Heart ECG filter with DFT

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The electrocardiography record of the heart shows the potential difference in the form of wavelength that occurs with heartbeats as the heart contracts. This project aims to filter the measured current to remove the noise in frequency domain. The sampling frequency is 500Hz and the unit of ECG is mV.

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Figure 1. With/without zero-padding.

The zero-padding number was chosen as padding\_length/2 = (filterlength-1)/2 and to solve problems of datatype floor(padding\_length/2) at the start to get the smallest integral and ceil(padding\_length/2) was used at the end to get the largest integral.

To check the unit signal we extracted a single 2 second channel from the data and filtered it with a 16-pt averaging filter. Two 16-pt averaging filter each with/without zero-padding was used. The Non-zero-padding result had problems with the edge compared to the zero-padded filtering result. The zero-padding the filter will prevent the edge artifacts, making the signal smooth. This will make the result more accurate.

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Figure 2. Magnitude spectrum of segments from 0 to 10 sec.

The plot shows the magnitude from 0Hz to Nyquist frequency(fs/2). The amplitude is doubled due to the negative frequencies.

The frequency characteristic of the input signal shows a large amplitude near 0Hz and the small amplitude over 25Hz. The large amplitude near 0Hz is likely to be the noise we are looking for.

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Figure 3&4. Cutoff frequency of 50Hz for LPF and 0.5Hz for HPF.

The cutoff frequency was selected from the Figure 2 spectrum. The large magnitude near 0Hz were cutoff by HPF and the small unnecessary parts over 50Hz were cutoff by LPF. The LPF of 25Hz and 50Hz did not show a significant difference. Therefore, 50Hz was selected to show the signal close to the original signal.

The HPF shows the normal sinus rhythm of the heart ECG unit and the LPF shows the trend of the units. To get the heartbeat signal HPF result which removes the noise will be more appropriate.