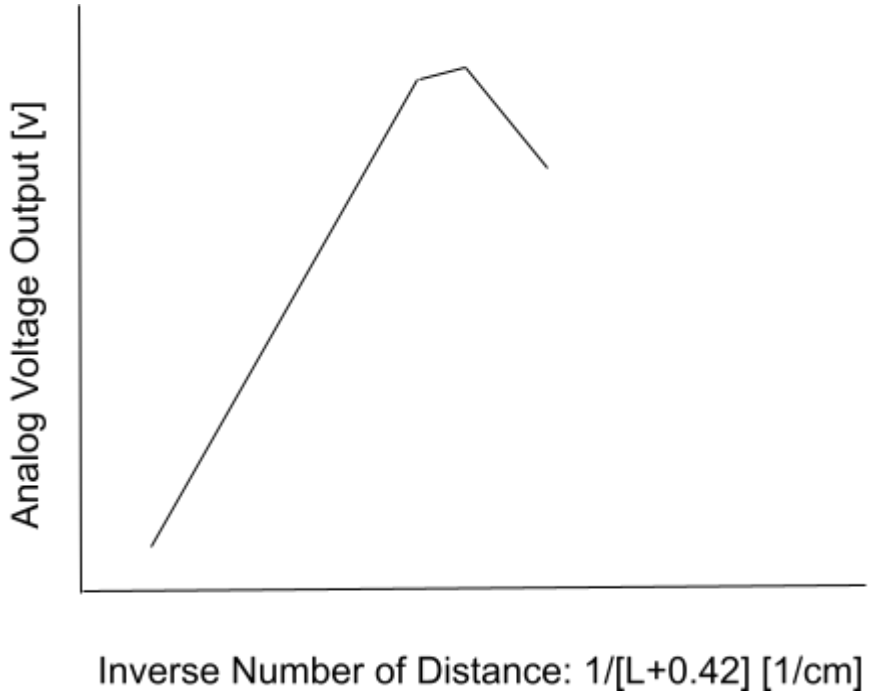
3. Pre-Lab Exercises

1. What is the effective range of the Sharp GP2Y0A41SK0F Infrared Rangefinder? Sketch the theoretical calibration curve supplied in the datasheet. Do not take a screenshot of the original datasheet.

   Effective Range: 4 - 30 cm



2. What is the optimal sensing distance (from the reflective surface) that the QTR-MD 08RC sensor should be?

Optimal Sensing Distance: 5mm

3. Create two MATLAB functions to implement a moving average FIR filter (name it FIR_MA) filter and a weighted recursive average IIR filter (name it IIR_WA). The FIR function should take a data set (X) and number of samples (N) to average as inputs. The IIR function should take a data set (X) and weighting factor (α) as inputs. They should output the filtered data set (Y). Bring your functions to lab. Include screenshots of your code and plots in line with this question. Also submit your .m files to canvas. Do not use the Matlab "filter" function; you need to write your own code for these. Be sure to include your name and lab section in the comments of your code. Function definitions are below:

   Y = FIR_MA(X,N)
   Y = IIR_WA(X,alpha)

```
%Brandon Lim
%Moving Average Filter (Finite Impusle Response)
function Y = FIR_MA(X, N)
    Y(1:N-1)=X(1:N-1); %initializing first terms in filtered data as initial data

    for k=N:length(X)
        Y(k) = sum(X(k-(N-1):k))/N;
    end
end
```

```
%Brandon Lim
%Weighted Recursive Average Filter (Infinite Impulse Response)
function Y = IIR_WA(X, alpha)

    Y(1)=X(1,1);
    for k = 2:length(X)
        Y(k)=alpha*X(k)+(1-alpha)*Y(k-1);
    end

end
```

4. Using the provided signal file **Lab7_prelab4_noisydata.mat**, plot the original data and a filtered version of it on the same plot. Do this for each of the filters below using your functions from the previous problem. Attach these properly labeled plots to your prelab. Use a legend to designate filtered and unfiltered data. The X-axis should be time (sec) and the Y-axis should be voltage (V)). Include screenshots of your code and plots in line with this question. Also submit your .m files to canvas.

   a. IIR: $Y_i = 0.75\, Y_{i-1} + 0.25\, X_i$

   b. IIR: $Y_i = 0.9\, Y_{i-1} + 0.1\, X_i$

   c. FIR: $Y_i = \frac{X_{i-7}+X_{i-6}+X_{i-5}+X_{i-4}+X_{i-3}+X_{i-2}+X_{i-1}+X_i}{8}$

   d. FIR: $Y_i = \frac{\sum_{j=0}^{24} X_{i-j}}{25}$

```
%Brandon Lim
%PreLab7
clear, clc, close all

load("Lab7_prelab4_noisydata.mat");

YIIRa = IIR_WA(data(:,2), 0.25);
YIIRb = IIR_WA(data(:,2), 0.1);
YFIRc = FIR_MA(data(:,2), 8);
YFIRd = FIR_MA(data(:,2), 25);

figure
plot(data(:,1),data(:,2)); %Raw Data
hold on
plot(data(:,1), YIIRa) %IIR, alpha = 0.25
hold on
plot(data(:,1), YIIRb) %IIR, alpha = 0.1
hold on
plot(data(:,1), YFIRc) %FIR, N = 8
hold on
plot(data(:,1), YFIRd) %FIR, N = 25

xlabel("Time [sec]");
ylabel("Voltage [V]");
title("Voltage vs Time | Brandon Lim u1244501")
legend("Unfiltered Data", "IIR: alpha = 0.25", "IIR: alpha = 0.1", "FIR:N = 8","FIR:N = 25")
```

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