4AL Lab 2C Pre-lab

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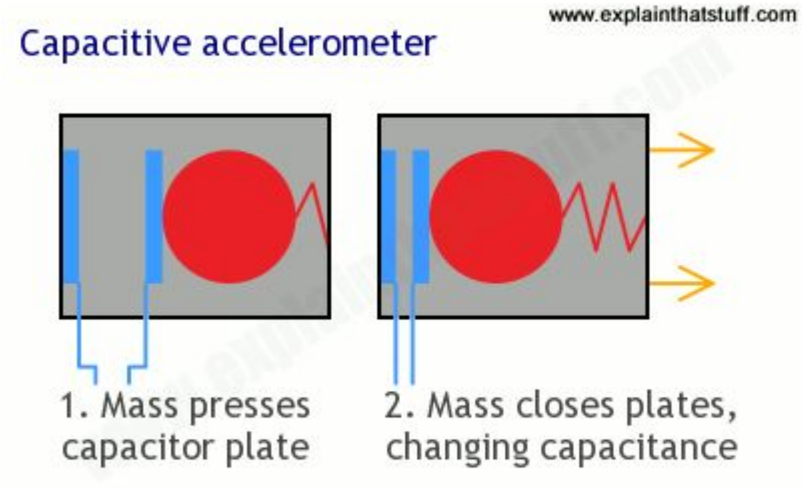
Accelerometer

The accelerometer measures acceleration based on the force that a miniature mass connected to a spring inside it experiences. When an external force causes the spring to extend, the distance between internal capacitive plates go down. The distance between the capacitor affects the voltage output from the accelerometer. The voltage reading from the accelerometer can then be transmitted through an Arduino pin. The output, in the units of volts, of the accelerometer needs to be calibrated in order to convert it into an acceleration in m/s^2.



Accelerometer

Suppose you had the accelerometer resting on the table. The force of gravity compresses the spring with a force of F_g = m * g. This causes the capacitive plates to move closer together such that the calibrated output of the accelerometer is g=9.8 m/s^2.

Q. What would you expect to be the output of the accelerometer if it's experiencing free-fall? Why?

- The output should be 0 m/s^2 because the mass within the accelerometer will experience no weight. The proper acceleration of the object will be measured as 0.

Calibration

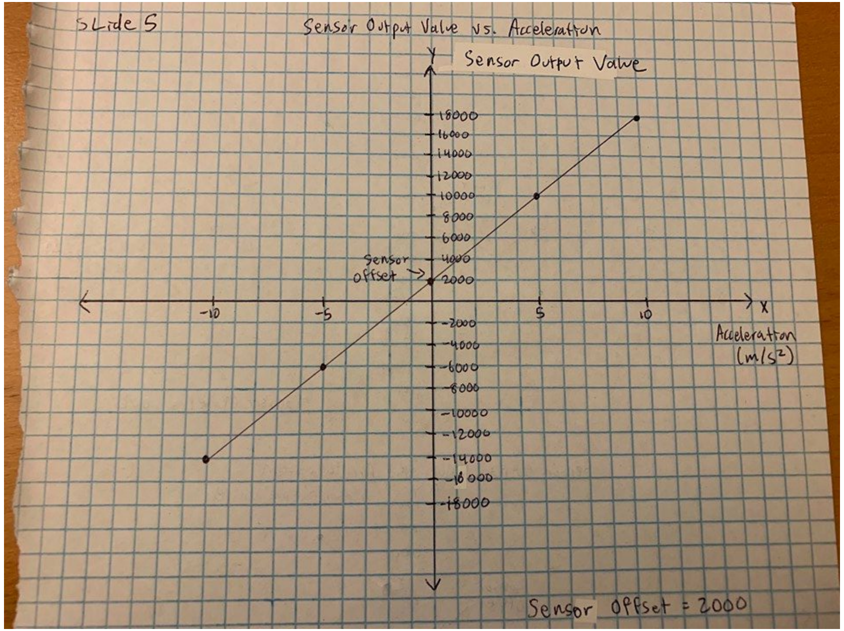
When you took data with the ultrasound sensor, you had to convert, the Arduino output of “delay time” in microseconds to our more meaningful quantity of “distance” in meters. This process of finding a conversion factor from a computer output to a meaningful quantity is called calibration. Similarly, the accelerometer will provide a numerical value calibration which has to be scaled to obtain acceleration. Fill the table below assuming linear scaling.

Sensor output (arbitrary units)	Acceleration (m/s^2)
16000	10
8000	5
0	0
-16000	-10
-4000	-2.5
12000	7.5

Calibration

Ideally, a zero value from acceleration corresponds to a zero value for the sensor output. However, most sensors are not ideal and give an offset such that a true acceleration of 0 m/s^2 corresponds to a non-zero sensor output. Below are some readings of a non-ideal sensor with an sensor offset = 2000 and plot the true acceleration in (m/s^2) on the x axis and sensor output value on the y axis (a hand drawn plot is acceptable). Label the offset.

Sensor output	Acceleration (m/s^2)
18000	10
10000	5
2000 (Offset)	0
-6000	-5
-14000	-10



Calibration

Make plots from the data below (put them on another slide), and use the plots to identify the offset for the following cases and fill up the table (??s below).

Sensor output	Acceleration (m/s^2)
17000	10
9000	5
-7000	-5
-15000	-10
(1000)	0

Sensor output	Acceleration (m/s^2)
7500	5
2700	2
-6900	-4
-16500	-10
(-500)	0

Graphs for Slide 6

Left graph goes with left-side data table, right graph goes with right-side data table