Swansea University

College of Engineering

EGLM03 Modern Control Systems

Homework 3: Lag Compensation

Problems

1. A satellite attitude control system has an open-loop transfer function

$$G_o(s) = \frac{4(s+2)}{s}$$

determine the low frequency gain required to ensure that the steady-state error to a constant acceleration input of 1 rad/s^2 is 1/40 rad. Design a lag compensator to give the required low frequency gain.

1. A plant has a transfer function

$$G(s) = \frac{K}{s(s+10)^2}$$

The velocity constant K_v of a feedback control system for this plant is to be 20, while the damping ratio ζ of the dominant second-order closed-loop poles is to be 0.707. Design a lag compensator to achieve this specification.

1. A numerical path-controlled turret lathe control system is illustrated in Figure 1. The gear ratio is $n = 0.1$, the motor inertia is $J = 10^{-3}$ kg.m^2 and the motor resistance is $R = 10^{-2}$ Nm/(rad/s). It is necessary to attain an accuracy of 0.5 thousandths of an inch in the position of the cutting tool relative to the workpiece and therefore a position accuracy of 1% is required for a ramp input. Design a cascade controller, to be inserted before the silicon-controlled-rectifiers (SCRs), in order to provide a step command with an overshoot of less than 2%. A suitable damping ratio for the system is 0.8. The gain of the SCRs is $K_r = 5$.

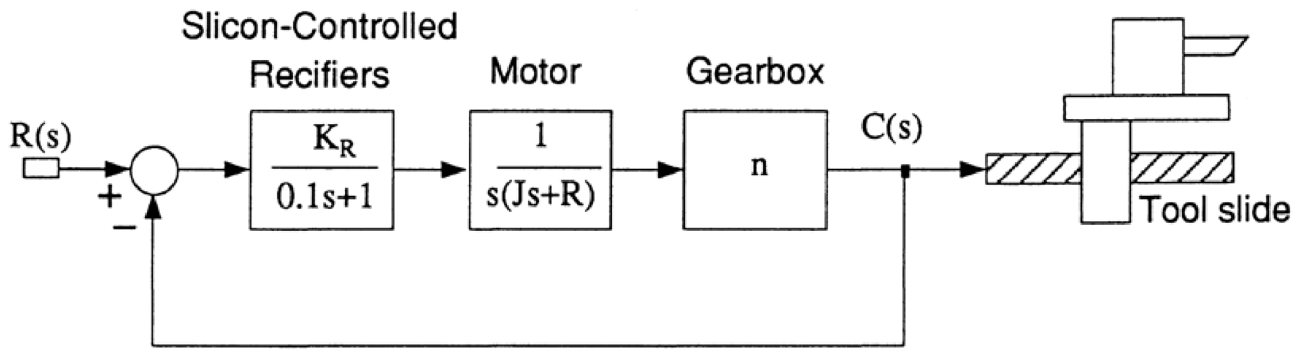

Figure 1