EMG-Controlled Transradial Prostheses - An Investigation into Machine Learning Techniques

International Journal of Computer Applications
Foundation of Computer Science (FCS), NY, USA

Volume 174
Number 3

Year of Publication: 2017

Authors:
Mufassir Abdur Rahim, Ghulam Rasool, Nasir Ahmad

10.5120/ijca2017915354

Abstract

The electromyogram (EMG) signals recorded from the surface of skeletal muscles are stochastic in nature and exhibit repeatable patterns for similar muscle activations. Therefore, machine learning algorithms can be used to learn their patterns and identify the movement intent even in the absence of an actual limb. The EMG signals are recorded from the residual muscles/muscle sites after amputation (acquired or congenital) and a representative set of features is extracted. The feature data are passed on to a machine learning algorithm for training and later use in real-time for controlling a prosthetic device. Numerous features of the EMG signal based on its amplitude, spectral contents, and stochastic nature have been proposed. Similarly, various dimensionality reduction techniques, as well as, classification algorithms have also been used. In this study, we provide in-depth analyses of different features of the EMG signals and classification algorithms along with the effect of dimensionality reduction on the classification accuracy. The surface EMG data recorded from the forearm muscles of twelve able-bodied volunteers was used to extract six different feature sets (fourteen individual features). The feature data with/without dimensionality reduction was used to train
and test three different classification algorithms, i.e., the linear discriminant analysis (LDA), support vector machines (SVM), and artificial neural networks (ANN). Our extensive study showed that the feature set consisting of the EMG amplitude, spectral, and stochasticity information provided the highest classification accuracy with a linear classifier, i.e., the LDA.

References


Index Terms

Computer Science
Control Systems

Keywords

Electromyogram, Prosthesis, Linear Discriminant Analysis, Support Vector Machines, Artificial Neural Networks