Abstract

Trans-radial amputees struggle daily when it comes to performing one or more of their activities of daily living (ADLs). Myoelectric prosthetic hands have recently been developed to a point where they can assist trans-radial amputees to perform their ADLs, making use of electromyographic (EMG) signals to drive the prosthetic hand. In order to function, a myoelectric prosthetic hand requires multiple electrodes to collect EMG data (denoted a channel) from a prosthetic user's remaining forearm muscles, as well as complex classification algorithms to process the data in real time. The focus of research in this field is directed at developing or improving the classification algorithms, often ignoring the optimisation of the EMG electrodes themselves. The electrodes can be optimised either by position or number, however in research where electrodes are optimised, classification accuracy is used as a measure of success for the optimisation, which requires optimisation of the classification algorithm itself.

The focus of the current study was to develop a method that could optimise the EMG electrode placements and number, without needing a classification algorithm. A pre-existing 8-EMG channel dataset for seven subjects was used. The experimental method involved generating combinations of two, three and four channels from which optimal channel combinations were selected. The optimisation process made use of principal component analysis (PCA), which generated a reduced-quality model for each potential combination. The reduced-quality and original models were compared, and the optimal channel combinations identified from those comparisons with the least error. The success of the optimisation was defined as the impact that a reduced number of EMG channels would have on the percentage of variance retained (PVR) by the optimal channel combinations.

The optimal channels for each subject were compared, and although each subject displayed variation, in general the important channels were identified as those that were located over the Extensor digitorum (ED), Flexor pollicis longus (FPL), Flexor digitorum superficialis (FDS), Flexor digitorum profundis (FDP), and

Extensor carpi ulnaris (ECU) muscles. The optimal channel combinations for all subjects together had an average of 64.5% PVR for the 2-channel setup, 73.9% for the 3-channel setup, and 76.5% for the 4-channel setup. This shows that it is possible to reduce the number of channels and retain a large amount of variance in the data without the use of classification algorithms.