



(http://mechatronics.mech.northwestern.edu/design_ref/sensors/encoders.html)

Encoders

For computing the distance traveled by a mobile robot, we are going to use sensors that measure the motion of the wheels, i.e. the angle turned by each wheel.

Optical encoders are very popular in mobile robotics for measuring the position within a motor drive or at the shaft of a wheel. They consist of a source of light, a pattern disc, and a light detector. As the disc turns, light pulses are converted to a binary signal, which is counted and as a result an angle is produced.

First, as usual, let's initialize the robot.

In [1]:

```
import packages.initialization
import pioneer3dx as p3dx
p3dx.init()
```

Now, a GUI widget will allow you to control the speed of **each wheel** independently, and display the value (in radians) of the angle turned by each wheel.

In [2]:

```
import encoder_widget
```

The values of the encoders are stored in these variables:

In []:

```
p3dx.leftEncoder
```

In []:

```
p3dx.rightEncoder
```

You can use them in your programs; for example, the following code displays their values more prettily.

In [3]:

```
print(" Left Encoder: %7.3f radians" % p3dx.leftEncoder)
print("Right Encoder: %7.3f radians" % p3dx.rightEncoder)
```

```
Left Encoder: 370.190 radians
Right Encoder: 0.059 radians
```

Radians and Degrees

Not familiar with [radians](https://en.wikipedia.org/wiki/Radian) (<https://en.wikipedia.org/wiki/Radian>)? Angles can be converted from radians to degrees with some simple math:

$$\text{degrees} = \text{radians} \frac{180}{\pi}$$

Use the code below, and replace the dots in the first line with the value in radians that you want to convert, then run the cell.

In [4]:

```
radians =
import math
degrees = radians * 180 / math.pi
print("%.3f radians are equivalent to %.3f degrees" % (radians, degrees))
```

```
-----
-----
NameError                                Traceback (most recent call
1 last)
<ipython-input-4-26c88eb4b068> in <module>()
----> 1 radians = pi
      2 import math
      3 degrees = radians * 180 / math.pi
      4 print("%.3f radians are equivalent to %.3f degrees" % (radians, degrees))
```

```
NameError: name 'pi' is not defined
```

However, radians will be widely used as angular magnitude, since they result in simpler mathematical expressions.

For the proper use of encoders, it's time for a bit of geometry in the next notebook: [Angles and Distances \(Angles%20and%20Distances.ipynb\)](#)

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