Phase Lead Design Example

The controlled system is given in the following form:

$$G(s) = \frac{1}{s(s+3)(s+21)} \tag{1}$$

together with the *phase lead network* that has to be designed:

$$C(s) = K\frac{(1+s/s_0)}{(1+s/s_p)} \tag{2}$$

Its parameters are selected so that $s_p = 100$, whilst s_0 has to cancel the pole - 3 of the controlled system. The network gain K has to be determined in order to obtain a maximum overshoot lower than or equal to 9% (corresponding to $\delta \geq 0.64$) and a settling time $T_a \leq 0.45s$.

The performances of the continuous-time system of Eq. (1) without controller are compared to the closed-loop system with the designed controller of Eq. (2) by using a scheme in the *SIMULINK* environment.

Finally, the overall achieved performances have to be verified and validated in both the MATLAB and SIMULINK environments.

Phase Lag Design Example

The controlled system is given in the form of Eq. (1):

$$G(s) = \frac{1}{(s+1)(s+2)(s+10)} \tag{1}$$

together with the regulator described by the transfer function of Eq. (2):

$$C(s) = K\,\frac{s+1}{s} \tag{2}$$

By using the continuous time root locus in the MATLAB environment, the value of the gain K has to be determined so that the closed-loop system of Eqs. (1) and (2) presents a maximum overshoot $S\% \leq 10\%$ (corresponding to $\delta > 0.9$) and settling time $T_a < 4.5s$.

Finally, the overall closed-loop system has to be implemented in the SIMULINK environment and the achieved performances have to be verified and validated for the selected gain K.

Phase Lag Design Example

The system to be controlled is given in the form of Eq. (1):

$$G(s) = \frac{0.1}{s(s+1)(s+10)} \tag{1}$$

whislt the proposed regulator is described by the transfer function of Eq. (2):

$$R(s) = K \cdot \frac{s/10 + 1}{s/2 + 1} \tag{2}$$

representing a phase lag controller. By means of the continuous-time root locus generated in the MATLAB environment, the network gain K has to be determined so that the overall closed-loop system presents a maximum overshoot $S\% < 9.5$ (corresponding to $\delta > 0.6$) and a settling time $T_a < 10.5s$.

Finally, the achieved performances of the overall closed-loop system consisting of the transfer function blocks of Eqs. (1) and (2) has to be verified and validated in the SIMULINK environment, and compared to the behaviour of the system (1) without any controller.