Research description

Marco A. Herrera-Valdez, Ph.D.

September 11, 2008

My scientific interests are centered around understanding the interaction between physiological processes from different systems in different temporal and spatial scales. So far, I have been able to combine theoretical and experimental approaches in my investigations. In the past few years, I have carried out theoretical research using stochastic processes and dynamical systems applied to topics like integration and generation of electrical signals in excitable tissue, network modulation and synchrony, spontaneous reactivation of joint activity in neurons and analysis methods for multidimensional data. I have also done intracellular recordings in insects, as well as whole animal multiunit recordings in insects, freely-behaving rodents and primates. Some of the results from the research mentioned above are being prepared for publication ([1], [2], [3]).

I obtained a Ph.D. in Physiological Sciences from the University of Arizona in August, 2008. My dissertation in Physiological Sciences is about the relationship between nearly-coincident spiking and common excitatory synaptic input in motor neurons. This work was supervised and supported by Dr. Andrew J. Fuglevand from the Physiology Department at the University of Arizona. I am currently pursuing a second Ph.D. this time in Mathematics. I expect to complete my Ph.D. in mathematics during the spring of 2008. My research in Mathematics focuses on the dynamics of excitability and its propagation in minimal biophysical models. This work is being directed by Dr. Joceline Lega from the Mathematics Department at the University of Arizona.

My long term goal as a scientist is to combine theoretical and experimental approaches to study the dynamics of physiological phenomena in excitable tissues, both at the single cell and network levels. For instance, at the cellular level, I am currently interested in studying changes in excitability that result from neuromodulation and the functional implications of such changes (e.g. activation of persistent inward currents in motor neurons). At the systems level, I am interested in studying dynamical changes in the spiking activity of populations of cells during learning (e.g. reactivation of neural traces in forebrain and midbrain structures during sleep).

References

[1] Herrera-Valdez M.A. and Lega J. (2008). Different pacemaker dynamics in different cardiac cell types predicted by the existence of the same minimal complement of ionic currents. *In preparation.*

[2] Herrera-Valdez M.A. and Lega J. (2008). Spatial dynamics of cardiac excitability and arrythmia during ischemic events. *In preparation.*

[3] Herrera-Valdez M.A. and Fuglevand A.J. (2008). Nearly-coincident spiking and coherence in motoneurones receiving common cortico-spinal input. *In preparation.*