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Presentation Abstract

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Title:	A web-based neuromuscular simulator applied to the teaching of the basics of neuroscience
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Abstract:	The learning of core concepts in neuroscience can be reinforced by a hands-on approach, either experimental or computer-based. Here we present a web-based large-scale neuromuscular simulator that is being used for teaching in a campus-wide course on the Foundations of Neuroscience. The simulator has several individual models based on cat and human biophysics, which are interconnected to represent a part of the neuromuscular system that controls leg muscles. Individual neuron models have a Hodgkin-Huxley-like mathematical approach with voltage-gated ionic channels responsible for the genesis of action potentials (sodium and fast potassium), AHP (slow potassium), and persistent inward currents (L-type calcium). The modeled spinal circuitry is biologically plausible and represents the motor nuclei associated with the Soleus, Gastrocnemii, and Tibialis Anterior muscles. MN spike trains are transmitted to muscle units to generate force and EMG. Each motor nuclei may be commanded by (1) stochastic inputs (representing the descending volitional force control), (2) electrical currents injected into the neurons, mimicking animal experiments, (3) synaptic inputs from peripheral nerves that can be electrically stimulated. The latter are able to generate spinal reflexes, producing muscle twitches and EMG H-reflexes. The applications of this simulator to teaching range from studies of individual neuron to full muscle force generation behaviors. Single neuron simulations allow the student to explore several concepts, such as: refractory period, rheobase and minimum firing rate, intensity vs frequency relations, interspike interval variability, effects of channel blocking, synaptic dynamics, such as synaptic depression or facilitation. From a systems point

of view, one may study, for example, the firing of MUAPs, the EMG interference pattern, the force generated by a muscle during a contraction, and the interplay between rate coding and recruitment of new motor units during an increasing contraction. More advanced concepts can also be explored using several other features of the simulator (e.g., reciprocal inhibition). The advantage of this teaching platform is its free availability on the internet (http://remoto.leb.usp.br) as well as its user-friendly graphical interface.

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