BIOE 198MI Biomedical Data Analysis. Spring Semester 2018.
Final Project: Analyzing Physiological Data

Assignment:

Prepare **2** complete lab reports analyzing the provided ECG and EMG data in order to answer the discussion questions and address the deliverables that are detailed in the two parts below. **Each lab report** should have all of the sections that are detailed in the course syllabus. However, the introduction sections for each report can be a bit shorter than usual.

Final reports are due **in PDF format** at noon on May 4th. Reports should be submitted on Compass.

Part I. ECG Data

Deliverables:

Three pulse rates, in beats per minute, for each dataset:

1. At rest
2. At rest, with hand raised
3. After exercise

Discussion Questions (for your final/best method):

1. Evaluate your method for calculating the pulse rate? How do the results compare to manually counted pulse rates? What are your methods' strengths and weaknesses?

2. What challenges did you face in fitting the noisy data?

3. How would your code handle a changing pulse rate?

4. Under what conditions might your code fail? Why?

Part II. EMG Data

Analysis Approach:

1. Create a standard curve of EMG amplitude plotted against normalized force data (using the initial increasing force EMG signal).
    a. This will require two sub-steps:
        i. Rectifying the signal – i.e. making sure you are only dealing with positive values
        ii. Applying a moving average filter to the EMG data in order to smooth out the signal (see Lab 3)
    b. Example plots of the analysis approach were given in class.

2. Create standard curves of average frequency and frequency amplitude plotted against normalized force data (using the initial increasing force EMG signal)
    a. This will require the following steps:
        i. Transforming appropriate segments of the EMG data into the frequency domain (see Lab 6)
        ii. Fitting the frequency domain data to a Gaussian function with the following equation:

$$EMG(f) = A \cdot e^{\frac{-(f-b)^2}{2\sigma^2}}$$

where *EMG(f)* is the EMG signal in the frequency domain, *f* is the frequency in Hz, *A* is the amplitude of the Gaussian distribution, *b* is the mean of the Gaussian distribution, which we are calling the center frequency (units of Hz), and σ is the standard deviation of the distribution. *A, b,* and σ are the three parameters that need to be fitted (see Lab 7).

    b. Example plots of the analysis approach were given in class.

3. Analyze the fatigue data in terms of changes in amplitude and frequency over time.
    a. Factors that you will have to consider and justify your choices for:
        i. How many segments of EMG data did you analyze?
        ii. How large of a window size did you choose for a given segment of EMG data to analyze?

Discussion Questions:

1. What happened over time with the fatigue data in terms of amplitudes, frequency amplitudes, and center frequency values? Provide plots to justify your answers.

2. Justify the factors behind EMG segmentation and the window size that you selected.

3. How did you correlate the fatigue data with the initial data with increasing force and what was the correlation that you determined?