 730320–730320-10.

[Bradbury, K.](#) and J. Noonan. "Covert Binary Communications through the Application of Chaos Theory: Three Novel Approaches," Journal of Systemics, Cybernetics and Informatics, 2008, Vol. 6, No. 3, pp. 28-33.

WHITE PAPERS

Knox, M., [K. Bradbury](#), L. Collins, and R. Newell. "NILM system performance over a range of low frequency sampling rates." 2016.

[Bradbury, K.](#), M. Knox, L. Collins, and R. Newell. "Generating Synthetic Device-level Electricity Consumption Data." 2016.

Lin, M, [K. Bradbury](#), and R. Newell. "Energy Saving Control Strategies for Conventional Domestic Water Heaters." Final Report to Sunnovations, Inc., 2016.

Xu, F., [K. Bradbury](#), and D. Patino-Echeverri. "Techniques for Measuring the Green Economy." Final Report to Hawaii's Department of Business, Economic Development and Tourism, 2015.

[Bradbury, K.](#) "Energy Storage Technology Review." 2010.

[Bradbury, K.](#) "Hidden Markov Models: Theory, Implementation, and Extensions," 2007.

OTHER PRESENTATIONS

"Public Sector Building Energy Efficiency: Maybe There is a Silver Bullet." Panel Presentation with H. Bergmann and D. Seligman. U.S. Department of Energy Better Buildings Summit. Washington, D.C., 17 May 2017.

"From Pixels to Knowledge: Using Machine Learning to Extract Insights from Energy Data." Analytics Experience 2016. SAS. Las Vegas, NV. 14 September 2016.

"Energy Storage and the Grid: Prospects and Policy." Panel Presentation with M. Dorsey, S. Ackerman, V. Koritarov, and C. Hunt. American Chemical Society Science & the Congress Project. Washington, D.C. 28 June 2016.

"From Pixels to Knowledge: Extracting Insights from Energy Data through Visualization." Duke Visualization Friday Forum. Duke University. 15 April 2016.

"New Research in Predictive Analytics for Utilities." Panel presentation with Arcot Rajasekar, Tim Driscoll, Ozge Kaplan, and Rudy Shankar. North Carolina Clean Tech Summit. Chapel Hill, NC. 19 February 2016.

"Overview of the Energy Data Analytics Lab." Energy Research Collaboration Workshop. Duke University, Durham, NC. 5 May 2015.

"Big Data & Analytics." Panel presentation with Marco Loeffke and Jack Connell. 2015 State Energy Conference. Raleigh, NC. 21-22 April 2015.

"Using Data to Change Behavior." Data4Decisions Conference. Panel presentation with Vikram Rao and Timur Hicyilmaz. Raleigh, NC. 25 March 2015.

"Design and Implementation of an Energy Data Analysis System." Energy and Environment Lunch and Learn, RTI International, 21 August 2014.

"Electric Power Systems." Energy Industry Fundamentals Conference, Fuqua School of Business, Duke University, 28 August 2014.

"Design and Implementation of an Energy Data Analysis System." Duke University Energy Research Collaboration Workshop, Duke University, 6 May 2014.

"Electric Power Markets." Energy Industry Fundamentals Conference, Fuqua School of Business, Duke University, 30 August 2013.

"The University as an Energy Laboratory: Design and Implementation of an Energy Disaggregation System." Duke University Energy Researcher Workshop, Duke University, 30 August 2013.

DATASETS

[Bradbury, K.](#), B. Brigman, L. Collins, T. Johnson, S. Lin, R. Newell, S. Park, S. Suresh, H. Wiesner, and Y. Xi. "Aerial imagery object identification dataset for building and road detection, and building height estimation." figshare, 2016.
<https://dx.doi.org/10.6084/m9.figshare.c.3290519.v1>

[Bradbury, K.](#), R. Saboo, T. Johnson, J. Malof, A. Devarajan, W. Zhang, L. Collins, R. Newell. "Distributed Solar Photovoltaic Array Location and Extent Data Set for Remote Sensing Object Identification." figshare, 2016. <https://dx.doi.org/10.6084/m9.figshare.c.3255643.v1>

TEACHING EXPERIENCE

Instructor: ENERGY 396/796, Energy Data Analytics Lab, Duke University, S2017
Instructor: ENERGY 395/795, Energy Data Analytics Lab, Duke University, F2016
Instructor: ENERGY 396/796, Energy Data Analytics Lab, Duke University, S2016
Instructor: ENERGY 395/795, Energy Data Analytics Lab, Duke University, F2015
Instructor: ENERGY 396/796, Smart Grid Data Analytics, Duke University, S2015

Instructor: ENERGY 395/795, Smart Grid Data Analytics, Duke University, F2014
Instructor: ENERGY 396/596, Energy Disaggregation System Design, Duke University, S2014
Instructor: ENERGY 395/595, Energy Disaggregation System Design, Duke University, F2013
Teaching Assistant: ENV 211, Energy & the Environment, Duke University, S2011
Teaching Assistant: ENV 130, Energy & the Environment, Duke University, F2010
Lecture series (12 sessions) on Electric Power Systems, Duke University, S2010
Teaching Assistant: ENV 298.19, Hydrocarbons, Houston, Duke University, F2010
Teaching Assistant: ENV 298.19, Hydrocarbons, Houston, Duke University, F2009
Sustainable Energy Fellowship Coordinator, University of Michigan, June 2009
Tutor: ES 3, Introduction to Electrical Systems, F2006-S2007
Teaching Assistant: EE 14, Microprocessor Architecture, Tufts University, F2006

MENTORING

Data+ Advisor. Electricity Access in Developing Countries from Aerial Imagery. 2017.
Undergraduate Thesis Co-advisor (Sophia Park) Spring 2016-Spring 2017
Pratt Fellows Co-advisor Spring 2016-Spring 2017
Innovations & Entrepreneurship Undergraduate Certificate Program. Fall 2016-Spring 2017
Data+ Advisor. Energy Resource Assessment. 2016.
Data+ Advisor. Solar Power Estimation. 2015.

INSTITUTIONAL SERVICE

Interdisciplinary Data Science Master's curriculum development committee. 2017-Present
Carbon Offsets Subcommittee. Fall 2016 - Present
The Foundry Governing Committee. Spring 2015 - Present
Smart Home Governing Board. Spring 2014 - Present

PROFESSIONAL SERVICE

Member, Technical Program Committee and Session Chair. NILM2016: 3rd International Workshop on Non-Intrusive Load Monitoring. 2016.
Member, Technical Review Committee. Department of Energy's (DOE's) Energy Policy and Systems Analysis (EPSA) project with Oak Ridge National Laboratory (ORNL) on Solar Photovoltaic Detection. 2016.
Member, Technical Review Committee. 2015 IEEE International Conference on Smart Grid Communications (SmartGridComm), Miami, Fl. 2015.
Referee for: Environmental Science & Technology; Alfred P. Sloan Foundation; Energy & Buildings; Energy Policy; Energies; International Multi-Conference on Complexity, Informatics and Cybernetics; International Workshop on Non-Intrusive Load Monitoring.

AWARDS

Duke University Blue Devil of the Week, 2014
Nomination: Outstanding Postdoc at Duke University, 2013
Estwing Award: Teaching Assistant of the Year, 2011
[National Science Foundation, Graduate Research Fellowship, 2008](#)
Tufts University: Class of 1947 Victor Prather Prize, 2007
Tufts University: The Harry Poole Burden Prize in Electrical Engineering, 2007
Astronaut Scholarship Foundation Award, 2006
Tau Beta Pi Scholarship, 2006

GRANTS

Nicholas Institute Catalyst Program Grant, "Does rural energy access promote economic development through improved food and water access?" With Marc Jeuland, Mark Borsuk, Leslie Collins, Jordan Malof, and Lydia Olander. 2017.

Bass Connections Course Development Grant, "Introductory Machine Learning for Data Science." With Leslie Collins. 2017.

NVIDIA Hardware Grant. Hardware: Titan X GPU. NVIDIA Corporation. 2016.

Alfred P. Sloan Foundation. Energy Data Analytics Lab. With Richard Newell and Matthew Harding. 2015-2017.

Sunnovations, Inc. Sponsored Research Agreement. With Richard Newell. 2015-2016.

Wells Fargo Foundation. Advanced Analytics for Smart Meter Building Data. With Richard Newell. 2015-2016.

Lord Foundation of North Carolina. Energy Disaggregation and Signal Processing: Connecting Fundamental Concepts to Real Problems. With Lisa Huettel. 2014.

National Science Foundation Graduate Research Fellowship. 2008-2012.

PROFESSIONAL MEMBERSHIPS

Eta Kappa Nu, Electrical and Computer Engineering Honor Society (2006-Present)

Tau Beta Pi, Engineering Honor Society (2005-Present)

IEEE, Member (2005-Present), Power and Energy Society (2008-Present)

MEDIA COVERAGE

Bradbury, K., (2016, October 11). Reddit American Chemical Society 'Ask Me Anything' on Energy Storage and Energy Data Analytics.

<https://www.reddit.com/r/science/comments/56xpas/>

Kingery, K., (2016, October 5). "Engineers seek energy insights by reading a building's electrical signatures." Available at: <https://techxplore.com/news/2016-10-energy-insights-electrical-signatures.html>

Kingery, K., (2016, August 29). "Distinguishing Solar Panels from Swimming Pools." Available at: <http://pratt.duke.edu/about/news/distinguishing-solar-panels-swimming-pools>

"Home Energy Use," (2015, January 25). Podcast Interview with Brian Southwell and Mike Gallaher. *The Measure of Everyday Life*. WNCU 90.7 FM. Available on iTunes at: <https://itunes.apple.com/us/podcast/the-measure-of-everyday-life/id956844695>