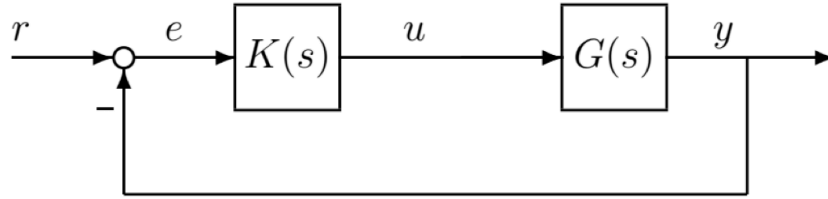


4 Block Diagrams

4.1 Design Pre-Compensators

Consider a feedback system in the below figure with $G(s) = \frac{2}{s+2}$ and $K(s) = \frac{3s+12.5}{s}$.



- What is the transfer function $T(s)$ from r to y ?
- Design a low pass $F(s)$ to filter the reference command.

Solution :

$$(a) \quad T(s) = \frac{G(s)K(s)}{1+G(s)K(s)} = \frac{6s+25}{s^2+8s+25}.$$

$$(b) \quad \text{Ensuring that } F(0) = 1, \text{ we set } F(s) = \frac{25}{6s+25}. \text{ The resulting closed-loop from } r \rightarrow y \text{ is now}$$

$$T(s)F(s) = \frac{25}{s^2+8s+25}.$$

GPT Answer :

The transfer function $T(s)$ from r to y in a feedback system is given by the formula:

$$T(s) = \frac{G(s)K(s)}{1 + G(s)K(s)}$$

Given $G(s) = \frac{2}{s+2}$ and $K(s) = \frac{3s+12.5}{s}$, we substitute these into the formula:

$$T(s) = \frac{\left(\frac{2}{s+2}\right) \left(\frac{3s+12.5}{s}\right)}{1 + \left(\frac{2}{s+2}\right) \left(\frac{3s+12.5}{s}\right)}$$

To design a low pass filter $F(s)$ to filter the reference command, a common choice is:

$$F(s) = \frac{\omega_c}{s + \omega_c}$$

where ω_c is the desired cutoff frequency.

Confidence Level: 95%

Correct

Claude Answer :

he provided image shows a block diagram of a unity feedback control system with a controller $K(s)$ and a plant $G(s)$. The given transfer functions are:

$$G(s) = \frac{2}{s+2}$$

$$K(s) = \frac{3s+12.5}{s}$$

(a) To find the transfer function $T(s)$ from r to y , we can use the following formula for a unity feedback system:

$$T(s) = \frac{K(s) \cdot G(s)}{1 + K(s) \cdot G(s)}$$

Substituting the given values:

$$T(s) = \frac{\left(\frac{3s+12.5}{s}\right) \cdot \left(\frac{2}{s+2}\right)}{1 + \left(\frac{3s+12.5}{s}\right) \cdot \left(\frac{2}{s+2}\right)}$$

Simplifying the numerator and denominator:

$$T(s) = \frac{6s+25}{s(s+2) + (6s+25)}$$

$$T(s) = \frac{6s+25}{s^2+8s+25}$$

Therefore, the transfer function $T(s)$ from r to y is:

$$T(s) = \frac{6s+25}{s^2+8s+25}$$

(b) To design a low-pass filter $F(s)$ for the reference command, a common choice is a first-order filter with the following structure:

$$F(s) = \frac{\omega_c}{s + \omega_c}$$

where ω_c is the cutoff frequency. The cutoff frequency should be chosen based on the desired bandwidth of the system and the frequency content of the reference command. A lower cutoff frequency will result in more filtering of high-frequency components in the reference command.

The exact value of ω_c would depend on the specific requirements and constraints of the system, which are not provided in the question. The choice of ω_c is a design decision that should be made based on the desired system performance and the characteristics of the reference command.

Confidence Level: 95%

Correct