REAL-TIME CLASSIFICATION OF FIVE GRIP PATTERNS WITH ONLY TWO SENSORS

Agamemnon Krasoulis[1,2], Kianoush Nazarpour[3, 4], Sethu Vijayakumar[1]

[1]*Institute of Perception, Action and Behaviour, School of Informatics, University of Edinburgh, UK*

[2]*Institute for Adaptive and Neural Computation, School of Informatics, University of Edinburgh, UK*

[3]*School of Electrical and Electronic Engineering, Newcastle University, UK*

[4]*Institute of Neuroscience, Newcastle University, UK*

ABSTRACT

Current state-of-the-art prosthetic hand systems utilize electromyography (EMG) signals recorded from the user's residual muscles to decipher movement intention and control the prosthesis. To achieve a high level of decoding accuracy and robustness, a large number of EMG sensors is typically required. This requirement can both limit the functionality of the device from the user's perspective, as well as increase the power/computational requirements of the system. In this study, we propose a full framework for efficient and robust pattern recognition-based prosthetic hand control by using a single pair of EMG/inertial measurement (IM) sensors. Our proposed framework can be summarised as follows: 1) identify the optimal sensor location during an initial screening session by using a standard sequential forward selection algorithm; 2) deploy a regularized version of discriminant analysis classification which we have found that greatly outperforms linear discriminant analysis (LDA) when the input feature dimensionality is small; 3) adopt a novel classification rejection algorithm to minimize the controller's false positive rate (FPR). We assessed the performance of our proposed framework by conducting a real-time pick-and-place experiment with twelve able-bodied and two trans-radial amputee subjects Five different hand grips were included in our experiments: power/cylindrical, lateral/key, tripod, index pointer, and hand open. We found that after a few trials, participants were able to achieve robust prosthetic control performance (95% and 85% completion rates for able-bodied and amputee subjects, respectively). Furthermore, completion times were comparable to our previous work, where a larger number of sensors were used (4-6). This study provides a proof-of-principle for efficient pattern recognition-based prosthetic hand control with existing two-site EMG clinical systems.