Control System: Homework 04 for Units 4A, 4B: Feedback Analysis

Assigned: October 22, 2021

Due: November 4, 2021 (23:59)

1. (U4A: Sensitivity)

4. A unity feedback control system has the open-loop transfer function

$$G(s) = \frac{A}{s(s+a)}.$$

(a) Compute the sensitivity of the closed-loop transfer function to changes in the parameter A.

(b) Compute the sensitivity of the closed-loop transfer function to changes in the parameter a.

(c) If the unity gain in the feedback changes to a value of $\beta \neq 1$, compute the sensitivity of the closed-loop transfer function with respect to β.

2. (U4B: Steady-State Error and System Type)

8. A standard feedback control block diagram is shown in Fig. 4.5 with

$$G(s) = \frac{1.5}{s};\ D_c(s) = \frac{(s+9)}{(s+3)};H(s) = \frac{70}{(s+70)};V(s) = 0.$$

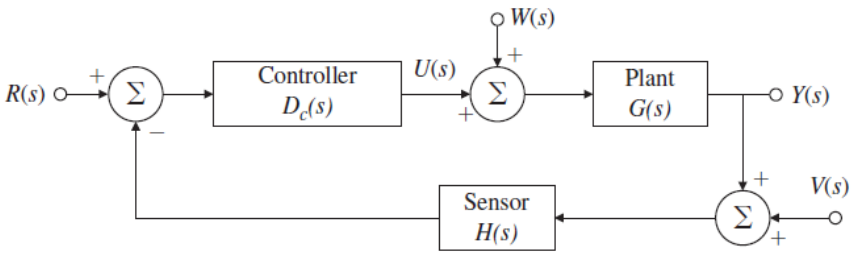
(a) Let $W = 0$ and compute the transfer function from R to Y.

(b) Let $R = 0$ and compute the transfer function from W to Y.

(c) What is the tracking error if R a unit-step input and W = 0?

(d) What is the tracking error if R is a unit-ramp input and W = 0?

(e) What is the system type with respect to the reference inputs and the corresponding error coefficient?



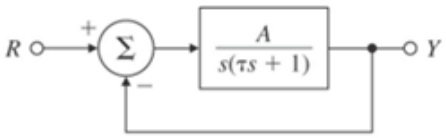
3. (U4B: System Type and Tracking)

14. Consider the system shown in Fig. 4.36(a).

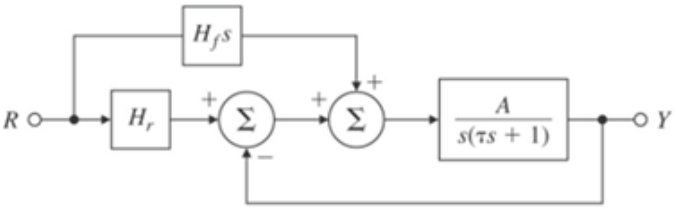
(a) What is the system type? Compute the steady-state tracking error due to a ramp input $r(t) = r_o t1(t)$.

(b) For the modified system with a feed forward path shown in Fig.4.36(b), give the value of H_f so the system is Type 2 for reference inputs and compute the K_a in this case.

(c) Is the resulting Type 2 property of this system robust with respect to changes in H_f i.e., will the system remain Type 2 if H_f changes slightly?



(a)



(b)