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Course: ECE 5210

Subject: Lab 5, Polyphase decimation and interpolation

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1 Introduction

In this lab, we explore the implementation and analysis of polyphase decimation and interpolation on STM32F769I development boards. Through theoretical insights and practical experimentation, we aim to understand the behavior of the filter and its performance in real-time signal processing applications. We will be implementing the system using C and using the oscilloscope to plot the phase and magnitude of the frequency response by performing a frequency sweep.

2 Theory

This lab did not require any new calculations although it did utilize the coefficients from the previous lab's filter.

3 Results

The results for this lab can be seen in Fig.1 which shows the frequency response. We can see that the gain is constant and the phase is linear. The maximum number of taps I was able to achieve was 1000.

The results for this lab can be seen in Fig.1 and Fig.2. Fig.1 shows the noise removal using my filter, we can see that the vast majority of the noise is removed and it looks much more like the generated ECG wave than in the pass-through channel. Not all noise is removed however which is why the figure still shows some wiggle after being processed. Note that the magnitude of filtered signal is half that of the pass through signal. There does not seem to be much of a difference in the noise removal when compared to the previous lab.

In Fig.2 there are two subplots. One subplot for the magnitude and the other for the phase.

4 Discussion and Conclusions

I don't notice a very big difference in noise reduction when I look at the results from lab 4. This filter is capable of many more taps than my previous filter which only achieved 32. This filter also introduces a slight phase phase shift although it is hard to see in the plot. We increment our taps by increments of 100 because the number of taps needs to be divisible by 100.

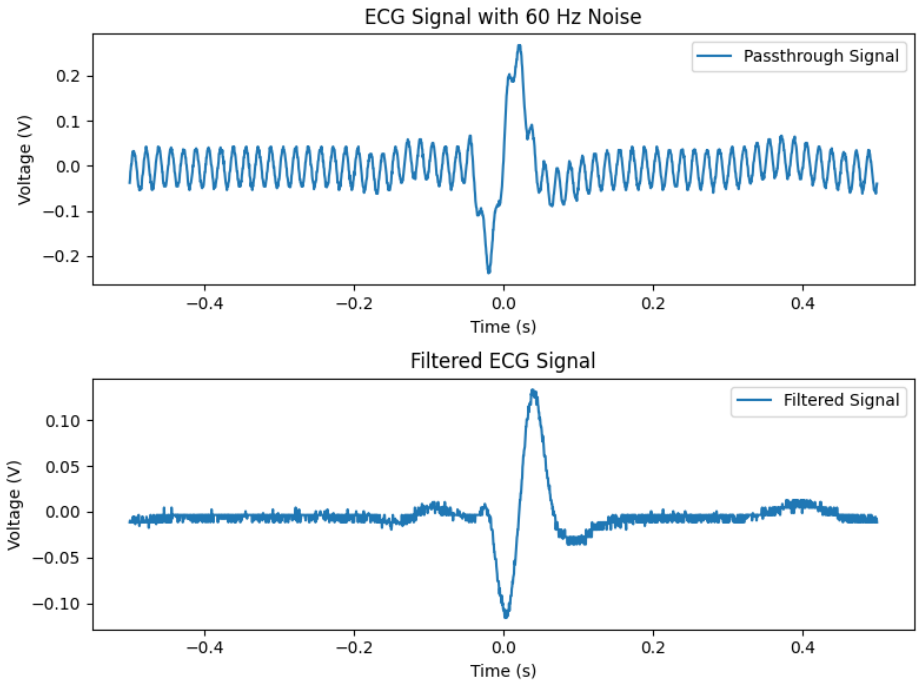

Figure 1: Noise removal of a 60 Hz ECG signal using upsampling and downsampling as well as interpolation

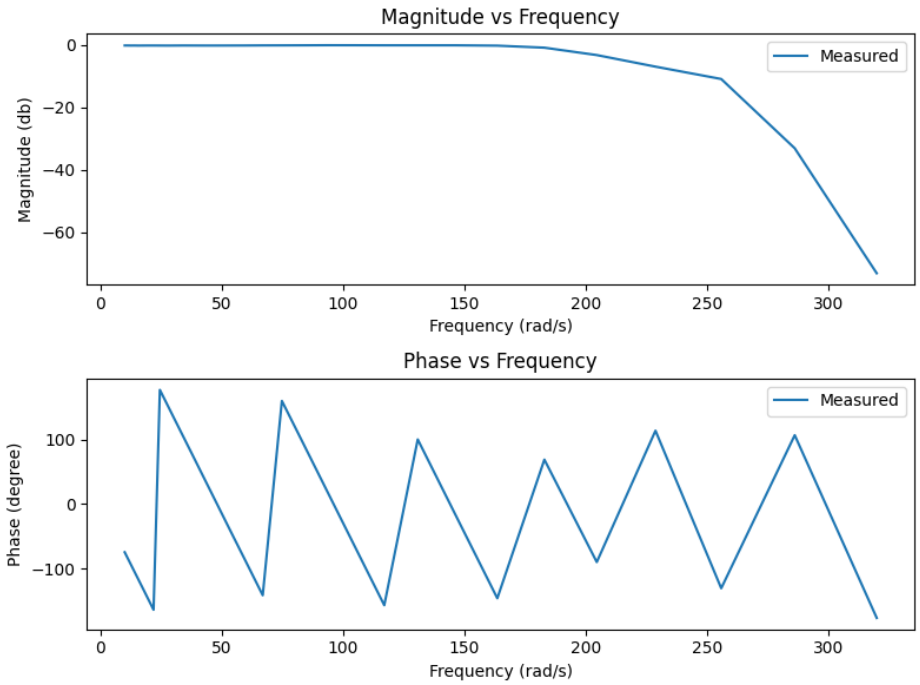

Figure 2: Magnitude and phase of the frequency response using measured and analytical data