NEUROSCIENCE

EMG-to-torque models for exoskeleton assistance: a framework for the evaluation of in situ calibration

Publié le 9 février 2024

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In the field of robotic exoskeleton control, it is critical to accurately predict the intention of the user. While surface electromyography (EMG) holds the potential for such precision, current limitations arise from the absence of robust EMG-to-torque model calibration procedures and a universally accepted model. This paper introduces a practical framework for calibrating and evaluating EMG-to-torque models, accompanied by a novel nonlinear model. The framework includes an in situ procedure that involves generating calibration trajectories and subsequently evaluating them using standardized criteria. A comprehensive assessment on a dataset with 17 participants, encompassing single-joint and multi-joint conditions, suggests that the novel model outperforms the others in terms of accuracy while conserving computational efficiency. This contribution introduces an efficient model and establishes a versatile framework for EMG-to-torque model calibration and evaluation, complemented by a dataset made available. This further lays the groundwork for future advancements in EMG-based exoskeleton control and human intent detection.