

Longitudinal Speed Control with PID

Course 1, Module 5, Lesson 2



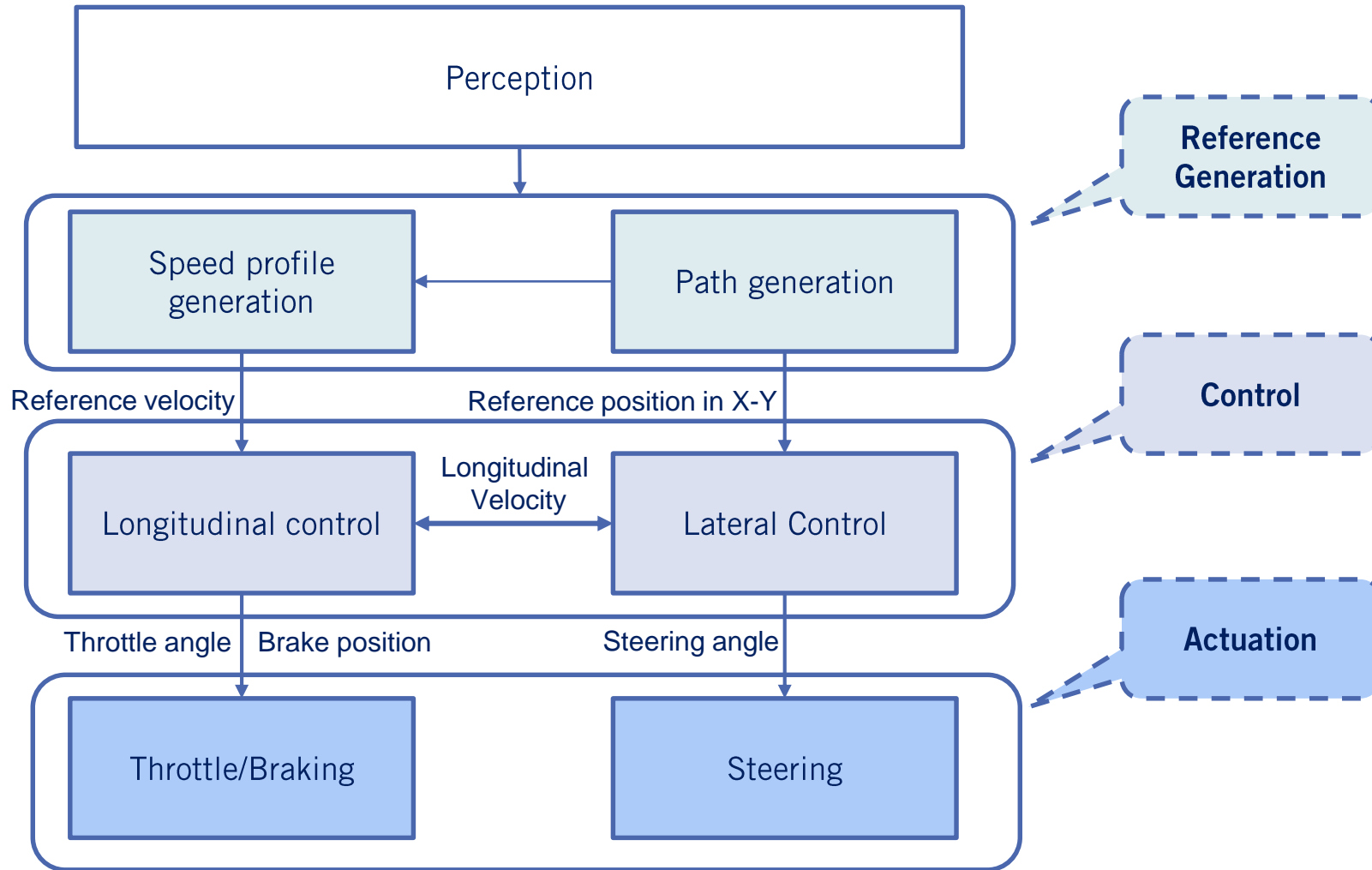
UNIVERSITY OF TORONTO
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Learning Objectives

In this video, you'll ...

- Define the full vehicle planning and control architecture
- Design a PID controller for cruise control/speed regulation

Architecture of Vehicle Control Strategy

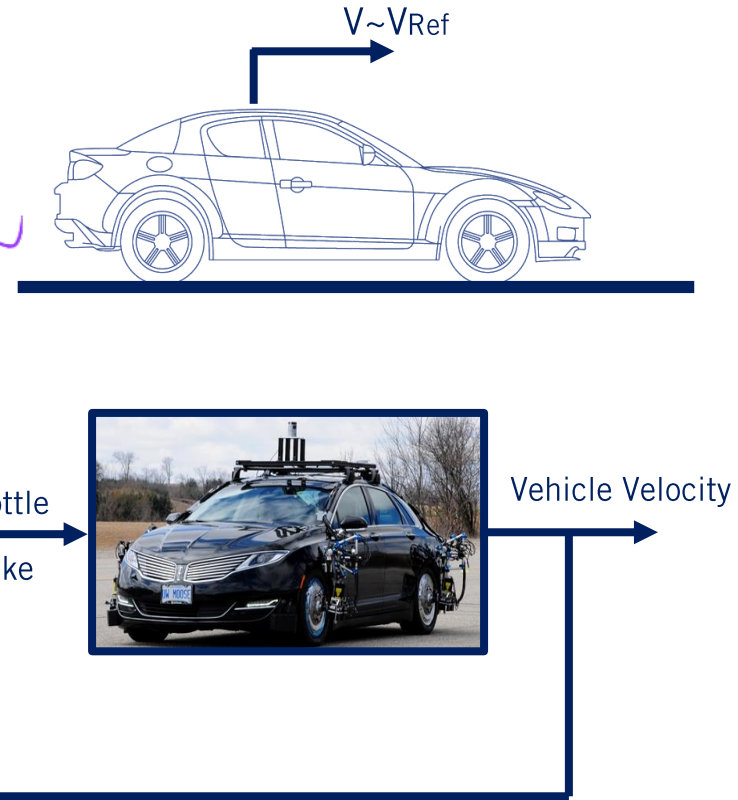


Longitudinal Speed Control

Cruise control:

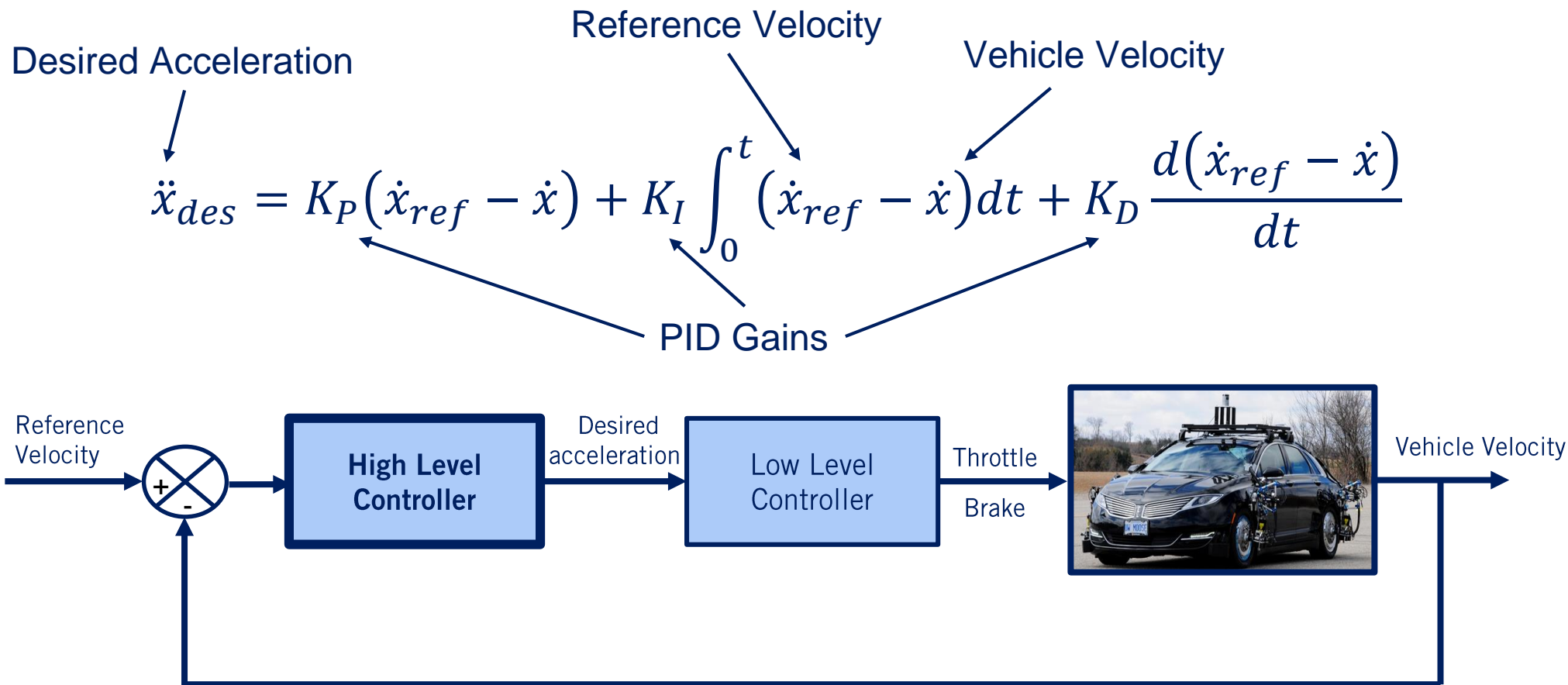
- Speed of the vehicle is controlled (by throttling and braking) to be kept at the reference speed

它可以处理例如堵车等情况
比更高阶的控制需要



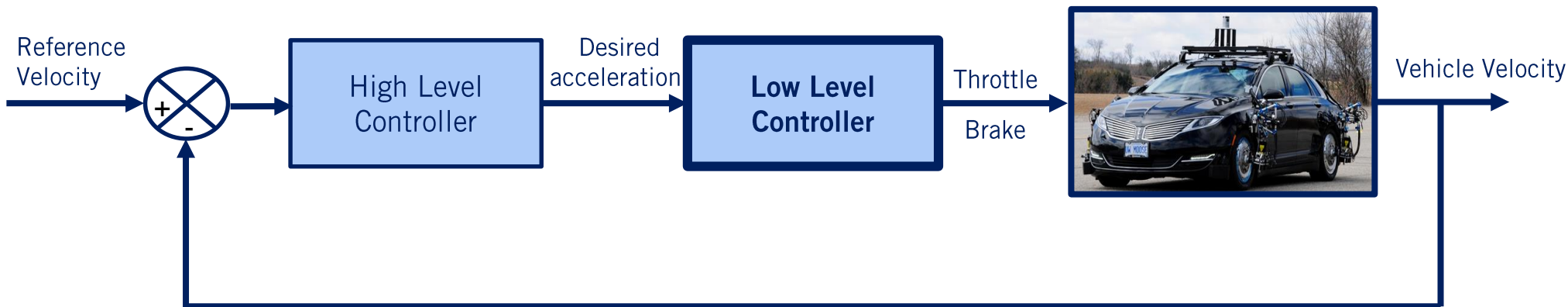
Upper Level Controller

- Determines the desired acceleration for the vehicle (based on the reference and actual velocity).



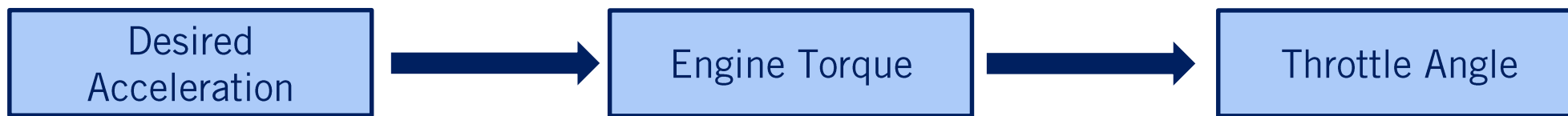
Lower Level Controller

- Lower Level Controller:
 - Throttle input is calculated such that the vehicle track the desired acceleration determined by the upper level controller
- Assumptions:
 - Only throttle actuations is considered (no braking) 不考慮制動
 - The torque converter is locked (gear 3+) 沒有變速器損失
 - The tire slip is small (gentle longitudinal maneuvers) 運動是平滑的



Lower Level Controller

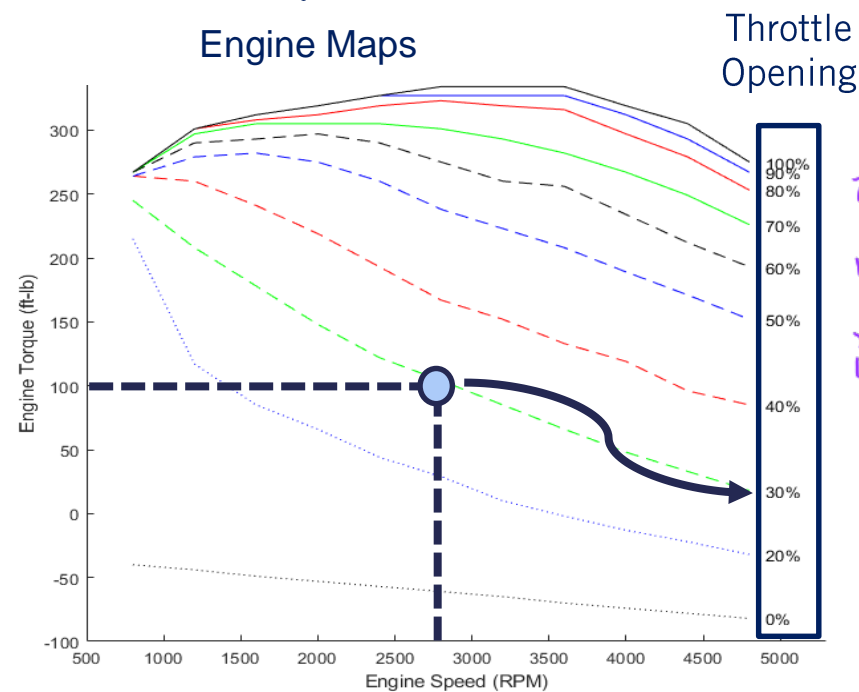
此过程是非线性的



Vehicle Drivetrain Dynamics
(Previous Module)

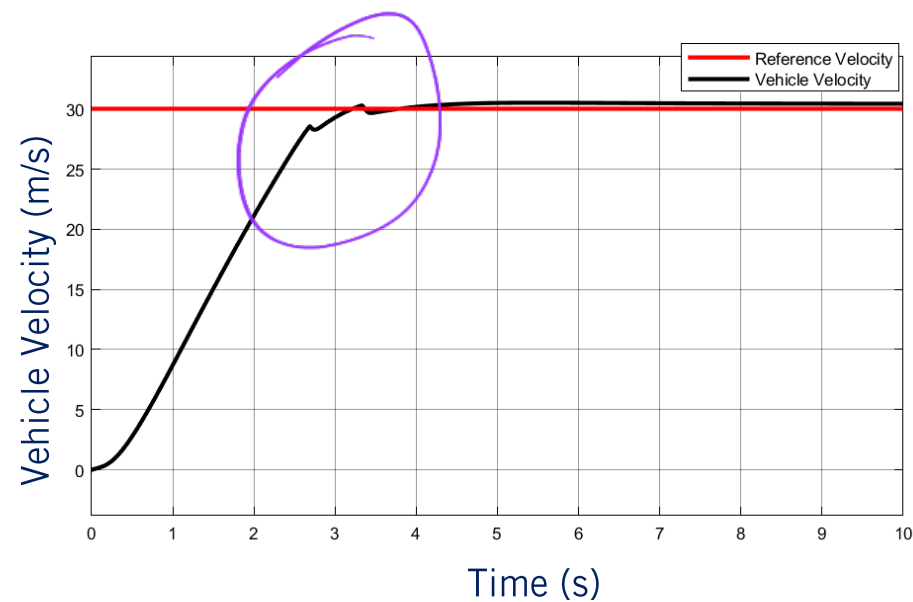
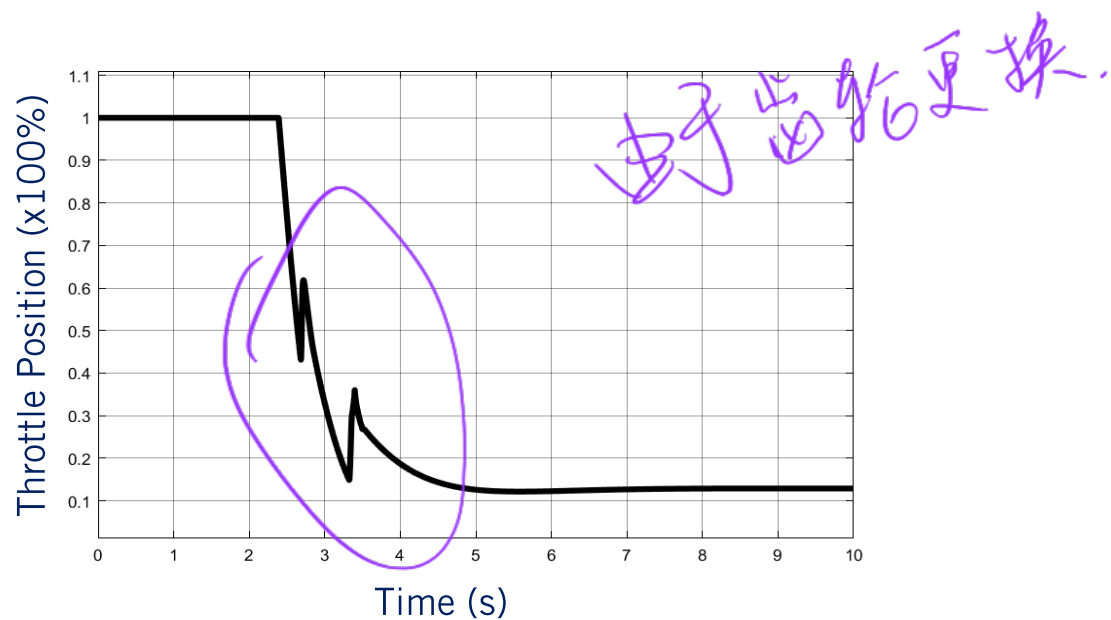
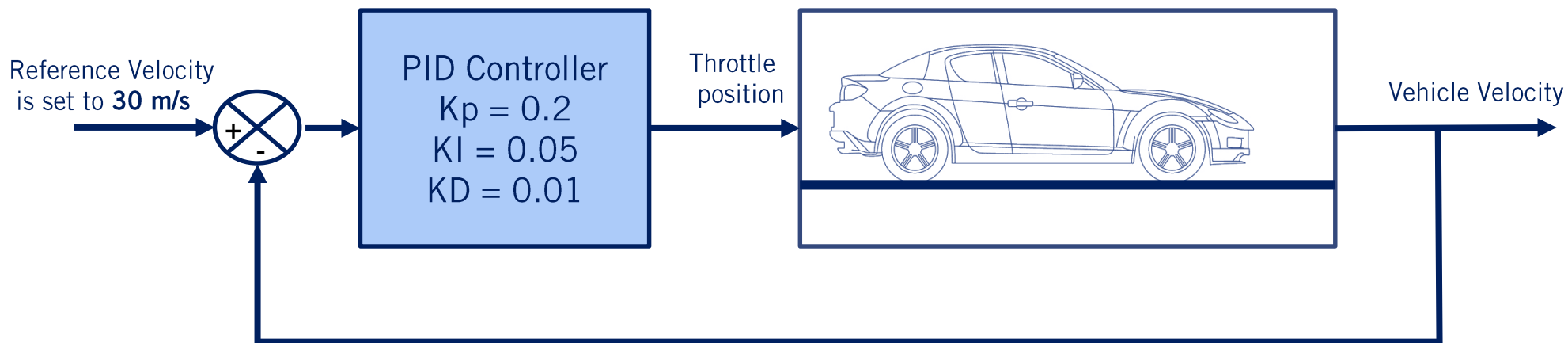
$$T_{Engine} = \frac{J_e}{(r_{eff})(GR)} \ddot{x}_{des} + T_{Load}$$

提前测量并
绘制这个图。



根据期望的转速
以及扭矩来确定
油门开合量。

Simulation Example



Summary

What we have learned from this lesson:

- Vehicle longitudinal cruise control
- High and low-level control structure based on PID and engine maps

What is next?

- We will go through the vehicle feedforward control design