Signal Processing Notes for 4BD4 Lab 3

You are asked to calculate time and frequency features for the EMG signal recorded during different contractions including the fatiguing contraction.

- As indicated the time feature is the average of the rectified signal (rms gives you similar values) so you have had no problems calculating this feature for each 10 sec epoch of the fatiguing EMG. You should see an increase in amplitude of the EMG, especially near the end of the total contraction. Why? We fatigue mechanically , not electrically so more motor units have to be recruited and these have to contract at a higher rate to make up for the reduced force output from fatiguing motor units (i.e. more motor unit action potentials /second contributing to the signal.
- To calculate the frequency response you can use the Matlab FFT function for each contraction and each 10 sec window of the fatiguing contraction. For the 10 second window, this gives you 5000 coefficients (plot looks like a bunch of grass). A better approach is to use the Welch periodogram function, pwelch, breaking the signal up into 2-sec windows, with a 50% overlap, giving you the average of a total of 9 2-second windows of EMG. The resulting power spectral density plot looks much smoother since there are now only 1000 coefficients.
- Next whatever method you use, you have to characterize the frequency power spectrum by a single feature if you want to plot it. The usual feature is the centroid frequency (sometimes erroneously called the median) which is a Matlab function as well. If you don't know what the formula is look it up in Wikipedia.
- The centroid frequency should shift to lower frequencies as the muscle fatigues. Why? Lactic acid buildup in the tissue due to contraction interferes with the conduction of the fibre action potentials, slowing them down and thus lengthening the recorded potentials. Most of the frequency content of the EMG signal is determined by the frequency content of individual motor unit action potentials