Contents

ECE 8 Robotics Notes 11-3-22

- Start of class comments:
  - Proportional control
  - Tuesday: Virtual Simulation
  - Last week of classes we do experiments in the labs
  - Important image:

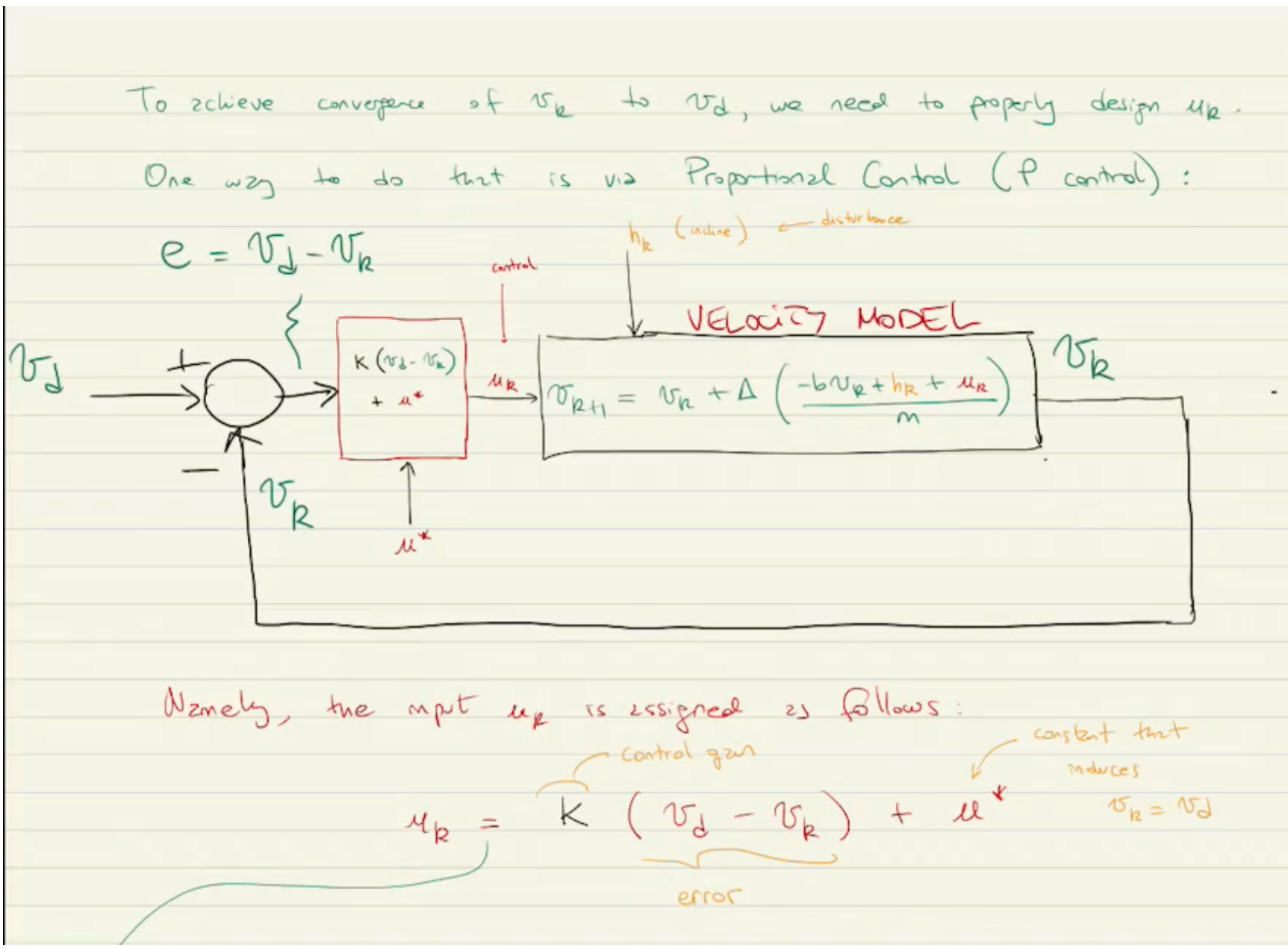

Figure 1: P Control/ Proportional Control - Cruise Control Example

Move to Matlab

- see file `CruiseControl.m` and `CruiseControlv1.m`

Lecture 12

- Today we will design the proportional control we introduced in lecture 10 for the cruise control system

Example 7 (revisited)

- From example 7 in lecture 10 we have simulated the previous image with:

$$\text{Zero inputs} \begin{cases} \mu_k = 0 & \text{for all } k \\ h_k = 0 & \text{for all} k \end{cases}$$

- To implement Proportional Control we define the controller block (the block before the velocity model)
  - This issues the control signal by calculating the error between the desired and current velocity

$$\mu_k = K \cdot (v_d - v_k) + \mu^*$$

  - K = Control gain
  - μ^* = Constant input/ steady state input
- Our design problem:
  - Given parameters of the system:
    * parameters (related to the physics)
      · m = mass
      · b = friction/resistance
    * step size (part of the model)
      · Δ = essentially how much do we want to compute or how fast
  - Given the specifications of the desired speed v_d
  - As a designer we need to find K and μ^*
    * We want to achieve/our goal for a cruise control algorithm
      · we want v_k to approach v_d as discrete time increases
- We can show [v_k approaching v_d] mathematically: "limit"
  - (The following is fun facts)
  - See Figure 2
  - v_k approaching v_d can be written mathematically as:
    * aka Asymptotic convergence to the reference
    * requires infinitely many steps to arrive

$$\lim_{k \to \infty} v_k = vd$$

  - or for discrete case:
    * aka finite time convergence to the reference
    * requires a finite amount of steps to arrive

$$\begin{cases} v_{k^*} = v_d & \text{for some} k^* \in \{0, 1, 2, \dots\} \\ v_k = v_d & \text{for all } kk^* \end{cases}$$

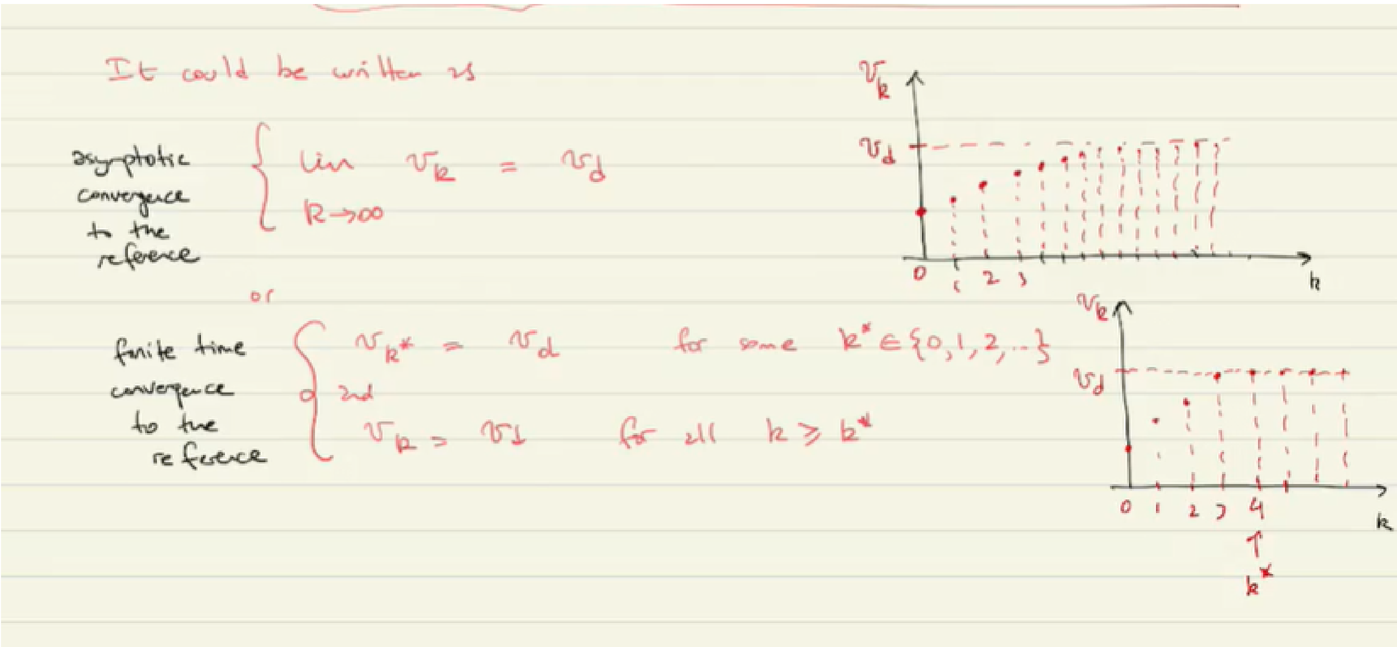

Figure 2: Asymptotic convergence (never arrive) vs discrete convergence (rarely occurs)

Moved to MATLAB for in class practice

- See his handwritten notes for explicit definitions from the equations to the code.
- Written in blue, below the boxes

Find μ^* and K

- Recall from lect 10-25-22
  - We found

$$u^* = bv_d K = 0$$

  - if we let $v_0 = v_d$ which led to $u_0 = u^*$

IMPORTANT:

- the professor jumps between:

$$u = \mu u^* = \mu^*$$