# Marco Arieli Herrera Valdez

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## Education

University of Arizona. Ph.D. Mathematics (Sched. Defense: June, 2010).
Ph.D. Physiology. August, 2008.
M.Sc. Mathematics, minor in Neuroscience. May, 2002.

Universidad Nacional Autónoma de México (UNAM), Facultad de Ciencias.
B.Sc. Actuarial Sciences. August, 1997.

## General scientific interests

Mathematical physiology. Biophysical determinants of neural excitability, plasticity, and their effects on network dynamics. Network, cellular, and molecular correlates of learning and memory during early development and aging. Network dynamics in epidemilogy. Bifurcation analysis and dynamical systems under random perturbations.

## Work and Training

### Arizona State University

*Mathematical, Computational, and Modeling Sciences Center, and School of Statistics and Mathematics*. Postdoctoral scholar, Fall, 2008-present. Research: Biophysical determinants of excitability during early development in insect neurons. Olfactory processing and plasticity in the honey bee. Multiple wave generation during influenza epidemics. Teaching: Graduate Seminar on Interdisciplinary Science.

### University of Arizona

*Graduate Program in Mathematics*. Research assistant, 2007-2008. Dissertation on the geometry of reduced biophysical models of membrane excitability. Training on probability, stochastic processes, dynamical systems, and computer simulation of biological processes. PhD dissertation title: ”Minimal biophysical models of membrane excitability”. PhD director: Joceline Lega.

*Interdisciplinary Program in Physiological Sciences*. *Research Assistant*, Fall 2002- Summer 2008. Dissertation on the relationship between nearly coincident spiking and common excitatory synaptic input in motor neurons. Speciality in systems neurophysiology. Training on single cell recordings in situ and in vitro, multiple unit recordings on freely behaving animals, data analysis and modeling of neural networks. PhD dissertation title: "Relationship between nearly coincident spiking and common excitatory synaptic input predicted by a model of spiking motor neurons." PhD director: Andrew J. Fuglevand.

*Arizona Research Laboratories, Division of Neurobiology,* Jan. 2001 - Jan. 2003. *Research Assistant.* Data analysis and modeling of dendritic trees from the antennal lobe of the moth *Manduca Sexta*.

*Mathematics Department*, *Assistant Network administrator*, Nov. 1997-May 2001. Tasks included software-hardware help for linux and windows systems, and teaching seminars on linux and windows applications.

*Teaching Assistant*, Nov. 1997 - June 1999. Courses taught: Ordinary Differential Equations, Calculus, Calculus, Algebra, Statistics, and Discrete Mathematics.

*Research Visiting Scholar*, UNAM Foundation, August 1997- June 1998. Fellowship award for outstanding academic performance, 1997.

**Universidad Nacional Autónoma de México**

*College of Science, UNAM*, August 1996 - August 1997.

Research Assistant, Mathematics Department, August 1996 - August 1997.

Teaching Assistant, Mathematics Department, August 1995 - August 1996. Courses taught: Vector Calculus and Probability.

*Athletic Department, UNAM*, January 1994 - August 1997.

High School Head Coach.

**Publications**

Herrera-Valdez M.A. and Fuglevand A.J. (2008). Relationship between nearly coincident spiking and common excitatory synaptic input predicted by a model of spiking motor neurons. *Dissertation. Physiological Sciences, University of Arizona.*

***Articles recently submitted***

Herrera-Valdez M.A. and Lega J. (2010). A reduced model for the pacemaker dynamics of cardiac cells. *Submitted to Journal of Theoretical Biology.*

Radulescu A., Herrera-Valdez M.A. (2010). Transitions between tonic, phasic, and seizure-like spiking in neural populations explained through a minimal firing rate model. *Submitted to PLOS Computational Biology.*

Herrera-Valdez M.A., Cruz-Aponte M., Castillo-Chavez C. (2010). Multiple waves during in an influenza epidemic explained by behavioral changes and transportation: Mexico 2009. *Submitted to PLOS ONE*.

Herrera-Valdez M.A., Cruz-Aponte M., Vega J., Chowell-Puente, G, Castillo-Chavez C. (2010). Transient perturbations in the infection rates, delayed vaccination and waste during the AH1N1 epidemic in México 2009. *Submitted to BME*.

***Articles scheduled for submission during the spring of 2010.***

Herrera-Valdez M.A., Berger S.D., Duch, C., and Crook, S. (2010). Excitability profiles of Drosophila neurons induced by the expression of different potassium channels. *Submitting in March to PLOS Computational Biology, 2010*.

Strube-Bloss M., Herrera-Valdez M.A., Smith B.H. (2010). Representation of single odors and their mixture at the input and output stages of the honey bee mushroom bodies. *Scheduled for submission to Nature Neuroscience, March 2010*.

Herrera-Valdez M.A. and Fuglevand A.J. (2010). Relationship between nearly coincident spiking and common excitatory synaptic input predicted by a model of spiking motor neurons. *In preparation.*

***Posters presented at scientific meetings***

Strube-Bloss M., Herrera-Valdez M.A., Smith B.H. (2009). Representation of single odors and their mixture at the input and output stages of the honey bee mushroom body. Society for Neuroscience Meeting, Chicago, October, 2009.

Satvat E., Herrera-Valdez M.A , Gheidi A., Adams A.A., Hertel A. , Marone D. F. (2009). D1 Receptor activation is not required for place cell-related Arc Expression. Society for Neuroscience Meeting, Chicago, October, 2009.

Herrera-Valdez M.A., Berger S.D., Duch C.C., Crook S. (2009). Predicting changes in neuronal excitability type in response to genetic manipulations of $K^+$-channels. Annual Meeting of Computational Neuroscience. Berlin, July, 2009.

Berger S.D., Herrera-Valdez M.A., Duch C.C., Crook S. (2009). Passive current transfer in wildtype and genetically modified drosophila motoneuron dendrites. Annual Meeting of Computational Neuroscience. Berlin, July, 2009.

Herrera-Valdez M.A., Fuglevand, A.J. (2008). Relationship between nearly coincident spiking and common excitatory synaptic activity in motor neurons. Presented during the Conference on Mechanisms of Plasticity and Disease in Motor Neurons. University of Washington, Seattle, June 26-29, 2008. Also during the Annual Meeting for the Society for Neuroscience, Washington, D.C. November, 2008.

Thome A., Skaggs W. E., Herrera-Valdez M.A., McNaughton B.L, Barnes C.A. (2007). Effects of performance accuracy on intra-cycle $\alpha$- and $\gamma$-band cross frequency coupling between temporal lobe sites of behaving monkeys. Society for Neuroscience Meeting, 07-A-34312-SfN.

**Contributed Lectures and Workshops**

Talk series on qualitative predictions about the time course of secondary epidemic outbreaks as a function of social distancing, vaccination, and treatment. Meeting between Mexico, Canada, and U.S.A (Tempe, USA, June, 2009, and Vancouver, Canada, September, 2009): Mitigating the spread of AH1N1 influenza.

Effects of vaccination, treatment, and social distancing, on the time course of an A/H1N1 epidemic outbrake. Annual Meeting of the Society for Industrial and Applied Mathematics, July 2009.

Minimal biophysical models of pacemaking activity in the vertebrate heart. Annual Meeting of the Society for Industrial and Applied Mathematics, July 2008.

Using nearly coincident spiking to predict common synaptic input to neurons. Computational Physiology seminar, Wilfrid Laurer University, Waterloo, Canada. November, 2008.

Predicting common synaptic input to motor neurons. Biomathematics seminar, ASU. October, 2008.

A low dimensional, biophysical model of cardiac excitability. Biomathematics workshop, Annual Meeting of the Society for Industrial and Applied Mathematics, July, 2008.

Introduction to the Ventral Tegmental Area. Neural Systems Memory and Aging Seminar, U. of A. August, 2007.

Space-dependent responses and synchronization with hippocampal local field potentials are exhibited by spiking activity in neurons of the ventral-tegmental area. Physiological Sciences Seminar, Department of Physiology, U. of A. August 2005.

Phase-space analysis predicts sexually dimorphic ocular scanning of facial expressions in *Rhesus* monkeys. Physiological Sciences Seminar, Department of Physiology, U. of A. August 2004.

Input frequency gates olfactory responses in multiglomerular interneurons of the antennal lobe of *Manduca Sexta*. Physiological Sciences Seminar, Department of Physiology, U. of A. August 2003.

Neural network of the primate primary visual cortex, layer 4C$\alpha$. Biomathematics seminar, Facultad de Ciencias, UNAM, 5/02.

Computer reconstructions of dendritic trees based on real morphology. Facultad de Ciencias, UNAM, 05/02. Conference.

Morphological properties of dendrites: Fractal dimensions. Mathematics Colloquium, University of Arizona, 03/02. Lecture.

Coupling between glomerulli in passive dendritic trees from the antennal lobe of *Manduca Sexta*. Antennal lobe seminar, ARLDN, University of Arizona, 10/01. Lecture.

Models of neural networks of integrate and fire cells. Applied Mathematics Seminar, University of Arizona, 11/01. Lecture.

Dynamical systems and neural systems, introduction to computational neurobiology. Mathematics Colloquium, University of Arizona, 04/01. Lecture.

Stochastic modeling of ionic channels. Applied Mathematics Brown Bag Seminar, University of Arizona, 04/01.

Cryptography session for the workshop on High school mathematics. Department of Mathematics, University of Arizona, 02/01.

Financial applications of probability and stochastic processes. Research review.SMM 1997. Lecture.

**Meetings, Courses and Workshops attended**

Neuron Course in Parallel Computing, University of Arizona, Tucson, AZ, March, 2010.

Annual Meeting of Society for Neuroscience, 1998-2000, 2004, 2008.

Conference in Dynamical Systems in Physiology. Mathematics and Bioengineering Departments, Purdue University, October 2008.

Short course in Mathematical Physiology. Mathematical Biosciences Institute, Ohio State University, October, 2007.

Workshop in Neural Networks. Mathematical Biosciences Institute, Ohio State University, October, 2002.

Summer Course of Methods in Computational Neuroscience. Marine Biological Laboratories, Woods Hole, MA, August, 2002.

Neuron Simulation Environment Summer Course. San Diego Super Computer Center, 6/01.

Mexican Mathematical Society (SMM) annual meetings, 1995-1998.

**Fellowships**

- Diversity Fellowship, NSF, University of Arizona, 2008.
- Fellowship award for outstanding academic performance, Fundación UNAM, 1989-1992, 1994-1995, 1997.
- Fellowship from the National Council for Science and Technology (CONACyT), México, 1996.

**Athletic and extracurricular activities**

College Football.*Condores*-UNAM, 1993 - 96. Position: Running Back. Merits: “Pumas” selection team 1994 - 96.

Football coach. UNAM Football Club, 1993 - 97. Spring & summer: Head Coach for junior high school and pop warner categories. Responsible for coaching and coordinating the Spring Youth Football Program involving nearly 180 children, and 30 coaches.

Offensive Coordinator for the High school Football team “Tigers, UNAM”, 1996. National Championship Game.

Offensive Coordinator for the High school Football team “Gamos”, 1994 - 95. Two National Championship games. National Champions 1995.

Radio broadcasting. ITESM 89.5, Mexico City, 1995. Program: “Traveling waves”. Alternative music and literature for young people.

**Summary of Training and Skills**

- Graduate training in Mathematics and Physiology.
  - Past and current research combines biophysics, physiology, and mathematics to model systemic phenomena from a single cell perspective. Problems of interest include vertebrate and invertebrate model organisms.
  - Background on probability, stochastic processes, dynamical systems, cellular and systems physiology.
  - Experience collecting electrophysiological data and performing computer simulation of biological processes. Extensive experience with multiple unit recordings on freely behaving animals, data analysis and modeling of neural networks.

- Programming and scripting: Python, C/C++, Pascal, Matlab, HOC (Neuron), latex and HTML. Also, network administration of linux-based systems.

- Courses taught: Algebra, Calculus, Differential Equations, Set Topology, Probability, Statistics, and Systems Physiology.

- Fluent in Spanish (native speaker) and English (written and verbal). Basic understanding of italian, portuguese and french .