Talk 1.1

Dynamic models of a central pattern generator for locomotion

(NIH R01-NS050943 FY 04)

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This project studies neural networks in mouse spinal cord that generate rhythmic movements of hind legs. Preparations of isolated spinal cord of mice are a model system for electrophysiological investigations of the left-right coordination of walking. We are developing and analyzing dynamical models of these networks. In addition, the project supports research on improved methods for fitting models to dynamical data.

Commissural interneurons whose axons cross the spinal cord and synapse on motoneurons or other interneurons on the opposite side of the cord are key elements in the models and experimental investigations. We study the effects of neuromodulators and genetic modifications in this system. Use of this data will help constrain the models further and help test their predictions.

The computer models being developed in this project are coupled cell systems of differential equations for membrane currents, whose structure incorporates what is known about the spinal cord. Experiments measure the physiological properties of neurons and their synapses that are needed to parameterize these conductance based models. In addition, connectivity of the network is studied in the laboratory. These data provide the foundation for quantitative comparison of the output of the model networks with that of the spinal cord. New algorithms are being developed to estimate parameters that produce the best fit between rhythmic data from model and experimental observations. The parameter estimation algorithms will be used to iteratively refine the models to increase their fidelity further.

Project (or PI) Website

http://www.math.cornell.edu/~gucken/

Publications

1. Zhong, G., M. Diaz-Rios and R. M. Harris-Warrick. Serotonin modulates the properties of ascending commissural interneurons in the neonatal mouse spinal cord. J. Neurophysiol., 95: 1545-1555 (2006).

2. K.A. Quinlan, O. Kiehn. Synaptic effects of intrasegmental commissural interneurons in the mouse spinal cord Program No. 516.1. Society for Neuroscience, 2005.