

Michael Rempe, PhD

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EDUCATION

Post-doctoral fellow, Mathematical Biosciences Institute (MBI)
September 2006-present
Ohio State University
Mentor: David Terman

Ph.D. Applied Mathematics, August 2006
Northwestern University
Advisor: David Chopp

M.S. Applied Mathematics, December 2002
Northwestern University

B.S. Applied Mathematics, May 1999
University of Colorado, Boulder

RESEARCH EXPERIENCE

Postdoctoral Research, Mathematical Biosciences Institute, Ohio State University, 2006-present

I am using various computational and mathematical techniques to study diverse neural systems. For one project I use single compartment Hodgkin-Huxley like models to simulate neurons in the hypothalamus that regulate body temperature. In another project I use more detailed morphological models to understand a phenomena seen in the retina. Finally, I am using dynamical systems and phase plane analysis to study the neural systems involved in sleep.

Dissertation Research, Northwestern University, 2001-2006

My PhD research dealt with simulating the electrical activity in neurons. I worked with an applied mathematician and an experimental neurophysiologist to develop a domain-decomposition numerical algorithm that allows for spatial adaptivity. The spatial adaptivity results in significant performance improvements compared to non-adaptive methods.

RESEARCH PRESENTATIONS

- *A Mathematical Model of the Human Sleep/Wake Cycle* Poster presentation at Society for Neuroscience annual meeting Nov. 15-19, 2008
- *Circadian and homeostatic dependence of sleep rhythms.* Oral presentation at the first annual OSU-Michigan Sleep Meeting, Ann Arbor, Michigan, September 18, 2008
- *A Mathematical Model of the Sleep/Wake Cycle Based on Neurophysiology.* Oral presentation at the SIAM Conference on the Life Sciences, Montreal, Canada, August 4-7, 2008

- *A Neurobiological Model of the Human Sleep/Wake Cycle*. Poster presentation at the CNS 2008 Meeting, Portland, OR, July 19-24, 2008
- *A Neurobiological model of the human sleep/wake cycle*. Oral presentation at the AMS 2008 Spring Central Section Meeting, Bloomington, IN, April 5-6, 2008
- *Modeling Chloride Cotransporter-dependent Direction Selectivity in the Network of Retinal Starburst Amacrine Cells*. Poster presentation at Society for Neuroscience annual meeting Nov. 3-7, 2007
- *Modeling the Human Sleep/Wake Cycle*. Presentation at the 2007 MBI Institute Partners Meeting, Oct. 28, 2007
- *Compartmental Neural Simulations with Spatial Adaptivity*. Poster presentation at the Society for Neuroscience Central Ohio Chapter Meeting, April 25, 2007
- *Efficient Computational Strategies for Simulating Neural Activity on Branched Structures*. Ohio State Mathematical Biosciences Institute postdoc seminar Oct. 19, 2006
- *Efficient Computational Strategies for Simulating Neural Activity on Branched Structures*. Invited presentation at the University of Colorado Applied Mathematics department Colloquium, Oct. 6, 2006
- *A Domain-Decomposition Algorithm for Neural Simulations with Realistic Morphology*. Poster presentation at Society for Neuroscience annual meeting Nov. 12-16, 2005
- *Efficient Computational Strategies for Simulating Neural Activity*. Poster presentation at Society for Neuroscience annual meeting Oct. 23-27, 2004
- *Adaptive and Moving Meshes in Neural Simulations*. Oral presentation at the NEURON Simulators Meeting, Chicago, IL, May 14-16, 2004
- *Computational Neuroscience: from Hodgkin and Huxley to adaptive meshes*. IGERT Student Seminar, Northwestern University, May 7, 2003

PUBLICATIONS

- Rempe, M.J., Dmitriev, A.V., Gavrikov, K.E., Terman, D. and Mangel, S.C. A Morphologically-Accurate Model of Direction Selectivity in the Starburst Amacrine Cell Network (*In preparation*)
- Rempe, M.J., Best, J. and Terman, D. A Neurobiological Model of the Human Sleep/Wake Cycle.(MBI Technical Report No. 72)
- Rempe, M.J., Spruston, N., Kath, W.L. and Chopp, D.L. Compartmental Neural Simulations with Spatial Adaptivity *J Comp Neuro* **25:3** 465-480 (2008)
- Rempe, M.J. and Chopp, D.L. A Predictor-Corrector Algorithm for Reaction-Diffusion Equations Associated with Neural Activity on Branched Structures *SIAM J. Sci. Comput.* **28:6** 2139-2161 (2006)
- Staab, P.L., Rempe, M.J. and Kassoy, D.R., Acoustic-Rotational Internal Flow Caused by Transient Sidewall Mass Addition. *SIAM J. of Applied Mathematics* **65** 587-617 (2005).

TEACHING
EXPERIENCE

*Course Instructor, Calculus III
Mathematics Department*

**Ohio State University
Spring 2008**

*Group Project Leader, Calculus for
Life Sciences
Mathematics Department*

**Ohio State University
Winter 2007 & Winter 2008**

This course is designed to introduce biology students to mathematical modeling in biology. In 2007 I designed a group project that applied calculus to EEG recordings. In 2008 I designed a project about coupled integrate-and-fire neuron models. For each class I gave review sessions and met with students in smaller groups to answer questions and give them guidance.

*Course Instructor, Calculus III
EXCEL summer program*

**Northwestern University
Summer 2004 and 2005**

The EXCEL program is a one-month intensive program for incoming freshmen at Northwestern. Teaching responsibilities are similar to those of a professor: preparing a course syllabus, preparing and giving lectures, preparing and grading homework and exams, assigning final grades.

*Teaching Assistant
Honors Calculus*

**Northwestern University
Fall 2003**

Responsibilities included teaching a class of 20 once a week, holding office hours, and grading homework and exams.

SERVICE

**MBI Summer program in Mathematical Biology for Undergraduates,
July 2008**

As a team leader I designed and oversaw a research project for a group of 5 talented undergraduates. The students presented their results in a poster session and oral presentation. In addition, I advised two students who continued the research for the rest of the summer. One student is doing a senior thesis project on this work.

**MBI Workshop for Young Researchers in Mathematical Biology
Spring 2007, Fall 2007 and Fall 2008**

This workshop is organized entirely by the post-docs at the MBI. Working on a committee with other post-docs I reviewed applications, invited speakers, organized the workshop schedule and chaired sessions.

MBI Postdoc Seminar, Fall 2007

I organized this weekly seminar during the fall quarter of 2007. I invited speakers and arranged the schedule. During the seminar I introduced the speakers and facilitated questions.

Journal Referee

Journal of Computational Neuroscience

AWARDS

- IGERT Interdisciplinary Dynamics of Complex Systems Fellowship 2001-2004
- COMAP Mathematical Contest in Modeling, 1999 Honorable Mention
- 4th Undergraduate Data Analysis Contest, 1998, tied for second place in written portion and first place in analysis portion

SOCIETY MEMBERSHIPS

- Society for Industrial and Applied Mathematics (SIAM)
- Society for Neuroscience (SfN)