Implementation of artificial neural networks to classify human forearm muscle signals for individual finger movement of a robotic hand

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Abstract: Artificial Neural Networks (ANNs) have been utilized in the engineering field to identify patterns from a given dataset. Powered prosthetics have specifically implemented them to detect muscle patterns; however, this has been achieved only for two patterns (open and closing). The objectives of this study were to acquire surface electromyography (sEMG) signals from human forearm muscles on fifteen participants, train Scaled Conjugate Gradient (SCG), Levenberg-Marquardt (LM), and Bayesian Regularization (BR) ANNs to extract eight features (six for fingers, hand close and hand open), and implement real-time control algorithms to individual finger movement of the YouBionic robotic hand using Arduino Mega 2560 microcontroller and Simulink. An Institutional Review Board approval was acquired prior to human subject testing. Each participant sat at a computer desk and performed individual finger movements while wearing a Myoband; a wireless noninvasive band of eight sEMG sensors. Results shows that the BR training algorithm outperforms the SCG and the LM training algorithms for accuracy in identifying the individual finger movements. The lowest and highest percentages in the confusion matrix were 70.4%, 89.9%, 69.2%, 89.3%, 64.3%, and 84.6% for BR, LM, and SCG training algorithms respectively. Future work includes testing these algorithms on persons with disabilities and integration of deep convolutional neural networks for higher accuracy.

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