**Student:** Garrett Nadauld

**Course:** ECE 5210

**Subject:** Lab 8, Fixed-Point DSP

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WEBER STATE UNIVERSITY
Engineering, Applied Science & Technology
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

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# 1 Introduction

The goal of this lab was to implement an FIR filter using fixed-point data rather than floating point. The purpose for doing so would be to increase the speed and efficiency of our board. On our board specifically the benefits will be minimal due to it coming with a floating-point unit (FPU) which enables fast floating-point arithmetic. This lab will still prove to be valuable as not every processor will include a quality FPU due to their complexities and cost.

# 2 Theory

This lab did not require any calculations.

# 3 Results

The results for this lab can be seen in Fig.1 - Fig.3. Fig.1 shows the zeros and poles of our transfer function plotted on the unit circle for both the floating and fixed point implementations. In Fig.2 there are two subplots, each containing three lines. One line is for the theoretical floating point magnitude and phase, another for the theoretical fixed point and the final one for the measured fixed point implementation. Fig.3 shows the filter coefficients.

# 4 Discussion and Conclusions

This lab was especially easy to implement just as the previous lab. When looking at the poles and zeros in Fig.1 the floating and fixed-point values line up pretty well but not completely. This is due to loosing some accuracy in the conversion from floating-point to fixed-point and back again to floating-point. Our theoretical frequency responses line up pretty well but get further apart as the frequency increases. The frequency response from our implementation is slightly more off than the analytical, the magnitude still lines up very well. The phase however, gets off by quite a bit even after correction. I would assume this is also due to losing precision in between conversions.

In my implementation of this lab I used 15 fractional bits, this seemed to yield the best result as many more or less I began to fail the tests sporadically. Using this implementation I was only able to use 34 taps which I believe is the same number as in the floating point implementation earlier this semester. This is because of the integrated floating-point unit on our board. I didn't try to optimize this code all that much because I am about a week behind on labs and decided it was more important to start the next lab rather than trying to optimize working code.

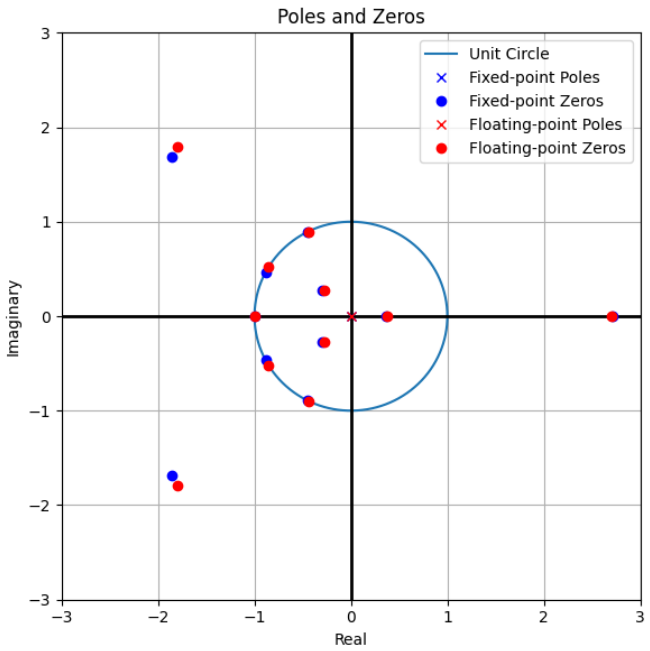


Figure 1: Zeros and poles of both the floating and fixed-point coefficients

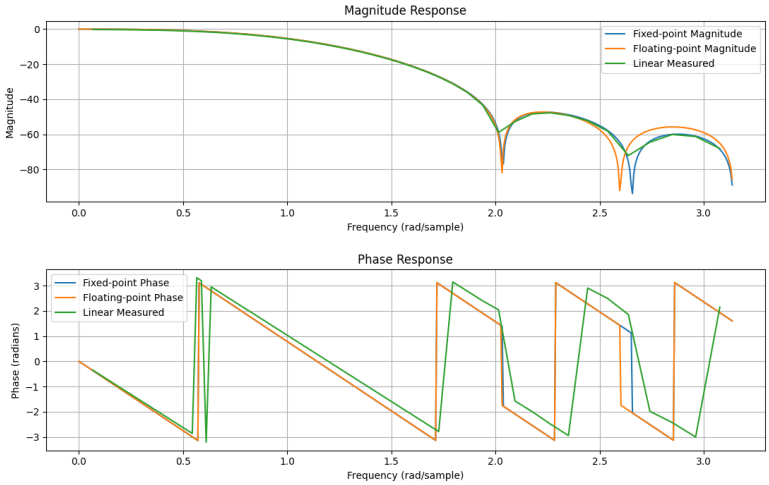


Figure 2: Magnitude and phase of the frequency response using measured and analytical data

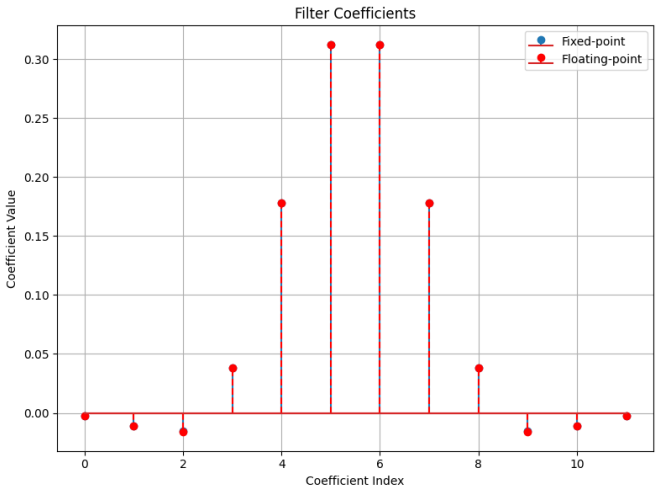


Figure 3: Impulse response for floating-point and fixed-point transfer function