

Final Report for Period: 11/2011 - 04/2012**Submitted on:** 09/20/2012**Principal Investigator:** Butera, Robert J.**Award ID:** 0333411**Organization:** Georgia Tech Research Corp**Submitted By:**

Butera, Robert - Principal Investigator

Title:

IGERT: Hybrid Neural Microsystems: Integrating Neural Tissue and Engineered Systems

Project Participants**Senior Personnel****Name:** Calabrese, Ronald**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Newstetter, Wendy**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Butera, Robert**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Lee, Terri**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Butera, Robert**Worked for more than 160 Hours:** Yes**Contribution to Project:****Post-doc****Graduate Student****Undergraduate Student****Technician, Programmer****Other Participant****Research Experience for Undergraduates****Organizational Partners****Other Collaborators or Contacts**

Activities and Findings

Research and Education Activities:

see uploaded report

Findings:

see uploaded report

Training and Development:

see uploaded report

Outreach Activities:

see uploaded report

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

see attached report

Contributions to Other Disciplines:

see attached report

Contributions to Human Resource Development:

see attached report

Contributions to Resources for Research and Education:

see attached report

Contributions Beyond Science and Engineering:

see attached report

Conference Proceedings

Categories for which nothing is reported:

Organizational Partners

Any Journal

Any Book

Any Web/Internet Site

Any Product

Any Conference

NSF Integrative Graduate Education and Research Traineeship

Final Report

Award ID: 0333411

Final Report for Period: 2003 - 2013

Institution: Georgia Institute of Technology

Title: Hybrid Neural Microsystems: Integrating Neural Tissue and Engineered Systems

Research Accomplishments

The goal of this IGERT program was to cross train engineers and neuroscientists on the development of technologies and methodologies related to interfacing engineered systems to neural tissue, especially at the microscale level. Due to the breadth of the scope, it is hard to discern particular well-defined aggregate or programmatic accomplishments. However, when one examines the many research accomplishment we have reported by various IGERT trainees through the years, one common theme stands out: our most successful project all broadly fit into the category of "technologies and methodologies that accelerate scientific discovery." This is not entirely surprising, but I do not think we expected back in 2003 that this term would accurately describe our most notable accomplishments.

Here are a few brief examples:

 Graduated trainee Brock Wester's development and commercialization of "micro-tweezers", already described under the Research Accomplishments section of this report;

graduated trainee Risa Lin, who was a key developer of open-source software facilitating novel forms of electrophysiology experiments (<http://www.rtxi.org>);

and

graduated trainee Jeremy Lewi, who utilized optimization and statistical approaches to maximize information that can be obtained in a limited amount of time in sensory neuroscience experiments.

Below are 3 more expanded examples of technologies and methodologies accelerating scientific discovery in neuroscience.

IGERT graduate Dr. Cassie Mitchell (PhD 2009) developed relational modeling and analysis techniques to predict the mechanisms and dynamics of various physiologies and pathologies. The techniques enabled the development of comprehensive, multi-scalar models of systems that are intractable to traditional mechanistic modeling techniques. The methods facilitate the elucidation of mechanisms that underlie the emergent properties of complex biological systems, giving predictive insights that can be used to generate testable hypotheses from computational models or from experimental and clinical data. The technique has been successfully used to produce the first-ever comprehensive view of spinal cord injury (SCI) that accurately predicts previously unknown dynamics of 20 common metrics of SCI for up to 16 hours post insult. This model was utilized as a test bed to predict the results of over 50,000 different combinatorial therapeutic treatment strategies. Cassie has continued this work and is now funded by NIH with a career development award to continue this line of research.

C. elegans is a nematode widely used in neuroscience because of its simple nervous system. Its mapped genome enables it to serve as a screen for novel mutations linked to neuropathologies. Visual screens require significant amounts of manual operations and can be very time consuming. In recent years, researchers have coupled microfluidic devices with genetic screening methods of *C. elegans* to perform high-throughput experiments. Trainee Ivan Caceres designed a microfluidic device capable of passively orienting nematodes into lateral orientations by exploiting device channel geometry. By utilizing curved channel designs, Ivan's device can position animals into lateral orientations greater than 80% of instances, when compared to less than 25% using traditional straight channel methods. To verify this new technique, Ivan performed a genetic pilot screen of over 10,000 *C. elegans* on-chip, and isolated 6 mutations that are suspected to be involved with neurodegeneration and development genes.

Successful locomotion by animals emerges from the interplay between neuromechanical systems with the physical environment. Trainee Sarah Sharpe, Yang Ding and Daniel Goldman investigated the neuromechanical control strategy utilized by the sandfish lizard during subsurface swimming through sand. This study combined the use of high speed x-ray and visible light video with synchronized electromyogram recordings of axial musculature. They found an anterior-to-posterior traveling wave of muscle activation that corresponded with a single period traveling wave of curvature. EMG intensity increased with depth and was independent of speed; similarly, resistive forces within granular media increased with depth but not speed due to friction-dominated intrusion forces. Models revealed that the waveform utilized by the sandfish maximized speed and minimized mechanical cost of transport, suggesting that sandfish targeted these kinematics to achieve optimal sand-swimming.

Educational Accomplishments

There are two major educational accomplishments worth noting. One is with regards to the recruitment and training of graduate students across disciplines. The second is with regards to the post-IGERT impact on the graduate and undergraduate curricula.

First: A programmatic goal of the IGERT was to train a new generation of student in the techniques of interfacing engineered systems to neural tissue. One of the by-products of this training has been the creation of a sizeable demand for engineering PhD students to work for neuroscientists. Five neuroscience faculty at Emory University have advised over 15 IGERT fellows over the course of the IGERT funding. While the IGERT funding has now ended, this demand has continued, and we routinely place Bioengineering and Biomedical Engineering PhD students in Neuroscience labs at Emory University. Evidence of this demand is financial: Neuroscience faculty seek out these students even though they "cost more!" . While Neuroscience PhD students are no cost to the PI for the first 18 months and engineering students must be financially supported from day one, these faculty and other still seek to hire our PhD students with every new incoming class. The success of the IGERT program has built a reputation that attracts these high caliber of students to our PhD programs. Second: A primary goal of our Hybrid Neural Microsystems course is self-directed inquiry in a laboratory

setting. The primary goals for the course were for each team of students to explore a research area linked to these neurobiological system and related technology presented in the course, to propose a research project to control the activity of the targeted neuronal system, and to complete this research project and write/present the results. With the conclusion of the IGERT program, the course no longer exists - this is largely due to the time and effort to support the faculty time to teach a graduate-level laboratory course, which is unusual. On the positive side, elements of this course have impacted the graduate and undergraduate curriculum. The Biomedical Engineering "Integrative Core" graduate courses utilize problem-based learning to introduce students into their sub-discipline, and the topics and teaching methods were influenced by the Hybrid Neural Microsystems course. At the undergraduate level, many elements of the Hybrid Neural Microsystems course have been incorporated into a senior level "Neuroengineering Fundamentals" course taught by Dr. Steve Potter. It is one of the few senior electives in the undergraduate program with an extensive lab component. Some of these labs derived from the labs that we developed for the IGERT-funded Hybrid Neural Microsystems course.

Major Trainee Accomplishments

A common outcome of many of our trainees was to leverage their engineering backgrounds with a solid scientific experience through co-mentorship. Many of our students have become accomplished in their fields (see past annual reports) by applying quantitative and engineering techniques to basic neuroscience problems. These cross-trained students represent the future, and their hybrid training will likely impact the training of future neuro-engineers who will become skilled researchers in both the science and engineering aspects of neuroscience research. It would be redundant to repeat the examples that have been described in earlier annual reports of individual accomplishments. However, in this final report we wish to highlight a few examples of those individuals who really went "above and beyond" the typical trainee trajectory to a Ph.D. All of these examples highlight the level of initiative of our trainees to go beyond "just research" and leverage their expertise in new directions, whether they be educational or entrepreneurial.

IGERT trainee Jon Newman served as a volunteer mentor at Rainbow Village, a non-profit institution that provides transitional housing to families in North Atlanta suffering from domestic or economic crisis. Jon volunteered for five hours, one day a week as a mentor in Rainbow Village's after school youth program for about five months, teaching basic scientific principals in a formal setting to students In Grades 1-9. With subsequent funding by Cisco Systems, Jon worked with a group of professional engineers from various organizations around Atlanta to mentor the children at Rainbow village through a coherent month long engineering project. Students worked in groups to apply the engineering design process and the scientific method to the creation of a device inspired by their imagination.

IGERT trainee Brock Wester was involved in a research project to fabricate microtweezers and to develop their biomedical applications. This technology was initially developed across three IGERT labs (Mark Allen, Steve DeWeerth, and Michelle LaPlaca) to serve a specific in-house need. More generally, the technology addresses critical needs for robust, low-cost tools to manipulate and interface with micron and sup-micron scaled objects. To address these needs,

Brock and two other graduate students developed a company to commercialize the technology. The company enjoyed some initial commercial success by distributing its bas microtweezer tool suite through Signatone Corporation (www.signatone.com), a micro-probe company. The company, called NanoGrip Technologies (c-corp), developed a more commercially outsource-able second generation microtweezer platform and tool suite. This company no longer exists, but its technology has been licensed and is commercially available. A video demonstrating these tweezers is available at <http://www.youtube.com/watch?v=XNT6OCXzhBM>

As a final example, trainee Sarah Sharpe (Steinmetz), pursuing a PhD in Bioengineering, is an outstanding example of utilizing engineering training to tackle complex scientific problems. She works in the laboratory of physicist Dan Goldman. Organisms like the desert sandfish lizard must locomote on and within a complex granular medium. Sarah investigates how the sandfish accommodates to different medium conditions. She used synchronized x-ray and visible light imaging with electrically-recorded muscle activity during above-surface and subsurface movement. While moving on the surface, the sandfish does not exhibit lateral bending and does not activate its back muscles. During subsurface sand-swimming, the sandfish uses a single-period traveling wave of body undulations. Muscle activation intensity only changes slightly between a closely and loosely packed medium. Overall, the difference in the EMG pattern can be attributed to the unique physics of the granular media in which the sandfish interacts. This was the first study of its kind to investigate muscle activation in a desert sand-swimmer. This kind of research is not just science for science's sake, but informs our understanding of general principles underlying locomotion and has been utilized by others for advances in biologically inspired robots.

Accomplishments from the International Component

The international component was a surprising outcome.

As originally envisioned, students would work with their advisors to find collaborative relationships with overseas laboratories. This didn't work as well as planned. First, although NSF provided a generous \$500K for this initiative, the students felt that they were not ready (intellectually, as well as advanced enough on their research projects). Also, there seemed to be some hesitation on the part of the students.

Steve DeWeerth (PI at the time) took the initiative to kick-start international efforts. In the summer of 2008, eight of the IGERT students went to Europe, to spend 3-4 weeks in foreign labs. Students went to labs in Paris, Bordeaux, Marseille, Lausanne and Milan. Labs had been selected based on research interests, potential for collaboration and existing faculty relationships. The main goals of this program were: spend time in a lab in another country; understand cultural differences in scientific research; learn new techniques and new ideas; initiate potential longer-term relationships; and lay the basis for future international collaborations.

Something amazing happened after this trip - the "word" was out. For the summers of 2009 and beyond, we had no trouble at all motivating the students to seek out collaborators and propose

such joint initiatives. Students were invited to submit proposed for trips of 3-6 weeks in duration, and were required to submit final reports shortly after returning. Over two dozen individual trips were funded, the largest being the summer of 2010 where 16 IGERT fellows traveled to work in over-seas laboratories.

This wound up being a resounding success, as evidenced by the number of trips and countries visited, itemized on our individual annual reports. Many students reported having a life-changing perspective on both how research is conducted in another country as well as the experience of living in another country, and not as a tourist! Some students wound up learning new techniques, others developed collaborative projects in new directions they could not have pursued with their current advisor, and still more catalyzed joint activities between their lab and the overseas lab where they visited.

Here we highlight some excellent examples of such collaboration:

Fred Sieling (Advisors: A. Prinz, R. Butera) worked with a group in at the University of Bordeaux to measure changes in network behavior in an identified neural circuit. He obtained preliminary data and plans to return to the host lab for additional experiments that will give rise to one or more publications. IGERT trainee Fred Sieling developed a collaborative project with Drs. Romuald Nargeot and John Simmers at the Neurobiologie Adaptative des Systèmes Moteurs Laboratory at Université Victor Segalen Bordeaux 2. Using IGERT international travel funds, he worked for three weeks in Bordeaux in June 2008, first setting up two real-time measurement and stimulation devices to work with the existing electrophysiology hardware, then conducting experiments in a model of operant conditioning contained primarily in a network of six neurons of the Buccal Ganglia In *Aplysia* that Drs. Nargeot and Simmers had published in a recent paper. Preliminary data were promising. Fred returned to Bordeaux in June 2009 and again in 2010 to collect more data and write up the results. This collaborative research project applied Fred's skills (learned in Atlanta) to study the neural basis of feeding behavior in the marine mollusc *Aplysia*. This entire project was Fred's initiative and will result in a peer reviewed paper and a longer-term technical/scientific collaboration.

Trainee Ivan Caceres, a doctoral student in the Georgia Tech Bioengineering degree program (advised by Dr. Hang Lu, Associated Professor In the School of Chemical and Biomolecular Engineering), traveled to Australia to the University of Queensland to work with Dr. Massimo Hilliard to learn genetic mapping techniques and to learn more about what tools the Hilliard laboratory would need to make their work more efficient. During his three weeks there he setup crosses between mutant and wild type strains to purify genetic mutations Involved In neurodegeneration in addition to setting a standard for classification of animals with neurodegenerative phenotypes between both the Lu and Hilliard laboratories. Ivan returned on a subsequent summer to (1) recreate his microfluidic system for high throughput screening of *C. elegans* using the hardware available in the Hilliard laboratory, (2) train members of the Hilliard laboratory how to operate his system, and (3) perform a pilot screen searching for novel neural development and degeneration mutants. They successfully isolated a mutant from our pilot screen believed to be involved with neural development, and since his return have further characterized this animal and included the results of the analysis in a journal publication. This publication was highlighted as the "Nugget" on our 2012 annual report.

Trainee Ming-Fai Fong visited Juerg Streit's group at the University of Bern in 2010. She chose this lab because they use similar techniques and model systems as her current lab (e.g. multielectrode arrays, whole cell patch clamp, and spinal slices), but are asking questions with

more direct application than her current project. The goal of the visit was to help develop and validate an in vitro model for recovery after spinal cord injury, using both functional and morphological markers. One particularly interesting skill she acquired was culturing organotypic slices onto MEAs. Over the course of five weeks, Ming conducted 83 experiments, that involved culturing, lesioning, electrophysiology, and immunohistochemistry. She is currently in the processing of preparing an abstract with Dr. Streit, and expects that her results will be included in a manuscript.

IGERT Project Personnel and Trainees

Principal Investigator(s)

Name: Robert J. Butera

Project Years Active: 2009-2010, 2010-2011, 2011-2012

Name: Stephen P. DeWeerth

Project Years Active: 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010

Co-Principal Investigator(s) or Trainee/Associate Advisor(s)

Name: Mark G. Allen

Project Years Active: 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: David V. Anderson

Project Years Active: 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011

Role in Project: Trainee/Associate Advisor

Name: Ravi V. Bellamkonda

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Barbara D. Boyan

Project Years Active: 2005-2006

Role in Project: Trainee/Associate Advisor

Name: Beth Buffalo

Project Years Active: 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Robert J. Butera

Project Years Active: 2003-2004, 2004-2005, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Co-PI and Trainee/Associate Advisor

Name: Ronald L. Calabrese

Project Years Active: 2003-2004, 2004-2005, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Co-PI and Trainee/Associate Advisor

Name: Young-Hui Chang

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Stefan Clemens

Project Years Active: 2006-2007, 2007-2008, 2008-2009

Role in Project: Trainee/Associate Advisor

Name: Daniel I. Goldman

Project Years Active: 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Danielle N. Gray

Project Years Active: 2003-2004

Role in Project: Co-PI

Name: Martha Grover

Project Years Active: 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Paul E. Hasler

Project Years Active: 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Shawn Hochman

Project Years Active: 2005-2006, 2007-2008, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Dieter Jaeger

Project Years Active: 2006-2007, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Michelle C. LaPlaca

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Robert H. Lee

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011

Role in Project: Co-PI and Trainee/Associate Advisor

Name: Terri T. Lee

Project Years Active: 2004-2005, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Co-PI

Name: Robert C. Liu

Project Years Active: 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Hang Lu

Project Years Active: 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Wendy C. Newstetter

Project Years Active: 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Co-PI

Name: T Richard Nichols

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Steve M. Potter

Project Years Active: 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Astrid A. Prinz

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011

Role in Project: Trainee/Associate Advisor

Name: Christopher Rozell

Project Years Active: 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Stephen Sprigle

Project Years Active: 2005-2006, 2007-2008, 2008-2009, 2009-2010, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Garrett B. Stanley

Project Years Active: 2009-2010, 2010-2011, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Allen R. Tannenbaum

Project Years Active: 2007-2008

Role in Project: Trainee/Associate Advisor

Name: Lena H. Ting

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011

Role in Project: Trainee/Associate Advisor

Name: Eberhard O. Voit

Project Years Active: 2007-2008, 2008-2009, 2009-2010, 2011-2012

Role in Project: Trainee/Associate Advisor

Name: Peter Wenner

Project Years Active: 2011-2012

Role in Project: Trainee/Associate Advisor

Trainees

Name: JoAnna T. Anderson

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months

2006-2007 Project Year - Trainee supported for 12 months

2007-2008 Project Year - Trainee supported for 0 months

2008-2009 Project Year - Trainee supported for 0 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Santiago Archila

Total number of months funded: 24

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months

2007-2008 Project Year - Trainee supported for 12 months

2008-2009 Project Year - Trainee supported for 0 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Delano J. Billingsley

Total number of months funded: 12

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months

Date left the IGERT project: 06/2006

Left IGERT with a terminal master's degree: No

Reason for stopping the pursuit of the Ph.D.:

Name: Stephen I. Brink

Total number of months funded: 24

Project Years Active:

2006-2007 Project Year - Trainee supported for 10 months

2007-2008 Project Year - Trainee supported for 12 months

2008-2009 Project Year - Trainee supported for 2 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Anthony S. Buscemi

Total number of months funded: 14

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months

2006-2007 Project Year - Trainee supported for 2 months

Date left the IGERT project: 05/2007

Left IGERT with a terminal master's degree: No

Reason for stopping the pursuit of the Ph.D.:

Name: Ivan D. Caceres

Total number of months funded: 26

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months

2007-2008 Project Year - Trainee supported for 12 months

2008-2009 Project Year - Trainee supported for 2 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Jason A. Carpentier

Total number of months funded: 3

Project Years Active:

2005-2006 Project Year - Trainee supported for 3 months

Date left the IGERT project: 10/2005

Left IGERT with a terminal master's degree: No

Reason for stopping the pursuit of the Ph.D.:

Name: Stacie A. Chvatal

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months

2006-2007 Project Year - Trainee supported for 12 months

2007-2008 Project Year - Trainee supported for 0 months

2008-2009 Project Year - Trainee supported for 0 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

Name: Isaac P. Clements

Total number of months funded: 26

Project Years Active:

2004-2005 Project Year - Trainee supported for 12 months

2005-2006 Project Year - Trainee supported for 12 months

2006-2007 Project Year - Trainee supported for 2 months

2007-2008 Project Year - Trainee supported for 0 months

2008-2009 Project Year - Trainee supported for 0 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

Name: Si J. Feng

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months

Name: Ming-fai Fong

Total number of months funded: 12

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 2 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Clare A. Gollnick

Total number of months funded: 17

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 2 months
2010-2011 Project Year - Trainee supported for 5 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Kenneth R. Hammett

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Heather B. Hayes

Total number of months funded: 26

Project Years Active:

2004-2005 Project Year - Trainee supported for 12 months
2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 2 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months

Name: Eric B. Hendrickson

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months

Name: Ryan M. Hooper

Total number of months funded: 10

Project Years Active:

2007-2008 Project Year - Trainee supported for 10 months

2008-2009 Project Year - Trainee supported for 0 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Amber E. Hudson

Total number of months funded: 22

Project Years Active:

2006-2007 Project Year - Trainee supported for 10 months

2007-2008 Project Year - Trainee supported for 12 months

2008-2009 Project Year - Trainee supported for 0 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Aaron C. Hughes

Total number of months funded: 10

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

Name: Nathan J. Killian

Total number of months funded: 22

Project Years Active:

2007-2008 Project Year - Trainee supported for 10 months

2008-2009 Project Year - Trainee supported for 12 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Michelle L. Kuykendal

Total number of months funded: 24

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months

2007-2008 Project Year - Trainee supported for 2 months

2008-2009 Project Year - Trainee supported for 10 months

2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

2011-2012 Project Year - Trainee supported for 0 months

Name: Damon Lamb

Total number of months funded: 23

Project Years Active:

2007-2008 Project Year - Trainee supported for 11 months

2008-2009 Project Year - Trainee supported for 12 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Jeremy M. Lewi

Total number of months funded: 13

Project Years Active:

2004-2005 Project Year - Trainee supported for 12 months
2005-2006 Project Year - Trainee supported for 1 months
2006-2007 Project Year - Trainee supported for 0 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months

Name: Frank Lin

Total number of months funded: 26

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 12 months
2008-2009 Project Year - Trainee supported for 2 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Risa J. Lin

Total number of months funded: 26

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 12 months
2008-2009 Project Year - Trainee supported for 2 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: John M. Melonakos

Total number of months funded: 12

Project Years Active:

2004-2005 Project Year - Trainee supported for 12 months
2005-2006 Project Year - Trainee supported for 0 months
2006-2007 Project Year - Trainee supported for 0 months

Name: Graham T. Miller

Total number of months funded: 13

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 3 months

Name: Cassie S. Mitchell

Total number of months funded: 21*

Project Years Active:

2004-2005 Project Year - Trainee supported for 0 months
2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months

Name: Jonathan P. Newman

Total number of months funded: 22

Project Years Active:

2007-2008 Project Year - Trainee supported for 10 months
2008-2009 Project Year - Trainee supported for 12 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Sharon E. Norman

Total number of months funded: 24

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 2 months
2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Robert L. Ortman

Total number of months funded: 12

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 2 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Lauren E. Reese

Total number of months funded: 24

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 12 months
2008-2009 Project Year - Trainee supported for 0 months

Name: Samuel Shapero

Total number of months funded: 12

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 2 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Sarah S. Sharpe

Total number of months funded: 22

Project Years Active:

2007-2008 Project Year - Trainee supported for 10 months
2008-2009 Project Year - Trainee supported for 12 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: James T. Shoemaker

Total number of months funded: 26

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 12 months
2008-2009 Project Year - Trainee supported for 2 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Fred H. Sieling

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months

Name: Wafa A. Soofi

Total number of months funded: 17

Project Years Active:

2008-2009 Project Year - Trainee supported for 10 months
2009-2010 Project Year - Trainee supported for 2 months
2010-2011 Project Year - Trainee supported for 5 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Victoria A. Stahl

Total number of months funded: 26

Project Years Active:

2004-2005 Project Year - Trainee supported for 12 months
2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 2 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months

Name: Christopher I. Tuthill

Total number of months funded: 26

Project Years Active:

2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 12 months

2008-2009 Project Year - Trainee supported for 2 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months
2011-2012 Project Year - Trainee supported for 0 months

Name: Keith W. Van Antwerp

Total number of months funded: 8

Project Years Active:

2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 8 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months

Name: Brock A. Wester

Total number of months funded: 14

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 2 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months

Name: Terrence M. Wright

Total number of months funded: 24

Project Years Active:

2004-2005 Project Year - Trainee supported for 12 months
2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 0 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months

Name: Jasper T. Yen

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months
2010-2011 Project Year - Trainee supported for 0 months

Name: Amanda L. Zimmerman

Total number of months funded: 21*

Project Years Active:

2005-2006 Project Year - Trainee supported for 12 months
2006-2007 Project Year - Trainee supported for 12 months
2007-2008 Project Year - Trainee supported for 0 months
2008-2009 Project Year - Trainee supported for 0 months
2009-2010 Project Year - Trainee supported for 0 months

2010-2011 Project Year - Trainee supported for 0 months

* The total number of months funded has been adjusted to account for the change in reporting period that happened in the 2006-2007 project year. Due to the changes in the reporting period there was a 3 month overlap between the 2005-2006 and 2006-2007 project years.

Associates

Name: Jeffrey T. Bingham

Project Years Active: 2010-2011, 2011-2012, 2012-2013

Name: Samir K. Das

Project Years Active: 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: Mason Graff

Project Years Active: 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: Dustin J. Li

Project Years Active: 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: George C. McConnell

Project Years Active: 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: Douglas Ollerenshaw

Project Years Active: 2010-2011, 2011-2012, 2012-2013

Name: Sharon E. Sonenblum

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: Kartik Sundar

Project Years Active: 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: Tzu-Hsin B. Tsao

Project Years Active: 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Name: Randall K. Weinstein

Project Years Active: 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013

Publications, Presentations, and Patents

Journal Articles in Refereed Publications

Weinstein, Randall K. and Lee, Robert H. (2006) Architectures for High-Performance FPGA Implementations of Neural Models, *Journal of Neuroengineering*, 3(1), 21-34.

Raju, D V.; Dhah, D J.; *Wright, Terrence M.; Hall, R A.; and Smith, Y. (2007) Developmental reorganization of the output of a GABAergic interneuronal circuit, *Journal of Neurophysiology*, 22(2), 258-264.

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Auyang A.G., Yen*, J.T. & Chang, Y.H. (2009) Neuromechanical Stabilization of Leg Length and Orientation through Interjoint Compensation during Human Hopping. *Experimental Brain Research* 192: 253-264. BalE, Harden E, Lamb D*, Van Heeke AV, Denver JW, Porges SW (2010) Emotion recognition in children with autism spectrum disorders: relations to eye gaze and autonomic state. *Journal of Autism and Developmental Disorders* 40:358-70. Basu, A., *Brink, S., Schlottmann, C., Ramakrishnan, S., Petre C., Koziol, S., Baskya, F., Twigg, C., and Hasler, P. (2010). A Floating-gate based Field Programmable Analog Array. *IEEE Journal of Solid State Circuits*. 45:1781-1794. Basu, A., Ramakrishnan, S., Petre C., Koziol, S., *Brink, S. and Hasler, P. (2010). Neural Dynamics in Reconfigurable Silicon. *IEEE Transactions on Biomedical Circuits and Systems*. 4:311-319. *Caceres IC, Valmas N, Hilliard MA, Lu H (2012) Laterally Orienting C. elegans Using Geometry at Microscale for HighThroughput Visual Screens in Neurodegeneration and Neuronal Development Studies. *PLoS ONE* 7(4): e35037. Canavier, C.C., Sieling", F.H. & Prinz, A.A. (2009). Dynamic-clamp constructed hybrid circuits for the study of synchronization phenomena in networks of bursting neurons. In: Destexhe A, Bal T, eds. *Dynamic clamp: from principles to applications*. Springer, New York NY: 261-273. Clemens, Stefan; Rye, D; and Hochman, Shawn. (2006) Restless Legs Syndrome: Revisiting the Dopamine Hypothesis from the Spinal Cord Perspective", *Neurology*, 67(1), 125-130. Galindo-Leon EE Lin FG*, Liu RC (2009) Inhibitory plasticity in a lateral band improves cortical detection of natural vocalizations. *Neuron* 62:705-716. Clements IP*, Kim YT, English AW, LuX, Chung A, Bellamkonda RV. (2009) "Thin-film enhanced nerve guidance channels for peripheral nerve repair." *Biomaterials* 30(23-24):3834-46. Grill WE, Norman SE*, and Bellamkonda RM. (2009) "Implanted Neural Interfaces: Biochallenges and Engineered Solutions", *Annual Review of Biomedical Engineering*, 11:1-24. Hayes*, H.B., Chang, Young-Hui. & Hochman, S. (2009). An in vitro Spinal-cord Hindlimb Preparation for Studying Behaviorally Relevant Rat Locomotor Function. *Journal of Neurophysiol* 101(2): 1114-1122. Hochman S, Gozal EA, *Hayes HB, *Anderson JT, DeWeerth SP, Chang Y-H (2012) Enabling techniques for in vitro studies

on mammalian spinal locomotor mechanisms. *Frontiers in Bioscience* 17, 2158-2180.

Hudson AE*, Prinz AA. Conductance ratios and cellular identity. (2010) *PLoS Computational Biology*. 6(7):e1000838. *Hudson, A.E., *Archila, S., and Prinz, A.A. (2010). Identifiable cells in the crustacean stomatogastric ganglion. *Physiology*. 25:311-318.

Ivanova, T., Matthews, A., Gross, C., Mappus, R. C., *Gollnick, C., Swanson, A., Bassell, G. J., and Liu, R. C. (2011). Arc/Arg3.1 mRNA expression reveals a sub-cellular trace of prior sound exposure in adult primary auditory cortex. *Neuroscience*. 181:117-126.

Kotov NA, Winter JO, Clements IP*, JanE, Timko BP, Campidelli S, Pathak S, Mazzatenta A, Lieber CM, Prato M, Bellamkonda RV, (2009) Nanomaterials for Neural Interfaces. *Advanced Materials* 21(40):3970-4004. *Lamb DG, Calabrese RL. (2012) Small is beautiful: Models of small neuronal networks. *Current Opinion in Neurobiology*, PMID: 22364687

*Lamb DG, Calabrese RL. (2011) Neural circuits controlling behavior and autonomic functions in medicinal leeches. *Neural Systems and Circuits*, 1:13.

*Lin, F. G., and Liu, R.C. (2010). Subset of thin spike cortical neurons preserve the peripheral encoding of stimulus onsets, *Journal of Neurophysiology*. 104:3588-3599.

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Maran, S.K., *Sieling, F.H., Demla, K., Prinz, A.A., and Canavier, C.C. (2011). Responses of a bursting pacemaker to excitation reveal spatial segregation between bursting and spiking mechanisms. *Journal of Computational Neuroscience*. 31(2):419-40.

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Norris, B.J., Wenning, A., *Wright, T.M., and Calabrese, R.L. (2011). Constancy and variability in the output of a central pattern generator. *Journal of Neuroscience*. 31:4663-4674.

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*Sieling FH, *Archila S, *Hooper RS, Canavier CC, Prinz AA. (2012) Phase response theory extended to nonoscillatory network components. *Physical Review*, article 056208 (5 pages).

*Soofi WA, *Archila S, Prinz, AA. (2011) Co-variation of ionic conductances supports phase maintenance in stomatogastric neurons. *Journal of Computational Neuroscience*. 33(1):77-95.

Vaughan Van Heeke A, Lebow J, Bale E, Lamb D*, Harden E, Kramer A, Denver J, Bazhenova O, Porges SW (2009) Electroencephalogram and heart rate regulation to familiar and unfamiliar people in children with autism spectrum disorders. *Child Development* 80:1118-1133.

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*Wester, B.A., and *Ross, J.D., and Rajaraman, S. and Allen, M.G. (2011) Development and characterization of a packaged mechanically

actuated microtweezer system. *Sensors and Actuators*. 167:502-511. Williamson J, Nyenhuis D, Stebbins GT, Lamb D*, Simkus V, Sripathirathan K, Wang C, Detolledo-Morrell L, Gorelick P (2010) Regional differences in relationships between apparent white matter integrity, cognition and mood in patients with ischemic stroke. *Journal of Clinical and Experimental Neuropsychology* 32:673-681. Williamson JB, Lewis G, Grippo AJ, Lamb D*, Harden E, Randleman M, Lebow J, Carter CS, Porges SW (2010) Autonomic predictors of recovery following surgery: A comparative study. *Autonomic Neuroscience* 156:60-66. Yen JT*, Auyang AG, and Chang YH. (2009) Joint-level kinetic redundancy is exploited to control limb-level forces during human hopping. *Experimental Brain Research* 196(3):439-51. Yen JT* and Chang YH. (2010) Rate-dependent control strategies stabilize limb forces during human locomotion. *Journal of the Royal Society Interface* 7(46): 801-10. Zimmerman AL * and Hochman S. (2010) Heterogeneity of membrane properties in sympathetic preganglionic neurons of neonatal mice: Evidence of four subpopulations in the intermediolateral nucleus. *Journal of Neurophysiology*, 103(1):490-8.

* denotes IGERT trainee

*Caceres IC, Valmas N, Hilliard MA, Lu H (2012) Laterally Orienting *C. elegans* Using Geometry at Microscale for High-Throughput Visual Screens in Neurodegeneration and Neuronal Development Studies. *PLoS ONE* 7(4): e35037.
doi:10.1371/journal.pone.0035037

Hochman S, Gozal EA, *Hayes HB, *Anderson JT, DeWeerth SP, Chang Y-H. Enabling techniques for in vitro studies on mammalian spinal locomotor mechanisms. *Frontiers in Bioscience* 17, 2158-2180, June 1 2012.

*Lamb DG, Calabrese RL. Small is beautiful: Models of small neuronal networks. *Current Opinion in Neurobiology*, 2012. PMID: 22364687

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*Sieling FH, *Archila S, *Hooper RS, Canavier CC, Prinz AA. (2012) Phase response theory extended to nonoscillatory network components. *Physical Review*, article 056208 (5 pages).

Basu, A., *Brink, S., Schlottmann, C., Ramakrishnan, S., Petre C., Koziol, S., Baskya, F.,

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Ivanova, T., Matthews, A., Gross, C., Mappus, R. C., *Gollnick, C., Swanson, A., Bassell, G. J., and Liu, R. C. (2011). Arc/Arg3.1 mRNA expression reveals a sub-cellular trace of prior sound exposure in adult primary auditory cortex. *Neuroscience*. 181:117-126.

*Hudson, A.E., *Archlia, S., and Prinz, A.A. (2010). Identifiable cells in the crustacean stomatogastric ganglion. *Physiology*. 25:311-318.

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*Lin, R. and D. Jaeger (2011). "Using computer simulations to determine the limitations of dynamic clamp stimuli applied at the soma in mimicking distributed conductance sources." *Journal of Neurophysiology*. Epub 16-Feb-2011. doi:10.1152/jn.00968.2010.

Maran, S.K., *Sieling, F.H., Demla, K., Prinz, A.A., and Canavier, C.C. (2011). Responses of a bursting pacemaker to excitation reveal spatial segregation between bursting and spiking mechanisms. *Journal of Computational Neuroscience*. Epub 01-Mar-2011. doi: 10.1007/s10827-011-0319-y.

*Newman, J. P. and Butera, R.J. Mechanism, dynamics and Biological Existence of multistability in a large class of bursting neurons. (201). *Chaos*. 20:e023118.

Norris, B.J., Wenning, A., *Wright, T.M., and Calabrese, R.L. (2011). Constancy and variability in the output of a central pattern generator. *Journal of Neuroscience*. 31:4663-4674.

*Sieling, F.H., Canavier, C.C., and Prinz, A.A. (2010). Inclusion of noise in iterated firing time maps based on the phase response curve. *Physical Review E*. 81: 061923.

*Wester, B.A., and *Ross, J.D., and Rajaraman, S. and Allen, M.G. (2011) Development and characterization of a packaged mechanically actuated microtweezer system. *Sensors and Actuators*. 167(:502-511).

Journal Articles in Refereed Publications

Hudson AE*, Prinz AA. Conductance ratios and cellular identity. (2010) *PLoS Computational Biology*. 6(7):e1000838.

Zimmerman AL* and Hochman S. Heterogeneity of membrane properties in sympathetic preganglionic neurons of neonatal mice: Evidence of four subpopulations in the intermediolateral nucleus. *Journal of Neurophysiology*, 2010 Jan. 103(1):490-8.

Galindo-Leon EE#, Lin FG*#, Liu RC (2009) Inhibitory plasticity in a lateral band improves cortical detection of natural vocalizations. *Neuron* 62:705-716. #Authors contributed equally.

Clements IP*, Kim YT, English AW, Lu X, Chung A, Bellamkonda RV. "Thin-film enhanced nerve guidance channels for peripheral nerve repair." *Biomaterials* 2009; 30(23-24):3834-46.

Kotov NA, Winter JO, Clements IP*, Jan E, Timko BP, Campidelli S, Pathak S, Mazzatenta A, Lieber CM, Prato M, Bellamkonda RV, Silva GA, Nadine Wong Shi Kam, Fernando Patolsky, Laura Ballerini. *Nanomaterials for Neural Interfaces*. *Advanced Materials* 2009; 21(40):3970-4004.

Yen JT* and Chang YH. Rate-dependent control strategies stabilize limb forces during human locomotion. *Journal of the Royal Society Interface* 7(46): 801-10, 2010.

Yen JT*, Auyang AG, and Chang YH. Joint-level kinetic redundancy is exploited to control limb-level forces during human hopping. *Experimental Brain Research* 196(3):439-51, 2009.

Bal E, Harden E, Lamb D*, Van Hecke AV, Denver JW, Porges SW (2010) Emotion recognition in children with autism spectrum disorders: relations to eye gaze and autonomic state. *Journal of Autism and Developmental Disorders* 40:358-70.

Williamson J, Nyenhuis D, Stebbins GT, Lamb D*, Simkus V, Sripathirathan K, Wang C, Detoleto-Morrell L, Gorelick P (2010) Regional differences in relationships between apparent white matter integrity, cognition and mood in patients with ischemic stroke. *Journal of Clinical and Experimental Neuropsychology* 32:673-681.

Williamson JB, Lewis G, Grippo AJ, Lamb D*, Harden E, Handleman M, Lebow J,

Carter CS, Porges SW (2010) Autonomic predictors of recovery following surgery: A comparative study. *Autonomic Neuroscience* 156:60-66.

Vaughan Van Hecke A, Lebow J, Bal E, Lamb D*, Harden E, Kramer A, Denver J, Bazhenova O, Porges SW (2009) Electroencephalogram and heart rate regulation to familiar and unfamiliar people in children with autism spectrum disorders. *Child Development* 80:1118-1133.

Sieling FH*, Canavier CC, and Prinz AA. Inclusion of noise in iterated firing time maps based on the PRC. (2010) *Physical Review E* 81(6 Pt 1):061923.

Grill WE, Norman SE*, and Bellamkonda RM, "Implanted Neural Interfaces: Biochallenges and Engineered Solutions", *Annual Review of Biomedical Engineering*, 2009, Volume 11, pg 1-24

Newman JP* and Butera RJ. Mechanism, dynamics, and biological existence of multistability in a large class of bursting neurons. *Chaos* (2010) 20(2):023118.

IGERT Publications

June 1, 2008 to May 31, 2009

Basu, A., Twigg, C.M., Brink*, S., Hasler, P., Petre, C., Ramakrishnan, S., Koziol, S. & Schlottmann, C. (2008). RASP 2.8: A New Generation of Floating-gate based Field Programmable Analog Array. *IEEE Custom Integrated Circuits Conference*, 213216.

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Newman*, J.P., Sayama, H. (2008). The Effect of Sensory Blind Zones on Milling Behavior in a Dynamic Self-Propelled Particle Model. *Phys Rev E*; 78: 011913.

Hayes*, H.B., Chang, Young-Hui. & Hochman, S. (2009). An in vitro Spinal-cord

Hindlimb Preparation for Studying Behaviorally Relevant Rat Locomotor Function.
Journal of Neurophysiol 101(2): 1114-1122.

Ortman, R., Hooper*, R., Soofi, W., Van Antwerp, K. *, Venayagamoorthy, K. & Potter, S.P. (2009) Foundations for Training Living Neuronal Networks to Predict Power Grid Parameters. Abstract: Emerging Frontiers in Research and Innovation Workshop. (submitted).

Auyang A.G., Yen*, J.T. & Chang, Y.H. (2009) Neuromechanical Stabilization of Leg Length and Orientation through Interjoint Compensation during Human Hopping. Experimental Brain Research 192: 253-264.

Canavier, C.C., Sieling*, F.H. & Prinz, A.A. (2009). Dynamic-clamp constructed hybrid circuits for the study of synchronization phenomena in networks of bursting neurons. In: Destexhe A, Bal T, eds. Dynamic clamp: from principles to applications. Springer, New York NY: 261-273.

Journal Articles in Non-Refereed Publications

Sieling FH. 4 channel dynamic clamp implementation using Spike2 and 1401plus. In: CED eNews: The eNewsletter from Cambridge Electronic Design, 2009.

Journal Articles in Non-Refereed Publications

Sieling FH. 4 channel dynamic clamp implementation using Spike2 and 1401plus. In: CED eNews: The eNewsletter from Cambridge Electronic Design, 2009.

Books

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Book Chapters

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Prinz, AA, Smolinski TG, and *Hudson, AE (2011). Understanding animal-to-animal variability in neuronal and network properties. In Ding, M. and Glanzman D. (Eds.) Dynamic Brain: An exploration of neuronal variability and its functional significance. Oxford University Press, New York NY. 119-138. ISBN: 978-0195393798.

Ting, L.H. and *Chvatal, S.A. (2011). Decomposing muscle activity in motor tasks: methods and interpretation. In Danion, F. and Latash, M.L. (Eds.), Motor Control: Theories, Experiments, and Applications. New York: Oxford University Press. 102-138. ISBN: 978-0195395273.

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Prinz, A.A, Smolinski T.G., and *Hudson, A.E. (2011). Understanding animal-to-animal variability in neuronal and network properties. In Ding, M. and Glanzman D. (Eds.), Dynamic Brain: An exploration of neuronal variability and its functional significance (pp. 119-138). New York: Oxford University Press. Ting, L.H. and *Chvatal, S.A. (2010). Decomposing muscle activity in motor tasks: methods and interpretation. In Danion, F. and Latash, M.L. (Eds.), Motor Control. New York: Oxford University Press.

Book Chapters

June 1, 2008 to May 31, 2009

Canavier, C.C., Sieling*, F.H. & Prinz AA (2009). Dynamic-clamp constructed hybrid circuits for the study of synchronization phenomena in networks of bursting n

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Purvis, L K.; *Wright, Terrence M.; Smith, J C.; and Butera, Robert J. "Significance of Pacemaker vs. Non-Pacemaker Neurons in an Excitatory Rhythmic Network." In EMBS (Engineering in Medicine and Biology Society), 2006 607-608.

*Lewi, Jeremy M.; Butera, Robert J.; and Paninski, L. "Real Time Adaptive Information-Theoretic Optimization of Neurophysiology Experiments." In Neural Information Processing Systems, 2006 TBD.

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Basu, A., Twigg, C.M., *Brink, S., Hasler, P., Petre, C., Ramakrishnan, S., Koziol, S. & Schlottmann, C. (2008). RASP 2.8: A New Generation of Floating-gate based Field Programmable Analog Array. IEEE Custom Integrated Circuits Conference, 213216.

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*Clements, Isaac P.; Kim, Y T.; Andreasen, D; and Bellamkonda, Ravi V. "A Regenerative Electrode Scaffold for Peripheral Nerve Interfacing." In 3rd International IEEE EMBS Conference on Neural Engineering, (2007) 390-393. Gunay C, Dharmar L,

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*Zimmerman AL, Sawchuk MA, and Hochman S. Electrophysiological identification of intermediolateral sympathetic preganglionic neuron subpopulations in the neonatal mouse. 35th Annual Meeting of the Society for Neuroscience. Chicago,IL, October 2009.

*Zimmerman AL, Sawchuk MA, and Hochman S. Neuromodulation of sympathetic preganglionic neurons in neonatal and adult mice. Cellular and Network Function in the Spinal Cord. Madison, WI. June 2009.

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Title:Muscle activation during surface and subsurface locomotion in sandfish (*Scincus scincus*) (**Sarah Steinmetz**)

A. C. Hughes, L. Guo, and S. P. DeWeerth, Interleaved Multichannel Epimysial Stimulation for Eliciting Smooth Contraction of Muscle with Reduced Fatigue, 32nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2010.

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Paper accepted for Asilomar:

Evaluating Brain Software Simulations Using Common Test Suite

Authors:

K. Richard Hammett, David V. Anderson

Paper accepted for NIPS2010:

Semi-Supervised Hierarchy Learning

Visar Berisha, Ailar Javadi, **K. Richard Hammett**, David V. Anderson, Alexander Gray

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Weinstein, Randall K.; Church, C T.; and Lee, Robert H. "Real Time Neural Circuit Modeling on FPGs via a Dynamical System Compiler." Paper presented at Society for Neuroscience, Washington, DC, USA. November 15, 2005, Georgia Institute of Technology.

*Wright, Terrence M. and Butera, Robert J. "EFFECTS OF GAP-JUNCTIONAL COUPLING ON CELLULAR AND NETWORK DYNAMICS IN THE PRE-BTZINGER COMPLEX." Paper presented at Society for Neuroscience, Washington, DC, USA. November 16, 2005, Georgia Institute of Technology & Emory University.

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*Hayes, Heather B.; Chang, Young-Hui; and Hochman, Shawn. "A New Model for Investigating Neural Control of Locomotion at Multiple Hierarchical Levels." Paper presented at South East Biomechanics Conference, Atlanta, GA, USA. March 31, 2006, Georgia Institute of Technology.

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*Stahl, Victoria A. and Nichols, T Richard. "End point forces transmitted by the crural fascia for muscles across the hip, knee, and ankle." Paper presented at Society for Neuroscience, Atlanta, GA, USA. October 17, 2006, Society for Neuroscience.

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*Wright, Terrence M. and Butera, Robert J. "Effects of Electrical Coupling on Excitatory Coupled Pacemaker Neurons in the pre-Böttinger Complex." Paper presented at Computational Neuroscience, Edinburgh, FO, Scotland. July 17, 2006, Georgia Institute of Technology/Emory University.

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*Zimmerman AL, Sawchuk MA, and Hochman S. Electrophysiological identification of intermediolateral sympathetic preganglionic neuron subpopulations in the neonatal mouse. 35th Annual Meeting of the Society for Neuroscience. Chicago,IL, October 2009. POSTER. *Zimmerman AL, Sawchuk MA, and Hochman S. Neuromodulation of sympathetic preganglionic neurons in neonatal and adult mice. Cellular and Network Function in the Spinal Cord. Madison, WI. June 2009. ORAL PRESENTATION.

*Archila S and Prinz AA. Activity-dependent synaptic plasticity in the crab *Cancer borealis* pyloric circuit. Poster for Society for Neuroscience (SFN) annual meeting, Washington, DC. (2011)

Bingham JT and Ting LH. Changes in stance width and feedback gain can compensate for slowed responses in a frontal-plane delayed feedback model of standing balance: Implications for aging. Society for Neuroscience Meeting, November 12-16, 2011, Washington DC.

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Ollerenshaw DR, Bari BA, Millard DC, Orr LE, Zhen HV, Wang Q and Stanley GB, *Sensory adaptation increases discriminability at the expense of detectability in the whisker system of awake, behaving rats* Abstract for Poster Presentation, Society for Neuroscience, Washington DC, November 2011

*Soofi W, Diehl F, and Stein W. Characterizing pyloric phase relationships in intact *Cancer pagurus*. 22nd Neurobiologischer Doktoranden-Workshop (student-run). Bonn, Germany. July 27-30, 2011.

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*Sharpe SS, Ding Y, Goldman DI (2012) Muscle activation strategy in swimming sandfish influenced by granular drag force. International Physics of Living Systems Conference- Montpellier, France. *Sharpe SS, Kuckuk R, and Goldman DI. (2012) Burrowing of the ocellated skink (*Chalcides ocellatus*) in wet and dry granular media. Georgia Tech Research and Innovation Conference- Atlanta, GA.

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*Anderson, J.T., DeWeerth, S.P., and Hochman S. (2010, November). Complex cholinergic pharmacology of alternating left-right lumbar motor rhythms. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

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*Caceres, I., Hilliard, M., and Lu, H. (2011, February). Optimizing Microfluidic Devices for Immobilization of *C. elegans* for High-Throughput Screens. Poster presented at the Georgia Tech Research & Innovation Conference, Atlanta, GA.

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*Chvatal, S.A. and Ting, L.H. (2010 November). Anticipatory postural adjustments during multidirectional reactive and voluntary steps depend on mechanical task demands. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Gollnick, C., Wang, Q., Koenig, S., Millard, D., Bellamkonda, R., and Stanley, G. (2010, November). Can the degradation of perineuronal nets alter the activity of local inhibitory circuits in the barrel cortex? Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Hammett, R. and Anderson, D. V. (2010, November). Evaluating Brain Software Simulations using Common Test Suite. Talk presented at the Asilomar Conference on Signals, Systems, and Computers.

*Killian, N. J. and Buffalo, E. A. (2010, November) The time-course of gamma-band synchronization across layers of the macaque entorhinal cortex predicts the strength of memory formation. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Lamb, D. G., *Wright, T. M., Wenning, A., Norris, B. J., Calabrese, R. L. (2010, November). Contribution of intrinsic properties to the input-output relationship of leech heart motor neurons evaluated with a multi-compartmental model. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

Leonard, J., Ting, L.H., *Chvatal, S. A., and Stapley, P. (2011, April). Muscle synergies of feed-forward postural adjustments during reaching to multi-directional targets in standing. Poster presented at the Neural Control of Movement Annual Meeting, San Juan, Puerto Rico.

*Lin, R., J. Bettencourt, J., White, J. W., Christini, D., and Butera, R.J. (2010, October). Real-time experiment interface for biological control applications. Poster presented at the 32nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Buenos Aires, Argentina.

*Lin, R. and Butera, R. J. (2010, November). Real-time experimental interface for electrophysiology experiments. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Lin, R. (2010, July). RTX: Test Drive a Real-Time Linux Based Dynamic Clamp System on Your Laptop. Organized a workshop at the 2010 Computational Neuroscience Meeting, San Antonio, TX.

*Ollerenshaw, D.R., Bari, B.A., Millard, D.C., Orr, L.E., Wang, Q., Zheng, H., and Stanley, G.B. (2011, February). Tactile detection and discrimination: behavioral predictions from VSD imaging of cortex. Poster presentation at the Computational and Systems Neuroscience (Cosyne) meeting, Salt Lake City, Utah.

*Ortman, R.L., Venayagamoorthy, K., and Potter, S.M. (2011, April). Input Separability in Living Liquid State Machines. Poster presented at the 10th International Conference on Adaptive and Natural Computing Algorithms (ICANNGA).

*Tuthill, C., Goolsby, W.N., Niazi, I., and Nichols, T.R. (2010, November). Mapping task dependent changes to limb impedance: A robotic approach. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

Safavynia, S., *Chvatal, S.A., and Ting, L.H. (2010, November). Recruitment of muscle synergies by center-of-mass feedback throughout postural perturbations. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Shapero, S. BrÄ¼derle, D., Hasler, P., and Rozell, C. (2011, February). Sparse Approximation on a network of locally competitive integrate and fire neurons. Poster presentation at the Computational and Systems Neuroscience (Cosyne) meeting, Salt Lake City, Utah.

*Shapero, S. and Hasler, P. (2011, February). Accurate Analog Signal Processing with Mismatch Compensation. Poster presented at the Georgia Tech Research & Innovation Conference, Atlanta, GA.

*Steinmetz, S.M., Ding, Y., and Goldman, D.I. (2011, January). Sandfish model predicts muscle activation pattern during subsurface sand diving. Poster presented at the Society for Integrative and Comparative Biology Annual Meeting, Seattle, WA.

*Steinmetz, S.M., Ding, Y., Maladen, R.D., and Goldman, D.I. (2010, September) Interaction with granular media influences activation strategy during subsurface sand swimming. Poster presentation at the annual Neurohike Meeting: Alberta Motor Control Association.

*Soofi, W. and Prinz, A. A. (2010, July). Covarying ionic conductances to emulate phase maintenance in stomatogastric neurons. Poster presentation at the 2010 Computational Neuroscience Meeting, San Antonio, TX.

*Soofi, W. and Prinz, A. A. (2010, November). Emulating phase maintenance in stomatogastric neurons through the covariance of ionic conductances. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Wright, T.M., and Calabrese, R.L. (2011, February). Interaction of premotor timing information and synaptic strengths in the production of motor output. Presentation at the Emory University Spinal Cord Research Center Seminar Series, Atlanta Georgia.

*Wright, T.M. and Calabrese, R.L. (2010, September). Contribution of motor neurons to fictive motor pattern generation. Presentation at the Emory University Spinal Cord Research Center Seminar Series, Atlanta Georgia.

*Wright, T.M., Norris, B.J., Wenning, A., and Calabrese, R.L. (2010, November). The role of electrical coupling and spatiotemporal patterns to coordinated motor output. Poster presented at the Society for Neuroscience Annual Meeting, San Diego, CA.

*Yen, J.T. and Chang, Y.H. (2011, April). Sparse control of human locomotion: Evidence from hopscotch. Poster presented at the Neural Control of Movement Annual Meeting, San Juan, Puerto Rico.

Conference Presentations

Conductance ratios can be used to constrain features of cellular identity. **Hudson AE**, Prinz AA. Poster. Society for Neuroscience. Oct 2009. Chicago, USA.

Activity-type dependent conductance relationships in a model neuron database. **Hudson AE**, Prinz AA. Poster. Computational Neuroscience. July 2009. Berlin, Germany.

Anderson JT, DeWeerth SP, Hochman S. Closed-loop reinforcement of locomotor-like activity via stimulation of the sacral dorsal column. Georgia Tech Research and Innovation Conference. 2010 Feb 8, Atlanta, GA. Poster presentation.

Todd JL, DeWeerth SP, Hochman S. Sacral dorsal column stimulation induced locomotor-like activity is enhanced via tubocurarine and output-based positive feedback. 39th Annual Meeting of the Society for Neuroscience. 2009 Oct 17-21, Chicago, IL. Poster presentation.

Todd JL, DeWeerth SP, Hochman S. Characterization of a sacral dorsal column pathway controlling hindlimb motor behavior. Cellular and Network Functions in the Spinal Cord. 2009 June 23-26, Madison, WI.

Lin, F.G, Galindo-Leon, EE, Liu, R.C. Inhibitory plasticity in a lateral band improves cortical detection of natural vocalizations. Auditory Cortex 2009, Magdeburg, Germany

Lin, F.G, Galindo-Leon, EE, Miranda, J.A, Liu, R.C. Plasticity in pup call evoked cortical inhibition reflects differences in maternal experience. Society for Neuroscience 2009, Chicago, Illinois

Lin, F.G, Galindo-Leon, EE, Miranda, J.A, Liu, R.C. Plasticity in pup call evoked cortical inhibition reflects differences in maternal experience. Advances and Perspectives in Auditory Neurophysiology 2009, Chicago, Illinois

Lin, F.G, Liu, R.C. Cortical First Spikes Can Encode the Peripheral Transformation of Natural Sounds. Association for Research in Otolaryngology 2010, Anaheim, California

"Rapid Phenotyping and Visual Screens Enabled by Microfluidics," 4th South East Workshop on Soft Materials, Atlanta, GA. (**Ivan Caceres**)

Yen JT and Chang YH. Interlimb coordination for force control during human hopping. Annual Meeting of the American Society of Biomechanics. State College Pennsylvania USA, August 26-29 2009.

Wafa Soofi, Santiago Archila, Astrid Prinz. "Covarying Ionic Conductances to Emulate Phase Maintenance in Stomatogastric Neurons." "Dynamics of Bursting Activity of Neurons" Workshop. Commerce Club, 34 Broad St, Atlanta, GA. April 16 17.

Killian, NJ, Buffalo, EA. Laminar analysis of recognition memory signals in the macaque entorhinal cortex. Program No. 480.7. 2009 Neuroscience Meeting Planner. Chicago, IL: Society for Neuroscience, 2009. Online.

Killian, NJ, Buffalo, EA. The time-course of gamma-band synchronization across layers of the macaque entorhinal cortex affects the strength of memory formation. Pittsburgh, PA: Statistical Analysis of Neural Data 5, 2010.

Gunay C, Dharmar L, **Sieling F,** Marley R, Lin W, Baines RA, Prinz AA. Modeling Drosophila motoneurons to examine the functional effect of Na channel splice variants. In: Southeast Nerve Net. Atlanta: 2010.

Sieling FH, Canavier CC, and Prinz AA. Inclusion of noise in iterated firing time maps based on the phase response curve. In: (a) Computational Neuroscience. Berlin: BMC Neuroscience, 2009 (b) Society for Neuroscience. Chicago: 2009

Maran SK, Canavier CC, Prinz AA, and **Sieling FH.** Analyzing circuits comprised of pacemakers and postinhibitory rebound neurons using functional phase resetting curves. In: Society for Neuroscience. Chicago: 2009.

S. Archila, A.A. Prinz. (2009) Long term synaptic dynamics in the crab *Cancer borealis* pyloric circuit. Poster presentation for Society for Neuroscience annual meeting, Chicago, IL.

Robert Ortman, Ryan Hooper, Wafa Soofi, Keith Van Antwerp, Kumar Venayagamoorthy, Steve M. Potter. "Foundations for Training Living Neural Networks to Predict Power Grid Parameters." First Annual NSF EFRI-MST-GTECH Workshop at Missouri University of Science and Technology, Rolla, MO. June 8-9, 2009.

Robert Ortman, Riley T. Zeller-Townson, Gareth Guvanase, Christopher Rozell, Ganesh K. Venayagamoorthy. "Methods for Prediction of Synchronous Generator Dynamics Using Living and Simulated Neural Networks." Second Annual NSF EFRI-MST-GTECH Workshop at Georgia Institute of Technology, Atlanta, GA. May 16-19, 2010.

Poster Sessions

June 1, 2008 to May 31, 2009

Sieling*, F.H, Canavier, C.C. & Prinz, A.A. (2008, July). Predicting phase-locking in excitatory hybrid circuits. Poster session presented at Seventeenth Annual Computational Neuroscience Meeting, Portland, OR.

Zimmerman*, A.L. & Hochman, S. (2008, November). Electrophysiological characterization of sympathetic preganglionic neurons in HB9-GFP transgenic mice. Poster session presented at the annual meeting of the Society for Neuroscience, Washington, DC.

Todd*, J.L., DeWeerth S.P. & Hochman, S. (2008, November). Capsaicin-sensitive Afferents in the Sacral Dorsal Column Activate the Hindlimb Locomotor CPG. Poster session presented at the annual meeting of the Society for Neuroscience, Washington, DC.

Sieling*, F.H, Canavier, C.C. & Prinz, A.A. (2008, November). Predicting phase-locking in excitatory hybrid networks. Poster session presented at annual meeting for Society for Neuroscience, Washington DC.

Sieling*, F. H., Canavier, C. C. & Prinz, A.A. (2009, March). Inclusion of noise in iterated firing time maps based on the phase response curve. Poster session presented at the annual meeting for Southeast Nerve Net Annual Meeting, Jacksonville, FL.

Sieling*, F.H., Canavier, C.C. & Prinz, A.A. (2008, July). Predicting phase-locking in excitatory hybrid circuits. Poster session at the Seventeenth Annual Computational Neuroscience Meeting, Portland, OR.

Conference Presentations

June 1, 2008 to May 31, 2009

Sieling*, F. (2008, June). Neurobiologie Adaptative des Systèmes Moteurs, Bordeaux Neurosciences Institute.

Zimmerman*, A. (2008, August). Department of Physiology, Emory University. Monoamines and the sympathetic nervous system . Spinal Cord Research Seminar: August 15, 2008

Zimmerman*, A. (2008, February). Department of Physiology, Emory University. Plasticity of spinal sympathetic function after spinal cord injury. Spinal Cord Research Seminar: February 18, 2009.

Galindo-Leon, E., Lin*, F.G. & Liu, R.C. (2008, August). Communication Processing in a Mammalian Auditory Cortex: Pre-wired or Plastic? Presented at Acoustic Communication by Animals Conference.

Caceres*, Ivan; Lu, Hang. (2008, August). Microfluidics for Rapid Phenotyping of *C. Elegans* using Machine Learning. Presented at Georgia Tech IGERT Symposium, Atlanta, GA.

Lin*, F.G, Galindo-Leon, E. & Liu, R.C. (2008, November). Network Precision Plasticity for Communication Calls in Awake Mouse Auditory Cortex. Presented at Advances and Perspectives in Auditory Neurophysiology.

Lin*, F.G, Galindo-Leon, E. & Liu, R.C. (2008, November). Predicting first spikes at the onset of natural calls in the awake mouse auditory cortex. Presented at the Society for Neuroscience conference.

Todd*, J.L., DeWeerth, S.P. & Hochman S. (2009, February). Characterization of a

Sacral Dorsal Column Pathway Controlling Hindlimb Motor Behavior. Presented at Spinal Cord Research Center, Atlanta, GA.

Lin*, F.G, Galindo-Leon, E. & Liu, R.C. (2009, February). Predicting First Spikes at the Onset of Natural Calls in the Awake Mouse Auditory Cortex. Presented at Gordon Research Conference.

Caceres*, Ivan; Lu, Hang. (2009, May). Rapid Phenotyping and Visual Screens Enabled by Microfluidics. Presented at 3rd Southeast meeting on Soft Materials, Atlanta, GA.

Peng, S., Gurun, G., Twigg, C., Qureshi, M., Basu, A., Brink*, S., Hasler, P. & Degertekin, F. (2009, May). A Large-Scale Reconfigurable Smart Sensory Chip. Presented at IEEE Proceedings of the International Symposium on Circuits and Systems.

Chvatal, S.A.*, Torres-Oviedo, G., Safavynia, S.A., Ting, L.H.. (April 2008), Common muscle synergies for directional control of center of mass during two different postural strategies, Neural Control of Movement meeting (Naples, FL)

(Young-tae presented):

Kim, Y-T., Chvatal, S.A.*, Bratt-Leal, A., Bellamkonda, R.V. (April 2007), Nanoparticle-mediated Topical Delivery of Methylprednisolone After Contusion Injury to the Spinal Cord, Society for Biomaterials Annual Meeting (Chicago, IL)

Hendrickson, E.B.*, Edgerton, J.R., Gunay, C, Schultheiss, N, Jaeger, D (2007, July). Converting a globus pallidus neuron model from 585 to 6 compartments using an evolutionary algorithm, Presented at CNS in Toronto, Canada

Hendrickson, E.B.*, Edgerton, J.R., Jaeger D. (2007, November). A generalized method for the 100-fold reduction of full morphological neuron models using evolutionary algorithms, Presented at SFN in San Diego, CA

Mitchell, C.S.* and Lee R.H. (2007, November). A Comparison of Degenerate NMDA Receptor Models within the Context of a Larger Model. Poster presented at the Society for Neuroscience meeting in San Diego, CA.

Mitchell, C.S.* and Lee R.H. (2007, November). **A Computational Model of**

Secondary Traumatic Injury. Poster presented at the Society for Neuroscience meeting in San Diego, CA.

Stahl, V.A.*, Gotschall, J.S. & Nichols, T.R. (2007, October). A Biomechanical Analysis of the Crural Fascia in the Feline Hindlimb during Locomotion and Intra-Muscular Stimulation. Oral presented at the meeting of the Fascia Research Congress, Boston, MA.

Stahl, V.A.*, Gotschall, J.S. & Nichols, T.R. (2007, November). The crural fascia contributes to intra-limb coordination and stability in the decerebrate cat during locomotion. Poster presented at the meeting of the Fascia Research Congress, San Diego, CA.

Todd, J.L.*, DeWeerth, S.P., Hochman, S. (2007, Sept). Closed-loop control of spinal pattern generation. Symposium on Neural Engineering: Biomimetic Signal Processing at the Biomedical Engineering Society Annual Meeting, Los Angeles, CA, USA.

Todd, J.L.*, DeWeerth, S.P., Hochman, S. (2007, Oct.) Sacral spinal dorsal column stimulation activates locomotor-like activity via a cholinergic pathway in the neonatal rat spinal cord. Poster session presented at the annual meeting of the Atlanta Chapter for the Society for Neuroscience, Atlanta, GA, USA.

Todd, J.L.*, DeWeerth, S.P., Hochman, S. (2007, Nov.) Sacral spinal dorsal column stimulation activates locomotor-like activity via a cholinergic pathway in the neonatal rat spinal cord. Poster session presented at the annual meeting of the Society for Neuroscience, San Diego, CA, USA.

Wester, B.A.*, Allen, M.G., Lee, R.H. and LaPlaca, M.C. (2007, November). Development of flexible electrodes for electrical recording in the cortex during and immediately following traumatic brain injury. Poster session presented at the annual meeting of the Society for Neuroscience, San Diego, CA, USA.

Wright, TM*, Wenning, A, Garcia, PA, Norris, BJ, Calabrese, RL. Contribution of Motor Neurons to Fictive Motor Pattern Generation. Southeast Nerve Net (2008), Atlanta, Georgia

T.T. Tsao, Wright, Jr., TM* and Butera, RJ. Spike synchrony within a burst alters burst dynamics in a simulated network: Changes in network-level slow dynamics mediated by single-cell level fast dynamics. Society for Neuroscience Abstracts (2007)

RL Calabrese and Wright, Jr., TM*. Quantitative analysis of the dynamics of electrical coupling between heart motor neurons in the leech. Society for Neuroscience Abstracts (2007)

Wright, Jr., TM*, IR Cunningham, PA Garcia, BJ Norris, AA Wenning and RL Calabrese. The contribution of motor neurons to the elaboration of the fictive heartbeat motor pattern of the leech: Experimental and computational approaches. Society for Neuroscience Abstracts (2007)

Wright, Jr., TM*, AA Prinz and RL Calabrese. Initiating the (un)initiated: Using mathematical modeling to teach cellular neuroscience. Society for Neuroscience Abstracts (2007)

R.L. Calabrese, P.S. Garcia, B.J. Norris, Wright, Jr., TM*. Modeling the output of a central pattern generator. Computational Neuroscience Meeting, Toronto (2007)

Outreach Activities

Title: Bioengineering Design Challenge

Media Outlet/Organization: Atlanta City Middle Schools

Activity Date: 07/01/2006

Description: Jasper Yen, an HNM IGERT trainee, hosted and judged a bioengineering design challenge for middle school students from the Atlanta inner city area.

Title: Brain Awareness

Media Outlet/Organization: K.E. Taylor Elementary School

Activity Date: 05/08/2007

Description: Dr. Robert Liu, Emory IGERT faculty member, gave a vision lecture to gifted third graders at K.E. Taylor Elementary School in Lawrenceville, GA.

Title: Brain Awareness Month

Media Outlet/Organization: Rock Chapel Annex (Allgood Elementary School)

Activity Date: 03/21/2007

Description: Santiago Archila, an IGERT trainee, gave a 45 minute presentation on the brain to the entire 4th grade class at Rock Chapel Annex.

Title: Brain Awareness Month Activity

Media Outlet/Organization: Southwest DeKalb High School

Activity Date: 05/15/2007

Description: Dr. Astrid Prinz, an HNM IGERT faculty member, taught 2 9th grade classes at Southwest Dekalb High School (a school with a a predominantly african-american population) about the brain as part of the Brain awareness month.

Title: Brain Awareness Month Activity- Workshop

Media Outlet/Organization: Morehous School of Medicine

Activity Date: 03/01/2008

Description: Michelle Kuykendal participated in a workshop with middle school and high school students at Morehouse School of Medicine to expose these students to interesting neuroscience concepts.

Title: Brain Awareness Month School Visits

Media Outlet/Organization: Otwell Middle School

Activity Date: 04/27/2007

Description: Stacie Chvatal and Keith van Antwerp visited two 7th grade classes at Otwell Middle School to talk about neuroscience and control of movement.

Title: Brain Awareness Presentation

Media Outlet/Organization: Kingsley Charter Elementary School

Activity Date: 03/23/2007

Description: Santiago Archila, an IGERT trainee, gave a 45 minute presentation to the 1st and 2nd grade classes at Kingsley Charter School.

Title: Buzz on Biotechnology

Media Outlet/Organization: Bioengineering and Bioscience Unified Graduate Students

Activity Date: 10/15/2006

Description: Stacie Chvatal ran a demonstration during visits by Atlanta area middle and high school students discussing the types of research occurring in the laboratory for neuroengineering at GA Tech and Emory.

Title: Demo at Morehouse School of Medicine

Media Outlet/Organization: Morehouse School of MEDicine

Activity Date: 02/01/2007

Description: Jasper Yen presented a motor illusions demonstration at the Morehouse School of Medicine.

Title: Georgia Brain Bee

Media Outlet/Organization: Society for Neuroscience

Activity Date: 02/04/2012

Description: Trainees Wafa Soofi, Richard Hammett, Risa Lin, John Newman, Sharon Norman, and Ming-Fai Fong volunteered and developed curricula to help organize the annual Georgia Regional Brain Bee competition.

Title: Graduate School

Media Outlet/Organization: Emory University-BRAIN Summer Program

Activity Date: 07/01/2008

Description: Terrence Michael Wright participated in a panel about graduate school (the nature of graduate school, the application process, what is research, etc.) for a summer REU program at Emory University.

Title: graduate school STEM outreach

Media Outlet/Organization: Emory University

Activity Date: 01/31/2012

Description: Trainee Wafa Soofi volunteered in a mentoring program at Emory University to provide advice and counseling about pursuing a career in research.

Title: high school outreach

Media Outlet/Organization: Benjamin Mays High School

Activity Date: 12/07/2011

Description: raine Wafa Soofi served on a panel of science fair judges at Benjamin Mays High School and provided mentorship and advice to the students on followup work.

Title: Inside the Black Box

Media Outlet/Organization: WREK

Activity Date: 01/28/2009

Description: Prof. DeWeerth was a guest on Inside the Black Box, a radio show focused on the introduction of scientific topics to lay audiences. He discussed human augmentation related to the types of hybrid neural microsystems developed in our IGERT program.

Title: Lab Tours

Media Outlet/Organization: Tech High School and Marietta High School

Activity Date: 12/01/2007

Description: Brock Wester conducted lab tours for area high school students at Tech and Marietta High Schools.

Title: Motor Illusions Demonstration

Media Outlet/Organization: Atlanta City High School

Activity Date: 11/01/2006

Description: Jasper Yen, an IGERT trainee, presented a motor illusions demonstration to educate Atlanta area high school students on neurophysiology and bioengineering.

Title: Research Presentation at Local High School

Media Outlet/Organization: Marietta High School

Activity Date: 03/01/2008

Description: Brock Wester gave a presentation on his research at Marietta High School as part of March's Brain Awareness Month.

Title: Sandfish Project

Media Outlet/Organization: Discovery Channel Canada

Activity Date: 04/01/2008

Description: Sarah Steinmetz, one of our first year IGERT students rotating in Dr. Goldman's lab worked on a sandfish project. Some of her EMG recordings may be included as part of the feature of Dr. Goldman's research on Discovery Channel Canada.

Title: STEM recruitment

Media Outlet/Organization: Grady High School

Activity Date: 02/02/2012

Description: Trainee Wafa Soofi visited Grady High School in Atlanta, GA, with other volunteers from the Georgia Tech Women in Engineering Ambassadors Program. She and other female colleagues gave a presentation on engineering careers to high school students.

Title: underrepresented minority recruitment

Media Outlet/Organization: Cal State San Marcos

Activity Date: 11/02/2011

Description: Former Trainee Dr. Terrence Michael Wright visited Cal State San Marcos to speak to undergraduates about his graduate school experiences.

Title: URM graduate school outreach and recruitment

Media Outlet/Organization: Georgia Tech

Activity Date: 01/14/2012

Description: Trainee Ivan Caceres worked with students visiting Georgia Tech for FOCUS, an event to recruit underrepresented minorities to Georgia Tech for grad school. He served as a mentor to some visiting students and spoke on panels about graduate school life

Title: Volunteer at Montessorri School

Media Outlet/Organization: Casa Elementary

Activity Date: 03/01/2008

Description: Jon Newman and Damon Lamb(2 IGERT trainees) volunteered at a local elementary school where they taught the children fundamental neuroscience and engineering principles.

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Hybrid Neural-robotic Systems, Geometric model, Electrical And Electronic Engineering. The IM-CLeVeR Project: Intrinsically Motivated Cumulative Learning Versatile Robots. This short paper presents the core ideas of the IM-CLeVeR Project. A DCM integrated with a quaternion provided an advanced technique for precise USV attitude estimation and position determination using low-cost sensors. This paper presents the implementation of an INS developed by the integration of DCM and quaternion. Save to Library. From an engineering point of view, the nervous system, which is made of neural tissue, is a most complex biological system. All possible instruments or tools for applications related to the nervous system are part of another type of complex systems: biomedical instrument systems. As in any interacting system, "communication" can occur at the interface of these two systems. Micromachined devices with substrate-integrated electrodes are the key component in implantable microsystems—one important group of BIOMEMS for recording of neural signals or electrical stimulation of nerves. So far, electrodes have been located on only one side of the microsystems.