Velocity Calc

October 13, 2020

[4]:

```python
import sympy as sym
from IPython.display import Math as m
from sympy import Function, cos, sin, pi, atan2, sqrt,Eq
from sympy import symbols
from sympy.abc import t

# Varaible define
H, W, T = symbols('H, W, T')
# Placement Equations
x_d = (W/2)*sin(2*pi*t/T)
y_d = (H/2)*sin(4*pi*t/T)
th = atan2(y_d,x_d)

print('Turtlebot firgue-eight trajectory looks like')
display(m(r'x_d(t) = \frac{W}{2}sin\frac{2\pi t}{T}'))
display(m(r'y_d(t) = \frac{H}{2}sin\frac{4\pi t}{T}'))
# Velocity Equations (rhs)
vxd = x_d.diff(t)
axd = vxd.diff(t)
vyd = y_d.diff(t)
ayd = vyd.diff(t)
v = sqrt(vxd**2+vyd**2)
xdot = v*cos(th)
ydot = v*sin(th)
omega = (ayd*vxd-axd*vyd)/(vxd**2+vyd**2)
# Define lhs to make it look nice
dis_xdot, dis_ydot, dis_w = symbols(r'\dot{x}, \dot{y}, \omega')
print('lienar velocities in x,y and angular velocity are:')
display(Eq(dis_xdot,xdot))
display(Eq(dis_ydot,ydot))
display(Eq(dis_w,omega))
```

```
Turtlebot firgue-eight trajectory looks like
```

$$x_d(t) = \frac{W}{2}sin\frac{2\pi t}{T}$$

$$y_d(t) = \frac{H}{2}sin\frac{4\pi t}{T}$$

lienar velocities in x,y and angular velocity are:

$$\dot{x} = \frac{W\sqrt{\frac{4\pi^2 H^2 \cos^2\left(\frac{4\pi t}{T}\right)}{T^2} + \frac{\pi^2 W^2 \cos^2\left(\frac{2\pi t}{T}\right)}{T^2}} \sin\left(\frac{2\pi t}{T}\right)}{2\sqrt{\frac{H^2 \sin^2\left(\frac{4\pi t}{T}\right)}{4} + \frac{W^2 \sin^2\left(\frac{2\pi t}{T}\right)}{4}}}$$

$$\dot{y} = \frac{H\sqrt{\frac{4\pi^2 H^2 \cos^2\left(\frac{4\pi t}{T}\right)}{T^2} + \frac{\pi^2 W^2 \cos^2\left(\frac{2\pi t}{T}\right)}{T^2}} \sin\left(\frac{4\pi t}{T}\right)}{2\sqrt{\frac{H^2 \sin^2\left(\frac{4\pi t}{T}\right)}{4} + \frac{W^2 \sin^2\left(\frac{2\pi t}{T}\right)}{4}}}$$

$$\omega = \frac{\frac{4\pi^3 HW \sin\left(\frac{2\pi t}{T}\right)\cos\left(\frac{4\pi t}{T}\right)}{T^3} - \frac{8\pi^3 HW \sin\left(\frac{4\pi t}{T}\right)\cos\left(\frac{2\pi t}{T}\right)}{T^3}}{\frac{4\pi^2 H^2 \cos^2\left(\frac{4\pi t}{T}\right)}{T^2} + \frac{\pi^2 W^2 \cos^2\left(\frac{2\pi t}{T}\right)}{T^2}}$$