# Differential Drive Dynamics

9th January 2020 at 2:15pm

## Tricycle Model

$$\mathrm{R} = \text{Radius of wheel}$$
$$\mathrm{L} = \text{Distance between wheels}$$
$$\dot{x} = \frac{R}{2}(v_r + v_l)\cos\phi$$
$$\dot{y} = \frac{R}{2}(v_r + v_l)\sin\phi$$
$$\dot{\phi} = \frac{R}{L}(v_r - v_l)$$

# Twist model

9th January 2020 at 2:15pm

$$\dot{x} = v\cos\phi$$
$$\dot{y} = v\sin\phi$$
$$\dot{\phi} = \omega$$

# Twist to Differential drive

9th January 2020 at 8:35am

$$v = \frac{R}{2}(v_r + v_l)$$
$$\omega = \frac{R}{L}(v_r - v_l)$$

rearraging above equations

$$\frac{2v}{R} = v_r + v_l$$
$$\frac{L}{R} = v_r - v_l$$

Now adding and subtracting above two equations

$$v_r = \frac{2v + \omega L}{2R}$$
$$v_r = \frac{2v - \omega L}{2R}$$

# Base Controller and Robot Bringup Steps

9th January 2020 at 9:11am

## Interface Sensors and Motor Drivers

- Set Serial messaging format
- Get tick count of wheel encoders
- Increase or decrease the motor speed by setting PWM value

## Base controller setup

- Get sensor data to base controller and convert to various topics
- Convert `\cmd_vel` Twist messages to differential drive values
- Velocity control node using PID algorithm

## Build the robot buildup package

```
board_bringup.py #Script for getting the serial data and publishing into
topics
twist_to_motors.py #Converting twist to right and left wheel velocity
pid_velocity.py #velocity control for right and left wheels
diff_tf.py #publish odometry and tf topics for robot
```