

Heather Zinn Brooks



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RESEARCH INTERESTS

Applied mathematics, mathematical modeling, complex systems, nonlinear dynamics, network theory, social systems, mathematical biology

ACADEMIC POSITIONS

Harvey Mudd College
Assistant Professor 2020 – present
Department of Mathematics

University of California, Los Angeles
CAM Assistant Professor (postdoctoral position) 2018 – 2020
Department of Mathematics
Mentor: Mason Porter

EDUCATION

University of Utah 2018
Ph.D., Mathematics
Concentration: Mathematical Biology
Advisor: Paul Bressloff
Dissertation: Dynamics and structure: from microtubule networks to population networks

B.S., Applied Mathematics 2012
Advisor: Alla Borisyyuk
Project: Influence of intrinsic and synaptic properties on transmission of spike timing precision
Undergraduate Research Scholar
College of Science Research Award finalist

PEER-REVIEWED PUBLICATIONS

HZB and Mason A. Porter: Modeling the influence of media on opinion dynamics in social networks. *Physical Review Research*, 2(2):023041, 2020.

Shelby N. Wilson, Suzanne S. Sindi, HZB, Maryann E. Hohn, Candice R. Price, Ami E. Radunskaya, Nakeya D. Williams, and Nina H. Fefferman: How emergent social patterns in allogrooming combat parasitic infections. *Frontiers in Ecology and Evolution*, 8:54, 2020.

Sam R. Carroll, HZB, and Paul C. Bressloff: Bifurcation analysis of pattern formation in a two-dimensional hybrid reaction-transport model. *Physica D: Nonlinear Phenomena*, 402:132274, 2020.

HZB, Maryann E. Hohn, Candice R. Price, Ami E. Radunskaya, Suzanne S. Sindi, Nakeya D. Williams, Shelby N. Wilson, and Nina H. Fefferman: Mathematical analysis of the impact of social structure on ectoparasite load in allogrooming populations, in *Understanding Complex Biological Systems in Mathematics*, Springer (2018), pp. 47–62.

Nakeya D. Williams, [H2B](#), Maryann E. Hohn, Candice R. Price, Ami E. Radunskaya, Suzanne S. Sindi, Shelby N. Wilson, and Nina H. Fefferman: How disease risks can impact the evolution of social behaviors and emergent population organization, in *Understanding Complex Biological Systems in Mathematics*, Springer (2018), pp. 31–46.

[H2B](#) and Paul C. Bressloff: Turing mechanism for homeostatic control of synaptic density during *C. elegans* growth. *Physical Review E*, 96(1):012413, 2017.

[H2B](#) and Paul C. Bressloff: A mechanism for Turing pattern formation with active and passive transport. *SIAM Journal on Applied Dynamical Systems* 15(4):1823–1843, 2016.

Sean D. Lawley, Marie Tuft, and [H2B](#): Coarse-graining intermittent intracellular transport: two and three-dimensional models. *Physical Review E*, 92(4):042709, 2015.

[H2B](#) and Paul C. Bressloff: Quasicycles in the stochastic hybrid Morris–Lecar neural model. *Physical Review E*, 92(1):012704, 2015.

PAPERS IN PREPARATION

Zehan Chao, Zheyuan Cui, Avery Edson, Cesar Guajardo, Yihuan Huang, Xingjia Wang, Zhanyuan Yin, [H2B](#), P. Jeffrey Brantingham, and Andrea Bertozzi: Evaluating effectiveness of the Gang Reduction and Youth Development program with dynamic mode decomposition and machine learning techniques.

PRESS & OUTREACH WRITING

[H2B](#), Unchitta Kanjanasaratool, Yacoub H. Kureh, and Mason A. Porter: Disease detectives: using mathematics to forecast the spread of infectious diseases. *SocArXiv*, doi:10.31235/osf.io/mvn9z, 2020.

Research on media influence in social networks featured in *SIAM News* (May 22, 2019), “*The Power of Persuasion: Media’s Impact on the Opinion Dynamics of Online Social Networks*”.

INVITED SEMINARS

Continuous-time opinion formation on graphs
University of Houston, Networks Seminar
Houston, TX
February 2020

Influence of media on opinion dynamics in social networks
Tulane University, Probability Seminar
New Orleans, LA
October 2019

Influence of media on opinion dynamics in social networks
Caltech, Computational Math + X Seminar
Pasadena, CA
April 2019

Turing mechanism for homeostatic control of synaptic density during C. elegans growth
Claremont Colleges, Applied Math Seminar
Claremont, CA
November 2018

Pattern formation mechanism for homeostatic control of synapse density during C. elegans growth
Brigham Young University, Applied PDEs Seminar
Provo, UT
February 2018

Mathematical modeling of transport processes in cell biology
 University of California Los Angeles, Biophysics Seminar
 Los Angeles, CA

October 2017

How movement creates pattern: Turing mechanisms for intracellular transport
 Howard Hughes Medical Institute Summer Research Program
 Claremont, CA

July 2017

**INVITED
 CONFERENCE
 TALKS**

Continuous-time opinion formation on graphs
 Society for Industrial and Applied Math, Analysis of PDEs
 Mean-field Models for Large Interacting Agent Systems
 La Quinta, CA

December 2019

Turing mechanism for homeostatic control of synaptic density during C. elegans growth
 American Mathematical Society, Western Sectional Meeting
 Mathematical Biology: Multi-Scale Modeling of Complex Biological Systems
 Riverside, CA

November 2019

Influence of media on opinion dynamics in social networks
 Society for Industrial and Applied Math, Dynamical Systems
 Dynamics in Democracy
 Snowbird, UT

May 2019

Parasites and the evolution of sociality: How social complexity and grooming efficiency affect the selective pressures on group organization
 Association for Women in Mathematics Research Symposium
 Advances in Mathematical Biology
 Houston, TX

April 2019

Parasites and the evolution of sociality: how social complexity and grooming efficiency affect the selective pressures on group organization
 American Mathematical Society, Joint Math Meetings
 Agent-Based Modeling in Biological and Social Systems
 Baltimore, MD

January 2019

Pattern formation mechanism for homeostatic control of synapse density during C. elegans growth
 Society for Industrial and Applied Math, Life Sciences
 Modeling Cell Motility and Cytoskeleton Interactions
 Minneapolis, MN

August 2018

Quasicycles in the stochastic hybrid Morris-Lecar neural model
 Mathematical Association of America, MathFest
 Modeling Biological Rhythms
 Denver, CO

August 2018

Pattern formation mechanism for homeostatic control of synapse density during C. elegans growth
 Society for Industrial and Applied Math, Annual Meeting
 Workshop Celebrating Diversity: Nonlinear Dynamics and Complex Systems
 Portland, OR

July 2018

Pattern formation mechanism for homeostatic control of synapse density during C. elegans growth
 Society for Industrial and Applied Math, Nonlinear Waves and Coherent Structures
 Spatial Dynamics: Local and Global Results June 2018
 Anaheim, CA

Pattern formation mechanism for homeostatic control of synapse density during C. elegans growth
 Joint Mathematics Meeting January 2018
 Modeling Disease and Biological Processes
 San Diego, CA

Turing mechanism for homeostatic control of synaptic density during C. elegans growth
 Society for Mathematical Biology July 2017
 Salt Lake City, UT

Quasicycles in the stochastic hybrid Morris–Lecar neural model
 Organization for Computational Neuroscience July 2015
 Stochastic Neural Dynamics Workshop
 Prague, Czech Republic

WORKSHOPS Applied Mathematical Modeling with Topological Techniques August 2019
Invited participant
 ICERM Topical Workshop
 Providence, Rhode Island

Mathematics of Gun Violence May 2019
Invited participant
 NIMBioS/DySoC Investigative Workshop
 University of Tennessee, Knoxville, TN

Learning in Networks March 2019
Invited participant
 NIMBioS/DySoC Working Group
 University of Tennessee, Knoxville, TN

Cultural Analytics December 2018
Invited participant
 Institute for Pure and Applied Mathematics
 Lake Arrowhead Conference Center, CA

Agent-Based Modeling in Biological and Social Systems June 2018
Invited participant
 AMS Mathematics Research Communities
 West Greenwich, RI

Women Advancing Mathematical Biology Workshop April 2017
Invited participant
 Mathematical Biosciences Institute
 The Ohio State University, Columbus, OH

FELLOWSHIPS AND AWARDS *MAA Project NExT Fellowship* 2019–2021
 ~\$ 5,000 (travel funding)

<i>Stockham Medal for Conspicuously Effective Teaching nominee</i> \$1,000	2017
<i>T. Benny and Gail T. Rushing Fellowship Award</i> \$5,000	2017
<i>Center for Teaching and Learning Excellence Graduate Fellowship</i> \$15,000	2016
<i>NSF Research Training Grant Fellowship RTG-1148230</i> \$20,457 per year	2014-2016
<i>RTG Lab Rotation, Neuronal Dynamics Laboratory (PI: John White)</i> \$5,000	2014
<i>Travel Awards:</i>	
SIAM Early Career Travel Grant, \$650	2019
AMS MRC Travel Grant, \$850	2018
SIAM Early Career Travel Grant, \$650	2018
Joint Mathematics Meeting Travel Grant, \$500	2017
SIAM Student Travel Grant, \$600	2016
NSF-RTG Travel Grant, \$1000	2015
Organization for Computational Neurosciences Travel Grant, \$800	2013

MENTORSHIP OF STUDENT RESEARCH

<i>Undergraduate Research in Mathematics, UCLA</i>	2019 – 2020
<ul style="list-style-type: none"> • Sneha Sambandam (UCLA, class of 2020) and Annie Zhang (UCLA, class of 2021). Content spread on networks with bounded-confidence dynamics. • Gabrielle Lorenzi (UCLA, class of 2021). Modeling gender bias and homophily in professional networks (co-mentor Mason Porter). 	
<i>Summer Undergraduate Research Fellowship, Caltech</i>	2019 – 2020
<ul style="list-style-type: none"> • Siqiao Mu (Caltech, class of 2021). SEIR models on networks (co-mentors Mason Porter and Franca Hoffmann). • Sujai Hiremath (Caltech, class of 2023) and Alex Pan (Caltech, class of 2022). Opinion formation on networks (co-mentors Mason Porter and Franca Hoffmann). 	
<i>California Research Training Program in Computational & Applied Math</i>	2019
Project: Evaluating effectiveness of the Gang Reduction and Youth Development Program with dynamic mode decomposition and machine learning techniques.	
<ul style="list-style-type: none"> • Zehan Chao (UCLA, graduate student), Zheyuan Cui (UCLA, class of 2021), Avery Edson (UCLA, class of 2020), Cesar Guajardo (Santa Monica College, class of 2020), Yihuan Huang (UCLA, class of 2021), Xingjia Wang (UCLA, class of 2020), and Zhanyuan Yin (UCLA, class of 2021). 	
<i>Honors Thesis Project in Mathematics, University of Utah</i>	2015
Project: Quantitative analysis of virus trafficking in a biological cell (co-mentor Sean Lawley)	
<ul style="list-style-type: none"> • Marie Tuft (University of Utah, class of 2015) 	

Research Training Grant REU in Mathematical Biology 2014–2015

- Oliver Richardson (University of Utah, class of 2017)
Project: Modeling learning on neural networks. (co-mentor Sean Lawley)
- Braden Schaer (University of Utah, class of 2015) and Anand Singh (University of Utah, class of 2016)
Project: Modeling diffusion of neurotransmitters. (co-mentor Sean Lawley)

TEACHING

Instructor of record (full responsibility for lectures, assessment, and grades):

- Math 168: Introduction to Networks [Spring 2020, UCLA]
- Math 142: Mathematical Modeling [Fall 2019, UCLA]
- Math 197: Reading Course in Nonlinear Dynamics [Spring 2019, UCLA]
- Math 134: Linear and Nonlinear Systems of Differential Equations [Fall 2018 and Winter 2019, UCLA]
- Math 3140: Vector Calculus and Partial Differential Equations [Spring 2018, U. Utah]
- Math 1210: Calculus I, online course [Fall 2017, U. Utah]
- Math 2270: Linear Algebra [Spring 2017, U. Utah]
- Math 3150: Partial Differential Equations for Engineers [Summer 2016 and Fall 2016, U. Utah]
- Math 1050: College Algebra [Summer 2013, U. Utah]
- Math 1010: Intermediate Algebra [Spring 2013 and Spring 2014, U. Utah]
- Math 1030: Intro to Quantitative Reasoning [Fall 2012, U. Utah]

Teaching assistant (responsibility for lab/discussion sections and grading):

- Math 1170: Calculus II for Biologists [Spring 2016, U. Utah]
- Math 1180: Calculus I for Biologists [Fall 2015, U. Utah]
- Math 2250: Differential Equations and Linear Algebra for Engineers [Fall 2013, U. Utah]

Project NExT Fellowship 2019–2021

Professional development program for early career mathematicians focused on innovative approaches to teaching mathematics, strategies for student engagement, balancing teaching with scholarship, and promoting equity in the mathematics community.

Co-Principal Investigator, Research Project on Calculus Persistence 2016–2018

Ongoing research project involving implementation of formative assessment interventions intended to increase calculus persistence in the University of Utah engineering calculus sequence. Project includes gathering and analysis of data on student confidence surveys before and after interventions. (Joint work with Anna Romanov)

Center for Teaching and Learning Excellence Graduate Fellow 2016–2017

Conducted classroom observations, student focus groups, and consultations with instructors to improve pedagogy. Aided in the preparation of teaching workshops and materials development.

Mathematics TA Training Workshop Facilitator 2016, 2017

Facilitated annual workshop for new teaching assistants in the mathematics department.

ACCESS program TA

2012

Teaching assistant for codes and cryptography course for young women in science and mathematics.

**SERVICE &
OUTREACH***'Exploring Your Universe' Event Booth*

November 2019

Designing and running a booth at a science festival for families and children in the Los Angeles community. Our activities, titled 'Disease Detectives: Stopping the Zombie Apocalypse with Mathematics', focus on the role of mathematics and networks in epidemiology. (Joint with Yacoub Kureh)

Student and Postdoc Icebreaker Session, organizer

May 2019

Organized and led an introductory session for young researchers at the SIAM conference on Dynamical Systems. Our goal was to create an inclusive environment at the conference. (Joint with Alexandria Volkening)

Vice President, Association for Women in Mathematics Student Chapter

- Chapter activities include: AWM speaker series, self-defense workshop, monthly lunch discussions on gender and academia, outreach events at an after school program for girls, a local high school, and a science museum, and initiation of undergraduate mentoring network.
- Workshop on Implicit Bias and Gendered Language 2016–2017
Organized two-part workshop to help graduate students and faculty to recognize implicit bias and develop strategies to eliminate gendered language when writing recommendation letters.
- "What is Math?" Day 2013–2016
Invited speakers and created activities to introduce advanced high school and early undergraduate students to a variety of areas in mathematical research.

Undergraduate Colloquium: Applying for Graduate School, panelist

2017

Serve on a panel to share experiences and answer questions for undergraduate students who are considering graduate programs in mathematics.

Graduate Student Advisory Committee, active member

- Recruitment Committee 2014–2016
Coordinate prospective graduate recruitment scheduling and activities.
Committee chair 2015–2016.
- Retention, Promotion, and Tenure Committee 2013–2014
Review teaching evaluations for faculty promotions.

Graduate student counselor, high school summer math program

2013

Provide support and mentoring to high school students participating in the university's math summer camp program.

**OUTREACH
TALKS***Modeling content spread on social media*

UCLA Women in Math Mentorship Program Research Night
Los Angeles, CA

February 2019

Using student-created videos to promote engagement and achieve learning outcomes

Annual Teaching Symposium, University of Utah
Salt Lake City, UT

August 2017

How do animals get their spots?
Girls Math Night, Zaniac after-school program
Salt Lake City, UT

October 2016

Parrondo's paradox: hope for losers
Graduate Student Colloquium, University of Utah
Salt Lake City, UT

September 2015

What is math biology?
"What is Math?" Day, University of Utah
Salt Lake City, UT

April 2014

The mathematics of synchrony
Graduate Student Colloquium, University of Utah
Salt Lake City, UT

November 2013

**WORKSHOP
AND SESSION
ORGANIZING**

Mathematical and Computational Methods for Complex Social Systems January 2021
AMS Short Course (Joint with Michelle Feng, Mason Porter, and Alexandria Volkening)

Minisymposium on Topological Data Analysis and Data-Driven Modeling in Complex Systems
SIAM Conference on the Mathematics of Data Science (Joint with Mason Porter)

proposed May 2020

AMS-AWM Special Session on Women in Mathematical Biology
Joint Mathematics Meeting (Joint with Christina Edholm, Katharine Gurski, and Amanda Laubmeier)

January 2020

Interactive Session on Fostering Equitable Classrooms
Joint Mathematics Meeting (Joint with Christina Edholm, Ryan Moruzzi, and Mark Weaver)

January 2020

Minisymposium on Dynamics of Democracy
SIAM Conference on Applied Dynamical Systems (Joint with Alexandria Volkening)

May 2019

**PROFESSIONAL
MEMBERSHIPS**

Society for Industrial and Applied Mathematics
Association for Women in Mathematics
American Mathematical Society
Mathematical Association of America