# EECS 192: Mechatronics Design Lab

## Discussion 9: V-REP Simulation

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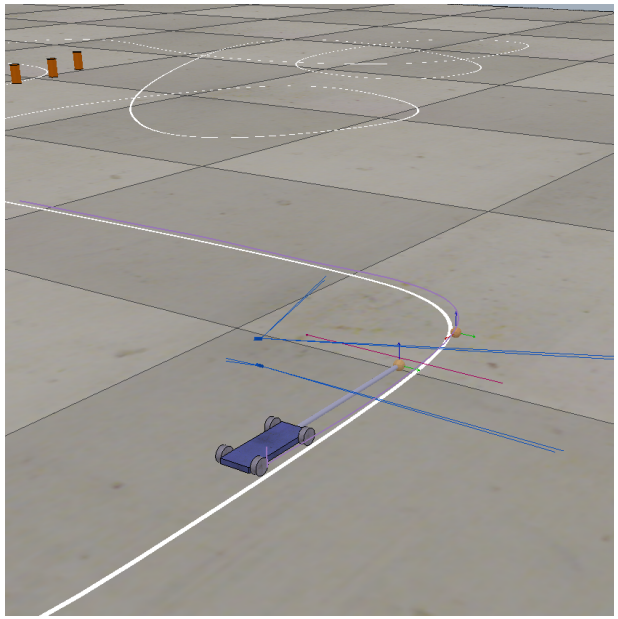
- Simulation Intro
- Simulation Syntax
- Demos

# V-REP Simulator

- Robot simulation environment
- Built on several standard physics engines
- Some nice prebuild robot components and interfacing
- Full free educational version
- (User Manual Link)

# V-REP Car Simulation

- Car modelled in V-REP
- Tune control in simulation through python to get a starting point for the real car
- Homework 2



# Setup

- Installation
  - Download V-REP (Linux/Windows/Mac Download Link) and unzip it
  - Clone the simulator-pub repo
- Running
  - Run V-REP: File "open scene" cory-track-fastcar.ttt,
  - In a terminal, run python controller.py
    - V-REP will pop up a warning. Ignore the warning and close the pop-up message each time (3x).

# Getting and Setting

Time elapsed between control loop iterations:

- `sim_time = car.get_sim_time()`
- `dt = sim_time - self.last_sim_time`

Line sensing camera frame and line error:

- `camera_image = car.get_line_camera_image(0)`
- `line_err = self.get_line_camera_error(camera_image)`

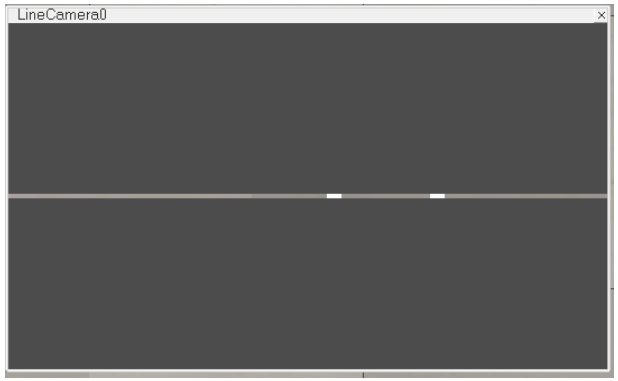
Vehicle state information:

- `pos = car.get_position()`
- `vel = car.get_wheel_velocity()`

# Line Finding

In addition to simulating the dynamics of the vehicle, we are simulating its perception!

- You will need to implement your line-finding algorithm
- Try to be as faithful to your hardware implementation as possible
- Very good opportunity to prototype line crossing robustness




An example line image from the simulator

# Line Finding

The basic controller given has a rudimentary line-finding algorithm

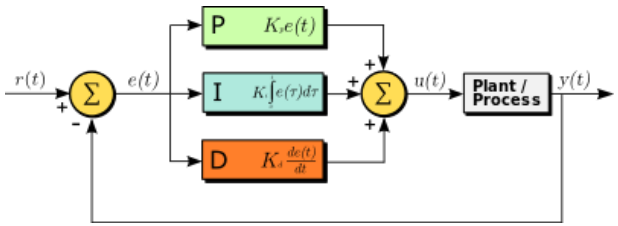
- This will not be enough!
- Refer back to your line-finding homework
- ... and the discussion we had on line-finding

# Controller Tuning

- Recall our discussion of PID controller Tuning
- Homework will walk you through some interesting exercises

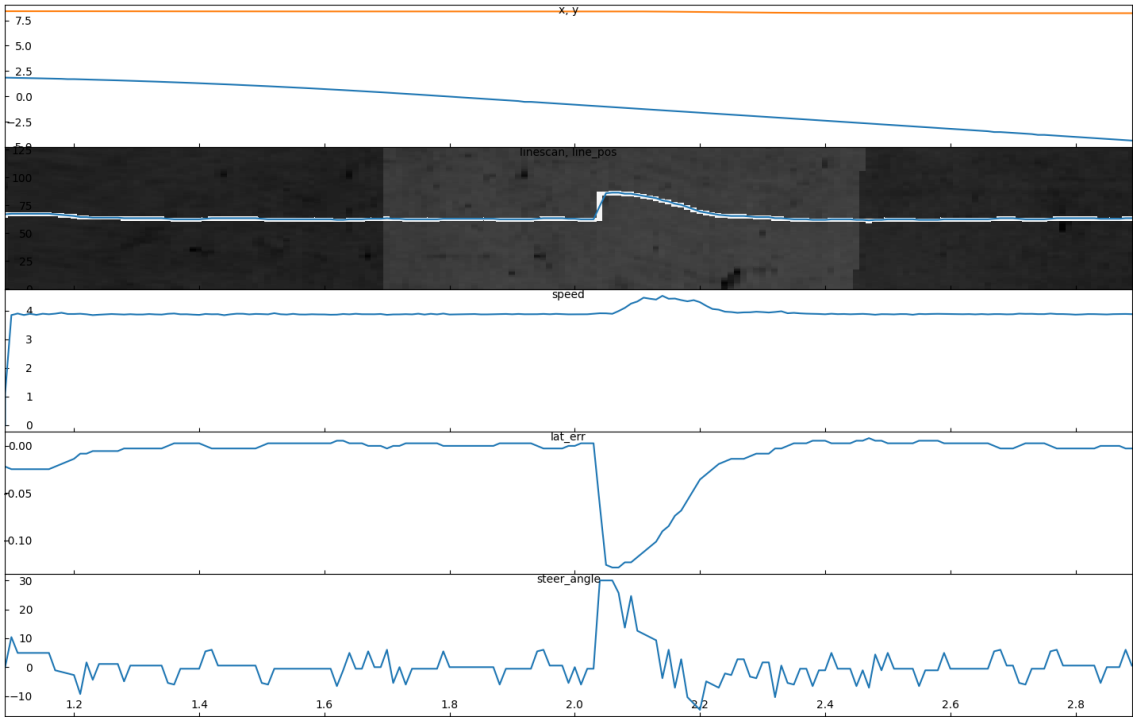
You can specify your gains in the control loop:

- `kp = 200`
- `kd = 20`
- `ki = 0`
- `-kp * lat_err - kd * lat_vel - ki * self.int_err`



# Visualizing Data

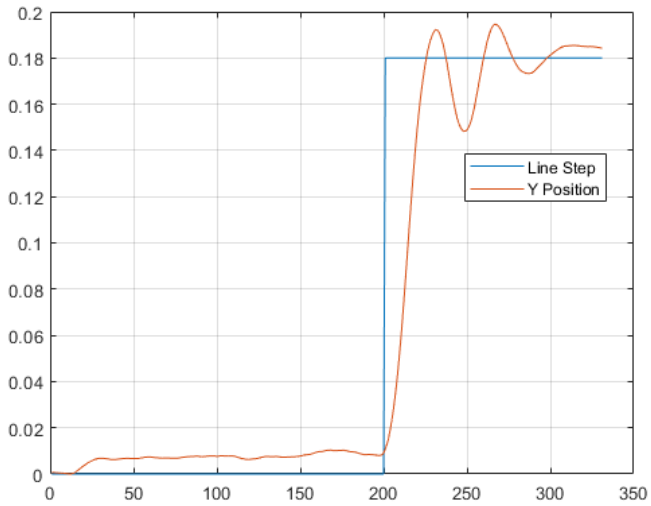
```
python log-visualizer.py car_data_lap0.csv
python log-visualizer.py --merge arg1,arg2 car_data_lap0.csv
```



# System ID

We can also use system idenfitication techniques to analyze our data!

- Matlab, import as CSV
- Keep in mind the effect of your controller on system transfer function
  - *What order is our open loop system? Our closed loop system?*
- System ID Tool in Matlab can be useful



# V-REP Simulator and System ID Demo