

Carter L. Johnson

Mathematics Department
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Objective

Applied mathematics Ph.D. candidate studying the neural and mechanical mechanisms of swimming behavior in the nematode *C. elegans*. Committed to the inclusion and encouragement of underprivileged or otherwise underrepresented peoples in STEM studies.

Research interests neuroethology, dynamical systems, mathematical physiology

Education

- 2020 **Ph.D. in Applied Mathematics**, *University of California, Davis*, Davis, CA.
(Expected) Advisors: Prof. Timothy J. Lewis and Prof. Robert D. Guy
- 2017 **M.S. in Applied Mathematics**, *University of California, Davis*, Davis, CA.
GPA: 3.98
- 2015 **B.S. in Applied Mathematics**, *University of California, Davis*, Davis, CA.
Highest Honors, Magna Cum Laude, GPA: 3.92

Service and Outreach

- May 2019 **STEM for Girls Workshop Organizer**, *STEM for Girls*, Women's Resources and Research Center, Davis, CA.
Organized and led a math workshop at STEM for Girls, an annual program which brings local middle-school girls to the university for a day to share with them the joys of STEM. Our workshop had the girls using permutations to get their "brains" back in their own bodies and coloring maps to discover the four-color theorem.
- Nov 2015- **Student Chapter Secretary**, *Association for Women in Mathematics*, Davis, CA.
Present Mentored undergraduate female math majors, ran information sessions on applying to graduate school in math, helped to host talks by female speakers in the math department, provided online resources for women in math. Student chapter Secretary as of March 2018, duties include: keeping official records, planning and coordinating events, maintaining the website.
- Jan 2018 - **Volunteer**, *M-PACT UC Davis*, Smythe Academy Middle School, Sacramento, CA.
Present Designed and taught logic problem sessions designed to encourage creative and critical thinking, helped bring non-standard mathematics education to underprivileged middle-school students in the Sacramento area through this unique afterschool program.
- Sept 2017 - **Volunteer**, *Horseplay Therapeutic Riding Center*, Dixon, CA.
- July 2019 Assisted in horse riding lessons for students with disabilities, worked one-on-one with riders to overcome individual challenges and advance towards the students' riding goals, trained horses to better serve their disabled riders.

Sept 2015 - **Volunteer Math Tutor**, *Women's Resources and Research Center STEM Cafe*,
Mar 2018 Davis, CA.
Provided free math tutoring in a safe space for all undergraduate minorities.

Professional Memberships

Sept 2015 - **Student Chapter Member**, *Society of Industrial and Applied Mathematics*
Present (*SIAM*), Davis, CA.
Active member in the UC Davis SIAM student chapter.

Academic Experience

2017-Present **Graduate Student Researcher**, *University of California, Davis*, Davis, CA, Advisors: Timothy Lewis and Robert Guy.
Studying the neural underpinnings of swimming behavior in the *C. elegans* nematode. Methods include: differential equations to model the coupled neuromechanical system of the body, "brain", and behavior, coupled oscillators theory to understand the pattern of rhythm generation and coordination, and numerical PDE simulations to determine the closed-loop effects of the fluid environment and body.

2015 - 2017 **Graduate Student Researcher**, *University of California, Davis*, Davis, CA, Advisor: Alan Hastings.
Studied the effects of migration on the resilience of connected ecosystems in a differential equations model. Investigated the qualitative changes in the dynamical system behavior induced by parameter changes. Concluded research with a publication in *Theoretical Ecology*.

Work Experience

Aug 2019 - **Associate Instructor**, *University of California, Davis*, Davis, CA.
Sept 2019 Taught Calculus for Biology and Medicine in a six-week summer session, designed and taught lectures, constructed educational supplements, and evaluated student performances.

June 2017 - **Applied Machine Learning Summer Research Internship**, Los Alamos, NM,
Aug 2017 Supervisors: Dr. Kipton Barros and Dr. Nicholas Lubbers.
Performed machine learning analysis of large-scale experimental data. Applied random forests, gradient-boosted decision trees, and convolutional neural networks in Python for regression and classification problems.

Jan 2017 - **Course Developer**, *University of California, Davis*, Davis, CA, Supervisor: Dr.
June 2017 Korana Burke.
Developed laboratory sections and MATLAB computing exercises for a new differential equations course for quantitative biology majors. The class was first offered in Spring 2019, and we further adjusted the laboratory sections before and after each session.

2015 - **Teaching Assistant**, *University of California, Davis*, Davis, CA.
Present Held weekly discussion sections, constructed educational supplements, and evaluated student performances for courses in: differential calculus, vector calculus, ordinary differential equations, partial differential equations, numerical analysis, and graduate methods in applied mathematics.

Publications

Johnson, C.L. and Hastings, A., “*Resilience in a Two-Population System: Interactions between Allee effects and connectivity*”, *Theoretical Ecology* (2018) 11:281-289, <https://doi.org/10.1007/s12080-018-0365-4>

Carter Johnson, “*Coupling in Networks of Neuronal Oscillators*”, Mathematics Dept. Undergraduate Honors Thesis, June 2015.

Carter Johnson, “*Phase Response Properties and Phase-Locking in Neural Systems with Delayed Negative-Feedback*”, *UC Davis Explorations*, June 2015.

Conference Presentations

SIAM Pacific Northwest Conference, Oct. 2019, *Neuromechanical Mechanisms of Locomotion in C. Elegans: relative roles of mechanical and neural coupling*, Talk, Co-authors: Tim Lewis and Robert D. Guy

SIAM Dynamical Systems, May 2019, *Analysis of the Relative Roles of Neural and Mechanical Coupling in C. Elegans Gait Modulation*, Talk, Co-authors: Tim Lewis and Robert D. Guy.

Computational Neuroscience Seattle 2018, July 2018, “*Neuromechanical Mechanism of Locomotion in C. Elegans: relative roles of mechanical and neural coupling*”, Poster, Co-authors: Tim Lewis and Robert D. Guy.

Project Meeting, LDRD-sponsored project on Critical Stress, July 2017, “*Applying Machine Learning to 2-D photoelastic laboratory studies*”, Talk, Co-authors: Kishan Supreet Alguri, Nick Lubbers, and Kipton Barros.

UC Davis Undergraduate Research Conference, April 2014. “*Phase Response Properties and Phase-Locking in Neural Systems with Delayed Negative Feedback*”, Poster.

Awards

May 2019 SIAM Student Travel Award

June 2015 Yueh-Jing Lin Scholarship in Mathematics

June 2015 UC Davis Dept. of Mathematics - Citation for Outstanding Performance

2011-2015 University of California Regents Scholarship

2011-2014 UC Davis Integrated Studies Honors Program

References

Professor Timothy Lewis, Department of Mathematics, University of California, Davis
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Professor Robert Guy, Department of Mathematics, University of California, Davis
guy@math.ucdavis.edu

Professor Alan Hastings, Department of Environmental Science and Policy, UCD
amhastings@ucdavis.edu

Dr. Kiptos Barros, Center for Nonlinear Studies, Los Alamos National Laboratory
kbarros@lanl.gov

Dr. Nicholas Lubbers, Center for Nonlinear Studies, Los Alamos National Laboratory
nlubbers@lanl.gov

Dr. Korana Burke, Lecturer, Dept. of Mathematics, University of California, Davis
kburke@ucdavis.edu

Coursework

Graduate Mathematics Analysis, Methods of Applied Mathematics, Numerical Methods: Fundamentals, Numerical Methods for Partial Differential Equations, Stochastic Dynamics and Applications, Numerical Methods: Large-Scale Matrix Computations, Applied and Computational Harmonic Analysis, Mathematical Biology (Emphasis on Neurophysiological Models)

Other Graduate Physiology for Bioengineers, Machine Learning (Topics in Theoretical Neuroscience), Theoretical Ecology, Computational Methods in Population Biology, Vector-Borne Infectious Diseases

Undergrad. Mathematics Ordinary Differential Equations, Partial Differential Equations, Numerical Analysis, Linear Algebra, Probability

Undergrad. Programming Applied Statistics for Biological Sciences (R), Introduction to Programming and Problem Solving (C), Software and Object-Oriented Programming (C++), MATLAB