Erica Rutter

Current Position: Assistant Professor, University of California, Merced

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Education

Aug 2012- Aug 2016	Ph.D. in Applied Mathematics, Arizona State University Thesis: A Mathematical Journey of Cancer Growth.
Sept 2005- May 2009	B.Sc in Applied Mathematics & Japanese, The University of Michigan

Research Employment

July 2019-	Assistant Professor, University of California, Merced
Aug 2016- June 2019	Postdoctoral Researcher, North Carolina State University *PIs: Kevin B. Flores and H. T. Banks*
May 2009- July 2012	Research Technician, University of Michigan *PI: R. Paul Drake*

Publications

Peer-Reviewed Papers in Mathematics

[1] John Lagergren, John T. Nardini, G. Michael Lavigne, **Erica M. Rutter**, and Kevin B. Flores. Learning partial differential equations for biological transport models from noisy spatiotemporal data. *Proceedings of the Royal Society: A*, 476(2234):20190800, 2020. 10.1098/rspa.2019.0800

[2] **Erica M. Rutter**, John Lagergren, and Kevin B. Flores. A Convolutional Neural Network Method for Boundary Optimization Enables Few-Shot Learning for Biomedical Image Segmentation. In: *Domain Adaptation and Representation Transfer and Medical Image Learning with Less Labels and Imperfect Data*, 190–198. Springer, Cham, 2019. 10.1007/978-3-030-33391-1_22

[3] **Erica M. Rutter**, H. T. Banks, and Kevin B. Flores. Estimating Intratumoral Heterogeneity from Spatiotemporal Data. *Journal of Mathematical Biology*, 77(6-7):1999–2022, 2018. doi:10.1007/s00285-018-1238-6

[4] **Erica M. Rutter**, John Lagergren, and Kevin B. Flores. Automated Object Tracing for Biomedical Image Segmentation Using a Deep Convolutional Neural Network. In: *International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, 686–694. Springer, Cham, 2018. doi:10.1007/978-3-030-00937-3_78

[5] **Erica M. Rutter**, Christopher L. Langdale, James A. Hokanson, Franz Hamilton, Hien Tran, Warren M. Grill, and Kevin B. Flores. Detection of bladder contractions from the activity of the external urethral sphincter in rats using sparse regression. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 26(8):1636–1644, 2018. doi:10.1109/TNSRE.2018.2854675

[6] H. T. Banks, Kevin B. Flores, I. G. Rosen, **Erica M. Rutter**, Melike Sirlanci, and W. Clayton Thompson. The Prohorove metric framework and aggregate data inverse problems for random PDEs. *Communications in Applied Analysis*, 23(3):415–446, 2018. doi:10.12732/caa.v22i3.6

[7] Tracy L. Stepien, **Erica M. Rutter** and Yang Kuang. Traveling Waves of a Go-or-grow Model of Glioma Growth. *SIAM Journal of Applied Mathematics*, 78(3):1778–1801, 2018. doi:10.1137/17M1146257

[8] Tin Phan, Bruce Pell, **Erica M. Rutter**, Gerardo Chowell, and Yang Kuang. Simple multi-scale modeling of the transmission dynamics of the 1905 plague epidemic in Bombay. *Mathematical Biosciences*. 301:83–92, 2018. doi:10.1016/j.mbs.2018.04.003

[9] **Erica M. Rutter**, H. T. Banks, Gerald A. LeBlanc, and Kevin B. Flores. Continuous structured population models for *Daphnia magna*. *Bulletin of Mathematical Biology*, 79(11):2627–2648, 2017. doi:10.1007/s11538-017-0344-8

[10] Adam Mahdi, **Erica M. Rutter**, and Stephen J. Payne. Effects of non-physiological blood pressure artefacts on measures of cerebral autoregulation. *Medical Engineering and Physics*, 47:218–221, 2017. doi:10.1016/j.medengphy.2017.06.007

[11] **Erica M. Rutter**, Tracy L. Stepien, Barrett J. Anderies, Jonathan D. Placensia, Eric C. Woolf, Adrienne C. Scheck, et al. Mathematical Analysis of Glioma Growth in a Murine Model. *Scientific Reports*, 7(2508), 2017. doi:10.1038/s41598-017-02462-0

[12] **Erica M. Rutter** and Yang Kuang. Global dynamics of a model of joint hormone treatment with dendritic cell vaccine for prostate cancer. *Discrete and Continuous Dynamical Systems: DCDS-B*, 22(3):1001–1021, 2017. doi:10.3934/dcdsb.2017050

[13] Tracy L. Stepien, **Erica M. Rutter**, and Yang Kuang. A data-motivated density-dependent diffusion model of in vitro glioblastoma growth. *Mathematical Biosciences and Engineering: MBE*, 12(6):1157-1172, 2015. doi:10.3934/mbe.2015.12.1157

[14] Nikolay L. Martirosyan*, **Erica M. Rutter***, Wyatt L. Ramey, Eric J. Kostelich, Yang Kuang, and Mark C. Preul. Mathematically modeling the biological properties of gliomas: A review. *Mathematical Biosciences and Engineering: MBE*, 12(4):879–905, 2015. doi:10.3934/mbe.2015.12.879 (* denotes equal author contributions.)

Peer-Reviewed Papers in Physics

[15] Avishek Chakraborty, Derek Bingham, Soma S. Dhavala, Carolyn C. Kuranz, R. P. Drake, Michael J. Grosskopf, **Erica M. Rutter**, et al. Emulation of Numerical Models with Over-Specified Basis Functions. *Technometrics*, 59(2):153–164, 2017. doi:10.1080/00401706.2016.1164078

[16] Robert B. Gramacy, Derek Bingham, James P. Holloway, Michael J. Grosskopf, Carolyn C. Kuranz, **Erica Rutter**, Matt Trantham, and R. P. Drake. Calibrating a large computer experiment simulating radiative shock hydrodynamics. *The Annals of Applied Statistics*, 9(3):1141-1168, 2015. doi:10.1214/15-AOAS850

[17] Joslin Goh, Derek Bingham, James P. Holloway, Michael J. Grosskopf, Carolyn C. Kuranz, and **Erica Rutter**. Prediction and computer model calibration using outputs from multifidelity simulators. *Technometrics*, 55(4):501–512, 2013. doi:10.1080/00401706.2013.838910

[18] Avishek Chakraborty, Bani K. Mallick, Ryan G. McClarren, Carolyn C. Kuranz, Derek Bingham, Michael J. Grosskopf, **Erica M. Rutter**, Hayes F. Stripling, and R. P. Drake. Spline-based emulators for radiative shock experiments with measurement error. *Journal of the American Statistical Association*, 108(502):411–428, 2013. doi:10.1080/01621459.2013.770688

[19] Carolyn C. Kuranz, R. P. Drake, Christine M. Krauland, Donna C. Marion, Michael J. Grosskopf, **Erica Rutter**, Ben Torralva, James P. Holloway, Derek Bingham, Joslin Goh, et al. Initial conditions of radiative shock experiments). *Physics of Plasmas (1994-present)*, 20(5):056321, 2013. doi:10.1063/1.4805021

[20] **Erica M. Rutter**, Michael J. Grosskopf, Guy Malamud, Carolyn C. Kuranz, Eric C. Harding, Paul A. Keiter, and R. P. Drake. Comparison between Kelvin–Helmholtz instability experiments on omega and simulation results using the CRASH code. *High Energy Density Physics*, 9(1):148–151, 2013. doi:10.1016/j.hedp.2012.12.002

[21] Michael J. Grosskopf, R. P. Drake, Carolyn C. Kuranz, **Erica M. Rutter**, James S. Ross, Nathan L. Kugland, et al. Simulation of laser-driven, ablated plasma flows in collisionless shock experiments on omega and the nif. *High Energy Density Physics*, 9(1):192–197, 2013. doi:10.1016/j.hedp.2012.11.004

[22] Hayes F. Stripling, Ryan G. McClarren, Carolyn C. Kuranz, Michael J. Grosskopf, **Erica Rutter**, and Ben R. Torralva. A calibration and data assimilation method using the bayesian mars emulator. *Annals of Nuclear Energy*, 52:103–112, 2013. doi:10.1016/j.anucene.2012.08.025

[23] Bruce Fryxell, **Erica Rutter**, and Eric S. Myra. Simulations of laser experiments of radiative and non-radiative shocks. *High Energy Density Physics*, 8(2):141–149, 2012. doi:10.1016/j.hedp.2011.12.002

[24] Ryan G. McClarren, Duchwan Ryu, R. P. Drake, Michael Grosskopf, Derek Bingham, Chuan-Chih Chou, [and 7 others, including **Erica M. Rutter**]. A physics informed emulator for laser-driven radiating shock simulations. *Reliability Engineering & System Safety*, 96(9):1194–1207, 2011. doi:10.1016/j.ress.2010.08.012

[25] R P. Drake, Forrest W. Doss, Ryan G. McClarren, Marvin L. Adams, Nancy Amato, Derek Bingham, Chuan-Chih Chou, [and 29 others, including **Erica M. Rutter**]. Radiative effects in radiative shocks in shock tubes. *High Energy Density Physics*, 7(3):130–140, 2011. doi:10.1016/j.hedp.2011.03.005

Peer-Reviewed Conference Proceedings

[26] Hayes F. Stripling, Ryan G. McClarren, Carolyn C. Kuranz, Michael J. Grosskopf, **Erica Rutter**, and Ben R. Torralva. Calibration of uncertain inputs to computer models using experimentally measured quantities and the BMARS emulator. In *Proceedings of international conference on mathematics and computational methods applied to nuclear science and engineering. Rio de Janeiro, Brazil*, 2011.

Pedagogical Materials

[*] Jed Harmon. *Calculus*. Openstax College, 2016. Calculus Volume 1. Calculus Volume 2. Calculus Volume 3. (Listed as contributing author)

[*] Jay P. Abramson and Valereee Falduto. *Precalculus*. Openstax College, 2014. Precalculus. (Listed as a reviewer and consultant in the preface, here)

Grants, Scholarships, and Awards

Grants

In Review	U01, National Cancer Institute, NIH *Title*: Deep Learning Tools for Robust Expert Segmentation in NeuroOncology *Role*: Key Personnel

Scholarships

2016–2017	Dissertation Fellowship, Arizona State University
Fall 2014	GAANN Graduate Student Fellowship
2013	Summer Block Grant Recipient, Arizona State University

Awards

Sept 2018	Travel Award, MICCAI Society NIH
June 2016	Travel Grant, Graduate and Professional Student Association (GPSA), Arizona State University
Apr 2016	Outstanding Research Award, GPSA, Arizona State University
Dec 2015	Teaching Excellence Award, GPSA, Arizona State University
July 2015	Landahl Travel Award, Society for Mathematical Biology
June 2015	Outstanding Poster Award, Mathematical Methods in Systems Biology

Presentations and Invited Talks

Oral

1. (Invited) "Methods for Few-Shot Biomedical Image Segmentation and Learning Equations from Data", presented at the Applied Artificial Intelligence Initiative Seminar Series at University of California, Santa Cruz; March 4, 2020; Santa Cruz, CA.

2. (Invited) "Towards Understanding Cell Migration by Synthesizing Machine Learning and Mathematical Modeling" presented at the Southern California Regional Systems Biology Conference; February 1, 2020; Riverside, CA.

3. (Invited) "Non-Parametric Estimation of Intratumoral Heterogeneity from Spatiotemporal Data" presented at the AMS Special Session on Utilizing Mathematical Models to Understand Tumor Heterogeneity and Drug Resistance, Joint Mathematical Meetings; January 15–18, 2020; Denver, CO.

4. (Invited) "Few-Shot Learning for Biomedical Image Segmentation" presented at the Bay Area Scientific Computing Day; Dec 16, 2019; Berkeley, CA.

5. (Invited) "Propagating Individual Behavior to the Population Scale in Daphnia Magna" presented at the American Mathematical Society (AMS) Western Sectional Meeting; Nov 8–11, 2019; Riverside, CA.

6. "A Convolutional Neural Network Method for Boundary Optimization Enables Few-Shot Learning for Biomedical Image Segmentation" presented at the International Conference for Medical Image Computing and Computer Assisted Intervention (MICCAI); October 13–18, 2019; Shenzhen, China.

7. (Invited) "Modeling, Estimating and Quantifying Uncertainty in Heterogeneous Cancer Models" presented at the Society for Mathematical Biology (SMB) Annual Meeting; July 22–26, 2019; Montreal, Canada.

8. (Invited) "Using Automated Biomedical Image Segmentation to Investigate Cell Morphology" presented at the International Congress on Industrial and Applied Mathematics (ICIAM); July 15–19, 2019; Valencia, Spain.

9. "Non-parametric Techniques for Estimating Tumor Heterogeneity" presented at the Statistical and Applied Mathematical Sciences Institute (SAMSI) Precision Medicine (PMED) Transition Workshop; May 20–21, 2019; Raleigh, North Carolina.

10. (Invited) "Synthesizing Data Science and Dynamical Systems to Model Biological Phenomena" presented at the Mathematical Biology Seminar at Virginia Tech; May 8, 2019; Blacksburg, Virginia.

11. (Invited) "Estimating Intratumoral Heterogeneity from Spatiotemporal Data" presented at the Banff International Research Station - Casa Matemática Oaxaca (BIRS-CMO): Mathematical Challenges in the Analysis of Continuum Models for Cancer Growth, Evolution and Therapy Workshop; Nov 26–30, 2018; Oaxaca, Mexico.

12. (Invited) "Modeling and Estimating Biological Heterogeneity in Spatiotemporal Data" presented at the Statistical and Applied Mathematical Sciences Institute (SAMSI) E&O: Undergraduate Workshop; Oct 22–23, 2018; Raleigh, NC.

13. (Invited) "Optimal Experimental Design for *Daphnia magna* Age-Structured Models" presented at the Society for Mathematical Biology Annual Meeting; July 17–20, 2017; Salt Lake City, Utah.

14. "Influence of Non-Physiological Blood Pressure Artifacts on Cerebral Autoregulation" presented at the AMS Special Session on Mathematics in Physiology and Medicine II, Joint Mathematical Meetings; Jan 4-7, 2016; Atlanta, Georgia.

15. (Invited) "A Mathematical Model of GL261-Luc2 Glioma Growth in Mice" presented at SIAM Conference on the Life Sciences; July 11-14, 2016; Boston, MA.

16. (Invited) "Global Dynamics of a Joint Hormone Therapy and Dendritic Cell Vaccine for Late-Stage Prostate Cancer", presented at the 11th AIMS Conference on Dynamical Systems, Differential Equations, and Applications; July 1-5, 2016; Orlando, FL.

17. "Global Dynamics of a Joint Hormone Therapy and Dendritic Cell Vaccine for Late-Stage Prostate Cancer", presented at BAMM! (Biology and Medicine through Mathematics); May 20-22, 2016; Richmond, VA.

18. "Exploring Partial Differential Equation Models of Glioma Growth", presented at the Partial Differential Equation Seminar at Arizona State University; March 25, 2016; Tempe, Arizona.

19. "Global Dynamics of a Joint Hormone Therapy and Dendritic Cell Vaccine for Late-Stage Prostate Cancer", presented at the Mathematical Biology Seminar at Arizona State University; January 22, 2016; Tempe, Arizona.

20. "A Mathematical Model of GL261-Luc2 Glioma Growth in Mice", presented at Joint Mathematical Meetings; Jan 6-9, 2016; Seattle, Washington.

Poster

1. "Automated Object Tracing for Biomedical Image Segmentation Using a Deep Convolutional Neural Network", presented at the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI); Sept 16-20, 2018; Granada, Spain.

2. "Modeling Tumor Heterogeneity", presented at the Precisision Medicine (PMED) Opening Workshop; August 14, 2018; Raleigh, NC.

3. "Mathematically Modeling Populations of *Daphnia magna*", presented at the Postdoctoral Research Symposium; May 24, 2017; Raleigh, NC.

4. "Global Dynamics of a Joint Hormone Therapy and Dendritic Cell Vaccine for Late-Stage Prostate Cancer", presented at the Association of Women in Mathematics Workshop at Joint Mathematical Meetings; Jan 6-9, 2016; Seattle, Washington.

5. "Data-Validated Model of Glioblastoma Growth in Murine Brains", presented at Society of Mathematical Biology Annual Meeting; June 30-July 3, 2015; Atlanta, Georgia

6. "Analysis of Dendritic Cell Vaccine Therapy with Intermittent Androgen Deprivation Therapy for Late-Stage Prostate Cancer", presented at Mathematical Methods in Systems Biology; June 15-19, 2015; Dublin, Ireland. **Outstanding Poster Award**.

7. "Data-Motivated Models of *in vitro* Glioblastoma Growth", presented a Micro and Macro Systems in Life Sciences; June 8-13, 2015; Bedlewo, Poland.

8. "A Data-Validated Density-Dependent Diffusion model of Glioblastoma Growth" at MBI (Mathematical Biosciences Institute) Cancer and the Immune System Workshop; November 17-21, 2014; Columbus, Ohio.

9. "Kelvin-Helmholtz Instability Modeling using the CRASH Code", presented at 9th International Conference on High Energy Density Laboratory Astrophysics; April 30-May 4, 2012; Tallahassee, Florida.

10. "Modeling the Kelvin-Helmholtz Instability in High-Energy-Density Experiments using CRASH Code", presented at 53rd American Physical Society Annual Division of Plasma Physics Meeting; November 14-18, 2011; Salt Lake City, Utah.

11. "Early-Time Radiation-Hydrodynamic Modeling of Radiative shock Experiments", presented at the 52nd American Physical Society Annual Division of Plasma Physics Meeting; November 8-12, 2010; Chicago, Illinois.

12. "Expected Variation in Shock Behavior due to Experimental Variability" at 8th International Conference on High Energy Density Laboratory Astrophysics; March 15-18, 2010; Pasadena, California.

13. "1D Hyades Study of Varying Input Parameters of a Gaussian Distribution" presented at the 51st American Physical Society Annual Division of Plasma Physics Meeting; November 2-6, 2009; Atlanta, Georgia.

Special Sessions and Minisymposia Organized

1. "Mathematical Biology: Confronting Models with Data" for the American Mathematical Society (AMS) Western Sectional Meeting; May 3–5, 2020; Fresno, CA. *(Canceled due to COVID-19)*

2. "Data-driven mathematical Models of Cell Migration" for 9th International Congress on Industrial and Applied Mathematics (ICIAM); July 15–19, 2019; Valencia, Spain.

3. "Data-Driven Methods for Biological Modeling" for Society of Mathematical Biology Annual Meeting; July 22–26, 2019; Montreal Canada.

Workshops and Short Courses

1. Program on Statistical, Mathematical, and Computational Methods for Precision Medicine (PMED) Opening Workshop; 2018 August 13–17; Raleigh, NC.

2. Tutorial Workshop on Parameter Estimation for Biological Models; 2018 July 25–28; Raleigh, NC.

3. Cancer Systems Biology Short Course at the Center for Cancer Systems Biology UC Irvine; 2018 May 7–26; Irvine, CA.
4. Stoichiometric Ecotoxicology Workshop at NimBios; 2018 Jan 17–19; Knoxville, TN.
5. Tutorial Workshop on Parameter Estimation for Biological Models; 2016 July 28–31; Raleigh, NC.
6. Mathematics in Physiology and Medicine, Mathematics Research Communities (MRC); 2016 June 19–25; Snowbird, UT.

Teaching Experience

Instructor Of Record

Fall 2019	Vector Calculus, University of California, Merced
Fall 2017	Differential Equations for the Life Sciences, North Carolina State University
Spring 2016	Calculus for Engineers II, Arizona State University
Fall 2015	Calculus for Engineers II, Arizona State University
Summer 2015	Calculus for Engineers I, Arizona State University

Teaching Assistant

Fall 2014	Differential Equations Lab Instructor, Arizona State University
Fall 2014	Linear Algebra Lab Instructor, Arizona State University
Spring 2013	Differential Eqns Lab Instructor, Arizona State University
Fall 2012	Calculus and Analytic Geometry I TA, Arizona State University

Teaching Development

Aug 2015	Teaching Assistant Trainer at Arizona State University
2013 – 2015	Textbook Writer for OpenStax

Student Research Experiences

Jan 2014- May 2014	Research Assistant, Arizona State University *PIs: Yang Kuang and Eric Kostelich*
May 2008- Aug 2009	SUBMERGE Research Participant, University of Michigan *PI: Patrick Nelson*
Summer 2007	REU Participant, North Carolina State University *PI: Mette Olufsen*

Professional Development

2019-2021	Project NeXT Fellow
July 2017	Society of Mathematical Biology Mentoring Workshop
2015 – 2016	Preparing Future Faculty, Arizona State Univeristy
Jan. 2016	Association of Women in Mathematics Workshop
June 2015	Society of Mathematical Biology Mentoring Workshop

Service

National: Served as reviewer for the following journals:
- *Scientific Reports*
- *Discrete and Dynamical Systems-B*
- *Mathematical Biosciences and Engineering*
- *Letters in Biomathematics*
- *International Journal for Numerical Methods in Biomedical Engineering*

University-level: Member of the Postdoc Research Symposium Organization committee (2017–2018). Organized an all-day symposium showcasing postdoctoral research at Duke, University of North Carolina and North Carolina State University.

Outreach: Volunteered at "BugFest", hosted at the Raleigh Natural Science Museum in 2016, 2017, and 2018 at the "Math Doesn't Bug Me" Booth. Introduced kids and parents to the fun things that can be done with math.

Research Skills

Wet Lab: Lab Equipment Proficiency: Spectrophotometry, D.O./p.H. readings, pipetting, making hard water, and other basic lab skills.
Electronics: Building computer workstations with GPUs, 3D printing design and usage, robot design and building experience

Computational: Programming Languages: *MATLAB, Fortran, Python, Tensorflow, Keras*
Operating Systems: *Windows, Mac OS, Linux/Unix*
Other Skills: Supercomputing, bash scripting