Computational Neuroscience

The main focus of this field of research in our lab is the development of mathematical models and a simulator of the neuromuscular system in human beings. The approach takes us from the dynamics of ionic channels to the generation and control of movement, i.e., ranging from a microscopic to a macroscopic level. The structures that are the targets for modeling include motoneurons, interneurons, cortical neurons, muscle spindles, Golgi tendon organs, cutaneous receptors, axons, sinapses, muscle fibers, tendons and joints (plus some biomechanics to compose the human body). A partial implementation of the simulator can be found in http://remoto.leb.usp.br, being a useful tool for research and teaching. One of the final goals is to obtain a simulator that represents neuronal circuits at different levels of the nervous system (spinal cord, brainstem, brain) involved in processing sensory inputs (proprioceptive, cutaneous, visual and vestibular) and in generating motor commands for a given set of muscles. A specific focus is on the control of leg muscles and one application is the study of postural control in humans. More recently we have used with great power the results obtained from model simulations to improve our understanding of experimental results we have obtained from humans (see the line of research Neurophysiology of Human Motor Control).