Laboratory title : CNRS UMR 5287 - Jean-René Cazalets

Supervisor

Name : Daniel CATTAERT

Thesis title :

Proprioceptive cues and movements in crayfish: neurophysiology and modeling

Keywords : Neural networks, Posture and locomotion, sensory-motor integration, electrophysiology, neuromechanical simulation

Contact

Firstname : Daniel Name : CATTAERT

E-mail : daniel.cattaert@u-bordeaux.fr

phone number : 05 57 57 70 26

Fax : 05 40 00 87 43

Abstract

The movement control by the nervous system was never fully understood because it was impossible to capture the cellular mechanisms operating when the nervous system receives continuous sensory information related to movements generated by its own activity ("closed-loop" situation). Indeed, during intracellular recordings the sensory-motor loop was, up to now, always opened. To close this loop we propose to use a simulated limb directly linked to the nervous system via both sensory and motor connections, to be able to study movement control in such a dynamic system.

We will use the simple neural network of the crayfish Procambarus clarkii that controls posture and walking with few and identified neurons. The hybrid systems consists in the in vitro preparation of thoracic ganglia in which the locomotor network is kept intact with its motor output (motor nerves) and proprioceptors of the three main leg joints (and their sensory nerves in relation with the ganglia). Proprioceptors will be mechanically stimulated by electromagnetic pullers controlled by a computer according to the motor output of the in vitro preparation (a virtual leg model elaborated in collaboration with Pr. D. Edwards, Atlanta, will be used to transform motor activity into joint movements used to stimulate the proprioceptors).

On this hybrid system, intracellular recordings from the neurons will be performed. In addition to the description of the activity of the various classes of neurons during postural and locomotor activities, the modification of activity-dependent properties of neurons will be analyzed (some of which were previously described in open loop condition by our team). Finally, a modeling of the network in closed-loop condition will be implemented for studying its dynamical properties.

Qualification required

A strong motivation for research and basic knowledge in neurosciences are needed. Skills in electrophysiological techniques (extra and intracellular) in situ constitute an important advantage but is not absolutely required. An interest in simulation techniques is also a plus.