

# Paul Carter

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## Research interests

Dynamical systems, nonlinear waves, pattern formation, singular perturbations, partial differential equations, applied mathematics

## Professional appointments

2021 – present Assistant Professor, University of California, Irvine, CA  
2019 – 2021 Assistant Professor, University of Minnesota, Minneapolis, MN  
2016 – 2019 Postdoctoral Research Associate, University of Arizona, Tucson, AZ  
2017 – 2018 Postdoctoral Researcher, Leiden University, Leiden, NL

## Education

2011 – 2016 Brown University, Providence, RI  
PhD, Mathematics, 2016, advisor: Björn Sandstede  
Thesis: *Fast pulses with oscillatory tails in the FitzHugh–Nagumo system*  
ScM, Mathematics, 2013  
2010 – 2011 Magdalene College, University of Cambridge, Cambridge, UK  
MASt, Applied Mathematics and Theoretical Physics (Distinction), 2011  
2007 – 2010 Mansfield College, University of Oxford, Oxford, UK  
BA, Mathematics (First), 2010

## Grants & Awards

2023 – 2028 PI: NSF CAREER DMS-2238127 (\$496,663)  
“Pattern formation in singularly perturbed partial differential equations”  
2021 – 2024 PI: NSF DMS-2105816 (\$237,885)  
“Self-organization, stability, and defects in pattern-forming systems”  
2018 – 2023 PI: NSF DMS-2204758 (formerly DMS-2016216, DMS-1815315) (\$117,956)  
“Patterns and bifurcations in multiple timescale dynamical systems”  
2020 – 2021 PI/Faculty Sponsor: MAA Tensor Women in Mathematics Grant (\$12,000)  
“Mathematics Project at Minnesota”  
2016 – 2018 AMS Simons Travel Grant (\$4,000)  
2015 – 2016 SIAM/AMS Student Travel Awards (various)  
2014 Brown University Doctoral Research Travel Grant (\$1,688)  
2014 SIAM NWCS14 Conference “best poster” prize.  
2008 – 2009 Scholarship & Exhibition Prizes, University of Oxford

## Research publications

- P Carter. A stabilizing effect of advection on planar interfaces in singularly perturbed reaction diffusion equations. *SIAM Journal on Applied Mathematics* (accepted).
- E Byrnes, P Carter, A Doelman, and L Liu. Large amplitude radially symmetric spots and gaps in a dryland ecosystem model. *Journal of Nonlinear Science* 33(107) (2023).
- P Carter, K Lilly, E Obermayer, S Rao, and A Doelman. Criteria for the (in)stability of planar interfaces in singularly perturbed 2-component reaction-diffusion equations. *Physica D* 444 (2023), 133596.

- P Carter and A Champneys. Wiggly canards: growth of traveling wave trains through a family of fast-subsystem foci. *Discrete and Continuous Dynamical Systems - S* 15(9) (2022), pp. 2433-2466.
- T Chin, J Ruth, C Sanford, R Santorella, P Carter, and B Sandstede. Enabling equation-free modeling via diffusion maps. *Journal of Dynamics and Differential Equations* (2022, published online).
- P Carter, J Rademacher, and B Sandstede. Pulse replication and accumulation of eigenvalues. *SIAM Journal on Mathematical Analysis* 53(3) (2021), pp. 3520-3576.
- A Bauer and P Carter. Existence of transonic solutions in the stellar wind problem with viscosity and heat conduction. *SIAM Journal on Applied Dynamical Systems* 20(1) (2021), pp. 262-298.
- P Carter. Spike-adding canard explosion of bursting oscillations. *Journal of Nonlinear Science* 30(6) (2020), pp. 2613-2669.
- T Aougab, M Beck, P Carter, S Desai, B Sandstede, M Stadt, and A Wheeler. Isolates versus snaking of localized rolls. *Journal of Dynamics and Differential Equations* 31(3) (2019), pp. 1199-1222.
- J Bramburger, D Altschuler, C Avery, T Sangsawang, M Beck, P Carter, and B Sandstede. Localized radial roll patterns in higher space dimensions. *SIAM Journal on Applied Dynamical Systems* 18(3) (2019), pp. 1420-1453.
- R Bastiaansen, P Carter, and A Doelman. Stable planar vegetation stripe patterns on sloped terrain in dryland ecosystems. *Nonlinearity* 32(8) (2019), pp. 2759-2814.
- P Carter and A Doelman. Traveling vegetation stripes in the Klausmeier model. *SIAM Journal on Applied Mathematics* 78(6) (2018), pp. 3213-3237.
- P Carter and A Scheel. Wave train selection by invasion fronts in the FitzHugh–Nagumo equation. *Nonlinearity* 31(12) (2018), pp. 5536-5572.
- P Carter and B Sandstede. Unpeeling a homoclinic banana in the FitzHugh–Nagumo system. *SIAM Journal on Applied Dynamical Systems* 17(1) (2018), pp. 236-349.
- C Xia, C Cochrane, J DeGuire, G Fan, E Holmes, M McGuirl, P Murphy, J Palmer, P Carter, L Slivinski, and B Sandstede. Assimilating Eulerian and Lagrangian data in traffic-flow models. *Physica D* 346 (2017), pp. 59-72.
- P Carter, E Knobloch, and M Wechselberger. Transonic canards and stellar wind. *Nonlinearity* 30(3) (2017), pp. 1006-1033.
- P Carter, B de Rijk, and B Sandstede. Stability of traveling pulses with oscillatory tails in the FitzHugh–Nagumo system. *Journal of Nonlinear Science* 26(5) (2016), pp. 1369-1444.
- P Carter and B Sandstede. Fast pulses with oscillatory tails in the FitzHugh–Nagumo system. *SIAM Journal on Mathematical Analysis* 47(5) (2015), pp. 3393-3441.
- P Carter, PL Christiansen, YB Gaididei, C Gorria, B Sandstede, MP Sorensen, and J Starke. Multi-jam solutions in traffic models with velocity-dependent driver strategies. *SIAM Journal on Applied Mathematics* 74(6) (2014), pp. 1895-1918.

## Preprints

- P Carter, A Doelman, A Iuorio, F Veerman. Travelling pulses on three spatial scales in a Klausmeier-type vegetation-autotoxicity model. Submitted, 2023.
- M Avery, P Carter, B de Rijk, and A Scheel. Stability of coherent pattern formation through invasion in the FitzHugh–Nagumo system. Submitted, 2023.
- S Banerjee, M Baudena, P Carter, R Bastiaansen, A Doelman, and M Rietkerk. Rethinking tipping points in spatial ecosystems. Submitted, 2023.

## Conference proceedings/reports

- P Carter. Pulse replication and slow absolute spectrum in the FitzHugh–Nagumo system. *Oberwolfach Reports* 37 (2021), pp. 45-48.

## Publications aimed at undergraduates

- P Carter and D Lowry-Duda. On functions whose mean value abscissas are midpoints. *The American Mathematical Monthly* 124(6) (2017), 535-542.
- P Carter and Y Solomon. Relaxing the integral test: An “elementary” challenge for the advanced calculus student. *College Mathematics Journal* 48(4) (2017), 290-291.

## Invited talks

- 2024 UCI Systems Biology Retreat, Pasadena, CA.
- 2023 Patterns and Waves in Niseko, Niseko, JP.
- 2023 ICIAM 2023, Waseda University, Tokyo, JP.
- 2023 NDNS+ Annual Workshop, Universiteit Twente, Enschede, NL.
- 2023 SIAM Conference on Applications of Dynamical Systems, Portland, OR
- 2023 PDE Seminar, UH, Houston, TX
- 2023 Symposium on Fronts, Patterns, and Self-Organization, UMN, Minneapolis, MN
- 2022 BIRS Workshop on “Topics in Multiple Time Scale Dynamics”, Banff, CA.
- 2022 SIAM Conference on Nonlinear Waves and Coherent Structures, Bremen, DE.
- 2022 Wave Phenomena Seminar, Karlsruhe Institute of Technology, Karlsruhe, DE.
- 2022 Dynamical Systems Seminar, Leiden University, Leiden, NL
- 2021 UCI Dynamical Systems Seminar, Irvine, CA
- 2021 MFO workshop on Dynamics of Waves and Patterns, Oberwolfach, DE.
- 2021 SIAM Conference on Applications of Dynamical Systems (virtual).
- 2020 Analysis, Dynamics, and Applications Seminar, University of Arizona, Tucson, AZ.
- 2020 Colloquium, UC Irvine, Irvine, CA.
- 2020 Dynamical Systems Seminar, BU, Boston, MA
- 2019 Equadiff, Leiden, NL.
- 2019 SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
- 2019 Colloquium, NC State University, Raleigh, NC.
- 2019 Applied Math Seminar, UC Irvine, Irvine, CA.
- 2018 Climate Seminar, UMN, Minneapolis, MN.
- 2018 Oliver Club, Cornell University, Ithaca, NY.
- 2018 Analysis and Applied Math Seminar, University of Toronto, Toronto, ON.
- 2018 SIAM Annual Meeting, Portland, OR.
- 2018 NDNS+ Annual Workshop, Universiteit Twente, Enschede, NL.

- 2018 SIAM Conference on Nonlinear Waves and Coherent Structures, Orange, CA.
- 2018 Dynamical Systems Seminar, UMN, Minneapolis, MN.
- 2018 Oberseminar Dynamics, Munich, Germany.
- 2018 Oberseminar Analysis and Modelling, Stuttgart, Germany.
- 2018 Applied Analysis Seminar, Bremen, Germany.
- 2017 Applied Analysis Seminar, Bremen, Germany.
- 2017 Equadiff, Bratislava, Slovakia.
- 2017 The Future of Singular Perturbations, Lorentz Center, Leiden, NL.
- 2017 Analysis Lunch Seminar, Leiden University, Leiden, NL.
- 2017 Mathematics of Climate Seminar, UMN, Minneapolis, MN.
- 2017 Dynamical Systems Seminar, UMN, Minneapolis, MN.
- 2017 IMACS Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA
- 2016 SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, PA
- 2016 AIMS Conference on Dynamical Systems, Differential Eqs, and Applications, Orlando, FL
- 2015 SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
- 2015 Applied and Computational Math Seminar, GMU, Fairfax, VA.
- 2015 AMS Central Spring Sectional Meeting, MSU, East Lansing, MI.
- 2014 Brown/BU PDE seminar, Brown University, Providence, RI.

## Contributed talks & poster presentations

- 2020 Applied Math COVID-19 Working Group, University of Arizona, Tucson, AZ.
- 2020 Mathematics of Climate Seminar, UMN, Minneapolis, MN.
- 2018 Analysis, Dynamics, and Applications Seminar, University of Arizona, Tucson, AZ.
- 2017 Analysis, Dynamics, and Applications Seminar, University of Arizona, Tucson, AZ.
- 2017 SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
- 2017 Analysis, Dynamics, and Applications Seminar, University of Arizona, Tucson, AZ.
- 2016 Uncertainty Quantification Group Seminar, University of Arizona, Tucson, AZ.
- 2016 Analysis, Dynamics, and Applications Seminar, University of Arizona, Tucson, AZ.
- 2016 Analysis of PDEs using Dynamical Systems Techniques, Boston, MA [Poster]
- 2015 Equadiff, Lyon, France
- 2014 SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge, UK. [Poster]
- 2014 SDG workshop “Multiscale problems arising in the biosciences”, Blackheath, NSW. [Poster]
- 2014 Brown Informal PDE seminar, Brown University, Providence, RI.
- 2012 Brown Informal PDE seminar, Brown University, Providence, RI.
- 2012 Brown Informal PDE seminar, Brown University, Providence, RI.

## Research visits

- 2023 Collaborate@ICERM: “Stability of pattern-forming fronts in the FitzHugh-Nagumo system”  
Institute for Computational and Experimental Research in Mathematics, Providence, RI.

## Workshop participation

- 2016 KUMU Conference on PDE, Dynamical Systems, and Applications, MU, Columbia, MO.
- 2014 IMA workshop on “Algebraic topology in dynamics and data”, Minneapolis, MN.
- 2013 DTU winter school “Multi-scale analysis in dynamical systems”, Copenhagen, Denmark.

## Teaching

- University of California, Irvine

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| Winter 2024          | Math 117: Dynamical Systems                  |
| Fall 2023, Fall 2022 | Math 290A: Methods of Applied Mathematics I  |
| Winter 2023          | Math 112B: Intro to PDEs and Applications II |
| Winter 2022          | Math 290B: Methods of Applied Mathematics II |
| Winter 2022          | Math 3A: Introduction to Linear Algebra      |
| Fall 2021            | Math 112A: Intro to PDEs and Applications I  |
- University of Minnesota
 

Fall 2020	Math 8501: Differential Equations and Dynamical Systems
Fall 2019, Fall 2020	Math 2374: CSE Multivariable Calculus and Vector Analysis
  - University of Arizona
 

Spring 2019	Math 456/556: Applied Partial Differential Equations
Fall 2018	Math 454: ODEs and Stability Theory
Spring 2017	Math 355: Analysis of Ordinary Differential Equations
Fall 2016, Fall 2018	Math 125: Calculus I
  - Brown University
 

Fall 2014	MA0200: Intermediate calculus (physics/engineering) (Instructor)
Spring 2013	MA0180: Intermediate calculus (TA)
Fall 2012	MA0100: Introduction to calculus II (TA)
  - Summer@Brown
 

Summer 2013, 2014, 2015	CEMA0904: How big is infinity? (Instructor)
Summer 2013, 2014, 2015	CEMA0908: Fundamentals for calculus (Instructor)

## Mentoring & Advising

- Graduate advising and committees
 

Daniel Shvartsman	2023 – present	PhD Advisor, UCI
Jaaziel De La Luz	Winter 2024	Supervised reading/research, UCI
Clara Park	Winter 2024	Supervised reading/research, UCI
Rachel D'Souza	Fall 2023	PhD Advancement Committee, UCI
Grace Zhang	Spring 2022	PhD Oral Preliminary Exam Committee, UMN
Matthew Hirning	Winter 2022	PhD Advancement Committee, UCI
Eleonora Mosesov	Summer 2021	Master's Final Exam Committee, UMN
Olivia Cannon	Fall 2020	PhD Oral Preliminary Exam Committee, UMN
Montie Avery	Spring 2020	PhD Oral Preliminary Exam Committee, UMN
Michelle Mastrianni	Spring 2020	Independent study, UMN
Tianyu Tao	Spring 2020	PhD Final Oral Exam Committee, UMN
- Undergraduate advising
 

Sijia Zhang	Fall 2023 – present, Supervised reading/research, UCI
Daniel Levy	Summer 2023, NSF REU
Erin Okey	Summer 2023, NSF REU
Paige Yeung	Summer 2023, NSF REU
Guogen Lan	Summer 2022, NSF REU
Kaitlynn Lilly	Summer 2021, NSF REU (virtual)
Erin Obermayer	Summer 2021, NSF REU (virtual)
Shreyas Rao	Summer 2021, NSF REU (virtual)
Zeyu Li	Fall 2020, Independent study/senior project, UMN

Ellie Byrnes	Summer 2020, NSF REU (virtual)
Lily Liu	Summer 2020, NSF REU (virtual)
Stephen Ingraham	Spring 2020, Independent study/senior project, UMN
Adam Bauer	Spring/Summer 2019, NSF REU and Independent study, UArizona
Parker Liu	Spring 2019, Independent study/directed research, UArizona

- Mentoring activities

2021 – present	UC Irvine Math Circle
2016 – 2017, 2018 – 2019	Tucson Math Circle, University of Arizona
Spring 2017, Fall 2018	Mentor for UArizona Undergraduate TA Program Students advised: Erika Leatherwood, Kevin Milligan
Summer 2016	Postdoc TA/mentor for the Summer@ICERM REU program Students advised: Dylan Altschuler, Chloe Avery, Tracy Chin Surabhi Desai, Jacob Ruth, Therathep Sangsawang Rebecca Santorella, Melissa Stadt, Aric Wheeler

## Editorial activities

- Physica D. Early Career Editorial Board member (2022 – present)
- Discrete and Continuous Dynamical Systems - S. Guest editor for special issue on “Advances in the mathematical study of pattern formation,” September 2022.
- Referee/reviewer: Applied Mathematical Modeling, Archive for Rational Mechanics and Analysis, Communications in Nonlinear Science and Numerical Simulation, Discrete and Continuous Dynamical Systems, Indiana University Mathematics Journal, International J. Bifurcation and Chaos, J. Mathematical Biology, J. Nonlinear Science, Mathematical Reviews, Nonlinear Differential Equations and Applications, Nonlinearity, Physica D, Reports on Mathematical Physics, SIAM J. Applied Dynamical Systems, SIAM J. Applied Mathematics, SIAM J. Mathematical Analysis, SIAM Review, Zeitschrift fuer Angewandte Mathematik und Physik

## Professional development

- Division of Teaching Excellence and Innovation, University of California, Irvine  
Winter 2023 – Active Learning Institute
- Office of Inclusive Excellence, University of California, Irvine  
2022 – Inclusive Excellence Certificate Program
- Office for Equity and Diversity Education, University of Minnesota  
2021 – Equity and Diversity Certificate
- Office for Diversity and Inclusive Excellence, University of Arizona  
2018 – Leader in Classroom Diversity & Inclusion Certificate
- Eller College of Management, University of Arizona  
2018 – Tomorrow’s Leaders Equipped for Diversity Certificate

- Sheridan Center for Teaching and Learning
  - 2013 – 2016 Sheridan Center teaching consultant
  - Fall 2015 New TA orientation workshop leader
  - 2013 – 2015 Sheridan Center Certificate IV
  - 2013 – 2014 Sheridan Center Certificate I workshop discussion leader
  - 2012 – 2013 Sheridan Center Certificate I

## Organizing

2021 – present	Co-organizer, Applied and Computational Mathematics Seminar, UC Irvine
2022	Co-organizer of minisymposium “Planar and Higher-Dimensional Patterns: Analysis & Numerics” SIAM Conference on Nonlinear Waves and Coherent Structures, Bremen, DE
2020 – 2021	Co-organizer, Dynamical Systems Seminar, University of Minnesota
2021	Co-organizer of minisymposium “Wave & front dynamics: propagation and stability” SIAM Conference on Applications of Dynamical Systems (Virtual)
2019	Co-organizer of minisymposium “Traveling Waves: Selection Principles and Stability” SIAM Conference on Analysis of PDEs, La Quinta, CA
2018	Co-organizer of minisymposium “Defects and Inhomogeneities in Pattern Forming Systems” SIAM Annual Meeting, Portland, OR
2017	Co-organizer of minisymposium “Nonlocal Behavior in Biological Applications” SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
2016	Co-organizer of minisymposium “Geometric approaches to traveling waves in PDE models” SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, PA
2015	Co-organizer of minisymposium “The behavior of autonomous agents in diverse applications” SIAM Conference on Applications of Dynamical Systems, Snowbird, UT

## Service

2023 – present	Applied Mathematics Qualifying Exam Committee, UC Irvine
2021 – present	Inclusive Excellence Committee, Department of Mathematics, UC Irvine
2022 – 2023	Graduate Admissions Committee, Department of Mathematics, UC Irvine
2021 – 2022	Awards Committee, Department of Mathematics, UC Irvine
2020 – 2021	Faculty Sponsor for “Mathematics Project at Minnesota” Workshop
2020 – 2021	Dunham Jackson Postdoc Search Committee, School of Mathematics, UMN
2019 – 2021	Instructional Evaluation Committee, School of Mathematics, UMN
2019 – 2020	Graduate Committee, School of Mathematics, UMN
2016	Panel Member, Brown University SIAM Student Chapter Math Postdoc Panel.
2016	Judge, Brown Math Modeling Competition, Providence, RI
2015	Organizer, Brown University Math Postdoc panel.
2009 – 2010	Mansfield College Rep. for the Maths Undergraduate Representative Committee