

Worksheet 7

Braitenberg Vehicles

Purpose.

To investigate Braitenberg Vehicles 2a and 2b using the Parallax Robot

Learning Outcome 1, 3

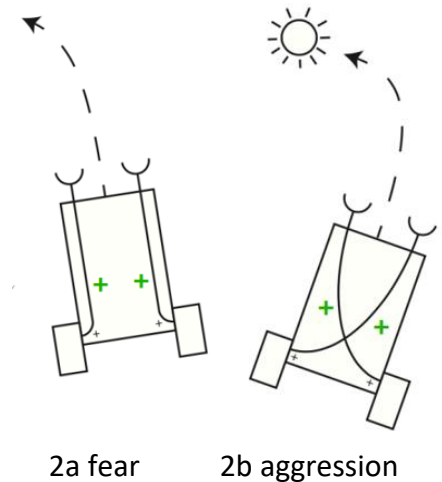
Book Chapter 6

1. Vehicle 2b (Aggression)

Vehicle 2b is excited by the light source, it turns towards the source then increases its speed until it hits the light at a high speed and comes to a sudden stop.

The neural circuit is shown in the box below. Neurons **u[0]** and **u[1]** are the retinal neurons, their input comes from the LDRs I_L and I_R and pass through an exponential function which converts measured voltage to luminance. These neurons subtract an offset O related to the background luminance.

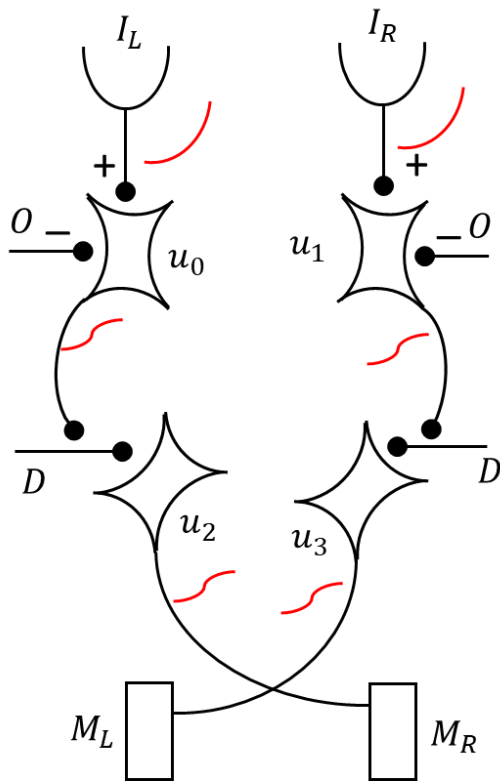
Neurons **u[2]** and **u[3]** are the motor drive neurons, note how the right motor receives drive originating from the left eye and vice versa, to obtain the 'crossed' connexion for vehicle 2b.



2. Setting the retinal neuron parameters

(a) First, we have to set the retinal neuron's parameters. Open up the sketch **BBDrive_EyeFunc_Test1** and arrange the robot so both eyes receive the background ambient illumination.

(b) Fire up the serial monitor. This will give you **inL1** and **inR1** the analogue voltages, also **inLexp** and **inRexp** the luminance values (output of the exponential function) and **outL1** and **outR1**, the neurons' output, after the sigmoid function.



(c) Use the values of **inLexp** and **inRexp** to set the **offset** value which is subtracted from the luminance.

(d) We need to set parameter **A** for the sigmoid so that the output **outL1** etc lies between 0.0 and 1.0 when the input luminance varies between 0 and max. So, take the robot near the light source, and set **A** around half the maximum luminance value.

(e) Set **B** to a suitable value, something like $A/4$. Now use the octave script **Sigmoid_Explore** to check out the shape of your sigmoid.

(f) Now upload your sketch to the Arduino and test check that the neuron outputs vary between about 0.0 and 1.0 as you vary the input luminance. Be prepared to tweak your values of **A** and **B**.

3. Completing Vehicle 2b

(a) Open the sketch **BBDrive_Test_2_exp** and insert your values for **A** and **B** and also for **offsetL** and **offsetR**. Upload and test out your robot on the arena.

(b) Explain the values of **C** and **D** for the motor neuron sigmoid.

4. Vehicle 2a (Fear)

Change your code to produce vehicle 2's behaviour.

5. Autosensing Background luminance.

The sketch **BBDrive_Test_4a_exp** contains additional neurons that learn the background luminance.

(a) Start the sketch *with the light source turned off* and wait until the LED connected to pin 4 goes out. Then turn the light source on.

6. Explain the Code

Explain how the neural circuit work for one example seen above. Include explanation of any offset and sigma parameters.
