Department of Engineering Cybernetics

TTK4215 Adaptive Control

Assignment 8

6.1 Consider the first order plant

$$y = \frac{b}{s-1}u$$

where $b > 0$ is the only unknown parameter. Design and analyze a direct MRAC scheme that can stabilize the plant and force y to follow the output y_m of the reference model

$$y_m = \frac{2}{s+2}r$$

for any bounded and continuous reference signal r.

6.2 The dynamics of a throttle to speed subsystem of a vehicle may be represented by the first-order system

$$V = \frac{b}{s+a}\theta + d$$

where V is the vehicle speed, θ is the throttle angle and d is a constant load disturbance. The parameters $b > 0, a$ are unknown constants whose values depend on the operating state of the vehicle that is defined by the gear state, steady-state velocity, drag, etc. We would like to design a cruise control system by choosing the throttle angle θ so that V follows a desired velocity V_m generated by the reference model

$$V_m = \frac{0.5}{s+0.5}V_s$$

where V_s is the desired velocity set by the driver.

(a) Assume that a, b, and d are known exactly. Design an MRC law that meets the control objective.

(b) Design and analyze a direct MRAC scheme to be used in the case of a, b, and d (with $b > 0$) being unknown.

(c) Simulate your scheme in (b) by assuming $V_s = 35$ and using the following values for a, b, and d: (i) $a = 0.02, b = 1.3, d = 10$; (ii) $a = 0.02(2 + \sin 0.01t), b = 1.3, d = 10 \sin 0.02t$.