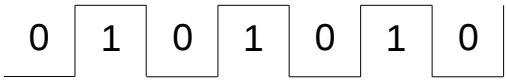
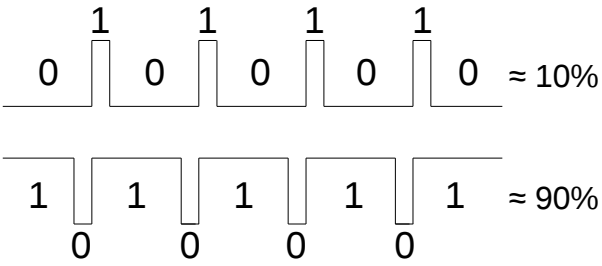
ELEC 3004 Experiment 3: LeviLab Part 1

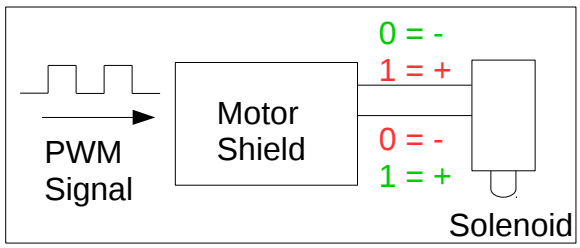
Activity 1

This is a system calibration. We want to know the magnetic field strength of the solenoid for various PWM values. The PWM signal is either 1 or 0, but the amount of time that it is 1 varies from 1% to 99%, and the 0 time is 100% - '1' time.



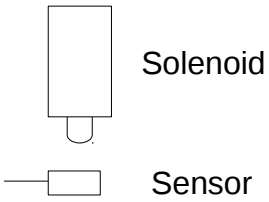
Equal time = 50% duty cycle



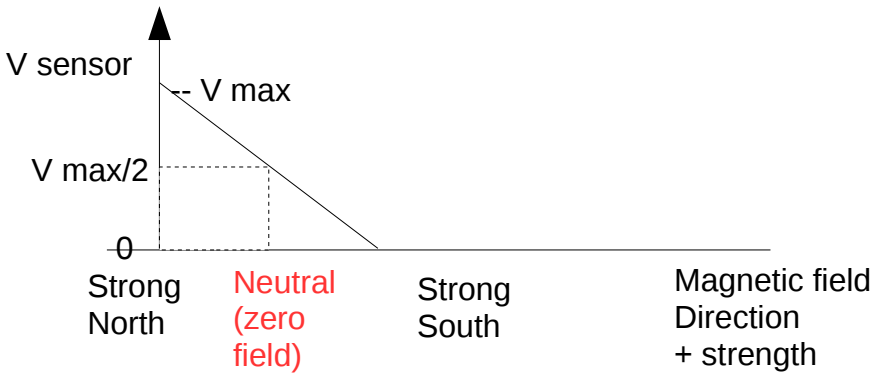


The PWM signal controls the polarity of the solenoid's magnetic field – i.e. 1 = north, 0 = south.

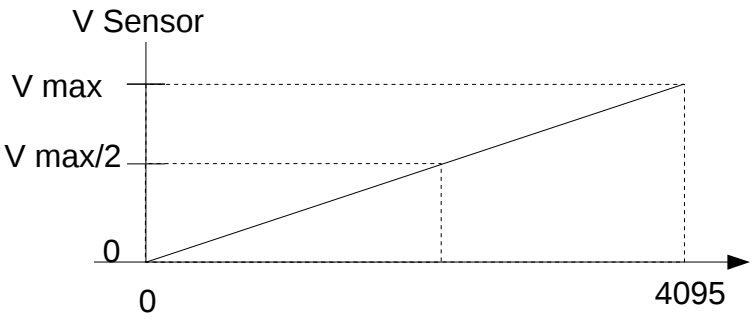
- At 50% duty cycle the average magnetic field appears to be zero, because it is rapidly switching from north to south.
- At 90% duty cycle, the magnetic field is mostly north.
- At 10% duty cycle, the magnetic field is mostly south.



- The sensor voltage depends on the strength and polarity of the average magnetic field.
- If you apply PWM of 50%, the sensor should measure in the middle of its range. See the data sheet for details.
- The PWM value is controlled by the digital value written to it. For 12 bits this is values 0 to 4095, representing 0% to 100%, which then maps to full south at 0% to full north at 100%.

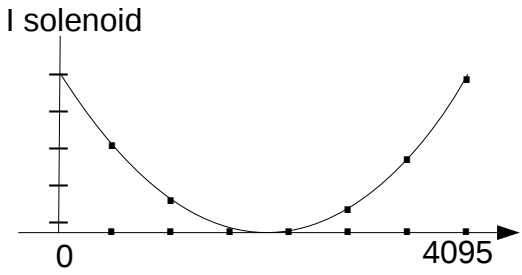


- For activity 1, you can measure the solenoid field strength by applying a known PWM value, then measuring the sensor voltage. Repeat this for all values up to 4095. This will give you this relationship between PWM and sensor voltage.



Something like this, but it may not map to these values.

- Now we can repeat for current to the solenoid vs PWM, but we have to measure current manually. Pick about 10 PWM values from 0 to 4095 and measure the current at each one. Set only 1 discrete value at a time. Don't use a loop unless you have a very large time delay between value changes.

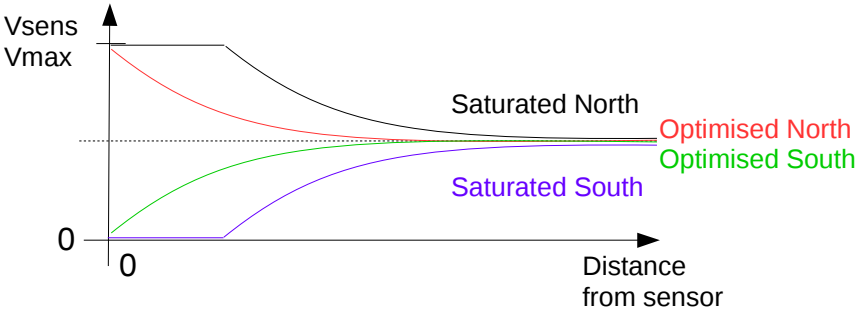


PWM Val =	0	Manually	Measure	Current
	500	Manually	Measure	Current
	1000	Manually	Measure	Current
	.			
	.			
	.			
	4000	Manually	Measure	Current
	4095	Manually	Measure	Current

- You now have Vsensor vs PWM and Isolenoid vs PWM. From this you can plot Vsensor vs Isolenoid. Using the data sheet, find the mV/G value to calculate the field strength from Vsensor vs PWM.

- Now run some code in a loop to continually read Vsensor, but with either the solenoid unpowered, or PWM = 2047. Use your supplied magnet and place it under the sensor about 5cm away, then lift it towards the sensor. You should see the values change. When the magnet is right on the sensor you will measure its full magnetic strength.

- If the magnet is too strong, Vsensor will reach one of its limits (zero or Vmax) befor the magnet touches the sensor.



- From this graph you can see the relationship between distance and field strength (plus polarity) Use the data sheet to find magnet strength.

- Compare this to Vsensor vs PWM and you can see the relationship between strength of the solenoid field at a given distance, versus the magnet's field at a given distance.

- Can you calculate where they might balance to compensate for gravity's effect on the magnet?