NOISE CANCELLATION OF EMG SIGNAL

Introduction & Problem Statement

What is EMG?

Electromyography (EMG) is a test that checks the health of the muscles and the nerves that control the muscles.

Problem With EMG Signal?

Noise is the unwanted electrical signal in an EMG signal. This noise and artifacts in the signal is a serious issue to be considered, as this will adversely effects the quality of the signal. Also the analysis of EMG signals are difficult due to this.

Range at which emg signals can be recorded ?

It is well established that the amplitude of the EMG signal is stochastic (random) in nature and can be reasonably represented by a Gausian distribution function. The amplitude of the signal can range from 0 to 10 mV (peak-to-peak) or 0 to 1.5 mV (rms). The usable energy of the signal is limited to the 0 to 500 Hz frequency range, with the dominant energy being in the 50-150 Hz range. Usable signals are those with energy above the electrical noise level.

System – Source of the Signal

https://physionet.org/physiobank/database/emgdb/
https://physionet.org/physiobank/database/emgdb/emg_healthy.txt
https://physionet.org/physiobank/database/emgdb/emg_myopathy.txt
https://physionet.org/physiobank/database/emgdb/emg_neuropathy.txt

Signal Analysis

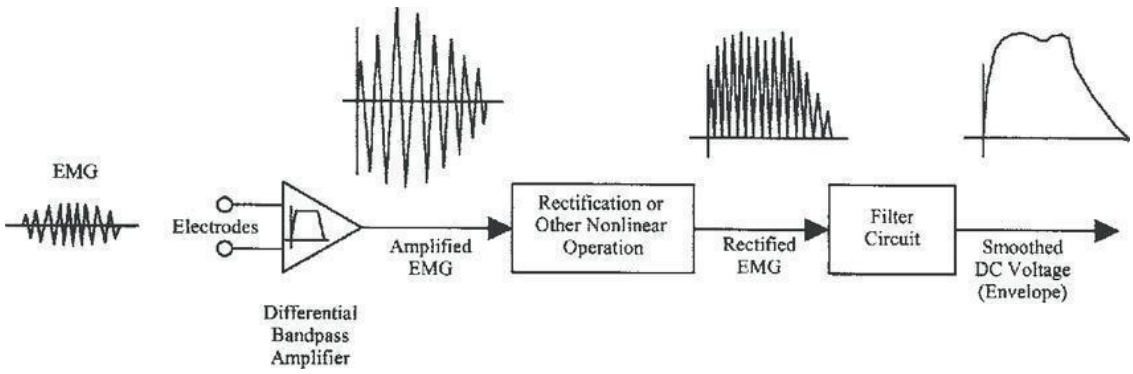
- We have obtained the EMG signals from various different sources and use it in matlab for desired output.

- The raw data of an EMG signal has a lot of noise and disturbance which makes it hard to interpret the results.

- We rectify the signal using a band-pass filter(butterworth).

- The signal obtained is easier to interpret as the low cutoff frequency removes baseline drift and DC offset.

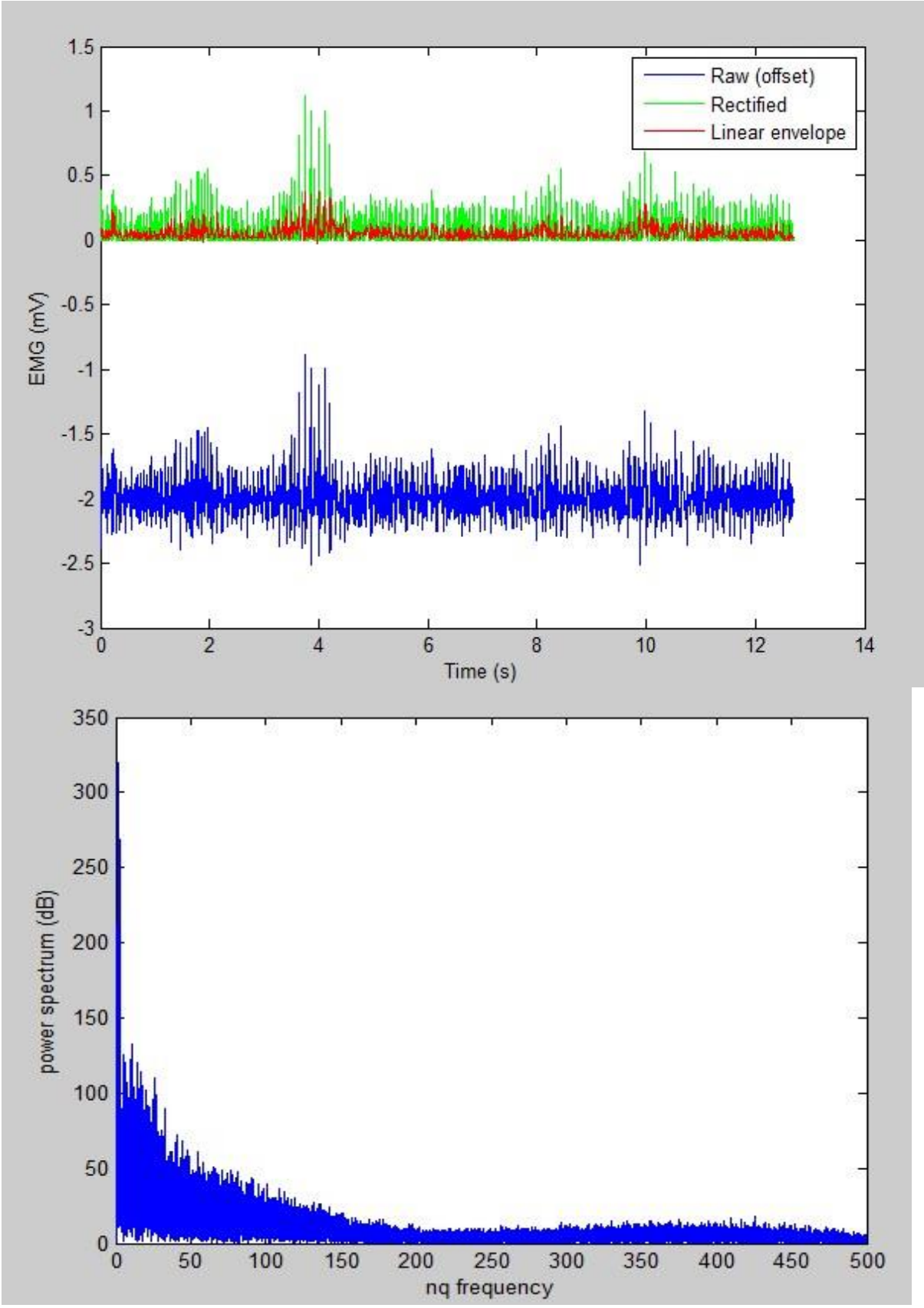
Algorithm/ Flow Chart:



MATLAB CODE

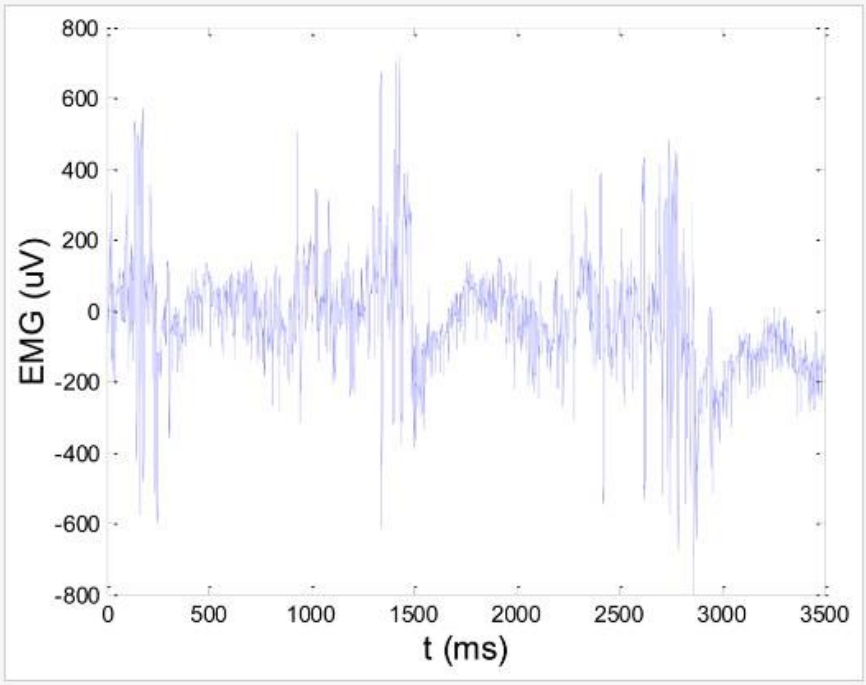
```
close all
clear all
fq = 25;
loc='E:\';
x=load([loc 'emg_myopathy.txt']);
t=x(:,1);
Fs=1000;
Fnyq=Fs/2;
y=abs(x(:,2)-mean(x(:,2)));
fco=20;
[b,a]=butter(4,fco*1.25/Fnyq);
z=filtfilt(b,a,y);
plot(t,x(:,2)-mean(x(:,2)),'b',t,y,'g',t,z,'r');
xlabel('Time (s)'); ylabel('EMG (mV)');
legend('Raw (offset)','Rectified','Linear envelope');
N=length(x);
freqs=0:1000/N:Fnyq;
xfft = fft(x(:,2)-mean(x(:,2)));
figure;
plot(freqs,abs(xfft(1:N/2+1)));
xlabel('nq frequency'); ylabel('amplitude spectrum');
```

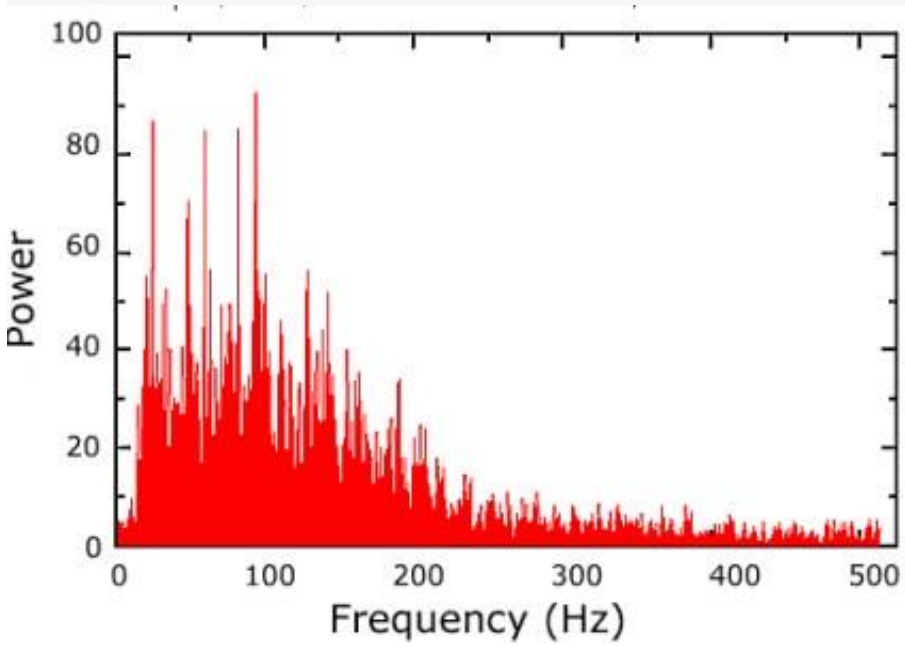
Result(healthy emg) using data from physionet (A 25mm concentric needle electrode was placed into the tibialis anterior muscle of each subject.)(MATLAB RESULTS)



These are the recorded readings of a healthy person obtained online for comparison for what we got on matlab.

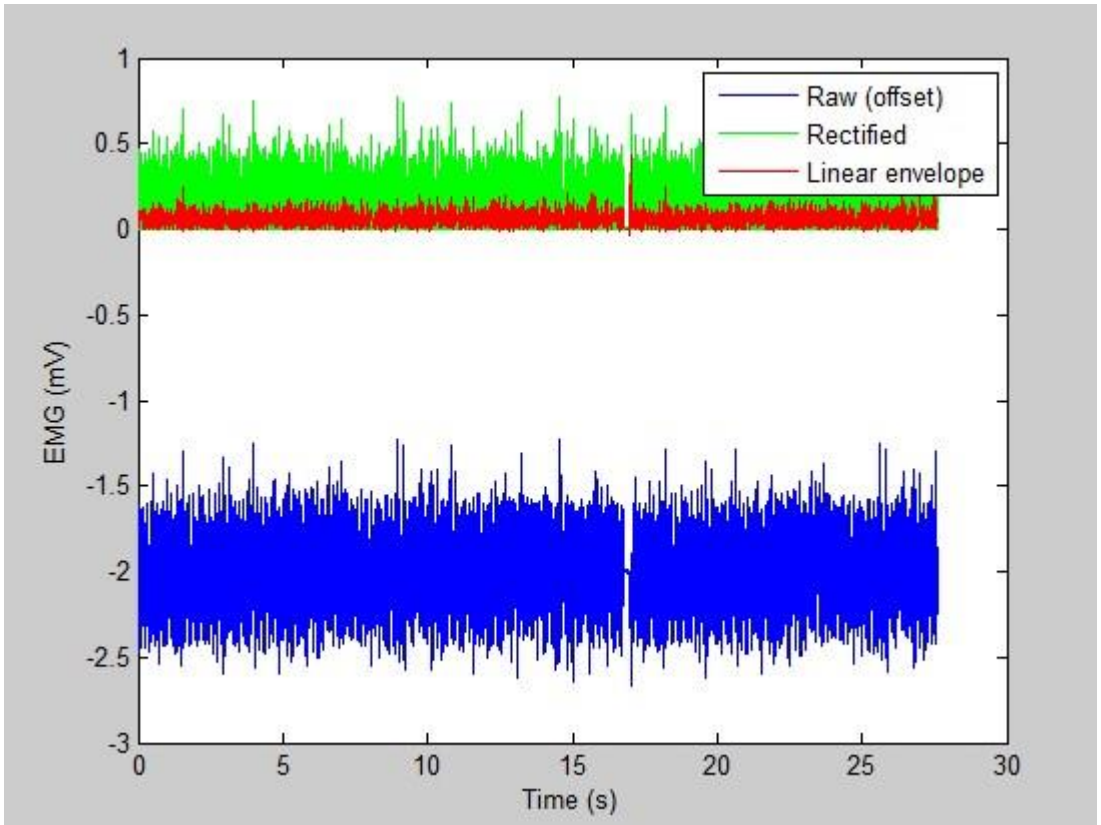
Figure 13. Raw EMG signal recorded on tibialis anterior muscle.

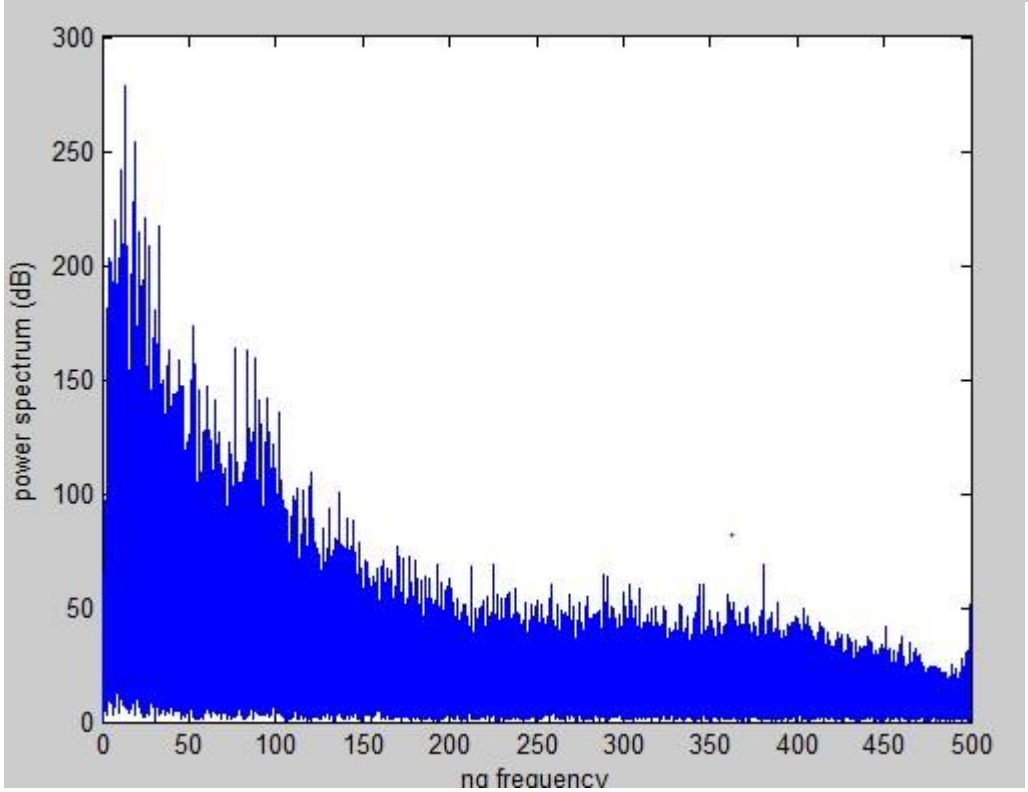




The range of power ranges from (0-200 db)

EMG SIGNAL OBATINED AND PROCESSED USING BUTTERWORTH FILTER FOR MYOPATHY(MATLAB)FROM PHYSIONET





Application

    - Band-pass filters can be used to obtain high definition EMG signals which can be read by doctors.
    - Real time muscle monitoring of athletes to maximize performance and improve vitality of athletes. Monitoring injury recovery.
- To determine the activation timing of the muscle; that is, when the excitation to the muscle begins and ends
- To estimate the force produced by the muscle.
- To obtain an index of the rate at which a muscle fatigues through the analysis of the frequency