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EC EN 483
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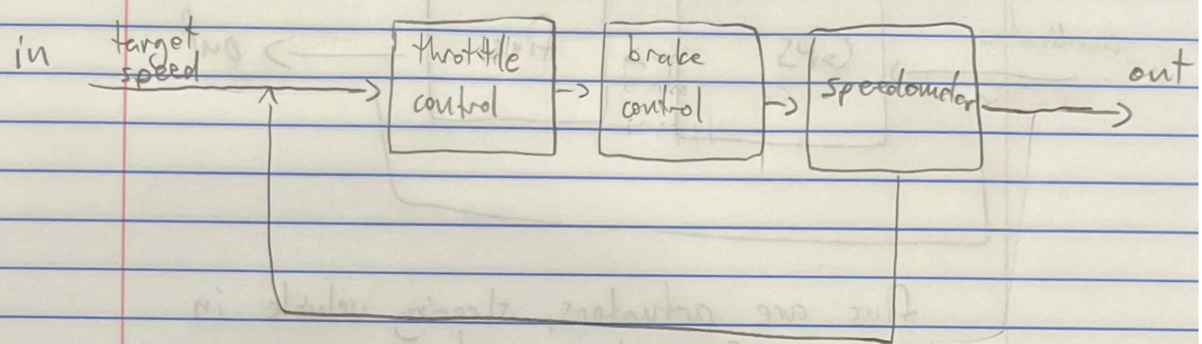
Assignment 1

(4 pts) List 3 different control systems you see in the world around you. Draw a picture that represents each control system as a block diagram, and make sure to clearly say what the actuators, sensors, and system being controlled is. It can be biological, mechanical, electrical, etc.

1. Cruise control
2. Bodies
3. GPS guidance

Assignment 1

1. Cruise control

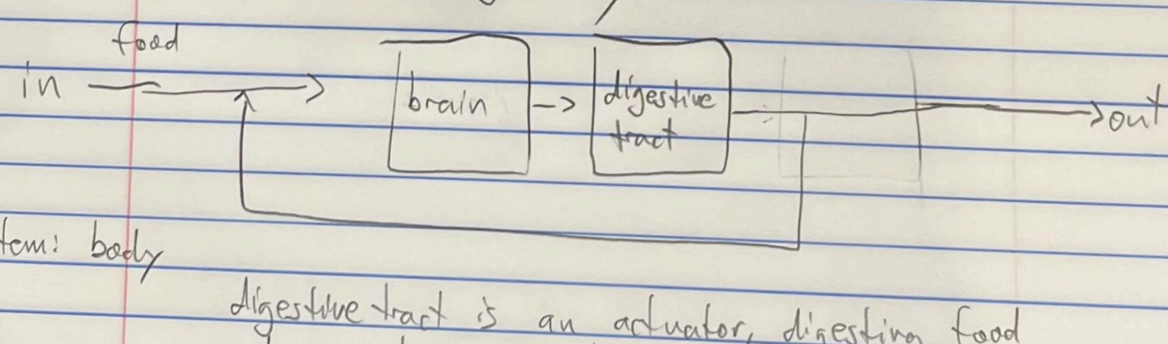


throttle & brakes are actuators, and are used to keep the car moving at the target speed

speedometer is the sensor, sends information to a microcontroller which activates either the throttle or brakes

the system is a car

2. Stomach/hunger/body

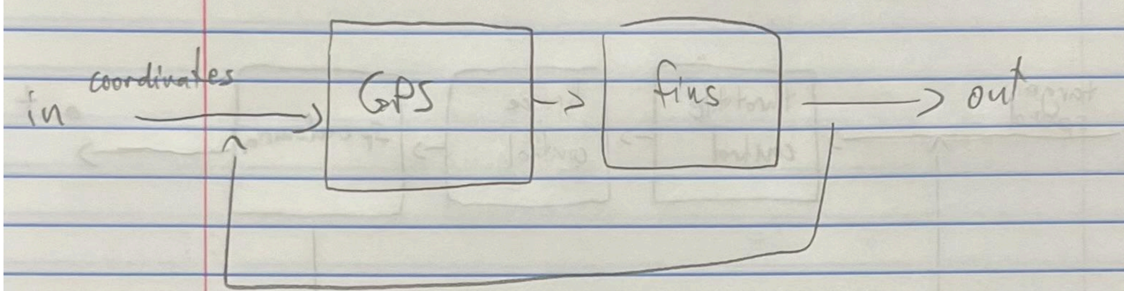


ystem: body

digestive tract is an actuator, digesting food and nourishing the body

brain is a sensor, detects size of stomach/blood sugar/other indicators and tells the body it needs food

3, GPS guidance



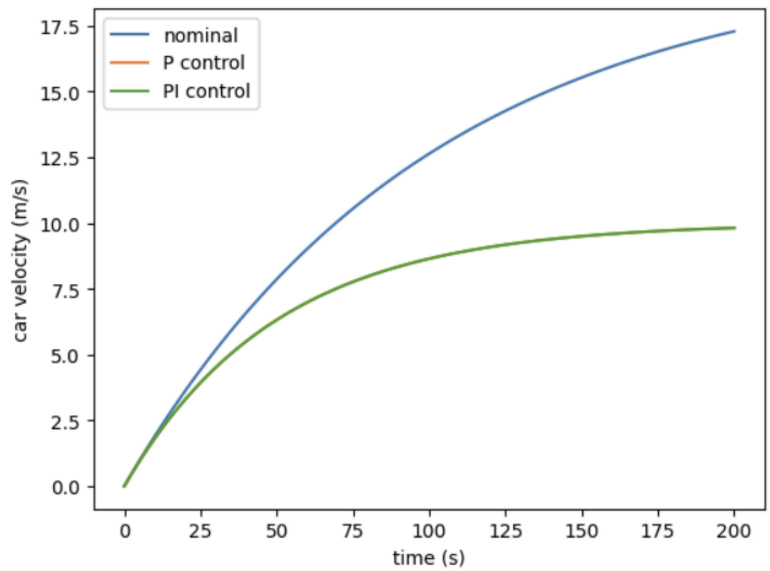
fins are actuators, steering vehicle in direction of input coordinates

GPS is a sensor, using real-time measurements to tell fins where to direct the vehicle

system is an airborne vehicle

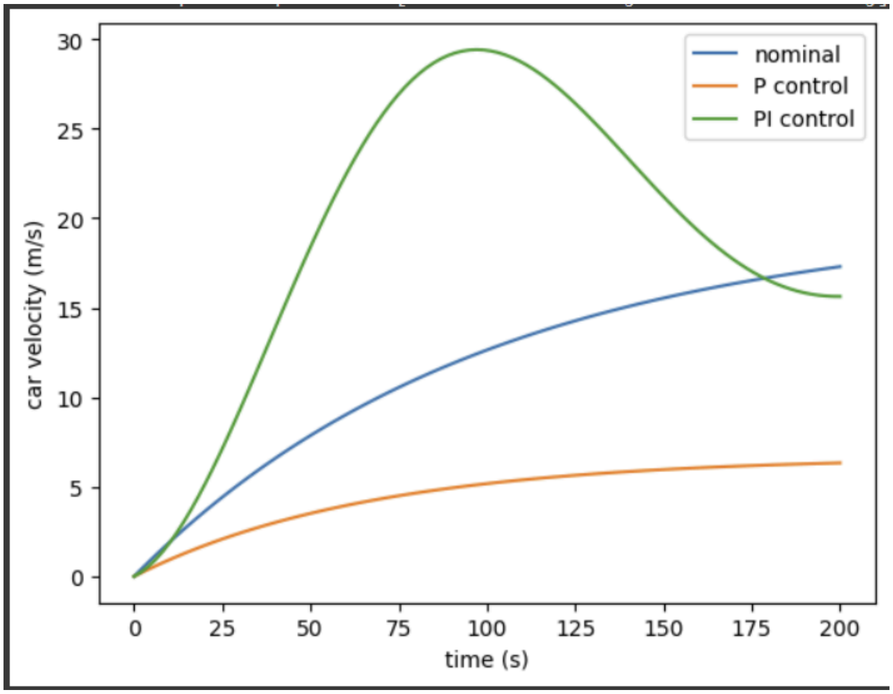
(8 pts) Spend at least 10-15 minutes playing with the parameters k_p, k_i, and u_cmd in the code below for case study 0 (cruise control example). Try to build up some intuition about poles and how they affect the time response based on the behavior you see in the plots and how that relates to the linearized time solution for the cruise control system. Turn in at least two different plots (or more) that show what you learned about the trends as you change the two available gains.

Proportional gain, or k_p, is seen most clearly in the way the PI graph begins. As the system sees it is off-course it corrects to return to the nominal plot, but with a small k_p it does not appear to be approaching the desired path with any significant speed.

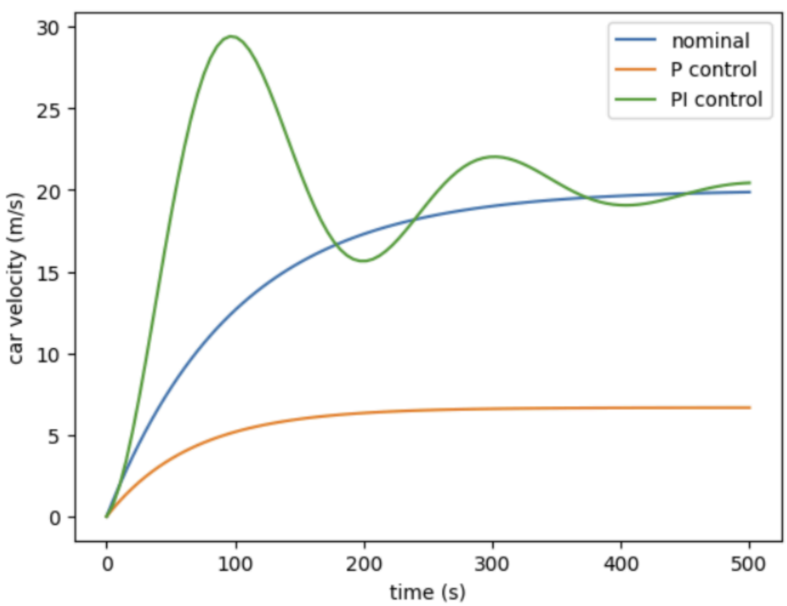


This graph has k_p = 10 and k_i = 0. The system follows the nominal path fairly well for the first 10 seconds but eventually, it falls short and can't keep up with the path. Additional guidance is needed for any real accuracy, so solely using proportional gain isn't effective in most scenarios.

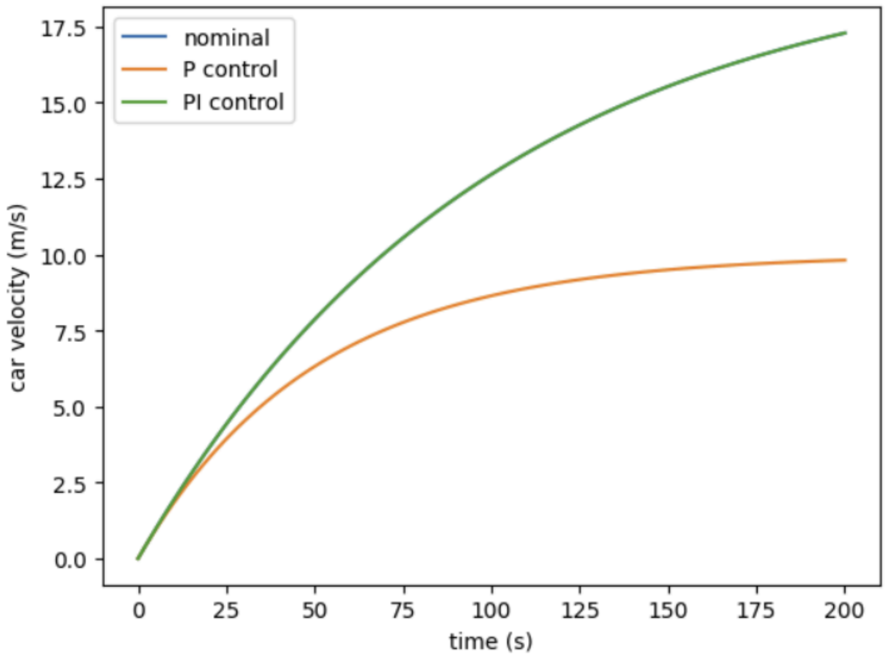
The integral gain, k_i, is used for correcting and continuing to guide the system along the desired path, but if it is not tuned right it can throw the system off. This is clearly demonstrated when observing the path taken when k_p = 5 and k_i = 1.



There is an immediate jump upwards that lasts for over a minute before the system starts to correct but it will take a very long time for the system to stabilize. Even with a graph stretching to 500 seconds it still hasn't stabilized.



Playing with the values some more I found that k_p = 10 and k_i = 0.1 yielded the best results, with this plot popping up:



These are very round and friendly values to find, but it makes sense for an early assignment. From what I've seen in industry a lot of tuning and adjustment happens manually, but monte carlo-ing various set ups is often the best way to find the right amounts of gain for different control systems.