Michael A. Schwemmer

Contact Information

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Research Interests

I work in mathematical biology, specifically, developing and analyzing mathematical models in neuroscience and psychology. Using asymptotic methods, numerical simulations, bifurcation theory, and deterministic and stochastic dynamical systems, I seek to illuminate underlying mechanisms, and motivate and guide further experimentation.

Education

University of California, Davis, Davis, California, USA

Ph.D., Applied Mathematics, August 2010

- Thesis Topic: *The Influence of Dendritic Properties on the Dynamics of Oscillatory Neurons*
- Adviser: Professor Timothy J. Lewis
- Area of Study: Mathematical Neuroscience

Queens College, CUNY, Flushing, New York, USA

B.A., Mathematics, June 2005

- *Magna cum Laude*
- Phi Beta Kappa
- Minor in Music

Academic Appointments

Postdoctoral Fellow **September 2012 to Present**
Mathematical Biosciences Institute,
The Ohio State University

Postdoctoral Research Fellow **September 2010 to August 2012**
Program in Applied and Computational Mathematics,
Princeton Neuroscience Institute,
Princeton University

NSF VIGRE Research Fellow **September 2005 to August 2010**
Department of Mathematics,
University of California, Davis

Teaching Experience

The Ohio State University
Department of Mathematics

Instructor **Autumn Semester 2013**
(sample student evaluations available upon request)

- MATH 1156: Calculus for the Biological Sciences

Princeton University
Department of Mathematics

Instructor **Spring Semester 2012**
(sample student evaluations available upon request)

- MAT 342: Numerical Methods

Instructor **Spring Semester 2011**
(sample student evaluations available upon request)

- MAT 351: Mathematical Neuroscience
  - Fully responsible for the course which included grading of final presentations and projects in which the students performed original research on topics covered in the course (see my website for example projects).

University of California, Davis
Department of Neurobiology, Physiology, and Behavior

Teaching Assistant **Fall Quarter 2009**

- NPB 267/167: Computational Neuroscience
  - Held office hours, graded homework assignments, and helped the students through a learning module on the simulation environment NEURON.

Department of Evolution and Ecology

Teaching Assistant **September 2008 to September 2009**

- Collaborative Learning at the Interface of Mathematics and Biology (CLIMB) Program
  - A one year research-training program in mathematical biology for UC Davis students in mathematical sciences or biology.
  - I assisted in the mentoring of several scholarship undergraduate students in learning the concepts behind mathematical modeling and analysis in different biological fields and helped them to formulate their own research project. Aided them in their pursuit of their research project: modeling the effects of age structure and voluntary vaccination on outbreaks of measles epidemics.
  - Submitted a research paper with the students and the faculty advisers.

Department of Mathematics

Associate Instructor **Summer Session II 2008**

- Instructor for MAT 22B: Differential Equations
  - Fully responsible for the course.

Teaching Assistant **September 2006 to June 2010**

- MAT 17A and 17C: Calculus for Biology and Medicine (Fall Quarter 2006 and Spring Quarter 2008), MAT 119A: Ordinary Differential Equations (Winter Quarter 2007), and MAT 124: Mathematical Biology (Spring Quarter 2008 and Spring Quarter 2010)
  - Led discussion sections, held office hours, and graded exams.

Undergraduate Mentoring

The Ohio State University

MBI Summer Undergraduate REU Program May 2013

- Introduced students to programming in Matlab and XPP.
- Lead several students in a group project on computational neuroscience.

Princeton University

Abulhair Saparov, B.S.E. Computer Science — August 2011 to August 2013

- PACM Applied Math Certificate Work: Effects of Spike Shape on the Firing Dynamics and Synchronization Properties of Leaky-Integrate-and-Fire Neurons with Dendritic Structure
- This work was awarded the PACM Certificate Prize.

Joel Shor, B.S. Mathematics — July 2011 to September 2011

- Junior Independent Work: Small Dendrites in Networks of Electrically Coupled Fast-Spiking Interneurons.

Refereed Journal Articles

Newby JM and Schwemmer MA. Effects of moderate noise on a limit cycle oscillator: Counterroation and bistability. *Phys. Rev. Lett.* 2014. doi: 10.1103/PhysRevLett.112.114101

Feng SF, Schwemmer MA, Gershman SJ, and Cohen JD. Multitasking vs. multiplexing: Toward a normative account of capacity constraints in cognitive control. *Cogn. Affect. Behav. Ne.* 2014. doi: 10.3758/s13415-013-0236-9

Schwemmer MA and Lewis TJ. The Robustness of Phase-Locking In Neurons with Dendro-Dendritic Electrical Coupling *J. Math. Biol.* 2012. doi: 10.1007/s00285-012-0635-5

Goldfarb S, Wong-Lin K, Schwemmer M, Leonard NE and Holmes P. Can post-error dynamics explain sequential reaction time patterns? *Front. Psychology* 2012. doi: 10.3389/fpsyg.2012.00213

Schwemmer MA and Lewis TJ. Bistability in a Leaky Integrate-and-Fire Neuron with a Passive Dendrite. *SIAM J. Appl. Dyn. Syst.* 2012. doi: 10.1137/110847354

Schraiber JG, Silverstein R, Kaczmarczyk AN, Rutaganira RU, Aggarwal T, Schwemmer MA , Hom CL, Grossberg RK and Schreiber SJ. Constraints on the use of lifespan shortening Wolbachia to control dengue fever. *J. Theor. Biol.* 2012. doi: 10.1016/j.jtbi.2011.12.006

Schwemmer MA and Lewis TJ. Effects of Dendritic Load on the Firing Frequency of Oscillating Neurons. *Phys. Rev. E*, 83:031906. 2011.
doi: 10.1103/PhysRevE.83.031906

Book Chapters

Lewis TJ and Schwemmer MA. Weak Coupling Theory. In: *Encyclopedia of Computational Neuroscience.* (Jaeger D and Jung R eds.), Springer. 2014.

Netoff T, Schwemmer MA, and Lewis TJ. Experimentally Estimating Phase Response Curves of Neurons: Theoretical and Practical Issues. In: *Phase Response Curves in Neuroscience: Theory, Experiment, and Analysis.* (Schultheiss N, Butera R, and Prinz A eds.), Springer. 2012
ISBN: 978-1-4614-0738-6

Schwemmer MA and Lewis TJ. The Theory of Weakly Coupled Oscillators. In: *Phase Response Curves in Neuroscience: Theory, Experiment, and Analysis.* (Schultheiss N, Butera R, and Prinz A eds.), Springer. 2012
ISBN: 978-1-4614-0738-6

Submitted Articles

Davison P, Leonard NE, Olshevsky A, and Schwemmer MA. Nonuniform Line Coverage from Noisy Scalar Measurements.

Conference Papers

Davison P, Schwemmer M, and Leonard NE. Distributed nonuniform coverage with limited scalar measurements. *Proc. Allerton Conf. Communication, Control and Computing*. 2012. doi: 10.1109/Allerton.2012.6483390

Conference Abstracts

Schwemmer MA, Denéve S, Fairhall A, and Shea-Brown E. How precise can we make a biophysical neural integrator? Poster Abstract. Computational and Systems Neuroscience (Cosyne) 2014.

Todd MT, Botvinick MM, Schwemmer MA, Cohen JD, and Dayan P. Rational Analysis of Task Switching. Program No. 194.21, 2011 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2011. Online. Poster Abstract.

Feng SF, Schwemmer MA, Gershman SJ, Holmes PJ, and Cohen JD. Computational Constraints on Cognitive Control. Program No. 930.27, 2011 Neuroscience Meeting Planner. Washington, DC: Society for Neuroscience, 2011. Online. Poster Abstract.

Schwemmer MA and Lewis TJ. Effects of Passive Dendritic Properties on the Dynamics of an Oscillating Neuron. *BMC Neuroscience*, 9:P120 2008. CNS 2008, July, 2008. Poster abstract.

Papers in Preparation

Schwemmer MA, Feng SF, Holmes PJ, Cohen JD, and Gottlieb J. A multi-area stochastic model for a covert visual search task.

Saparov A and Schwemmer MA. Effects of spike shape and dendritic properties on the firing dynamics of leaky-integrate-and-fire Neurons.

Schwemmer MA, Denéve S, Fairhall A, and Shea-Brown E. How precise can we make a biophysical neural integrator?

Shen T, Schwemmer MA, Ludvig E, Groten R, and Leonard NE. On the dynamics of compromise for shared human decision-making with limited feedback and conflicting information

Submitted Grants

NSF DMS-Mathematical Biology
Title: Topological Pressure and the Importance of Spatio-Temporal Interactions in Neural Decoding.
Principal Investigators: D. Koslicki and M.A. Schwemmer
Status: Declined

Referee Service

- *SIAM Journal of Applied Math*
- *PLOS ONE*
- *Journal of Mathematical Neuroscience*
- *Nonlinearity*
- *Journal of Mathematical Psychology*
- *Physical Review*

Conference Service

Co-Organizer for minisymposium:
"Understanding the Link Between Neuronal Dynamics and Neuronal Computation"
SIAM Conference on the Life Sciences 2010 (LS10)
Pittsburgh, PA, July, 2010.

Awards and Honors

Best Graduate Student Poster Award
SIAM Conference on the Life Sciences (LS10)
Pittsburgh, PA. 07/2010

Alice Leung Scholarship in Mathematics
University of California, Davis, CA. 06/2010

Floyd and Mary Schwall Dissertation Year Fellowship in Medical Research
University of California, Davis, CA. 09/2009–06/2010

Samuel Jacobs Award for Excellence in Mathematics
Queens College, CUNY, Flushing, NY. 05/2005

CUNY Honors College Scholar
Queens College, CUNY, Flushing, NY. 08/2001–05/2005

Invited Talks

Science Colloquium 2/6/2014
Ohio Wesleyan University
Rational Analysis in Task Switching

Undergraduate Mathematics Seminar 2/6/2014
Ohio Wesleyan University
Effects of Dendritic Properties on the Firing Dynamics of Neurons

Mathematical Life Sciences Seminar 4/22/2013
Case Western Reserve University
The Effects of Dendritic Properties on the Dynamics of Oscillatory Neurons

Mathematical Biology Seminar 5/31/2011
University of California, Davis
Rational Analysis of Task Switching

Mathematical Biology Seminar 4/5/2011
New Jersey Institute of Technology
The Effects of Dendritic Properties on the Dynamics of Oscillatory Neurons

Dynamical Systems and Nonlinear Science Seminar 2/19/2010
Princeton University
The Effects of Dendritic Properties on the Dynamics of Oscillatory Neurons

Colloquium 2/15/2010
Rice University
The Effects of Dendritic Properties on the Dynamics of Oscillatory Neurons

Poster Sessions

Nonlinear dynamics and stochastic methods: from neuroscience to other biological applications
Pittsburgh, PA. 03/2014
Effects of moderate noise on a limit cycle oscillator: Counterrotation and bistability

Computational and Systems Neuroscience (Cosyne) 2014
Salt Lake City, UT. 02/2014
How precise can we make a biophysical neural integrator?

SIAM Conference on the Life Sciences (LS10)
Pittsburgh, PA. 07/2010
Bistability in a Leaky-Integrate-and-Fire Neuron with a Passive Dendrite

Conference in Honor of John Rinzel's 60^{th} Birthday
NYU, New York, NY. 06/2009
Effects of Dendritic Load on the Firing Frequency of Oscillating Neurons

Seventeenth Annual Computational Neuroscience Conference CNS 2008
Portland, OR. 7/2008
Effects of passive dendritic properties on the dynamics of an oscillating neuron

Davis SIAM Student Research Conference (DSSRC 2008)
University of California, Davis, CA. 5/2008
Effects of passive dendritic properties on the dynamics of an oscillating neuron

Einsteins in the City
City College of New York, CUNY, New York, NY. 2005
Action potential dynamics in simulated and real axons

Society for Neuroscience (SFN), 34th Annual Meeting
San Diego, CA. 10/2004
Action potential dynamics in simulated and real axons

University Service

Co-Lead Organizer Workshop for Young Researchers in Mathematical Biology (WYRMB) 2013
Mathematical Biosciences Institute, 8/2013

Co-Organizer Dynamical Systems and Nonlinear Science Seminar
Princeton University, 9/2010–5/2011

SIAM Club Executive Chairman
University of California, Davis, 6/2008–6/2009

- Chaired the five member executive committee for the Society of Industrial and Applied Mathematics (SIAM) club at UC Davis which promotes applied mathematics throughout the UC Davis campus and provides a forum for students interested in applied mathematics. Organized the second annual Davis SIAM Student Research Conference (DSSRC 2009) which highlights the cutting edge applied mathematics research being performed by students at UC Davis and included two keynote addresses. Successfully orchestrated SIAM funding grant and NSF VIGRE grant proposals to fund projects.

Research Experience for Undergraduates (REU) Aide
University of California, Davis, 7/2006, 7/2008

- Assisted undergraduate students that were performing research with my Ph.D. adviser during the summer.

Workshops Attended

Methods in Computational Neuroscience
Marine Biological Laboratory, Woods Hole, MA
Invited participant, 08/2009

Math Biology Workshop on Building an Interdisciplinary Career
University of Utah, Salt Lake City, UT
Invited Participant, 05/2009

Computational Cell Biology
Cold Springs Harbor Laboratory, Cold Springs Harbor, NY
Invited participant, 06/2008

Professional Memberships

- American Mathematical Society
- Society for Industrial and Applied Mathematics
- Society for Neuroscience

Conferences Attended

Nonlinear dynamics and stochastic methods: from neuroscience to other biological applications
Pittsburgh, PA. (3/2014)

Computational and Systems Neuroscience (Cosyne) 2014
Salt Lake City, UT. (2/2014)

SIAM Conference on the Life Sciences (LS10)
Pittsburgh, PA. (7/2010)

Computational and Systems Neuroscience (Cosyne) 2010
Salt Lake City, UT. (2/2010)

Conference on Neural Dynamics in Honor of John Rinzel's 60^{th} Birthday
NYU, New York, NY. (6/2009)

Davis SIAM Student Research Conference
Davis, CA. (5/2008, 5/2009)

17^{th} Annual Computational Neuroscience Meeting
Portland, OR. (7/2008)

16^{th} Annual Computational Neuroscience Meeting
Toronto, Canda. (7/2007)

Society for Neuroscience 34^{th} Annual Meeting
San Diego, CA. (10/2004)

Skills

Programming Languages: LaTeX, MATLab, FORTRAN, C.
Software: XPP AUTO