Lab 1 - EMG

- **For questions about this lab please contact the TA, Saeed Arasteh <sarasteh@sfu.ca>**
- **Two files to be uploaded on Canvas:**
  - **Report. The report should have student's name, SFU ID, and email address**
  - **MATLAB m-files**

Problem

8 pairs of electromyography (EMG) electrodes were used to record muscles activity (see Figure 1) related to the following 5 classes (see Figure 2): neutral, wrist extension, wrist flexion, radial deviation, and ulnar deviation. The recorded data can be downloaded from Canvas (FYI: this is a subset of data from the following paper we recently published: Xiao ZG, and Menon, C, *Performance of Forearm FMG and sEMG for Estimating Elbow, Forearm and Wrist Positions,* Journal of Bionic Engineering, Vo. 14, No. 2, pp. 284–295, 2017). The data are grouped as follows:

- xTrain: data to be used for training
- yTrain: labels to be used during training
- xTest: data for testing
- yTest: correct labels for the testing

A 1KHz sampling rate was used when recording the data.

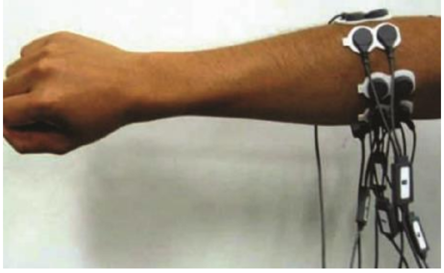

Figure 1: EMG placement

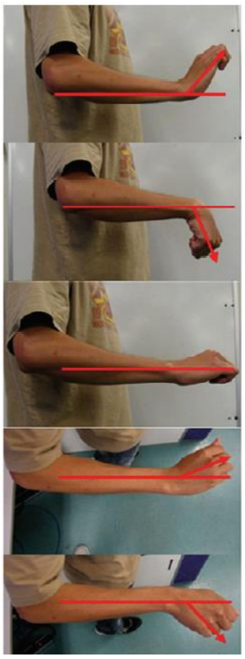

Figure 2: 5 classes. From the top: wrist flexion, extension, neutral, radial deviation, ulnar deviation.

Questions

1. Using MATLAB, extract the following three groups of features from the EMG signals: Root-Mean-Squares (RMS) and waveform length and fourth order autoregressive coefficients (AR). Implement the first two features in MATLAB (do not use MATLAB built-in functions for these). Use instead the MATLAB built-in function for AR (use the function: "aryule"). Please plot:
   a. raw data of the xTest dataset ("Volt" vs "ms")
   b. RMS of xTest using a window size of 100ms
   c. RMS of xTest using a window size of 1,000ms
   d. Waveform length of xTest using a window size of 100ms

   e. Waveform length of xTest using a window size of 1,000ms
   f. AR coefficients of xTest using a window size of 100ms
   g. AR coefficients of xTest using a window size of 1,000ms

2. Using 100ms of window size and using LDA built in MATLAB, determine the classification accuracy for both the training and the testing dataset.
   a. Create a plot showing the correct class and your predicted class as a function of time for the training dataset.
   b. Create a similar plot also for the testing dataset.
3. Repeat the previous point for two other window sizes at your choice (ideally one that yields better and one worse accuracy than using the 100ms window)
4. Create a table reporting the numerical values of the overall accuracy for the training and testing dataset that you obtained for the different window sizes.