EMG Wrist-Hand Pose Classification

Collection of M-files (computer Matlab code) for EMG classification system to identify nine wrist-hand movements based on randomly acquiesced forearm EMG signals from Myo Armband as described in [1]. The system uses a linear combination of eight time-domain features followed by linear discriminant analysis (LDA) projection and multi-layer perceptron (MLP) classification. It is developed and tested on EMG recordings from 10-subjects (seven male,three female) aged 27±4 years using 8-active sensors enclosed in Myo Armband. The system operates on an EMG segment across eight channels. Requires Matlab programming environments. Updates can be found at https://github.com/sumitraurale/wrist-hand-pose-classification.

To cite this system, please use reference [1,2].
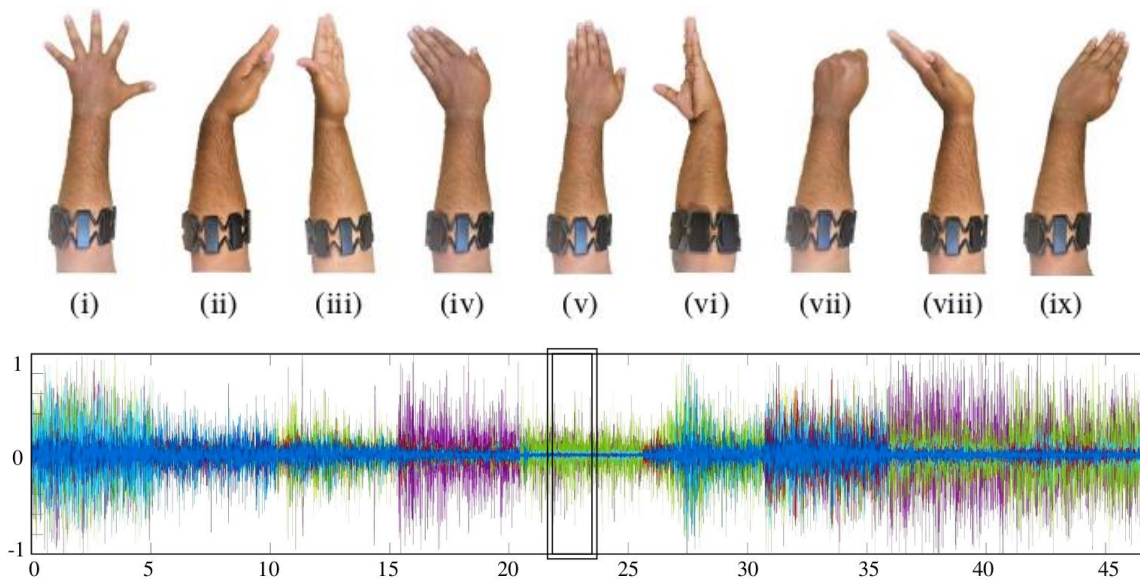
Overview

Figure 1: Example of wrist hand movements and acquired EMG signals from eight channels. The movement considered are: (i) hand open (ii) wrist flexion(iii) wrist pronation (iv) wrist ulnar flexion (v) relaxation(vi) wrist supination (vii) hand close (viii) wrist extension (ix) wrist radial flexion

A low-complexity method to nine wrist-hand movements based on randomly acquired forearm EMG signals. The method was developed by assessing eight time-domain features from a 256-segement EMG window across eight channels. Estimated features from eight channels were concatenated and reduced with LDA analysis and is classified using data driven MLP approach. The code here implements this movement classification system, which was trained with EMG recording for nine movement data with 100 sessions from 10 healthy subjects.

Quick Start

Set system trained parameters in Matlab using the system_parameters function:

```
>> system_parameters;
```

Example

```
% Generate random signal segment
>> segment_dim=256;
>> channel_no=8;
>> emg_data = rand(segment_dim,channel_no);
>> Fs=200;

% Plot EMG segment
>> figure(1);
>> t=(0: segment_dim-1)./Fs;
>> plot(t,emg_data);
>> xlabel('time (seconds)'); ylabel('Amplitude (mV)');

% Evaluate feature vector
>> feature_overall = feature_extract(emg_data);
```

Files

All Matlab files (.m files) have a description and an example in the header. To read this header, type help <filename.m> in Matlab.

Requirements

Matlab (R2013 or newer, Mathworks website).

Test Computer Setup

• hardware: Intel® i7® CPU 3.6 GHz, 64-bit, 4GB Memory.
• operating system: Windows 7 Enterprise, 64-bit.
• software: Matlab (R2016a) with Signal Processing Toolbox.

References

1. SA Raurale, J McAllister, JM del Rincon, "Real-Time Embedded EMG Signal Analysis for Wrist-Hand Pose Identification", *IEEE Transactions on Signal Processing,* April 2020. DOI: 10.1109/TSP.2020.2985299

2. S Raurale, J McAllister, JM del Rincon, "EMG Acquisition and Hand Pose Classification for Bionic Hands from Randomly-placed Sensors", in *2018 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 1105-1109, IEEE, 2015. DOI: 10.1109/ICASSP.2018.8462409

Contact

Sumit A. Raurale, Ph.D.

Data Science and Scalable Computing,

The Institute of Electronics, Communications and Information Technology (ECIT),

Queen's University Belfast,

United Kingdom