Context Aware Regression for Myoelectric Control

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Abstract:

Dexterous upper-limb prostheses are available to restore grasping, but a reliable control is still missing. The aim of this work was to improve the robustness of myoelectric control by using context information from sensors embedded within the prosthesis. Traditionally, the usage of additional information, apart from the direct control signals (generated by the user in form of electromyography), has rarely been considered in the framework of machine learning for prosthetic control. Even when additional information has been used, the implementation has followed the conventional black-box paradigm, i.e., all available information is presented as an input to the classifier [1], [2]. We developed a novel context-driven myoelectric regression scheme (cREG) that incorporates the inference of context information from proprioception and exteroception sensors to modulate the parameters of a purely machine-learning-based regression controller (REG). In the novel approach, the context information was modelled as a state machine describing the behavior of the prosthesis and the REG parameters were modulated to increase the robustness against expected disturbances specific to a given prosthetic behavior. Further, a realistic evaluation of the cREG was performed in able-bodied subjects using different functional tasks, during which the cREG was compared to REG. The results demonstrated that utilizing context information decreased the number of unwanted commands in all functional tasks. Specifically, the median number of objects dropped with cREG was zero in all tasks, which was not the case with REG. Additionally, the subjects reported better user experience. This is the first online evaluation of a method integrating information from multiple on-board prosthesis sensors to modulate the parameters of a machine-learning-based myoelectric controller. The proposed scheme is general and presents a simple, non-invasive and cost-effective approach for improving the robustness of myoelectric control. [3] contains further details regarding the online experiment and the obtained results.

