
Dynamic Models of A Neural Network for Locomotion

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This project studies neural networks in the mammalian 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 will support research on improved methods for fitting models to dynamical data.

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 will be conducted to measure the physiological properties of neurons and their synapses that are needed to parametrize these conductance based models. In addition, connectivity of the network will be studied in the laboratory. This will provide the foundation for an initial quantitative comparison of the output of the model networks with that of the spinal cord. New algorithms will be 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.

Interneurons whose axons cross the spinal cord and synapse on motoneurons or other interneurons on the opposite side of the cord will be key elements in the models and experimental investigations. The effects of neuromodulators and genetic modifications to the CPG will be explored. Use of this data will help constrain the models further and help test their predictions.