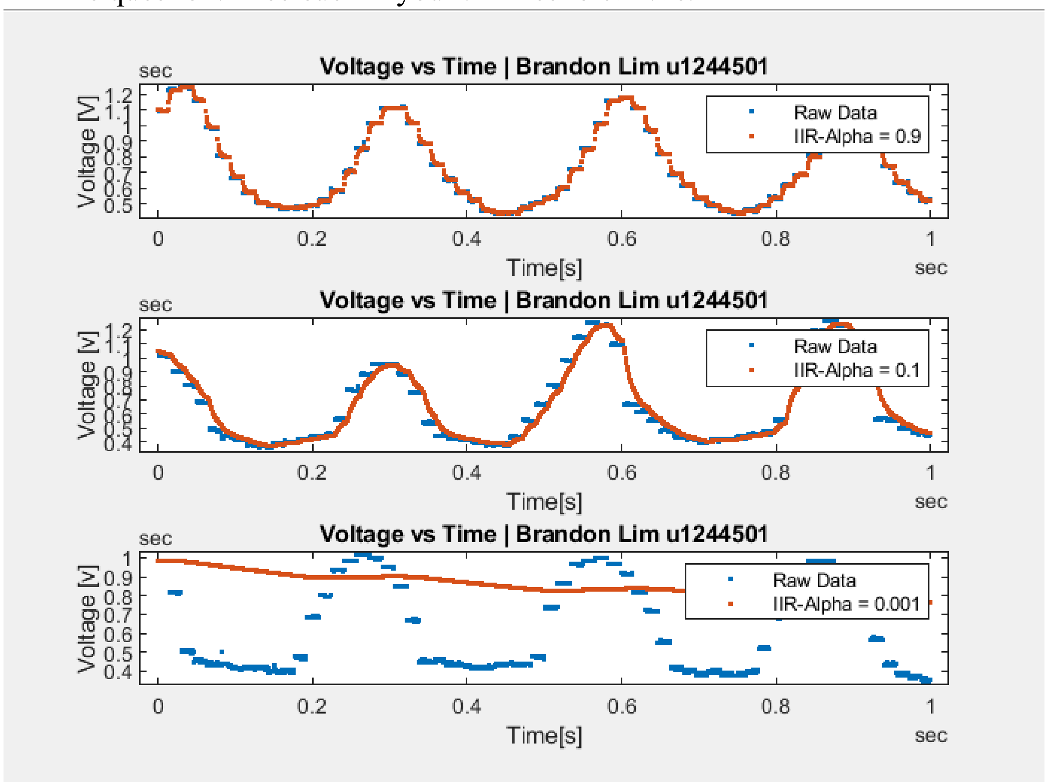
Brandon Lim u1244501

5. Post-Lab Exercises

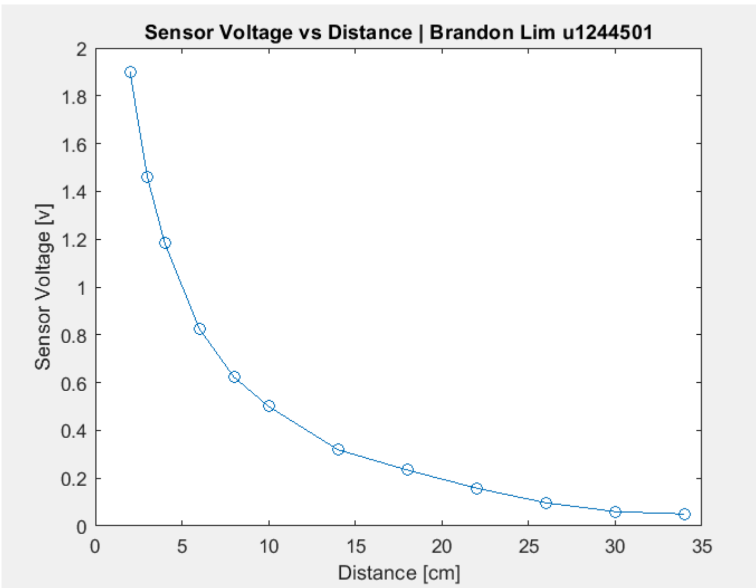
1. Using MATLAB, plot your three data sets of IR rangefinder output from 4.1.4. You should have one plot with three subplots. Each subplot should have a different α value displayed. Show the raw and filtered data super imposed on one another. Distinguish between raw and filtered values. Include screenshots of your code and plots in line with this question. Also submit your .m files to canvas.




```
% Brandon Lim u1244501
% Post Lab 7
clear,clc,close all

underfiltered = load("UnderFiltered.mat").rawdata;
tunder = underfiltered(:,1);
underraw = underfiltered(:,2);
underfil = underfiltered(:,3);

wellfiltered = load("WellFiltered.mat").rawdata;
twell = wellfiltered(:,1);
wellraw = wellfiltered(:,2);
wellfil = wellfiltered(:,3);

overfiltered = load("OverFiltered.mat").rawdata;
tover = overfiltered(:,1);
overraw = overfiltered(:,2);
overfil = overfiltered(:,3);

subplot(3,1,1)

%underfiltered
plot(tunder,underraw,".")
hold on
plot(tunder,underfil,".")
xlabel("Time[s]")
ylabel("Voltage [v]")
title("Voltage vs Time | Brandon Lim u1244501")
legend("Raw Data", "IIR-Alpha = 0.9")
```

```
subplot(3,1,2)
%wellfiltered
plot(twell,wellraw,".")
hold on
plot(twell,wellfil,".")
xlabel("Time[s]")
ylabel("Voltage [v]")
title("Voltage vs Time | Brandon Lim u1244501")
legend("Raw Data", "IIR-Alpha = 0.1")

subplot(3,1,3)
%overfiltered
plot(tover,overraw,".")
hold on
plot(tover,overfil,".")
xlabel("Time[s]")
ylabel("Voltage [v]")
title("Voltage vs Time | Brandon Lim u1244501")
legend("Raw Data", "IIR-Alpha = 0.001")
```

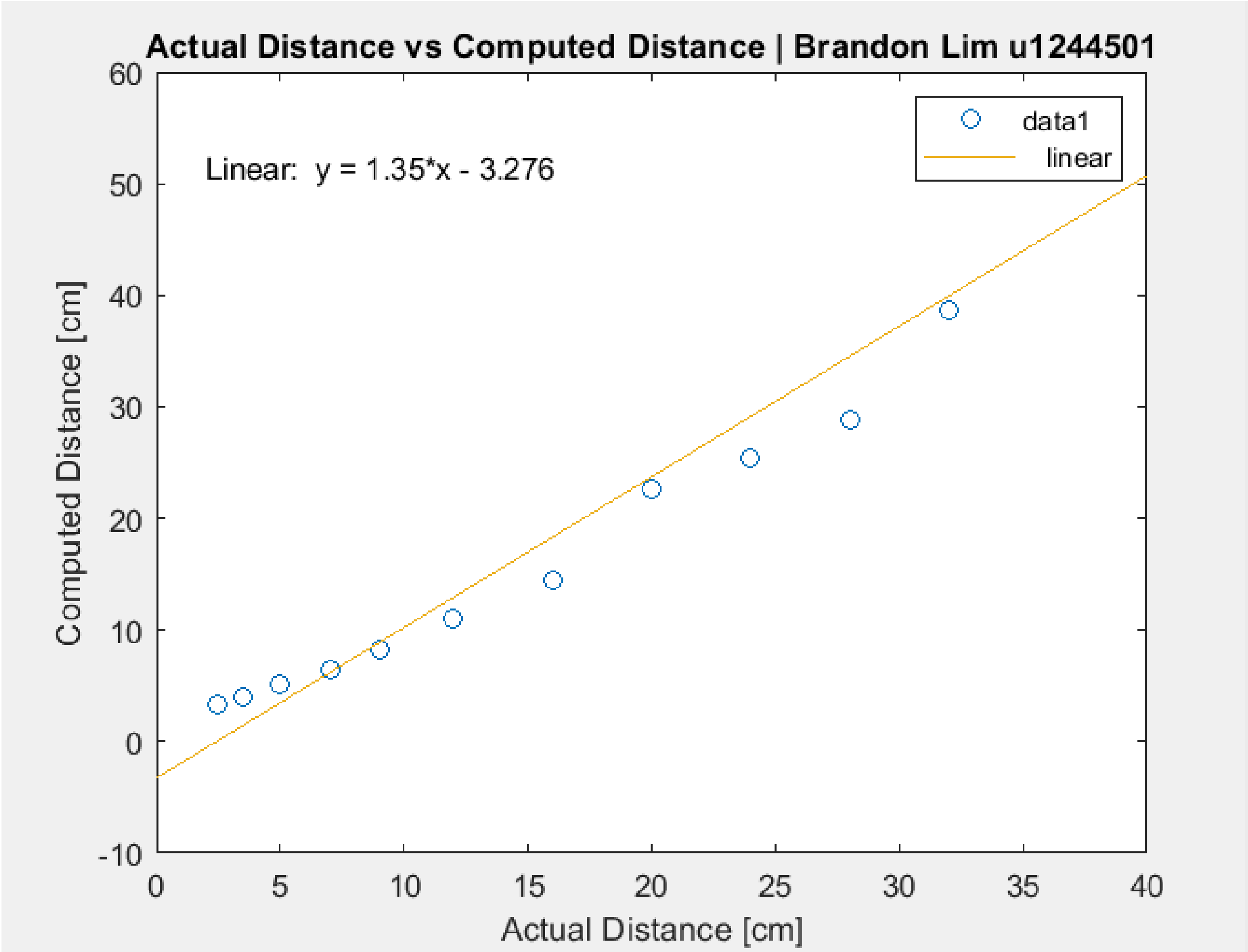
2. Using MATLAB, plot the data from table 4.2.1 with sensor voltage on the y-axis and the distance on the x-axis. Use linear scaling on both axes. Attach your properly labeled plot to the Post-lab. Discuss how your plot compares to the plot in the data sheet. Include screenshots of your code and plots in line with this question. Also submit your .m files to canvas.




```
%% Brandon Lim u1244501
clear, clc, close all

sensorVol = [1.9 1.46 1.185 0.825 0.623 0.5 0.319 0.234 0.158 0.097 0.06 0.05];
dist = [2 3 4 6 8 10 14 18 22 26 30 34];

figure
plot(dist,sensorVol,"-o")
xlabel("Distance [cm]")
ylabel("Sensor Voltage [v]")
title("Sensor Voltage vs Distance")
```

- The graph in the data sheet is identical to my matlab plot of the data. The only difference is that the data sheet plotted distances 2-4cm and we did not plot them.

3. Using MATLAB, plot your IR verification data from table 4.2.2. Fit a line to the Actual (cm) vs. Sensor (cm). A slope of 1 and a bias of zero would be a perfect match. Attach your properly labeled plot with linear fit equation displayed on it. Include screenshots of your code and plots in line with this question. Also submit your .m files to canvas. What does your fit say about the calibration equation you created in lab?




```
%% Brandon Lim u1244501
clear, clc, close all

actualdis = [2.5 3.5 5 7 9 12 16 20 24 28 32 36];
compdis = [3.32 4.03 5.15 6.51 8.27 11 14.5 22.6 25.35 28.77 38.65 55.8];

figure
plot(actualdis,compdis,"o")
xlabel("Actual Distance [cm]")
ylabel("Computed Distance [cm]")
title("Actual Distance vs Computed Distance | Brandon Lim u1244501")
```

- My fit has a slope of 1.35 which is slightly off from a perfect slope of 1. My bias is -3.276 which is slightly off from a perfect bias of 0. This means that my calibration was not as perfect as it could be. This could be a result of slightly inaccurate voltage measurements due to imperfect distancing when collecting data points to create an equation that relates distance and voltage. This would then create errors in computed voltages. Overall, there was still good estimation of distances from voltage values.

4. How does the shape of an object affect the IR range sensor's measurements? How does the material/surface finish of an object affect the IR range sensor's measurements?

- The shape of an object can affect the IR range sensor measurements by affecting the IR laser's reflection. For example, a flat wall has very consistent reflectance while a round object can reflect off its various radii non consistently. The material or surface finish also affects an IR range sensor's measurements based on its reflectance properties. For example, it won't be easy to get a reflection off glass but will be easier for a solid material.

5. Using pseudocode, show how you could check for 3-way intersections while line following. In other words, what criteria would you place on the sensor values from your reflectance sensor to recognize that you've arrived at the intersection?

- While sensor values(4-5) read black[>=1500])
    - If sensor values (1-3) or sensor values (6-8) read black[>=1500]
        - Then location = 3 way intersection
    - End
- end