Lab 3: Digital Signal Processing

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ECE 5 - UC San Diego

Part 1: Signal Processing with MATLAB and Microcontrollers

Objective

What is the objective of this lab (in your own words)?

The objective of this lab is to get us familiar with how frequency, amplitude and wavelengths work using a photoresistor. We are expected to understand the computation of what it means for a wave to be 5Hz, 1kHz, etc.

Challenge #1 - Onramp Tutorial

Part 1

MathWorks | Training Services

Course Completion Certificate

Ruben Gonzalez

has successfully completed **100%** of the self-paced training course

MATLAB Onramp

DIRECTOR, TRAINING SERVICES

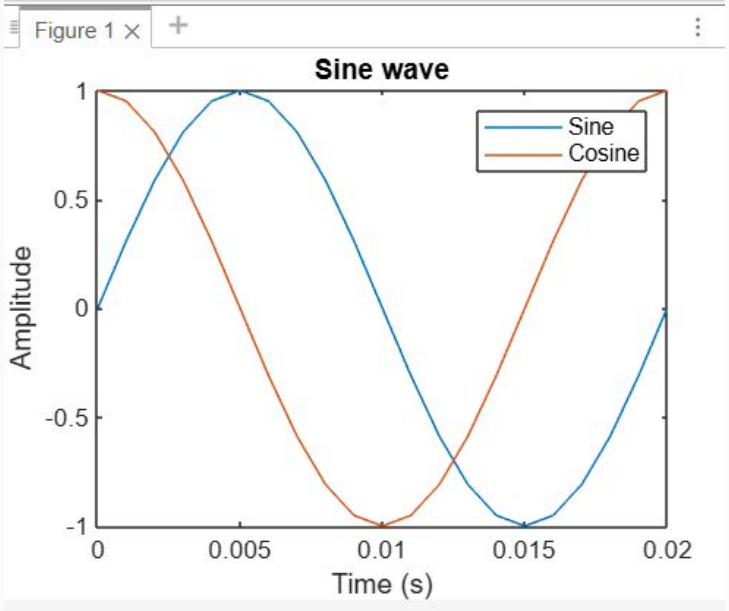
7 May 2025

I would like to highlight the plot tutorial, since that's something we will be working on a lot.

Challenge #2A - Creating a signal in MATLAB

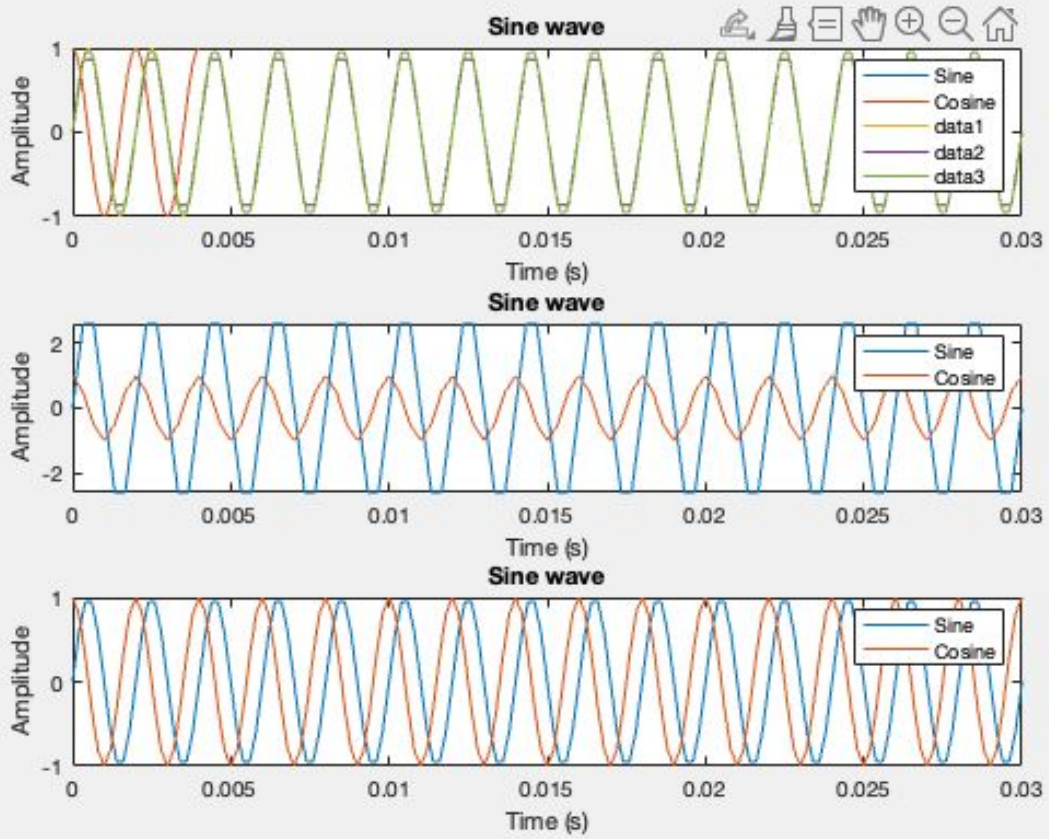
Part 1

(2A.1) Copy your sine wave plot at Frequency 500 Hz Amplitude 1



Challenge #2A - Creating a signal in MATLAB

Part 1



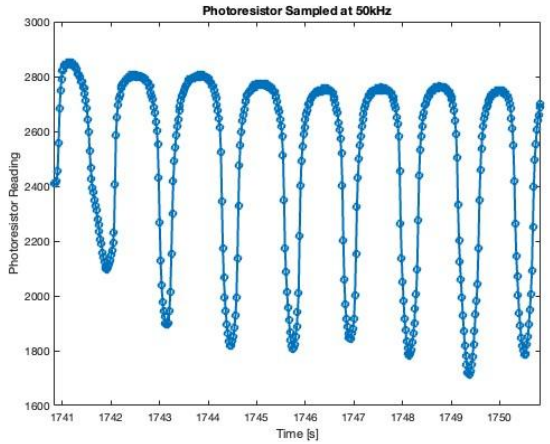
(2A.3) Comment on how the shape of the sine wave changes as you change the sampling frequency. Do certain plots look better than others?

I notice that the first plot is better than most, then would be the last one. I can tell that the pitch is much lower with less frequency.

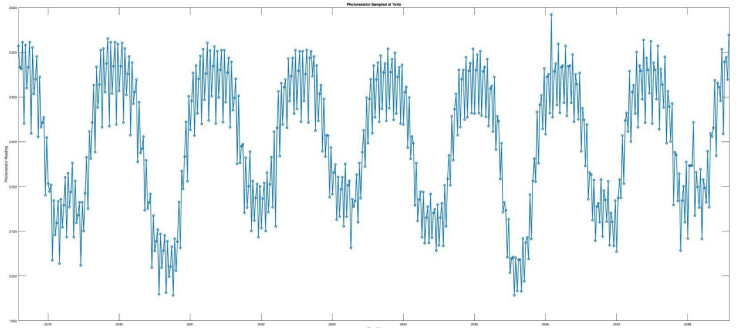
Challenge #2B - Creating a signal in MATLAB + Microcontrollers

Part 1

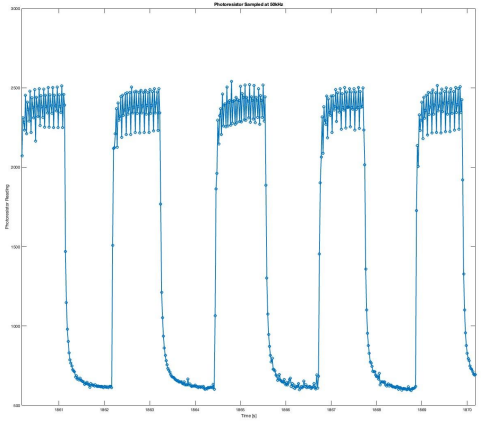
(2B.1a) Copy your 0.5 Hz “sine wave” plot here.



(2B.1b) Copy your 1 Hz “sine wave” plot



(2B.2) Copy your 0.5 Hz “square wave” plot here.



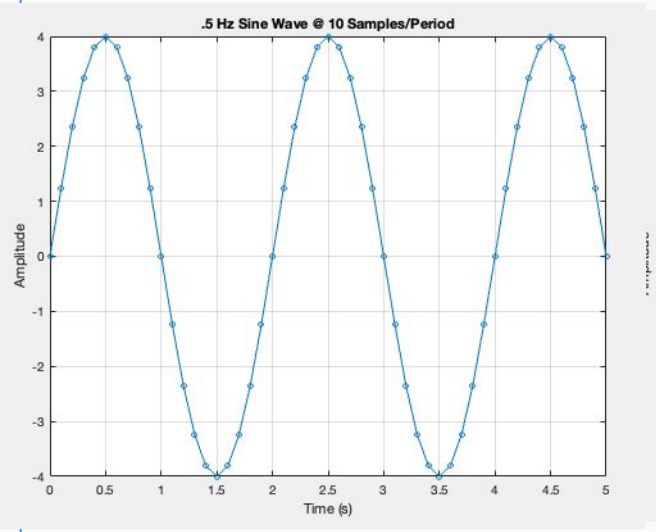
(2B.3) What was your amplitude for each wave?

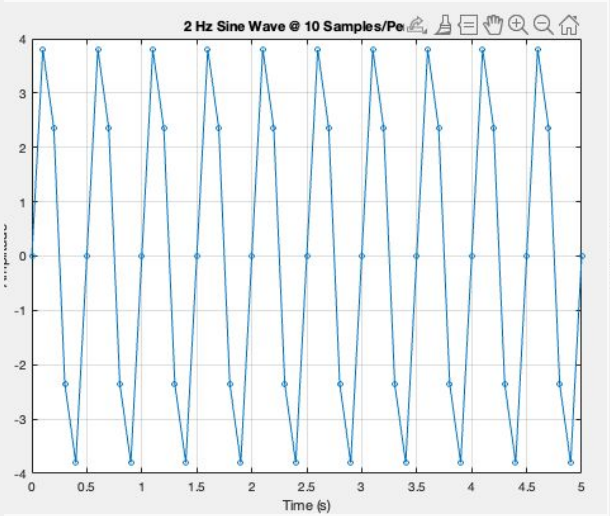
My amplitude for these waves were 1.

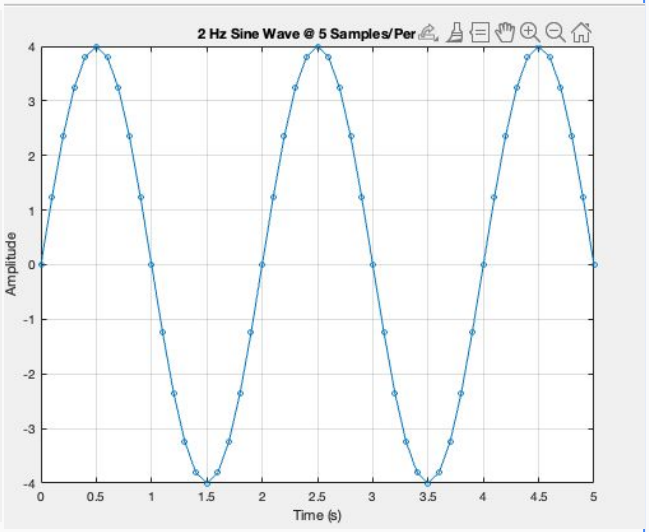
Challenge #3A – Generating Signals via Functions

Part 1

Copy your three plots in the same figure window with different sine wave frequencies / sample rates here. Use subplot. Remember to title your plots and label axes.



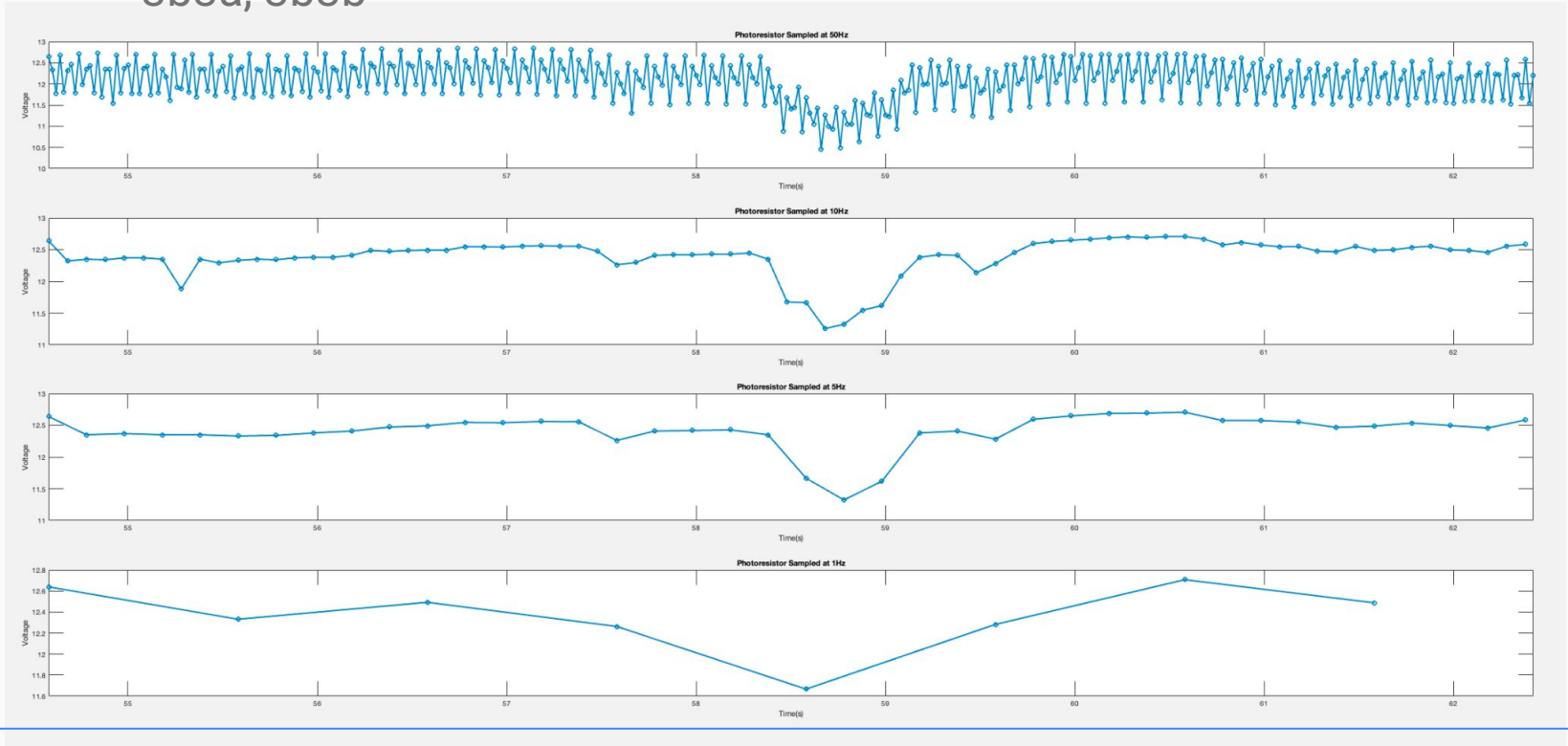




Challenge #3B – Sampling w/ MATLAB + Microcontrollers

Part 1

3b3a, 3b3b



(3B.4) The effect on having a lower sampling frequency causes the signal to be less accurate since a more accurate frequency consist of a lot of samples.

Challenge #4A – Time vs. Frequency Representations

Part 1

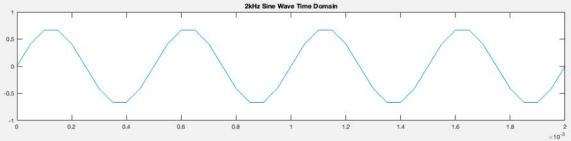
(4A.1) What can you read from the power spectrum plots? What does the spike mean?

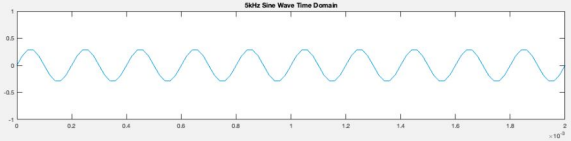
I'm able to read the spikes in whenever there is a lot of energy (with the light noise around me).

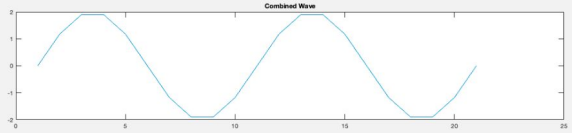
(4A.2) What's the benefit on analyzing signals using power spectrum plot (frequency domain)? Especially on the combined signal?

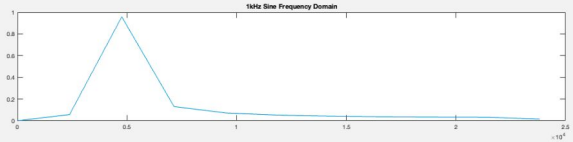
It's good to know analyze signal using power spectrum plot since it allows us to better understand the change in environments which can be used to use in real world applications.

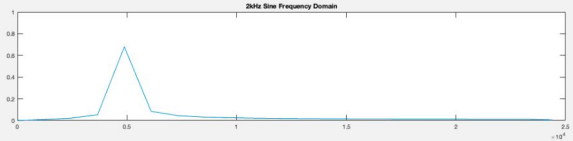

1kHz Sine Time Domain

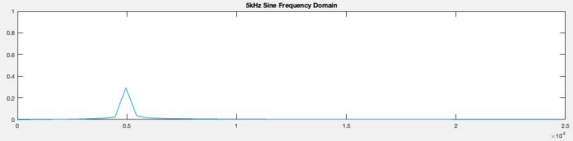

2kHz Sine Wave Time Domain

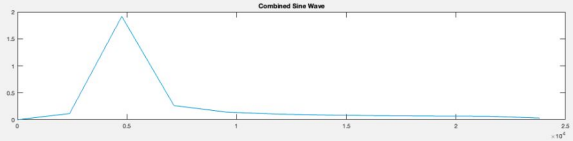

5kHz Sine Wave Time Domain


Combined Wave


1kHz Sine Frequency Domain

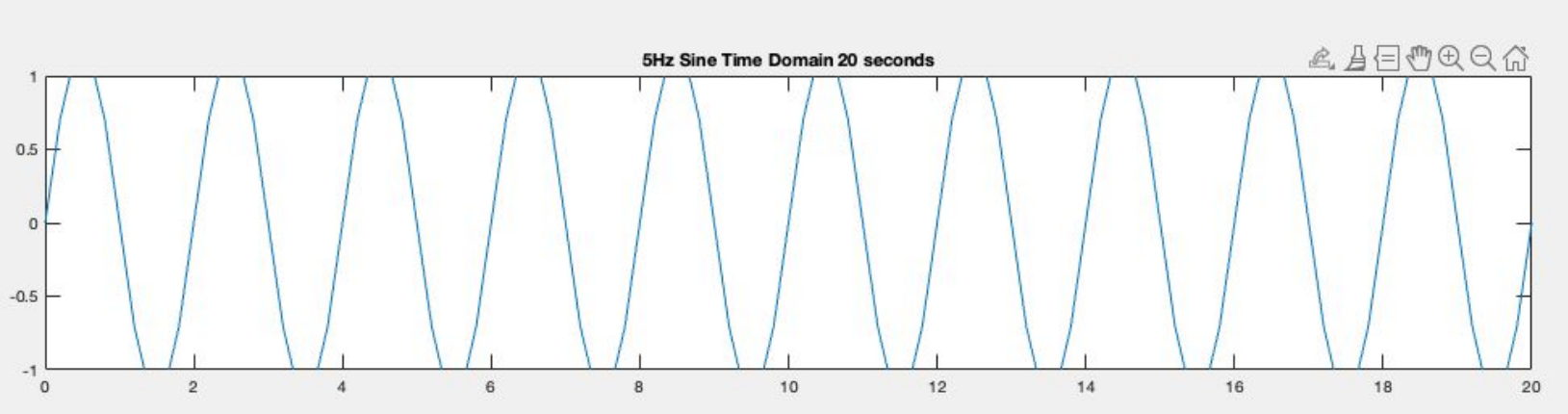

2kHz Sine Frequency Domain

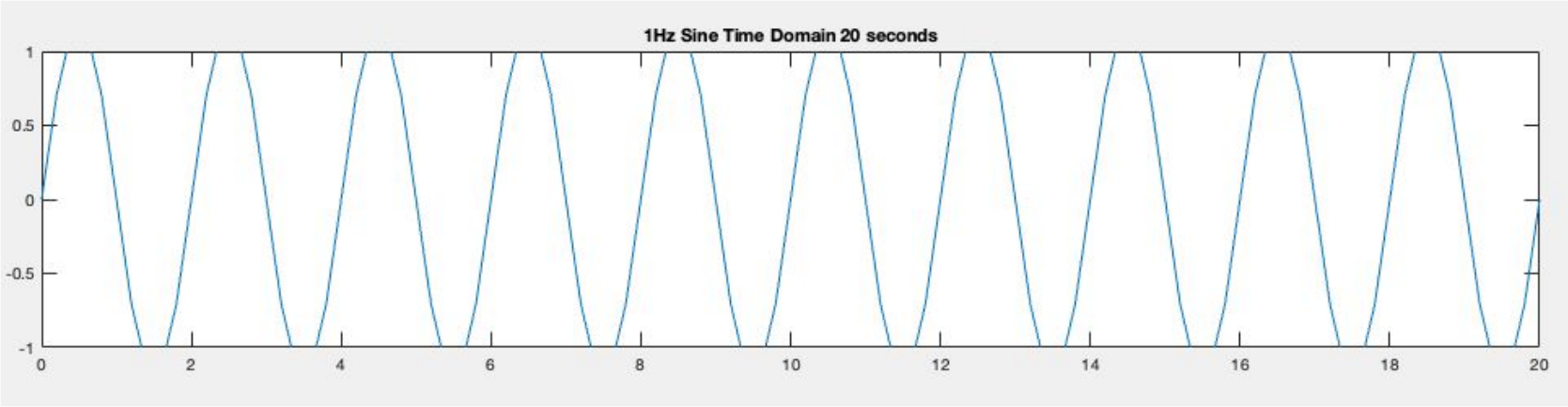

5kHz Sine Frequency Domain


Combined Sine Wave

Challenge #4B – Time vs. Frequency Representations

Part 1





Challenge #4B – Time vs. Frequency Representations

Part 1

(4B.1) What did you observe on the power spectrum plot (second subplot) on your two screenshots? What does it mean?

I was able to observe the peaks of the signal, more specifically the change it frequency.

(4B.2) What did you notice on the spectrogram? How is that related to your hand moving frequencies?

In the spectrogram I was able to see the time in the x-axis and the frequency level on the y-axis. I was able to see how quick the sensor was at detecting any hand movement and light room change.