
Move the StructureBOT

Objectives

- Program the StructureBOT to rotate and move forward and backward.

Materials and Equipment

Part Number	Description	Qty
ME-7039	StructureBOT, assembled	1
PS-3232	//control.Node	1
ME-7032	Aluminum Meter Stick	1
	Masking tape	10 cm
	PASCO Capstone™ data collection software	

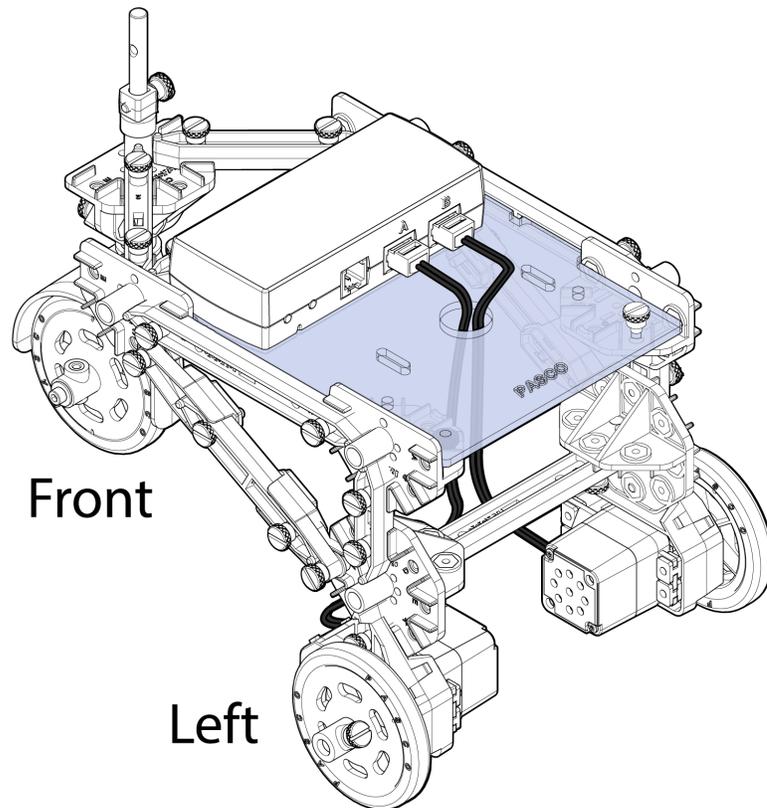


Figure 1. StructureBOT assembled with //control.Node

Procedure

Setup

1. Assemble the StructureBOT as described in “Build the StructureBOT with 2-Wheel Drive”.
2. Charge the //control.Node.
3. Make sure the stepper motor on the left side of the BOT is plugged into **Port A** of the //control.Node and the stepper motor on the right side of the BOT is plugged into **Port B**.

Part 1: Moving the BOT Forward and Backward

1. Connect the //control.Node to PASCO Capstone via Bluetooth.

*NOTE: For guidance related to the software tasks such as connecting wireless devices and using Blockly, refer to the **Help** menu in PASCO Capstone.*

2. Create a graph of **Angle, Port A** versus **time**. Then add a plot area and plot **Angle, Port B** versus **time**.
3. Create the following code:

```
sleep for 1 s
set stepper using units rev/s
for //control.Node :
  configure port A ✓
  rotate stepper continuously
    to max ±speed (rev/s) -1
    with acceleration (rev/s²) 2
  configure port B ✓
  rotate stepper continuously
    to max ±speed (rev/s) 1
    with acceleration (rev/s²) 2
sleep for 3 s
```

Note that the **max speed** on each stepper motor is set to +1 rev/s.

4. Start recording. Recording will automatically stop when the code finishes execution. On the graph for each stepper motor, note the sign of the angle.
5. Investigate the effect of changing the sign of **max speed** on each stepper motor. Try:
 - +1 rev/s on both stepper motors
 - -1 rev/s on both stepper motors
 - +1 rev/s on **port A** and -1 rev/s on **port B**
 - -1 rev/s on **port A** and +1 rev/s on **port B**
6. Which combination of signs makes the BOT move forward? Which combination makes the BOT move backward? What do the other combinations make the BOT do?

Write your observations in **Table 1**.

Part 2: Moving the BOT a Certain Distance

1. For each stepper motor, we know the angle through which the motor shaft turns, but we must calculate the distance the wheel moves along the surface. What is the relationship between the angle and the distance traveled by the BOT?
2. Measure the wheel diameter. What is the equation for the circumference of the wheel?
3. Start a new experiment and create the following code.

Note that you will need to create two variables: **Wheel Diameter (cm)** and **x(cm)**.

```

sleep for 1 s
set Wheel Diameter (cm) to 6.3
set x (cm) to 100
set stepper using units rev/s
for //control.Node :
  configure port A ✓
  rotate stepper through
    angle (rev) (x (cm) ÷ (π × Wheel Diameter (cm)))
    to max ±speed (rev/s) 1.5
    with acceleration (rev/s²) 2
  configure port B ✓
  rotate stepper through
    angle (rev) (x (cm) ÷ (π × Wheel Diameter (cm)))
    to max ±speed (rev/s) -1.5
    with acceleration (rev/s²) 2
Wait for completion ✓

```

NOTE: Be sure to select *Wait for completion*.

4. Create a graph of **Angle, Port A (rev)** versus **time**.
5. Set the BOT on the floor and mark with tape where the back wheel is. Start recording data. Once the BOT stops moving, mark with tape where the back wheel stopped. Measure the distance between the two pieces of tape. Did the BOT move 100 cm? If not, why not?
6. Use the coordinates tool on the graph to find the maximum angle in revolutions. Multiply this number of revolutions by the circumference of the tire. Does this equal 100 cm?
7. Using your findings, adjust the value of the **Wheel Diameter** variable, and test your code again. Try to find a value that will make the BOT move exactly 100 cm.

Part 3: Backup Beeper

1. Modify your code to make the BOT back up. You will have to change the signs of the max speed.
2. Add a backup beeper.

NOTE: Be sure to clear the *Wait for completion* selection so the beeper code will execute while the BOT is backing up.

Data Collection

*Table 1. Effect of changing the sign of the **max speed** on each stepper*

Max Speed Port A	Max Speed Port B	Result
+1	+1	
-1	-1	
+1	-1	
-1	+1	