# Biomedical Robotics
## EEG data analysis assignment 2

### Deadline: November 15th

Group ___

Names _____

EMG data preprocessing

1) Load the EMG file EMG_data.mat
   *(Fs=1000Hz; 1st row Events: 1='Cue'; 2='Go'; 2nd row EMG signal Right Biceps; 3rd row: Triceps)*

2) For each muscle implement the following steps:

   a. Filter (band pass 30-450 Hz) advise FIR filter, recover phase delay 2 with 'filtfilt'.
   b. rectify
   c. compute the envelop of the muscle signals (low pass 3-6 hz)
   d. down-sample the signal

3) Load the motion data kinem_####.mat
   *(Fs=100hz; 1st raw Time points; 2nd raw Events 1 STOP, 2 CUE, 3 GO, 4 TARGET, 8 longer than target; 3rd raw x cursor, 4th raw y cursor; 5th raw x target; 6th y target)*

4) Considering the experimental design (see below); extract EMG and Motion Data of the first set of movements; the first and last sets of force field; the first set of washout

| set | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Epoch_start | 1 | 97 | 193 | 289 | 385 | 481 | 577 | 673 | 769 | 865 | 961 | 1057 |
| Epoch_end | 96 | 192 | 288 | 384 | 480 | 576 | 672 | 768 | 864 | 960 | 1056 | 1152 |
| Condition | NF | NF | NF | NF | NF | FF | FF | FF | FF | FF | WA | WA |

Each set contains 96 movements (48 out and 48 back movements). NF= No Force; FF=Force Field; WA=Washout. Remember: each movement has a Cue and a Go events which help you segmenting into sets

Questions:
Why the down sampling is computed at the end of the EMG processing?

The down sampling is done at the end because we reduce the band width so we loose information.

When the muscle activation starts with respect to the movement (see motion signal)?

The muscle activation starts from 1.8 secs with respect to the movement

Which differences can you detect between the sets with and without the application of the force field?
1. The EMG signal becomes more noisy when force is applied
2. The rectified signal in the force applied region starts immediately at 0 and dissapear at 4 while in the no force applied state the rectified signal starts at 1.4 with a peak.
3. The muscle with the force applied reacts after few seconds.
4. The movement signal is uniform when no force is applied but when force is applied the movement signal is not uniform.

The final folder of the assignment must be named Group_# and it must contain:

The Matlab code with comments and generating the following figures for each muscle and each of the 4 sets you extracted (tip: subplots are easier to understand and follow):
-   EMG row signal with on top the filtered signal plotted with a different color.
-   EMG rectified with on top the Envelope plotted with a different color.
-   The movement signal X and Y in time
-   The xy movements signal together with the targets
-   this pdf files filled out

Please, do not put additional files in the final folder