

Intelligent Wireless Robotics

Lab on PID Control

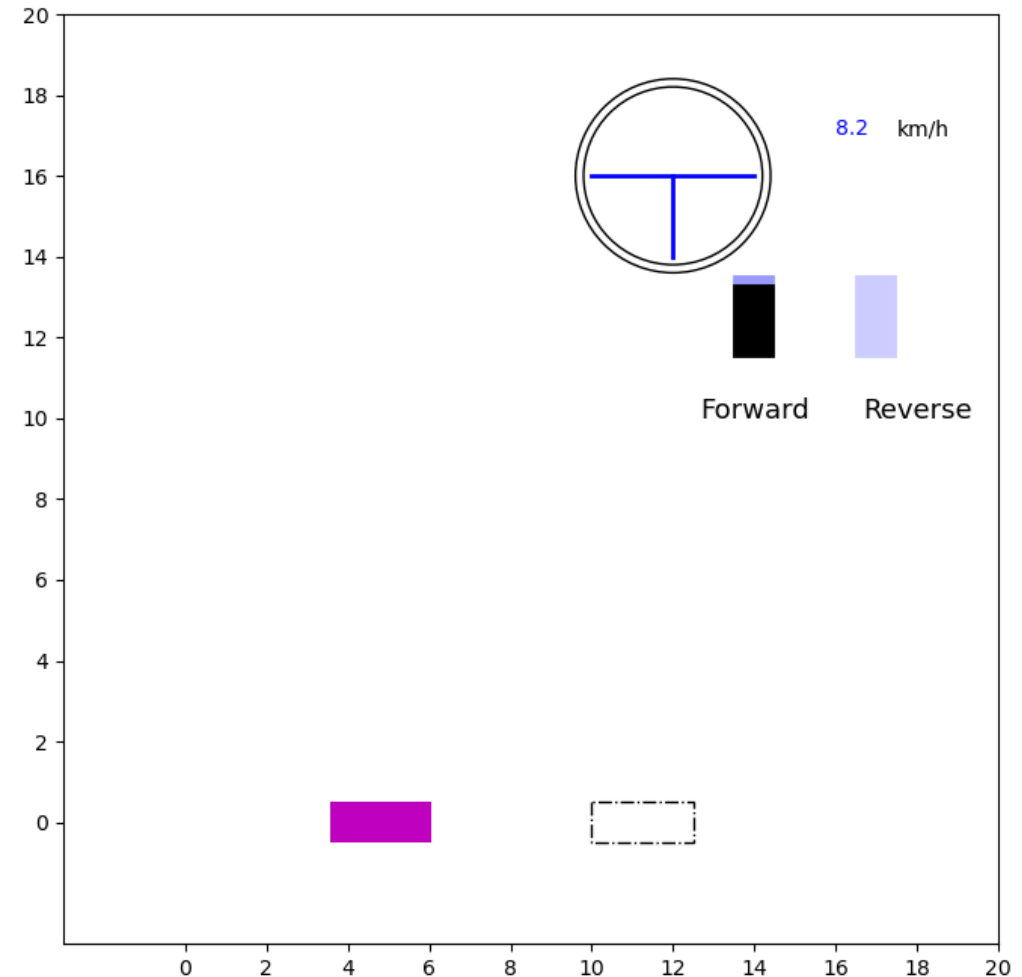
Pengxia Wu

Toy Experiment – Parking at destination (1)

Imagine you are the controller, write some code to drive the car from starting position to the end position

`toy_controller_st.py`

1. Control inputs: pedal, steering
2. Fill in the control method `control(self, state)` to control the car to move from the starting position to the end position. Try to perfectly stop at the destination pose $[x, y, \theta]$
`stop_pose = [x, y, \theta] = [10, 0, 0]`

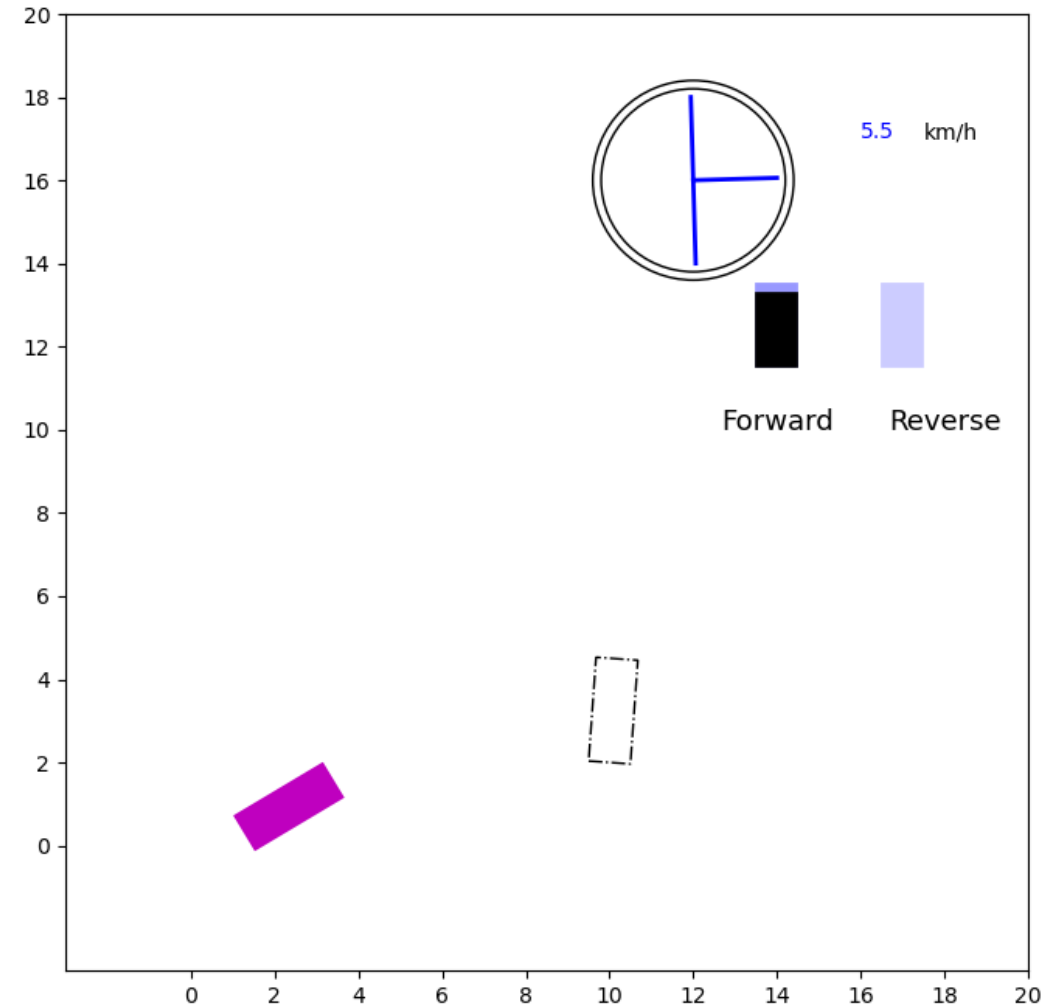


Toy Experiment – Parking at destination (2)

Imagine you are the controller, write some code to drive the car from starting position to the end position

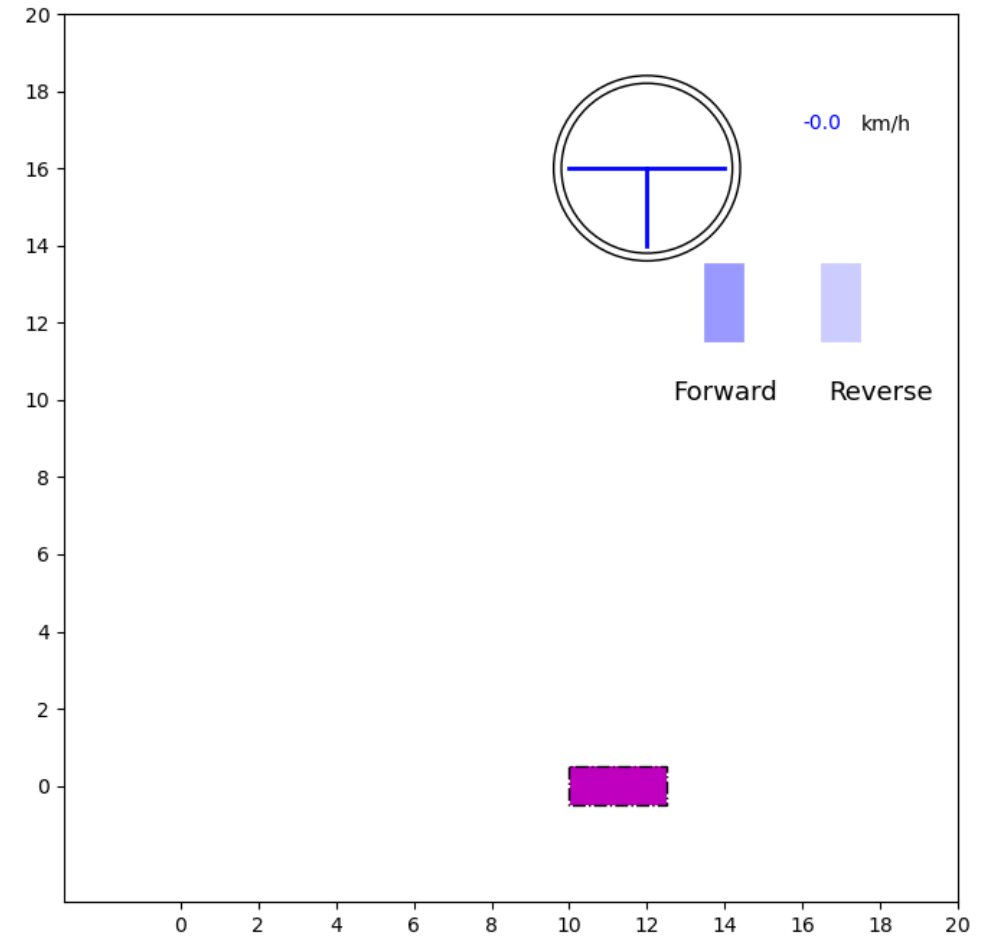
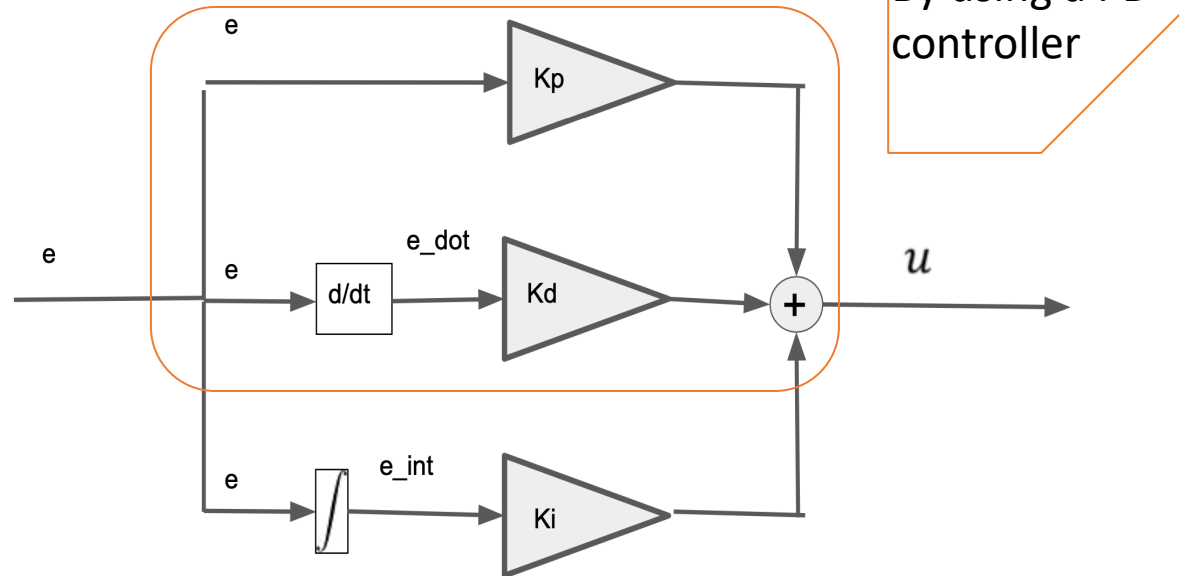
`toy_controller_st.py`

1. Control inputs: pedal, steering
2. Fill in the control method `control(self, state)` to control the car to move from the starting position to the end position. Try to perfectly stop at the destination pose $[x, y, \theta]$
 $stop_pose = [x, y, \theta] = [10, 2, 3.14/2]$



PID for a self-driving car on 1D trajectory

PID controller



PID for a self-driving car on 1D trajectory

- Apply PID controller to 1D self-driving car
 - Drive the car from starting position $[0, 0, 0]$ to end position $\text{ref} = [10, 0, 0]$
 - **Control Inputs:** $u = [\text{pedal}, \text{steering}]$, where pedal is in the range $[-1, 1] = [\text{full brake}, \text{full throttle}]$
 - Starter code: `car_controller_pid_st.py`
 - Think about what's the difference if the car moves with the following two system model?

System Model 1:

$$\begin{aligned} x_{t+1} &= x_t + \dot{x} dt & \dot{x} &= v_t \\ v_{t+1} &= v_t + \dot{v} dt & \dot{v} &= \text{pedal}_t * 5 \end{aligned}$$

System Model 2:

$$\begin{aligned} x_{t+1} &= x_t + \dot{x} dt & \dot{x} &= v_t \\ v_{t+1} &= v_t + \dot{v} dt - v_t / 25 & \dot{v} &= \text{pedal}_t * 5 \end{aligned}$$

System Model 3:

$$\begin{aligned} x_{t+1} &= x_t + \dot{x} dt & \dot{x} &= v_t \\ v_{t+1} &= v_t + \dot{v} dt - v_t / 25 & \dot{v} &= \text{pedal}_t * 5 - 0.5 \end{aligned}$$

Assume a constant resistive force