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Title: An optimized visual biofeedback to train users in using prosthesis with pattern recognition myoelectric control

Retour visuel optimisé pour l'entraînement de personnes amputées au contrôle de prothèses utilisant la classification des activités myoélectriques

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Background and aims: Next generation prosthetics will rely massively on myoelectric "Pattern Recognition" (PR) based control approaches, as proposed with the Ottobock Myo Plus system. Those uses multiple recording electrodes and complex machine learning algorithms to recognize multiple muscle activation patterns and increase user dexterity. One major factor of successful functioning of these approaches lies in the training of amputated users and in their understanding of how those works. We thus propose here an intuitive visual biofeedback which can be easily used to train amputated subjects and allow them to learn to adapt and modulate their muscular contractions to improve their control performance.

Methods: An experimental campaign was conducted on 8 healthy subjects and 1 transradial amputee, fitted with a 8 channel myoelectric recording system. Their performance in controlling an interface through a myoelectric PR algorithm were evaluated; before and after a short (3 minutes) automatic user training session consisting in using the proposed visual biofeedback for one group, and using a generic PR algorithm output feedback for the control group. The objective was to train the most problematic gesture. Differences in the variations of performance before and after this user's training sessions are then analysed to evaluate the potential of the proposed approach.

Results: Participants trained with the proposed biofeedback increased their classification score for the retrained gesture by 27%, with an improvement of the after-training average global successful classification rate of 8.8% (final overall score of 93%). The control group obtained an increase of 49% for the retrained gesture, but with a global increase of 1.9% (final overall score of 75%). Analysis of the variations of the average myoelectric patterns (RMS

values of the myoelectric activity across the channels) for the trained gesture before and after training indicates a clear change in contraction strategy only in the group who used the proposed biofeedback.

Conclusions: The preliminary results obtained highlight the potential of this method which does not focus so much on over-optimizing the pattern recognition algorithm or on physically training the users than on providing them simple and intuitive information to adapt or even radically change their motor strategies to solve some misclassification issues. While future work should be focused on the experimental evaluation on more amputated users, we believe that such biofeedback could pave the road toward generic tools for prosthetists to train the amputees who will be fitted, in a near future, with the new generation of myoelectric pattern recognition controlled prostheses.