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Presentation Abstract

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Presentation Title:	Influences of Ia feedback on low-frequency fluctuations of plantar flexion torque
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Abstract:	Several feedback loops are potentially involved while a subject performs a plantarflexion. One of these loops encompasses the proprioceptive feedback from muscle spindle Ia afferents and the motoneurons (MNs). In this work, the objective was to investigate the role of the Ia feedback loop on the low-frequency fluctuations of the plantar flexion torque during the performance of a position task (PT) and a force task (FT). Experiments were conducted on nine young healthy subjects and provided reference data for the computer simulation studies using a biologically-based large-scale neuromusculoskeletal model. The model consisted of: i) conductance-based spinal MNs arranged in three motor pools (for the Soleus and Gastrocnemii muscles); ii) muscle spindle model providing Ia afferent feedback; iii) Hill-type muscle models; iv) second-order system to model the foot during PT; v) stochastic point processes to represent the activities of the descending neurons and of the afferents, which provide the randomness of the system. In the computer simulations the torque produced was equivalent to 20% of the maximum voluntary contraction, the same value adopted experimentally. For experimental data, torque power spectrum for the PT presented peaks at two different frequencies (3.40 ± 0.48 Hz and 6.24 ± 1.66 Hz) while for the FT only one peak was observed (1.67 ± 0.52 Hz). Simulation results reproduced the experimental torque power spectrum when the Ia proprioceptive feedback was active, but with a higher synaptic gain in the Ia-MN synapses for the PT. For the simulated PT two peaks were observed at 3.05 Hz and 6.01 Hz, respectively, whereas for the FT only one peak at 1.81 Hz was obtained. It is worth noting that for the FT the peak vanished when the Ia

proprioceptive feedback was absent (Ia-MN synapses were turned off). Therefore, these results provide evidence that Ia afferent feedback may be responsible for the low-frequency fluctuations of plantar flexion torque found experimentally. It should be stressed that the muscle spindles during FT are active due to the low compliance of the muscle tendon. Further research will exploit the contributions of additional feedback loops to the torque spectrum and analyze the impact of these fluctuations on motor control.

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COMPUTATIONAL MODEL

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