ENHANCING PROSTHETIC CONTROL: NEURAL NETWORK CLASSIFICATION OF THUMB MUSCLE CONTRACTION USING HD-SEMG SIGNALS

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Abstract

The progression of prosthetic technology, enabling precise thumb control and movement, has reached a stage where noninvasive techniques for capturing bioelectrical signals from muscle activity are preferred over alternative methods. While electromyography's applications extend beyond just interfacing with prostheses, this initial investigation delves into evaluating various classifiers' accuracy in identifying rest and contraction states of the thumb muscles using extrinsic forearm readings. Employing a HighDensity Surface Electromyogram (HD-sEMG) device, bioelectrical signals generated by muscle activity, detectable from the skin's surface, were transformed into contours. A training system for the thumb induced muscle activity in four postures: 0 degrees, 30 degrees, 60 degrees, and 90 degrees. The collection of HD-sEMG signals originating from both the anterior and posterior forearms of seventeen participants has been proficiently classified using a neural network with 100% accuracy and a mean square error (MSE) of 1.4923 x 10-5 based on the testing dataset. This accomplishment in classification was realized by employing the Bayesian regularization backpropagation (trainbr) training technique, integrating seven concealed layers, and adopting a training-validation-testing proportion of 70-15-15. In the realm of future research, an

avenue worth exploring involves the potential integration of real-time feedback mechanisms predicated on the recognition of thumb muscle contraction states. This integration could offer an enhanced interaction experience between users and prosthetic devices.

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